4. Passive Use Values

Beneficial effects measured under the NED account include increases in the economic value of the national output of goods and services, the value of output resulting from external economies caused by the proposed alternatives, and the value associated with the use of otherwise unemployed or under-employed labor resources (WRC, 1983). Adverse effects are usually the opportunity costs of resources used in implementing a plan. These effects typically include implementation outlays, associated costs, and other direct costs.

The NED account addresses direct use value, which may be simply defined as the value that an individual derives from the direct use of a natural resource. Direct uses include "consumptive uses, such as fishing and hunting in which resources are harvested, and non-consumptive uses, in which the activity does not reduce the stock of resources available for others at another time, such as bird watching or swimming" (NOAA, 1994; p. 1,073). The unique characteristics of some resources have, however, caused some economists to question whether this type of analysis incorporates all of a resource's value. It has been argued that some individuals who are not directly using a resource might be willing to pay some amount of money just to know that the resource exists even though they have no intention of ever using it. Passive use or existence values of this type may be defined as "the values individuals place on natural resources independent of direct use of a resource by the individual. Passive use values include, but are not limited to: the value of knowing the resource is available for use by family, friends or the general public; and the value derived from protecting the natural resource for its own sake; and the value of knowing that future generations will be able to use the resource" (NOAA, 1994; p. 1,073). Passive use values are not included as part of the NED accounting stance.

The preservation of endangered species and free-flowing rivers are well recognized as possible sources of passive use value (Krutilla and Fisher, 1975; Meyer Resources, 1974, Randall and Stoll, 1983; Stoll and Johnson, 1984). Passive use values for Pacific Northwest salmon and steelhead populations may be motivated by the public's desire to preserve these species and their associated habitats for the enjoyment of future generations. These natural resources may be viewed as a significant component of what distinguishes the Pacific Northwest from other parts of the country. While a free-flowing river is arguably less symbolic of the Pacific Northwest, the public may still be motivated to return the lower Snake River to a free-flowing condition for the benefit of future generations even if they never visit or use it themselves. Passive use values are an example of what economists refer to as a public good—a good that can be simultaneously enjoyed by multiple consumers without diminishing its overall value. Recognizing the growing support for the use of passive use values in resource allocation analysis in the economics community, a passive use analysis was conducted as part of this project. This analysis estimates passive use values for both endangered salmon and steelhead stocks and also a free-flowing lower Snake River.

4.1 Passive Use, Contingent Valuation and Benefit-Transfer[1]

Passive use values for non-market goods cannot be estimated using market data because such goods are not exchanged in markets. Therefore, economists have turned to stated preference methods,

[1] Much of this section and the preceding introductory discussion is excerpted from a technical memorandum prepared for the Multi-Species Framework (Kealy, 1999). This memorandum summarizes the current state of knowledge concerning passive use value and its measurement.

most notably, contingent valuation methods to measure passive use values. These methods generally use surveys of a representative sample of the relevant population to obtain expressions of a stated preference based on hypothetical market conditions. These stated preferences are then directly or indirectly used to determine willingness to pay for a good or service. This willingness to pay value is contingent upon the nature of the constructed market described in the survey scenario, hence the name "contingent value."

The contingent valuation method is controversial because of the difficulty of establishing the validity of the public's value statements and of determining the applicability of these value statements to the relevant policy decisions. The reliability and validity of contingent values depend upon the extent to which they precisely and accurately measure true values. Many economists are skeptical because they believe that the actual exchange of dollars for goods is fundamental to truthful revelation of preferences, or because results do not seem reasonable. Without an actual monetary transaction, people may lack the incentive to carefully research their preferences and may be overly influenced by information provided in a hypothetical exercise. While this influence theoretically should not affect their underlying values it very well might. Some experiments have shown that stated values are largely independent of the scale of the resource, that stated values are strongly related to the format of questioning, or that interpolation to numerous environmental goods implies unlikely or infeasible levels of payment. (See Hausman, 1993, for a critical assessment of contingent valuation.) Other studies, however, have shown that contingent values are sensitive to the scale of the good and that they are similar to (usually lower than) the value estimates obtained using other methods (Carson, 1997; Carson et al., 1996). The contingent valuation method has been given limited endorsement by a Blue-Ribbon panel chaired by two Nobel Laureate economists (Arrow et al., 1993). Many people believe that without an actual monetary transaction, respondents are likely to indicate they would pay more than they actually have in disposable income.

DREW originally requested that a passive use survey be conducted by the DREW Recreation Workgroup. This survey was designed and pretested. Controversy surrounding the pretest mailing and contingent valuation methodology prevented this survey from being conducted. Rather, passive use values were approximated using a benefit-transfer approach based on existing passive use value estimates. The benefit transfer approach is generally considered a practical alternative to valuation methods that involve the collection of original data on preferences. The benefit-transfer approach involves "transferring" existing studies, value estimates, and willingness to pay functions to new policy contexts, sites, and affected populations. The reliability and validity of such transferred values depend upon the quality of the original studies as well as the degree of similarity between the original context in which the values were estimated and the new policy context. At best, passive use values estimated using the benefit-transfer method can only be as accurate as the original studies on which they are based.

The passive use analysis conducted by the DREW Recreation Workgroup assumed that there are no passive use values associated with the existing lower Snake River dams and reservoirs. While it is possible that man-made objects such as dams may have existence value, economic theory and empirical evidence to date suggest that this is likely to be small (Lockwood et al., 1994). Scarcity and uniqueness are typically major determinants of the size of passive use values. Dams and reservoirs are not scarce in the Columbia River Basin or the Pacific Northwest. While dams and reservoirs are not scarce in the Pacific Northwest, the policy context that underlies this analysis is fairly unique. For some, the four lower Snake River dams are a planned manipulation of natural

resources representative of human and technological progress. For some individuals, breaching these dams may be regarded as a retreat from technological progress. These individuals may value the continued operation of the dams, even though they may not directly benefit or use the dams or reservoirs themselves. Most of the value of development, such as dams or barge transport, is believed to come from the market outputs created or the non-market recreation use values. Most public support for the dams can be traced to the economic or recreation benefits provided by dams and reservoirs. These direct use values are measured as part of the NED analysis presented in Section 3 of this document. A second source of public support for dams is the indirect local economic activity they generate. Local and regional indirect economic effects are addressed in the RED analysis presented in Section 6 of this document.

4.2 Salmon

Three approaches were used to transfer benefits from four existing studies to estimate the change in passive use value for lower Snake River salmon populations. While none of these existing studies precisely matches the policy setting of this study (which is why an original passive use value study was originally proposed by DREW), each provides an indication of the likely range of the passive use values for increasing salmon populations. All three of these approaches do a reasonable job of meeting the criteria for benefit transfer laid out by Boyle and Bergstrom (1992; 659). The criteria identified by Boyle and Bergstrom are as follows: "(1) the nonmarket commodity valued at the study site must be identical to the nonmarket commodity to be valued at the policy site; (2) the populations affected by the nonmarket commodity at the study site and policy site have identical characteristics; and (3) assignment of property rights at both sites must lead to the same theoretically appropriate welfare measures (e.g., willingness to pay versus willingness to accept compensation)." All four studies measure the same resource—salmon; three of the studies estimate passive use values for salmon in Washington State; and they all estimate these values based on the same measure—willingness to pay.

The existing studies do not perfectly match the policy setting of the Lower Snake River Juvenile Salmon Migration Feasibility Study because no reference is made to threatened or endangered species in the surveys used in these studies. This suggests that the margin of error associated with applying the results of these studies to the threatened and endangered stocks of the lower Snake River is likely to be in the conservative direction. It is likely that if the original surveys had specifically addressed threatened and endangered stocks, the resulting values per fish would have been higher because people would be willing to pay more to save a species they perceive to be near extinction. Second, most of the existing studies valued a larger increase in the number of salmon than is being evaluated in the lower Snake River study. The law of diminishing marginal returns suggests that consumers will value each successive unit of a good less than its predecessor. This suggests that the average marginal value per fish is inversely related to the number of fish being evaluated. Diminishing marginal existence values were found in the existing studies used for this analysis and confirmed in other economic literature. Taking a marginal value per fish from a study that valued a large increase and applying it to a smaller increase on the lower Snake River will also underestimate the value of that smaller increment.

The following sections discuss the three benefit-transfer approaches employed in this analysis. The first approach estimates a willingness to pay function from salmon based on the results from all four existing studies. The other two approaches each apply the results from just one of the four studies to the lower Snake River case.

4.1.1 Regression Approach

The first approach statistically estimates a willingness to pay function for salmon using incremental existence values per salmon calculated from four contingent valuation method studies of West Coast residents' willingness to pay for increasing salmon populations. The four original studies (Olsen, et al., 1991; Hanemann, et al., 1991; Loomis, 1996b; and Layton, et al., 1999) provided five estimates of the incremental value of an additional salmon (two estimates were obtained from Layton, et al). The regression function estimated from these five estimates has an explanatory power of 62 percent, and the number of salmon is significant at the 1 percent level, even given the limited degrees of freedom (see DREW Recreation Workgroup, 1999).

Using this function, the change in annual total passive use values with different levels of wild salmon and wild steelhead recovery was calculated for *non*-user households in the Pacific Northwest and California to avoid any double counting of passive use values and recreation use values. Data on wild salmon and steelhead run sizes were based on preliminary equal weight PATH data extrapolated by the DREW Anadromous Fish Workgroup (1999) to represent all Snake River wild stocks. The change in annual total passive use value is measured in terms of the change from Alternative 1, Existing Conditions, which formed the baseline for this analysis. Passive use values were calculated for Alternatives 2 through 4 by applying the regression function to the estimated change in wild salmon and steelhead populations associated with each alternative. The results of this analysis are presented in Table 4.1.

Alternative 4, Dam Breaching, is estimated to yield wild salmon and steelhead populations that are 66 percent more than those estimated under Alternative 1, Existing Conditions. Based on the regression approach this increase in stocks would result in a $879.3 million average annual increase in passive use values. Wild salmon and steelhead run sizes projected for Alternative 2, Maximum Transport of Juvenile Salmon, and Alternative 3, Major System Improvements, were lower than those projected for Alternative 1, Existing Conditions. As a result, there would be net annual reductions in passive use values of $9.54 million and $97.36 million under Alternatives 2 and 3, respectively (Table 4-1).

Table 4-1. Passive Use Value Analysis for Salmon (Average Annual 1998 Dollars) ($1,000)

Alternative	Average Annual Wild Return[1/]	Change from Alt. 1	Regression-Based Transfer[2/]	Elwha River Only[3/]	Transfer of 1999 Columbia River Estimates Only[4/]	
1	71,110				Stable Baseline	Low Baseline
2	70,682	-428	($9.54)	($1.28)	($0.60)	($4.58)
3	69,641	-1,469	($97.36)	($4.41)	($2.06)	($15.70)
4	118,571	47,461	$879.34	$142.30	$66.47	$508.40

1/ Average annual returns of wild salmon and steelhead are based on preliminary equal weight PATH data extrapolated by the DREW Anadromous Fish Workgroup to represent all Snake River wild stocks.

2/ This approach statistically estimated a willingness-to-pay function based on four existing studies (Olsen, et al., 1991; Hanemann, et al., 1991; Loomis, 1996b; and Layton, et al., 1999).

3/ This approach is based on values generated in the Elwha River study only (Loomis, 1996b).

4/ This approach is based on a stated preference survey of Washington residents (Layton et al., 1999). The stable baseline condition assumed that fish populations stabilized at current levels over the next 20 years. The low baseline condition assumed that populations declined over the next 20 years at the same rate as the previous 20 years.

4.1.2 Transfer of Elwha River Estimates

A second approach to calculating the passive use value involved matching the change in anadromous fish populations in Alternative 4, Dam Breaching, to the one existing study that valued a similar size change in salmon (Loomis, 1996b) rather than using the statistical function estimated from all four studies. The change in salmon runs evaluated in the Elwha River study was around 300,000, about six times the size of the net annual increase projected for Alternative 4, Dam Breaching (Table 4-1). This suggests that application of the Elwha River study results to the lower Snake River may be a reasonable benefit transfer. The fact that both projects involve dam removal and are located in the state of Washington further supports this reasoning.

The household value calculated from a nationwide survey of residents willingness to pay for salmon on the Elwha River was applied to non-user households in the Pacific Northwest and California. The value obtained for Washington residents in the Elwha study was applied to Washington non-user households. Ninety-three percent of this value was applied to residents in the rest of the Pacific Northwest and California. This adjustment is based on the results of the Elwha survey (Loomis, 1996a) which compared Washington residents' willingness to pay for salmon on the Elwha River with the amount that residents in the rest of the United States would pay for the same increase in salmon on the Elwha River.[2]

Applying the respective values per household to non-user households in the Pacific Northwest and California yields a gain in passive use value of about $142 million per year with dam breaching. The results of this analysis are presented for each alternative in Table 4.1. These may be considered conservative estimates for four reasons. First, the lower Snake River salmon are threatened and endangered, while the salmon returning to the Elwha were not endangered when the survey was written. This suggests that transferring the values from the Elwha River study to the lower Snake River case is likely to underestimate the passive use values for the lower Snake River's threatened and endangered salmon. Second, the change in salmon on the Elwha River is about six times that expected on the lower Snake River, which further reinforces the conservative nature of the passive use value per fish calculated from the Elwha due to diminishing marginal existence values. Third, limiting passive use values to non-user households assumes that users receive no passive use values, an unlikely situation. Finally, this analysis does not account for passive use value for households located elsewhere in the United States, despite evidence from the Elwha River study that such households do receive passive use values from salmon recovery and dam removal (Loomis, 1996a, 1996b).

4.1.3 Transfer of Columbia River Estimates

The third approach used just the most recent stated preference survey of Washington residents (Layton et al., 1999) to estimate the passive use value of increasing salmon on the lower Snake River. Layton et al.'s survey asked Washington residents to rate four different scenarios that involved three different generic stocks of fish species (freshwater, migratory, and saltwater) in two geographic areas (eastern and western Washington). This study was designed to estimate the value

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[2]Ninety-three percent is an average for the nation and includes residents in the eastern United States where willingness to pay was just 75 percent of the Washington value. Values in the rest of the Pacific Northwest and California were typically higher than 93 percent. Applying 93 percent of the Washington value to the rest of the Pacific Northwest and California may overstate the necessary downward adjustment (see Loomis, 1996b for a graph of the distance willingness-to-pay function for Elwha River salmon).

to Washington households of changes in fish populations in Washington waters for a full range of fish under a variety of conditions.

The Layton et al. survey was designed to value incremental changes in the various types of fish populations over time relative to baseline conditions. Uncertainty over future baseline conditions led the authors to use two different baselines in their survey, which were presented to a split sample of respondents. The low baseline condition showed populations declining over the next 20 years at the same rate as the previous 20 years. In the stable baseline condition, populations stabilized at current levels over the next 20 years. Given the diminishing marginal value of incremental gains in fish, the stable baseline condition resulted in lower values per fish than the low baseline condition. Layton, et al. found their estimated values per household were consistent with past passive use value studies of Loomis (1996) and Olsen, et al. (1991) using the non-declining future baseline. While the PATH salmon numbers assume a non-declining future, Columbia River Inter-Tribal Fisheries Commission (CRITFC) biologists, based on their evaluation of past trend data (Weber, 1999), suggest continued future declines.

The survey by Layton, et al. was conducted by mail and had a respectable response rate of 68 percent. The survey design included a budget reminder exercise which involved households having to determine how their household spending would change with a reduction in monthly income that was equal to the dollar amounts they were asked to pay for the four different fish programs. The authors conducted a statistical analysis of the survey results and calculated a value per household for a 50 percent increase in the number of eastern Washington/Columbia River migratory fish (e.g., salmon and steelhead), an increase of 1 million fish. An increase of 50 percent is comparable to the relative change in projected salmon and steelhead from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching. The resulting value is $119 per household annually for each additional 1 million salmon and steelhead. The average annual difference between Alternatives 1 and 4 is estimated to be 47,461 fish. This suggests that transfer of the Layton et al. value to the lower Snake River context would result in a conservative estimate due to diminishing marginal existence values. It should also be noted, however, that application of the Layton et al. value could represent an overestimate because this value includes both use and non-use values. Efforts were made to exclude those households with recreation use values to avoid double-counting these values.

This value from Washington residents was used for Washington, with 93 percent of it applied to households in the rest of the Pacific Northwest and California. This value is multiplied by the number of non-angler (e.g., non-user) households in the study region. Non-angler households were defined as those that do not hold fishing licenses. Households with a fishing license were assigned zero passive use value. This represents a conservative estimate because it assumes that all households holding fishing licenses would visit the lower Snake River. It also assumes that users receive no passive use value. Total willingness to pay was then divided by 1 million to identify the passive use value per fish. This value per fish was applied to the number of wild salmon and steelhead that would return under each EIS alternative to estimate the passive use values associated with that alternative. Using the Layton, et al. first scenario of an assumed stable future salmon population baseline, the annual gain from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching, is $66.47 million annually. Layton et al.'s declining future baseline results in an annual gain of $508 million, similar in magnitude to the regression estimate of $879 million (see Table 4-1).

4.3 Free-Flowing River

While a free-flowing river is arguably less symbolic of the Pacific Northwest, the public may be motivated to return the lower Snake River to a free-flowing condition for the benefit of future generations, even if they never visit or use it themselves. The DREW Recreation Workgroup estimated the passive use value for a free-flowing lower Snake River based on two existing studies. These studies measure the same resource—free-flowing rivers—but address rivers located in Colorado and the upper Snake River in Idaho. The survey populations are geographically limited to Colorado residents in the first case and residents of the immediately surrounding counties in the upper Snake River case. The policy context is also notably different than the lower Snake River study. Both of the existing studies are concerned with preserving free-flowing rivers, while the present analysis is concerned with restoring the lower Snake River to a free-flowing condition by removing existing structures.

Sanders et al. (1990) conducted a mail survey of the willingness of Colorado households to pay to preserve free-flowing rivers. The annual willingness to pay per household was $77 in 1983 dollars or $116 in 1996 dollars based on 51 percent response rate. Dividing this by the 555 miles being valued yields a value of 21 cents per mile. Multiplying this by the 140 miles of the lower Snake River yields a value per household of $29.40 per year per household. The rivers included in this list are all within Colorado and include the Yampa, Dolores, and Green rivers.

Another study was a contingent valuation method estimate of preserving the 63-mile-long Black Canyon of the upper Snake River by not allowing development (Scott and Wandschneider, 1993). The University of Idaho conducted telephone interviews of residents of the four Southeastern Idaho counties that surround this section of the river. This survey, conducted on behalf of the Bureau of Land Management (BLM), had a response rate of 76 percent and a sample size of nearly 350.

The upper Snake River survey indicated that the slightly more than half of this sample population who were non-users (n=196) had an annual willingness to pay of $58 for preservation of the upper Snake River (as compared to users who had a willingness to pay of $92). Dividing this value by the 63 protected miles yields a value of 92 cents per mile per household. This value is relatively high because only individuals living in counties adjacent to the river were sampled. This value per household per mile was applied to non-user households in the counties surrounding the lower Snake River. Thus a value of 92 cents times 140 miles or $129 was multiplied by the 305,467 non-user households located in the counties surrounding the lower Snake River. This resulted in a $39.4 million in passive use value for restoring a free-flowing lower Snake River. The Sanders et al. value of $29.40 was applied to the 12.95 million non-user households in the rest of Washington, Oregon, Idaho, Montana, and California, resulting in an estimated non-use value of $380.73 million for restoring the lower Snake River. Combining these two totals results in an aggregate passive use value for just the restoration of the free-flowing nature of the lower Snake River that is the sum of the two regions' values, or $420.13 million.

This value should be viewed with caution for at least two reasons. First, results taken from Colorado are applied to the entire Pacific Northwest and California with no allowance made for a possible distance willingness-to-pay function similar to the one that Loomis (1996a) identified for Elwha River salmon stocks. In addition, Colorado households may simply value free-flowing rivers differently than households in the Pacific Northwest and California. The difference in policy context—preservation versus restoration—may affect household willingness to pay. Some

households in the Columbia River Basin would be directly and negatively affected by breaching of the lower Snake River dams. They would experience loss of navigation and increased electricity rates, for example. This was not the case with the populations surveyed in the two existing studies. These types of direct use values would likely influence household passive use values for a free-flowing river.

4.4 Conclusion

The concept of passive use value is rarely challenged, but considerable controversy surrounds its measurement. The passive use values compiled in this study are not included in the NED account. The challenge in this study was to approximate passive use values based on the existing literature. Four studies, three of which valued salmon in the Pacific Northwest, were applied in different ways to estimate the passive use values of increases in salmon populations in the lower Snake River. The incremental passive use values for the increase in anadromous fish due to the dam breaching alternative ranges from a high of $879 million for households in the Pacific Northwest and California to a low of $66 million with a middle range between $142 and $508 million. These findings suggest that there is a passive use value associated with increases in wild Snake River salmon and steelhead stocks, but the wide possible range identified for this value—$66 million to $879 million—underlines the difficulty in estimating this type of value from benefit transfer.

The DREW Recreation Team also identified an annual passive use value of $420 million associated with returning the lower Snake River to a free-flowing condition, independent of any effect on salmon populations. Again, this analysis suggests that a passive use value likely exists. But this estimate should be viewed with caution because the existing studies on which it is based evaluated different geographic regions, and those studies were performed under a different policy context than this study. Additionally, the reader is cautioned regarding the uncertainty considering the validity of the public's value statements. Many believe that without an actual monetary transaction, respondents are likely to indicate they would pay more than they actually have in disposable income.

5. Tribal Circumstances

5.1 Overview

During thousands of years of development, the regional Native Cultures built subsistence-based economies. By the early 19th century, these cultures had a variety of effective ways for living in the unique environments of the Pacific Northwest. A variety of significant natural resources and habitats, such as riverine, lake, or other aquatic environments supported their subsistence-based economies. These subsistence-based economies were in turn bolstered by established trade, political and social networks, and alliances that served to connect the region's different cultures. In these societies, villages harvested local resources and hosted inter-band resource/trade centers in their own lands through mutually beneficial agreements and concepts of exchange. The Pacific Northwest salmon play an important role in Native American economies as commercial, ceremonial, and subsistence harvest.

There are 14 tribes in the study area. These tribes are listed in Section 3.6 of this appendix and described in Section 4.8 of the main FR/EIS and Section 5.7 of Technical Appendix Q, Tribal Consultation and Coordination. Each tribe is unique, however, many tribes have retained linkages over the years: through blood ties; in cooperative pursuit of salmon and other food; and through religion; sharing of languages, and similarity of treaties. Some of these tribes live further away from the Snake River drainage and are more separated from the immediate vicinity of the lower Snake River. Economic information is not available on all 14 tribes at this time, however, this FR/EIS does include a substantial amount of material drawn from a Tribal Circumstances and Perspectives report, prepared for this FR/EIS by a private contractor in association with the Columbia River Inter Tribal Fisheries Commission (CRITFC) (Meyer Resources, 1999). This report presents information that represents the viewpoints of four CRITFC tribes—the Nez Perce Tribe (Nez Perce), the Yakama Indian Nation (Yakama), the Confederated Tribes of the Umatilla Indian Reservation (Umatilla), and the Confederated Tribes of the Warms Springs Reservation of Oregon (Warm Springs)—together with the Shoshone-Bannock Tribes of the Fort Hall Reservation (Shoshone-Bannocks). These five tribes were selected for specific input because of their close cultural and economic links to the salmon. Impacts to tribal circumstances may be viewed in terms of tribal ceremonial, subsistence, and commercial harvest of salmon and tribal access to lands valuable to the tribes. These five tribes are referred to as the study tribes in the remainder of this section.

Dollar revenue is considered by the study tribes to be a severely limited indicator of tribal value that provides distorted impressions of the full impact on tribes. The study tribes emphasize that while revenue obtained from commercial sales of salmon provides important income to tribal peoples, it does not represent the greatest part of value that tribal peoples associate with salmon. As a result, the Tribal Circumstances and Perspectives report provides a qualitative assessment of the alternatives considered as part of this FR/EIS. The key findings of this qualitative assessment are summarized in this section. A much lengthier discussion is provided in the Tribal Circumstances and Perspectives report (Meyer Resources, 1999a). From the perspective of the WRC guidelines that inform the overall economic analysis conducted as part of this FR/EIS (see Section 1.3), this discussion is part of the environmental quality account, which addresses non-monetary effects on significant natural and cultural resources. The Tribal Circumstances and Perspectives report also addresses tribal circumstances from an environmental justice perspective. The environmental justice

portion of the Tribal Circumstances and Perspectives report is summarized in the section of the main FR/EIS that addresses disproportionate impacts to minority populations.

The majority of the statistics presented in this section are derived from the Tribal Circumstances and Perspectives Report (Meyer Resources, 1999). These statistics include comparisons of present social and economic well-being, estimates of historic and future tribal salmon harvest, and identify the loss of tribal lands. Information addressing sources of tribal income and the on- and off-reservation employment of tribal peoples was not available. As a result, the evaluation of the economic effects of the proposed alternatives on the study tribes is limited to information in the Tribal Circumstances and Perspectives report.

5.2 Present Circumstances of the Study Tribes

The Tribal Circumstances and Perspectives report states that the peoples of the study tribes cope with poverty, high unemployment, and high rates of death (cited as from 20 percent to more than twice the death rate for residents of Washington, Oregon, and Idaho). The Tribal Circumstances and Perspective report includes a table that compares the recent present well being of the Study Tribes with their non-tribal neighbors (reproduced here as Table 5-1).

The data presented in this table indicate that tribal unemployment rates range from 3 to 13 times higher than state averages. The higher portion of this range, derived by Meyer Resources (1999) from data compiled by the U.S. Bureau of Indian Affairs (BIA), is likely indicative of tribal employment during winter months and appears to reflect the seasonal employment of tribal members. Nevertheless, there is little doubt that tribal unemployment rates exceed those of their non-tribal neighbors. The data in Table 5-1 also indicate that study tribe per capita income is less than state averages. Finally, Table 5-1 suggests that the ratio of tribal death rates to non-tribal death rates ranges from 1.2 times to more than twice the state averages.

Table 5-1. Comparison of Present Wellbeing of the Study Tribes and Their Non-Tribal Neighbors

Indicator of Well-Being[1/]	Nez Perce Tribe	Shoshone - Bannock	Yakama Indian Nation	Umatilla	Warm Springs Tribes	State of Idaho	State of Oregon	State of Washington
Families in Poverty (%)	29.4	43.8	42.8	26.9	32.1	9.7	12.4	10.9
Unemployment[2/]								
US Census (%)	19.8	26.5	23.4	20.4	19.3	6.1	6.2	5.7
BIA (%)	62.0	80.0	73.0	21.0	45.0			
Per Capita Income ($000s)	8.7	4.6	5.7	7.9	4.3	11.5	13.4	14.9
Ratio of Tribal Death rate to Non-Tribal Death Rate[3/]	1.7	2.3	1.9	1.2	1.6			

1/ The data presented in this table are taken directly from the Tribal Circumstances and Perspectives report (Table 41). See the tribe by tribe sections in that report for further information.

2/ Census data (U.S. Bureau of the Census – 1990 Census of Population: Social and Economic Characteristics – American Indian and Alaska Native Areas) and BIA data (U.S. Bureau of Indian Affairs, 1995. Indian Service Population and Labor Force Estimates) are both included because Census data is more rigorous but tends to overestimate employment. BIA numbers are less rigorous but more likely indicative of Tribal Circumstances, particularly over winter months.

3/ These data derived in part from the Indian Health Service, various years, are age-adjusted.

Source: Meyer Resources, 1999 (Table 41).

The Tribal Circumstances and Perspectives report suggests that the following quotations provide a more graphic description of present tribal circumstances:

> The personal suffering and tragic lives of many (Indian) people are not revealed in the cold reports of tribal and Federal governments. It can, however, be seen and felt in the towns and the countryside—in the eyes of men and the despair of mothers, with few options for change. When you can no longer do what your ancestors did; when your father or mother could not do these things either; when they or you found little meaning in and limited access to the ways of mainstream culture—the power of 70 percent winter time unemployment, and 46 percent of the population below the poverty level, is visible throughout the Nez Perce landscape.
>
> (Central Washington University, 1991)

The Tribal Circumstances and Perspectives report states that tribal spokespersons are uncomfortable with statistical treatment of their peoples. They feel that such data sometimes elicits a "blaming the

> I don't much like this talk of unemployment and poverty. Before the white man came, we had no such thing as poverty. We lived off the land. We fished, we hunted, we gathered roots and berries. We worked hard all year round. We had no time for unemployment.
>
> Poverty came with the Reservations. We were forced to live away from our salmon and our other resources. Our poverty is our lack of our Indian resources. These resources are being destroyed by the white man. That's what's causing our poverty.
>
> (Nathan Jim, Sr., Warms Springs Fish Commissioner)

5.3 Causes of Present Economic Circumstances for the Study Tribes

5.3.1 Losing Tribal Salmon

The study tribes have identified the salmon decline as a great loss to tribal peoples. According to the Tribal Circumstances and Perspectives report, current tribal salmon harvests above the four lower Snake River dams are less than 1 percent of pre-contact levels (Table 5-2). The Tribal Circumstances and Perspectives report states that the principal cause of historic reductions in tribal salmon harvest was preemption by competing non-Indian harvesters, and obstruction or denial of access to usual and accustomed fishing places—sometimes fenced off by non-Indian property owners. Many of these issues were eventually challenged in court. For further information on the tribal historical perspective see Tribal Circumstances and Perspectives report (Meyer Resources 1999).

The transformation of the rivers to produce electricity, irrigation for agriculture, navigation services, etc., has affected salmon populations, which in turn have affected tribal salmon harvest (ceremonial, subsistence, and commercial). The Tribal Circumstances and Perspectives report indicates that as each dam was constructed, the tribes objected, calling on the government to reconsider. The tribes' arguments that these actions were contrary to their Treaties with the United States were unsuccessful.

Table 5-2. Estimated Tribal Fish Harvests—Traditional Times to the Present (1000 lbs)[1/]

	Nez Perce	Shoshone Bannock[2/]	Yakama	Umatilla	Warm Springs
Estimated Pre-Contact Harvest[3/]	2,800	2,500	5,600	3,500	3,400
Estimated Harvest in the mid-1800s[3/]	1,600	1,300	2,400	1,600	1,000
Current Tribal Harvest[4/]	160	1	1,100	77 for both tribes	
Present versus Pre-Contact Harvests (%)[5/]					
Above lower Snake River dams	0.6	0.04	-	-	
Below lower Snake River dams	5.1	-	19.6	1.1	
Present versus mid-1800s Harvests (%)[5/]					
Above lower Snake River dams	1.0	0.08	-	-	
Below lower Snake River dams	9.0	-	45.8	3.0	

1/ These data are presented in pounds of fish which are not easily compared to other fish data presented in this FR/EIS in terms of numbers of fish.

2/ Shoshone Bannock estimates include harvests by Sho-Pai Duck Valley peoples.

3/ Pre-contact and mid-1800s harvest estimates are based on estimated annual per capita consumption figures multiplied by estimated population totals for the early and mid-1800s. The population and per capita consumption estimates used to derive these numbers are discussed for each tribe in the Tribal Circumstances and Perspectives report.

4/ The peoples of the Yakama, Nez Perce, Umatilla, and Warm Springs reservations all fish in Zone 6 on the mid-Columbia River. CRITFC maintains data on the total tribal Zone 6 commercial catch. The Yakamas and the Nez Perce also keep their own Zone 6 catch subtotals but the Umatilla and Warm Springs do not. The commercial component of the combined figure shown for the Umatilla and Warm Springs tribes was calculated by subtracting the Yakama and Nez Perce subtotals from the CRITFC total. The residual harvest not accounted for by the Yakama and Nez Perce estimates is assumed to be harvested by either the Umatilla or the Warm Springs. The totals presented in Table 4-2 include these commercial harvest totals along with estimated ceremonial and subsistence totals obtained from each tribe. These estimates are only approximate but the Tribal Circumstances and Perspectives report suggests that they may be considered accurate within a reasonable range of magnitude and sufficient to indicate that present day tribal harvests are less than estimated pre-contact and mid-1800 harvest levels.

5/ Only the Nez Perce fish both above and below the lower Snake River dams.

Source: Meyer Resources, 1999.

5.3.2 Losing Tribal Lands

The Tribal Circumstances and Perspectives report states that the five study tribes control 2.6 million acres of their original Reservation lands—only 22 percent of the lands reserved in their treaties with the United States. Nine million acres of original tribal lands, together with the wealth those lands produce, are no longer in the hands of the tribes or their members. The estimated extent of tribal lands from traditional times to the present is indicated in Table 5-3. This table is taken directly from the Tribal Circumstances and Perspectives report. The tribes are reported to believe that the transfer of tribal wealth associated with Reservation lands into non-Indian hands was based on many injustices. For more information on this viewpoint see the Tribal Circumstances and Perspective report (Meyer Resources, 1999).

Table 5-3. Estimated Extent of Tribal "Own Lands"—Traditional Times to the Present (in Thousands of Acres)

	Nez Perce	Shoshone Bannock	Yakama	Umatilla	Warm Springs
Tribal lands ceded to the United States by Treaty	7,500	E-NQ	10,400	6,400	9,400
Retained Treaty lands (1855)	7,500	-	1,600	510	578
Retained Treaty lands (1868)	-	2,000	-	-	-
Umatilla land retained after boundary "survey error"	-	-	-	245	-
Nez Perce land retained after "steal treaty" of 1863	760	-	-	-	-
Lands owned today[1/]	94	544	1,126	158	658
Percent of Treaty lands owned today.	1.2	27.2	70.4	31.0	100+

1/ Tribal lands owned today have been reduced from treaty times as a result of Dawes Act "surplusing" and sales, right-of-way takings, and other losses. Non-Indians often hold the highest valued lands within Reservation boundaries. Reservation lands held by Indians are often interspersed with lands held by non-Indians in a "checkerboard," exacerbating difficulties for tribal resource protection and economic development.

E-NQ = extensive, but not quantified.

Source: Meyer Resources, 1999 (page xiii).

5.3.3 Tribal Perception Concerning the Adverse Circumstances of the Study Tribes

The Tribal Circumstances and Perspectives report is the most current information we have available on tribal views. It indicates a tribal belief that non-Indians have taken most Treaty-protected assets of value from the tribes—particularly their lands, waters, and salmon. Quotations illustrating the cumulative effects of these actions from a tribal perspective are presented in the Tribal Circumstances and Perspectives report. For example:

> My heart cries for my people, cuz we are no more Indians... All our horses are gone. No more cattle. All the pastures, the land, the hillsides, taken up by the farmers, by the white man.... Every inch of tillable ground is taken up. Where our houses used to be, they tear that down, and they put wheat in there or peas right on every inch of the ground. And they've taken down all the fences, and they've plowed through there. These big farmers, they've got everything in the world. The (Indian) owners have nothing. And they've taken everything.
>
> Like I say, they've taken our land, they've taken our rivers, they've taken our fish. I don't know what more they want.
>
> (Carrie Sampson, Umatilla Elder)

5.4 The Present Importance of Salmon to the Tribes

Today, salmon remain connected to the core of tribal material and spiritual life. Faced with bleak present circumstances, the tribal peoples still look first to the salmon with hope of a better future. This perspective is illustrated by the following quotations taken from the Tribal Circumstances and Perspectives report:

> Traditional activities such as fishing, hunting and gathering roots, berries and medicinal plants build self-esteem for Nez Perce peoples—and this has the capacity to reduce the level of death by accident, violence and suicide affecting our people. When you engage in cultural activities you build pride. You are helped to understand "what it is to be a Nez Perce"—as opposed to trying to be someone who is not a Nez Perce. In this way, the salmon, the game, the roots, the berries and the plants are the pillars of our world.
>
> (Leroy Seth, Nez Perce Elder)
>
> The loss of the food and the salmon is monumental—and its all tied together. Food is a really big part of the Yakama culture—as it is elsewhere. Anywhere you look in the world, food carries culture. So if you lose your foods, you lose part of your culture—and it has a devastating effect on the psyche. You also lose the social interaction. When you fish, you spend time together—you share all the things that impact your life—and you plan together for the next year. Salmon is more important than just food.
>
> In sum, there's a huge connection between salmon and tribal health. Restoring salmon restores a way of life. It restores physical activity. It restores mental health. It improves nutrition and thus restores physical health. It restores a traditional food source, which we know isn't everything—but its a big deal. It allows families to share time together and builds connections between family members. It passes on traditions that are being lost. If the salmon come back, these positive changes would start.
>
> (Chris Walsh, Yakama Psycho-Social Nursing Specialist)
>
> Salmon are the centerpiece of our culture, religion, spirit, and indeed, our very existence. As Indians, we speak solely for the salmon. We have no hidden agenda. We do not make decisions to appease special interest groups. We do not bow to the will of powerful economic interests. Our people's desire is simple—to preserve the fish, to preserve our way of life, now and for future generations.
>
> (Donald Sampson, Umatilla)

5.5 Reservation of the Tribal Right to Harvest Salmon

Treaties and their interpretations have been recognized to hold certain reserved rights, one being the right to fish. The Tribal Circumstances and Perspectives report depicts a few of these treaties. These are identified in Table 5-4.

Table 5-4. Key Treaties between the United States and the Five Tribal Circumstances Study Tribes

Treaty	Signing Date	Present Tribal Organization
Treaty with the Yakama Tribe	June 8, 1855	Yakama Indian Nation
Treaty with the Umatilla Tribe	June 9, 1855	Confederated Tribes of the Umatilla Indian Reservation
Treaty with the Nez Perce Tribe	June 11, 1855	Nez Perce Tribe
Treaty with the Tribes of Middle Oregon	June 25, 1855	Confederated Tribes of the Warm Springs Reservations of Oregon
Fort Bridger Treaty	July 3, 1868	Shoshone-Bannock Tribes

Source: Meyer Resources, 1999 (page xvi).

Tribal negotiators were careful to protect their rights to harvest salmon and the other key resources they depended on for survival in their treaties. According to the Tribal Circumstances and Perspectives report, the following explicit protection can be found in each of the treaties of the Nez Perce, Yakama, Umatilla, and Warm Springs:

> Article 3: The exclusive right of taking fish in all streams, where running through or bordering said reservations, is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at usual and accustomed places in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands.

The Tribal Circumstances and Perspectives report also highlights the following article in the Fort Bridger Treaty between the United States and the Shoshone-Bannock:

> Article 4: The Indians herein named...shall have the right to hunt on the unoccupied lands of the United States so long as the game may be found thereon, and as long as peace subsists among the whites and the Indians on the borders of the hunting districts.

The Court in State of Idaho v. Tinno, (497 P.2d 1386) stated that, in Article 4, “to hunt” also meant

The Tribal Circumstances and Perspectives report indicates that the intent of tribal negotiators during Treaty signings was to reserve the salmon resource for harvest from river systems that were biologically functional and fully productive. It has been opined that if the tribal treaty negotiators believed they were bargaining to reserve “only a small fraction” of the salmon available to harvest in the mid-1800’s, the treaty negotiations would have been much different—if they had occurred at all.

It is also a tribal perspective that the treaty signers, both tribal and non-tribal, intended and designed the Treaties to take care of the needs of tribal peoples in perpetuity. Consequently, there is no date in time, subsequent to 1855 that cuts off tribal Treaty entitlements.

In conclusion, the study tribes maintain that they have an entitlement to a fair share of the salmon harvest from all streams in their ceded area(s). For further discussion on this issue, see the Tribal Circumstances and Perspectives report (Meyer Resources, 1999).

5.6 Effects of the Lower Snake River Dams on the Study Tribes

As stated in the biological sections of this FR/EIS, the four lower Snake River dams have played a part in the decline of the salmon. The tribes have been affected economically by the dams to the extent that the dams influence the decline of salmon and reduce the pounds of fish available to be incorporated into their present day economic circumstances. See the main FR/EIS for discussion of other impacts and the Tribal Circumstances and Perspectives report for tribal views.

At the same time, the lower Snake River dams have increased the wealth of the region through enhanced production of electricity, agricultural products, transportation services, and other associated benefits. The Tribal Circumstances and Perspectives report states that tribal peoples believe they have not shared in this increased wealth on a commensurate basis.

Construction of the four lower Snake River dams and reservoirs also inundated numerous river miles of privately-owned land that the Tribal Circumstances and Perspectives report asserts to be usual and accustomed tribal fishing areas. The historical connections between present tribal groups, original tribal groups, and the lower Snake River reservoirs are highlighted in Table 5-5, which is taken directly from the Tribal Circumstances and Perspectives report (Meyer Resources, 1999).

Table 5-5. The Relationship between Present Tribal Groups, Pre-Treaty Tribal Groups, and Flooding of Lower Snake River Reservoir Areas

Present Tribal Group	Original Tribal Groups in lower Snake River Territory	Associated Flooding by lower Snake River Reservoirs
Nez Perce Tribe	Nez Perce Indians living along the Clearwater River, and downstream along the lower Snake River to the Palouse River (north bank) and the Tucannon River (south bank)	Lower Granite, Little Goose, and Lower Monumental reservoirs
Yakama Indian Nation	Palous peoples living at the confluence of the Snake and Palouse rivers, and downstream along the north bank. Possibly other bands near the mouth of the Snake River.	Lower Monumental and Ice Harbor reservoirs.
Confederated Tribes of the Umatilla Indian Reservation	Palous people living at the confluence of the Snake and Palouse rivers, and downstream along the north bank. Walla Walla peoples living from the mouth of the Tucannon River downstream along the south bank of the Snake River.	Lower Monumental and Ice Harbor reservoirs.

Source: Meyer Resources, 1999 (Table 2).

5.6.1 The Alternatives and Their Impacts

The Lower Snake River Juvenile Salmon Migration FR/EIS considers future alternatives with respect to the four dams and their reservoirs, affecting about 140 miles along the lower Snake River and approximately four miles along the lower Clearwater River. The effects of the four proposed alternatives on salmon and tribal lands are discussed in the following sections.

5.6.1.1 Tribal Salmon Harvest

The Plan for Analyzing and Testing Hypotheses (PATH) measured the effect of the proposed alternatives on seven index salmon stocks. The discussion of alternatives presented below is based on preliminary PATH data weighted by PATH's panel of independent experts and extended by the

DREW Anadromous Fish Workgroup to represent all Snake River wild and hatchery stocks. The Tribal Circumstances and Perspectives report presents tribal harvest recovery rates based on this preliminary PATH data and converts these rates into pounds, assuming average weights of 20.1 pounds per salmon for spring and summer chinook, 19.1 pounds per salmon for fall chinook, and 8.5 pounds per fish for steelhead. Results are discussed below for the 30-year and 50-year benchmarks. It should be noted that the NMFS analysis uses more recent PATH data that is unweighted. These data presented in pounds of fish are not easily compared to other fish data presented in the FR/EIS in terms of numbers of fish.

Tribal harvest data are presented for wild salmon and steelhead only in Table 5-7. Data are presented for both wild and hatchery salmon and steelhead in Table 5-8. The Tribal Circumstances and Perspectives report suggests that these forecasts may be overestimates because the PATH analysis is built from present-day conditions and fails to incorporate long-term negative trends in Columbia River/Snake River stock sizes. The report also suggests that the year zero assumptions, which were developed by the DREW Anadromous Fish Workgroup (see Section 3.5 of this appendix), likely exceed PATH's present conditions by approximately 34 percent for spring/summer chinook, and 43 percent for fall chinook (Meyer Resources, 1999; 214). The following sections assess the effects of the proposed alternatives in terms of the change from the year zero estimates. In addition, following the Tribal Circumstances and Perspectives report, comparison is made with current study tribe harvests from all Columbia River/Snake River system steelhead stocks. The Tribal Circumstances and Perspectives report estimates that current study tribe harvest from all Columbia River/Snake River system steelhead stocks is about 1,338,000 pounds (Table 5-2).

Table 5-7. Estimated Tribal Harvest of Wild Snake River Stocks in Pounds by Species

Alternative/ Project Year	Spring/Summer Chinook (1000 lbs)	Fall Chinook (1000 lbs)	Summer Steelhead (1000 lbs)	Total (1000 lbs)	Total Change from Year 0 (1000 lbs)	Total Change from Year 0 (%)
Alternative 1, Existing Conditions						
0	10.7	8.9	13	32.6		
10	28.2	16.8	19	64	31.4	96.3
30	54.7	21.9	93.6	170.2	137.6	422.1
50	62.4	21.5	94.8	178.7	146.1	448.2
Alternative 2, Maximum Transport of Juvenile Salmon						
0	10.7	8.9	13	32.6		
10	26.8	16.8	18.4	62	29.4	90.2
30	46.1	21.9	90.7	158.7	126.1	386.8
50	48.2	21.5	91.1	160.8	128.2	393.3
Alternative 4, Dam Breaching						
0	10.7	8.9	13	32.6		
10	27.2	24.6	18.9	70.7	38.1	116.9
30	149.3	133.1	113.1	395.5	362.9	1,113.2
50	174.6	133.6	117.6	425.8	393.2	1,206.1

Note: The Tribal Circumstances and Perspectives report does not address Alternative 3, but the impacts of this alternative on tribal harvest are likely to be similar to those projected for Alternative 2.

Source: Meyer Resources, 1999 (Table 50).

Table 5-8. Estimated Tribal Harvest of Wild and Hatchery Snake River Stocks in Pounds by Species

Alternative/ Project Year	Spring/Summer Chinook ("000 lbs)	Fall Chinook ('000 lbs)	Summer Steelhead ("000 lbs)	Total ('000 lbs)	Total Change from Year 0 ('000 lbs)	Total Change from Year 0 (%)
Alternative 1, Existing Conditions						
0	20.6	36.2	255.7	312.5		
10	36.7	41.2	272.3	350.2	37.7	12.1
30	97	58.2	639.1	794.3	481.8	154.2
50	110.8	65.1	660.6	836.5	524	167.7
Alternative 2, Maximum Transport of Juvenile Salmon						
0	20.6	36.2	255.7	312.5		
10	35.3	41.2	269.9	346.4	33.9	10.8
30	82.4	58.2	606.2	746.8	434.3	139.0
50	86.4	65.1	618.3	769.8	457.3	146.3
Alternative 4, Dam Breaching						
0	20.6	36.2	255.7	312.5		
10	43.1	87.9	356.3	487.3	174.8	55.9
30	304.2	650.7	951.5	1906.4	1593.9	510.0
50	355	668	990.4	2013.4	1700.9	544.3

Note:
The Tribal Circumstances and Perspectives report does not address Alternative 3, but the impacts of this alternative on tribal harvest are likely to be similar to those projected for Alternative 2.
Source: Meyer Resources, 1999 (Table 50).

Alternative 1, Existing Conditions

Alternative 1 would maintain existing conditions with scheduled improvements. The Tribal Circumstances and Perspectives report states that this alternative offers a 35 to 42 percent probability that spring/summer chinook would be delisted after 48 years and limited hope of salmon recovery within a reasonable timeframe. Data presented in the Tribal Circumstances and Perspectives report indicate that the tribes would harvest 32,600 pounds of wild Snake River salmon and steelhead and 312,500 pounds of wild and hatchery Snake River salmon and steelhead at project year zero. Under Alternative 1 tribal harvest of wild salmon and steelhead would increase more than four times by the 30-year benchmark. The combined wild and hatchery tribal harvest would increase by about 1.5 times over this period. As noted above, the Tribal Circumstances and Perspectives report asserts that these estimates based on PATH preliminary estimates extended by the DREW Anadromous Fish Workgroup are too high. These numbers do, however, allow some comparison to be made between alternatives.

Alternative 2, Maximum Transport of Juvenile Salmon

Alternative 2 would produce lower stock levels than Alternative 1. The Tribal Circumstances and Perspectives report states that this alternative offers a 30 to 40 percent probability that spring/summer chinook would be delisted after 48 years and would be unlikely to meet tribal salmon recovery objectives within a reasonable timeframe. Tribal wild salmon harvests would increase by about 387 percent over estimated year zero totals by the 30-year benchmark, while the combined tribal wild and hatchery harvest would increase by about 1.4 times. According to the Tribal Circumstances and Perspectives report, tribal harvest of wild Snake River stocks under this alternative would be about 7 percent lower than under Alternative 1. Tribal harvest of wild and hatchery stocks taken together would be about 6 percent less than under Alternative 1.

Alternative 3, Major System Improvements

The Tribal Circumstances and Perspectives report does not address Alternative 3, but the impacts of this alternative on tribal harvest are likely to be similar to those projected for Alternative 2.

Alternative 4, Dam Breaching

The Tribal Circumstances and Perspectives report states that this alternative offers a 80 percent probability that spring/summer chinook would be delisted after 48 years and concludes that only this alternative would redirect river actions toward significant improvement of the cultural and material circumstances of the five study tribes. Tribal harvest of wild salmon could increase by more than 11 times over estimated year zero totals by the 30-year benchmark and 12 times by the 50-year benchmark under this alternative. Combined wild and hatchery salmon harvests would be about 5.1 and 5.4 times higher than current harvest levels at the 30-year and 50-year benchmarks, respectively. By year 50 estimated tribal wild and hatchery harvest would increase by about 1.7 million pounds — increasing current study tribe harvests from all Columbia/Snake system steelhead stocks by 2.3 times. This alternative would produce 2.4 times more tribal harvest of Snake River wild salmon and steelhead stocks than Alternative 1 (2.6 times more harvest than Alternative 2).

5.6.1.2 Impacts on Flooded Lands Important to Tribes

Alternatives 1 through 3

Under Alternatives 1 through 3, tribal people would continue to be separated from the grounds in which their ancestors are buried along lower Snake River stream sides and unable to care for their graves.

The four reservoirs prevent tribal fishing, hunting, and harvesting of roots, plants and berries at some usual and accustomed stream side locations. These reservoirs prevent the subject tribes from holding religious and cultural ceremonies at locations that are below the present-day water levels.

The dams and reservoirs inundate lands associated with the substantial aspects of cultural, material, and spiritual life along the lower Snake River for affected tribal peoples — and separate tribal peoples from those areas.

Alternative 4, Dam Breaching

This alternative would drain the four lower Snake River reservoirs, and could potentially create substantial benefits for affected tribes. According to the Tribal Circumstances and Perspectives report, the study tribes feel that this would allow tribal peoples to renew their close religious/spiritual connection with approximately 34,000 acres of lands where their ancestors lived and are buried, and allow them to properly care for their grave sites. They could return to more than 600 to 700 locations where they were accustomed to live; fish; hunt; harvest plants, roots and berries; conduct cultural and religious ceremonies; and pursue other aspects of their normal traditional lives.

Tribal benefits associated with lands that are presently inundated could be obtained under Alternative 4, Dam Breaching, in the following ways if these actions were implemented:

- By restoring Treaty-based tribal access rights to usual and accustomed fishing places along the restored river sides.
- By restoring Treaty-based tribal access rights to hunt and gather on ceded, open, and unclaimed public lands alongside the restored river sides.
- By making it possible to return any tribal individual allotment lands in the reservoir area, acquired by the Federal government when the reservoirs were built, to tribal hands (i.e., to the Native American families that may have held any such allotments).
- By making it possible to transfer uncovered reservoir lands to tribes. (Congressional legislation would be needed for implementation of this action.)

5.7 Cumulative Tribal Impacts of Lower Snake River Project Alternatives

In conclusion, the Tribal Circumstances and Perspectives report restates the view that Alternative 4, Dam Breaching, is the only viable alternative for restoring the tribal fishery and providing other benefits to the tribes.

Alternatives 1 through 3

The tribes feel that under Alternatives 1 through 3, the lower Snake River would continue to function at present levels, continue tribal losses of treaty-protected salmon due to the dams, and, therefore, maintain the distribution of benefits from the river primarily to non-tribal hands.

Alternative 4, Dam Breaching

The study tribes believe that selection of Alternative 4, Dam Breaching, which would involve returning the lower Snake River to a free-flowing condition, would have the opposite effect on cumulative trends along the lower Snake River. Study tribes state it offers more than twice the tribal harvest projected under the other alternatives and would increase current study tribe harvests from all Columbia River/Snake River system salmon and steelhead stocks by 2.3 times. It would remove waters presently covering some 140-plus miles of shoreline and create access to important usual and accustomed tribal locations along the lower Snake River. For additional tribal views on impacts associated with flooding at lower Snake River reservoirs see the Tribal Circumstances and Perspectives report (Meyer Resources, 1999, Table 53).

According to the Tribal Circumstances and Perspectives report, from a cumulative policy perspective, the study tribes see selection of Alternative 4, Dam Breaching, as reversing an almost century and one-half trend which cumulatively stripped the tribes of their valued and treaty-protected assets, and would move toward "rebalancing" distributions of the wealth that the lower Snake River can produce between the tribes and non-tribal peoples of the study area. Such actions may not result in immediate improvements to tribal material well-being and health, but the Tribal Circumstances and Perspectives report states that over future years, as the salmon stocks become stronger, so would the health and economic well-being of tribal members.

The study tribes conclusions, as reported in the Tribal Circumstances and Perspectives report, with respect to the cumulative impact of lower Snake River Project alternatives on distribution of wealth, tribal health and material well-being, tribal spiritual and religious well-being, and tribal self-sufficiency and self-empowerment are summarized in Table 5-9.

Table 5-9. Summary of Cumulative Tribal Impacts from Lower Snake River A1, A2, and A3 Alternatives

Tribal Impact	Alternative 1	Alternatives 2 and 3	Alternative 3
Wealth Distribution	Non-tribal interests continue to accumulate wealth. Tribal loss of valuable assets continues.	Same as Alternative 1, but slightly more adverse.	Begins rebalancing the river's production function. Some wealth transfers from non-Indian interests back to the tribes begin as inundated lands are exposed and salmon is restored.
Health and Material Well-being	Will continue to preempt tribal subsistence and economic activity. Will continue adverse effects on tribal nutrition and general health.	Same as Alternative 1, but slightly more adverse.	Will begin reversal of adverse cumulative nutrition and health circumstances. Will reduce tribal poverty over time. Will broaden the base for tribal subsistence and, where appropriate, tribal economies.
Spiritual/ Religious Well-being	Continues to endanger the salmon, one of the key elements that provide religious, spiritual, and cultural definition for the study tribes.	Same as Alternative 1, but slightly more adverse.	Will remove salmon from endangerment. This will generate major benefits for key elements of tribal religion and spirituality, which will be removed from endangerment as well.
Tribal Empowerment	Continues to discount the knowledge and recommendations of tribal peoples concerning survival of Snake River salmon, disempowering the tribes.	Same as Alternative 1.	Credits the knowledge and advice of tribal peoples on what is required for the Snake River salmon to survive and recover. This would increase feelings of empowerment and self-worth among tribal peoples.

Source: Meyer Resources, 1999 (Table 54).

6. Regional Economic Development (RED) Analysis

6.1 Introduction

Regional economic analysis is concerned with changes in the local economy that would be created by the alternatives. The NED sections of this appendix (Section 3) have discussed the direct economic effects that the proposed alternatives would have on power, transportation, water supply, and other aspects of the national economy. Increased or reduced spending associated with these changes would also affect the regional economy. These effects would be larger than those directly associated with the initial change in spending because direct changes in one sector of the regional or local economy have indirect and induced effects on other sectors. An influx of funds, for example, is spent and re-spent in the local economy as expanding sectors hire labor and buy business inputs and services from local suppliers. This process is known as the multiplier effect. The more locally produced goods and services purchased, the larger the multiplier effect. A reduction in spending also has indirect and induced effects. Closure of a business in a particular community, for example, has predictable impacts on other firms located in that community. Loss of a business results in less local spending of workers' wages and salaries, and less local spending for business inputs and services, therefore, making the total impact to the economy larger than the initial change.

The regional economic analysis developed for this study addresses the regional economic impacts of changes in spending projected by various DREW workgroups. These impacts, evaluated in terms of business sales, employment, and income, were estimated using input-output models, which model the interactions among different sectors of the economy. Business sales are the estimated gross receipts received by a business (with the exception of those businesses in the trade sectors where it is the margin or the value added by that business). Business sales are the driving force behind the economy from an input-output modeling perspective. Employment is measured in full-time and part-time jobs. Jobs are usually viewed as the single most important outcome of increased business sales and the greatest concern when economic growth falters. Personal income, the third measure used here, consists of wages, salaries, social insurance, and profit received by individuals.

The impacts to regional business sales, employment, and income summarized in the following sections are presented as net changes from existing conditions. The DREW Regional Analysis Workgroup projected changes to employment and income over a 100-year study period. Job totals include both full-time and part-time employment. The economy of the lower Snake River study area and the Pacific Northwest as a whole has changed since 1970. Historically important job sectors such as logging, mining, and farming and ranching have declined or remained stagnant over this period, while employment in the services sector has dramatically increased. Non-labor sources of income, particularly transfer payments, have increased as a component of total regional income. Employment is projected to increase over the next 20 years in the lower Snake River study area. These projected increases and the evolving structure of the regional economy form a backdrop against which changes in employment projected for the proposed alternatives should be considered. Although resource-based industries, such as logging and farming, will likely decline as a share of total employment at a state-

level, they will remain important parts of the region's economic base, especially in counties and communities where they are the dominant form of economic activity. Projected job changes may represent a small percentage of existing and projected employment, but the loss of these jobs could be significant for the counties and communities where they are concentrated. Potential effects to local communities are discussed in the DREW Social Analysis report (DREW Social Analysis Workgroup, 1999) and Section 7 of this appendix.

The remainder of this section is divided into four parts. Section 6.2 provides a brief discussion of the input-output methodology employed for this analysis. Section 6.3 presents the results of this analysis by resource area. In many cases only Alternative 4, Dam Breaching, creates economic change sufficiently large to warrant measurement. The impacts are summarized across the three measures employed in this analysis—business sales, employment, and income—in Section 6.4. Section 6.5 discusses remaining unresolved issues associated with this study. The main component of this section is a qualitative discussion of potential impacts to regional industries that could not be addressed quantitatively using the input-output methodology.

6.2 Input-Output Methodology

Input-output models estimate the effects of changes in one sector on the rest of the regional economy. Input-output is an accounting system that includes all the industries in a study region. The input-output accounts measure the interdependence among industries and workers in an economy. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy (and jobs) if a local industry makes sales to persons or firms outside the region or to government. The input-output technique is a model of sales flows among industries and government agencies that is based on historical purchase patterns for each industry and for consumers. The input-output model simultaneously considers the interdependent spending changes among industries in the region that provide goods as inputs (the indirect effects), and households in the region that provide labor and management services to directly and indirectly affected industries (the induced effects).

Sales to final demand are the portion of an industry's sales that are for export (from the defined study region), sales to government, or to create new physical investment. Sales to final demand are an important measure because they are the driving force that supports the economy. Exports, sales to government, or sales for investment (i.e., new physical capital or addition to inventory) are the only sources of new spending for a regional economy. In this analysis, the primary changes in final demand sales are sales to Federal government and exports. Sales to final demand have a multiplier effect on the economic activity of a region because the expanding sector buys local labor and other inputs from local suppliers to create added output. Local suppliers must increase their purchases, spreading the expansion throughout the economy.

Each alternative has positive or negative changes in sales to final demand (including changes in government spending, changes in output of affected industries, and physical investments by private enterprise) which create indirect and induced changes in business sales, employment, and personal income in the study regions. These economic changes are shown by input-output multipliers that are applied to the change in sales to final demand to calculate the cumulative economic effects throughout the economy of a region. The secondary impacts for some industries are mainly local while other industries' impacts would occur at locations throughout the Pacific Northwest.

Economic changes created by the alternatives can be “short-run” or “long-run.” Short run is used in this section to describe the effects of construction or other temporary spending that lasts for less than 10 years. In contrast, long-run effects are permanent and continue for the 100-year period analyzed in this study.

6.2.1 Limitations of the Analysis

Regional economic effects are measured in this analysis using input-output models with industry spending coefficients estimated or synthesized from national data rather than from surveys of local industry. These models were constructed based on the 1994 IMpact analysis for PLANning (IMPLAN) computer system originally developed by the U.S. Forest Service. The IMPLAN model is now being offered for general use by the Minnesota IMPLAN Group. This system can be used to construct county or multi-county models for any region in the United States. The regional models constructed by the Forest Service are based on technical coefficients from a national input-output model and localized estimates of total gross outputs by sector. IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region. Some valid criticisms have been directed at synthesized input-output as opposed to survey based input-output. First, the synthesized industry spending coefficients are based on relationships between industries on a national scale. These generalized relationships may not apply to the specific region under study. An input-output model, unlike many other economic models, is constrained and consistent. The model is a double-entry bookkeeping system of accounts. Total sales must equal total purchases in each sector and for the economy as a whole and including imports and exports from the study region. A 90-industry input-output model (as used in this study) is equivalent to a sales maximizing linear program with 90 constraint equations that limit the outcomes. These built-in constraints limit most input-output models business sales multipliers (direct, indirect, and induced effects) to lie between 1.5 and 3.00 regardless of the underlying data source. Recent IMPLAN models, which use much more refined data than earlier models, are typically within plus or minus 10 percent of the multipliers that would be found using survey data in place of national averages. This conclusion is based on experience with constructing about 30 direct survey input-output models. Furthermore, IMPLAN contains known sources of error that have been adjusted (DREW Regional Analysis Workgroup, 1999).

One limitation of this type of regional impact analysis is that it presents a picture of the economy at a single point in time. This picture is based on historical ratios between different sectors of the economy rather than a dynamic structure of changing relationships. When prices or costs change in response to public policy changes, consumers, and producers respond by substituting among final goods, substituting among inputs to production, migrating among regions, and shutting down businesses that are no longer profitable. To evaluate these sorts of changes, economists must first use supply and demand models to estimate the direct effects, which are then used to drive the input-output model. Accurate estimates of regional change are dependent upon the projections of direct effects by sector that drive the input-output modeling.

It has also been suggested that this type of regional analysis tends to overstate long-term impacts because it assumes that all possible adjustments to disturbance are instantaneous and permanent, and that individual responses to disturbances are limited. People who lose jobs, for example, are assumed

to stay unemployed. In reality, people and businesses adjust over time, as they consider and try alternative occupations, technologies, and locations (IEAB, 1999).

6.2.2 Study Regions

Eight input-output models were constructed to address potential regional effects associated with the alternatives. Models were developed for Washington, Oregon, Idaho, and Montana, the downriver, reservoir, upriver subregions, and the lower Snake River study area, which consists of the three subregions (see Table 6-1 and Figure 1-1). The downriver subregion is defined as the region that would be the terminus of barge transport under Alternative 4, Dam Breaching. The reservoir subregion, which consists of those counties that adjoin the four lower Snake River reservoirs, would see changes in barge transport and gain free-flowing river recreation under Alternative 4, Dam Breaching. The upriver subregion is defined as the region in central Idaho and northeast Oregon that would lose barge transport and gain free-flowing river recreation and increased fishing opportunities.

Table 6-1. Regional Economic Analysis Study Area by State and County

Downriver Subregion	Reservoir Subregion	Upriver Subregion
Oregon	**Washington**	**Idaho**
Gilliam	Adams	Clearwater
Hood River	Asotin	Custer
Morrow	Columbia	Idaho
Sherman	Garfield	Latah
Umatilla	Walla Walla	Lemhi
Wasco	Whitman	Lewis
		Nez Perce
Washington		Valley
Benton		
Franklin		**Oregon**
Klickitat		Wallowa
Skamania		

The subregion models were developed to examine cases, such as a reduction in irrigated agriculture on Ice Harbor Reservoir, where impacts are relatively localized. Evaluating localized changes using a statewide model would tend to overestimate the impact. States are less dependent on imports than smaller regions and, therefore, tend to have larger multiplier effects. The state models are used to evaluate impacts, such as increases in electric rates, that occur at a larger scale.

In addition, the DREW Anadromous Fish Workgroup used a Fishery Economic Assessment Model (FEAM) based on IMPLAN technical coefficients to estimate the economic impacts of changes in anadromous fish harvests. These impacts were evaluated for the states of Washington, Oregon, and Alaska, and for British Columbia, Canada.

6.3 Economic Impacts by Resource Category

This section shows the direct, indirect, and induced regional economic effects of the proposed alternatives by resource category. Employment changes projected by the 1994 IMPLAN model were divided by 1.07 to adjust for inflation when using final demand changes of the alternatives that were

in 1998 dollars. The IMPLAN model projects employment on the basis of jobs per dollar of sales in 1994. Thus, without this adjustment, inflation would cause projected changes in jobs to be overstated. All impacts are shown in 1998 dollars. Readers are referred to the DREW Regional Analysis Workgroup (1999) report for a more detailed discussion of the methodology and findings of this analysis.

6.3.1 Power

6.3.1.1 Potential Rate Increases

Alternative 4, Dam Breaching, would terminate hydroelectric generation at the four Corps dams on the lower Snake River. This would lead to a need for replacement power generation. The capital costs for constructing the new power plants and the increased operating costs for these plants would lead to increased electricity bills to ratepayers. In addition to increased power generation costs, there is also the question of how the costs of implementing the alternatives will be distributed. It is not possible to say how the costs associated with Alternative 4, Dam Breaching, would ultimately be paid. Before restructuring of the electricity industry, a large portion of the costs would have been BPA's responsibility and BPA would have raised its rates to recover increased costs. In a restructured, competitive, wholesale power market, the price that BPA can charge its customers is effectively capped by the market price of electricity. BPA can no longer recover higher costs by raising its rates because utilities that buy power from BPA now have alternate sources of electricity supplied by the wholesale electricity market. A number of possible cost allocation scenarios exist ranging from BPA customers through the entire Pacific Northwest load. This is discussed further in the financial analysis presented in DREW Hydropower Impact Team (1999).

Increased electric rates may cause customers to switch from electricity and increase the demand for natural gas, propane, fuel oil, and insulation. Over time, more efficient household, commercial, and industrial electric appliances, machines, and processes would be substituted for electricity use. The long-run demand for electricity has been shown to be sensitive to price increases. As a result, increasing the price per kilowatt-hour (kWh) consumed would reduce the amount of electricity that must be produced and increase the demand for substitute products. If the increased electric bill were paid by an increased fixed monthly charge as opposed to a rate increase, the substitution effects would be minimal because few customers would be willing to give up their electricity connection.

Electric bill increases would reduce net income for industries and reduce disposable income for households in the region. The extent to which business firms would leave the region or reduce output and employment in reaction to reduced net income is unknown. Some industries may be able to pass part of the increased electric bill on to their customers. Other industries, such as agriculture, cannot do this because of intense national or global competition. Higher electric bills paid by residential consumers, farmers, and business owners would reduce their disposable income, leading to reduce consumer spending for other goods and services. Projected increases in annual electricity expenditures are presented by state and sector in Table 6-2.

The economic impact of increased electricity bills on the aluminum sector is unknown because information is not available to predict the effects of increased operating costs on production and employment. The aluminum processing sector could be severely impacted. Based on their share of current electricity use, aluminum plants in Washington would have an increase in their annual

electricity bill of $26 million, while plants in Oregon would have an increase of $12.88 million, and plants in Montana would have an increase of $4.58 million (Table 6-2).

Table 6-2. Annual Electricity Expenditure Increases Caused by Alternative 4, Dam Breaching by State and Sector, (1998 dollars) (Million Dollars)[1/]

	State							
Sector	**Wash.**	**Ore.**	**Idaho**	**Mont.**	**Cal.**	**Nev.**	**Wyom.**	**Total**
Commercial	39.45	24.88	8.49	1.78	0.45	0.07	0.14	72.56
Industrial[2/]	35.24	22.35	12.44	5.10	0.22	1.08	0.27	76.70
Irrigation	3.39	1.74	4.06	0.12	0.18	0.01	0.01	9.51
Residential	53.94	30.26	12.26	2.38	0.71	0.82	0.41	100.78
Aluminum	26.00	12.88	0.00	4.58	0.00	0.00	0.00	43.46
Federal	2.67	0.00	0.00	0.00	0.00	0.00	0.00	2.67
Total	**160.69**	**92.11**	**37.25**	**13.96**	**1.56**	**1.98**	**0.83**	**308.38**

1/ Electricity spending increases are distributed to sectors based on the existing spending shares.

2/ These totals exclude the aluminum industry which is shown in a separate row below.

Source: DREW Hydropower Impact Team (1999).

Impacts on Residential and Farm Incomes

Increased electric bills to residential and farm irrigation customers are assumed to be paid by households and create a reduction in disposable income to households. The cost to individual households would rise by approximately one to six dollars depending on how many ratepayers were subject to the rate increase. The direct, indirect, and induced economic effects of reduced household income in the States of Washington, Oregon, Idaho, and Montana are estimated using input-output models for these four States. Alternative 4, Dam Breaching, is the only alternative that would create a significant changes in household electricity bills. Table 6-2 shows the projected increase of electricity bills for residential and farm irrigation customers based on current consumption patterns (DREW Hydropower Impact Workgroup, 1999).

Increased electric power bills paid by residential and farm households would cause household personal income to fall in the states of Washington, Oregon, Idaho, and Montana. Initial decreases in personal income were multiplied by each state's input-output multipliers to identify their impacts on state business sales, employment, and personal income. These results are presented by state in Table 6-3.

Impacts on Local Owners of Commercial and Industrial Firms

Although the effects on the viability and operating levels of electricity-intensive firms and plants are unknown, the effect on the personal income of in-state owners of many small commercial and industrial firms can be estimated (primary aluminum is excluded because it is not a locally owned small business). Projected increase in electricity bills for commercial and industrial firms are presented in Table 6-2. Based on unpublished payroll data, a rough estimate of in-state ownership for commercial and industrial firms is 50 percent and 30 percent respectively (precise estimates would require knowledge of electricity consumption by many individual firms and industries). Thus, the commercial row of Table 6-2 was multiplied times 0.5 and the industrial row times 0.3 to find the

increased electricity bills paid by in-state owners if Alternative 4, Dam Breaching, were selected. These estimates of increased electricity bills to local owners of commercial and industrial establishments are treated as reductions of their spendable personal income.

Table 6-3. Annual Regional Effects of Increased Electric Bills to Residential and Farm Irrigation Customers under Alternative 4, Dam Breaching (1998 dollars) [1/]

	Initial Reduction in Household Personal Income ($ million)	Business Sales (1998 $ million per year)	Employment	Personal Income (1998 $ million per year) [2/]
Washington	(57.32)	(134.56)	(743)	(78.39)
Oregon	(32.00)	(80.52)	(507)	(45.81)
Idaho	(16.32)	(37.10)	(248)	(22.22)
Montana	(2.50)	(5.26)	(36)	(3.11)
Total	(108.14)	(257.44)	(1534)	(149.53)

1/ The impacts shown above are for the "middle" estimate of the change in electric bills. The effects of the "low" estimate can be found by dividing these results by 1.284. The effects of the "high" estimate can be found by multiplying the results shown above by 1.241 (DREW Hydropower Impact Team, 1999).

2/ The multiplier effect results in personal income decreasing by a multiple of the original change.

Increased electric power bills paid for commercial and industrial uses would cause household personal income to fall in the states of Washington, Oregon, Idaho, and Montana. Initial decreases in personal income were multiplied by each state's input-output multipliers to identify their impacts on state business sales, employment, and personal income. These results are presented by state in Table 6-4.

Table 6-4. Annual Regional Effects of Increased Electric Bills to Local Owners of Commercial and Industrial Firms under Alternative 4, Dam Breaching (1998 dollars) [1/]

	Initial Reduction in Household Personal Income ($ million)	Business Sales (1998 $ million per year)	Employment	Personal Income (1998 $ million per year) [2/]
Washington	(30.30)	(71.13)	(393)	(41.43)
Oregon	(19.15)	(48.18)	(303)	(27.41)
Idaho	(7.79)	(17.71)	(118)	(10.61)
Montana	(2.43)	(5.11)	(34)	(3.09)
Total	(9.67)	(142.13)	(848)	(82.54)

1/ The impacts shown above are for the "middle" estimate of the change in electric bills. The effects of the "low" estimate can be found by dividing these results by 1.284. The effects of the "high" estimate can be found by multiplying the results shown above by 1.241 (DREW Hydropower Impact Team, 1999).

2/ The multiplier effect results in personal income decreasing by a multiple of the original change.

6.3.1.2 Hydroelectric Operation and Maintenance

Alternative 4, Dam Breaching, would result in shut down of hydroelectric generation at the four lower Snake River dams. Reduced operation and maintenance costs (the plants require security and

preservation services after shut down) would create negative direct, indirect, and induced economic impacts on the region. These impacts are included in Section 6.6.6 of this appendix.

6.3.1.3 Power Plant Construction

It is assumed that six new 250-megawatt (MW) combined-cycle, gas-fired electric power plants would be constructed to replace the lower Snake River dam power output. Two of the six plants are needed to support system reliability. Three new combined-cycle plants are expected to be constructed in the downriver subregion. The first two plants would potentially be constructed in 2007 and go on line in 2008. It was assumed that the first two plants would be constructed in Hermiston and Tri-Cities. It is estimated that a third plant would be built in 2008 in Tri-Cities. Three more plants could be constructed in the Puget Sound region. These plants could be constructed in 2009, 2010, and 2016, respectively (DREW Hydropower Impact Team, 1999).

Each plant is assumed to take one year to construct. Plant construction costs are estimated to be $601,000 per megawatt or $150.25 million per plant. These costs would be incurred during the year of construction in each case. Based on the downriver subregion utility construction multipliers, each one-year construction project would generate business sales of $332.40 million, 2,786 jobs, and an increase of $104.80 million in personal income. These impacts would be doubled in 2007 because two plants could be constructed simultaneously. Similar construction impacts can be expected in the Puget Sound area.

6.3.1.4 Power Plant Operation

According to BPA power system modeling, the new combined-cycle plants would operate at 90 percent of their design capacity. Operating costs of the new plants are estimated to be $13.61/megawatt hour (MWh) resulting in an annual operating cost of $26.80 million per year. Six new plants would generate operation spending of $160.80 million per year. This operation spending would be distributed between labor (households) and labor-intensive services (21 percent), and the natural gas production, transmission, and distribution sector (79 percent). This division was based on information on combined-cycle plants (DREW Hydropower Impact Team, 1999).

Annual spending increases in the lower Snake River region to operate the plants would be $53.60 million ($26.8 million times 2) per year in 2008 and $80.40 million ($26.8 million times 3) per year in 2009 and thereafter. Annual spending increases in the Puget Sound region would be about $26.8 million per year in 2010, $53.60 million per year in 2011, and $80.40 million per year in 2017 and thereafter. The shortfall of power generated in the region would require electricity imports to the region prior to the construction of the new plants. It is assumed that these temporary electricity imports would not create any measurable changes in spending or employment within the study region.

While the three plants that would be constructed in the lower Snake River region would be located in the downriver subregion, the adjacent reservoir subregion could also be affected by construction activities. Thus, the Lower Snake River Model was used to estimate impacts. Operation and maintenance spending on labor and labor-intensive services associated with the first two plants would be about $11.26 million. Based on lower Snake River study area multipliers this would generate $26.70 million in business sales, 168 jobs, and $4.16 million in personal income. These effects would occur annually starting in 2008. Completion of the third plant in 2009 would increase these annual

impacts to $40.05 million in business sales, 252 jobs, and $6.24 million in personal income. The remaining three combined-cycle power plants would add to the impacts in a similar manner in the Puget Sound area in 2010, 2011, and 2017.

The major input to this type of power plant is natural gas. Natural gas would account for $42.34 million per year of purchases from the gas distribution sector for the first two plants. Based on lower Snake River study area multipliers, this would generate $67.10 million in business sales, 416 jobs, and $11.56 million in personal income. These effects would occur annually starting in 2008. Completion of the third plant in 2009 would increase these annual impacts to $100.65 million in business sales, 624 jobs, and $17.34 million in personal income. The remaining three combined-cycle power plants would add to the impacts in a similar manner in the Puget Sound area in 2010, 2011, and 2017.

6.3.1.5 Transmission Line Construction

A total construction expenditure to modify electricity transmission lines of $177 to $271 million would occur over a 2-year period during the breaching process. A new transmission line from Spokane to Tri-Cities would account for $100 to $150 million of the expense. The remainder of the spending is for projects in the downriver subregion. It is assumed that the impacts all occur in the downriver subregion. The annual spending of $88.50 to $135.50 million to modify power lines would result in $196.10 to $300.30 million in business sales, 1,643 to 2,516 jobs, and $61.90 to $94.70 million of personal income.

6.3.1.6 Transmission Line Operation and Maintenance

Spending to operate and maintain new electricity transmission lines of approximately $0.85 million is assumed to occur annually. It is assumed that the spending would occur somewhere in the lower Snake River region. The lower Snake River region electric utility multipliers are 1.9634, 0.00001052, and 0.4095 for business sales, employment, and personal income respectively. The $0.85 million spent to operate and maintain power lines would result in $1.67 million of business sales, eight jobs and $0.35 million of personal income.

6.3.2 Recreation

Fishing trips and recreation and tourism trips by non-residents create new spending flows in the region where the visit occurs. Sportfishing, recreation, and tourism by non-residents are, as a result, exports that stimulate the local economy. Changes in recreation projected by the DREW Recreation Workgroup (1999) would increase these types of exports in two ways. First, the total number of trips per year to the fishing and recreation sites would increase. Second, the share of trips made by non-residents would also increase.

Alternative 4, Dam Breaching, is expected to increase steelhead and salmon runs in all three subregions, and along the coastal areas of the Pacific Northwest (DREW Anadromous Workgroup, 1999). Breaching, however, reduces or eliminates some species of fish currently available on the four lower Snake River reservoirs and the allocation of salmon for sportfishing harvest, even after breaching, is very small. The number of fishing trips made to these areas is expected to increase in response to increased fishing opportunities. This increase would, however, be severely limited by the number of fish available for recreational harvest.

Alternative 4, Dam Breaching, would also return the lower Snake River to free flow, suitable for rafting, kayaking and other river-based activities. Current flat-water oriented recreation activities would no longer be possible. A contingent behavior survey conducted by the DREW Recreation Workgroup (1999) projected that the number of recreation trips to a free-flowing lower Snake River in the reservoir subregion would be greater than the number of trips that would be made to the reservoirs (see Section 3.2). The contingent behavior surveys measured consumer intentions to visit the sportfishing and river recreation sites with and without Alternative 4, Dam Breaching.

Changes in spending on sportfishing and other recreation trips with Alternative 4, Dam Breaching, are based on surveys of current sportfishing and other recreation visitation for the reservoir and upriver subregions, Corps visitation data, and the contingent behavior surveys (DREW Recreation Workgroup, 1999).

6.3.2.1 Sportfishing in the Upriver Subregion

Increases in sportfishing in central Idaho and northeast Oregon are projected under Alternative 4. These increases would generate additional business sales, employment, and personal income in the upriver subregion (Table 6-5). These impacts, based on the number of fish available for harvest, increase over time. Sportfishing projections made by the DREW Recreation Workgroup are based on preliminary PATH data extended by the DREW Anadromous Fish Workgroup (1999). Alternatives 2 and 3 would not create significant upriver fishing impacts.

Table 6-5. Annual Economic Effects of Fishing in the Upriver Subregion for Alternative 4, Dam Breaching (1998 dollars) [1/]

Year	Increase in Business Sales, 1998 ($ Million per Year)	Increase in Jobs	Increase in Personal Income, ($ Million per Year)
0	6.15	92	1.73
5	4.40	66	1.24
10	28.74	432	8.10
15	20.98	312	5.85
20	24.57	369	6.92
25	25.70	386	7.24
30 to 100	26.74 to 28.43	402 to 427	7.56 to 8.01

1/ The increase in fishing trips is constrained by the supply of fish projected by PATH and the DREW Anadromous Fish Workgroup, 1999.

Source: DREW Recreation Workgroup, 1999

6.3.2.2 Sportfishing in the Reservoir Subregion

Increases in sportfishing in the reservoir subregion are projected under Alternative 4. The associated increases in business sales, employment, and personal income are presented in Table 6-6. These impacts, based on the number of fish available for harvest, increase over time. These impacts are based on numbers of fish projected by PATH and the DREW Anadromous Fish Workgroup (1999). Fishing trips are constrained below both the DREW Recreation Workgroup contingent behavior "low" and "medium" forecasts of fishing demand by the limited availability of fish projected by

PATH and the DREW Anadromous Fish Workgroup. Alternatives 2 and 3 would not create significant upriver fishing impacts.

Table 6-6. Annual Economic Effects of Fishing in the Reservoir Subregion for Alternative 4, Dam Breaching (1998 dollars) [1/]

Year	Increase in Business Sales ($ Million per Year)	Increase in Jobs	Increase in Personal Income ($ Million per Year)
0	3.4	36	0.86
5	2.79	29	0.71
10	4.72	50	1.2
15	5.44	57	1.39
20	7.1	75	1.81
25	8.77	92	2.23
30 to 100	8.99 to 9.47	93 to 99	2.29 to 2.41

1/ Fishing trips are constrained below both the "middle" and "low" DREW Recreation Impact Workgroup (1999) contingent behavior forecasts of fishing demand due to the limited availability of fish projected by PATH and the DREW Anadromous Fish Workgroup (1999).

Source: DREW Recreation Impact Workgroup (1999).

6.3.2.3 Recreation and Tourism in the Reservoir Subregion

Increases in recreation and tourism are projected under Alternative 4, Dam Breaching. The associated increases in business sales, employment, and personal income are presented in Table 6-7. The impacts shown are based on the DREW Recreation Workgroup contingent behavior "middle level" forecast, which were not constrained by available recreation facilities and river congestion (see Section 3.2). Alternatives 2 and 3 would not affect existing and currently projected recreation and tourism in the reservoir subregion.

Table 6-7. Annual Economic Effects of River Recreation in the Reservoir Subregion Middle Forecast for Alternative 4, Dam Breaching (1998 dollars) [1/]

Year	Increase in Business Sales ($ Million per Year)	Increase in Jobs	Increase in Personal Income 1998 ($ Million per Year)
0	35.95	456	9.65
5	49.84	631	13.37
10	73.14	927	19.63
20 to 100	77.28	980	20.74

1/ The "middle" forecast is based on the DREW Recreation Impact Workgroup (1999) contingent behavior survey for recreation visits with breaching.

Source: Based on data from the DREW Recreation Workgroup, 1999

6.3.3 Commercial and Ocean Recreational Fishing

Regional economic impacts associated with commercial and ocean recreational fishing were estimated by the DREW Anadromous Fish Workgroup using input-output models that translate direct fishing

expenditures and hatchery costs into personal income. This analysis addressed changes in the Pacific Northwest states, Alaska, and British Columbia. Representative budgets from the fish harvesting and processing sectors, as well as a price and cost structure for processing are used to estimate the changes.

The economic evaluation not only considered commercial harvesting and processing of wild and hatchery originating fish, but also sales of hatchery returns for egg, carcass, and food fish sales. The economic modeling provided per fish unit values for the various user groups and fisheries. Anadromous fish forecasts provided a simulation of where, how many, what species, and which user group (ocean and river commercial, treaty, hatchery surplus sales) is doing the harvests of stocks that will be affected by the hydrosystem actions. Total economic impacts values are then a function of distributed harvests and fish unit values.

Increases in commercial and ocean recreation harvest of anadromous fish would add $31.87 million in business sales, 249 jobs, and $10.6 million in personal income. Most of the regional economic impacts would be generated from the inriver commercial treaty fishery contributed from fall chinook.

6.3.4 Transportation

6.3.4.1 New Construction for Rail Transport

If dam breaching were to occur, a large portion of grain presently shipped via the lower Snake River would be diverted to rail. New railroad hopper cars costing $14.00 to $26.85 million would be required. For the purposes of analysis, it was assumed, that construction of these railcars would take place outside the Pacific Northwest region.

Increased grain shipments via rail would result in an increase of 8 to 12 unit-trains or 900 to 1,330 cars being delivered to tidewater terminals each month. Rail storage at tidewater terminals would be needed for 450 to 650 of these cars. Existing rail car storage would be inadequate to accommodate this increase. Construction of tidewater railroad track for car storage is projected to cost between $1.99 and $4.05 million. This construction, which would take place in Oregon, was modeled using the IMPLAN new road construction sector multipliers for Oregon. This sector includes other heavy construction, such as railroad construction. This construction spending would generate from $4.74 to $9.64 million in business sales, 41 to 81 jobs, and $1.21 to $2.46 million in personal income.

Upgrades to mainline track would be required. Construction spending associated with these upgrades is estimated to range from $14 to $24 million. Upgrades would also be required for short-line railroads. These costs are estimated to range from $33.9 to $47.8 million. This construction, which would take place in the lower Snake River region, was modeled using the IMPLAN new road construction sector multipliers for the lower Snake River study area. This new construction spending would generate from $86.73 to $122.29 million in business sales, 723 to 1,020 jobs, and $23.16 to $32.66 million in personal income. It is assumed that railroad track improvements would have to be completed rapidly (within a year) to meet the increased rail car traffic.

6.3.4.2 Impacts of New Construction for Road Transport

Dam breaching would also result in increased volumes of truck traffic on Washington highways. This increase in traffic would require one-time intersection and road improvements. Estimated

construction costs range from $84.10 to $100.70 million. This construction, which would take place in the lower Snake River region, was modeled using the IMPLAN new road construction sector multipliers for the lower Snake River study area. This new construction spending would generate from $215.16 to $257.63 million in business sales, 1,794 to 2,149 jobs, and $57.46 to $68.80 million in personal income. Road and intersection improvements would have to be completed rapidly (within a year) to accommodate the increased heavy truck traffic.

6.3.4.3 Impacts of New Construction for Transport-related Facilities

The projected shift of grain from the lower Snake River to rail would require country grain elevator upgrades with estimated construction costs of $14.00 to $16.90 million. Construction costs for river elevator upgrades are estimated to range from $58.7 to $335.4 million depending on the type of facility built. This construction, which would take place in the lower Snake River region, was modeled using the IMPLAN new industrial buildings sector multipliers for the lower Snake River study area. This new construction spending would generate from $202.95 to $983.48 million in business sales, 1,991 to 9,646 jobs, and $6.75 to $329.96 million in personal income. (Note: the most likely impacts were set at 1.2 times the average impacts for transport-related facilities by the DREW Transportation Workgroup, 1999.) Grain elevator improvements would have to be completed rapidly (within a year) to accommodate the increased use of rail and truck in place of barge transport.

6.3.4.4 Impacts of Dam Breaching on Industries Using or Replacing Barge Transport

The potential effects of increased transportation costs associated with dam breaching are complex. On the one hand, the trucking/warehousing sector could decline because current shipments of grains and other products to ports in Lewiston/Clarkston from locations in Idaho, Montana, and North Dakota would no longer take place. On the other hand, trucking to rail terminals and ports located near Tri-Cities might increase.

The effect on rail transport which is more labor-intensive than barge transportation, is also complicated. A shift of transport mode from barge to rail implies slightly increased transport employment in the upriver and reservoir subregions. This outcome is, however, based on the implicit assumption that demand for transportation would not be affected by increases in cost.

Increased transportation costs as a result of dam breaching could have a number of effects. First, a “substitution effect” can cause a search for alternate carriers or alternate routes to minimize the impact of increased transport costs. Lacking alternate carriers, routes for some products may shift away from the West Coast and the upriver subregion. Second, the “output effect” of increased transport costs can cause producers to reduce their outputs because they become less competitive on national and world markets when their cost of production increases. A third effect is the “stages of production” effect. Export of raw materials is promoted by low-cost transportation. Bulk materials are less likely to be shipped if the cost per ton is increased. The choice is either to stop producing the bulk materials, or increase the stages of production so that the materials shipped out have a higher value per ton. The latter option implies that more processed goods would be shipped out of the region and fewer bulk materials. Local value added (and employment) within the upriver subregion could

rise if this were to take effect. Total quantity shipped might fall and yet the total value shipped might rise if more processing of raw materials were conducted in the upriver subregion.

Given these possible long-run adjustments to increased transport costs, it is unclear how much transport volume might fall over time if barging were eliminated. No studies exist to project the possible changes in shipping volume. As a result, it is not possible to model the direct, indirect, and induced effects in the industries using the transport sector or in the transport sector itself. The price sensitivity of transport demand depends upon the impacts upon, and the unknown reactions by, the sectors that use these transport services.

6.3.4.5 Cruise Ship Effects of Alternative 4, Dam Breaching

Existing cruise ships would not be able to operate on a free-flowing Snake River. Based on contacts made with a sample of cruise ship companies, it appears that breaching the lower Snake River dams would terminate the cruise-ship industry in the Lewiston/Clarkston area and probably on the Columbia River with the exception of day-trips (DREW Transportation Workgroup, 1999). It is, however, likely that some of the cruise ship employment and retail sales to passengers would shift to the downriver subregion if the Snake River were unavailable with breaching.

Direct non-payroll purchases by the cruise ship sector in the upriver subregion are estimated at $2.64 million per year (DREW Transportation Workgroup, 1999). Cruise ship companies purchase engine fuel, jet boat services, laundry services, water supplies, and docking. The largest purchases are for prepaid jet boat tours and fuel, which account for about 46 and 45 percent of direct purchases. A reduction in direct purchases and payroll by cruise ship companies in the upriver subregion would result in a decrease of $7.96 million in annual business sales, 76 lost jobs, and $2.11 million lost personal income per year. The total impact estimate also includes the effects of direct cruise ship employment and payroll in the upriver subregion based on confidential reports (DREW Regional Workgroup, 1999).

About 21,315 passengers are estimated to travel to the upriver subregion by cruise ship (DREW Transportation Workgroup, 1999). Assuming that the average spending per passenger in Lewiston is $57, the annual loss of retail sales to cruise ship passengers in the upriver subregion would be about $1.21 million. The IMPLAN multipliers for retail trade apply on the sales margin, which is about 15 percent of actual retail sales. Lost retail sales would reduce total business sales by $0.43 million, employment by seven jobs, and personal income by $0.14 million in the upriver subregion.

Total impacts include the effects of lost sales to cruise ship companies, lost cruise ship payroll, and lost retail sales to passengers. Total direct, indirect, and induced losses in the upriver subregion are estimated at $8.39 million per year in business sales, 83 jobs, and $2.25 million per year in personal income.

6.3.5 Water Supply

6.3.5.1 Agricultural Pump Stations

Approximately 37,000 acres of cropland are presently irrigated from Ice Harbor Reservoir. The analysis conducted by the DREW Water Supply Workgroup (1999) (see Section 3.4) suggested that in the absence of Congressional appropriation, the costs to modify the existing pump system would be

prohibitive based on the estimated value of the land. The estimated change in farmland value would be in the reservoir subregion, but reduced farm spending would also occur in the downriver subregion, therefore, the lower Snake River study area multipliers were used.

The following is an attempt to display an array of scenarios of regional impacts. Assuming that the entire 37,000 acres were to go of business would result in an annual decrease in business sales of $232.26 million, a loss of 2,256 jobs, and an annual reduction in personal income of $79.19 million. About 21 percent of the irrigated land might support the development of alternative water supplies to replace the lost irrigation water. If fruit orchards and vineyard production continued on 7,735 of the 37,000 acres, the direct value of production lost would be $38.37 million. In this case, annual business sales would fall by $119.43 million, 901 jobs would be lost, and personal income would fall by $42.07 million per year.

6.3.5.2 Municipal and Industrial (M&I) Pump Station Modifications

There are eight existing municipal and industrial pump stations along the lower Snake River, all located on the Lower Granite Reservoir. Water withdrawn from these stations is used for municipal water system backup, golf course irrigation, industrial process water for paper production, concrete aggregate washing, and park irrigation. Under Alternative 4, Dam Breaching, the river elevation would be substantially lower and these pumping stations would require modification to maintain current water supplies (DREW Water Workgroup, 1999).

Modification of municipal and industrial pump stations was estimated to cost between $11.51 million and $55.20 million (DREW Water Supply Workgroup, 1999). This wide range of costs reflects uncertainty about required modifications to the Potlatch Corporation system (DREW Water Supply Workgroup, 1999). The impacts of construction associated with these modifications were estimated using the upriver subregion utility construction multiplier and assumed to be one-year impacts. This spending would result in an increase in business sales of $25.14 to $120.56 million, an increase of 292 to 1,397 jobs, and increases in personal income that would range from $7.73 to $37.10 million.

6.3.5.3 Construction Expenditures to Modify Private Wells

Approximately 209 functioning wells are presently located within one mile of the lower Snake River. About 95 of these wells are expected to require modification if dam breaching were to occur (DREW Water Supply Workgroup, 1999). Construction spending in the reservoir subregion to modify private wells was estimated at $56.45 million (DREW Water Supply Workgroup, 1999). About 22 percent of the wells were in the downriver subregion (Franklin County) and the rest were in the reservoir subregion. The impact of construction expenditures to modify private wells was estimated using the maintenance and repair not elsewhere classified sales multiplier. Well modification in the reservoir subregion would result in a $107.76 million increase in business sales, an increase of 916 jobs, and an increase in personal income of $29.52 million. Well modification in the downriver subregion would result in a $30.40 million increase in business sales, an increase of 259 jobs, and an increase in personal income of $8.33 million. These are assumed to be 1-year impacts.

6.3.6 Implementation Expenditure Effects

Implementation of the selected alternative would require modifications to the operation and physical structure of the four lower Snake River dams, hydroelectric plants, and reservoirs. Implementation activities proposed under each alternative include new construction spending and spending on mitigation.

The implementation effects of breaching the four dams are summarized in Tables 6-8 through 6-10. These effects were estimated based on information provided by the DREW Implementation Workgroup (1999). Direct, indirect, and induced effects are shown for business sales, employment, and personal income by alternative and over time.

6.3.7 Avoided Cost Expenditure Effects (Changes in Corps Operating Spending)

Alternatives 2 and 3 would result in relatively small modifications to Corps spending. Alternative 4, Dam Breaching, results in much reduced spending because of the shut down of electric generation operations, dam operations, and lock operations. Tables 6-11 through 6-13 summarize the effects for Alternatives 2 and 3. The effects of the reduced Corps operating costs under the Alternative 4, Dam Breaching, are presented in Table 6-14. Effects are shown for business sales, employment, and personal income over time. These effects would primarily occur in the lower Snake River study area.

Table 6-8. Short Term Economic Effects of Implementation of Business Sales (1998 dollars) ($ Million per Year)[1/]

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 – Major System Improvements	Alternative 4 - Dam Breaching
2001	(1.89)	(1.48)	11.03
2002	(7.36)	(4.39)	(8.92)
2003	(4.63) or (6.94)	11.72 or 9.41	22.95 or 20.63
2004	1.64 or (5.15)	33.05 or 26.26	111.28 or 104.48
2005	0	28.41	202.27
2006	0	14.96	198.54
2007	0	0	169.37
2008	0	0	47.02
2009	0	0	24.71

1/ Two sets of baseline data definitions were used for the years 2003 and 2004 by the DREW Implementation Workgroup (1999).

Table 6-9. Short Term Economic Effects of Implementation on Employment (Jobs)[1/]

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 - Major System Improvements	Alternative 4 - Dam Breaching
2001	(28)	(22)	164
2002	(110)	(67)	(132)
2003	69 or (103)	176 or 140	343 or 308
2004	24 or (77)	495 or 392	1,664 or 1,564
2005	0	426	3,025
2006	0	223	2,970
2007	0	0	2,532
2008	0	0	704
2009	0	0	369

1/ Two sets of baseline data definitions were used for the years 2003 and 2004 by the DREW Implementation Workgroup (1999).

Table 6-10. Short Term Economic Effects of Implementation on Personal Income (1998 dollars) ($ Million)[1/]

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 - Major System Improvements	Alternative 4 - Dam Breaching
2001	(0.76)	(0.6)	4.52
2002	(3.01)	(1.8)	(3.66)
2003	(1.89) or (2.84)	4.79 or 3.85	9.41 or 8.46
2004	0.67 or (2.11)	13.51 or 10.74	45.62 or 42.84
2005	0	11.62	82.93
2006	0	6.12	81.4
2007	0	0	69.44
2008	0	0	19.28
2009	0	0	10.13

1/ Two sets of baseline data definitions were used for the years 2003 and 2004 by the DREW Implementation Workgroup (1999).

Table 6-11. Annual Economic Effects of Avoided Costs on Business Sales (1998 dollars) ($ Million), Alternatives 2 and 3

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 - Major System Improvements
2001 to 2026	(4.09)	2.18
2027 to 2100	0	1.26

Table 6-12. Annual Economic Effects of Avoided Costs on Employment (Jobs), Alternatives 2 and 3

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 - Major System Improvements
2001 to 2026	(83)	44
2027 to 2100	0	25

Table 6-13. Annual Economic Effects of Avoided Costs on Personal Income (1998 dollars)
($ Million), Alternatives 2 and 3

Year	Alternative 2 - Maximum Transport of Juvenile Salmon	Alternative 3 - Major System Improvements
2001 to 2026	(2.36)	1.26
2027 to 2100	0	0.73

Table 6-14. Annual Economic Effects of Avoided Costs on Business Sales, Jobs and Personal Income for Alternative 4, Dam Breaching (1998 dollars)

Year	Change in Business Sales, 1998 ($ Million per Year)	Change in Employment (Jobs)	Change in Personal Income, 1998 ($ Million per Year)
2001	(6.67)	(135)	(3.85)
2002	(6.67)	(135)	(3.85)
2003	(6.67)	(135)	(3.85)
2004	(7.08)	(143)	(4.09)
2005	(6.05)	(122)	(3.5)
2006	(27.97)	(565)	(16.16)
2007 to 2100	(59.04) to (81.72)	(1,193) to (1,651)	(34.11) to (47.22)

6.4 Summary of Effects

6.4.1 Effects at the State Level

Several impact categories occur either throughout the Pacific Northwest, throughout a State, or in an area of a State outside the Subregions. In addition, impacts associated with changes in commercial and ocean recreational fishing occur in the Pacific Northwest states, Alaska, and British Columbia, Canada.

Increased electric power bills would cause business sales, employment, and personal income to fall in the States of Washington, Oregon, Idaho, and Montana, as shown in Table 6-15.

Table 6-15. Annual Impacts of Increased Electric Power Bills, by State (1998 dollars)[1/]

	Washington	Oregon	Idaho	Montana
Business Sales ($ million per year)	(205.69)	(128.70)	(54.81)	(10.37)
Employment (jobs)	(1,136)	(810)	(366)	(70)
Personal Income ($ million per year)	(119.82)	(73.22)	(32.83)	(6.20)

1/ This table excludes the impacts of plant shut down or business failures caused by increased electric bills.

Three combined cycle electric power plants would be built in the Puget Sound region of Washington. Construction of each of these plants would occur in different years and would create about $332.40 million in business sales, 2,786 jobs, and $104.80 million in personal income in the State of Washington over three one year periods.

Operation and maintenance of the three combined cycle power plants would add $140.70 million in business sales, 876 jobs, and $23.58 million in personal income to Puget Sound region of the Washington State economy.

Construction of tidewater rail car storage in Oregon is projected to cost about $3.02 million and create $7.19 million in sales, 63 jobs, and $1.84 million in personal income. These construction impacts would only last one year.

Increases in commercial and ocean recreation harvest of anadromous fish in the Pacific Northwest states of Washington and Oregon, Alaska, and British Columbia, Canada would add $31.87 million in business sales, 249 jobs, and $10.6 million in personal income.

Effects by subregion are discussed for business sales, employment, and income in the following three sections. The effects summarized in these sections were modeled using the upriver, reservoir, and downriver subregion and total lower Snake River study area input-output models. These models identify localized impacts associated with the proposed alternatives.

6.4.2 Business Sales

6.4.2.1 Alternative 1, Existing Conditions

Alternative 1, Existing Conditions, represents the baseline for this analysis. Current business sales estimated by IMPLAN are $34,427.47 million for the lower Snake River study area. Subregion totals range from $6,744.85 million for the reservoir subregion to $19,717.96 million for the downriver subregion.

6.4.2.2 Alternative 2, Maximum Transport of Juvenile Salmon

Changes to business sales under this alternative would be relatively minor and limited to the implementation and avoided costs categories. Business sales associated with implementing this alternative from 2001 to 2004 are projected to range from an annual loss of $5.15 million to an annual gain of $1.64 million compared to Alternative 1, Existing Conditions (Table 6-8). Changes in the Corps' operating expenditures (avoided costs) would result in an annual reduction of $4.09 million in business sales from 2001 to 2026 (Table 6-11).

6.4.2.3 Alternative 3, Major System Improvements

Employment change under this alternative would also be relatively minor and limited to jobs associated with implementation and avoided costs. Business sales associated with implementing this alternative from 2001 to 2006 are projected to range from an annual loss of $4.39 to an annual gain of $33.05 million compared to Alternative 1, Existing Conditions (Table 6-8). Changes in the Corps' operating expenditures (avoided costs) would result in increased annual business sales of $2.18 million from 2001 to 2026 and $1.26 million from 2027 to 2100 (Table 6-11).

6.4.2.4 Alternative 4, Dam Breaching

Changes in business sales associated with this alternative can be divided into short-term and long-term effects. Short-term effects, mainly associated with construction activities, would be temporary and last less than 10 years (Table 6-16). Long-term effects would be permanent (Table 6-17). These impacts caused by changes in spending include indirect and induced business sales, therefore, changes

in business sales are distributed throughout the regional economy and not only concentrated in the sector where the initial change in spending occurs.

Construction activities resulting directly and indirectly from breaching the four lower Snake River dams would result in increased business sales of $2,263 million in the lower Snake River study area over a 10-year period (Table 6-16). The exact total would fluctuate from year to year. Major construction projects would include replacement power facilities ($913 million) and new grain elevators ($711.86 million).

In the long-run, annual business sales in the lower Snake River study area would increase by $216 million (Table 6-17). This increase would mainly be associated with the operation of replacement power facilities and recreation activities. The lower Snake River study area would, however, lose annual business sales of $249.66 million. The lost business sales would be mainly associated with Corps' operations and farmland irrigated from Ice Harbor Reservoir. This estimated long-term net change in annual business sales (-$33.65 million) represents less than 1 percent of current business sales in the lower Snake River study area.

Table 6-16. Annual Short-Term Business Sales Effects (1998 dollars) ($ Million) [1/]

	Upriver	**Reservoir**	**Downriver**	**Total Lower Snake River Study Area**[2/]
Total Business Sales[3/]	7,964.66	6,744.85	19,717.96	34,427.47
Power Plant Construction[4/]	0.00	0.00	664.80	664.80
Transmission Line Construction	0.00	0.00	248.20	248.20
Rail Construction[5/]				104.51
Road Construction[5/]				236.40
Transportation Facilities Construction[5/]				711.86
Well Modification	0.00	107.76	30.40	138.16
Pump Modification	72.85	0.00	0.00	72.85
Implementation	17.29	34.59	34.59	86.47
Total Change[6/]	90.14	142.35	977.99	2,263.25
Change as % of Existing Business Sales	1.13	2.11	4.96	6.57

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years. A number of the impacts have a wide range of variation depending on the magnitude of construction and the length of the time period.

2/ The three subregions comprise the lower Snake River study area. Changes in business sales in this area include the sum of changes in business sales across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ Existing business sales estimates were obtained from IMPLAN.

4/ The DREW Hydropower Impact Team (DREW Hydropower Impact Team) assumed that a total of six replacement power plants would be built. The exact locations of these plants are unknown but DREW Hydropower Impact Team assumed that three would be located in the downriver subregion, with the other three most likely located in the Puget Sound region. Construction of each power plant is estimated to generate $332.40 million in short-term business sales. The estimates shown in this table are the maximum increase in business sales that would occur in any one year—$664.80 million in the downriver subregion, where two plants would be constructed simultaneously.

5/ These effects would occur in the lower Snake River study area but it is not known how they would be distributed among the subregions.

6/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

The preceding estimates are based on midpoints when only lower and upper bounds were available from the other DREW workgroups. Averages are shown when the effects vary by year over a number of years. The average for the implementation category was calculated over a 9-year period. The averages for the recreation and avoided costs categories were calculated over a 100-year period.

Table 6-17. Annual Long-Term Business Sales Effects (1998 dollars) ($ Million) [1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2/]
Total Business Sales[3/]	7,964.66	6,744.85	19,717.96	34,427.47
O&M Spending on Replacement Power Plants & New Transmission Lines	0.00	0.00	142.37	142.37
Recreation (inc. Angling) [4/]	24.90	8.07		73.64
Total Long-Term Increase in Business Sales[5/]	**24.90**	**8.07**	**142.37**	**216.01**
Reduction in Irrigated Lands	0.00	(123.09)	(52.76)	(175.85)
Avoided Costs (Reductions in Corps' Spending)	(6.54)	(52.34)	(6.54)	(65.42)
Reduced Cruise Ship Operations	(8.39)	0.00	0.00	(8.39)
Total Long-Term Loss in Business Sales	**(14.93)**	**(175.43)**	**(59.30)**	**(249.66)**
Net Long-Term Change in Business Sales[5/]	(14.93)	(175.43)	83.07	(33.65)
Net Change as % of Existing Business Sales	0.19	(2.60)	0.42	(0.10)

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years.

2/ The three subregions comprise the lower Snake River study area. Change in business sales in this area is the sum of business sales changes across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ Existing business sales estimates were obtained from IMPLAN.

4/ These effects would occur in the lower Snake River study area, but it is not known how they would be distributed among the subregions.

5/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

6.4.3 Employment

6.4.3.1 Alternative 1, Existing Conditions

Alternative 1, Existing Conditions, represents the baseline for this analysis. Total full-time and part-time employment in the 25-county lower Snake River study area was 318,740 in 1995.

6.4.3.2 Alternative 2, Maximum Transport of Juvenile Salmon

Employment change under this alternative would be relatively minor and limited to jobs associated with implementation and avoided costs. Employment associated with implementing this alternative from 2001 to 2004 is projected to range from a loss of 110 jobs to a gain of 69 jobs compared to Alternative 1, Existing Conditions (Table 6-9). Changes in the Corps' operating expenditures

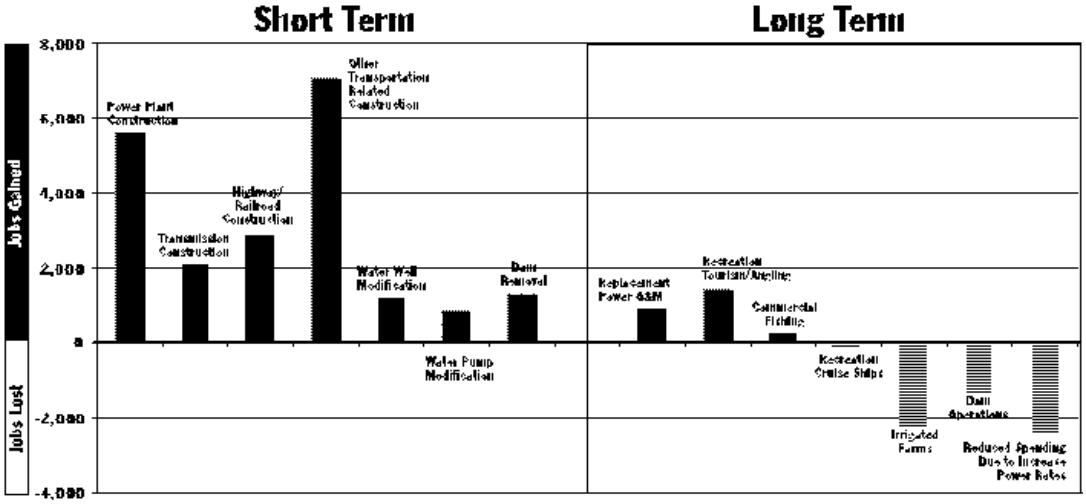
(avoided costs) would result in 83 less jobs from 2001 to 2026 than Alternative 1, Existing Conditions (Table 6-12).

6.4.3.3 Alternative 3, Major System Improvements

Employment change under this alternative would also be relatively minor and limited to jobs associated with implementation and avoided costs. Employment associated with implementing this alternative from 2001 to 2006 is projected to range from a loss of 67 jobs to a gain of 495 jobs compared to Alternative 1, Existing Conditions (Table 6-9). Changes in the Corps' operating expenditures (avoided costs) would result in 44 more jobs than Alternative 1, Existing Conditions, from 2001 to 2026 and 25 more jobs from 2027 to 2100 (Table 6-12).

6.4.3.4 Alternative 4, Dam Breaching

Employment effects associated with this alternative can be divided into short-term and long-term effects. Short-term effects, mainly associated with construction activities, would be temporary and last less than 10 years. Long-term effects would be permanent. These impacts caused by changes in spending include indirect and induced jobs. Therefore, jobs gained and lost are distributed throughout the regional economy and not only concentrated in the sector where the initial change in spending occurs. Projected short- and long-term effects are summarized graphically in Figure 6-1.



Notes

1. Short-term impacts would be temporary and last less than 10 years.
2. Long-term impacts would be permanent.
3. Effects are presented net of the base case (Alternative 1, Existing Conditions).
4. Short-term and long-term employment estimates for each resource area range from low to high and vary from year to year. These point estimates are either average, mid-point numbers, or "most likely" estimates provided by DREW workgroup leaders.
5. Increased electricity rates and transportation costs may cause affected firms or plants to reduce output and employment or possibly close or relocate to another region. Potentially-affected industries include aluminum manufacturing, paper manufacturing, and grain farms. Substantial proprietary information would be required to predict how individual firms would react to cost increases. As a result, possible job losses in these sectors are unknown.

Figure 6-1. Short- and Long-Term Employment Change

Short-term Employment Effects

Construction activities resulting directly and indirectly from breaching the four lower Snake River dams would result in a total of about 20,790 temporary jobs being generated in the lower Snake River study area over a 10-year period (Table 6-18). The exact number of jobs would fluctuate from year-to-year. This activity would generate a temporary increase in personal income of about $677 million (see Section 6.4.4) or an average income of $32,548 per job ($676.7 million in personal income/20,790 jobs). Major construction projects would include replacement power facilities (5,572 jobs) and new grain elevators (6,982 jobs).

Table 6-18. Short-Term Employment Effects (Jobs)[1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2/]
1995 Employment	75,081	92,535	151,124	318,740
Power Plant Construction[3/]	0	0	5,572	5,572
Transmission Line Construction	0	0	2,080	2,080
Rail Construction[4/]				872
Road Construction[4/]				1,972
Facilities Construction[4/]				6,982
Well Modification	0	916	259	1,175
Pump Modification	844	0	0	844
Implementation	259	517	517	1,293
Total Change[5/]	**1,103**	**1,433**	**8,428**	**20,790**
Change as % of 1995 Employment	1.47	1.55	5.58	6.52

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years. A number of the impacts have a wide range of variation depending on the magnitude of construction and the length of the time period.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area includes the sum of employment change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ The DREW Hydropower Impact Team (DREW Hydropower Impact Team) assumed that a total of six replacement power plants would be built. The exact locations of these plants are unknown but DREW Hydropower Impact Team assumed that three would be located in the downriver subregion, with the other three most likely located in the Puget Sound region. Construction of each power plant is estimated to generate 2,786 short-term jobs. The estimates shown in this table are the maximum number of these jobs that would be generated in any one year—5,572 in the downriver subregion, where two plants would be constructed simultaneously.

4/ These effects would occur in the lower Snake River study area but it is not known how they would be distributed among the subregions.

5/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

Long-term Employment Effects

Lower Snake River Study Area

In the long run, the lower Snake River study area would gain 2,277 jobs with an average income of $23,144 ($52.7 million in personal income/2,277 jobs) (Table 6-19). These jobs would mainly be

associated with the operation of replacement power facilities and recreation activities. The lower Snake River study area would, however, lose 2,988 jobs with an average personal income of $33,066 ($98.8 million in personal income/2,988 jobs). The lost jobs would be mainly associated with Corps' operations and farmland irrigated from Ice Harbor Reservoir. The average annual income in the lower Snake River study area in 1995 was $32,088. This estimated net change in long-term jobs (-711 jobs) represents less than 1 percent of 1995 employment in the lower Snake River study area.

Table 6-19. Long-Term Employment Effects (Jobs) [1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2]
1995 Employment	75,081	92,535	151,124	318,740
O&M Spending on Replacement Power Plants & New Transmission Lines	0	0	884	884
Recreation (inc. Angling) [3/]				1,393
Total Long-Term Employment Gain[4/]	**0**	**0**	**884**	**2,277**
Reduction in Irrigated Lands	0	(1,105)	(474)	(1,579)
Avoided Costs (Reductions in Corps' Spending)	(133)	(1,060)	(133)	(1,326)
Reduced Cruise Ship Operations	(83)	0	0	(83)
Total Long-Term Employment Loss	**(216)**	**(2,165)**	**(607)**	**(2,988)**
Net Long-Term Employment Change[4/]	(216)	(2,165)	277	(711)
Net Change as a % of 1995 Employment	(0.29)	(2.34)	0.18	(0.22)

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area includes the sum of employment change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ These effects would occur in the lower Snake River study area, but it is not known how they would be distributed among the subregions.

4/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the Study Area impacts were not distributed by subregion.

The average personal income figures presented above for the jobs gained and lost were derived by dividing the projected changes in total personal income (see Section 6.4.4) by the number of jobs. These projected changes in income, like the projected changes in employment, include direct, indirect, and induced jobs. Therefore, the average personal income projections calculated by dividing change in total personal income by change in jobs represent changes throughout the regional economy not just in the directly affected sectors. It is also important to recognize that personal income, as used in this analysis, consists of wages, salaries, social insurance, and profit received by individuals. As a result, the personal income figure calculated by dividing changes in total personal income by changes in jobs is not directly equivalent to the average wage or salary that would be received by the workers doing those jobs.

It may also be noted that the projected job totals include both full-time and part-time employment. The standard conversion factor from full-time and part-time employment totals to full-time equivalents (FTE) is 0.88. In other words, the projected job losses and gains in the lower Snake River study area should be multiplied by 0.88 to obtain an indication of the number of full-time jobs these totals represent. These conversion factors vary from sector to sector. The FTEs for the retail and services

these totals represent. These conversion factors vary from sector to sector. The FTEs for the retail and services sectors, for example, are 0.81 and 0.87, respectively. The FTEs for the civilian and Federal government and manufacturing sectors are both 0.97.

The regional economic analysis prepared for this study developed estimates for each year of the 100-year study period. High, medium, and low estimates were developed for each year. The data presented in Tables 6-18 and 6-19 and summarized graphically in Figure 6-1 are point estimates based on mid-point numbers or "most likely" estimates provided by the DREW workgroups. Averages are shown when effects vary by year over a number of years. These numbers indicate the type and magnitude of annual employment changes that could occur. Another way to view this change is to view the net annual change in these mid-point or "most likely" estimates (Figure 6-2). Figure 6-2 includes regional impacts modeled for the lower Snake River study area and associated subregions and all state-wide impacts, including those associated with increased anadromous fish harvest. This figure indicates that despite the initial short-term construction boom, the long-term impact of breaching the four lower Snake River dams would be negative. It is important to recognize that there is considerable uncertainty surrounding long-term projections. Also, this presentation combines job change in the lower Snake River study area with job changes that would be spread over one or more states.

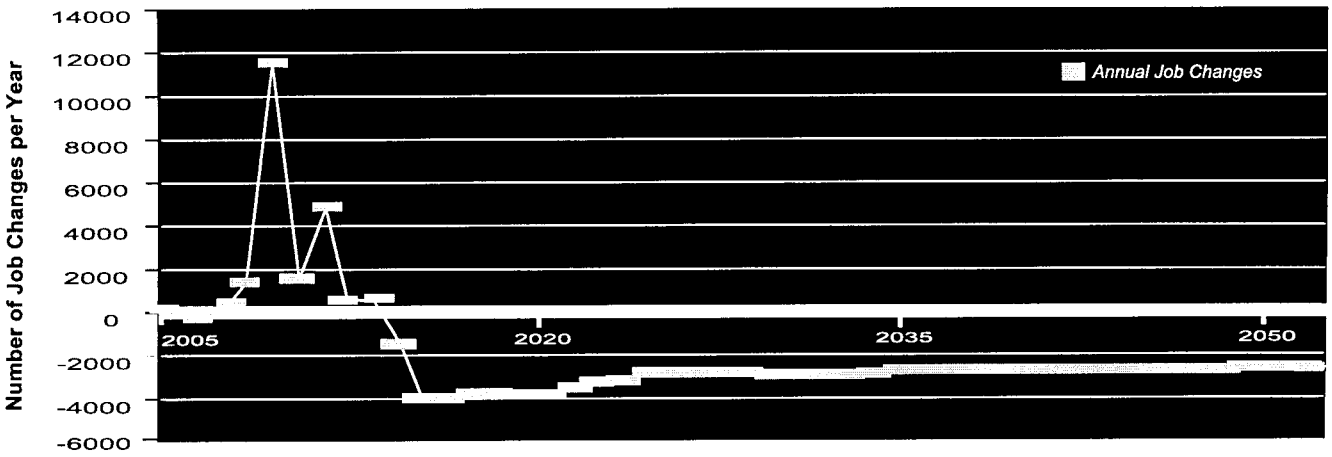


Figure 6-2. Net Annual Employment Change (2005-2055)

A third way to view these projected changes in long-term employment is presented in Section 7.1, Social Analysis. This analysis takes the net forecast developed for project year 20 and presents the range—low, medium, high—of projected impacts for that year and compares them to regional employment. This provides a different perspective to the estimates presented in this section which, as noted, are point estimates based on mid-point numbers or "most likely" estimates.

6.4.4 Income

6.4.4.1 Alternative 1, Existing Conditions

Alternative 1, Existing Conditions, is the baseline for this analysis. Total personal income in the 25-county lower Snake River study area was $10,822.81 million in 1995.

6.4.4.2 Alternative 2, Maximum Transport of Juvenile Salmon

Changes in personal income under this alternative would be associated with implementation and avoided costs. Changes in income associated with implementing this alternative from 2001 to 2004 are projected to range from a loss of $3.01 million to a gain of $0.67 million compared to Alternative 1, Existing Conditions (Table 6-10). Changes in the Corps' operating expenditures (avoided costs) would result in a relative loss of $2.36 million from 2001 to 2026 (Table 6-13).

6.4.4.3 Alternative 3, Major System Improvements

Changes in personal income under this alternative would also be associated with implementation and avoided costs. Changes in income associated with implementing this alternative from 2001 to 2006 are projected to range from a loss of $1.8 million to a gain of $13.51 million compared to Alternative 1, Existing Conditions (Table 6-10). Changes in the Corps' operating expenditures (avoided costs) would result in a gain of $1.26 million in personal income over Alternative 1, Existing Conditions, from 2001 to 2026 and $0.73 million from 2027 to 2100 (Table 6-13).

6.4.4.4 Alternative 4, Dam Breaching

Changes in personal income mirror the changes in jobs discussed in the preceding section. Personal income effects associated with this alternative can be divided into short-term and long-term effects. Short-term effects, mainly associated with construction activities, would be temporary and last less than 10 years. Long-term effects would be permanent. These impacts are summarized by subregion and state in Tables 6-20 and 6-21. These effects are caused by changes in spending patterns include indirect and induced jobs. Therefore, associated changes in income are distributed throughout the regional economy and not only concentrated in the sector where the initial change in spending occurs.

Net changes in short-term and long-term personal income are presented by subregion in Tables 6-20 and 6-21, respectively. Short-term increases in personal income in the lower Snake River study area would be about $676.7 million spread over 10 years. In the long run, total personal income in would increase by $52.7 million. This increase in income would mainly be associated with the operation of replacement power facilities and recreation activities. The lower Snake River study area would, however, experience a decrease in personal income of about $98.8 million. This lost income would be mainly associated with Corps' operations and farmland irrigated from Ice Harbor Reservoir. This estimated net change in long-term income (-$46.1 million) represents about 0.43 percent of total personal income in the lower Snake River study area in 1995.

Table 6-20. Short-Term Income Effects (1998 dollars) ($ million per year) [1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2/]
1995 Total Income	2,215	3,071	5,440	10,725
Power Plant Construction [3/]	0.0	0.0	209.6	209.6
Transmission Line Construction	0.0	0.0	78.3	78.3
Rail Construction [4/]				27.9
Road Construction [4/]				63.1
Facilities Construction [4/]				202.0
Tidewater Railcar Storage Construction				
Well Modification	0.0	29.5	8.3	37.9
Pump Modification	22.4	0.0	0.0	22.4
Implementation	7.1	14.2	14.2	35.5
Total Change[5/]	**29.5**	**43.7**	**310.4**	**676.7**
Change as % of 1995 Income	1.33	1.42	5.7	6.3

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years. A number of the impacts have a wide range of variation depending on the magnitude of construction and the length of the time period.

2/ The three subregions comprise the lower Snake River study area. The change in personal income in this area includes the sum of income change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ The DREW Hydropower Impact Team (DREW Hydropower Impact Team) assumed that a total of six replacement power plants would be built. The exact locations of these plants are unknown but DREW Hydropower Impact Team assumed that three would be located in the downriver subregion, with the other three most likely located in the Puget Sound region. Construction of each power plant is estimated to generate 2,786 short-term jobs. The estimates shown in this table are the maximum number of these jobs that would be generated in any one year—5,572 in the downriver subregion, where two plants would be constructed simultaneously, and 2,786 jobs in the Puget Sound region, where the projected replacement plants would likely be constructed at different times.

4/ These effects would occur in the lower Snake River study area but it is not known how they would be distributed among the subregions.

5/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

Table 6-21. Long-Term Income Effects ($ million)[1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2/]
1995 Income	2,215	3,071	5,440	10,725
O&M Spending on Replacement Power Plants & New Transmission Lines	0.0	0.0	23.6	23.6
Increased Recreation (inc. Angling)[3/]				29.1
Total Long-Term Increase in Income[4/]	**0.0**	**0.0**	**23.6**	**52.7**
Reduction in Irrigated Lands	0.0	(41.1)	(17.6)	(58.6)
Avoided Costs (Reductions in Corps' Spending)	(3.8)	(30.3)	(3.8)	(37.9)
Reduced Cruise Ship Operations	(2.3)	0.0	0.0	(2.3)
Total Long-Term Loss of Income	**(6.0)**	**(71.4)**	**(21.4)**	**(98.8)**
Net Long-Term Change in Income[4/]	(6.0)	(71.4)	2.2	(46.1)
Net Change as a % of 1995 Income	(0.27)	(2.32)	0.05	(0.43)

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years.

2/ The three subregions comprise the lower Snake River study area. Change in personal income in this area is the sum of income change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ These effects would occur in the lower Snake River study area, but it is not known how they would be distributed among the subregions.

4/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River study area figure because some of the projected Study Area impacts were not distributed by subregion.

6.5 Unresolved Issues

The regional economic analysis depends upon information from the DREW study teams as the basis for estimating economic impacts. Thus, most of the unresolved issues listed by the other DREW study teams also limit the regional economic analysis.

In addition, insufficient information was available to model the potential impacts that the Alternative 4, Dam Breaching, could have on a number of regional industries. Increases in costs for electric power and transportation, decreases in the availability of irrigated farm output, and removal of the reservoirs and locks could cause significant cost increases for energy and transport intensive industries or in industries requiring reservoirs or inputs from agriculture. In some cases, it is possible that these cost increases could be large enough to cause affected plants or firms to close down or relocate to another region. Substantial proprietary information about each firm or plant, such as the cost and profit structure, would be required to allow prediction of those businesses that would close or relocate. It would also be necessary to forecast market prices for the potentially affected products into the future. These types of information are not publicly available and, therefore, it was not possible to identify those firms or plants that would be likely to close or relocate if dam breaching were to occur.

6.5.1 Potentially Affected Businesses

This section provides a qualitative discussion of those industries with businesses that might face increased costs and therefore respond by passing these costs on to consumers, restructuring, relocating, or closing if dam breaching were to occur. These industries include: primary aluminum manufacturing (electricity-intensive), paper manufacturing (transport-intensive), grain production (transport-intensive), food processing (dependent on fruit and vegetable inputs from irrigated agriculture), and water transport services (barge marine cargo, cruise ships, and marinas, requiring reservoirs and locks). The geographic extents of these potential impacts vary by industry. Potential increases in electricity rates associated with Alternative 4, Dam Breaching, would likely cause power costs to rise throughout the Pacific Northwest and could potentially affect primary aluminum manufacturers located throughout Washington, Oregon, and Idaho. Impacts associated with the other four potentially affected industries would likely be more localized. Potentially affected food processing firms are those located in the downriver and reservoir subregions. The portion of the paper manufacturing sector that has the most potential to be affected is concentrated in the upriver subregion. Grain farms located in the upriver subregion and the eastern part of the reservoir subregion would be most likely affected by breaching. Water transport firms that could potentially be affected by the dam breaching alternative are mainly concentrated in the upriver subregion.

Table 6-22 presents the estimated direct subregion and state employment in these sectors. This table identifies total direct employment in each sector in the subregions and region where unmeasured effects may occur. It also identifies total employment in each sector for the lower Snake River study area and the states of Washington, Oregon, and Idaho and the shares of this employment that are at risk in each sector.

The potentially affected jobs presented in Table 6-22 represent the maximum number of direct jobs that could be affected by sector and subregion (or states in the case of primary aluminum manufacturing). The extent of possible effects on these industries are unknown at this time. It should also be noted, however, that these are just direct jobs and do not include the multiplier effect that would occur with business closure. If, for example, a primary aluminum manufacturing plant with 580 employees in the downriver subregion shut down, the resulting multiplier effect throughout the local economy would result in a loss of 820 jobs. This would result in a total job loss of 1,400.

Possible effects on the food processing and paper manufacturing sectors are discussed further in the following sections.

Table 6-22. Estimated Direct Jobs in Potentially-Affected Industries by Subregion

Geographic Area	Primary Aluminum Mfg.	Food Processing (can/freeze)	Paper Mfg.	Grain Farms	Water Transport
Potentially Affected Jobs					
Upriver Subregion	0	0	1,778	1,646	134
Reservoir Subregion	0	1,917	0	3,488	0
Downriver Subregion	1,159	5,388	0	0	0
Lower Snake River Study Area Total	1,159	7,305	1,778	5,134	134
Pacific Northwest Total	6,260	7,305	1,778	5,134	134
Total Employment by Sector in the:					
Lower Snake River Study Area	1,159	7,305	2,423	11,314	185
Washington	5,300	21,705	11,579	10,893	9,495
Oregon	930	13,265	5,234	7,828	2,195
Idaho	30	9,275	1,780	8,668	300
Combined State Total	6,260	44,245	18,593	27,389	11,990
Potentially Affected Jobs as % of Total Jobs by Sector in the:					
Lower Snake River Study Area	100.0	100.0	73.4	45.4	72.4
Combined State Total	100.0	16.5	9.6	18.7	1.1

Source: Data compiled from IMPLAN

Food Processing

The potential loss of 37,000 acres of agricultural land presently irrigated from Ice Harbor Reservoir could affect food processing businesses that purchase the agricultural products presently grown on this land. Preliminary estimates of employment in the food processing industry that might potentially use products from the affected irrigated lands are approximately 5,000 to 6,500 full-time and part-time jobs. Estimates from IMPLAN indicate that direct employment in the food processing sector is approximately 7,305 full-time and part-time jobs in the reservoir and downriver subregions (Table 6-22).

The mix of crops presently grown on the 37,000 acres presently irrigated from Ice Harbor Reservoir was identified in a farm survey conducted by the DREW Water Supply Workgroup during 1997 and 1998 (see Section 3.4). The respective acreages identified during this survey were compared to the acreage in the states of Washington and Oregon that was dedicated to these same crops and also to the acreage dedicated to these crops in the counties surrounding the Tri Cities (Table 6-23). The potentially-affected 37,000 acres represents 1 percent of total irrigated agricultural lands in Washington and Oregon and 4 percent of irrigated lands in Walla Walla, Benton, Franklin, Yakima, Umatilla, and Morrow counties. The Ice Harbor irrigated acreages are presently dedicated to potatoes, orchards (apples, cherries, vineyards, etc.), and represent 8, 6, and 7 percent respectively of the acreage dedicated to these crops in the surrounding six-county area (Table 6-23). This comparison suggests that the crops grown on the 37,000 acres comprise a relatively small share of regional and state-wide production of these crops.

Table 6-23. Ice Harbor Irrigated Acres as a Percent of State and Surrounding County Totals

Irrigated Crop	Total Ice Harbor Irrigated Acreage	States of WA and OR Irrigated Acreage (1997)	Total Irrigated Acreage in Surrounding Counties[2]	Ice Harbor acreage as a % of OR and WA	Ice Harbor Acreage as a % of Surrounding Counties[2]
Potatoes	5,513	146,932	71,213	4%	8%
Wheat	3,515	401,363	115,123	1%	3%
Orchards	10,508	390,240	176,970	3%	6%
Vegetables	8,103	317,197	109,162	3%	7%
Total Harvested Irrigated Acres[1/]	37,000	3,051,054	933,447	1%	4%

1/ "Total Harvested Acres" figures from Ice Harbor do not equal totals of other lines because the Corps' survey was unable to identify the use of all the irrigated lands. In addition, 8,500 of the 37,000 acres are dedicated to hybrid poplar plantations.

2/ The surrounding counties are those contiguous to the hub of the Tri-Cities. Walla Walla, Franklin, Benton, Yakima, Umatilla and Morrow Counties were included in this supply region.

Industry representatives contacted as part of this study indicated that there are dynamic linkages between the food production and food processing sectors. Different businesses would be affected differently depending on the nature of these linkages. These relationships are complex and cannot be fully evaluated in the absence of an industry-specific study. The industry representatives contacted are not necessarily representative of the entire industry and information for the largest food processors in the region was not available. Therefore, while it is possible to identify a possible range of impacts, this qualitative assessment should be considered preliminary.

Contacts made with local food processors indicated that not all processors purchase products from Ice Harbor growers. Products that were purchased by food processors included wine grapes, asparagus, potatoes, corn, and apples. For those contacted firms that do purchase products from the Ice Harbor-irrigated lands, purchases ranged from 1 percent to 40 percent of their supply. One orchardist on Ice Harbor would not only lose water for a part of the farm but also the ability to pack 100 percent of these products on site. Processors were asked to indicate the significance of the loss of this supply to their operations. Responses ranged from insignificant to devastating.

Potential effects to processors may vary by crop type. Some processors suggested that the impacts associated with perennial crops, such as asparagus, which takes more than one year to establish, would be more significant. One processor indicated that the acres irrigated from Ice Harbor Reservoir produce high-quality products. Loss of this supply would affect the high-quality product lines even though it represents a relatively small portion of total supply. Another processor suggested that the loss of this supply might increase competition for remaining supplies, which would be more harmful for some firms than others. Finally, one processor noted that while firms would be unlikely to shut down, they would face supply problems and increased costs.

In addition to short-term effects on supply, increased competition for remaining raw materials, and associated increases in prices, industry representatives indicated that this loss of supply might have

long-term detrimental effects on the food processing industry if alternate supplies are not developed. Less certainty that the region could meet food processors demands for raw materials may represent a set-back for the industry, making it a higher investment risk and possibly slowing investment-dependent technological growth within the industry.

While this assessment is preliminary, it suggests that dam breaching may be unlikely to cause immediate significant job loss among the workers presently employed in the food processing sector in the reservoir and downriver subregions.

Forest Products

Increased transportation and other costs associated with dam breaching could affect the forest products industry in north-central Idaho. Detailed industry studies would be needed to fully evaluate the effects of these cost increases. In the absence of these studies, the following qualitative discussion illustrates a range of possible effects to this sector.

The Idaho forest products industry achieved roughly $2 billion in sales of lumber and wood products and $540 million in sales of pulp and paper in 1992 (Idaho Forest Products Commission, 1999). In 1993, lumber production totaled about 1.86 billion board feet with an estimated wholesale value of $874 million. The majority of this economic activity is centered in north-central Idaho. In 1990, approximately 60 percent of Idaho's forest income was earned in the northern counties.

Projected transportation cost increases for wood products (pulp and waste paper, paper products, primary wood products) and wood chips and logs (fuel wood; wood chips, wood in the rough, lumber, forest products not elsewhere classified) shipped on the lower Snake River were developed by the DREW Transportation Workgroup (Table 6-24). Transportation costs were projected to increase by $2.5 million if the dams were breached and transportation on the lower Snake River were no longer possible. This would represent a 20 percent increase for the higher value added wood products commodity group, The cost for the logs and wood chips category would increase by 3 percent (Table 6-24).

Table 6-24. Projected Transportation Cost Increases for the North-Central Idaho Forest Products Industry (1998 dollars)

Product	2002 Volume in tons	Total Transportation Cost Increase ($)	Cost Increase per Ton ($)	Percentage Increase from Base Case Cost (2002)
Wood Products	66,000	1,064,591	16.13	20
Logs and Wood chips	694,000	1,481,295	2.13	3
Totals	760,000	2,545,886	na	na

Source: DREW Transportation Workgroup, 1999

North-central Idaho has a diverse mix of mills producing various degrees of value-added wood products such as wood chips, dimensional lumber, decking, and other forest products, as well as pulp and paper products. The byproducts of the milling process are bark, hogfuel, sawdust, and wood

chips. These byproducts are consumed internally to generate electricity or heat, sold to a local pulp and paper mill, or shipped by barge to pulp mills in western Washington and Oregon.

Several wood products companies that use the Lewiston, Clarkston, and Whitman County ports. These companies use the existing system of barges to ship dimensional lumber, raw logs, wood chips, and other value-added wood products. Employment data is not readily available for these companies. The facilities that would be most potentially affected by dam breaching are the paper and three chipping mills.

A large pulp and paper mill operates three divisions (consumer products, pulp and paperboard, and wood products) and employs approximately 1,700 people in the Lewiston/Clarkston valley, with annual sales estimated to range from $500 to $650 million. This mill is linked to many of the region's other mills because it is the region's major consumer of wood chips and sawdust (Robison, McKetta, and Peterson, 1996). It is estimated that a total of 170,000 tons or one-third of their total paperboard production is shipped via the lower Snake River.

In the absence of an industry-specific study that details the specific volumes of goods shipped on the lower Snake River by individual forest products companies, the actual increased power costs, water supply and treatment costs, the financial health of each company, and the relationships between these companies, it is impossible to quantitatively estimate the magnitude of the impacts to individual companies and the industry as a whole. Overall, the magnitude of the projected transportation cost increase alone appears to be small in comparison to the value of the overall production from region. Possible reactions to these cost increases are summarized in Section 6.3.4.4.

7. Social Impact Analysis

7.1 Summary of Findings

Communities in the region of the lower Snake River can be characterized as primarily small rural towns that have moderate or low economic diversity and depend significantly on agricultural activities for their economic base. In addition to these rural communities, four areas of urban trade centers, Walla Walla, Pendelton/Hermiston, the Tri-Cities (Richland, Pasco, Kennewick), and the quad Cities (Lewiston, Clarkston, Pullman, and Moscow), provide high economic diversity and educational opportunities in the region. With the exception of the Tri-Cities region, both population and economic growth throughout the region have lagged behind general Pacific Northwest states and national growth trends. The two key industries that historically formed the base and currently provide an important component of the regional economy have been manufacturing of wood products and agricultural production. These two industries, though, have not been the engines of growth in the last decade, and agriculture particularly has experienced absolute declines in terms of employment and percentage of regional income. It is not anticipated that these sectors will be the engines of future regional growth. The agricultural sector will potentially be affected most significantly by Alternative 4, Dam Breaching.

The Social Analysis Report (Foster Wheeler Environmental, 1999) identified social impacts to nine focus communities, or case studies, taking into account the phases of project development for each of the alternatives under consideration to improve juvenile salmon migration through the four lower Snake River projects. These communities were chosen to capture a range of direct positive and negative impacts across types of communities and the geographic scope of the study area. This Social Analysis Report provides additional detail data and analysis to the conclusions presented in this section.

From the analysis of the nine case study communities, it appears that changes in the physical, biological, and economic human environment would have both adverse and beneficial impacts on communities throughout the study region. Each of the Alternatives under consideration would create winners and losers, both socially and economically, within and between communities and the subregions. Many of the economic and social losses for one community or group may present opportunities for gains by another community or group.

Major System Improvements, Alternatives 2 and 3

Alternatives 2, Maximum Transport, and 3, Major System Improvements, would have little effect on the economic and physical human environment for most communities throughout the region and would provide a degree of economic security for those communities and businesses (grain farms, bulk commodity shippers, and irrigated agriculture) that use the lower Snake River system. Some communities, particularly in the upriver region, that depend on the salmon and steelhead fishery both socially and economically would be adversely affected by the lower probabilities of salmon recovery. Overall changes in regional employment would be minor as a result of implementing these actions. They will consist primarily of employment associated with increased Corps spending. Additionally, all communities in the region would be adversely affected by the lower probability of salmon recovery and eventual delisting due to the continued Federal oversight of local and regional

economic development activities and the continuing uncertainty about the future of the lower Snake River projects.

Dam Breaching Alternative

Alternative 4, Dam Breaching, would change the economic and physical environment of the study region. Although the social and economic environment of the region is constantly changing due to market forces and demographic changes, this type of change to the human built environment would present economic uncertainty, stress, and fear for some residents of the region. For other residents, it would represent hope for recovering endangered anadromous fish populations.

Employment Impacts of Alternative 4

The overall employment effects of Alternative 4 would result in a net gain to communities in the upriver subregion, a net loss to communities in the reservoir subregion, and no change in the downriver subregion. The allocation of the total long-term employment changes under Alternative 4, including total jobs lost and net changes in employment, are presented by subregions in Tables 7-1 and 7-2. Table 7-3 shows the total short-term, primarily construction-related, employment changes by subregion. The regional economic analysis prepared for this study developed estimates for each year of the 100 year study period. High, medium, and low estimates were developed for project year 20 and presents the range—low, medium, high—of projected impacts for that year. This provides a different perspective to the estimates presented in Section 6, Regional Economic Analysis, which are point estimates based on mid-point numbers or "most likely" estimates, with averages shown when effects vary by year over a number of years.

The jobs presented in Tables 7-1 through 7-3 represent both full- and part-time employment. The standard conversion of full- and part-time jobs to full-time equivalents is 0.88. In other words, the overall job losses and gains shown in the tables could be multiplied by 0.88 to obtain a full-time equivalency (FTE) of employment. The conversion for the agricultural and service sectors would be slightly lower than the average (0.81) and slightly higher than the average for the government and transportation and public utilities sectors (0.96).

The total job losses forecast for each region would represent approximately 3.0 percent, 0.6 percent, and 0.3 percent of the reservoir, downriver, and upriver subregions' total employment, respectively, regardless of whether the high, medium, or low forecasts were considered (Table 7-1). The exception to this is the reservoir region where the low forecast would be approximately a 2.0 percent loss. Overall employment changes for the entire Pacific Northwest would range between 0.1 and 0.07 percent. This includes the low, medium, and high estimates. Most of these job losses are related to employment associated with irrigated agriculture on the Ice Harbor Reservoir, the Corps' operations of the four lower Snake River facilities, and the effects of increased power rates throughout the Pacific Northwest. Table 7-1 highlights only those jobs that would be lost as a result of implementation of Alternative 4 and does not include jobs that would be gained by less efficient energy production and grain transportation modes and increased travel and tourism activity.

As can be seen in Table 7-2 the combination of scenarios by subregion would not significantly change the net employment effects of Alternative 4. On the level of the Pacific Northwest region, total long-term net employment changes would range from a 0.02 percent decrease in the best case scenario to the worst case scenario of a 0.06 percent decrease in regional employment after 10

Table 7-1. Forecast Direct, Indirect and Induced Long-term Employment Losses by Subregion (Alternative 4)[1/,2/,3/]

Range of Employment Losses	PNW Job Losses	PNW Jobs	Losses as a Percentage of PNW Employment	Reservoir Region Losses	Reservoir Jobs	Losses as a Percentage of Reservoir Subregion Employment	Downriver Losses	Downriver Jobs	Losses as a Percentage of Downriver Region Employment	Upriver Losses	Upriver Jobs	Losses as a Percentage of Upriver Employment
High	(6,621)	5,703,840	(0.116)	(2,681)	92,535	(2.90)	(906)	151,124	(0.60)	(253)	75,081	(0.34)
Medium	(6,047)	5,703,840	(0.106)	(2,673)	92,535	(2.89)	(887)	151,124	(0.59)	(245)	75,081	(0.33)
Low	(4,166)	5,703,840	(0.073)	(1,717)	92,535	(1.86)	(463)	151,124	(0.31)	(239)	75,081	(0.32)

1/ Employment losses outside of lower Snake River region primarily related to the impacts of increased power rates on households, farms, industry, and commercial consumers throughout the PNW. The uncertainty associated with these estimates corresponds to the uncertainties faced by each of the DREW study teams.
2/ Percentages of employment changes calculated based on the existing 1997 employment structure of the study area. Considering the recent and short-term projected economic growth in the region, these percentages should be considered conservative. Both gains and losses as percentages may be smaller considering the growing employment base, but this static snapshot provides a relative comparison of the impacts.
3/ Long term effects are those that are permanent and lasting through the period of analysis.

Table 7-2. Net Long-Term Changes by Subregion and Pacific Northwest (Alternative 4)[1/,2/]

	PNW Region Net		Reservoir Region		Downriver Region		Upriver Region	
	20 year net forecast	20 yr. % net change	20 year net forecast	20 year % net change	20 year net forecast	20 year % net change	20 year net forecast	20 year % net change
Net worst case (low gains/high losses)	(3,354)	(0.06)	(1184)	(1.28)	13	0.01	116	0.15
Net Best case (high gains/low losses)	(899)	(0.02)	(220)	(0.24)	455	0.30	129	0.17
Net most likely (low gains/med. losses)	(2,780)	(0.05)	(1176)	(1.27)	32	0.02	123	0.16

1/ Totals may not add up to regional summary due to the allocation of power impacts by population distribution. Positive impacts of recreation are constrained by DREW recreation team and A-Fish team estimates. The uncertainty associated with these estimates corresponds to the uncertainties faced by each of the DREW study teams and the regional model.
2/ Long term effects are those that are permanent and lasting through the period of analysis.

Table 7-3. Short-term Employment Changes by Subregion (Alternative 4)[2/]

Average Short-Term Gains[1/]	PNW Distribution (Jobs)	PNW % Change	Reservoir Impacts (Jobs)	Reservoir % Change	Upriver Impacts (Jobs)	Upriver % Change	Downriver Impacts (Jobs)	Downriver % Change
Average	20,790	0.36	9,536	10.31	2,294	3.06	8,959	5.93
Total Employment	5,703,840		92,535		75,081		151,124	

1/ Used mid-point or average number of jobs created as a result of short-term construction. A number of the impacts have a wide range of variation depending on the magnitude of construction and the length of the time period. The subregion totals differ from those presented in Table 6-19 because this presentation allocates all of the projected job changes to a subregion.
2/ Short term effects are those that could occur in 10 years.

years. The major factors driving this range of uncertainty are the estimates associated with power rate impacts and with recreational employment impacts. Again, the reservoir region would have the most significant decreases. The downriver region might also see a net decrease in employment from 0.051 to 0.036 percent. The upriver and downriver regions would have a positive change in regional employment ranging from a 0.15 to 0.17 percent increase for the upriver region to a 0.01 to 0.03 increase in the downriver region.

The incomes associated with these gains and losses would not be equal. Although the indirect and induced employment effects would ripple through all sectors of the regional economy, the income differences in direct employment could be identified. Lost direct employment would be associated with irrigated farm owners and full-time and seasonal workers, as well as Corps' employment related to the operations and management of the lower Snake River facilities. Direct employment gained would be associated with the operations and maintenance of new power plants and increased recreation and tourism. The average wage of Corps employees in the Walla Walla District is approximately $45,000; this is significantly above the regional per capita or median income. On the other hand, approximately 2,563 part-time and seasonal employees work on the farms on the Ice Harbor Reservoir. According to the Washington State Employment Security Department, the average hourly wage for seasonal agricultural workers in southeastern Washington was $6.27, with or an annual salary of $12,500 for full-time workers.

According to the IMPLAN model, the average income per direct, indirect, and induced job created by the operations of new power facilities was approximately $27,000 per year. Because recreation and tourism are not distinct industries, the median wage in Riggins, Idaho, a town with a strong recreation and tourism base, was used to examine the income effects of increased employment in recreation. In 1994, earnings per worker were approximately $19,000 dollars, although this may be somewhat misleading because Riggins is an isolated community with a relatively low cost of living. Short-term construction employment is forecast assuming that changes are made to existing infrastructure. None of the changes made is included in the Corps implementation plan, except for those expenditures associated directly with implementation of Alternative 4.

Table 7-3 shows that average short-term employment change would contribute significantly to each of the study subregions. The reservoir region would experience approximately a 10 percent increase in regional employment, while the downriver and upriver subregions would experience increases of 5.9 and 3.0 percent, respectively.

Impacts by Subregion

The most significant social impact to the downriver region communities including Pasco, Kennewick, and Umatilla, would be the potential lost agricultural employment from the Ice Harbor pool and the supply uncertainty faced by food processors and fruit packers. This direct employment loss might be partially offset by the expected increase in transportation and power-generation-related employment. Increased flow of commerce into these communities would contribute to traffic safety and congestion concerns. Another significant social impact is the fear that the breaching of the four lower Snake River projects would lead to the inevitable breaching of projects on the Columbia River and the effect of this fear on investments in the region.

The most significant impacts to communities in the reservoir region, including the case study communities of Pomeroy, Colfax, and Clarkston, would be the loss of Corps employment and the increased financial pressure on family farms caused by increased transportation, storage, and

handling costs for agricultural products. This added pressure to an already depressed agricultural sector might lead to an increased rate of farm consolidation for those farms not fully owned and those with a high debt-to-equity ratio, increased stress in the farm sector, and an increased rate of loss for rural farm population. This impact would significantly affect the largest number of communities in both the reservoir and upriver regions. In addition, communities in the reservoir region would be affected by the short-term loss of recreation access and the increased flow of truck traffic on the two east-west highways (US12 and SR 26) that cross the region.

The most significant impact to communities in the upriver subregion including Lewiston, Orofino, and Riggins would be the expected increase in the recreation and tourism industry with a free-flowing river condition. Lewiston and Orofino face economic uncertainty because it is unknown how significantly the loss of river navigation would affect the forest products industry. Additionally, the effects of increased transportation costs to farmers would be the most significant in Latah, Nez Perce, Idaho, and Lewis counties in Idaho.

Effects Widely Dispersed Across the PNW

Although electrical rate increases would be expected across all communities and industries in these subregions, as well as across the states of Washington, Oregon, Idaho, and Montana, the estimated 2.8 to 9.4 percent increase for residential rates is relatively small considering the existing low electricity costs. These increases are not expected to have significant social or economic impacts in any of the focus communities under consideration, although those communities that purchase electricity from rural cooperatives or public utility districts might be more at risk for the higher rate increases. Effects on the aluminum industry are unknown, but significant regional impacts could occur, depending upon who pays the increased costs.

Responses to a Changed Social Environment

The responses of communities, industries, and individuals to these changes in the physical, biological, and economic human environment might be categorized as economic and social. According to the Independent Economic Analysis Board of the Northwest Power Planning Council, the response to the economic impacts described above would either be a migration of individuals and businesses seeking new opportunities, or the reemployment of human and capital resources in their next-best use within the community (IEAB-NWPPC, 1999).

Social responses might include mobilizing resources to minimize adverse impacts, charting a new vision for the community, and taking advantage of new opportunities. Each community is distinct in its ability to respond to these challenges and overcome obstacles in its developmental path. Community size has been identified as a critical factor to a community's ability to adapt to change. Communities may have less diverse economic bases and fewer human resources to draw upon in challenging times. In the case of communities affected by potential changes, almost all of them have recently responded to economic booms and busts, as well as declining returns in the historically important agricultural sector. Social and economic impacts projected by this study, in the context of recent historical changes and each community's potential responses, are discussed in Section 6.4.

7.1.1 Summary Comparison of Impacts by Community

The significance of changes in the physical, biological, and socioeconomic environment in each of the nine focus communities was evaluated based on the criteria indicated in Table 7-4. The

significance of the socioeconomic factors was determined as the difference between each alternative and the base case, Alternative 1, in both the short-term predevelopment and implementation and the long-term post-implementation phases. Some of the criteria are based on quantitative economic forecasts developed by other study teams, while others are based upon descriptions of physical changes in the study region. The economic impacts were estimated by disaggregating the regional employment and income effects identified in the regional study. Other criteria and the qualitative and quantitative data were developed specifically in the DREW Social Analysis Report (DREW Social Analysis Workgroup, 1999). A thorough literature review was conducted to determine how rural agricultural communities in eastern Washington and throughout the United States have been affected by economic and infrastructure changes. For more details on the methodology and the literature review, see the DREW Social Analysis Report (DREW Social Analysis Workgroup, 1999).

7.1.2 Mitigation Potential

Total long-term employment losses across the Pacific Northwest forecast by the regional study indicate that between approximately 4,166 and 6,621 jobs might be lost as a result of Alternative 4. Total jobs gained are forecast between 3,796 and 4,722 after 20 years. Some of these job losses represent identifiable dislocated or displaced workers, while others (such as those related to power rate increases) are dispersed and difficult to identify. Of these losses, approximately 3,500 direct job losses might be classified as dislocated. In addition to these losses, the regional study estimated gains in recreation and tourism and associated industrial sectors and in power generation and related sectors. These jobs, in addition to the short-term construction jobs created by Alternative 4, might provide new economic opportunities in the region that would help mitigate potential losses. Direct, indirect, and induced employment losses based on middle estimates are distributed throughout the three subregions as follows: upriver–245 jobs, reservoir–2,673, downriver–887. The state distribution of employment losses based on middle estimates is approximately 4,585, 582, and 810 for the states of Washington, Idaho, and Oregon, respectively.

Approximately 67 communities in the lower Snake River subregion would be adversely affected by increased transportation costs. An additional 15 communities outside the designated study area would also be affected by increased transportation costs. These affected communities are primarily smaller than 1,000 inhabitants, but would also include the larger cities of Lewiston, Clarkston, Pasco, Kennewick, Richland, and Walla Walla.

Overall adverse community level social impacts within the nine case study communities, as identified through the Social Analysis Report and through Community-Based Impact Assessments (Harris, et al., 1999) conducted by the University of Idaho, include the following:

1. Decreased net farm income and increased financial pressure on dryland farmers throughout the region, particularly for those farms close to the Lower Snake River
2. Risk of increased consolidation of family farms and decline in rural farm population
3. Decreased county property tax base in 20 regional counties from decreased farm land value and potential loss of irrigated lands
4. Dislocated full-time and seasonal workers from Ice Harbor irrigated agricultural lands and loss of a source of local school revenue for communities close to the reservoir
5. Minor realignment of communities' economic bases and changed potential for future growth.

Table 7-4. Significance of Changes in the Physical, Biological, and Socioeconomic Environments

Alternative	Indicators/Impact Measure	Evaluation Criteria	Clarkston	Colfax	Kennewick	Lewiston	Orofino	Pasco	Pomeroy	Riggins	Umatilla
	Power										
4	Residential Rate Increases	Residential Rate Increase > 5 percent			X			X			
4		Residential Rate Increase < 5 percent	X	X		X	X		X	X	X
4	Rate Employment Impacts	Decrease in Employment > 1 percent									
4		Decrease in Employment< 1 percent	X	X	X	X	X	X	X	X	X
4	Power Provider Rate Risk	Public Owned Utility			X			X		X	
4		Investor Owned Utility	X	X		X	X		X		X
4	Fixed Income Ratepayers	Poverty Rate >10 percent of all families	X		X			X		X	X
4		Poverty Rate < 10 percent of all families		X		X	X		X		
4	New Power Plant Operation	Increase in Employment > 1 percent									
4		Increase in Employment < 1 percent			X			X			X
4	ST: New Plant Construction	Increase in Regional Employment > 5 percent			X			X			X
4		Increase in Regional Employment < 5percent									
4		Within 50 miles of Potential Plant Siting			X			X			X
	Recreation										
4	Non-fishing River Recreation	Increase in Employment> 1 percent	X	X					X		
4		Increase in Employment < 1 percent			X	X		X			
4		Short-term Displacement	X	X	X	X		X	X		
4		Short-Term Crowding			X			X			X
4	Anadromous Fishing Recreation	Increase in Employment > 1 percent								X	
4		Increase in Employment < 1 percent	X	X	X	X	X	X			
4		Short-term Displacement	X			X	X	X			
4		Short-Term Crowding					X	X			
4		Local Fishing Opportunities	X	X	X	X	X	X	X	X	X
4	Site Access	Decrease in Site Access > 25 percent	X	X		X			X		
4		Decrease in Site Access <25 percent			X		X	X		X	X

ST=short-term employment associated with construction.
Uncertainty related to employment percentages is a result of uncertainties faced by other DREW workgroups, dynamics of local economies, and methodology for allocating regional impacts to local geographic area.

Table 7-4. Significance of Changes in the Physical, Biological, and Socioeconomic Environments

Alternative	Indicators/Impact Measure	Evaluation Criteria	Clarkston	Colfax	Kennewick	Lewiston	Orofino	Pasco	Pomeroy	Riggins	Umatilla
4	Site Services	Decrease in Site Services> 25 percent	X	X		X			X		
4		Decrease in Site Services< 25 percent			X		X	X		X	X
4	Elderly Recreationists	Over 65 years > 20 percent	X	X					X		
4		Over 65 years < 20 percent			X	X	X	X		X	X
	Transportation										
4	Transportation Related Employment	Increase in Employment > 1 percent									
4		Increase in Employment < 1 percent	X	X	X	X	X	X	X		
4	Farm Spending Related Employment	Decrease in Employment > 1 percent		X							
4		Decrease in Employment < 1 percent	X			X	X		X	X	
4	Dryland Farm Income	Decrease in Total County Farm Income > 10 Percent		X						X	
4		Decrease in Total County Farm Income < 10 percent	X			X	X	X	X		
4	County Property Tax Revenue	Decrease in Property Tax Revenue > 2 percent									
4		Decrease in Tax Revenue < 2 percent									
4	County Sales Tax Revenue	Increase in Sales Tax Revenue									
4		Decrease In Sales Tax Revenue									
4	ST: Road, Rail and Infrastructure	Increase in Employment > 1 percent	X	X	X	X			X		
4		Increase in Employment < 1 percent					X	X			
4	Road, Rail and Infrastructure Maintenance	Increase in Employment > 1 percent									
4		Increase in Employment < 1 percent									
4	Grain Transportation Costs	Increase in Avg. Cost > 15 cents per bushel	X	X		X	X			X	
4		Increase in Avg. Cost < 15 cents per bushel						X	X		
4	Farm Consolidation (Dryland)	Risk of Increased rate of Farm Consolidation	X	X		X	X		X	X	
4	Transportation Costs (other Shippers)	Increase in Transportation Cost	X	X		X	X		X	X	
4	Transportation Capacity Uncertainty	Increase in Transportation Uncertainty	X	X	X	X	X	X	X	X	
4	Highway Congestion	Increase in Traffic Volume > 2 percent						X	X		
4		Increase in Traffic Volume < 2 percent	X	X	X	X					
4		Decrease in Traffic Volume					X			X	

ST=short-term employment associated with construction.
Uncertainty related to employment percentages is a result of uncertainties faced by other DREW workgroups, dynamics of local economies, and methodology for allocating regional impacts to local geographic area.

Table 7-4. Significance of Changes in the Physical, Biological, and Socioeconomic Environments

Alternative	Indicators/Impact Measure	Evaluation Criteria	Clarkston	Colfax	Kennewick	Lewiston	Orofino	Pasco	Pomeroy	Riggins	Umatilla
4	Highway Safety	Increase in Highway Safety					X			X	
4		Decrease in Highway Safety	X	X	X	X		X	X		
	Water Supply										
4	Dislocated Agricultural Workers/Spending	Decrease in Employment > 1 percent			X			X			
4		Decrease in Employment < 1 percent									X
4	Farm Income	Decrease in Total County Farm Income > 10 Percent						X			
4		Decrease in Total County Farm Income < 10 percent									
4	County Property Tax Revenue	Decrease in Property Tax Revenue > 2 percent									
4		Decrease in Tax Revenue < 2 percent									
4	ST: Pump/Well Modifications	Increase in Employment > 1 percent	X			X					
4		Increase in Employment < 1 percent		X	X		X	X	X		
4		Increased costs for well irrigators/users	X			X		X	X		
	Effects on Food Processors	Decrease in local produce			X			X			X
	Implementation/Avoided Costs										
4	ST: Implementation Employment	Increase in Employment > 1 percent	X	X			X		X		
4		Increase in Employment < 1 percent			X	X		X			X
3		Increase in Employment < 1 percent	X	X	X	X	X	X	X		
4	Outside Workers	Increase in Outside Workers >10 percent	X						X		
4		Increase in Outside Workers < 10 percent		X	X	X		X			
4	Human Movement Patterns	Loss of Project Bridges within 50 miles		X	X			X	X		
4	Operations Employment	Decrease in Employment > 1 percent		X					X		
4		Decrease in Employment < 1 percent	X		X	X		X			X
3		Increase in Employment > 1 percent									
3		Increase in Employment < 1 percent	X		X	X		X	X		X
	Anadromous Fish Recovery										
4/3	ST: Social Cohesion	Increased Social Cohesion		X	X			X	X	X	X

ST=short-term employment associated with construction.
Uncertainty related to employment percentages is a result of uncertainties faced by other DREW workgroups, dynamics of local economies, and methodology for allocating regional impacts to local geographic area.

Table 7-4. Significance of Changes in the Physical, Biological, and Socioeconomic Environments

Alternative	Indicators/Impact Measure	Evaluation Criteria	Clarkston	Colfax	Kennewick	Lewiston	Orofino	Pasco	Pomeroy	Riggins	Umatilla
4/3		Decreased Social Cohesion	X			X	X				
4	Recovery Uncertainty/Risk	Lower Uncertainty of Salmon Recovery	X	X	X	X	X	X	X	X	X
3		Higher Uncertainty of Salmon Recovery	X	X	X	X	X	X	X	X	X
3	Business Uncertainty/Risk	Lower Economic Uncertainty/Risk	X	X	X	X	X	X	X	X	X
4		Higher Economic Uncertainty/Risk	X	X	X	X	X	X	X	X	X
3	Extinction Risk/Existence Value	Higher Extinction Risk	X	X	X	X	X	X	X	X	X
4		Lower Extinction Risk	X	X	X	X	X	X	X	X	X
	Other Social Effects										
4	Population Impacts	Decrease in Population > 5 percent						X			
4		Decrease in Population < 5 percent		X	X				X		
4		Increase in Population > 5 percent									
4		Increase in Population < 5 percent	X			X	X			X	X
4	Total Long-Term Employment	Employment Losses > 5 percent									
4		Employment Losses < 5 percent	X	X	X	X	X	X	X		X
4		Increase Net Employment > 1 percent									
4		Increase Net Employment < 1 percent	X			X	X			X	X
4		Decrease Net Employment > 1 percent									
4		Decrease Net Employment < 1 percent		X	X			X	X		
4	Total Short-Term Employment	Increase in Employment > 5 percent	X	X					X		
4		Increase in Employment < 5 percent			X	X	X	X			X
4	Total Subregional Employment	Increase Net Employment > 1 percent									
4		Increase Net Employment < 1 percent			X	X	X	X		X	
4		Decrease Net Employment > 1 percent	X	X					X		
4		Decrease Net Employment < 1 percent									X
4	Aesthetics	ST Exposed Shoreline	X	X	X	X	X	X	X		
4		LT Revegetated Shoreline	X	X	X	X	X	X	X		

ST=short-term employment associated with construction.

Uncertainty related to employment percentages is a result of uncertainties faced by other DREW workgroups, dynamics of local economies, and methodology for allocating regional impacts to local geographic area.

Many of these community-level and employment impacts would caused by increased transportation costs for trucking grain and by the loss of irrigated agriculture on the Ice Harbor Reservoir at the costs described in the Navigation and Water Supply reports. These impacts could be minimized or eliminated in part by mitigation spending to modify the irrigation pumps and direct upgrades to expand rail capacity in the region. Another strategy would be to directly subsidize the farms currently shipping on the lower Snake River. The costs of these mitigation measures have been discussed in the transportation and irrigation reports. In the absence of direct mitigation, employment- and community-level impacts could be mitigated or minimized as described below and as illustrated in the Mitigation Section of the Social Analysis Report.

Potential mitigation expenditures for 3,500 dislocated workers have been estimated at between $45.1 and $48.1 million to address employment losses through job retraining, income support, and academic training. Potential mitigation for 82 affected communities has been estimated at between $4.3 and $12.9 million, based on previous Federal and state mitigation expenditures used to address the impacts of free trade, old-growth forest conservation, and dislocated workers.

Under Alternative 2, the lower probability of salmon recovery and eventual increased or resumed harvest would affect approximately 10 communities in the lower Snake River region, an unknown number of tribal communities, and an unknown number of coastal fishing communities. No estimate for future mitigation is given under this alternative. One proxy might be the opportunity cost of foregone fishing revenue as forecast by the Recreation Team and the Anadromous Fish Economic Team.

7.1.3 Unresolved Issues

At this time, the assessment of social impacts to the region and to focus communities is incomplete due to unresolved key issues such as the following:

1. Lack of an industry-specific study detailing how the forest products industry of North Central Idaho might be affected by increased transportation costs
2. Actual magnitude of net county tax impacts resulting from increased road maintenance activity and decreased agricultural land values for dryland farms and irrigated farms under Alternative 4
3. The expected rate response for alternative modes of transportation and the effects of the rate changes on shippers under Alternative 4
4. The degree of linkages between agricultural products from Ice Harbor and downriver food processors and alternative supply quantities under Alternative 4.

The remainder of this section presents the purpose and methods of the study, a characterization of the study region, a brief description of the case study community baselines, a more detailed comparison of alternatives by community and potential responses, and a discussion of the compensation or mitigation potential.

7.2 Introduction

7.2.1 Purpose

The purpose of this Social Analysis Section is to examine the range of potential social impacts that may occur as a result of implementing one of the four alternatives. This report focuses on the

potential community level impacts resulting from changes in the local and regional biological, economic, and physical environment. While other reports addressing the economic impacts of the proposed alternatives focus on national economic development (NED), this report attempts to outline the distributional and equity effects on specific communities within the broader regional context. Communities are the focus of this report because it is at this level that social impacts resulting from resource policy changes may be most keenly felt (Force and Machlis, 1997). This study has been designed to meet the requirements specified in the WRC Guidelines (WRC, 1983). The key issues addressed include the following:

- What the social impacts will be and when (timing)
- Who will be affected
- How they will be affected (beneficial/adverse)
- How much they will be affected
- How the communities may respond.

By answering these questions through the use of qualitative and quantitative data in the examination of nine case study communities, the social analysis provides a greater understanding of the anticipated impacts and highlights the need for and location of potential mitigation measures. Uncertainty exists throughout this analysis because of the uniqueness of the proposed actions and the unknown nature of how markets, communities, and political entities will respond to the implementation of these actions, particularly the natural river drawdown alternative. The degree and magnitude to which the proposed alternative will affect communities throughout the region depends in large part on how these communities, industries, families, and individuals respond to potential and actual changes.

7.2.2 Scope

The scope of the analysis in this report covers the potential social impacts associated with the four main alternatives under consideration by the Corps. These alternatives include the base case or existing condition (Alternative 1), existing conditions with maximum transport (Alternative 2), major system improvements (Alternative 3), and natural river drawdown or dam breaching (Alternative 4). The effects of Alternatives 2 and 3 on the human environment generally do not differ significantly, and will be discussed together.

The geographic scope of the analysis is limited to communities within the lower Snake River region. This region includes the counties listed in Table 7-5 and approximately 101 communities within these counties. For the purpose of analysis, the potentially affected lower Snake River region was divided into three subregions to explore the differential effects of the proposed alternatives: downriver, reservoir, and upriver. The counties that comprise these subregions and the combined lower Snake River study area are identified in Table 7-5. For a more complete description of the definition, justification, and delineation of the subregions see the Regional Economic Report (AEI, 1999).

Table 7-5. Regional Analysis Study Area

Downriver Subregion	Reservoir Subregion	Upriver Subregion
Oregon	**Washington**	**Idaho**
Gilliam	Adams	Clearwater
Hood River	Asotin	Custer
Morrow	Columbia	Idaho
Sherman	Garfield	Latah
Umatilla	Walla Walla	Lemhi
Wasco	Whitman	Lewis
		Nez Perce
Washington		Valley
Benton		
Klickitat		**Oregon**
Skamania		Wallowa
Franklin		

There are three distinct time phases to this analysis. Impacts do not occur just during the most intensive phases of project implementation, but also before and after implementation (Grambling and Freudenburg, 1992). The first phase includes the planning and decision-making period of the feasibility study from the initiation of the feasibility study and environmental impact statement (EIS) scoping to the final selection of a preferred alternative. The second phase includes the implementation phase, proposed from 2002 to 2012, depending on the alternative selected (Corps Implementation Report, 1999). The third phase includes the post-implementation social effects. Potential community-level impacts were examined across these three phases, but were limited to an overall study period of 20 years because forecasting the non-economic social impacts of the alternatives would be limited by the high degree of variability of social systems.

The scope of this social analysis neither provides a comprehensive assessment of all the communities within the defined study region, nor are the communities selected for this analysis representative of all communities in the region. Rather, the intent of the study is to provide decision-makers with information regarding the various impacts across a range of case study communities likely to be affected by the proposed alternatives. Tribal communities are not examined as part of this study. A study entitled "Tribal Circumstances and Perspectives," prepared by the CRITFC, documents the tribal perspective concerning the potential social, cultural, and economic effects of the proposed alternatives on tribal populations (Meyer Resources, 1999).

7.2.3 Methodology

In order to address the key study questions, the following steps were taken to obtain reliable information on potential social impacts:

1) Develop an understanding of the issues raised in the original scoping the Corps conducted in 1995 and the public information meetings the Corps conducted during this study.

2) Select key focus communities to capture the range of possible direct impacts.

3) Select appropriate social indicators for the types of anticipated social impacts.

4) Describe the trends and history of the region and case study communities.

5) Develop estimates of potential impacts, the magnitude of these impacts, and the range of community responses using information provided by the DREW work teams, NMFS, secondary data analysis, key informant interviews, and a thorough literature review.

This analysis is supplemented by information obtained through a series of interactive community forums, which included each of the focus communities. The community forum information includes each community's perceptions of its history, an assessment of its current situation, and a projection of potential social impacts under each of the proposed alternatives. For more information on the methodology and findings of the community-based assessments, see Harris et al., 1999.

7.2.3.1 Selection of Focus Communities

Secondary data sources, including the 1990 Census of Population and Housing and the 1992 Census of Agriculture, as well as preliminary impacts identified by the Drawdown Regional Economic Workgroup (DREW) study teams, were consulted to evaluate communities for inclusion as case study focus communities. The study team examined the potential impacts of the three alternatives under consideration to identify a group of focus communities that met the following criteria:

- Communities that might experience large potential impacts (positive or negative) as a result of the project alternatives
- Communities that are diverse in size, economic activity, and potential socioeconomic impacts (level, type, and timing of impacts).

Table 7-6 lists the communities selected as focus communities for this study.

7.3 Characterization of Study Region and Communities

7.3.1 Characteristics of Communities

The communities located throughout the study area are diverse in terms of their size, economic activity, and relationship to the lower Snake River. The purpose of this section is to describe these basic characteristics in order to put the analysis of the focus communities into the context of the other 101 communities in the study region.

Communities in Washington State (45) represent nearly 50 percent of the communities in the study region, with Oregon and Idaho almost equally represented with 29 and 27 communities, respectively. With the exception of four communities in the upriver region, the Oregon communities are downstream of the Lower Snake River Project. Two-thirds of the communities in Washington are located directly around the reservoirs. Approximately half of the Idaho communities are located at the eastern, upstream end of the reservoirs.

Table 7-6. Selected Focus Communities

Region	Focus Community		Size	Primary Economic Activities	Primary Direct Impacts
Reservoir	WA:	Clarkston	6,860	Medical services, wholesale & retail trade	Navigation, implementation, recreation, A-fish, power
		Colfax	2,865	Agriculture, state/local government, wholesale & retail trade	Transportation, recreation
		Pomeroy	1,475	Agriculture, state/local/ Federal government	Navigation, recreation, implementation
Downriver	WA:	Kennewick	48,010	Wholesale & retail trade, services, F.I.R.E	Navigation, recreation, irrigation, implementation, power
		Pasco	22,370	Agriculture, transportation	Navigation, recreation, irrigation, implementation, power
	OR:	Umatilla	3,155	Agriculture, state/local/ Federal government	Recreation, navigation, irrigation
Upriver	ID:	Lewiston	30,271	Manufacturing, wholesale & retail trade	Navigation, implementation, A-fish, power, recreation
		Orofino	3,122	Timber, agriculture, state/local/Federal government	A-fish
		Riggins	495	Travel & tourism, ag., state/local/Federal government	Recreation, A-fish

7.3.1.1 Population

The total population of the study area was approximately 582,124 in 1995. Population is distributed unevenly among the 25 counties and three subregions that comprise the study area. The downriver subregion, which extends from the confluence of the Snake and Columbia rivers to below Bonneville Dam, is the most populated, accounting for 278,429, or approximately 48 percent, of the study region's 1995 population.

In general the geographic area of northeastern Oregon, southeastern Washington, and north central Idaho is sparsely populated and rural. The size of communities ranges from small rural towns with populations less than 200 to cities with populations from 8,000 to almost 50,000. In general the communities in the lower Snake River study area are small. Sixty-six percent have populations lower than 1,500, and 60 percent have populations lower than 1,000. The major population centers are the Tri-Cities (Richland, Kennewick, and Pasco), Walla Walla, the Quad-Cities (Pullman, Moscow, Lewiston, and Clarkston), and Hermiston/Pendelton. Only five communities in the study region have populations that exceed 20,000. These larger population cities serve as regional trade and educational centers and provide a diversity of employment opportunities from manufacturing and professional services to tourism. These cities make up a large share of the economically diverse communities in the region.

7.3.1.2 Population Trends

Most rural areas in the dryland agricultural region of the Palouse (eastern Washington and north central Idaho) exhibited very slow growth over the 1980s and 1990s, while some rural areas offering high quality scenery and recreation have grown rapidly since 1990 (Johnson and Beales, 1994). Almost all the communities in the subregions have increased in population since 1990 and are expected to see moderate population growth over the next 15 years (Idaho, Washington, and Oregon State Population Estimates, 1996 and 1997).

7.3.1.3 Economic Characteristics

The economy of the Pacific Northwest has undergone substantial change over the past three decades. In terms of job formation it has grown much faster than the nation as a whole with total employment in the states of Washington, Oregon, and Idaho increasing by more than 210 percent. Employment in the 25-county study area increased by about 74 percent from 1970 to 1995. The total number of jobs in both the region and the study area has increased even as employment in historically important job sectors, such as manufacturing, logging, mining, farming, and ranching, has declined or remained stagnant. At the aggregate level, employment in the study area increased in nearly all sectors between 1970 and 1995. These patterns appear to be broadly similar across all three subregions, with absolute increases in all sectors with the exception of the farm and military sectors in the reservoir and upriver subregions and the mining sector in the downriver subregion. Employment in the farm sector declined by 14.1 and 20.9 percent in the reservoir and upriver subregions, respectively. The downriver subregion, by contrast, experienced a 9 percent increase in farm employment.

Most of the region's towns are small and, therefore, have narrow economic bases with fewer industries and fewer firms per industry than larger communities. Agriculture dominates in these small communities. Almost half of the communities in the region have 20 percent or more of their employment in agriculture, while 68 percent of the communities have 11 percent or more employment in the agricultural sector.

Per Capita Income

Average per capita income in the 25-county study area was $17,570 in 1995, with little variation across the three subregions. The states of Washington, Oregon, and Idaho had respective per capita incomes of $23,974, $21,915, and $19,199 in 1995. U.S. per capita income in 1995 was $23,359. The below average per capita income in the region indicates that many of these counties exhibit relatively high levels of poverty and unemployment.

Sources of Personal Income

Nonfarm earnings are the largest source of personal income in all three subregions. In 1995, nonfarm earnings as a percentage of total personal income ranged from 55.3 percent in the reservoir subregion to 65 percent in the downriver subregion.

Land Tenure Characteristics

Agricultural land tenure has undergone significant changes in all three subregions. In all cases, these changes have involved a decrease in the number of farms and an increase in average farm size. The downriver subregion has the largest number of farms and acres farmed of the three subregions. Between 1959 and 1992, this subregion lost 1,279 farms or 18.4 percent of the 1959 total. The reservoir and upriver subregions over this period lost 1,544 and 1,537 farms, respectively, or 34.1 and 32.6 percent of their 1959 totals.

This has not, however, been a simple linear decline. Rather, all three subregions experienced both increases and decreases in the number of farms between 1959 and 1992. The average size of farms also fluctuated over this period. In general, the trend has been toward increasing farm size in all three subregions.

7.3.2 Focus Community Baseline Profiles

Community profiles were prepared in the Social Analysis Report (Foster Wheeler, 1999). The profiles describe why each community was selected and provide an overview of historical community trends. They also outline each community's social, cultural, and economic relationship to the lower Snake River. Information related to four dimensions of community life—the people, the economy, the place, and vision and vitality—from 1970 to the present is also presented in these profiles. The information from these profiles provides the basis for evaluating the potential impacts and community responses. Much of this information is included in case-by-case discussions in Section 7.4. To organize the assessments of social impacts, communities were organized by these four dimensions of community. The people (demographics) dimension relates to the characteristics of individuals or households in the community and changes. The economic (jobs and wealth) dimension relates to the major businesses and sources of jobs in the community. The place (character) dimension refers to the built and natural environment of the community. The vision and vitality (organization and leadership capacity) dimension refers to the characteristics of the community's social organizations and ability to accomplish goals. The following sections provide a brief description of the community selection criteria and community history in order to frame the subsequent discussion of community-level impacts for the salmon recovery alternatives under consideration.

7.3.2.1 Clarkston, Washington

Clarkston is located in Asotin County, across the Snake River from Lewiston at the confluence of the Snake and Clearwater rivers. It was selected as a focus community because of anadromous fish runs, navigation, construction, and recreation opportunities along the Snake River.

History

In 1899, a bridge across the Snake River connected Lewiston and Jawbone Flats, the area officially incorporated as Clarkston in 1902. Agriculture, particularly berry production, dominated the town's economy in the early 1900s. By the 1950s, agricultural production grew to include grains and hay, peas, and other fruits. Livestock were also raised. Transportation was by railroad and boat which brought supplies up from Portland and grain down on the return trip. As water transportation on the Snake improved into Hells Canyon, Clarkston became a gateway for tourists. Lower Granite Dam was completed in 1975, flooding much of the fruit orchards and beef processing plants along the

river. A second bridge linking Clarkston and Lewiston was constructed in 1982. Today, Clarkston remains active as a regional trading center via its port, while agricultural production, outdoor recreational opportunities, and a growing retiree population add to its diversity.

7.3.2.2 Colfax, Washington

Colfax is located in Whitman County in the heart of the Palouse, the dryland wheat, barley, pea, and lentil region of eastern Washington and north central Idaho. It is approximately 19 miles north of the lower Snake River. It was selected as a focus community primarily because of navigation and recreation opportunities and access.

History

Incorporated in 1870, Colfax is the oldest town in eastern Washington. It was originally a sawmill town with cattle ranches and farms but, over the years, agriculture became the primary industry. Colfax became the county seat in 1871. A series of floods and fires threatened to destroy the community, but the residents rebuilt. In 1963 the Corps constructed a concrete flood control project to eliminate the flooding problem in the downtown area. With the arrival of slack water, the Port of Whitman County established new sites on the lower Snake River at Almota and Wilma. Colfax has recently completed a downtown revitalization project to widen Main Street, beautify the downtown, and enhance the business climate. The Port has also recently established a small industrial park on the outskirts of town.

7.3.2.3 Pomeroy, Washington

Pomeroy is located in Garfield County approximately 15 miles south of the lower Snake River in southeastern Washington. US 12 passes through town and connects Pomeroy to Clarkston and Lewiston to the east and Walla Walla and the Tri-Cities to the west. Pomeroy was selected because of navigation and recreation concerns.

History

Established in 1864, Pomeroy quickly experienced a rapid wave of population migration due to its location on the stagecoach line between the towns of Walla Walla and Lewiston. The economy was based primarily on cattle and vegetable farming. By 1878, the town had grown into a service and trade center containing a flour mill, retail stores, and a hotel. Arrival of the Starbuck-Pomeroy rail branch in 1885 further expanded Pomeroy's population, while serving as the major source of transportation for agricultural products. A pea cannery was built in 1942 and remained operational until the 1960s. The construction of Little Goose Dam in 1970, followed by Lower Granite Dam in 1975, significantly increased the local population and economic base in Pomeroy, as construction workers and their families moved in. The rail line was abandoned in 1981. In the 1990s, Pomeroy experienced many infrastructure improvements to its Main Street.

7.3.2.4 Kennewick, Washington

Kennewick is located in Benton County across the Columbia River from Pasco. It was selected as a focus community because of navigation, recreation, irrigation, and power concerns.

History

Incorporated in 1904, Kennewick is the largest community of the Tri-Cities. It began as a predominantly agricultural-driven economy, linked to the Northern Pacific Railroad route which moved its products to markets. World War II brought new prosperity to the region. In the 1940s, the plutonium production facilities at the Hanford Project were created. Hanford employees greatly expanded Kennewick's population, and the retail base grew to meet the needs of the increasing population. With the development of the Columbia Basin Project, irrigated agriculture expanded around the community, contributing to its rapid growth. Suspension of work at Hanford in the early 1980s and downsizing in the mid-1990s have greatly affected the economy of the community.

7.3.2.5 Pasco, Washington

Pasco is located in Franklin County to the north of the confluence of the Snake and Columbia rivers. Pasco and the other Tri-Cities create a hub of human and commodity movements through the lower Columbia Basin. Pasco was selected as a focus community because of water supply issues, navigation/transportation, power, recreation opportunities and sites, and anadromous fish runs.

History

Officially incorporated in 1891, Pasco attributes its establishment and early growth to railroad construction near the Snake and Columbia rivers in the 1870s. Steam-powered boats provided transportation into the region before the arrival of the railroad. Pasco soon moved from a single economy of rail to livestock and agricultural production made possible by pumping water from the rivers for irrigation in the 1890s. A more intensive irrigation project was developed in 1910. Airmail service to Pasco began in 1926, and a new airport by the rail was dedicated in 1929. In 1943, the Hanford nuclear project began. Although Pasco is located on the opposite side of the Columbia River from the Hanford facilities, it did receive some population and economic spillover, particularly with the 1985 creation of the I-182 highway bridge which connects Pasco to Richland. Suspension of work at Hanford in the early 1980s and downsizing in the mid-1990s have adversely affected the economy of the community. Work on environmental restoration in Hanford continues to provide economic benefits to Pasco. Dry land and irrigated agriculture in the surrounding countryside continues to play an important role in Pasco's development.

7.3.2.6 Umatilla, Oregon

Umatilla is located in Umatilla County, downstream from the confluence of the Snake and Columbia rivers on the Columbia River. Umatilla was selected as a focus community because of navigation/transportation, recreational opportunities and sites, and irrigation.

History

Initially called Columbia, the town of Umatilla was founded in 1863 as a site for transferring gold on the Columbia River to the Walla Walla route. When mining declined, the town stagnated, but then grew into a local service center for increasing irrigated agricultural activity. The building of the Umatilla Army Depot in the 1940s and the McNary Dam in the 1950s contributed to a population boom. In 1963, a major portion of Umatilla was destroyed because of flooding caused by the John Day Dam, built 40 miles downriver.

7.3.2.7 Lewiston, Idaho

Lewiston is located in Nez Perce County at the confluence of the Clearwater and Snake rivers. Three major US highways in the region intersect in Lewiston and provide access to eastern Washington, northern Idaho, Montana, and southern Idaho. It was selected as a focus community for the following reasons: navigation at the Port of Lewiston (the only seaport in Idaho), recreational opportunities and access along the lower Snake River, construction impacts associated with implementation, and anadromous fish runs on the Snake and Clearwater rivers.

History

Founded in May 1861, Lewiston was the second permanent settlement in Idaho and the first incorporated town. Because of its location on the junction of the Snake and Clearwater rivers and seasonal navigation on the lower Snake River, Lewiston served as a supply center for regional mining operations. Following the gold boom, Lewiston continued to grow as a regional shopping, market, and distribution center for agricultural and timber operations. The Port of Lewiston was established in 1958. The Lewiston Orchards were annexed in 1969, doubling the town's area and population. The construction of the Lower Granite Dam in 1975 brought slackwater to Lewiston, making it the most inland port on the 460-mile Columbia-Snake River transportation system.

7.3.2.8 Orofino, Idaho

Orofino is located in Clearwater County, 45 miles upstream from the lower Snake River at the confluence of the Northfork and the Clearwater rivers. US 12, the major highway connecting Lewiston to Montana, passes through the middle of town. National Forests, wild and scenic rivers, the Dworshak Reservoir, and the Selway-Bitterroot Wilderness Area are close by.

Orofino was selected because of the anadromous fish runs on the Clearwater River, the sport fishing industry related to those runs, and the current conflict over flow augmentation from the Dworshak Reservoir that affects recreation, but that is required under the 1995 Biological Opinion. Orofino markets itself as the "Steelhead Capital of the World" and boasts the world's largest steelhead fish hatchery.

History

Orofino's history is centered on its natural resources. Gold prospectors first settled Orofino in 1861 and then demolished it when ore deposits were found beneath the town. Orofino was later rebuilt in a different location at the confluence of Orofino Creek and the Clearwater River. In 1889, the Northern Pacific Railroad began service to the town, and the first post office was established in 1897. Starting in the 1900s, wood production dominated the economy and continues to do so today. Orofino was incorporated in 1925. By 1940, it was an established center for white pine logging. Agriculture also grew. In 1962, the Lewis and Clark Highway was completed and was seen as a source of economic stimulation for tourism and commerce. In 1968, construction began on Dworshak Dam, contributing to population increases. Much of the population remained post-construction. Although timber production has declined over the past decade due to diminishing supplies of timber from National Forest lands, new opportunities in recreational tourism were created from the Clearwater River and the Dworshak Reservoir. The nation's largest steelhead

hatchery contributes to this tourism. The listing of Snake River salmon has negatively impacted these recreational developments.

7.3.2.9 Riggins, Idaho

Riggins is located in Idaho County, upstream from the lower Snake River along the Salmon River, a tributary to the Snake River. A major north-south highway (US 95) passes through the middle of town. Riggins was selected as a focus community because of the anadromous fish runs on the Salmon River, the recreational and sport fishing on the Salmon River, and the effects of listed salmon stocks on whitewater recreation.

History

The discovery of gold first attracted settlement in the Riggins area, which was officially named in 1908. Mining was replaced by livestock raising, which remained prominent until the 1950s. National Forests were established nearby. With the Civilian Conservation Corps (CCC) program of the 1930s, as well as other Federal projects, many roads, trails, fences, and water developments were established. During World War II, a sawmill was built, and logging became a dominant industry. The 1982 fire that destroyed the mill forced the community to rebuild their economy. The residents who stayed shifted to a recreation-based economy of fishing, river floating, and hunting, made possible by the resources of the Salmon River. In 1982, there was only one river outfitting company. Now, Riggins boasts 15, plus six motels, five restaurants, and three real estate agencies, among other services. The Salmon River Economic Development Association was formed in 1992 to assess the economic health of the area. Since its inception, many city improvements have occurred. Additionally, a medical clinic recently opened, the Goff Bridge has been replaced, and a new water system is being coordinated with the improvement of US 95.

7.4 Description and Comparison of Community Social Impacts

7.4.1 Comparison of Alternatives by Community

A major limitation to the evaluation of social impacts at the community level is the availability of information regarding the economic impact on key sectors in the study area. Although this study has described the impacts to farms at the county level, and the regional study team conducted a sensitivity impact analysis of decreased land under production, it is not possible to predict how many farms would be affected and the level of that impact on a given community. In addition, no information exists to forecast the employment impacts on other waterway shippers such as forest products and their linkages to other mills in northeastern Oregon and north central Idaho. Finally, who will pay for increased electrical rates, how they pay, and how much they will pay have not been defined, thus this analysis used a mid-point estimate where Federal beneficiaries of BPA power would pay the costs.

In the absence of this information, the discussion of community-level impacts should be considered as preliminary. Notwithstanding these limitations, the following discussion will illustrate who may be affected, how they may be affected, and how they may respond to changes in the operation of the four lower Snake River facilities. Although the impact matrix and evaluation of impacts are presented in Table 7-4 by resource change, the discussion will put these changes into the context of the four dimensions used for the description of the base case. These dimensions are jobs and wealth

(economics), place (character of the natural and built environment), vision and vitality (social organization and leadership), and people (demographic changes and effects on individual populations). Discussions of the community-level impacts include the direct and indirect impacts, as identified in this study and the other Corps' studies. References to employment include direct, indirect, and induced employment changes in the community. The focus community analysis conducted is supplemented by the perceptions of community members who participated in the community-based assessments conducted by the University of Idaho (for detailed methodology and findings see Harris, et al., 1999). Finally, the communities' prior experience with change events will place the identified impacts into an historical context.

7.4.1.1 Clarkston, Washington

The socioeconomic impacts of the three alternatives on the community of Clarkston could include changes in recreation activities, navigation/transportation, water supply, implementation, anadromous fish recovery, and costs of electrical power. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 affect the probability of anadromous fish recovery while having minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in Clarkston. It would create both winners and losers through the loss of a navigable waterway, a shift in transportation modes, a change in recreational opportunities and access, an increased chance of anadromous fish recovery, and minor increases in power rates. In addition, the community could experience a dramatic short-term change in the character of the community as the reservoir is drained and a new shoreline is formed around the city. It is expected that Clarkston would realize short-term increases in implementation and municipal and industrial (M&I) water-supply, modification-related employment, as well as a temporary influx of outside workers. Overall, the community could experience both increases and decreases in employment, with a projected net gain in employment. Perhaps the most significant effect on the community could be the stranded social costs of planning and development activities structured around the continued existence of the four lower Snake River facilities and a navigable waterway.

Jobs and Wealth

Overall, Alternatives 2 and 3 provide a higher degree of certainty about the economic future of Clarkston. They do not adversely affect jobs and wealth directly, although the lower probability of salmon recovery may indirectly affect those businesses related to recreational fishing. Alternative 4 adversely affects future economic certainty and increases future economic risks, because not all of the indirect and induced effects of these changes are known. For example, it is unclear how the increased capital costs of pump and well modifications would affect local pulp and paper operations, the golf course, or irrigators along the Lower Granite pool.

Negative impacts on community employment from Alternative 4 could result from a reduction in county-wide farm income, loss of Corps-related jobs, loss of water-related port operations, loss of tour-boat-related employment, short-term decreased recreational opportunities, and increased residential electrical rates. Farmers and other shippers currently using the waterway to ship bulk products could experience increased costs to ship their goods. This might have a negative effect on employment in those economic sectors. Only Corps-related employment is projected to exceed a 1 percent decrease.

Positive impacts on community employment from Alternative 4 could result from increased truck transportation, post-implementation increases in river-recreation-related activities, increased anadromous fishing opportunities, road maintenance, and the short-term increases in employment from implementation activities and modifications to wells and water pumps.

The effects of these changes on the largest employers could demonstrate the degree to which there would be winners and losers in Clarkston. A wood products corporation, largest employer in the Lewiston-Clarkston valley, could be negatively affected by higher shipping costs for some of its products. On the other hand, asphalt companies could benefit from both the short-term construction-related implementation activities and the long-term road maintenance.

Place

Clarkston's natural and built environment could change dramatically under Alternative 4 much like it did 25 years ago when the pools were filled and orchards were inundated. Adverse impacts from the loss of the Lower Granite pool include the short-term exposure of shoreline and mudflats. The community could lose recreational access sites at Chief Lookinglass Park and Nisqually John Landing, as well as losing some recreational site services at Chief Timothy State Park, Hells Canyon Resort, Southway Park, and Hells Gate State Park. In addition, the community could have some short-term displacement from steelhead and salmon fishing, as well as displacement from other river-related recreation. The identity of the community as a working water port could also be adversely affected, although it would still retain its identity as a Snake River community and the gateway to Hells Canyon.

Another adverse effect of Alternative 4 could be an increase in truck traffic through the community and the county with a corresponding increased risk of traffic accidents. Additionally, the financial pressures exerted on local farmers from higher transportation costs may lead to a greater consolidation of farms and a change in the rural-urban interface of Clarkston.

Long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River and the community shoreline. Additionally, the increase of salmon would benefit the identity of the community as a place where salmon continue to exist, and local fishermen continue to pursue this element of the Clarkston's quality of life. Alternatives 2 and 3 have higher risks associated with salmon recovery and may, therefore, adversely affect the community's quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could all adversely affect Clarkston's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. Adverse effects of a change in the economic direction and identity of the community under Alternative 4 might include a pessimistic vision of not being able to control the community's future. The community has worked to develop recreational opportunities associated with the lower Snake River reservoirs, to bring tour boats from Portland into the community, to use the port as a development mechanism, and to develop retirement opportunities. Many of these plans could be significantly affected under this alternative. Additionally, the negative short- and long-term effects on both local and county property values and property tax revenue might create difficulties in

obtaining sufficient funding to pursue new avenues of economic development and maintain the current level of community services.

People

Changes in the physical and economic human environment could affect distinct populations in the community. The high number of fixed-income families may have to pay a larger proportion of their income to power bills. The growing elderly population in Clarkston might be physically unable to engage in the new recreational opportunities on a free-flowing lower Snake River. Finally, the influx of short-term, outside workers might disrupt traditional community patterns, although the number of forecast workers could be relatively small compared to the workforce that originally constructed the lower Snake facilities.

The forecast increase in long-term employment under Alternative 4 suggests that population trends should continue to increase. Given the uncertainties associated with the business climate, however, overall population might remain stable or decrease slightly given short-term job losses.

Historical Change Events and Potential Responses

Clarkston has a relatively high economic diversity and has undergone significant economic peaks and valleys over the past 25 years. During the construction of Lower Granite Dam and the dikes in the valley, unemployment was at an historical low. During the recession of the early 1980s, Asotin County lost over 1,200 jobs between 1980 and 1984. Clarkston has also experienced periodic layoffs in the wood manufacturing industry in the valley.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, it appears that the changes in the human environment would be within historical bounds.

7.4.1.2 Colfax, Washington

The socioeconomic impacts of the three alternatives on the community of Colfax could include the effects of changed recreation activity, navigation/transportation, water supply, implementation, anadromous fish recovery, and power costs. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 affect the probability of anadromous fish recovery, while having minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in Colfax. It could adversely affect the community primarily through the loss of a navigable waterway, a corresponding shift in transportation modes to more expensive rail and truck movements, a decrease in countywide net farm income, and a drop in property values for agricultural lands. It is expected that Colfax would realize short-term increases in implementation and well-modification-related employment, as well as a small temporary influx of outside workers. Overall, the community could experience both increases and decreases in employment, with a projected net loss in employment. The most significant effect on the community could be the additional financial pressures on grain farms from increased transportation, storage and handling costs, and uncertainty as to how the transportation system and individual farms would respond. The cumulative effects of Alternative 4 and the proposed phase-out of the loan deficiency payments under the Freedom to Farm Act could create even greater uncertainty for individual farmers and farm communities like Colfax.

Jobs and Wealth

Overall, Alternatives 2 and 3 would not adversely affect jobs and wealth directly. They could provide a higher degree of certainty about the economic future, although the degree of future regulatory oversight under these alternatives is unknown. Alternative 4 could adversely affect future economic certainty and increase future economic risks because not all of the indirect and induced effects of these changes are known. For example, it is unknown if some agricultural lands would go out of production or if none would go out of production, how many farm owners might be forced to sell, and how many would seek other employment.

Negative impacts on Colfax's employment from Alternative 4 could result from increased residential electrical rates, reduction in county-wide farm income, loss of Corps-related jobs, loss of water-related port operations, and short-term, decreased recreational opportunities. Farmers currently using the waterway to ship grains could experience increased costs to ship their goods. This could have a negative effect on farm income and further decrease jobs that support farm household expenditures. Total county farm income would probably decrease by at least 10 percent. The associated decrease in household spending would probably reduce employment in Colfax by more than 1 percent. With transportation, storage, and handling costs expected to increase an average of 17 cents per bushel for all grain production in the county, the value of agricultural land surrounding Colfax might be expected to fall by up to $140 per acre.

Positive impacts on community employment from Alternative 4 could result from an increase in truck and rail transportation employment, post-implementation increases in river recreation-related activities, increased anadromous fishing opportunities, and ongoing road maintenance. The increase in trucking- and rail-transportation-related employment might be higher than predicted by the allocation of employment impacts due to the large volumes of grain produced in the lands surrounding Colfax and the position of Colfax on the highway that would carry a large amount of the traffic. Short-term increases in employment could result from implementation activities, modifications to wells along the river, and upgrades to road and rail infrastructure.

Place

Colfax's natural and built environment may not change dramatically under Alternative 4. Changes would occur in the surrounding patterns of land ownership and in the access and recreational opportunities available on the nearby lower Snake River. Adverse impacts from the loss of the Lower Granite pool could include the loss of developed access at recreational sites such as Wawawai County Park, Ilia Dunes Landing, Willow Landing, Little Goose Landing, and Lyons Ferry Marina. Additionally, recreation services may diminish at sites such as Boyer Park and Marina, Central Ferry State Park, and Chief Timothy State Park. In addition, the community could experience short-term losses in recreational steelhead and salmon fishing and other river-related recreation as boat ramps are modified and the riverbank is revegetated. The identity of the community as agricultural may not be adversely affected by Alternative 4. The community should still continue to be the heart of the Palouse and a leader in wheat and lentil production.

Another adverse affect of Alternative 4 could be the financial pressures higher transportation costs would exert on local farmers. This might lead to a greater consolidation of farms and a decrease in the number of community members either directly or indirectly active in the farming industry. With or without a navigable waterway, Colfax would continue to be a transportation hub for the

movement of grain commodities produced in Whitman and neighboring counties. Truck traffic patterns could shift from a north-south to an east-west orientation with an estimated slight increase in overall traffic through town. This might be economically beneficial, but would increase congestion and impact safety through downtown and on Washington Route 26 westbound. Finally, Colfax could lose a river crossing at the Lower Granite facility. This crossing provides an alternative transportation corridor between Colfax and Pomeroy in Garfield County.

Long-term benefits of Alternative 4 could include the revegatation and restoration of the normative Snake River. Additionally, the increase of salmon would benefit the identity of the community as a place where salmon would continue to exist and local fishermen would continue to pursue this element of the Colfax's quality of life. Alternatives 2 and 3 could have higher risks associated with salmon recovery and might adversely affect this element of Colfax's quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could adversely affect Colfax's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. The community has been united in its opposition to Alternative 4. Adverse effects of a change in the economic direction and identity of the community under Alternative 4 might challenge the leadership and vision of the community to provide a cost-effective way to transport the large volumes of grains to market. One key factor is the uncertainty about the capacity of alternative modes of transportation to handle the volume of production currently shipped on the lower Snake River.

The community has worked with the Port of Whitman County to develop successful industrial and shipping facilities. Some of these developments such as industrial parks sited away from the river may be unaffected by the change in the waterway, while other facilities on the river may become obsolete. Perhaps the most significant impact on the vision and vitality of the community would be the expected drop in property tax revenue both from agricultural and non-agricultural lands. The community could face raising tax rates or cutting social services. Neither of these choices is harmonious with the community's future plans and could limit investments in the economic diversification efforts. One ameliorating factor could be that property tax revenue would not change overnight, but rather would be phased in over a 5-year period of decreased farm income being capitalized into the land.

People

Changes in the physical and economic human environment could affect distinct populations in the community. The poverty rate in Colfax is relatively low, as is the over-65 population; thus, large segments of the population may not be affected adversely by the increased electrical rates or the changes in slackwater recreation opportunities. Colfax might see a short-term influx of outside workers during the implementation, but this probably would not be a significant impact. The expected increased rate of land consolidation in the farm sector might contribute to a reduction in rural farm population.

Overall, the expected decrease in net employment under Alternative 4 suggests that community population would decrease slightly.

Historical Change Events and Potential Responses

Colfax's economy exhibits moderate economic diversity and has not experienced major economic peaks and valleys over the past 25 years, aside from the large cyclical swings in commodity prices and production yields. Community members have existed with the uncertainty associated with a farm-centered economy and lifestyle. Nevertheless, there is a strong cultural norm to make things work and build a future in this community.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community it appears that the changes in the human environment might exceed historical experience in this community.

7.4.1.3 Pomeroy, Washington

The socioeconomic impacts of the three alternatives on the community of Pomeroy could include the effects of changed recreation activity, navigation/transportation, water supply, implementation, anadromous fish recovery, and power costs. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 could affect the probability of anadromous fish recovery, while having a minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in Pomeroy. It could adversely affect the community primarily through the loss of a navigable waterway, a corresponding shift in transportation modes to more expensive rail and truck movements, a decrease in countywide net farm income, and a drop in property values for agricultural lands. Pomeroy probably would realize short-term increases in implementation- and well-modification-related employment, as well as a significant temporary influx of outside workers. Overall, the community could experience both increases and decreases in employment, with a projected net loss in employment. The most significant effect on the community could be the additional financial pressures on grain farms from increased transportation, storage, and handling costs and the uncertainty as to how the transportation system and individual farms would respond. The cumulative effects of Alternative 4 and the proposed phase-out of the loan deficiency payments under the Freedom to Farm Act could create an even greater uncertainty to individual farmers and farm communities like Pomeroy.

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could provide a higher degree of certainty about the economic future. Alternative 4 could adversely affect future economic certainty and increase future economic risks because not all of the indirect and induced effects of these changes are known. For example, it is unknown if some agricultural lands would go out of production or, if none went out of production, how many farm owners might be forced to sell out and seek other employment.

Negative impacts on Pomeroy's employment from Alternative 4 could result from reduction in countywide farm income, loss of Corps-related jobs, increased residential electrical rates, and short-term decreased recreational opportunities. Farmers currently using the waterway to ship grains could experience increased costs to ship their goods. This could have a negative effect on farm income and further decrease jobs that support farm household expenditures. Total county farm income probably could decrease less than 10 percent. The change in direct, indirect, and induced

employment from a decrease in farm household spending probably would decrease employment in Pomeroy by less than 1 percent. With transportation, storage, and handling costs expected to increase an average of 7 cents per bushel of total grain production, the value of agricultural land surrounding Pomeroy might be expected to fall by up to $40 to $50 per acre.

Positive impacts on community employment from Alternative 4 could result from an increase in truck and rail transportation employment, post-implementation increases in river-recreation-related activities, increased anadromous fishing opportunities, and ongoing road maintenance. The increase in trucking- and rail transportation-related employment might be higher than predicted by the allocation of employment impacts. Both the large volumes of grain produced in the lands surrounding Pomeroy and the position of Pomeroy on the highway that could carry a large load of the traffic from Idaho counties to ports on the Columbia River indicate that Pomeroy would see higher levels of transportation-related employment. Short-term increases in employment could result from implementation activities, modifications to wells along the river, and upgrades to road infrastructure.

Place

Pomeroy's natural and built environment may not change dramatically under Alternative 4. Changes could occur in the surrounding patterns of land ownership and in the access and recreational opportunities available on the nearby lower Snake River. Adverse impacts from the loss of the Lower Granite pool could include the loss of developed access at recreational sites such as Wawawai County Park, Ilia Dunes Landing, Willow Landing, Little Goose Landing, and Lyons Ferry Marina. Access to Boyer Park and Marina by crossing the Lower Granite facility would be lost. Additionally, recreation services could be diminished at sites such as Boyer Park and Marina, Central Ferry State Park, and Chief Timothy State Park. The community may also experience short-term losses in recreational steelhead and salmon fishing and other river-related recreation, as boat ramps were modified and the riverbank was revegetated. The identity of the community as agricultural should not be adversely affected by Alternative 4.

Another adverse affect of Alternative 4 could be the financial pressures exerted on local farmers from higher transportation costs. This might lead to a greater consolidation of farms and a decrease in the number of community members either directly or indirectly active in the farming industry. Without a navigable waterway and access to the ports of Whitman and Garfield counties, Pomeroy would be on the major transportation route for the movement of grain and other commodities from Idaho and Asotin County. Truck traffic patterns may increase total vehicle traffic on US 12 through Pomeroy by more than 2 percent. This might be economically beneficial to roadside services, but would be adverse for congestion and safety through downtown and on US 12 westbound. Finally, Pomeroy could lose a river crossing at the Lower Granite facility. The crossing currently provides an alternative transportation corridor between Pomeroy and Colfax in Whitman County.

Long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River. Additionally, the increase of salmon would benefit the identity of the community as a place where salmon would continue to exist and local fishermen would continue to pursue this element of Pomeroy's quality of life. Alternatives 2 and 3 would have higher risks associated with salmon recovery and might adversely affect this element of Pomeroy's quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could adversely affect Pomeroy's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. Changes in the economic direction and base of the community under Alternative 4 might challenge the leadership and vision of the community to provide cost-effective means of transporting the large volumes of grains to market since Pomeroy does not currently have rail access in the county. Additionally, leadership may be challenged to further enhance economic diversification efforts and to develop a recreational sector with a new type of tourism in mind.

Perhaps the most significant impact on the vision and vitality of the community may be the expected drop in property tax revenue both from agricultural and non-agricultural lands. The community could face raising tax rates or cutting social services. Neither of these choices is harmonious with the community's future plans and could limit investments in the economic diversification efforts. One ameliorating factor could be that property tax revenue would not change immediately but, rather, would be phased in over a 5-year period of decreased farm income.

People

Changes in the physical and economic human environment could affect distinct populations in the community. The poverty rate in Pomeroy is relatively low, but Pomeroy has the highest median age and largest percentage of people over 65 in the study region. This retirement population could be adversely affected by loss of slack-water recreational opportunities on the lower Snake River.

Another significant impact for Pomeroy could be the short-term influx of outside workers during implementation. Pomeroy and Garfield County housed large numbers of outside workers during the construction of the last two lower Snake River facilities. The community and the county experienced the social stresses and economic boom associated with that activity. The level of workforce anticipated for the implementation of Alternative 4 is not expected to be as large or to extend over as long a period as the prior construction. These workers might, however, have different values and habits than the local residents and might cause short-term stress to the community.

Overall, the expected decrease in net employment under Alternative 4 indicates that community population could decrease slightly. In addition, the expected increased rate of land consolidation in the farm sector might contribute to further reduction in rural farm population and hinder attempts to keep young community members in the town.

Historical Change Events and Potential Responses

Pomeroy's economy exhibits moderate economic diversity and has experienced major economic peaks and valleys over the past 25 years including the boom and bust of the Lower Granite Dam construction and the large cyclical swings in the commodity prices and production yields. Community members have existed with the uncertainty associated with an agriculturally centered economy and lifestyle.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, it appears that the changes in the human environment might not exceed historical experience in Pomeroy.

7.4.1.4 Kennewick, Washington

The socioeconomic impacts of the three alternatives on the community of Kennewick could include the indirect effects of irrigation, navigation/transportation, recreation activity, power costs, power production implementation, and anadromous fish recovery. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 affect the probability of anadromous fish recovery while having minimal effect on the physical or economic human environment. Alternative 4 could have minor direct effects on Kennewick but might have significant indirect effects since Kennewick is the retail and service center for the Tri-Cities and the surrounding region. The loss of Ice Harbor irrigated agriculture probably could produce the most significant impacts. Beneficial effects might come from siting new power plants, increased operations and maintenance employment, and related spending, as well as anadromous fish recovery. Increased transportation activity in the Tri-Cities, primarily Pasco, probably would also produce economic benefits for Kennewick.

Kennewick probably would realize short-term increases in implementation and power plant construction employment. Overall, the community could experience both increases and decreases in employment, with a projected net loss in employment. Perhaps the most significant effect on the community could be the loss of agricultural production due to the drawdown of the Ice Harbor pool and the uncertainty regarding the effect of those losses on the community economic structure. Aside from the specific physical and economic changes in Kennewick, a significant impact might be the fear that the successful breaching of the lower Snake River projects could jeopardize the future viability of the Columbia River waterway and the values it holds for Kennewick residents.

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could provide a higher degree of certainty about the economic future. Alternative 4 could adversely affect future economic certainty and could increase future economic risks because not all of the indirect and induced effects of these changes are known.

Negative indirect impacts on Kennewick's employment from Alternative 4 could primarily result from the loss of irrigated agriculture and increased residential electrical rates. The water supply analysis indicated that modifying the Ice Harbor pumps would cost more that the total land value or the value of the crops produced. The effect could be that Ice Harbor irrigated farm owners may not be able to make the necessary modifications and operations would cease. The effects of this economic loss to the region could indirectly impact the large service and retail sectors and, to a lesser degree, the agricultural service sectors in Kennewick. Losses are estimated at approximately 2 percent of total employment. The effects of increased residential electrical rates are estimated at below 1 percent. Total direct, indirect, and induced employment losses are estimated to be less than 2.5 percent of Kennewick's total employment.

Positive impacts on community employment from Alternative 4 could result from the operations and maintenance of new power plants in the region; increased trucking, rail, and barge transportation;

post-implementation increases in river recreation-related activities; and road maintenance. Short-term increases in employment could result from power plant construction, transportation infrastructure upgrades, and implementation activities. The long-term gains could probably be less than a 1 percent increase in Kennewick's total employment.

The positive and negative effects of these employment changes may be felt primarily in the service and retail and wholesale trade sectors. It does not appear that any one business or service would be disproportionately affected. Overall, the most significant effect of Alternative 4 could be the heightened uncertainty about the fate of the Columbia River.

Place

Kennewick's natural and built environment may not change significantly under Alternative 4. Adverse impacts from the breaching of the four lower Snake River facilities could eliminate nearby developed recreational access sites such as the North Shore Ramp, Ayer Boat Basin, and Lyons Ferry Marina. Kennewick may also lose some developed recreational site services at Charboneau Park, Levy Landing, Fishook Park, and Windust Park. Although this represents a small fraction of the recreational slack water recreational sites in the region, a more significant impact might be the short-term crowding at Columbia River sites from lower Snake River displaced recreationists. The identity of the community as a riverside retail and service urban center may not be affected adversely by this alternative.

Another indirect effect on Kennewick's place could be the increased traffic into the Tri-Cities. Traffic increases probably would not occur in the city of Kennewick, but could occur across the Columbia River in Pasco. Overall traffic volumes on highways from eastern Washington feeding into the Tri-Cities probably could increase between 2 and 6 percent. Some of this traffic might alter movement patterns by Kennewick commuters and might provide additional employment and income to Kennewick.

Long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River and the shoreline. Additionally, the increase of salmon would benefit the identity of the community as a place where salmon would continue to exist, and local fishermen would continue to pursue this element of the Kennewick's quality of life. Alternatives 2 and 3 could have higher risks associated with salmon recovery and might adversely affect the community's future quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could all adversely affect Kennewick's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. The Chamber of Commerce has issued a position paper on the breaching of the lower Snake River facilities and has joined in rallies to save the dams. One significant impact on the vision and vitality of Kennewick of each of the alternatives, but primarily from Alternative 4, could be the fear that successfully breaching the dams or the continued listing of the salmon and steelhead as endangered would lead to the eventual breaching of the Columbia River facilities. The proposed alternatives of this study are seen as a first step to the removal of dams that provide the navigable waterway and recreational benefits to the community. Kennewick has been actively developing its waterfront, green areas, and Clover Island, and the fear of future loss of its waterfront represents a significant effect of each of the study's alternatives.

People

Changes in the physical and economic human environment could affect distinct populations in the community. Benton County has been designated as an economically distressed area and has a high level of poverty. More than 10 percent of the families are classified as below the poverty line. Families on low or fixed incomes may have to spend a larger portion of their income on electrical bills. The forecast decrease in net long-term employment under Alternative 4 signifies that population trends might not continue to increase at current or historical rates, although the community's thriving economy probably could continue to grow and attract new community members.

Historical Change Events and Potential Responses

Kennewick's economy exhibits high economic diversity and has experienced major economic peaks and valleys over the past 25 years. These trends are associated primarily with activities at the Hanford Reservation. Community members have existed with the uncertainty associated with the level of government activity on the reservation and have built a strong, retail-based community around that uncertainty. In the 1980s, suspension of work on the WPPSS facilities resulted in a loss of 15,000 jobs in the Tri-Cities area. During the 1990s, the Tri-Cities have lost an estimated 6,700 jobs since peaking in 1994. Approximately 1,000 jobs per year have been associated with Hanford workplace reductions. During this recent downturn, the community has not lost population, and school enrollment has continued to grow.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, it appears that the changes in the human environment would not exceed historical experiences in Kennewick.

7.4.1.5 Pasco, Washington

The socioeconomic impacts of the three alternatives on the community of Pasco could include the effects of irrigation, navigation/transportation, recreation activity, power costs, implementation, and anadromous fish recovery. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 affect the probability of anadromous fish recovery, while having a minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in and around Pasco. It could create both winners and losers through the shift in transportation modes and nodes, changes in recreational opportunities and access, lost irrigation acreage and employment, construction and operation of new power plants, loss of power produced at the four projects, and an increased chance of anadromous fish recovery.

Additionally, the community could experience a dramatic short-term change in the character of the community as grain from eastern Washington, Idaho, Montana, and North Dakota shipped on the lower Snake River is rerouted into the Pasco port and through the Pasco rail yards. It is expected that Pasco could realize short-term increases in implementation and power plant construction employment. Overall, the community could experience both increases and decreases in employment, with a projected net loss in employment. Perhaps the most significant effect on the community could be the loss of agricultural production on the Ice Harbor Reservoir and the uncertainty of those losses on the community economic structure. Aside from the specific physical and economic changes in Pasco, a significant impact might be the fear that a successful breaching of

the lower Snake River facilities could jeopardize the future viability of the Columbia River waterway.

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could provide a higher degree of certainty about the economic future. Alternative 4 could adversely affect future economic certainty and increase future economic risks because all of the indirect and induced effects of these changes are not known. For example, it is unclear how the loss of irrigated agricultural production from Ice Harbor Reservoir may affect the growing food processing facilities in Pasco or how displaced agricultural workers would adapt to lost employment.

Negative impacts on Pasco employment from Alternative 4 could result from the loss of irrigated agriculture, higher residential electrical rates, reduction in countywide farm income, and a loss of Corps- related jobs. The water supply analysis indicated that modifying the Ice Harbor pumps could cost more than the total land value or the value of the crops produced. Ice Harbor irrigated farm owners may not be able to make the necessary modifications and operations could cease. Approximately 20 percent of the land is located in Franklin County, and much of the agricultural service sector that supplies these farms could be affected. The direct, indirect, and induced employment losses in Pasco in just the agriculture/agricultural services sector are estimated to be approximately 9 percent of the agricultural sector, although the total loss of employment from this change is estimated to be less than 2.5 percent of Pasco's total employment. None of the other negative employment effects decreases employment by more than 1 percent. Total direct, indirect, and induced employment losses are estimated to be less than 2.5 percent of Pasco's total employment.

Positive impacts on community employment from Alternative 4 could result from increased trucking, rail, and barge transportation, post-implementation increases in river-recreation-related activities; road maintenance, short-term increases in employment from power plant construction, transportation infrastructure upgrades, implementation activities; and modifications to lower Snake River wells. With Pasco becoming the closest port to eastern Washington and Idaho grain production, significant quantities of grain are forecast to move through the port rail and barge facilities. In effect, Pasco could receive a high percentage of the jobs lost by Lewiston, Clarkston, and the other lower Snake River water port operations. These gains are estimated to be less than a 1 percent increase in Pasco's total employment.

The effects of these employment changes on the largest employers in the community demonstrate the degree to which there will be winners, losers, and uncertain futures associated with Alternative 4. Local manufacturing operations depend to an unknown degree upon fiber plantations along the Ice Harbor Reservoir. The loss of these plantations could place financial pressure on their operations, and a long-term investment could be stranded. Railroads, on the other hand, could stand to gain or capture traffic volume as farmers and other shippers searched for cost-effective means to ship their products to Portland. Finally, food processing plants could have a diminished source of primary product for food processing activities. The degree to which a decreased supply of agricultural products could affect employment is unknown.

Place

Pasco's natural and built environment may not change significantly under Alternative 4. Adverse impacts from the breaching of the four lower Snake River facilities could eliminate developed recreational access sites such as the North Shore Ramp, Ayer Boat Basin, and Lyons Ferry Marina. Pasco could also lose some developed recreational site services at Charboneau Park, Levy Landing, Fishook Park, and Windust Park. Although this represents a small fraction of the slack water recreational sites in the region, a more significant impact might be the short-term crowding from lower Snake River displaced recreationists. The identity of the community as a riverside transportation and agricultural urban center may not be adversely affected by this alternative.

The most significant change could be the increased truck traffic into the ports. Increased truck traffic could converge from Interstate 395, US 12, and SR 124 into the port facilities. Truck traffic into the city from the north probably would rise between 6 and 21 percent above current truck traffic volumes. Overall vehicle traffic is expected to increase between 2 and 6 percent. Although this traffic represents an economic benefit to the community, it might congest the feeder streets to the port facilities and increase the safety risk within and outside of the city. This added traffic could also have a negative impact on the condition of city streets.

Long-term benefits of Alternative 4 could include revegetation and restoration of the normative Snake River and the shoreline. Additionally, the increase salmon would benefit the identity of the community as a place where salmon would continue to exist and local fishermen would continue to pursue this element of Pasco's quality of life. Alternatives 2 and 3 could have higher risks associated with salmon recovery and might adversely affect the community's future quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could all affect Pasco's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. The Chamber of Commerce has issued a position paper on the breaching of the lower Snake River facilities and has joined in rallies to save the dams. One significant impact on the vision and vitality of Pasco for each of the alternatives, but primarily for Alternative 4, could be the fear that successfully breaching the dams or the continued listing of the salmon and steelhead as endangered could lead to the eventual breaching of the Columbia River facilities. The proposed alternatives of this study are seen as a first step to the removal of the Columbia River dams that provide the navigable waterway and recreational benefits to the community. Alternative 4 might seriously challenge the leadership and vision of the community as community members work to address the large numbers of displaced full-time and seasonal workers from the irrigated lands on Ice Harbor. The community has worked to successfully develop the facilities at the Port of Pasco and to diversify the local economy by developing value-added food processing centers to the economic structure of Pasco. These plans and achievements might be affected adversely under this alternative.

Finally, the negative short- and long-term effects of lost agricultural production on both local and county property values and property tax revenue might create difficulties in obtaining enough funding to pursue new avenues of economic development and to maintain the current and anticipated increased levels of community services.

People

Changes in the physical and economic human environment could affect distinct populations in the community. Franklin County has been designated as an economically distressed area and has a high level of poverty. More than 10 percent of families are classified as below the poverty line, and these numbers might increase with the loss of employment on the Ice Harbor irrigated lands. These families on low or fixed incomes could have to spend a larger portion of their income on electrical bills. In addition, farm workers displaced from the Ice Harbor lands are primarily Hispanic, and Pasco's population is more than 40 percent Hispanic. The concerns related to the disproportional negative impacts of this alternative are addressed in the EIS's environmental justice discussion.

The forecast decrease in net long-term employment under Alternative 4 signifies that population trends might not continue to increase at current or historical rates.

Historical Change Events and Potential Responses

Pasco's economy exhibits high economic diversity and has experienced major economic peaks and valleys over the past 25 years. These changes are associated primarily with activities at the Hanford Reservation and the fortunes of agriculture. Community members have existed with the uncertainty associated with the level of government activity on the reservation and have built upon a strong transportation and agricultural base. Pasco has not been as directly affected by the benefits of the Hanford Reservation; nonetheless, some of the 15,000 jobs lost in the 1980s did occur in Pasco. More recently, the Tri-Cities have lost an estimated 6,700 jobs since peaking in 1994. Approximately 1,000 jobs per year have been associated with Hanford workplace reductions. During this recent downturn, the community has not experienced population declines, and school enrollment has continued to grow.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, changes in the human environment probably would not exceed historical experiences in Pasco. The direct effects on the agricultural sector might, however, be more significant than previous experiences in the absence of mitigation.

7.4.1.6 Umatilla, Oregon

The socioeconomic impacts of the three alternatives on the community of Umatilla could include the effects of irrigation, navigation/transportation, recreation activity, power costs, power production, implementation, and anadromous fish recovery. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 may affect the probability of anadromous fish recovery while having minimal effects on the physical or economic human environment. Alternative 4 could affect Umatilla through the siting of power plants to replace the lost hydroelectric power generated by the four lower Snake River facilities. The loss of Ice Harbor irrigated agriculture might adversely affect Umatilla food processors who obtain a small portion of their product from the Ice Harbor farms. Beneficial economic impacts might result from siting new power plants in the region and the associated increased operations and maintenance employment and related spending. Although not predicted in the Corps transportation model, the Port of Umatilla might experience increased activity due to the presence of grain-loading facilities and the projected shortages of these facilities in the Tri-Cities area. Overall, the community could experience both

increases and decreases in employment, with a small projected net loss in employment. This net loss might change to a significant net increase if the replacement power plants were sited in Umatilla or nearby. Aside from the expected physical and economic changes in Umatilla, a significant impact might be the fear that the successful breaching of the lower Snake River facilities could jeopardize the future viability of the Columbia River Waterway and in particular the John Day dam.

Jobs and Wealth

Overall, Alternatives 2 and 3 may have a higher degree of certainty about the economic future and may not adversely affect jobs and wealth directly. Alternative 4 could adversely affect future economic certainty and would increase future economic risks because not all of the indirect and induced effects of these changes are known.

Negative indirect impacts on Umatilla's employment from Alternative 4 could result from the loss of Ice Harbor irrigated agriculture and increased residential electrical rates. The water supply analysis indicated that modifying the Ice Harbor pumps could cost more that the total land value or the value of the crops produced. The effect could be that Ice Harbor irrigated farm owners would be unable to make the necessary modifications and operations would cease. The effects of this economic loss to the region could indirectly impact the agricultural and food-processing sectors in Umatilla. The magnitude of these effects on the food-processing sector are unknown. Sediment from the lower Snake River probably would not adversely affect irrigators out of the John Day pool. Overall employment losses are estimated to be approximately 1 percent of total employment. The effects of increased residential electrical rates are estimated at below 1 percent.

Positive impacts on community employment from Alternative 4 could result from the operation and maintenance of new power plants in the region. Short-term increases in employment could result from power plant construction, transportation infrastructure upgrades, recreation activities, and implementation. The long-term gains probably may be less than a 1 percent increase in Umatilla's total employment, but might be significantly higher if the new power plants were to be sited in the Hermiston/Umatilla/Bordman area. Total net employment changes are estimated to be less than a 1 percent decrease.

Overall, the most significant economic effect of Alternative 4 could be the heightened uncertainty about the fate of the Columbia River and the local irrigated agriculture that depends on river water.

Place

Umatilla's natural and built environment may not change significantly under Alternative 4 unless the new power plants were sited close to the community. It is beyond the scope of this report to analyze the effects of a proposed power plant, but adequate environmental and socioeconomic assessments would be required. Adverse impacts on recreation sites within 50 miles of Umatilla could include the elimination of the North Shore Ramp. Umatilla could also lose some developed recreational site services at Charboneau Park, Levy Landing, and Fishook Park. Although this represents a small fraction of the slack water recreational sites in the region, a more significant impact might be the short-term crowding at Columbia River sites from lower Snake River displaced recreationists. The identity of the community as the Walleye capital of the world would not be adversely affected by this alternative.

Long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River and the shoreline. Additionally, the increase salmon would benefit the identity of the community as a place where salmon would continue to exist, and local fishermen would continue to pursue this element of Umatilla's quality of life. Alternatives 2 and 3 could have higher risks associated with salmon recovery and might adversely affect future community quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could all adversely affect Umatilla's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. One significant impact on the vision and vitality of Umatilla of each of the alternatives, but primarily Alternative 4, could be the fear that successfully breaching the dams or the continued listing of the salmon and steelhead as endangered could lead to the eventual breaching of the Columbia River facilities. The proposed alternatives of this study are seen by community members as a first step to the removal of dams that provide the navigable waterway and recreational benefits to the community.

If the replacement power plants were sited near Umatilla or within Umatilla County, the community might achieve increased tax revenues to support essential county and community services.

People

Changes in the physical and economic human environment could affect distinct populations in Umatilla. A relatively high level of poverty exists for families in Umatilla, and these families could be expected to expend a larger of their income on increased electrical bills. The small forecast decrease in net long-term employment under Alternative 4 signifies that population trends might not continue to increase at current or historical rates. It is likely that in both the short- and the long-term, population could increase if the replacement power plants were sited close to the community.

Historical Change Events and Potential Responses

Umatilla's economy exhibits moderately high economic diversity and has experienced the cyclical flows associated with agriculture and food manufacturing. Irrigated agriculture expanded rapidly in the 1970s and 1980s. Recent years have seen a minor downturn in the food processing/ manufacturing industries.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, it appears that the minor changes in the human environment could not exceed historical experiences in Umatilla.

7.4.1.7 Lewiston, Idaho

The socioeconomic impacts of the three alternatives on the community of Lewiston could include the effects of changed recreation activities, navigation and transportation, M&I water supply, implementation, anadromous fish recovery, and power costs. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 could affect the probability of anadromous fish recovery, while having a minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on the specific populations of

Lewiston. It could create both winners and losers through the loss of a navigable waterway, loss of power produced at the four projects, a shift in transportation modes, a change in recreational opportunities and access, and an increased chance of anadromous fish recovery. In addition, the community could experience a dramatic short-term change in the character of the community as the reservoir was drained and a new shoreline was formed around the city with the existing levees left high above the new water line. It is expected that Lewiston could realize short-term increases in implementation and M&I water supply modification-related employment, as well as a temporary influx of outside workers. Overall, the community could experience both increases and decreases in employment, with a projected net gain in employment. Perhaps the most significant effect on the community could be the stranded social energy and costs of developing activities and plans centered around the continued existence of the four lower Snake River facilities, a navigable waterway, and an inland port.

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could have a higher degree of certainty about the economic future. Alternative 4 could adversely affect future economic certainty and increase future economic risks because not all of the indirect and induced effects of these changes are known. For example, it is unclear how the increased capital costs of pump and well modifications could affect local pulp and paper operations, the golf course, or local rock processors.

Negative impacts on Lewiston employment from Alternative 4 could result from a reduction in county-wide farm income, loss of Corps-related jobs, loss of water-related port operations, loss of tour boat-related employment, short-term decreased recreational opportunities, and an increase in residential electrical rates. Farmers and other shippers currently using the waterway to ship bulk products could experience increased costs to ship their goods. This might have a negative effect on employment in those and related economic sectors. None of the changes in the resource areas studied is projected to decrease employment in Lewiston by more than 1 percent.

Positive impacts on community employment from Alternative 4 could result from trucking transportation, post-implementation increases in river recreation-related activities, increased anadromous fishing opportunities, road maintenance, short-term increases in employment from implementation activities, and modifications to water pumps.

The potential effects of these changes on the largest employer, a local pulp and paper plant, demonstrate the degree of economic uncertainty associated with Alternative 4. It could be negatively affected by higher shipping costs for some of its products and by requirements to modify effluent and water intake systems. It is unknown how it would respond to these increased operational and capital costs, but these costs probably could be passed on to consumers.

Place

Lewiston’s natural and built environment could change dramatically under Alternative 4, much like it did 25 years ago when the levees were built, the Lower Granite pool filled, and slackwater reached Lewiston. Adverse impacts from the loss of the Lower Granite pool could include the short-term exposure of shoreline and mudflats and the isolation of the levee parks from the water. The community could lose recreational access sites at Chief Lookinglass Park and Nisqually John

Landing, as well as some recreational site services at Chief Timothy State Park, Hells Canyon Resort, Swallows Park, Clearwater Ramp, Southway Park, and Hells Gate State Park. In addition, the community could experience short-term losses in recreational steelhead and salmon fishing and other river-related recreation. The identity of the community as a working water port and the only inland water port in Idaho could also be adversely affected, although it could still retain its identity as a Snake River community surrounded by extensive natural features.

Another adverse affect of Alternative 4 could be the financial pressures exerted on local farmers from higher transportation costs. This might lead to a greater consolidation of farms and a change in the agricultural-urban identity of Lewiston.

Long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River and the community shoreline. Additionally, the increase of salmon would benefit the identity of the community as a place where salmon would continue to exist and local fishermen would continue to pursue this element of Lewiston's quality of life. Alternatives 2 and 3 could have higher risks associated with salmon recovery and might adversely affect future community quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 all could adversely affect Lewiston's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. The city council has debated the issue and been split in its position. Adverse effects of a change in the economic direction and identity of the community under Alternative 4 might seriously challenge the leadership and vision of the community. The community has worked successfully to develop the facilities at the Port of Lewiston and to diversify the local economy by enhancing recreational opportunities associated with the lower Snake River pools, Hells Canyon, and surrounding natural areas. They have also successfully developed green areas along the waterway, providing local recreational opportunities. The port serves as a vehicle for manufacturing and industrial growth through its industrial properties and loading facilities. Many of these plans and achievements could be significantly affected under this alternative. The Port of Lewiston is in a good position to continue to act as a development mechanism, using both rail and highway access, but this is not the current direction of the port's activities. Additionally, the negative short- and long-term effects on both local and county property values and property tax revenue might make it difficult to obtain enough funding to pursue new avenues of economic development and maintain the current level of community services.

People

Changes in the physical and economic human environment could affect distinct populations in the community, although not to the degree seen in Clarkston. Families, including those on fixed incomes, could have to pay a larger proportion of their income to power bills. In addition, the influx of short-term outside workers might disrupt traditional community patterns, although the number of forecast workers is relatively small compared to the workforce required to construct the lower Snake River facilities.

The forecast increase in long-term employment under Alternative 4 signifies that population trends should continue to increase. Given the uncertainties associated with the business climate, however,

overall population might remain stable or decrease slightly given short-term job losses and uncertain responses from businesses.

Historical Change Events and Potential Responses

Lewiston has a relatively high economic diversity and has undergone significant economic peaks and valleys over the past 25 years. During the construction of Lower Granite Dam and the Lewiston/Clarkston dikes, the valley unemployment was at an historical low. Lewiston lost over 1,000 jobs between 1981 and 1982. More recently, Nez Perce County lost approximately 300 manufacturing jobs between 1990 and 1991 and from 1994 to 1995.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community it appears that the changes in the human environment would be within historical bounds.

7.4.1.8 Orofino, Idaho

The socioeconomic impacts of the three alternatives on the community of Orofino could include the effects of power costs, recreation activity, navigation and transportation, M&I water supply, implementation, and anadromous fish recovery. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 could affect the probability of anadromous fish recovery, while having a minimal effect on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in Orofino. It could create both winners and losers through an increased chance of anadromous fish recovery, a change in recreational opportunities and access, loss of a navigable waterway, loss of power produced at the four projects, and a shift in transportation modes. It is expected that Orofino could realize short-term increases in implementation, infrastructure improvements, and M&I water supply modification-related employment. Overall, the community could experience both increases and decreases in employment, with a projected net gain in employment. Perhaps the most significant effect on the community could be from the increased chance of wild salmon and steelhead runs on the Clearwater River and the enhanced status of Orofino as “Steelhead Capital of the World.”

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could provide a lower degree of certainty about the economic future. It is not anticipated that these alternatives would significantly improve fish returns; therefore, the planned development of the tourism sector of the economy might not grow as anticipated. Alternative 4 could adversely affect future economic certainty in the forestry and agricultural sectors and could increase future economic risks because not all of the indirect and induced effects of these changes are known. For example, it is unclear how the increased transportation costs would affect the timber industry’s ability to sell wood chips or whether this increased cost would decrease the already unstable timber industry in Orofino. Alternative 4 could beneficially affect the future economic certainty of the tourism sector.

Negative impacts on community employment from Alternative 4 could result from increased transportation costs, reduction in countywide farm income, residential electrical rates, loss of Corps-related jobs, and short-term decreased recreational opportunities. Farmers and other shippers currently using the waterway to ship bulk products could experience increased costs to ship their

goods. This could have a negative effect on employment in those economic sectors. A small volume of grain currently moves from Clearwater County on the lower Snake River while a larger volume of wood products move to Lewiston for eventual shipment down the waterway. These decreases are not expected to be larger than 1 percent, although the magnitude of the effect on forest product manufacturers is unknown.

Positive impacts on community employment from Alternative 4 could result from increased truck transportation, increased anadromous fishing opportunities, and the short-term increases in employment from implementation activities and modifications to water pumps. The projected increases in wild fish returns after 20 years probably would increase employment by approximately 2 percent. Given the established sport fishing industry and strong retail trade sector in Orofino, the magnitude of this increase might be much greater given the potential future fish harvests.

Lumber companies are two of the largest employers in Orofino. The effects of increased transportation costs are unknown, but the increased financial obligations might adversely affect these employers.

Place

Orofino's natural and built environment may not be significantly changed under Alternatives 2, 3, and 4. Flow augmentation water currently withdrawn from the Dworshak Reservoir would continue under each of the proposed alternatives and would have negative effects on the local reservoir recreational opportunities and reservoir tourism. The loss of the Lower Granite pool could adversely affect the community's access to recreation sites on the lower Snake River within 50 miles of Orofino. The community could lose recreational access sites, including Chief Lookinglass Park and Nisqually John Landing, as well as some recreational site services at Chief Timothy State Park, Hells Canyon Resort, Southway Park, and Hells Gate State Park. The short-term displacement of Snake River recreationists might create crowding on the Dworshak Reservoir and at sites on the Clearwater River. This might also provide a short-term economic benefit to the community. Finally, the financial pressures exerted on local farmers from higher transportation costs might lead to a greater consolidation of farms and a change in the rural land-use patterns around Orofino.

One long-term benefit of Alternative 4 could be the decrease in truck traffic along US 12 as grains from Montana and North Dakota moved to new transportation corridors. This could have a positive effect of lessening traffic congestion and improving highway safety, but it might also decrease the existing economic benefits of truck traffic.

Other long-term benefits of Alternative 4 could include the revegetation and restoration of the normative Snake River. Additionally, the increase of salmon would benefit the identity of the community as a place where wild salmon would continue to exist and local fishermen would continue to pursue this element of Orofino's quality of life. Alternatives 2 and 3 have higher risks associated with salmon recovery and might adversely community quality of life. The identity of the community as the Steelhead Capital of the World would be enhanced by Alternative 4 and adversely affected by alternatives 2 and 3.

Vision and Vitality

Alternatives 2, 3 and 4 all adversely affect Orofino's vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. In addition, all of the alternatives could continue with flow augmentation over the protests of Orofino residents. The community has worked to develop recreation and tourism alternatives in steelhead fishing and reservoir recreation to diversify its predominately timber-dependent economy. Those plans specific to the Dworshak Reservoir could continue to be affected adversely by continued flow augmentation. Alternatives 2 and 3 could adversely affect development for the steelhead fishery and sportfishing industries. Alternative 4 could provide support these development efforts. Additionally, the negative effects of decreased farm income on both local and county property values and property tax revenue might create difficulties in obtaining sufficient funding to pursue new avenues of economic development and maintain the current level of community services.

People

Changes in the physical and economic human environment could affect distinct populations in the community. The high number of fixed-income families could have to pay a larger proportion of their income for power bills.

The forecast increase in long-term employment under Alternative 4 suggests that recent population trends should continue to increase but, given the 10- to 20-year horizon for increased salmon populations, population might increase slightly.

Historical Change Events and Potential Responses

Orofino has a relatively high economic diversity and has undergone significant economic shifts over the past 25 years. During the construction of Dworshak Dam, employment boomed. Throughout the 1980s and 1990s, the historically important timber industry experienced continuing employment decreases. Between 1980 and 1990, the population of Orofino shrunk by almost one-quarter or 1,000 people, primarily due to downturns in the timber industry.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community it appears that the minor changes in the human environment could be within historical bounds.

7.4.1.9 Riggins, Idaho

The socioeconomic impacts of the three alternatives on the community of Riggins could include the effects of changed recreation activity, navigation and transportation, anadromous fish recovery, and power costs. Table 7-4 presents a matrix of the various impacts and the effects of the proposed alternatives. Alternatives 2 and 3 could affect the probability of anadromous fish recovery, while having negative indirect effects on the physical or economic human environment. Alternative 4 could have significant effects on specific populations in Riggins and could create both winners and losers through an increased chance of anadromous fish recovery, a change in recreational opportunities and access, the loss of a navigable waterway, the loss of power produced at the four projects, and a shift in transportation modes. Overall, the community could experience both

increases and decreases in employment, with a projected net gain in employment. Perhaps the most significant effect on the community could be the increased chance of wild salmon and steelhead runs on the Salmon River and the potential economic benefits of increased sportfishing.

Jobs and Wealth

Overall, Alternatives 2 and 3 may not adversely affect jobs and wealth directly and could provide a higher degree of certainty about the economic future. It is not anticipated that these alternatives would significantly improve fish returns; therefore, the planned development of the tourism sector of the economy might not grow as anticipated. While Alternative 4 could adversely affect future economic certainty and the health of the agricultural sector, it probably would beneficially affect the future economic certainty of the tourism sector.

Negative impacts on community employment from Alternative 4 could result from increased transportation costs, reduction in countywide farm income, and increased residential electrical rates. Farmers in the county currently using the waterway to move grains would experience increased transportation costs. This might have a negative effect on employment. A large volume of grain currently moves from Idaho County on the lower Snake River, and the county's farmers are expected to see the highest increase in shipping costs in the region. The reduction in total county farm income probably could be greater than 10 percent. These are significant impacts for the grain-producing regions of Idaho County on the Camas Prairie, but are not expected to significantly affect the economy of Riggins. Decreases in employment are expected to be less than 1 percent.

Positive impacts on community employment from Alternative 4 could result from increased anadromous fishing opportunities. The projected increases in wild fish returns after 20 years probably could increase employment by approximately 1 percent. Given the established sport fishing industry and the strong retail trade and service sectors in Riggins, the magnitude of this increase might be much greater given the potential future fish harvests.

Place

Riggins' natural and built environment may not be significantly changed under Alternatives 2, 3, and 4. The short-term displacement of lower Snake River recreationists might create crowding at sites on the Salmon River. This might provide a short-term economic benefit to the community. The financial pressures exerted on local farmers from higher transportation costs might lead to a greater consolidation of farms and a change in the rural land-use patterns around Riggins.

One long-term benefit of Alternative 4 could be the decrease in truck traffic along US 95 as grains from Southern Idaho moved to new transportation corridors. This could have the positive effect of lessening traffic congestion and improving highway safety, but it might also decrease the existing economic benefits of through traffic.

Another long-term benefit of Alternative 4 could be the increased chance of salmon recovery. This could benefit the identity of the community as a place where wild salmon would continue to exist and local fishermen would continue to pursue this element of Riggins' quality of life. Alternatives 2 and 3 would have higher risks associated with salmon recovery and might adversely community quality of life.

Vision and Vitality

Alternatives 2, 3, and 4 could affect Riggins' vision and vitality by decreasing the social cohesion of the community over the issue of salmon recovery and the best way to achieve that goal. The community has worked to develop recreation and tourism alternatives in steelhead fishing and whitewater rafting after the community sawmill burned down. Alternatives 2 and 3 could adversely affect the development of tourism related to anadromous fish. Alternative 4 could provide support for these development efforts. Additionally, the negative effects of decreased farm income on both local and county property values and property tax revenue might create difficulties in obtaining sufficient funding to pursue new avenues of economic development and maintain the current level of community services.

People

Changes in the physical and economic human environment could affect distinct populations in the community. The high number of fixed-income families could have to pay a larger proportion of their income to power bills.

The forecast increase in long-term employment under Alternative 4 suggests that recent population trends could continue to increase, but given the 10- to 20-year horizon for increased salmon populations, population might increase slightly in the interim.

Historical Change Events and Potential Responses

Riggins has moderate economic diversity and has undergone significant economic shifts over the past 25 years. The loss of the sawmill, the towns largest employeer in 1982, was the most significant shift. The community relies on the seasonal and cyclical nature of the travel and tourism industry; thus it faces some economic uncertainty.

Given the estimated impacts described above, the historical adaptation to economic and physical changes in the community, and the current economic diversity of the community, it appears that the minor changes in the human environment are within historical bounds.

7.5 Mitigation Analysis

7.5.1 Compensation Potential

The employment impacts identified in the regional analysis could be addressed by providing targeted job retraining and education credits to dislocated workers. The effects on net farm income due to increased transportation costs could be mitigated through a program similar to the Conservation Reserve Program, whereby farmers would receive compensation equal to the transportation cost increases.

Community-level impacts could be addressed by providing block grants to affected communities in the region for economic diversification activities. For example, to mitigate farm communities most affected by the loss of river transportation, economic development programs similar to those mentioned above could be used to create more local value-added products and decrease dependency on the export of unprocessed grains to foreign markets.

Under Alternative 2, the lower probability of and the higher degree of risk associated with anadromous fish recovery, negative economic and social impacts to sport-fishing-dependent communities could develop. These communities might lose an important component of their economic base and might need assistance to transition to another non-fishery-dependent job base.

8. Risk and Uncertainty

8.1 Introduction

This section presents the risk and uncertainty assessment of economic and social analyses developed for the lower Snake River Juvenile Salmon Migration Feasibility Study. This feasibility study may affect decisions about environmental and economic values that people care about and want to protect. As such, it is important to consider the reliability of its findings. That is the purpose of this risk and uncertainty assessment. The overall conclusion of the risk and uncertainty assessment, in its most succinct form, is that unresolved social and economic issues do cause uncertainty about whether it would be more cost-effective to breach the four lower Snake River dams. At this point, the driving uncertainties include:

- The value of future recreational and passive use benefits if the dams are breached
- The future of anadromous fish stocks
- How social and economic costs will be distributed

Other economic uncertainties, although important, are unlikely to affect decisions about whether it would be more cost-effective to breach the four lower Snake River dams.

How best to assess risks and uncertainties in studies of natural resources management options is a difficult question to answer. Ignoring uncertainties can lead to bad decisions, but considering them can slow down the decision-making process. Two of the best references on the topic are *Confronting Uncertainty in Risk Management: A Guide for Decision Makers* (Finkel, 1990) and *Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis* (Morgan *et al.*, 1990). Both advocate uncertainty analysis, but warn against "paralysis by analysis." A classic paper on right and wrong ways for dealing with uncertainty in making risk management decisions is "Witches, Floods and Wonder Drugs: Historical Perspectives on Risk Management" (Clark, 1980). A compilation of classic papers on making risk management decisions under uncertainty can be found in the Resources for the Future book *Readings in Risk* (Glickman and Gough, 1990). Finally, a more recent and somewhat more technical treatment of the topic can be found in *Uncertainty Analysis in Ecological Risk Assessment* (Warren-Hicks and Moore, 1998).

The approach for this particular risk and uncertainty assessment draws from the U.S. Army Corps of Engineers' *Guidelines for Risk and Uncertainty Analysis in Water Resources Planning* (Corps, 1992) (the Guidelines) and was designed to incorporate the Corps' general recommendations. The Guidelines define a risk and uncertainty analysis as being composed of an *assessment* and an *evaluation*. Under the Guidelines' definition, this study is a risk and uncertainty assessment. When describing the end use of the risk and uncertainty assessment in the planning process, the Guidelines identify two basic issues:

- The risk and uncertainty assessment should provide a clear picture of the reliability of the overall assessment.
- The assessment should provide useful taxonomies and identification of important questions relevant to risk management. It should highlight where political and social judgments have to be made.

The remainder of this section addresses the methods and results of dealing with these issues for the lower Snake River Juvenile Salmon Migration Feasibility Study.

8.2 Methods

The primary source of information for the risk and uncertainty assessment was the DREW workgroups. The workgroups provided three general types of information:

- Point and range estimates of NED costs and benefits of alternatives under consideration
- Verbal and/or written responses to a questionnaire designed to help ascertain the reliability of cost and benefit estimates and identify potentially important unanswered questions for risk managers
- Risk and uncertainty discussions prepared as part of their study reports

8.2.1 National Economic Development

The NED risk and uncertainty assessment used a combination of quantitative and qualitative methods described below. NED has the most fully developed risk and uncertainty assessment. Brief, qualitative risk and uncertainty assessments for social and regional analysis and tribal circumstances were conducted as well. The methods for these assessments are discussed following the NED methods section.

8.2.1.1 Quantitative Methods

The quantitative methodology used for the risk and uncertainty assessment is nominal range sensitivity analysis (NRSA). Other methods developed by the DREW risk and uncertainty workgroup included a spreadsheet tool for estimating probability distributions of cost variables and an expert elicitation protocol for estimating probability distributions. NRSA provided a simpler way to identify important uncertainties than these probabilistic methods. This in turn allowed the workgroups to spend more time refining their models and assumptions, rather than trying to assign probabilities to variables that, with the advantage of hindsight, might be shown through NRSA to be unlikely to affect the cost-effectiveness ranking of alternatives.

NRSA involves holding all cost parameters except one at their nominal values (i.e., best estimates), while varying the remaining parameter from its low-end to high-end range estimate. Thus for an additive model (e.g., a model that computes net benefit from component benefits and costs) the NRSA gives a set of 2*n* outputs describing the range of possible model outputs (net benefit) given the uncertainties of the input (component benefit and cost):

$$Y_{i,\,low} = \sum_{\substack{j=1 \\ j \neq i}}^{n} X_{j,\,nom} + X_{i,\,low} \qquad (i = 1, \ldots, n)$$

$$Y_{i,\,high} = \sum_{\substack{j=1 \\ j \neq i}}^{n} X_{j,\,nom} + X_{i,\,high} \qquad (i = 1, \ldots, n) \tag{1}$$

Nominal and range estimates were provided by individual workgroups on an average annual basis. These data, presented in Table 8-1, were used to compute the nominal net benefit associated with Alternatives 2 (Maximum Transport of Juvenile Salmon), 3 (Major System Improvements), and 4

(Dam Breaching) relative to Alternative 1 (Existing Conditions) at 6.875, 4.75, and 0 percent discount rates. This simply involved using the benefit and cost estimates reported in the nominal value column of Table 8-1. For example, the nominal net benefit, at the 6.875 percent discount rate, for Alternative 4 relative to Alternative 1 is computed using the Alternative 4 data from the nominal value column of the 6.875 percent discount rate section from Table 8-1:

= - (196,425+1,593) + (48,787 + 271,000 – 29,178 + 24,034 + 15,424)
= $132,049,000

Similarly, the nominal net benefit at the 0 percent discount rate for Alternative 3 relative to Alternative 1 is computed using the Alternative 3 data from the nominal value column of the 0 percent discount rate section from Table 8-1:

= (1,180 + 188) + (1,390 – 8,000 + 0 + 0 + 0)
= -$7,978,000

The nominal range sensitivity analysis computed net benefits for nominal net benefits, except that the low-end or high-end range estimate for one parameter was substituted for its nominal value, as described by equation 1. Thus, the low-end nominal range estimate (varying the Recreation Benefits parameter at the 6.875 percent discount rate) for Alternative 4 relative to Alternative 1 is computed using the Alternative 4 data from the nominal value column of the 6.875 percent discount rate section from Table 8-1. This calculation is made for all parameters except Recreation Benefits, for which the value in the low-end range estimate column is substituted:

= - (+ 56,000 + 1,593) + (48,787 + 271,000 – 29,178 + 24,034 + 15,424)
= $272,474,000

As a final example, the high-end nominal range estimate (varying the Power Costs parameter at the 4.75 percent discount rate) for Alternative 2 relative to Alternative 1, is computed using the Alternative 2 data from the nominal value column of the 4.75 percent discount rate section from Table 8-1. This calculation is made for all parameters except power costs, for which the value in the high-end range estimate column is substituted:

= - (+ 1,940 + 176) + (– 2,556 – 7,000 + 0 + 0 + 0)
= -$11,672,000

The nominal range sensitivity, computed as the absolute difference between the high- and low-end nominal range estimates, provides an estimate of the overall sensitivity of the nominal net benefit to the uncertainty in a particular parameter. For example, at the 4.75 percent discount rate, the nominal net benefit for Alternative 4 relative to Alternative 1 is – $96,321,000. The low- and high-end nominal range estimates for implementation costs are – $94,546,000 and – $98,096,000 so the nominal range sensitivity for implementation costs at the 4.75 percent discount rate is the absolute value of the difference:

= | (– $98,096,000) – (– $94,546,000) |
= $3,550,000

Table 8-1. Point and Range Estimates for NED Costs and Benefits Relative to Alternative 1 (1998 dollars) ($1,000s)

6.875 PERCENT DISCOUNT RATE				
Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Range Estimate ($)**	**High-End Range Estimate ($)**
Implementation Costs	1	-	-	-
	2	3,457	3,284	3,630
	3	(5,931)	(5,634)	(6,228)
	4	(48,787)	(46,348)	(51,226)
Power Costs	1	-	-	-
	2	8,500	10,000	7,000
	3	8,500	10,000	7,000
	4	(271,000)	(251,000)	(291,000)
Avoided Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	29,178	27,719	30,637
Navigation Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(24,034)	(20,000)	(30,000)
Irrigation & Water System Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(15,424)	(13,919)	(16,928)
Recreation Benefits	1	-	-	-
	2	2,030	2,030	2,030
	3	2,080	2,080	2,080
	4	196,425	56,000	336,850
Anadromous Fish Benefits	1	-	-	-
	2	160	160	160
	3	161	161	161
	4	1,593	1,593	1,593

Table 8-1. Point and Range Estimates for NED Costs and Benefits Relative to Alternative 1 (1998 dollars) ($1,000s), continued

4.75 PERCENT DISCOUNT RATE				
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Range Estimate ($)**	**High-End Range Estimate ($)**
Implementation Costs	1	-	-	-
	2	2,556	2,428	2,684
	3	(4,376)	(4,157)	(4,595)
	4	(35,498)	(33,723)	(37,273)
Power Costs	1	-	-	-
	2	8,500	10,000	7,000
	3	8,500	10,000	7,000
	4	(267,500)	(247,000)	(288,000)
Avoided Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	29,343	27,876	30,810
Navigation Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(25,249)	(21,000)	(32,000)
Irrigation & Water System Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(10,746)	(9,698)	(11,794)
Recreation Benefits	1	-	-	-
	2	1,940	1,940	1,940
	3	1,970	1,970	1,970
	4	211,430	62,120	360,740
Anadromous Fish Benefits	1	-	-	-
	2	176	176	176
	3	174	174	174
	4	2,064	2,064	2,064

Table 8-1. Point and Range Estimates for NED Costs and Benefits Relative to Alternative 1 (1998 dollars) ($1,000s), continued

0 PERCENT DISCOUNT RATE				
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Range Estimate ($)**	**High-End Range Estimate ($)**
Implementation Costs	1	-	-	-
	2	663	630	696
	3	(1,390)	(1,321)	(1,460)
	4	(8,298)	(7,883)	(8,713)
Power Costs	1	-	-	-
	2	8,000	9,000	7,000
	3	8,000	9,000	7,000
	4	(263,500)	(241,000)	(286,000)
Avoided Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	29,050	27,598	30,503
Navigation Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(28,330)	(24,000)	(35,000)
Irrigation & Water System Costs	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	(2,241)	(2,022)	(2,459)
Recreation Benefits	1	-	-	-
	2	1,420	1,420	1,420
	3	1,180	1,180	1,180
	4	256,885	80,550	433,220
Anadromous Fish Benefits	1	-	-	-
	2	198	198	198
	3	188	188	188
	4	3,486	3,486	3,486

Paraphrasing, the estimate of the annual average net benefit of Alternative 4 relative to Alternative 1, at the 4.75 percent discount rate, has a sensitivity range of over $3 million due to uncertainty about implementation costs. While this level of uncertainty may seem high, uncertainty about implementation costs creates no uncertainty about the preferred alternative if one accepts the 4.75 percent discount rate, the nominal cost and benefit estimates, and the implementation costs range estimates for Alternative 4 relative to Alternative 1 provided in Table 8-1. At both the high and low ends of the sensitivity range, the annual net benefit of Alternative 1 exceeds the annual net benefit of Alternative 4 by over $90 million. In other words, uncertainty about implementation costs would not change a decision between Alternatives 1 and 4 based on a net benefit criterion; Alternative 1 would be the preferred alternative regardless of the value used for implementation costs.

The average of the high- and low-end nominal range estimates is a useful summary statistic for evaluating whether, given the parameter uncertainties, the point estimate of net benefits (the nominal value) is more likely to overestimate or underestimate the true value. So, looking again at the previous example, the average change for implementation costs at the 4.75 percent discount rate is:

$$= 0.5*(-\$98{,}096{,}000 - (-\$96{,}321{,}000)) + (-\$94{,}546{,}000 - (-\$96{,}321{,}000))$$
$$= 0.5*(-\$1{,}775{,}000 + \$1{,}775{,}000)$$
$$= -\$0$$

The value of 0 for the average change for implementation costs is an indication that the nominal value for Alternative 4 relative to Alternative 1 at the 4.75 percent discount rate is more likely to underestimate than overestimate the relative net benefit of Alternative 1.

A final statistic computed as part of the nominal range sensitivity analysis is the normalized nominal range sensitivity:

$$\text{normalized nominal range sensitivity for parameter } i = \frac{\text{nominal range sensitivity for parameter } i}{\sum_{j=1}^{n} \text{nominal range sensitivity for parameter } j} \quad (2)$$

The normalized nominal range sensitivity provides an estimate of the relative sensitivity of relative net benefit to each parameter uncertainty. The normalized nominal range sensitivity falls between 0 and 1. Parameters with higher normalized nominal range sensitivities create greater uncertainty about relative net benefit than parameters with lower normalized nominal range sensitivities. Because they are relative values, normalized nominal range sensitivities are only comparable across parameters, not across alternatives or discount rates.

8.2.1.2 Qualitative Methods

Each DREW workgroup was asked to write a risk and uncertainty discussion as part of their study report. These sections tended to focus on describing data, methods, and results. Therefore, after reviewing the workgroups' risk and uncertainty discussions, follow-up questioning was conducted to better understand the choices and assumptions used in their analyses, how these affected results, and how they compared across workgroups. The follow-up questioning was necessary to understand the reliability of the overall assessment and important risk management questions, which, again, are the two basic risk and uncertainty assessment issues identified in the Guidelines (Corps, 1992). Workgroup leaders were asked to review an uncertainty worksheet and questionnaire, after which the risk and uncertainty team leader interviewed them. The worksheet and questionnaire used by the

workgroup leaders to prepare for their interviews with the risk and uncertainty team leader are provided in Figures 8-1 and 8-2.

Information gathered through interviews and other follow-up discussions with workgroup leaders was used to help interpret the results of the NRSA. The results presented below are based on the qualitative and quantitative data obtained by these methods.

This worksheet breaks out seven specific types of uncertainty. Please identify three to five uncertainties of each type that have the biggest potential impact on your workgroup's results and conclusions. The worksheet is intended to make it easier to respond to the questionnaire, so please complete the worksheet before starting the questionnaire. Thank you.

1. *Incomplete information* – missing data; also could include concerns about the representativeness of the available data.
2. *Natural variability* – conditions that change over time, vary among individuals, or change with location.
3. *Model structural uncertainty* – uncertainties about the correct way to describe something in a model, or approximation errors, due to the fact that models are just models, not perfect representations of the real world.
4. *Missing variables* – things not considered simply because we do not know about them, or enough about them, to include them in the analysis.
5. *Lack of understanding* – inability to fully understand available data and models.
6. *Disagreement* – legitimate differences of opinion about priorities or values that in turn affect the system being assessed or the questions we are trying to answer about it.
7. *Ambiguity* – sloppiness or imprecision in defining objectives, variables, assumptions, or decision criteria.

Figure 8-1. Risk and Uncertainty Worksheet

- How reliable, representative and complete were your data?
- What nagging concerns do you have about your data?
- How did you decide on the methods you adopted?
- What alternative methods might you have used?
- What nagging concerns do you have about your methods?
- How did you choose the models you used?
- What other models might you have used instead?
- What nagging concerns do you have about your models?
- What key assumptions did you make in your analysis?
- Why did you make these assumptions?
- What information would have been most useful to help you refine your assumptions?
- If you could change any of your assumptions, what would they be and why?
- If you generated scenarios, how extreme are your high and low scenarios?
- What is the most realistic scenario you can think of that would give results outside the range of scenarios you used? How likely is it?
- What is the most realistic scenario you can think of that would change your ranking of alternatives? How likely is it?
- In your opinion, what are the most important unanswered questions about your work group's piece of the project?
- If you had it to do over again, what would you do differently and why?

Figure 8-2. Risk and Uncertainty Questionnaire

8.2.2 Social and Regional Analysis

The workgroups that provided input to the social and regional analyses reported that uncertainty about future cost allocation decisions impaired their ability to derive useful data for assessing the social and regional impacts of the alternatives. The regional economic impact analysis suffered from significant errors and omissions that prevented the workgroup from engaging in a meaningful risk and uncertainty assessment, beyond simply documenting the major errors and omissions that exist. Similarly, the methodology for assessing social risks and uncertainties was limited to documenting major sources of uncertainty.

8.2.3 Tribal Circumstances

The methods used to develop the Tribal Circumstances and Perspectives report developed by a private contractor in association with the Columbia River Inter Tribal Fisheries Commission (CRITFC) (Meyer Resources, 1999) workgroup differed from those described above. This examined tribal levels of cultural and material wellbeing and distress. The report also evaluated risk and uncertainty separately, whereas the other workgroups combined the two related concepts.

The tribal circumstances uncertainty assessment focused on the reliability of workgroup's ordinal ranking of the alternatives for the four lower Snake River dams. They ranked the alternatives based on the estimated relative magnitude of salmon recovered for the tribes, as well as the direction and general effect of the estimated relative magnitude of salmon recovery on tribal culture, rates of death and health, poverty, employment/unemployment, and income. They also evaluated the reliability of their ordinal ranking of alternatives based on duration of near-current levels of tribal pain and suffering.

The tribal circumstances risk assessment focused on the consequences of possible errors in PATH estimates on tribal levels of cultural and material wellbeing and distress. They evaluated the consequences of over-estimation and under-estimation errors to determine whether tribal levels of cultural and material wellbeing and distress would increase or decrease, and whether they might undergo qualitative changes instead of just changes in degree (specifically, a change from pain and suffering to extinction). The tribal circumstances workgroup also provided narrative assessments of tribal risks (1) from delays in implementing measures affecting salmon recovery, and (2) if tribal interests are ignored or marginalized in the process of implementing measures affecting salmon recovery.

8.3 Results and Conclusions

8.3.1 National Economic Development

Table 8-2 presents NRSA results. In general, both Alternatives 2 and 3 provide positive net benefits relative to Alternative 1. None of the uncertainties reported by the workgroups changed this finding.

Comparing the two fish transport alternatives, Alternative 2 always provides positive net benefit relative to Alternative 3, although the magnitude of the difference between these two alternatives diminishes as the discount rate is decreased.

Looking at the normalized nominal range sensitivity, it can be seen that the greatest contributor to uncertainty about Alternative 2 is power cost uncertainty (90 percent) followed by implementation cost uncertainty (10 percent). The greatest contributor to uncertainty about Alternative 3 is power cost uncertainty (83 percent) followed by implementation cost uncertainty (17 percent).

Looking at the 6.875 percent discount rate in Table 8-2, it can be seen that recreational benefits account for approximately 82 percent of the normalized nominal range sensitivity for Alternative 4 versus Alternative 1, followed by power cost uncertainty (12 percent). Power costs do not affect the ranking of alternatives unless the low end nominal range estimate is used with a 0 percent discount rate. The power costs risk and uncertainty is important because (a) it is large relative to the other cost uncertainties, and (b) as the following paragraph discusses, it is considered by the hydropower workgroup (elsewhere referred to as the DREW Hydropower Impact Team [DREW HIT]). to be a reliable risk and uncertainty estimate. Because the power risk and uncertainty is large relative to other cost uncertainties and is reliable (i.e., the risk and uncertainty estimate is unlikely to change), it serves to dampen any effects of possible changes in other cost range estimates. In other words, other cost uncertainties are less important because they are small relative to the reliable power cost uncertainty estimates. Moreover, the power cost uncertainty does not affect the ranking of alternatives, so the other cost uncertainties are even less likely to do so. Therefore, the real driver in this analysis is the uncertainty about benefits. Following the discussion of the hydropower workgroup's NED analysis, the remainder of this section focuses on benefits uncertainty.

The hydropower workgroup reports that the data they used had a fairly high degree of reliability. Because they were forecasting future conditions, the most up-to-date data may have confirmed or slightly changed the forecasted values. Members of the workgroup had knowledge of recent data, however, and did not suggest any revisions in forecasts. The workgroup used a high-medium-low forecast for each key variable, and is confident that this covered likely future conditions. Of most importance in the workgroup's forecasts was the water supply available for power generation. They used two different hydro-regulation models to define this parameter, with actual historic water conditions over 60 years providing the model input data. The workgroup was not confident that their ancillary benefits estimates were based on the best data, but this element only made up 3 percent of the economic effects associated with dam removal. The hydropower workgroup used the three available power system models, from the Corps, BPA, and the NPPC. After examining many possible approaches, the workgroup agreed that a comparison of results from these three models would capture all the members' concerns about risk and uncertainty in the power systems component of their analysis. Any concerns the workgroup had were somewhat overcome once the members compared the results of the power system models. The workgroup found the results to be surprisingly close, so the results of any one model were confirmed by the others.

The hydropower workgroup identified three major assumptions in its analysis: zero price elasticity of electricity demand, the projected natural gas prices on the West Coast, and the projected demand for power (load forecasts). The zero price elasticity assumption does not account for the probable reduction in demand for electricity that will occur if electricity prices increase with the implementation of the Alternative 4. There is significant evidence that there is price elasticity for electricity at both the wholesale and retail level, but it was considered beyond the scope of the hydropower workgroup to estimate elasticity for each consumer type. The possible significance of this simplifying assumption can be qualified by looking at the examination of demand elasticity for electricity that was done in the Columbia River System Operation Review (SOR) on a cursory basis. The SOR evaluated economic effects of changes in hydropower generation in the Columbia River Basin using approaches similar to what was used in this study. The SOR also looked at the economic effects using a price elasticity approach for the different consumer types. The SOR found that once price elasticity was accounted for, the economic effects for losses in hydropower were about 11 percent lower than with the analysis that ignored price elasticity. Though this finding is not directly applicable to the Snake River breaching analysis, it can be used to give a general feeling for the impact of not including price elasticity.

The price and demand assumptions used are well documented in the hydropower workgroup's report. The workgroup chose to use the forecasts of gas prices and loads developed by the NPPC in recent studies. The NPPC studies were done in a very open public forum and many experts had a chance to review, comment, and revise these forecasts. The workgroup felt that a major change in the natural gas supply would have a significant impact on costs, but while an interruption in natural gas supplies could happen, the work group believes the impacts would likely be short-lived. In the long run, repairs or market shifts would return the gas supply and prices within the workgroup's forecasted range. The workgroup reported that a major economic depression would push load forecasts outside the forecasted ranges.

The most important results of the risk and uncertainty assessment are for comparisons of Alternative 4 (dam breaching) to any of the non-breaching alternatives. Specifically, the analysis shows that the ranking of Alternative 4 is highly sensitive to uncertainty about power and recreation.

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s)

6.875 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Implementation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(13,974)	(14,320)	1	(1)	173	(173)	(346)	-	(10)
	3	(4,810)	(5,107)	(4,513)	(6)	6	(297)	297	(594)	-	(17)
	4	132,049	129,610	134,488	(2)	2	(2,439)	2,439	(4,878)	-	(1)
Power Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(15,647)	(12,647)	(11)	11	(1,500)	1,500	(3,000)	-	(90)
	3	(4,810)	(6,310)	(3,310)	(31)	31	(1,500)	1,500	(3,000)	-	(83)
	4	132,049	112,049	152,049	(15)	15	(20,000)	20,000	(40,000)	-	(12)
Avoided Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(14,147)	(14,147)	0	0	-	-	-	-	0
	3	(4,810)	(4,810)	(4,810)	0	0	-	-	-	-	0
	4	132,049	133,508	130,590	1	(1)	1,459	(1,459)	(2,918)	-	(1)
Navigation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(14,147)	(14,147)	0	0	-	-	-	-	0
	3	(4,810)	(4,810)	(4,810)	0	0	-	-	-	-	0
	4	132,049	128,015	138,015	(3)	5	(4,034)	5,966	(10,000)	966	(3)
Irrigation & Water System Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(14,147)	(14,147)	0	0	-	-	-	-	0
	3	(4,810)	(4,810)	(4,810)	0	0	-	-	-	-	0
	4	132,049	130,544	133,553	(1)	1	(1,505)	1,505	(3,009)	-	(1)

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s), continued

6.875 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Recreation Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(14,147)	(14,147)	0	0	-	-	-	-	0
	3	(4,810)	(4,810)	(4,810)	0	0	-	-	-	-	0
	4	132,049	272,474	(8,377)	106	(106)	140,425	(140,425)	(280,850)	-	(82)
Anadromous Fish Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(14,147)	(14,147)	(14,147)	0	0	-	-	-	-	0
	3	(4,810)	(4,810)	(4,810)	0	0	-	-	-	-	0
	4	132,049	132,049	132,049	0	0	-	-	-	-	0

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s), continued

4.75 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Implementation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,044)	(13,300)	1	(1)	128	(128)	(256)	-	(8)
	3	(6,268)	(6,487)	(6,049)	(3)	3	(219)	219	(438)	-	(13)
	4	96,321	94,546	98,096	(2)	2	(1,775)	1,775	(3,550)	-	(1)
Power Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(14,672)	(11,672)	(11)	11	(1,500)	1,500	(3,000)	-	(92)
	3	(6,268)	(7,768)	(4,768)	(24)	24	(1,500)	1,500	(3,000)	-	(87)
	4	96,321	75,821	116,821	(21)	21	(20,500)	20,500	(41,000)	-	(11)
Avoided Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,172)	(13,172)	0	0	-	-	-	-	0
	3	(6,268)	(6,268)	(6,268)	0	0	-	-	-	-	0
	4	96,321	97,780	94,862	2	(2)	1,459	(1,459)	(2,918)	-	(1)
Navigation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,172)	(13,172)	0	0	-	-	-	-	0
	3	(6,268)	(6,268)	(6,268)	0	0	-	-	-	-	0
	4	96,321	92,072	103,072	(4)	7	(4,249)	6,751	(11,000)	1,251	(3)
Irrigation & Water System Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,172)	(13,172)	0	0	-	-	-	-	0
	3	(6,268)	(6,268)	(6,268)	0	0	-	-	-	-	0
	4	96,321	95,273	97,369	(1)	1	(1,048)	1,048	(2,096)	-	(1)

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s), continued

4.75 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Recreation Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,172)	(13,172)	0	0	-	-	-	-	0
	3	(6,268)	(6,268)	(6,268)	0	0	-	-	-	-	0
	4	96,321	245,631	(52,989)	155	(155)	149,310	(149,310)	(298,620)	-	(83)
Anadromous Fish Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(13,172)	(13,172)	(13,172)	0	0	-	-	-	-	0
	3	(6,268)	(6,268)	(6,268)	0	0	-	-	-	-	0
	4	96,321	96,321	96,321	0	0	-	-	-	-	0

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s), continued

0 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Implementation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,248)	(13,248)	0	(29)	33	(2,967)	(3,000)	(1,467)	(60)
	3	(7,978)	(8,047)	(7,908)	(1)	1	(69)	70	(139)	1	(6)
	4	12,820	12,405	13,235	(3)	3	(415)	415	(830)	-	0
Power Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(11,281)	(9,281)	(10)	10	(1,000)	1,000	(2,000)	-	(40)
	3	(7,978)	(8,978)	(6,978)	(13)	13	(1,000)	1,000	(2,000)	-	(94)
	4	12,820	(9,681)	35,320	(176)	176	(22,500)	22,500	(45,000)	-	(11)
Avoided Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,281)	(10,281)	0	0	-	-	-	-	0
	3	(7,978)	(7,978)	(7,978)	0	0	-	-	-	-	0
	4	12,820	14,279	11,361	11	(11)	1,459	(1,459)	(2,918)	-	(1)
Navigation Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,281)	(10,281)	0	0	-	-	-	-	0
	3	(7,978)	(7,978)	(7,978)	0	0	-	-	-	-	0
	4	12,820	8,490	19,490	(34)	52	(4,330)	6,670	(11,000)	1,170	(3)

Table 8-2. Nominal Range Sensitivity Analysis of Net Benefit Difference from Alternative 1 ($1,000s), continued

0 PERCENT DISCOUNT RATE											
Varied Parameter	**Alternative**	**Nominal Value ($)**	**Low-End Nominal Range Estimate ($)**	**High-End Nominal Range Estimate ($)**	**Change (Low) (%)**	**Change (High) (%)**	**Change (Low) ($)**	**Change (High) ($)**	**Nominal Range Sensitivity ($)**	**Average Change ($)**	**Normalized Nominal Range Sensitivity (%)**
Irrigation & Water System Costs	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,281)	(10,281)	0	0	-	-	-	-	0
	3	(7,978)	(7,978)	(7,978)	0	0	-	-	-	-	0
	4	12,820	12,601	13,038	(2)	2	(219)	219	(437)	-	0
Recreation Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,281)	(10,281)	0	0	-	-	-	-	0
	3	(7,978)	(7,978)	(7,978)	0	0	-	-	-	-	0
	4	12,820	189,155	(163,516)	1376	(1376)	176,335	(176,335)	(352,670)	-	(85)
Anadromous Fish Benefits	1	-	-	-	0	0	-	-	-	-	0
	2	(10,281)	(10,281)	(10,281)	0	0	-	-	-	-	0
	3	(7,978)	(7,978)	(7,978)	0	0	-	-	-	-	0
	4	12,820	12,820	12,820	0	0	-	-	-	-	0

For the Alternative 4 to Alternative 1 comparison, the nominal range sensitivity to uncertainty about recreational benefits ranges from $280,850,000 at a 6.875 percent discount rate to $352,670,000 at a 0 percent discount rate (difference between the average annual net benefit of Alternative 4 and Alternative 1).

Table 8-5 shows how passive use benefits would affect the net benefit of Alternative 4 if they were included in the NED analysis. Passive use benefits for salmon were estimated using four different methods, resulting in four different estimates. Each of these four salmon passive use benefits estimates was added to the single free-flowing river passive use benefits estimate to obtain four different total passive use benefits estimates. Table 8-3 shows how these four estimates would affect the net benefit of Alternative 4 relative to Alternative 1 at the nominal case, and when power and recreation estimates are at the low or high end of their range estimates for the various discount rates. Adding in any of the four passive use benefits estimates would cause Alternative 4 to become the most highly ranked alternative at all discount rates, regardless of whether power or recreation are at the high or low end of their range estimates.

Table 8-3. Effect of Passive Use Benefits Estimates on Value of Alternative 4 Relative to Alternative 1 ($1000s)

Nominal Range Scenario	Difference Between Alternatives 1 and 4 (No Passive Use Benefits)	Including Passive Use Estimate 1 ($486,000)	Including Passive Use Estimate 2 ($562,000)	Including Passive Use Estimate 3 ($928,000)	Including Passive Use Estimate 4 ($1,299,000)
6.875 Percent Discount Rate					
Low-End Power	(112,049.00)	373,951.00	449,951.00	815,951.00	1,186,951.00
High-End Power	(152,049.00)	333,951.00	409,951.00	775,951.00	1,146,951.00
Low-End Recreation	(272,474.00)	213,526.00	289,526.00	655,526.00	1,026,526.00
High-End Recreation	8,377.00	494,377.00	570,377.00	936,377.00	1,307,377.00
Nominal	(132,049.00)	353,951.00	429,951.00	795,951.00	1,166,951.00
4.75 Percent Discount Rate					
Low-End Power	(75,821.00)	410,179.00	486,179.00	852,179.00	1,223,179.00
High-End Power	(116,821.00)	369,179.00	445,179.00	811,179.00	1,182,179.00
Low-End Recreation	(245,631.00)	240,369.00	316,369.00	682,369.00	1,053,369.00
High-End Recreation	52,989.00	538,989.00	614,989.00	980,989.00	1,351,989.00
Nominal	(96,321.00)	389,679.00	465,679.00	831,679.00	1,202,679.00
0 Percent Discount Rate					
Low-End Power	9,681.00	495,681.00	571,681.00	937,681.00	1,308,681.00
High-End Power	35,320.00	521,320.00	597,320.00	963,320.00	1,334,320.00
Low-End Recreation	(189,155.00)	296,845.00	372,845.00	738,845.00	1,109,845.00
High-End Recreation	163,516.00	649,516.00	725,516.00	1,091,516.00	1,462,516.00
Nominal	(12,820.00)	473,180.00	549,180.00	915,180.00	1,286,180.00

Figures 8-3 to 8-5 show the relative sensitivity of the difference between the average annual net benefit of Alternative 4 and Alternative 1 to each input at the three discount rates used in the economic analyses. It can be seen from these figures that recreation and passive use benefits uncertainties are of predominant importance, regardless of which of the three discount rates is used.

Not only are the nominal range sensitivities for recreation and passive use benefits high, but the ranking of alternatives changes. Looking again at Table 8-2, it can be seen that using the low-end nominal range estimate, the ranking is Alternative 2, Alternative 3, Alternative 1, Alternative 4. Using the high-end nominal range estimate, however, switches the ranking to Alternative 4, Alternative 2, Alternative 3, Alternative 1. In other words, whether breaching the four lower Snake River dams will give a positive or negative net NED benefit is unknown, because of the current level of uncertainty about the value of recreational and passive use benefits.

Even though the question of whether to breach the four lower Snake River dams is already highly sensitive to uncertainty about recreational and passive use benefits, the NRSA probably underestimates the recreational benefits uncertainty because it does not account for uncertainty in PATH estimates. The recreational benefits estimate is based on a point estimate of the size of the recreational fishery that would be available if the four lower Snake River dams were breached. Current PATH results predict a high level of unfulfilled recreational fishing demand (on the order of 95 percent of demand unfulfilled), indicating that the recreational fishing benefit is likely sensitive to the PATH estimate.

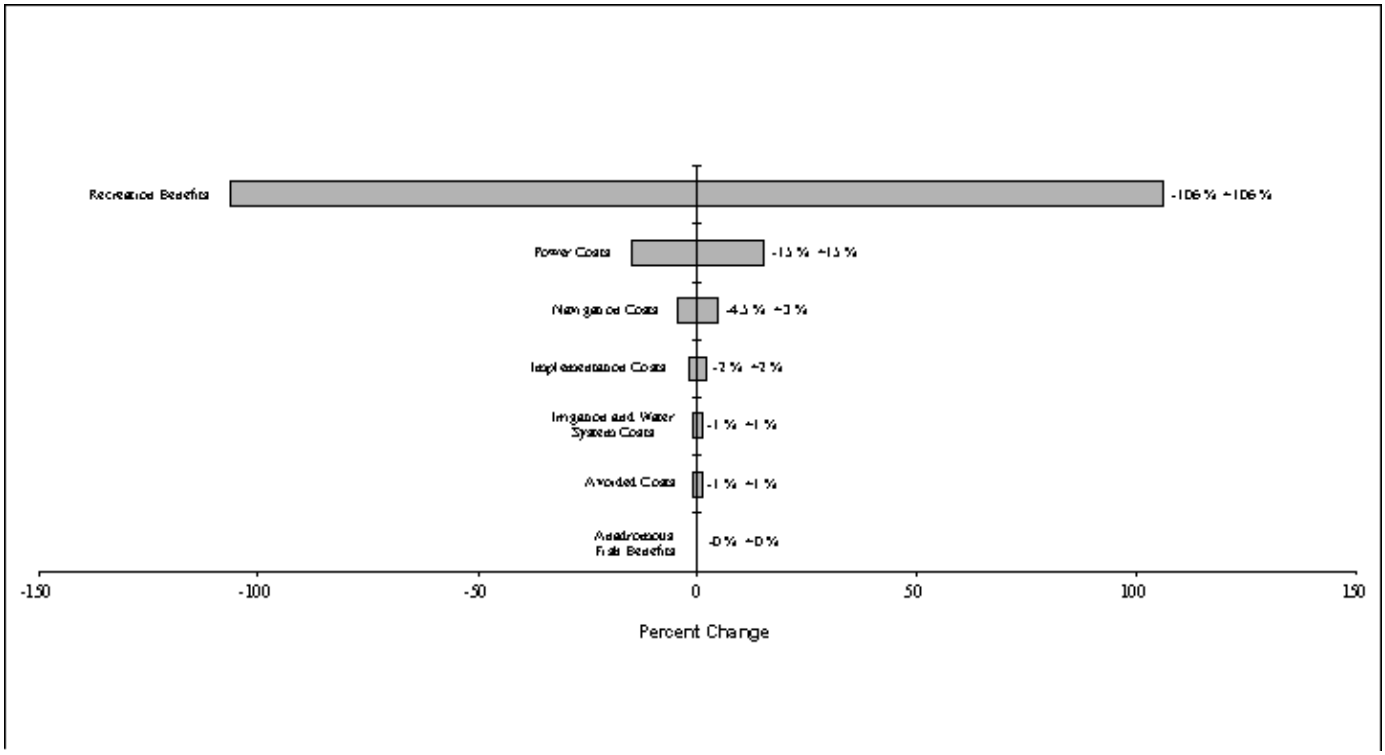


Figure 8-3. Nominal Range Sensitivity Expressed as Percent Change in the Difference Between Average Annual Net Benefit of Alternative 4 And Alternative 1 @ 6.875 Percent Discount Rate

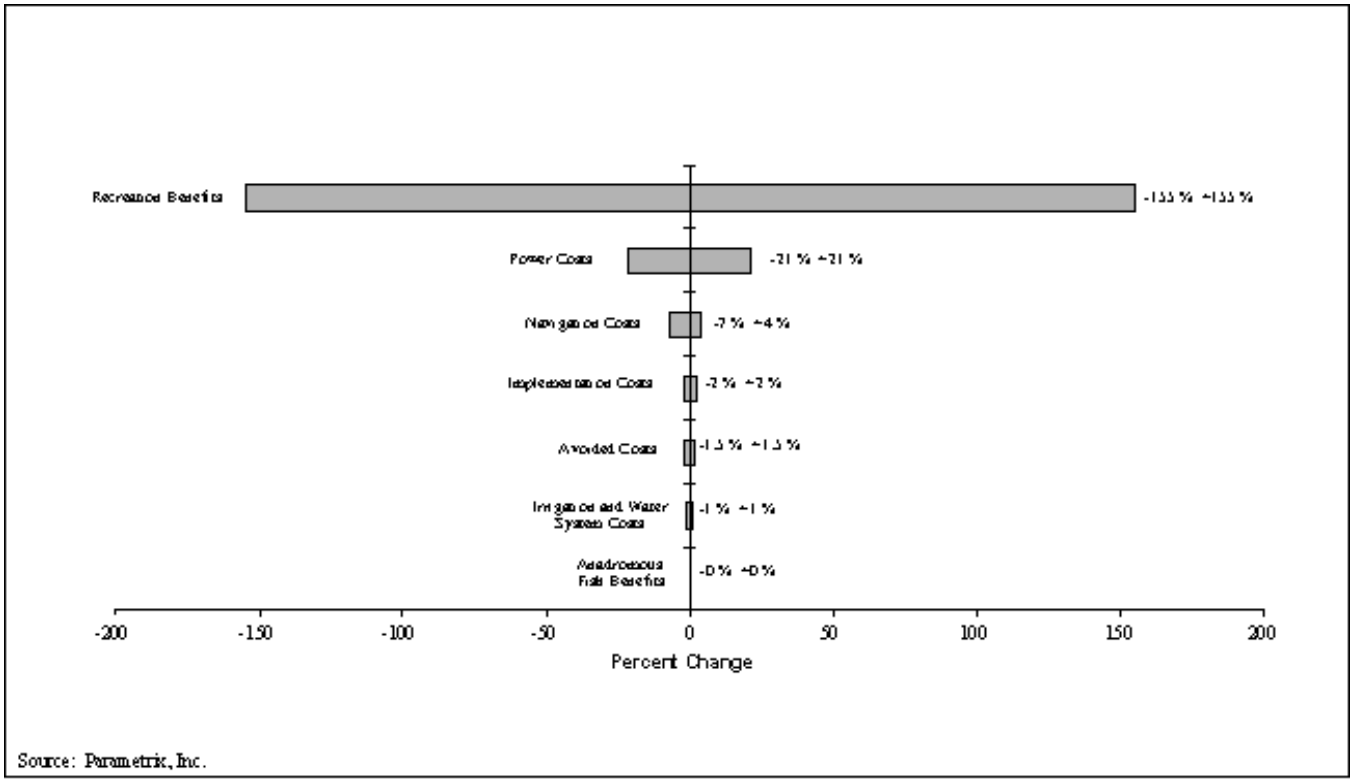


Figure 8-4. Nominal Range Sensitivity Expressed as Percent Change in the Difference Between Average Annual Net Benefit of Alternative 4 And Alternative 1 @ 4.75 Percent Discount Rate

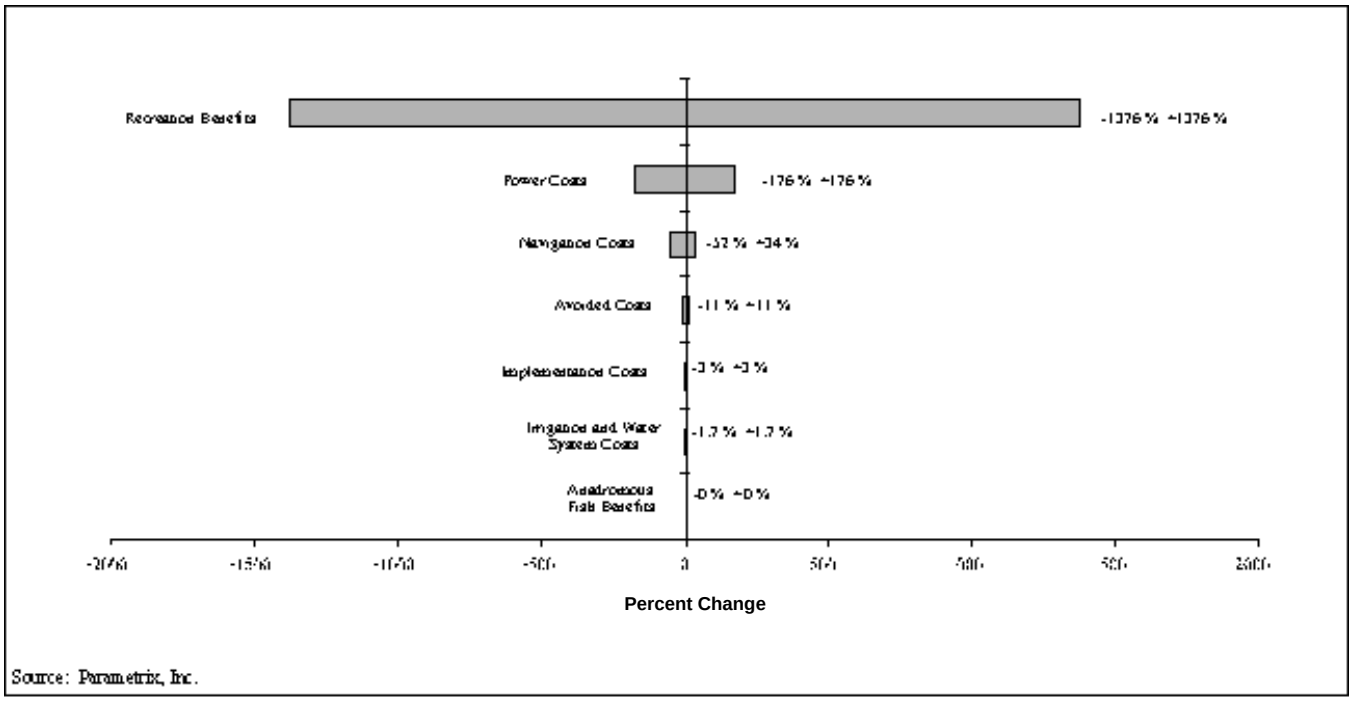


Figure 8-5. Nominal Range Sensitivity Expressed as Percent Change in the Difference Between Average Annual Net Benefit of Alternative 4 And Alternative 1 @ 0 percent Discount Rate

The interview with the recreation use benefits workgroup revealed two others factors that will tend to increase the average annual net benefits of Alternative 4 relative to Alternative 1. First, the recreation benefits report characterizes the estimates of California visitation as conservative (low). Although the degree of conservatism has not been quantified, any increase would increase the average annual net benefits of Alternative 4 relative to Alternative 1. California households make up about 70 percent of the study region's population. Second, the analysis has not accounted for the value of observing natural recovery of the lower Snake River if the dams are breached.

Range estimates were not available for the anadromous fish benefits. Non-linearity in the models used did not allow for ranges to be determined. Therefore, it is impossible to evaluate how range estimates for anadromous fish benefits may affect the ranking of alternatives.

There is a great deal of uncertainty in the recreational benefits of Alternatives 1, 2, 3, and 4 that is not reflected in the NED analysis. Uncertainties about the best methods for estimating these values are represented, but uncertainties within the methods themselves are not. Reservoir recreation benefits represent three-fourths of the recreational benefits of non-drawdown Alternatives (1, 2, and 3) and the confidence intervals are large ($47 to $148 a trip), indicating a great deal of uncertainty in the values. This uncertainty is not reflected in the NED analysis because only a point estimate was used (mean value of 71.31 per trip). The range of recreational benefits for Alternative 4 reflects different treatment of the data based on assumptions about non-respondent behavior. However, the range of recreational benefits used in the NED analysis were based one only one assumption about non-respondent data (middle use estimates, or assuming non-respondent use is the same as respondent use, but only using the rates for definite rather than probable visitors). River recreation benefits represent a large portion of the recreation benefits of Alternative 4. The low-end range estimate was based on scaling the river recreation and fishing demand curve using the cost per mile of reservoir visitors (travel cost method). A mean value of $71.36 per trip was used for the low end, but does not reflect the large confidence intervals for this method (95 percent confidence interval of $39 to $446 per trip). The high-end range estimate was based on scaling the demand curve using costs of visitors to free-flowing river sections as reported in a contingent behavior survey. A mean value of $297 per trip was used for the high end, which does not reflect the large confidence intervals for this method (95 percent confidence interval of $181 to $831 per trip). The nominal recreational benefits reflect the average of the mean of these two methods. Therefore, the Alternative 4 benefits reflect uncertainty about which method is the best estimator, but do not reflect uncertainty in the methods themselves. Also, recreational suitability recovery for various activities under Alternative 4 was based on point estimates, rather than range estimates, and no confidence limits were determined. If the confidence limits were included in the NED analysis, a larger range of possible values for recreational benefits would have occurred.

The DREW Recreation Workgroup indicated in their passive use report (see Section 4, Passive Use) that the nature of the existing surveys used for the benefit transfer study resulted in a number of factors that suggested that the resulting estimates might be called conservative. These include:

- Survey respondents were not told that they were evaluating threatened and endangered stocks. Providing respondents with this information would likely result in higher estimates of passive use benefits.
- Most existing studies evaluated a larger fish increase than is being evaluated in the lower Snake River. Because studies find that larger increases have diminishing returns on willingness to pay, applying these numbers to the lower Snake River likely underestimates its passive use benefits.

- The estimate of passive use benefits assumed zero benefit for angler households in the study area and zero benefit for all households outside of the study area.

Passive use benefits consist of salmon values and free-flowing river values. The range of values presented for passive use benefits of salmon reflect different approaches for estimating values, rather than uncertainties in the methods themselves. A single point estimate was available for the free-flowing river passive use benefits, and no confidence intervals were determined. Given that a number of conservative assumptions were used, passive use benefits are likely to be underestimated, but it is difficult to say by how much.

8.3.2 Social and Regional Analysis

The driving uncertainties in the regional analysis are identified errors and omissions, which are identified in the DREW Regional Analysis Workgroup (1999) report. The regional analysis workgroup reports that uncertainty is present in the regional economic impact analysis because of uncertainties in inputs received from other workgroups and uncertainties used to drive the models. The regional analysis workgroup noted that errors in the input data received from the other workgroups will be multiplied when the data are used in the regional economic impact model. The regional analysis workgroup identified the following specific examples of errors, omissions, and uncertainty in the input data they used in their analysis:

- The data for the 100-year fishing and outdoor recreation projections were based on now obsolete PATH analysis and since improved salmon life-cycle analysis. This has repercussions for the comparisons of outcomes in the recreation section of the regional analysis.
- The effect of increased shipping costs under Alternative 4 on industry output and employment for firms that use barge shipping was not studied, so changes in outputs and employment in the wood products, grain production, and other sectors are unknown.
- Effects of reduction in irrigated agriculture under Alternative 4 on the food processing sector are unknown.
- The required road investment outside Washington under Alternative 4 is unknown, as are future increases in spending for road maintenance.
- The future distribution of electricity rate increases under Alternative 4 across regions, industries, or consumers is unknown.

The hydropower workgroup elaborated on this last point in its interview with the risk and uncertainty workgroup. The members identified the possible rate impacts to regional power ratepayers as the only major risk and uncertainty concern. The workgroup expressed confidence in the reliability of its NED cost range estimate, but not in its ability to define who will pay these costs. This impacts the regional analysis and may be of significant social importance. The hydropower workgroup cannot improve the rate analysis until Congress determines the methods for funding dam removal. This would be done in the authorizing legislation if Alternative 4, Dam Breaching, were selected.

The executive summary of the Regional Economic Impact Models for the lower Snake River Juvenile Salmon Migration Feasibility Study also discusses the risk and uncertainty of the input-output economic analysis technique. First, industry spending calibrations are based on national averages, which may not apply to the specific region under study. Estimates using the national

averages are, however, likely to be within plus or minus 10 percent of multipliers that would be found using survey data. Second, the input-output analysis provides a "snapshot" of the economy at a point in time rather than a dynamic structure of changing relationships. No model can make accurate predictions of future changes in technology, prices, trade patterns, or consumer tastes and preferences, therefore, all models would suffer this same uncertainty. Third, the input-output model is driven by exogenous estimates of changes in sale to final demand (exports, investment, and certain components of government spending).

Finally, the social workgroup identified four sources of uncertainty about the appropriateness of some of the assumptions used in the social analysis:

- Allocation of sub-regional employment impacts to local communities based on a proportion of local employment to regional employment changes may understate or overstate the magnitude of impacts.
- Use of social indicators (e.g., steelhead fishing licenses) to represent the contribution of anadromous fish to local quality of life, poverty rates to identify populations sensitive to economic changes, developed recreation sites to indicate quality of life.
- Use of county level farm data to make generalizations about the expected changes to farming communities within the county.
- Assuming that positive gains in employment are positive and negative losses in employment are negative for a given community.

The social analysis report additionally identified significant uncertainty in the economic effects of Alternative 4 on upriver communities because it is unknown how significantly the loss of river navigation will affect the forest paper industry. Also, the effects of electrical rate increases on the aluminum industry are unknown, but could have significant regional impacts. The report also identified five key uncertainties that make the prediction of impacts on individual farms, farm regions, counties, and rural farm communities difficult to determine:

1. The future of farm deficiency payments may be extended.
2. International market conditions and prices received for export agricultural products vary greatly from year to year.
3. The fixed and variable costs of farming have increased over time and may continue to do so while at the same time new crops and rotations are being introduced to the region.
4. Technological advances in crop production and seasonal variations in rainfall make forecasting average yields difficult for more than 1 year in advance.
5. The actual magnitude of total transportation cost increases, including price adjustments for alternative modes of transportation in the absence of barges, is unknown at this time.

8.3.3 Tribal Circumstances

The tribal circumstances risk and uncertainty assessment was obtained from the Tribal Circumstances and Perspectives report.

8.3.3.1 Uncertainty

The Tribal Circumstances and Perspectives report identifies positive associations between abundance of tribal harvest of salmon, and tribal levels of cultural and material wellbeing, or

alternatively, of distress – indexed by perception of self, rates of death, health, poverty, unemployment, and per capita income.

Given information presently available, it is not possible to establish certain cardinal measurement linkages between such "cause and effect" parameters – either in the immediate term, or cumulatively.

The Tribal Circumstances and Perspectives report ranked the alternatives based on the relative magnitude of salmon recovered for the tribes under each project alternative, and respecting the direction and general effect of such respective magnitudes of salmon recovery on tribal culture, rates of death and health, poverty, employment/unemployment, and income.

Similarly, the Tribal Circumstances and Perspectives report provides a clear separation with respect to the length of time over which tribal pain and suffering would continue at close to present levels, under each project alternative.

The Tribal Circumstances and Perspectives report indicates that changes in underlying biological assumptions regarding recovery would result in some changes to cardinal estimates of salmon recovery. It further explains that such changes are not likely to substantially change the certainty associated with the ranking of tribal impacts from alternative project choices.

8.3.3.2 Tribal Risk

According to the Tribal Circumstances and Perspectives report, the tribes face four major elements of risk within the context of the lower Snake River Feasibility Study process.

First, the Tribal Circumstances and Perspectives report identified the close dependence of the study tribes on salmon, the declines in salmon available to the tribes from Treaty times to the present, and the consequent endangerment of not only the salmon, but the cultural and material wellbeing of the tribes as well.

Given present diminished stock levels, if the PATH estimates are too optimistic, there is a risk that the subject salmon species will become extinct – with attendant risks for continued survival of tribal peoples.

Second, if PATH recovery estimates are too pessimistic, differences in the magnitude and timing of salmon recovery between alternatives would be understated – reducing comparative net benefits posed for the alternative most likely to restore salmon.

Third, if the selected alternative forecasts salmon recovery that will need a time period far into the future before significant harvests are returned to the tribes, the Tribal Circumstances and Perspectives report indicates that tribal peoples will continue to risk unacceptable levels of pain, suffering and premature death, while bureaucrats "test and study."

Finally, the Tribal Circumstances and Perspectives report identifies that in almost all prior processes concerning Columbia/Snake River system dams, tribal concerns and the impact on tribes have been ignored or marginalized. The Tribal Circumstances and Perspectives report identifies that if marginalization occurs during the present process, the cumulative transfer of the river system's wealth from tribal to non-tribal residents of the region will continue – tribal peoples will continue to suffer and be disempowered, regardless of existing Treaty protections – and environmental injustice, as defined by EPA, will be exacerbated.

8.3.3.3 PATH Analysis

Data from the PATH analysis are used for a number of parts of the Economics Appendix I the lower Snake River Juvenile Salmon Migration Feasibility Study. Changes in the PATH results will directly affect estimates under different alternatives for commercial and recreational fishing, regional and social analysis, tribal circumstances, and passive and recreation use benefits. Uncertainties in each of these areas are multiplied by uncertainties in the PATH analysis; therefore changes in the PATH analysis can potentially change the ranking of alternatives. PATH has recently (November 1999) revised its estimates, but the economic studies presented in this document were developed using its previous estimates. This is a significant source of uncertainty in the NED analysis and may affect the ranking of alternatives.

The conclusions and recommendations from the PATH weight of evidence workshop quantified the relative degree of belief in the seven key uncertainties that have the greatest effect on the outcomes of management actions. The seven key uncertainties are:

1. Passage and transportation assumptions (uncertainty in direct survival of in-river fish, the partitioning of in-river survival between dam and reservoir survival, and survival of transported versus non-transported fish after they have exited the migration corridor).
2. Extra mortality outside of the juvenile migration corridor that is not accounted for by productivity parameters in spawner/recruit relationships, by estimates of direct mortality in the migration corridor, or common year effects affecting both Snake River and lower Columbia River Stocks (delta model only).
3. Uncertainty in the extent to which Snake River and lower Columbia share common mortality effects.
4. Length of the transition period between removal of dams and establishment of equilibrium in the drawndown section of the Snake River (reflecting uncertainty in physical and biological responses to drawdown).
5. Uncertainties in historical estimates of bypass and turbine mortality.
6. Uncertainty in the effect of the predator removal program (i.e., squawfish bounties) on future survival of salmon smolts in reservoirs.
7. Uncertainty of juvenile survival rate once equilibrium conditions have been reached.

Alternative hypotheses for each of these seven uncertainties were identified, and expert elicitation was used to determine belief in the hypothesis used versus the alternatives. Weighted averages were derived by four different experts for each hypothesis under each of the seven uncertainties. These weights were used to determine weighted averages for 24-year survival, 100-year survival, and 48-year recovery standards. The weighted averages show what the most likely outcomes of the actions will be, given uncertainties that affect future projections. Table 8-4 shows how meeting the standards is affected by using the sets of judgements from the different experts. The following conclusions were reached based on this analysis:

- The analysis determined that outcomes for Alternative 4 are better than those of Alternative 1 or Alternative 2 for all jeopardy standards, regardless of the expert used. The magnitude of the differences depends on the jeopardy standard used and assumptions about when drawdown will be implemented.
- The ability of actions to meet the 24-year survival standard varies with different experts. meets the standard with one out of four experts. Alternative 2 fails the standard regardless of

the expert. Drawdown with a 3-year delay meets the standard with three of the four sets of experts, while drawdown with an 8-year delay meets the standard with two of the four experts.

- Alternative 1 and Alternative 4 (both 3-year and 8-year) meet the 100-year survival standard regardless of the expert. Alternative 2 meets the 100-year survival standard with three of four experts.
- Alternative 1 and Alternative 2 meet the 48-year recovery standard with one of four experts. Alternative 4 meets the 48-year recovery standard with all experts regardless of whether a 3-year or 8-year delay is assumed.

PATH probabilities for achieving 24-year, 48-year, and 100-year escapement levels for survival and recovery were generally used as fixed point values in the NED analysis. The PATH numbers were generated using Monte Carlo simulations that established distribution ranges for the returning salmon stocks. The NED analysis did not use these distribution ranges but instead used fixed point estimates from the ranges. This represents a significant uncertainty that was not accounted for in the NED analysis. Using a point estimate could significantly overestimate or underestimate the salmon population.

The scientific review panel (SRP) also considered whether there were any new hypotheses that should be included in the PATH models. One hypothesis that the SRP thought worth evaluating was that hatchery fish might affect the survival of wild fish. This hypothesis was believed to have significant results on survival. The implementation of this hypothesis was not considered feasible because:

Table 8-4. Weighted Average Performance Measure

Expert	Action	24-year Survival	100-year Survival	48-year Recovery
1	1	x	x	x
	2		x	x
	4 (3-year)	x	x	x
	4 (8-year)	x	x	x
2	1		x	
	2			
	4 (3-year)		x	x
	4 (8-year)		x	x
3	1		x	
	2		x	
	4 (3-year)	x	x	x
	4 (8-year)		x	x
4	1		x	
	2		x	
	4 (3-year)	x	x	x
	4 (8-year)	x	x	x

Note: x = Meets Standard

- Hatchery effects are confounded with development of the hydrosystem.
- The distinction between the hatchery hypothesis and other mortality hypotheses was not clear.
- The responses of different actions under this hypothesis are not clear.

The SRP also noted that in some cases the evidence for evaluating alternative hypotheses was poor or lacking. Because of this, the SRP recommended taking actions that 1) result in the best chance at survival and recovery of stocks, and 2) generate information to reduce uncertainties and improve future decision-making. Significant increases in mortality have the potential to change the rankings of the alternatives (1, 2, and 4).

The SRP reviewed the PATH preliminary decision analysis report on Snake River spring/summer chinook. They concluded that uncertainties are extensively considered within the constraints imposed by bounding the system between the nursery habitat and above Bonneville. The SRP found, however, that there is not a consensus on the assumptions or analyses that precede the quantitative evaluation of uncertainty. Therefore, there is some uncertainty about the results of the PATH models. The SRP suggested designing and conducting a management experiment to resolve uncertainty. The SRP also believes that the role of uncertainty in the identification of models for spring and summer chinook salmon, and in the application of these models to prediction of management alternatives, may be underestimated. The SRP identified four problem areas for these models:

- Uncertainty about the model structure
- Uncertainty in the estimated model parameters
- The propagation of model prediction errors
- The design of experiments in order to reduce the critical uncertainties associated with the models.

The SRP felt that progress had been made on each of these problems, but that additional progress was needed, especially in the first two problem areas identified above. The SRP also felt that the three alternative hydrosystem actions (1, 2, and 4) may have been too narrowly defined and other alternatives or modeling approaches should have been evaluated at the beginning, rather than just focusing on uncertainty in the current models and alternatives. The SRP also suggested that an adaptive management approach could be used to resolve some of the remaining uncertainties. An adaptive management approach would involve systematically varying management options while carefully monitoring biological, economic, and social consequences of actions, in an attempt to reduce uncertainty and apply new information to the quantitative models.

The SRP also provided comments on the PATH final report for fiscal year 1998, some of which were relevant to uncertainties in the modeling. The SRP suggested that some of the uncertainties in the models could be evaluated more thoroughly using sensitivity analysis especially for 1) predator modeling (particularly the importance of temperature fluctuations), 2) evaluation of hatchery supplementation assumptions (including the hypothesis that hatcheries diminish returns), and 3) turbine mortality. The SRP suggested that PATH could calculate the expected value of perfect information for key uncertainties. These calculations would suggest how much it is worth to resolve

key uncertainties. The SRP also suggested that PATH could extend the prospective models to stimulate the collection of new data and thereby the rate of learning about uncertain hypotheses. Alternative methods were suggested for incorporating uncertainty into the models, such as interval analysis and fuzzy arithmetic.

PATH made different assumptions about the current salmon population than the anadromous fish benefits group. PATH assumed that the current salmon populations have reached a steady state and based future predictions on this assumption. In contrast, the anadromous fish benefits group assumed that salmon populations are currently in a declining state, and based its predictions for the no-action alternative accordingly.

8.4 Summary

In conclusion, the purpose of the risk and uncertainty assessment was to help 1) assess the overall reliability of the economic analysis conducted for this study, and 2) identify important unanswered questions for risk managers. There remain significant unresolved uncertainties about the economic costs and benefits of the alternatives considered by the Drawdown Regional Economic Workgroup for the four lower Snake River dams. The most important uncertainties from a national economic development perspective are:

- uncertainties about the value of future recreational and passive use benefits if the dams are breached
- uncertainties about the size of future anadromous fish stocks and the fisheries they will support.

Further work by PATH, the DREW Anadromous Fish Workgroup, and the DREW Recreational Workgroup could significantly improve the reliability of these analyses. The new PATH estimates determined in November 1999 need to be evaluated in the appropriate economic resource categories. In most cases, Alternative 2 is the preferred alternative in the NED analysis, however, inclusion of passive use benefits would make Alternative 4 the preferred alternative. Other NED uncertainties, though significant in an absolute sense, are unlikely to affect decisions about whether it would be more cost-effective to breach the four lower Snake River dams.

The driving uncertainties for the regional analysis are of two types: uncertainties due to errors and omissions in the currently available data and uncertainties about how costs will be distributed. the latter cannot be resolved until decisions are made about how the future power supply system would be configured if the four lower Snake River dams were breached. At least some of what has been characterized as errors and omissions in the currently available data also cannot be resolved until specific information is developed about how the future power supply system would be configured.

In conclusion, uncertainties about dam breaching remain that prevent reaching a conclusion on whether it would be more cost-effective to breach the four lower Snake River dams. In order to determine the economic feasibility of retaining or breaching the dams, further effort is needed to 1) more precisely quantify the recreational and passive use benefits of the lower Snake River if the dams are breached, 2) more thoroughly assess the effect of dam removal on future anadromous fish stocks, and 3) further specify the configuration of the future power supply system if the dams are breached.

9. Cost Effectiveness

9.1 Introduction & Study Organization

The purpose of the cost effectiveness analysis is to identify the least cost method for providing various levels of output. For example, if two of the alternatives under consideration meet the NMFS jeopardy standards, then cost effectiveness analysis helps to establish the less costly alternative.

The following chapter reports the results of the cost effectiveness analysis. It should be noted that this report only deals with NED costs and benefits, as defined by the Corps. The chapter is divided into five sections: introduction and study organization, discussion of biological outputs, discussion of net cost factors, cost effectiveness comparisons, and conclusions.

9.2 Discussion of Biological Outputs

There are four species of fish in the lower Snake River system that have been listed as endangered or threatened by NMFS under the Endangered Species Act, including spring/summer chinook, fall chinook, steelhead, and sockeye. The effects of the proposed alternatives in improving the chances of recovery and survival of these species are considered the "benefits" or “output” of undertaking the study alternatives. The following section reviews the development and application of the NMFS jeopardy standards.

The PATH analysis was based upon the sixth weakest of seven stocks of spring/summer chinook and one stock of fall chinook but PATH results were not extrapolated to the entire population of lower Snake River chinook. Data were not available to provide PATH modeling for steelhead and sockeye.

The DREW Anadromous Fish Workgroup, working in coordination with staff from NMFS and members of PATH, extrapolated the results of the PATH analysis to all lower Snake River spring/summer and fall chinook stocks and also prepared estimates for steelhead, which are believed to have a similar biological response to that of spring/summer chinook. Neither PATH nor the DREW Anadromous Fish Workgroup prepared estimates for sockeye, because there were insufficient data.

9.2.1 PATH Model Results

PATH is a formal and rigorous program of formulating and testing hypotheses by using a series of model simulations to estimate both past and future trends in fish abundance for each of the selected stocks. The primary objective of PATH’s modeling is to enhance the survival opportunities of the affected ESUs by considering the stock’s response to jeopardy standards, which were defined by the Biological Requirements Working Group (BRWG) and largely accepted by NMFS. (Source: Peters et al., 1999).

9.2.1.1 Definition of Jeopardy Standards

The jeopardy standards include both survival and recovery goals as defined below:

- Survival standards (which set the threshold for survival) are based on projected probabilities that the spawning abundance will exceed a pre-defined survival threshold over a 24- or 100-year simulation period. Survival standards are met when that probability is 70 percent or greater .
- Recovery standards (which are required to consider de-listing of the species) are based on probabilities of exceeding a recovery threshold in the last 8 years of a 48-year simulation period. This standard is met when the probability is 50 percent or greater" (PATH memo to IT team).

9.2.1.2 Spring/Summer Chinook 1998 Model Results

Table 9-1 presents the probability of each alternative meeting the NMFS 24-year and 100-year survival standards and the 48-year recovery standards for spring/summer chinook using data from the 1998 PATH model results as reported by NMFS. This table presents the median modeling results, which are considered the most likely outcome, as well as the 25th and 75th percentile model results, which bound the median result with a range from low to high outcomes.

Table 9-1. Probability of Attaining NMFS Jeopardy Standards for Spring/Summer Chinook Using Unweighted 1998 Model Results

		24-Year Survival	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.67	0.55	0.75
Alternative 2, Maximum Transport of Juvenile Salmon	0.65	0.54	0.75
Alternative 3, Major System Improvements	0.66	0.55	0.75
Alternative 4, Dam Breaching	0.69	0.63	0.76
		48-Year Recovery	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.48	0.31	0.65
Alternative 2, Maximum Transport of Juvenile Salmon	0.45	0.29	0.66
Alternative 3, Major System Improvements	0.46	0.31	0.67
Alternative 4, Dam Breaching	0.84	0.74	0.92
		100-Year Survival	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.79	0.68	0.87
Alternative 2, Maximum Transport of Juvenile Salmon	0.78	0.65	0.87
Alternative 3, Major System Improvements	0.79	0.67	0.87
Alternative 4, Dam Breaching	0.89	0.85	0.92

Source: Personal communication from NMFS

24-Year Survival Standard for Spring/Summer Chinook

None of the median results of any the alternatives under consideration meet the 24-year survival standards, which as discussed above, require a 70 percent probability. However, the median results of all alternatives are relatively close to the survival standard (e.g., within 1 percent to 5 percent of meeting this standard). In addition, all alternatives meet the standard under the 75th percentile model results.

48-Year Recovery Standard for Spring/Summer Chinook

Alternative 4, Dam Breaching, is the only alternative under consideration that meets the 48-year recovery standards for the median model results. None of the median results of dam retention alternatives (e.g., Alternatives 1, 2 and 3) meet the 48-year recovery standards. However, the median results of the dam retention alternatives are relatively close to meeting the standard (e.g., within 2 percent to 5 percent). In addition, the 75th percentile model results exceed the recovery standard for all alternatives.

100-Year Survival Standard for Spring/Summer Chinook

All of the median results of the alternatives under consideration meet the 100-year survival standards, which as discussed above, require a 70 percent probability.

9.2.1.3 Fall Chinook Model Results

Table 9-2 presents the probability of each alternative meeting the NMFS jeopardy standards for fall chinook. This table also presents the median modeling results, which are considered the most likely outcome, as well as the 25th and 75th percentile model results, which bound the median result with a range from low to high.

Table 9-2. Probability of Attaining NMFS Jeopardy Standards for Fall Chinook Using Unweighted 1998 Model Results

		24-Year Survival	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.85	0.78	0.97
Alternative 2, Maximum Transport of Juvenile Salmon	0.85	0.78	0.97
Alternative 3, Major System Improvements	0.81	0.69	0.95
Alternative 4, Dam Breaching	0.93	0.89	0.98
		48-Year Recovery	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.22	0.15	0.56
Alternative 2, Maximum Transport of Juvenile Salmon	0.22	0.15	0.56
Alternative 3, Major System Improvements	0.28	0.17	0.63
Alternative 4, Dam Breaching	1.00	1.00	1.00
		100-Year Survival	
Action	**Median**	**25th percentile**	**75th percentile**
Alternative 1, Existing Conditions	0.83	0.71	0.98
Alternative 2, Maximum Transport of Juvenile Salmon	0.83	0.71	0.98
Alternative 3, Major System Improvements	0.78	0.64	0.95
Alternative 4, Dam Breaching	0.98	0.97	1.00

Source: Personal communication from NMFS

24-Year Survival Standard for Fall Chinook

All of the median results of the alternatives under consideration meet the 24th year survival standards, which as discussed above requires a 70 percent probability.

48-Year Recovery Standard for Fall Chinook

Alternative 4, Dam Breaching, is the only alternative under consideration that meets the 48th year recovery standards, using the median results from the 1998 PATH modeling process. None of the median results of dam retention alternatives met the 48th year recovery standards under the modeling conducted in 1998, which as discussed above, require a 50 percent result. In this case, the median results of the dam retention alternatives are not close to the recovery standard (e.g., within 22 percent to 28 percent), but the 75th percentile model results for these alternatives do exceed the recovery standard.

However, as noted at the end of this report, PATH 1999 model results show that dam retention alternatives meet the 48-year recovery standard.

100-Year Survival Standard for Fall Chinook

All of the median results of the alternatives under consideration meet the 100th year survival standards, which as discussed above, require a 70 percent probability.

9.2.1.4 1999 PATH Model Results

PATH is continuing to refine the model, using new information on key variables related to delayed mortality (the D factor), ocean conditions, and ocean harvests, among other variables. These modifications are having an affect on model results for fall chinook. According to Peters et al. (1999):

- "**All hydrosystem actions meet survival standards** (probabilities of exceeding survival escapement thresholds are greater than 0.7), regardless of what is assumed about the estuary/ocean survival rate of transported fish.
- **All drawdown actions meet recovery standards** (probabilities of exceeding recovery escapement thresholds are greater than 0.5) regardless of what is assumed about the estuary/ocean survival rate of transported fish. The Alternative 4, Dam Breaching, exhibited the most robust response across those uncertainties considered to date, and produced higher recovery probabilities (as well as higher average spawning escapements) than other actions. This conclusion is sensitive to assumptions about adult upstream survival.
- For each hypothesis about relative survival of transported fish, **there is a non-breaching action (actions which do not involve drawdowns of dams) that meets the recovery standard**, although there is no single non-breaching alternative option that meets recovery standards under all assumptions about the relative survival of transported fish. If transported fish are assumed to have high relative survival (i.e., high D), maximizing transportation will achieve recovery standards. If transported fish are assumed to have low relative survival (i.e., low D), then retaining current system configuration and allowing all smolts to migrate in-river achieves the

recovery standards. **Non-breaching actions are not as robust to the current level of uncertainty in relative survival of transported fish as are drawdown actions."**

Unfortunately, these results were reported too late to be included in the economic appendix.

9.2.2 Model Results

As mentioned above, the DREW Anadromous Fish Workgroup worked with NMFS and PATH staff to extrapolate the results of the PATH models from the weakest stocks to all spring/summer and fall chinook stocks as well as to steelhead stocks. The following section summarizes the results of this effort, which is based upon the 1998 model results. (Using the 1999 model results will increase the number of fish associated with the dam retention alternatives and decrease the differential in output between dam retention alternatives and the dam breaching alternative.)

As shown in Figure 9-1, the dam breaching alternative (using the 1998 PATH model results) generates approximately 30,000 more fish than is expected under Alternative 1, Existing Conditions, approximately 25 years after implementation of dam breaching. The DREW Anadromous Fish Workgroup estimates that the increase would consist of approximately 3,000 more steelhead, 14,000 more spring/summer chinook, and 13,000 more fall chinook. This level of increase represents an approximate doubling (e.g., 100 percent increase) of the wild fish escapement under the dam breaching alternative over the level expected under the base case (e.g., the base case reaches 35,000 fish during the same time period).

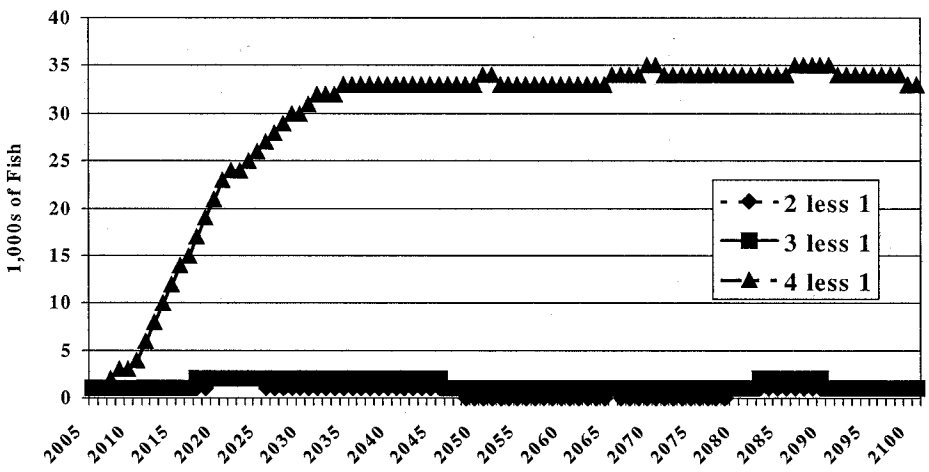


Figure 9-1. Net Increase in Fish over Base Case Conditions Using 1998 PATH Model Results (in 1,000s of Fish)

The dam retention alternatives (2 and 3) result in approximately 1,000 more fish than under the base case conditions, consisting mainly of spring/summer chinook.

The DREW Anadromous Fish Workgroup has not prepared revised estimates based upon the 1999 model results.

Harvest Standards

In addition to the survival and recovery standards, there may be harvest goals, which were not considered by PATH. These thresholds may be defined as a level of recovery which, in the judgment of the tribes, will lead to significantly increased tribal harvest, and commensurate significant improvement in cultural and material well being for tribal peoples (Meyer Resources, Inc.).

However, no measurable harvest goals were proposed during the course of the study. The tribal group has reported that the harvestable goals are met under Alternative 4, Dam Breaching, but not under other alternatives under the 1998 PATH model results. It is unknown whether the harvest goals would be met for dam retention alternatives using the 1999 PATH model results (see the Tribal Circumstance Chapter for more details).

9.3 Discussion of Net Cost Factors

Evaluation of environmental restoration and mitigation solutions requires an evaluation of monetary effects (or factors) in four general classes. When combined, these effects form the "net cost" information for cost effectiveness analyses, described in greater detail below.

9.3.1 Definition of Net NED Costs

Net costs are defined to include all NED effects, including:

- Implementation costs for the fish-related improvements (e.g., the construction and acquisition costs, annual costs for operation, maintenance, repair, replacement, rehabilitation, and monitoring, and Federal mitigation costs). These costs are presented in the implementation/avoided cost chapter of the appendix.
- Avoided costs, which include operations, maintenance, repair, replacement, and rehabilitation of existing infrastructure that would be avoided under alternative conditions (e.g., existing power systems, navigation locks, and other like costs that occur under the dam retention alternatives but not under the dam breaching alternative). These costs are also presented in the implementation/avoided cost chapter.
- NED costs, which are any existing costs that would be incurred as a result of implementing the dam breaching alternative, notably:
    - additional costs to provide power by the next least costly form of power generation (described in the hydropower chapter of the appendix),
    - additional transportation costs to shift barge-transported commodities to other truck, rail and barge systems (described in the transportation chapter of the appendix), and,
    - additional construction/O&M costs for irrigation and water supply systems (described in the water supply section of this report).
- NED Benefits, which are any existing benefits that would accrue as a result of implementing alternatives, notably:

- additional recreation benefits from drawdown conditions for anglers from enhanced fisheries and to users of the free flowing river (described in the recreation chapter of the appendix), and,
- additional commercial fishing benefits in the river and ocean, and recreation benefits occurring outside of the lower Snake River system (described in Section 3.5 of this appendix, Anadromous Fish).

Net NED costs are defined to equal implementation costs plus avoided costs, plus NED costs less NED benefits.

9.3.2 Presentation of Annual Results (Using PATH 1998 Model Results)

Table 9-3 presents the low, most likely, and high net NED annualized costs, as defined in the previous sections. Again, all comparative estimates are net of the base case.

Under the most likely case and a 6.875 percent discount rate:

- Alternative 2, Maximum Transport, is $14.1 million less costly per year than the existing conditions,
- Alternative 3, Major System Improvements, is $4.8 million less costly per year than the existing conditions and,
- Alternative 4, Dam Breaching, is $246.5 million more costly than the existing conditions annually over the 100-year study period. Alternative 4 is between $220.8 and $276.6 million more costly on an annual basis, compared for the existing conditions.

Table 9-3. Annualized Net Cost Comparison (1998 Dollars) ($1,000s)

Rate	Most Likely ($)	Low ($)	High ($)
@6.875 percent			
Alternative 2 less Alternative 1	(14,147)	(15,366)	(11,355)
Alternative 3 less Alternative 1	(4,810)	(6,501)	1,743
Alternative 4 less Alternative 1	246,474	220,758	276,569
@4.75 percent			
Alternative 2 less Alternative 1	(13,172)	(14,425)	(10,236)
Alternative 3 less Alternative 1	(6,268)	(7,876)	(78)
Alternative 4 less Alternative 1	245,467	220,378	274,192
@0.0 percent			
Alternative 2 less Alternative 1	(10,281)	(11,116)	(8,095)
Alternative 3 less Alternative 1	(7,978)	(8,944)	(4,400)
Alternative 4 less Alternative 1	208,810	184,439	235,284

Source: Implementation/Avoided Cost chapter (Tables 3.8-4 and 3.8-5), Hydropower chapter (Table 3.4-22), Transportation chapter (Table 3.3-34), Water Supply chapter (Table 3.4-17), Recreation chapter (Tables 3.4-8), and the Anadromous Fish chapter (Table 3.5-3).

Under the most likely case and a 4.75 percent discount rate, Alternative 2 is $13.2 million less costly, Alternative 3 is $6.2 million less costly and Alternative 4 is $245.5 million more costly than the existing conditions annually over the 100-year study period.

Under the most likely case and a 0.0 percent discount rate, Alternative 2 is $10.3 million less costly, Alternative 3 is $8.0 million less costly and Alternative 4 is $208.8 million more costly than the existing conditions annually over the 100-year study period.

9.4 Cost Effectiveness Comparisons

The following section provides a graphical and tabular comparison of the net NED costs and biological effectiveness for spring/summer chinook and fall chinook, separately, taking into account both the NMFS jeopardy standards and the estimated number of fish associated with each alternative. There are no PATH/NMFS estimates of the combined probabilities of meeting the jeopardy standards for both spring/summer and fall chinook salmon.

The cumulative costs are calculated by multiplying the annual costs by the number of years of the applied standard. As an example, Alternative 4, Dam Breaching, costs $5.9 billion to administer over a 24-year period (e.g., 24 years times the annual cost of $246,474,000 equals $5,915,367,000). The total number of fish is calculated in a similar manner. As an example, Alternative 4, Dam Breaching, results in 168,612 more fish during the first 24-year period than does Alternative 1, Existing Conditions.

The cost effectiveness assessment considers two different but related perspectives to determine the least costly means of meeting the NMFS jeopardy standards:

- The first evaluation considers the cost to attain an additional percentage of the jeopardy standards.
- The second evaluation considers the cost per additional fish.

9.4.1 Cost Effectiveness Assessment 1—All Costs Applied to Spring/Summer Chinook

Figures 9-2 through 9-4 and Table 9-4 present a comparison of the net NED cost and net biological effectiveness to achieve the NMFS' jeopardy standards for spring/summer chinook for the various alternatives under consideration. This cost effectiveness assessment considers the entire cost of the alternatives applied to spring/summer chinook.

9.4.1.1 24-Year Survival Standard for Spring/Summer Chinook

As noted above, under the most likely (median) conditions, none of the alternatives meet the 24-year survival standard for spring/summer chinook. However, all alternatives are relatively close to the goal (e.g., within 3 percent for Alternative 1, 5 percent for Alternative 2, 4 percent for Alternative 3, and 1 percent for Alternative 4) (see Table 9-1.).

The cumulative costs associated with Alternatives 2 and 3 are lower than those under Alternative 1, resulting in net savings. However, the probability of meeting the 24-year survival standard is also lower under these alternatives than under Alternative 1. Each percentage of improved survival is estimated to cost approximately $169.8 million under Alternative 2, Maximum Transport, and $115.5 million under Alternative 3, Major System Improvement, over the 24-year period (see Table 9-4).

There is only a marginal improvement associated with selecting Alternative 4, Dam Breaching, over Alternative 1, Existing Conditions, but this occurs at a high cost. Each additional percentage of survival attained in moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching, is expected to cost approximately $3.0 billion in cumulative costs over the 24-year period. Under Alternative 4, each additional spring/summer chinook is estimated to cost $35,000 over the 24-year period, using the 1998 PATH model results (see Figure 9-2 and Table 9-4).

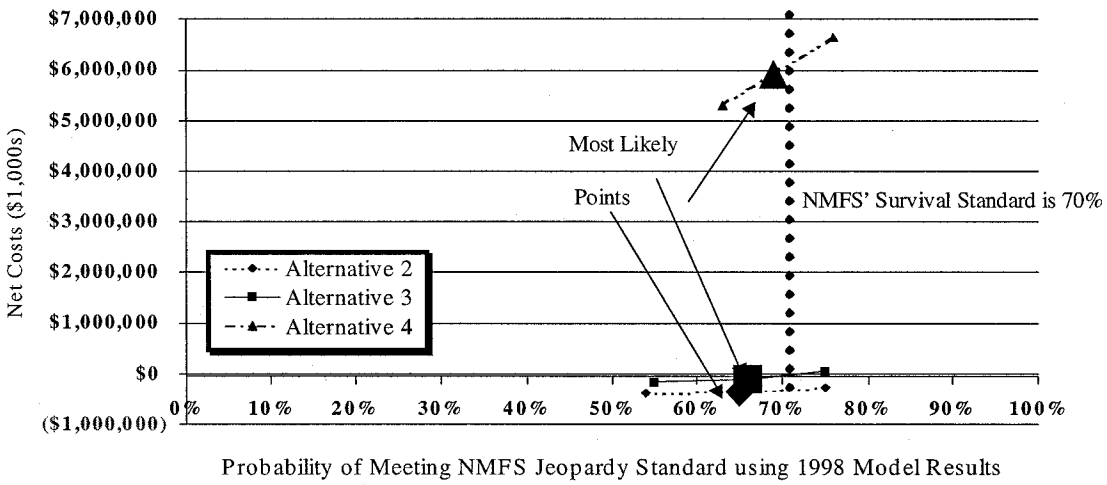


Figure 9-2. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 24-Year Survival Standards for Spring/Summer Chinook Using 1998 PATH Model Results

Table 9-4. Incremental Comparison of Net Costs (in $1,000s) and Biological Effectiveness for Spring/Summer Chinook (1998 Dollars)

Standard by Alternative	Cumulative Cost ($)	Percent ($)	Cost per percent ($)	Total Fish	Cost per Fish ($)
24-Year Standard					
Alternative 2 less Alternative 1	(339,522)	(2.0)	169,761	25,699	(13)
Alternative 3 less Alternative 1	(115,448)	(1.0)	115,448	40,934	(3)
Alternative 4 less Alternative 1	5,915,367	2.0	2,957,684	168,612	35
48-Year Standard					
Alternative 2 less Alternative 1	(679,045)	(3.0)	226,348	46,046	(15)
Alternative 3 less Alternative 1	(230,896)	(2.0)	115,448	78,012	(3)
Alternative 4 less Alternative 1	11,830,735	36.0	328,632	556,370	21
100-Year Standard					
Alternative 2 less Alternative 1	(1,414,677)	(1.0)	1,414,677	82,855	(17)
Alternative 3 less Alternative 1	(481,034)	-	NM	78,012	(6)
Alternative 4 less Alternative 1	24,647,365	10.0	2,464,736	1,419,466	17

Note: This table uses 1998 PATH model results; 1999 model results are not available in the same format.
Source: BST Associates using data from the Economic Appendix, NMFS and PATH
NM = Not met.

9.4.1.2 48-Year Recovery Standard for Spring/Summer Chinook

Only the dam breaching alternative meets the 48-year recovery standard using the 1998 PATH model results. The dam retention alternatives are relatively close (e.g., within 2 percent to 5 percent) of meeting the recovery standard under the median values. All alternatives attain the standard under the high-end of the probability distribution (e.g., at the 75th percentile).

The costs associated with Alternatives 2 and 3 are lower than those under Alternative 1, resulting in a net savings. However, the probability of meeting the NMFS 48-year standard is lower under these alternatives than under Alternative 1. Each percentage of improved survival is estimated to cost $226.3 million under Alternative 2 and $115.5 million under Alternative 3 (see Table 9-4.)

Each additional percentage attained from moving from Alternative 1, Existing Conditions (48 percent probability of attaining recovery) to Alternative 4, Dam Breaching (84 percent probability of recovery), is expected to cost $328.6 million over the 48-year period. Each fish attained by moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching is expected to cost approximately $21,000 per fish (see Figure 9-3 and Table 9-4).

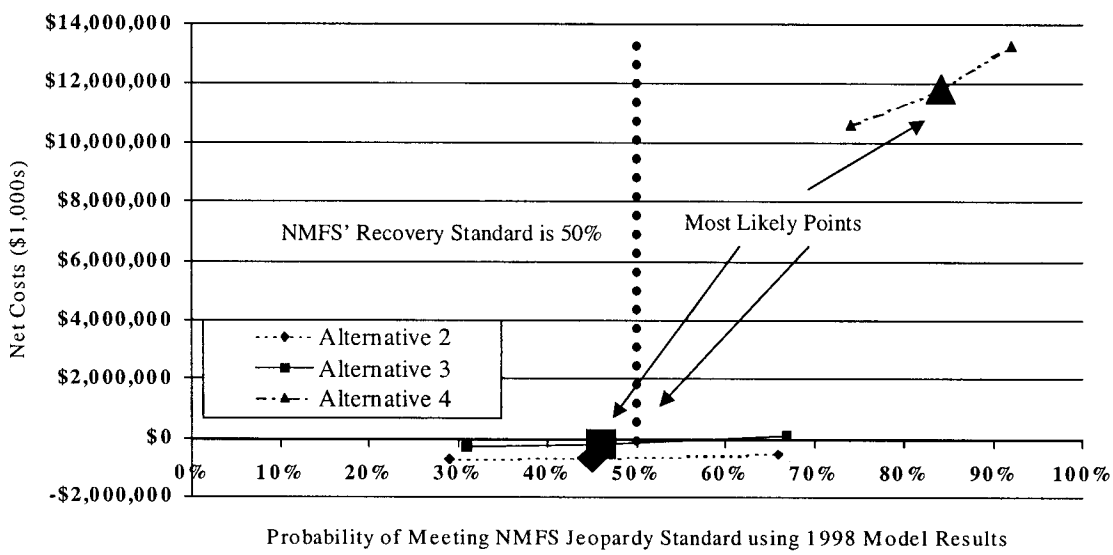


Figure 9-3. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 48-Year Recovery Standards for Spring/Summer Chinook Using 1998 PATH Model Results

9.4.1.3 100-Year Survival Standard for Spring/Summer Chinook

All alternatives meet the 100-year survival standard (see Figure 9-4 and Table 9-1).

Attaining an additional percentage of survival under Alternative 2 would cost approximately $1.4 billion. Alternatives 1 and 3 have the same median probability of meeting the 100-year standard.

Each additional percentage attained from moving from Alternative 1, Existing Conditions (79 percent probability of attaining recovery) to Alternative 4, Dam Breaching (89 percent probability of recovery) is expected to cost $2.5 billion over the 100-year period. Each fish attained by moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching is expected to cost approximately $17,000 per fish (see Figure 9-4 and Tables 9-1 and 9-4).

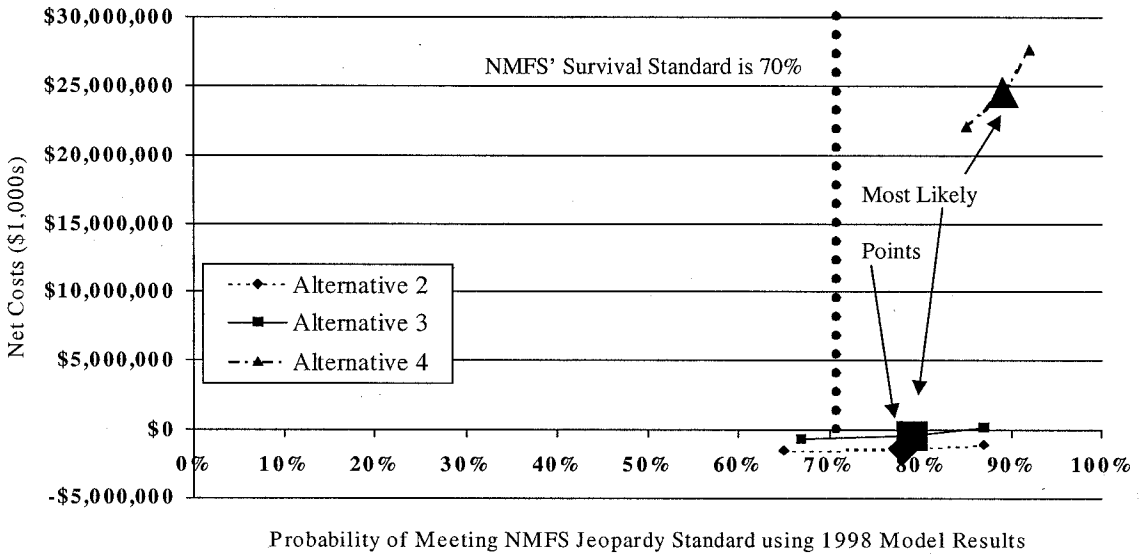


Figure 9-4. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 100-Year Survival Standards for Spring/Summer Chinook Using 1998 PATH Model Results

9.4.2 CE Assessment 2—All Costs Applied to Fall Chinook

Figures 9-5 through 9-7 and Table 9-5 present a comparison of the net cost and biological effectiveness to achieve the NMFS' jeopardy standards for fall chinook for the various alternatives under consideration. This cost effectiveness assessment considers the entire cost of the alternatives applied to fall chinook.

9.4.2.1 24-Year Survival Standard for Fall Chinook

Under the most likely (median) conditions, all of the alternatives meet the 70 percent survival standard on the 24th-year. The probability of success is the same for Alternatives 1 and 2. Hence there is no cost differential per percentage gained between these alternatives. However, Alternative 2 is $339.5 million less costly than Alternative 1.

The increase in one percentage probability in moving from Alternative 1, Existing Conditions, to the Alternative 3, Major System Improvements, is expected to cost $28.8 million over the 24-year period (see Figure 9-5 and Table 9-5)

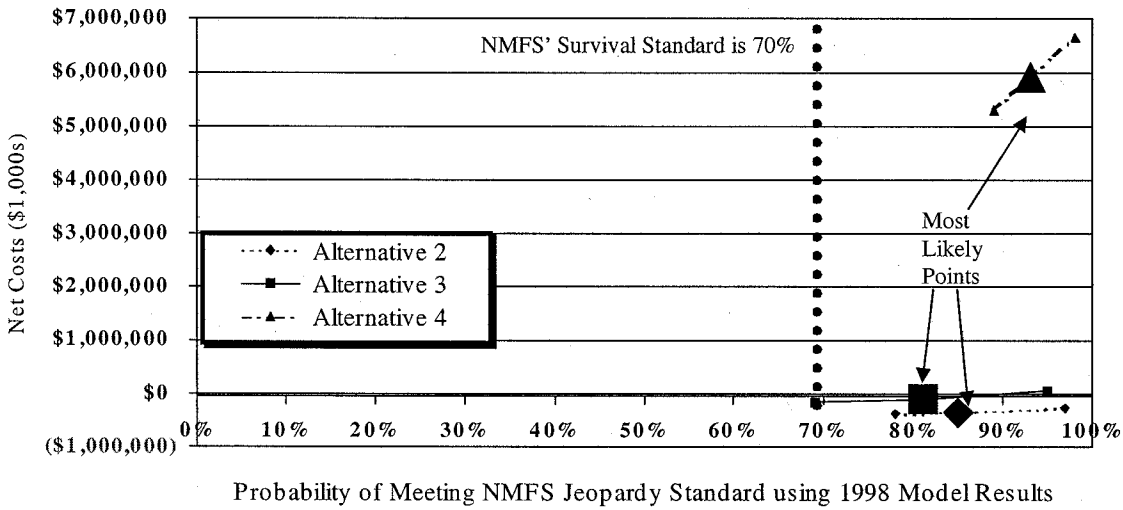


Figure 9-5. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 24-Year Survival Standards for Fall Chinook Using 1998 PATH Model Results

Table 9-5. Incremental Comparison of Net Costs (in $1,000s) and Biological Effectiveness for Fall Chinook Using 1998 PATH Model Results (1998 Dollars)

Standard by Alternative	Cumulative Cost ($)	Percent	Cost per percent ($)	Total Fish	Cost per Fish ($)
24-Year Standard					
Alternative 2 less Alternative 1	(339,522)	-	-	-	-
Alternative 3 less Alternative 1	(115,448)	(4.0)	28,862	4,524	(26)
Alternative 4 less Alternative 1	5,915,367	8.0	739,421	205,443	29
48-Year Standard					
Alternative 2 less Alternative 1	(679,045)	-	-	-	-
Alternative 3 less Alternative 1	(230,896)	6.0	(38,483)	11,735	(20)
Alternative 4 less Alternative 1	11,830,735	78.0	151,676	524,959	23
100-Year Standard					
Alternative 2 less Alternative 1	(1,414,677)	-	-	-	-
Alternative 3 less Alternative 1	(481,034)	(5.0)	96,207	25,444	(19)
Alternative 4 less Alternative 1	24,647,365	15.0	1,643,158	1,207,274	20

Note: This table uses 1998 PATH model results, 1999 model results are not available in a similar format.
Source: BST Associates using data from the Economic Appendix, NMFS and PATH

The increase in one percentage probability in Alternative 1, Existing Conditions, to the Alternative 4, Dam Breaching is expected to cost $739.4 million over the 24-year period. Each additional fish gained by dam breaching is estimated to cost $29,000 per fish (see Figure 9-5 and Table 9-5).

9.4.2.2 48-Year Recovery Standard for Fall Chinook

Only the dam breaching alternative meets the 48-year recovery standard using the 1998 PATH model results. The dam retention alternatives are not close to meeting this recovery standard (between 22 percent to 28 percent away from the 50 percent recovery standard), using the 1998 model results.

The benefit in moving from Alternative 1, Existing Conditions, to Alternative 3, Major System Improvements, is expected to save $38.5 million over the 48-year period (see Figure 9-5 and Table 9-4).

Each additional percentage of survival attained from moving from Alternative 1 (22 percent probability of attaining recovery) to Alternative 4 (100 percent probability of recovery) is expected to cost $151.7 million per year over the 48-year period. Each fish attained by moving from Alternative 1 to Alternative 3 is expected to cost approximately $23,000 per fish (see Figure 9-6 and Tables 9-2 and 9-5).

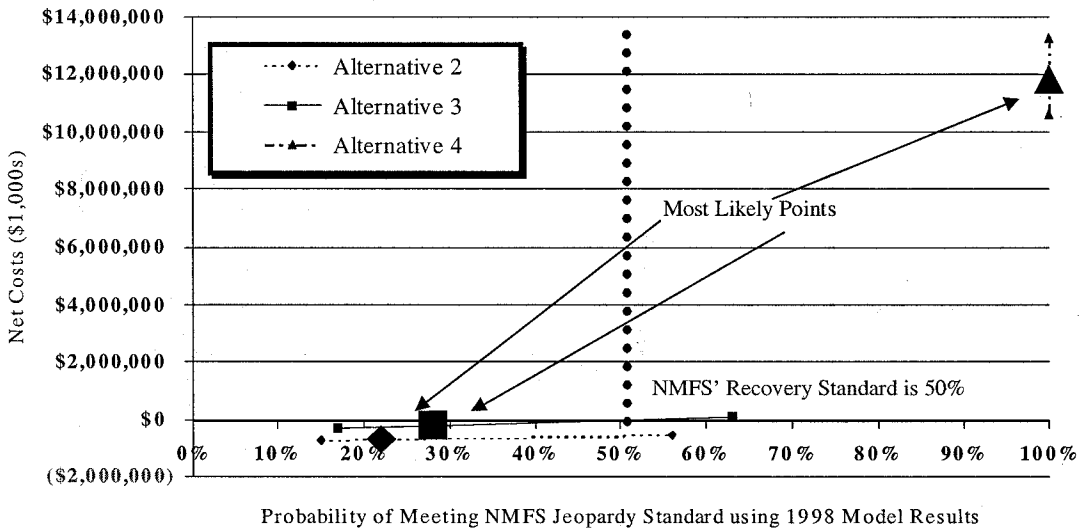


Figure 9-6. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 48-Year for Fall Chinook Using 1998 PATH Model Results

9.4.2.3 100-Year Survival Standard for Fall Chinook

All alternatives meet the 100-year survival standard (see Figure 9-7 and Table 9-2).

The benefit in moving from Alternative 1, Existing Conditions, to Alternative 3, Major System Improvements, is expected to cost $96.2 million over the 100-year period (see Figure 9-5 and Table 9-5).

Each additional percentage of survival attained from moving from Alternative 1 to Alternative 4 is expected to cost $1.6 billion per year over the 100-year period. Each fish attained by moving from Alternative 1 to Alternative 4 is expected to cost approximately $20,000 per fish (see Figure 9-7 and Table 9-5).

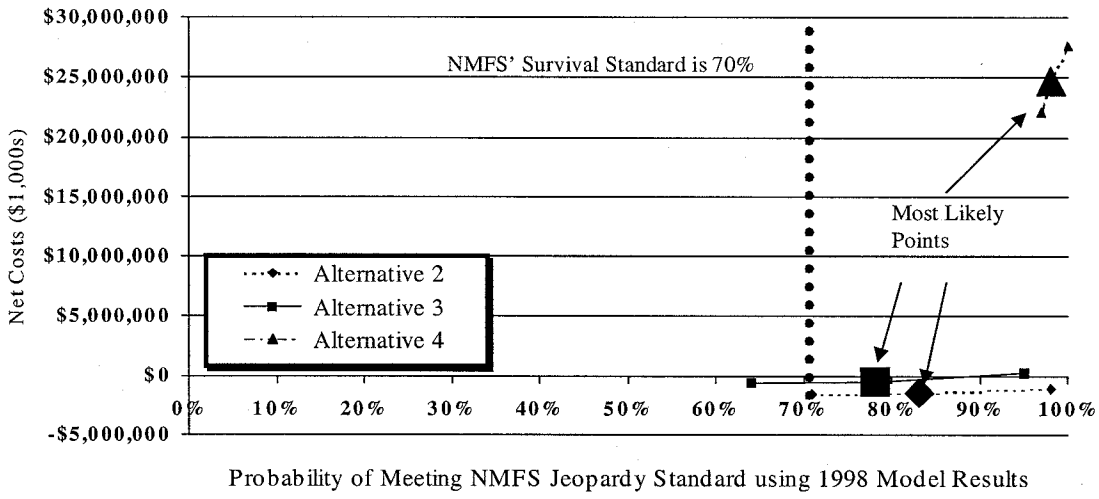


Figure 9-7. Net Cost & Biological Effectiveness Comparison for Meeting the NMFS' 100-Year Survival Standards for Fall Chinook Using 1998 PATH Model Results

9.4.3 CE Assessment 3—Costs Applied to all Fish

A comparison of the net cost and biological effectiveness to achieve the NMFS jeopardy standards across spring/summer and fall chinook and steelhead for the various alternatives under consideration is presented in Table 9-6. This cost effectiveness assessment spreads the cost of the alternatives to all fish, as determined by the anadromous fish working group. As mentioned previously, there is no combined probability associated with meeting the NMFS standards across all impacted species.

9.4.3.1 24-Year Survival Standard for all Fish

Alternatives 2 and 3 are estimated to generate more fish than Alternative 1 at a reduced cost. The savings from choosing these alternatives is estimated to be $11,000 and $3,000 per fish over the 24-year survival standard, for each respective alternative. The additional cost of moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching, is estimated to be $15,000 per fish over the 24-year period (see Figure 9-5 and Table 9-6).

9.4.3.2 48-Year Recovery Standard for all Fish

The savings from choosing Alternatives 2 or 3 is estimated to be $14,000 and $3,000 per fish over the 48-year recovery standard, respectively. The additional cost of moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching, is estimated to be $10,000 per fish over the 48-year period (see Figure 9-5 and Table 9-6).

9.4.3.3 100-Year Survival Standard for all Fish

The savings from choosing Alternatives 2 or 3 is estimated to be $18,000 and $4,000 per fish over the 100-year survival standard, respectively. The additional cost of moving from Alternative 1, Existing Conditions, to Alternative 4, Dam Breaching, is estimated to be $8,000 per fish over the 100-year period (see Figure 9-5 and Table 9-6).

Table 9-6. Incremental Comparison of Net Costs (in $1,000s) and Biological Effectiveness for Spring/Summer and Fall Chinook and for Steelhead using 1998 PATH Model Results, as Extrapolated by the DREW Anadromous Fish Workgroup (1998 dollars)

Standard by Alternative	Cumulative Cost ($)	Total Fish ($)	Cost per Fish ($)
24-Year Standard			
Alternative 2 less Alternative 1	(339,522)	29,757	(11)
Alternative 3 less Alternative 1	(115,448)	38,936	(3)
Alternative 4 less Alternative 1	5,915,367	403,115	15
48-Year Standard			
Alternative 2 less Alternative 1	(679,045)	48,157	(14)
Alternative 3 less Alternative 1	(230,896)	72,220	(3)
Alternative 4 less Alternative 1	11,830,735	1,188,900	10
100-Year Standard			
Alternative 2 less Alternative 1	(1,414,677)	78,634	(18)
Alternative 3 less Alternative 1	(481,034)	131,429	(4)
Alternative 4 less Alternative 1	24,647,365	2,915,720	8

Note: This table uses 1998 PATH model results; 1999 model results are not available in a similar format.
Source: BST Associates using data from the Economic Appendix, NMFS and PATH

9.5 Conclusions

9.5.1 Biological Considerations

9.5.1.1 1998 Model Results

None of the alternatives meets all of the jeopardy standards using 1998 PATH model results.

Alternative 4, Dam Breaching, **comes the closest** to meeting all of the jeopardy standards for both spring/summer and fall chinook (e.g., five out of six standards).

The dam retention alternatives **come relatively close** to meeting all of the jeopardy standards, with the exception of the 48-year recovery standard for fall chinook.

9.5.1.2 1999 Model Results

As discussed previously, PATH is continuing to refine the model, using new information on key variables related to delayed mortality (the D factor), ocean conditions, and ocean harvests, among other variables. These modifications are having an affect on model results for fall chinook, in the following ways:

- All alternatives meet the 24-year and 100-year survival standards.
- All drawdown actions meet the 48-year recovery standard.

- Non-breaching actions (e.g., Alternatives 1, 2 and 3) all meet the 48-year recovery standard but they are not considered as robust to the current level of uncertainty in relative survival of transported fish as is Alternative 4, Dam Breaching.

Unfortunately, the 1999 model results were reported too late to be included in the economic appendix.

9.5.2 Cost Effectiveness Analysis

The following conclusions **use the 1998 model results**, which suggested a larger variation in output between dam retention and dam breaching alternatives. **Model results from 1999 suggest that the difference is much narrower between these alternatives than stated in the 1998 model results.** As a consequence, the cost effectiveness results based on 1998 model results *over-state the benefits from dam breaching* relative to dam retention.

9.5.2.1 Cost Effectiveness Assessment 1—Costs Applied to Spring/Summer Chinook

There is little difference between the dam retention alternatives and the dam breaching alternative with respect to meeting the NMFS jeopardy standards for spring/summer chinook. As a result, dam breaching creates little additional biological output using 1998 model results but is significantly more costly. The additional cost of choosing Alternative 4, Dam Breaching, as opposed to Alternative 1, Existing Conditions, is estimated at $17,000 to $35,000 per fish, depending on the year under consideration (e.g., the cost decreases as the number of years increases).

9.5.2.2 Cost Effectiveness Assessment 2—Costs Applied to Fall Chinook

Under the 1998 model results, the dam retention alternatives meet the 24-year and 100-year survival standards but are not close to meeting the 48-year recovery standard. The additional cost of choosing Alternative 4, Dam Breaching, as opposed to Alternative 1, Existing Conditions, is estimated at $20,000 to $29,000 per fish, depending on the year under consideration (e.g., the cost decreases as the number of years increases).

Since dam retention alternatives meet or come close to meeting the NMFS jeopardy standards for spring/summer chinook but not for fall chinook using the 1998 model results, dam breaching could be considered preferred for fall chinook but unnecessary for spring/summer chinook.

9.5.2.3 Cost Effectiveness Assessment 3—Costs Applied to all Fish

Alternatives 2 and 3 are estimated to generate more fish than Alternative 1 at a reduced cost. The savings from choosing Alternative 2 is estimated to range between $11,000 and $18,000 per fish, depending upon the number of years under consideration. The savings from choosing Alternative 3 is estimated to range between $3,000 and $8,000 per fish, depending upon the number of years under consideration.

The additional cost of choosing Alternative 4, Dam Breaching, is estimated to be between $8,000 and $15,000 per fish, depending upon the number of years under consideration.

9.5.2.4 Implications of the 1999 Model Results

The 1999 model results have the following qualitative implications:

- Biological output—the number of fish associated with dam retention alternatives will increase and the difference in the number of fish, comparing dam retention and dam breaching alternatives, will decrease.
- NED costs—there will be no change in the NED cost estimates since they are based on moving to alternative and more costly systems (e.g., to produce power, transport commodities etc.) and are, thus, not sensitive to differences in biological output.
- NED benefits—the estimated benefits from commercial and recreational fishing associated with the dam breaching alternative as compared with the dam retention alternatives will decrease because the incremental fish output is smaller between alternatives with the 1999 model results.
- Although the 1999 model results are not available in a similar format as those prepared in 1998, the biological benefits of the dam retention alternatives improve markedly while the biological benefits of the dam breaching alternative do not change markedly. This new information suggests that all of the NMFS jeopardy standards can be met under dam retention alternatives at much lower cost than under dam breaching.

9.5.3 Unresolved Issues

The Economics Appendix was prepared before the PATH 1999 model results were available. The major unresolved issue in this chapter is updating the data results that would be expected to change as a result of the 1999 PATH model results. As described above, this includes:

- Relative biological outputs, including the PATH ranges of probabilities (from low to high and median results) and the DREW Anadromous Fish Workgroup economic extrapolations to the entire ESU stocks and to steelhead,
- Revised commercial and recreational NED benefits.

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10. Summary of Effects

10.1 Introduction

The purpose of this section is to present a balanced display of overall benefits and costs associated with each resource area across each alternative. The summary presents both the monetary and non-monetary effects of the national and regional analyses developed for this Feasibility Report.

It should be emphasized that the national and regional displays are distinct accounting stances and cannot be added or subtracted from each other. With the exception of selected monetary estimates noted by an asterisk, all estimates are presented net of Alternative 1, Existing Conditions.

10.2 National Benefits and Costs

The first section presents a comparison of national benefits and costs, including:

- Biological impacts associated with each alternative
- National economic development (NED) costs
- National economic development (NED) benefits.

10.2.1 Biological Benefits

Table 10.1 presents a comparison of alternative results based upon data provided by NMFS and PATH using 1998 model results. None of the alternatives meets all of the jeopardy standards using 1998 PATH model results. Alternative 4, Dam Breaching, comes the closest to meeting all of the jeopardy standards for both spring/summer and fall chinook (e.g., this alternative meets 5 out of 6 standards). The dam retention alternatives come relatively close to meeting all of the jeopardy standards, with the exception of the 48-year recovery standard for fall chinook.

However, PATH is continuing to refine the model, using new information on key variables related to delayed mortality (the D factor), ocean conditions, and ocean harvests, among other variables. These modifications are having an affect on model results for fall chinook. According to the Peters et al., 1999:

- "All hydrosystem actions meet survival standards (probabilities of exceeding survival escapement thresholds are greater than 0.7), regardless of what is assumed about the estuary/ocean survival rate of transported fish.
- All drawdown actions meet recovery standards (probabilities of exceeding recovery escapement thresholds are greater than 0.5) regardless of what is assumed about the estuary/ocean survival rate of transported fish. Alternative 4, Dam Breaching, exhibited the most robust response across those uncertainties considered to date, and produced higher recovery probabilities (as well as higher average spawning escapements) than other actions. This conclusion is sensitive to assumptions about adult upstream survival.
- For each hypothesis about relative survival of transported fish, there are non-breaching actions (actions which do not involve drawdowns of dams) that meets the recovery standard, although there is no single non-breaching alternative option that meets recovery standards under all assumptions about the relative survival of transported fish. If transported fish are assumed to

have high relative survival (i.e., high D), maximizing transportation will achieve recovery standards. If transported fish are assumed to have low relative survival (i.e., low D), then retaining current system configuration and allowing all smolts to migrate in-river achieves the recovery standards. Non-breaching actions are not as robust to the current level of uncertainty in relative survival of transported fish as are drawdown actions." (Page 8)

The 1999 model results are not available in the same format as the 1998 model results reported in Table 10-1.

Table 10-1. Ability to Meet the NMFS Jeopardy Standards for Survival and Recovery Based Upon 1998 PATH Model Results (Median Values Presented)

Biological Benefits	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Spring/Summer Chinook				
Survival in 24th year (standard is 0.70)	0.67	0.65	0.66	0.69
Recovery in 48th Year (standard is 0.50)	0.48	0.45	0.46	0.84
Survival in 100th year (standard is 0.70)	0.79	0.78	0.79	0.89
Fall Chinook				
Survival in 24th year (standard is 0.70)	0.85	0.85	0.81	0.93
Recovery in 48th Year (standard is 0.50)	0.22	0.22	0.28	1.00
Survival in 100th Year (standard is 0.50)	0.83	0.83	0.78	0.98

Source: NMFS, PATH

10.2.2 NED Costs

NED costs include the following cost categories:

- Implementation costs for the fish-related improvements (e.g., the construction and acquisition costs, annual costs for operation, maintenance, repair, replacement, rehabilitation, and monitoring and Federal mitigation costs). For more detail, the reader is referred to the chapter on implementation and avoided costs.
- NED Costs, which are any existing National Economic Development (NED) costs that would be incurred as a result of implementing the dam breaching alternative, notably:
  - additional costs to provide power by the next least costly form of power generation (described in the hydropower chapter)
  - additional transportation costs to shift barge-transported commodities to other truck, rail and barge systems (described in the transportation chapter)
  - additional construction/O&M costs for irrigation and water supply systems (described in the water supply chapter).

All costs presented in Table 10-2 are net of Alternative 1, Existing Conditions. NED costs associated with Alternative 2, Maximum Transport of Juvenile Salmon, and Alternative 3, Major System Improvements, are lower than under base case conditions, by $12.0 million and $2.6 million, respectively at a discount rate of 6 7/8 percent. The NED costs associated with Alternative 4, Dam Breaching, are estimated to be $359 million higher than under the base case conditions per year for 100 years, under the same discount rate.

Table 10-2. Summary of NED Costs Net of the Base Case (1998 Dollars) ($1,000s)

Description of NED Costs	Alternative 2	Alternative 3	Alternative 4
Implementation Costs			
@6.875%	3,457	(5,931)	(48,787)
@4.75%	2,556	(4,376)	(35,498)
@0.0%	663	(1,390)	(8,298)
Power			
@6.875%	8,500	8,500	(271,000)
@4.75%	8,500	8,500	(267,500)
@0.0%	8,000	8,000	(263,500)
Transportation			
@6.875%	-	-	(24,034)
@4.75%	-	-	(25,249)
@0.0%	-	-	(28,330)
Irrigation/Water Systems			
@6.875%	-	-	(15,424)
@4.75%	-	-	(10,746)
@0.0%	-	-	(2,241)
Total			
@6.875%	11,957	2,569	(359,245)
@4.75%	11,056	4,124	(338,993)
@0.0%	8,663	6,610	(302,368)

Source: Economics Appendix chapters

Using the 1999 NMFS/PATH results, which as discussed above will increase the biological output associated with the dam retention alternatives, will not impact net NED costs because these cost estimates are not sensitive to biological output.

10.2.3 NED Benefits

NED benefits include the following cost categories:

- Avoided costs, which include operations, maintenance, repair, replacement, rehabilitation of existing infrastructure that would be avoided under alternative conditions (e.g., existing power systems, navigation locks, and other like costs that occur under the dam retention alternatives but not under the dam breaching alternative). These costs, which are presented in the implementation/avoided cost chapter, are treated as a benefit in the following table because they can be avoided under the dam breaching alternative.
- NED Benefits, which include any existing National Economic Development (NED) benefits that could accrue as a result of implementing alternatives, notably:
    - additional recreation benefits from drawdown conditions for anglers from enhanced fisheries and to users of the free flowing river (described in the recreation chapter)

- additional commercial fishing benefits in the river and in the ocean and recreation benefits occurring outside of the Lower Snake River system (described in the anadromous fish chapter).

All benefits presented in Table 10-3 are net of Alternative 1, Existing Conditions. NED benefits associated with Alternative 2, Maximum Transport of Juvenile Salmon, and Alternative 3, Major System Improvements, are higher than under base case conditions by $2.2 million, at a discount rate of 6 7/8 percent. The NED benefits associated with Alternative 4, Dam Breaching, are estimated to be $113 million higher than under the base case conditions per year for 100 years, under the same discount rate.

Table 10-3. Summary of NED Benefits Net of the Base Case (1998 Dollars) ($1,000s)

Description of NED Benefits	Alternative 2	Alternative 3	Alternative 4
Avoided Costs			
@6.875%	-	-	29,178
@4.75%	-	-	29,343
@0.0%	-	-	29,050
Recreation			
@6.875%	2,030	2,080	82,000
@4.75%	1,940	1,970	62,120
@0.0%	1,420	1,180	61,022
Commercial Fishing			
@6.875%	160	161	1,593
@4.75%	176	174	2,064
@0.0%	198	188	3,486
Total NED Benefits			
@6.875%	2,190	2,241	112,771
@4.75%	2,116	2,144	93,527
@0.0%	1,618	1,368	93,558

Source: Economics Appendix chapters

Using the 1999 NMFS/PATH results, which as discussed above will increase the biological output associated with the dam retention alternatives, will not impact avoided costs since they are based on the costs of operating the existing systems and are not sensitive to biological output. However, using the 1999 model results will reduce NED benefits associated with Alternative 4, Dam Breaching, because relatively more fish are projected for the dam retention alternatives resulting in a smaller biological difference between the dam retention and dam breaching alternatives.

10.3 Tribal Benefits and Costs

This section presents a summary of tribal effects. The estimated increase in tribal harvest is based upon 1998 model results. As with NED benefits, using the 1999 model results will increase the harvest for Alternatives 1, 2 and 3 and reduce the difference between dam retention and dam breaching alternatives.

The Tribal Circumstances and Perspectives Report asserts that Alternatives 1 and 2 offer limited hope of salmon recovery within a timeframe considered reasonable by the five represented tribes. The report does not address Alternative 3, but the impacts for this alternative are likely closely match with those for Alternative 2. There would be no change in tribal land use under any of these alternatives.

According to the Tribal Circumstances and Perspectives Report, Alternative 4, Dam Breaching, would produce 2.4 times more tribal harvest of Snake River wild salmon and steelhead stocks compared to Alternative 1 (2.6 times more harvest than Alternative 2). At the 50-year benchmark, estimated tribal wild and hatchery harvest would increase by about 1.7 million pounds. The Tribal Circumstances and Perspectives Report concludes that only this alternative would redirect river actions toward significant improvement of the cultural and material circumstances of the tribes.

Approximately 14,000 acres of previously inundated land would be exposed under Alternative 4. The Tribal Circumstances and Perspectives Report states that the tribes would benefit greatly from implementation of this alternative by gaining access to lands once used for cultural, material, and spiritual purposes.

10.4 Passive Use Value Estimates

This section presents a summary of the passive use (or existence) values for salmon recovery and survival and for the creation of a free-flowing river. Economists recognize that there is a benefit associated with knowing that the resource exists even if no use is made of it. There are, however, disagreements about how to measure passive use values. The Economic Appendix used a benefit transfer approach. The reader is referred to Passive Use Values chapter of this appendix for more information. It should be noted that passive use values are not considered to be NED benefits.

The passive use values associated with salmonid recovery and survival in the Snake River were estimated to range from $66 million to $879 million per year, with a middle range between $142 and $508 million per year.

The passive use value of a free flowing Snake River was estimated at $420 million per year.

The passive use values for salmon recovery and survival are based upon the 1998 model results on a per fish basis. As with NED benefits and tribal harvests, using the 1999 model results will reduce the difference between dam retention and dam breaching alternatives and hence will decrease the difference in passive use values for salmon between dam retention and dam breaching alternatives. However, the passive use values associated with the free flowing river will not change because they are not sensitive to biological output.

10.5 Regional Benefits and Costs

The Regional Economic Development (RED) account addresses regional economic impacts in terms of jobs and income resulting from the alternatives under consideration. Impacts on employment and income include direct, indirect (e.g., inter-firm purchases) and induced (e.g., purchases by employees of affected firms) effects. The job totals reported below are estimates of total impacts and include both full- and part-time employment.

10.5.1 Regional Impacts Associated with Alternatives 2 and 3

Regional impacts under Alternatives 2 and 3 are expected to be relatively minor and limited to those associated with changes in implementation and avoided cost.

10.5.2 Regional Impacts Associated with Alternative 4 (RED)

The regional economic analysis developed for this study addresses the regional economic impacts of changes in spending projected by various DREW workgroups. These impacts, evaluated in terms of business sales, employment, and income, were estimated using input-output models, which model the interactions among different sectors of the economy. Eight models were constructed to address the potential regional effects associated with the alternatives. Models were developed for Washington, Oregon, Idaho, and Montana, three subregions—the downriver, reservoir, and upriver subregions, and the lower Snake River study area, which consists of the three subregions. In addition, the DREW Anadromous Fish Workgroup estimated the economic impacts of changes in anadromous fish harvests. These impacts were evaluated for the Pacific Northwest states, Alaska, and British Columbia, Canada.

Construction activities resulting directly and indirectly from breaching of the four lower Snake River dams would generate increased business sales of $2,263 million, 20,790 temporary jobs, and $676.7 million in personal income in the lower Snake River study area. These changes would occur within ten years of dam breaching and would fluctuate from year-to-year. In the long run, the lower Snake River study would experience a net decrease in business sales of $33.7 million, a loss of 711 jobs, and decrease of $46.1 million in personal income. Short- and long-term changes lower Snake River study area employment are presented by resource area and study region in Tables 10-4 and 10-5.

Table 10-4. Short-Term Employment Effects (Jobs)[1/]

	Upriver	**Reservoir**	**Downriver**	**Total Lower Snake River Study Area**[2/]
1995 Employment	75,081	92,535	151,124	318,740
Power Plant Construction[3/]	0	0	5,572	5,572
Transmission Line Construction	0	0	2,080	2,080
Rail Construction[4/]				872
Road Construction[4/]				1,972
Facilities Construction[4/]				6,982
Well Modification	0	916	259	1,175
Pump Modification	844	0	0	844
Implementation	259	517	517	1,293
Total Change[5/]	**1,103**	**1,433**	**8,428**	**20,790**
Change as % of 1995 Employment	1.47	1.55	5.58	6.52

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years. A number of the impacts have a wide range of variation depending on the magnitude of construction and the length of the time period.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area includes the sum of employment change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ The DREW Hydropower Impact Team (DREW Hydropower Impact Team) assumed that a total of six replacement power plants would be built. The exact locations of these plants are unknown but DREW Hydropower Impact Team assumed that three would be located in the downriver subregion, with the other three most likely located in the Puget Sound region. Construction of each power plant is estimated to generate 2,786 short-term jobs. The estimates shown in this table are the maximum number of these jobs that would be generated in any one year—5,572 in the downriver subregion, where two plants would be constructed simultaneously.

4/ These effects would occur in the lower Snake River study area but it is not known how they would be distributed among the subregions.

5/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River Study Area figure because some of the projected Study Area impacts were not distributed by subregion.

Table 10-5. Long-Term Employment Effects (Jobs) [1/]

	Upriver	Reservoir	Downriver	Total Lower Snake River Study Area[2/]
1995 Employment	75,081	92,535	151,124	318,740
O&M Spending on Replacement Power Plants & New Transmission Lines	0	0	884	884
Recreation (inc. Angling) [3/]				1,393
Total Long-Term Employment Gain[4/]	**0**	**0**	**884**	**2,277~**
Reduction in Irrigated Lands	0	(1,105)	(474)	(1,579)
Avoided Costs (Reductions in Corps' Spending)	(133)	(1,060)	(133)	(1,326)
Reduced Cruise Ship Operations	(83)	0	0	(83)
Total Long-Term Employment Loss	**(216)**	**(2,165)**	**(607)**	**(2,988)**
Net Long-Term Employment Change[4/]	(216)	(2,165)	277	(711)
Net Change as a % of 1995 Employment	(0.29)	(2.34)	0.18	(0.22)

1/ Midpoints are shown when only lower and upper bounds were available from other DREW workgroups. Averages are shown when the effects vary by year over a number of years.

2/ The three subregions comprise the lower Snake River study area. Employment change in this area is the sum of employment change across the three subregions. Some of the projected Study Area impacts were not distributed by subregion.

3/ These effects would occur in the lower Snake River study area, but it is not known how they would be distributed among the subregions.

4/ The upriver, reservoir, and downriver subtotals do not sum to the total lower Snake River Study Area figure because some of the Study Area impacts were not distributed by subregion.

Impacts would also occur throughout the Pacific Northwest, throughout a state, or in an area of a State outside a subregion. These impacts include reductions in business sales, employment, and personal income associated with increased electricity bills. Positive impacts would be associated with replacement power plant construction and operations in the Puget Sound region, construction of tidewater rail care storage in Oregon, and increases in commercial and ocean recreation harvest of anadromous fish in the Pacific Northwest states, Alaska, and British Columbia, Canada.

10.6 Social Impacts

The majority of communities in the lower Snake River region are small rural towns that have low to moderate economic diversity. These communities primarily rely on the agricultural and wood products sectors, even though they have declined as a source of regional employment and income over the past decade.

10.6.1 Alternatives 2 and 3

Alternatives 2 and 3 are estimated to have little effect on the existing social and economic environment for the majority of the communities within the region. Some communities, particularly those located up river, (e.g., Lewiston, Orofino, and Riggins), could be adversely affected by lower probabilities of salmon recovery. Continued Federal oversight and uncertainty about the future of the four dams may also have negative social effects on some communities.

10.6.2 Alternative 4

Breaching the four dams would change the physical and economic environment of the lower Snake River region. Communities located upriver of the four dams (e.g., Lewiston, Orofino, and Riggins) would likely experience net employment gains as a result of expected increases in recreation and tourism associated with a free-flowing river and to a lesser extent increased fish runs. Communities located within the six counties located adjacent to the lower Snake River reservoirs (e.g., Pomeroy, Colfax, and Clarkston) would likely experience a net decrease in employment due to decreases in Corps employment and increased pressure on family farms caused by increased transportation, storage, and handling costs for agricultural products.

Communities located downriver of Ice Harbor dam (e.g., Pasco, Kennewick, and Umatilla) would likely experience employment loss if farms presently irrigated from Ice Harbor reservoir go out of business. These losses may be partially offset by expected increases in transportation- and power generation-related employment.

Communities would likely adjust to these changes over time. New individuals and businesses seeking new opportunities may replace those that have been displaced. Displaced human and capital resources may be employed in their next best use within the community. This type of adjustment does, however, take time and would vary by community. Community size has been identified as a critical factor affecting a community's ability to adapt to change, with smaller, less diverse communities tending to respond less favorably.

Many of the community level impacts could be caused by the loss of irrigated agriculture on Ice Harbor reservoir and increased grain transportation costs. These impacts may be minimized or partially eliminated by mitigation spending to modify existing irrigation pumps and spending to expand rail capacity in the region or by directly subsidizing affected farms.

11. Cost Allocation

The purpose of the Cost Allocation analysis is to examine a range of possible cost allocation approaches that could be used to distribute costs of the proposed alternatives. The primary purpose of allocating project costs is to identify repayment responsibility with respect to cost recovery, cost sharing, or both (as may be required). The following discussion does not recommend a preferred approach at this time. However the cost implications of the approaches are shown using the preliminary construction costs and the unrecovered Federal investment.

11.1 Purpose

From a Federal perspective, cost allocations are made to derive an equitable distribution of project costs among authorized project uses, or those proposed for authorization. Laws and regulations requiring reimbursement or cost-sharing generally specify recovery of costs incurred for the service or function. Cost allocation is, therefore, required for most Federal multipurpose projects having reimbursable purposes.

The cost allocation is an essential part of the multipurpose planning process where cost-sharing will be required. It provides information needed to determine the magnitude and share of estimated project costs that are reimbursable. This information is essential to the tests of financial feasibility and plan acceptability. During subsequent planning and construction, it provides the information required for allocating actual expenditures and insures that cost accounts are maintained consistent with the plan formulation and allocation principles.

The authorizing document for the lower Snake River projects, PL 79-14, designated the Federal Power Commission (now the Federal Energy Regulatory Commission [FERC]) as the agency responsible for defining the allocation of costs to navigation and hydropower. The Final Cost Allocations were completed by FERC in 1965 for Ice Harbor, and 1984 for Lower Monumental, Little Goose, and Lower Granite. FERC completed the allocation studies based on data and preliminary allocations done by the Corps of Engineers. Any new cost allocations for these projects will be coordinated with FERC.

It has been Corps policy not to request reallocation of storage and/or project costs unless a major reformulation of a project is required. Some of the actions that may be recommended in this Feasibility Report could require authorization by Congress. The Congressional authorization could contain directive language concerning the allocation of costs. In the absence of such directive language, the Corps of Engineers' administratively developed procedures would be utilized to allocate the project costs.

11.2 Allocating Costs

11.2.1 Assumptions

The Dam Breaching alternative could affect the existing cost allocations because of the possible deletion of authorized uses (navigation and hydropower). Implementation could likely result in new cost allocations being considered for all the facilities being proposed for breaching (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor). A change in the existing allocations would not only affect how implementation costs are allocated, but also the existing debt on the projects.

Because the economic benefits at these multi-use facilities could be significantly altered between purposes, they can be considered for new cost allocations. Table 11-1 identifies which alternatives are likely to require new cost allocations.

Table 11-1. Alternatives Requiring New Cost Allocations

Alternatives	New Cost Allocations Necessary
1 Existing Condition – Base Case	No
2 Maximum Transportation	No
3 Major System Improvements	No
4 Dam Breaching	Yes

Approaches to cost allocation could be quite different depending on the alternative recommended. As long as the measures do not significantly effect the current authorized uses, the costs would be allocated to mitigation according to the existing joint-use percentages. Historically, costs for fish transportation and bypass measures have been defined as mitigation. It is assumed similar alternatives like transportation and fish bypass improvements would also be assigned to mitigation and shared according to the original joint-use percentages. Therefore, it is expected that new cost allocations would only be necessary for the drawdown or dam breaching alternative. Table 11-2 shows the construction joint-use percentages for the lower Snake River projects as established by the initial allocations.

Table 11-2. Joint-Use Percentages for Construction Costs by Authorized Project Uses

Facility	% Allocated to Power	% Allocated to Navigation
Lower Monumental	94.1	5.9
Ice Harbor	78.6	21.4
Little Goose	93.3	6.7
Lower Granite	98.4	1.6

11.2.2 Methodology

Alternatives being considered for this Feasibility Report could be described as either mitigation or restoration of endangered salmon runs.

How the alternatives are characterized could change the way the costs are allocated. Mitigation measures are joint-use costs allocated based on the original firm cost allocations. Joint-use costs are assigned to those facilities that serve more than one authorized use. Currently, barging of juvenile fish and bypass measures at the projects are considered mitigation actions. Restoration measures by comparison would be allocated solely to ecosystem restoration.

The unrecovered Federal debt is comprised of investment costs allocated to power for the four lower Snake facilities (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor). Total remaining debt as of the end of 1998 was approximately $479 million for construction of the dams and $271 for the lower Snake River fish hatcheries and fish mitigation. The BPA re-pays this debt to the Federal government from power revenues. The four lower Snake River facilities began producing power between 1962 and 1975.

For illustrative purposes, the unrecovered Federal debt is considered part of the implementation costs and is allocated according to the requirements for mitigation or restoration for the drawdown or dam breaching alternative. At this point however, it is not clear what obligation, if any, BPA would have to repay this outstanding debt in the event the dams are breached. BPA's obligation would likely be determined based on legal opinion, congressional direction, and negotiation.

11.3 Potential Approaches To Allocating Costs For Dam Breaching

It should be recognized that when Congress provides the authorizing legislation for any of the alternatives being investigated in this Feasibility Report, it can designate what cost allocation or cost sharing approach to be used. As such, the possible alternative approaches to allocating costs are infinite. This section, however, presents two possible approaches for allocating drawdown costs that follow the current administrative guidelines.

11.3.1 Cost Share as Mitigation

Under this option the cost of the drawdown alternative would be treated as a mitigation cost. The concept behind this option is that the construction and operation of these projects for the hydropower and navigation has resulted in declining wild salmon and steelhead stocks that represent an unmitigated loss that has accrued to the facilities. If the drawdown alternative is recommended for implementation as a mitigation project, it would be on the basis that it is the most effective mitigation or only effective mitigation for this loss. Therefore, the cost of achieving this mitigation would be properly assigned back to the authorized uses that necessitated the mitigation. This has been the approach for recent fish and wildlife measures at Columbia and Snake River dams. An issue is whether costs should be allocated to authorized uses that have been eliminated.

The costs could be allocated based on existing joint use percentages. Nearly 90 percent of the cost would be allocated to hydropower and repaid to the U.S. Treasury by BPA through collections from power customers. Navigation would be allocated 10 percent of the cost and these costs would be Federal and not recoverable. The remaining unrecovered hydropower debt on the lower Snake River dams would continue to be paid to the U.S. Treasury through collections from power customers. Any operation and maintenance costs associated with the drawdown alternative (for example maintenance of the locks and remaining dam in caretaker status) could be allocated to the hydropower and navigation and shared as the operation and maintenance costs.

If one assumes that breaching of the dams is an additional or new feature for mitigation purposes, costs should be allocated as joint-use construction costs. The joint-use cost percentages would be the basis for this allocation. Tables 11-3 and 11-4 estimate how the unrecovered debt and implementation and O&M costs would be allocated for Alternative 4, Dam Breaching.

Table 11-3. Mitigation – Allocated Investment Costs and Unrecovered Debt

Alternative 4 Preliminary Costs – Allocated by Authorized Uses (1998 dollars) ($1,000)		
	Investment Cost	Unrecovered Debt
Hydropower	875,334	750,000
Navigation	86,572	0
Non-reimbursable Costs	6,826	0
TOTAL	**968,732**	**750,000**

Source: Section 3.8 Implementation and Avoided Costs

Table11-4. Mitigation – Allocated O&M Costs

Alternative 4 Preliminary O&M Costs – Allocated by Authorized Uses (1998 dollars) ($1,000)	
	Operation & Maintenance Cost
Hydropower	4,375
Navigation	481
TOTAL	**$4,856**

Source: Section 3.8 Implementation and Avoided Costs

11.3.2 Cost Share As Restoration

Under this option, the cost of Alternative 4, Dam Breaching, would be shared as an ecosystem restoration cost and would require a non-Federal cost sharing sponsor. Remaining unrecovered hydropower debt on the lower Snake River dams would also be included as a restoration cost. Any operation and maintenance costs associated with the drawdown alternative (for example maintenance of the locks and remaining dam in caretaker status) would be financed 100 percent by a non-Federal sponsor. Section 210 of the Water Resources Development Act of 1996 established the non-Federal cost share for environmental protection and restoration as 35 percent non-Federal with operation and maintenance of the ecosystem restoration project being 100 percent non-Federal.

However, there may be precedent for 50 percent non-Federal cost sharing for ecosystem restoration activities which result in adverse impacts to purposes of an existing Federal project as in the case of the Kissimmee River Restoration and Everglades and South Florida Ecosystem. The operation and maintenance costs of the restoration remain non-Federal.

If one assumes that breaching of the dams is a restoration measure, costs could be allocated solely to this purpose. Because drawdown results in a single project purpose (ecosystem restoration), all costs should be allocated to this new project purpose. Tables 11-5 and 11-6 estimate how the unrecovered debt and implementation and O&M costs would be allocated for Alternative 4, Dam Breaching, assuming restoration is the sole purpose.

Table 11-5. Restoration – Allocated Investment Costs and Unrecovered Debt

Alternative 4 Preliminary Costs – Allocated to Ecosystem Restoration (1998 dollars) ($1,000)		
	Investment Cost	**Unrecovered Debt**
Ecosystem Restoration	**968,732**	**750,000**
TOTAL	**968,732**	**750,000**

Source: Section 3.8 Implementation and Avoided Costs

Table 11-6. Restoration – Allocated O&M Costs

Alternative 4 Preliminary O&M Costs – Allocated to Ecosystem Restoration (1998 Dollars) ($1,000)	
	Operation & Maintenance Cost
Ecosystem Restoration	**$4,856**
TOTAL	**$4,856**

Source: Section 3.8 Implementation and Avoided Costs

11.3.3 Financial Analysis

If all costs were allocated to ecosystem restoration, there would also be an issue of cost sharing. A non-Federal sponsor would need to be identified for cost sharing. A non-Federal sponsor is a legally constituted body with full authority and capability to perform the terms of its agreements and to pay damages, if necessary, in the event of failure to perform. The non-Federal share of the implementation costs and unrecovered debt would be 35 percent. The non-Federal sponsor would also be responsible for 100 percent of operation, maintenance, and replacement costs for a restoration project. Tables 11-7 and 11-8 display the cost sharing portions for the Federal and non-Federal sponsor if the action is determined to be restoration.

A more detailed discussion of potential funding options is presented in the following section, Section 12.0 Financial Analysis.

Table 11-7. Restoration – Unrecovered Debt and Investment Cost - Cost Sharing for the Federal and Non-Federal Sponsor

Alternative 4 Preliminary Costs – Allocated to Ecosystem Restoration (1998 Dollars) ($1,000)		
Sponsor	Investment Cost	Unrecovered Debt
Federal (65%)	629,676	487,500
Non-Federal (35%)	339,056	262,500
TOTAL	968,732	750,000

Source: Section 3.8 Implementation and Avoided Costs

Table 11-8. Restoration – O&M Costs – Cost Sharing for the Federal and Non-Federal Sponsor

Alternative 4 Preliminary O&M Costs – Allocated to Ecosystem Restoration (1998 Dollars) ($1,000)	
Sponsor	Operation & Maintenance Cost
Non-Federal (100%)	$4,856
TOTAL	$4,856

Source: Section 3.8 Implementation and Avoided Costs

12. Financial Analysis

12.1 Introduction

The purpose of this analysis is to describe the potential funding options for the projects being evaluated in the Lower Snake River Juvenile Salmon Migration Feasibility Study. This analysis is designed to provide information for policy makers regarding the availability of funding for the proposed alternatives within established *Principles and Guidelines for Water and Related Land Resources Implementation Studies* (WRC, 1983). The following discussion is divided into 3 sections that address the following issues: funding requirements, potential sources of funding, and financial impacts.

12.2 Funding Requirements

The potential funding request could include three items:

- Repayment of outstanding debt
- Implementation costs to construct fish-related improvements
- Mitigation and compensation costs

12.2.1 Repayment of Outstanding Debt

The Bonneville Power Administration (BPA) is obligated to repay to the Federal Treasury all costs allocated to hydropower from the Federal dams. The capitalized costs of the project (e.g., initial construction costs, replacement costs, etc.) are repaid by BPA over a 50 year period at designated interest rates. The current debt associated with the lower Snake River lock and dams is estimated as follows:

- Amounts already included in existing rate structure:
  - Approximately $479 million for construction of the dams (e.g., as of the end of 1998)
  - Additional outstanding debt for the lower Snake River fish hatcheries and fish mitigation funds of approximately $271 million as of the end of 1998
- Amounts that will be included in the rate structure, upon completion:
  - Construction work in progress account will transfer to BPA as new additional debt (e.g., approximately one-half of the $271 million in construction work in progress is occurring in the lower Snake River facilities)

As indicated, these costs are (or could be) built into the existing BPA power rates. If the lower Snake River lock and dams are breached, it is possible that Congress, through authorizing legislation, will reduce some or all of this long-term debt or BPA ratepayers may be required to continue repayment.

12.2.2 Implementation Costs

Table 12-1 presents a summary of the costs associated with fish-related facility improvements. These implementation costs could also require payment or, alternatively, could be covered by congressional appropriation.

Table 12-1. Construction & Acquisition Costs by Study Alternative (1998 dollars) ($1,000s)

Alternative	Detailed Description	Starting Year	Construction & Acquisition Costs ($)
1—Existing Conditions	Adaptive Management Strategy	2005	97,990
2—Maximum Transport of Juvenile Salmon	Maximum Transport	2005	74,693
3—Major System Improvements	SBC with Maximum Transport (low cost)	2006	167,972
4—Dam Breaching	Channel Bypass or Natural River Alternative	2007	809,530

1/ These costs have been adjusted to base year 2005 using the 6.875 percent discount rate.

SBC—Surface Bypass Collectors

Source: U.S. Army Corps of Engineers, Walla Walla District

The capital cost to retain the dams ranges from $74.7 million to undertake Alternative 2, Maximum Transport, to $168.0 million to undertake Alternative 3, Major System Improvements. Alternative 4, Dam Breaching, is expected to cost approximately $809.5 million for deconstruction of the dams, construction of a channeled river, and related capital costs.

12.2.3 Possible Mitigation and Compensation Costs

Alternative 4, Dam Breaching, would also engender other costs to replace services currently provided under existing conditions, including:

- Additional annual power costs of $241.8 million per year to develop alternative sources of power (e.g., includes the cost of constructing and operating combined cycle gas turbines less the cost of operating the existing system)
- Additional transportation costs of $24.0 million per year to move commodities by rail and/or to truck to more distant barge terminals in the John Day pool
- Additional costs to supply water to irrigators and municipal/industrial users of $15.4 million per year
- Additional (but non-quantified) costs to retrain workers, and mitigate or compensate public and private entities for such losses as idle barges and terminals, additional road damage, and other impacts

There is no requirement for the Federal government to provide compensation for these costs but a legislative solution may be developed to provide mitigation and/or compensation.

12.3 Potential Sources of Funding

Under the dam retention strategies, implementation costs would be covered by the existing cost allocation rules. However, if dam breaching were the selected alternative, there are three potential sources for funding:

- Continue with the existing cost allocation rules (under Corps fish mitigation principles)
- Seek a local sponsor who would share the costs with the Federal government for dam breaching, (under Corps fish recovery principles)
- Congress authorizes the Treasury to pay all (or a part) of the cost to breach

These issues are addressed in the following section.

12.3.1 Existing Cost Allocation Basis (Fish Mitigation)

As documented in the cost allocation analysis (Section 11.0), the repayment cost of existing projects is mainly allocated to power. Under existing cost allocation rules, power is currently required to pay for approximately 91 percent of the costs associated with the projects (e.g., averaged across all four lower Snake River facilities). BPA repays the Treasury for these costs. Navigation is responsible for the remaining 9 percent of costs, which is considered a Federal cost. Table 12-2 shows the joint-use percentages for construction costs by project uses.

Table 12-2. Joint-Use Percentages for Construction Costs by Project Purposes

Projects	% Allocated to Power	% Allocated to Navigation
Lower Monumental	94.1	5.9
Ice Harbor	78.6	21.4
Little Goose	93.3	6.7
Lower Granite	98.4	1.6
Simple average across all four facilities	91.1	8.9

Source: Cost Allocation Report

Existing cost allocation rules would require that approximately 91 percent of the implementation costs are covered in BPA rates, with the remaining 9 percent covered by the Federal government.

12.3.2 Cost Sharing with a Local Sponsor (Fish Recovery)

The typical process of developing a finance plan for a Corps construction program is to develop a cost sharing agreement between a local sponsor and the Federal government.

In accordance with the Water Resources Development Act of 1986 (PL 99-662), costs for studies and projects are shared between the Federal Government and the local sponsor. A sponsor is defined as:

> *A sponsor can be a state or any other political subpart of a stem or group of states; an Indian tribe; or a port authority; which has the legal and financial authority and capability to provide the cash and real estate requirements needed for a*

> *project. A sponsor can also be an interstate agency, established under two or more states with the consent of Congress under Section 15 of Article 1 of the Constitution Section 221 of the 1970 Flood Control Act defines a local sponsor for a Corps water resources project as a non-Federal interest that is "a legally constituted public body with full authority and capability to perform the terms of its agreements and to pay damages if necessary, in the event of failure to perform.*

In this study, there is no local sponsor. This feasibility report is furnished in response to the NMFS Biological Opinion for the *Reinitiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years.* Therefore, the source of funds to implement a drawdown is uncertain.

12.3.3 Congressional Appropriation

Implementation of the dam breaching alternative could be funded entirely (or partially) by direct congressional appropriation. As described in the Technical Report on Hydropower Costs and Benefits (DREW Hydropower Impact Team, 1999; Section 7.1., Page 104):

> *Congress will ultimately answer the repayment question in the legislation that would authorize the implementation of the selected alternative. The Congressional authorization could contain directive language concerning the allocation of project construction costs. For example, Congress could direct that removal of the Snake River Dams is of national interest and the taxpayers' responsibility, and BPA would not have to repay any of the construction costs.*

It is unknown at the present time whether congressional authorization would be forthcoming for all or part of the outstanding debt, implementation costs and/or mitigation/compensation costs.

12.4 Financial Impacts

The following section addresses BPA's authorization and ability to pay for the dam breaching costs as well as the potential impact of rate increases on BPA ratepayers.

12.4.1 BPA Funding

BPA is authorized to pay for fish and wildlife mitigation projects under the following legislation:

> Under provisions of the Northwest Power Planning and Conservation Act [PL 96-501, Section 4(h)(2)(A)], BPA is required *"to use its funding authorities to protect, mitigate, and enhance fish and wildlife to the extent such resources are affected by the hydroelectric projects of the Columbia River and its tributaries".*
>
> In addition, *...BPA expenditures shall be in addition to, not in lieu of, other expenditures authorized to be made by other entities under other agreements or provisions of the law. Other fisheries efforts outside this Act, for example, are expected to continue and to be funded separately.*
>
> Under provisions of the Northwest Power Planning and Conservation Act (PL 96-501), *the Bonneville Power Administration is self-financed. Pursuant to the Federal Columbia River Transmission Act, BPA must meet all its costs, including*

> *the cost of the Federal investment in the Columbia River system, from its power sale revenues. General tax revenues are not used to support BPA programs.*

However, there are limitations on how much of the additional fish and wildlife mitigation costs BPA can accommodate. Five Federal agencies involved in salmon and other fish and wildlife restoration activities in the Columbia River Basin established a Memorandum of Agreement (MOA) concerning BPA fish and wildlife costs for Fiscal Years 1996 through 2001. The MOA followed an agreement made between NMFS, members of the Pacific Northwest congressional delegation, and the Clinton Administration, to establish an upper limit on BPA costs for Columbia Basin fish and wildlife, at an average of $435 million per year through the 6-year period. This MOA was undertaken due to concern over BPA's financial position and its ability to fund future fish and wildlife programs in a deregulated power market.

The Technical Report on Hydropower Costs and Benefits further describes the limits of BPA's abilities to raise rates in the presence of increasing costs:

> *In a restructured, competitive, wholesale power market, BPA can no longer automatically recover higher costs by raising its rates. This is because the utilities that buy power from BPA have alternative supplies of electricity available at prices set by the wholesale electricity market. If BPA's prices are below the market price, it may be able to recover increased costs until its prices reach the market price. However, consumers of BPA power are no longer required to bear the financial impacts of increased hydroelectric costs if less expensive electricity is available in the market. In this case, the financial impacts will be more difficult to determine. Initially, the cost would appear as BPA losses, but those losses would have to be covered by someone such as taxpayers or users of the still-regulated transmission system.* (DREW Hydropower Impact Team, 1999; Section 7.1, page 104)

The Northwest Power Planning Council recently evaluated BPA's potential financial conditions under a wide range of future electricity market conditions and possible fish and wildlife mitigation scenarios, including all of the alternatives being considered in this study. The analysis concluded:

> *Under a wide range of conditions, Bonneville demonstrates significant value to customers even if called upon to bear relatively large additional fish and wildlife mitigation costs. Only under combinations of persistent low market conditions and increased fish and wildlife costs and/or operational impacts does Bonneville experience significant negative net revenues for extended periods. Those results are extremely sensitive to small changes in Bonneville's costs or market prices. This underscores the importance of Bonneville's cost management efforts. Financial risk management mechanisms like reserves can mitigate the negative net revenues in some conditions. In other conditions, however, the mitigating effect of the assumed reserves and/or further cost reductions is insufficient. In these cases, Bonneville would need larger reserves; some sort of contingent cost recovery mechanism or may have to look to other [sources] of funding. It is also possible that the schedules for implementation of the various fish and wildlife mitigation scenarios used in this analysis will not be met. The biological and economic effects of changes in the schedule for implementation of fish and wildlife measures should*

be evaluated. (Source: Analysis of the Bonneville Power Administration's Potential Future Costs and Revenues, June 5, 1998, Executive Summary, Page 9)

12.4.2 Potential Impact on Rate Payers

The Technical Report on Hydropower Costs and Benefits prepared an estimate of the impact of dam breaching on BPA ratepayers. It should be emphasized that these estimates are intended for illustrative purposes only and are based on several qualifying assumptions. The estimates of potential rate increases from the additional costs allocated to hydropower (e.g., this excludes the portion of implementation costs allocated to navigation as well as any mitigation/compensation costs) are summarized below:

- "the average PNW household monthly electricity bill could increase between $1.20 and $6.50 depending on which set of cost distribution and economic forecast assumptions is applied,
- the monthly bill impact for the average PNW commercial establishment could increase between $6.70 and $36.30, and,
- the major impact would be to the industrial sector if the assumed cost distributions occur. For example, the average industrial customer (excluding the aluminum companies and other Direct Service Industries) could see monthly electricity bills increase between $302 and $1,645. The aluminum companies in the PNW are extremely large consumers of electricity, and this is reflected in the average monthly consumption of 160,600,000 kWh. Clearly, any increase in the electricity rate will have a significant impact on the monthly power bills. Depending on the selection of cost distribution and economic condition impacts, the average monthly power bill for aluminum companies could increase between $172,600 and $940,400." (Source: DREW Hydropower Impact Team, 1999; Section 7.4, pages 107-113).

13. Compensatory Actions

13.1 Introduction & Study Organization

The purpose of this analysis is to describe and document the potential mitigation and/or compensatory actions that could be undertaken to alleviate the impacts associated with the study alternatives under consideration. There are two types of potential mitigation and/or compensation actions that are addressed in the following discussion:

1. Federal mitigation actions, which are included in implementation costs:
    - Fish & wildlife programs,
    - Cultural resources, and,
    - Tribal responsibilities.
2. Potential mitigation or compensation actions:
    - Mitigation activities which may be economically viable and socially desirable - if the combined cost of the mitigation plan and resulting reduced impacts are less than the initial impacts, the plan meets the requirements of being “reasonable and prudent” in an economic sense.
    - Compensation activities, which may be socially desirable, include areas where losers may be “made whole” by compensating them for losses.

The Corps process for determining NED impacts accounts for the most efficient (or least cost) way of accommodating changes in water budget use from the national perspective. In most cases, the national estimate of impacts documents the potential net increase in costs (or benefits) but does not provide a means to compensate or mitigate for the losses.

In addition, there may be significant regional costs that are not taken into account in the national impact estimates.

The decision to fund mitigation and compensation plans is ultimately a congressional decision. The goal of this report is to identify a menu of mitigation and compensation efforts for decisionmakers by documenting quantifiable NED impacts and qualitative regional impacts that may be considered to mitigate and/or compensate losses.

The following section provides a description of Federal mitigation costs and other potential mitigation/compensation costs.

The primary purpose of the economic appendix is to evaluate the costs associated with the four alternatives. Earlier PATH biological output (e.g., 1998 model results) suggested that the Alternative 4, Dam Breaching, was the only alternative that satisfied most of the NMFS jeopardy standards, especially for the 48-year recovery standard for fall chinook. However, newer PATH model results indicate that the dam retention alternatives also meet the NMFS jeopardy standards. As a result, the mitigation and compensation actions suggested below may not be needed. They are,

however, documented in this chapter to illustrate what actions may be considered, if dam breaching were the selected alternative.

13.2 Description of Federal Mitigation Costs

Federal mitigation efforts include fish and wildlife mitigation and cultural resources protection efforts, which may require mitigation of impacts caused by Alternative 4, Dam Breaching. Dam retention alternatives (Alternatives 1, 2, and 3) do not require new mitigation. However, previous mitigation projects, put in place when the dams were constructed, would remain under all alternatives.

13.2.1 Fish & Wildlife Mitigation

Fish and wildlife mitigation is estimated to cost $20.7 million per year over the 100-year study life for Alternative 4, Dam Breaching. This estimate is presented in year 2005 dollars and is based upon discounting at the 6 7/8 percent discount rate (see Table 13-1). Mitigation for fish and wildlife impacts related to the dam breaching alternative would include:

- Structure modifications — such as maintaining road access to existing habitat management units (HMUs), and modifications to fish hatcheries, among other items;
- Vegetation restoration — such as seeding the exposed banks of the river with grass, propagation of plants and willows, and noxious weed control, among other items;
- Maintenance of existing habitat management units — primarily developing alternative water sources or modifying systems for existing HMUs; and
- Monitoring of ongoing work to see how fish and wildlife species and vegetation are developing — efforts include conducting a seasonal bird census, nesting surveys, and habitat evaluation monitoring, among other items.

13.2.2 Cultural Resources Protection

Cultural resources preservation entails preserving and protecting cultural sites (e.g., burial grounds and other culturally significant sites) after the dams are breached. The cost to protect cultural resources includes protecting sites (e.g., preparing seed beds, undertaking bank stabilization as needed on a site-by-site basis). Cultural resources protection is expected to cost $4.9 million per year over the 100-year study period. This estimate is presented in year 2005 dollars and is based upon discounting at the 6 7/8 percent discount rate (see Table 13-1).

Table 13-1. Federal Mitigation Costs for Alternative 4, Dam Breaching (2005 dollars) ($1,000)

Component	Cost ($)
Fish & Wildlife Mitigation Costs	20,772
Cultural Resources Mitigation Costs	4,924
Total	25,696

Note: Average annual amounts based upon 6 7/8 percent discount rate.
Source: U.S. Army Corps of Engineers, Walla Walla District

13.3 Description of Other Potential Mitigation/Compensation Costs

These mitigation activities are defined to include:

- Mitigation activities, which may be economically viable and socially desirable (e.g., areas where impacts could be diminished or mitigated), and,
- Compensation activities, which may be socially desirable (e.g., areas where losers may be compensated for losses or "made whole" by compensating them for losses).

The following section describes both the potential quantifiable and qualitative impacts, for which mitigation and/or compensation efforts could be considered.

13.3.1 Implementation Costs

The cost of implementing the study alternatives ranges dramatically across alternative. Under the dam retention alternatives, implementation costs are expected to increase modestly (e.g., costs increase by approximately $5.9 million per year under Alternative 3, Major System Improvements — as compared with Alternative 1, Existing Conditions). However, under the dam-breaching alternative, implementation costs are expected to increase by nearly $8 to $49 million per year, depending on the discount rate (Table 13-2), if non-Federal mitigation is included.

Table 13-2. Summary of NED Costs (1998 dollars) ($1,000)

Discount Rate	Implementation Costs ($)	Power* Costs ($)	Navigation Costs ($)	Irrigation/Water Systems Costs ($)	Total Costs ($)
@6.875%					
Alternative 2	(3,457)	(8,500)	---	---	(11,957)
Alternative 3	5,931	(8,500)	---	---	(2,569)
Alternative 4	48,787	271,000	24,034	15,424	359,245
@4.75%					
Alternative 2	(2,556)	(8,500)	---	---	(11,056)
Alternative 3	4,376	(8,500)	---	---	(4,124)
Alternative 4	35,498	267,500	25,249	10,746	338,993
@0.0%					
Alternative 2	(663)	(8,000)	---	---	(8,663)
Alternative 3	1,390	(8,000)	---	---	(6,610)
Alternative 4	8,298	263,500	28,330	2,241	302,368

* Equals increased alternative power costs less avoided costs (e.g., turbine rehabilitation costs for the dam retention alternatives).
Source: U.S. Army Corps of Engineers, Walla Walla District and various FR/EIS study teams

There is currently no method to pay these implementation costs, which could be integrated into a mitigation/compensation strategy.

13.3.2 Power Mitigation/Compensation Actions

The overall cost of producing power (e.g., including system transmission reliability and ancillary services costs) is expected to decrease slightly under dam retention alternatives (Alternatives 2 and 3) as compared with the existing conditions (Alternative 1). Under Alternative 4, Dam Breaching, the cost of alternative power is expected to increase by approximately $263 to $271 million per year over the 100-year study period, depending on the discount rate.

The economic impacts of power rate increases are expected to be widely distributed in varying degrees amongst the electric ratepayers throughout the WSCC region (e.g., WSCC comprises all or part of the 14 western states and British Columbia, Canada). The Pacific Northwest region is, however, likely to be the most impacted sub-region based on the regional system production costs. It is expected that the power rate impacts to each individual electric ratepayer could fall within a wide range of possibilities.

No possible mitigation measures were identified in the hydropower analysis. To mitigate for the increased power system costs some alternative way of meeting power demands (loads) would need to be identified. The hydropower analysis, however, identified the most cost-effective way to meet power loads with each of the alternatives. Any possible mitigation plan would be more costly and hence would not mitigate the impacts, but only change them to some other mix of power resources.

Subsidizing each ratepayer an amount equivalent to the impact could compensate the economic effects of potential power rate increases. This could come from the nation's taxpayers to the regional ratepayers, which would require congressional authorization. This compensation would constitute a transfer of the economic effects from one region of the country to the entire country.

13.3.3 Navigation Mitigation/Compensation Actions

The loss of barge transportation under the dam breaching alternative would likely lead to an increased use of alternative (and more costly) cargo transportation systems. This would entail longer truck travel to more distant barge terminals or a shift to rail transportation services. The net NED costs incurred by cargo shippers are expected to be approximately $24 to $28 million per year for the 100-year study period, as shown in Table 13-2, depending on the discount rate.

According to the Transportation team, shifting from the existing transportation system to the next less costly system would increase overall grain transport costs by approximately 19 percent per bushel.

The magnitude of the NED costs does not, however, take into account a potential rate adjustment by railroad carriers in response to the loss of competition by the barge lines. There is a general concern among shippers that the railroads may raise their rates affecting the cargo currently moving by barge as well as some cargo that is currently carried by rail. If rail rates were raised, the additional cost to farmers would be a wealth transfer from farmers/exporters to the railroads but would not be considered a NED cost.

In addition to these additional NED costs, there are also additional expenditures that would be required to improve the transportation infrastructure. As shown in Table 13-3, the cost to upgrade railroads, highways and storage facilities could range from $210 to $535 million. The transportation analysis assumes that the existing rate structures would generate sufficient funds to pay for these improvements.

Table 13-3. Summary of Estimated Costs of Infrastructure Improvements (in millions of 1998 dollars)

Infrastructure Improvements	Low ($)	High ($)
Mainline Railroad Upgrades	14.0	24.0
Short-Line Railroad Upgrades	19.9	23.8
Additional Rail Cars	14.0	26.9
Highway Improvements	84.1	100.7
River Elevator Capacity	58.7	335.4
County Elevator Improvements	14.0	16.9
Rail Car Storage	5.3	7.4
Total	210.0	535.0

Source: Transportation Chapter, Table 3.3-19

In addition, other components of the barge industry transportation system could experience losses in income from:

- Commercial barge companies — foregone revenue and idle capacity,
- Selected grain elevators — loss of revenue, idle capacity,
- Selected port districts — loss of revenue, idle capacity,
- State and local governments — additional road and highway maintenance costs and possible loss of tax revenues.

There is no current means to mitigate or compensate for these potential NED costs, wealth transfers and qualitative losses.

13.3.4 Irrigation and Municipal/Industrial Water Supply Mitigation/ Compensation Actions

The NED costs for irrigation and water systems have been estimated at $15.4 million per year at a discount rate of 6 7/8 percent. This measure of impact assumes that:

- The value of the farmland would be reduced due to the loss of irrigation,
- Municipal and industrial pump stations will need to be improved, and
- Privately owned wells will need to be replaced.

There is no current means to mitigate or compensate for these potential NED costs. If congressionally authorized and funded, potential mitigation/compensation efforts could include:

- Payment for required improvements, and
- Potential purchase of farm land.

13.3.5 Social Mitigation/Compensation Actions

The long-term employment losses across the Pacific Northwest could be approximately 5,338 to 6,008 jobs as a result of implementation of Alternative 4, Dam Breaching, according to the Social Analysis Report. The total jobs gained under Alternative 4 are forecast at between 3,796 and 4,722 after 20 years. Approximately 4,000 of the job losses represent identifiable dislocated or displaced workers. Overall adverse community-level social impacts include the following:

- Decrease in net farm income and increased financial pressure on dryland farmers throughout the region,
- Increasing consolidation of family farms and a decrease in rural farm population,
- Decrease in county property tax base in 20 regional counties,
- Dislocated workers from Ice Harbor Irrigated agricultural lands and loss of source of local school revenue, and
- Shift in the economic base of communities and changed potential for future growth.

Many of these significant community-level and employment impacts are caused by the increased costs of grain transportation and by the loss of irrigated agriculture on the Ice Harbor Reservoir, which would occur under the dam breaching alternative. These impacts could be minimized in part by modification of the irrigation pumps and direct upgrades to expand rail capacity in the region and/or a direct subsidy to the farms currently shipping on the lower Snake River, as discussed in the previous section.

In the absence of direct mitigation to impacted parties for increased transportation costs, loss of irrigation water, and other impacts discussed above, employment losses could be addressed by providing targeted job retraining and education credits, at an estimated cost of between $45.1 million and $48.1 million.

Potential mitigation for 82 affected communities has been estimated at between $4.3 million and $12.9 million. Community-level impacts could be addressed by providing block grants to affected communities in the region for economic diversification activities. For example, to mitigate farm communities most affected by the loss of river transportation, economic development programs could be used to create more local value-added products and decrease the dependency on the export of unprocessed grains to foreign markets.

Under Alternative 2, Maximum Transport, the lower probability and higher degree of risk associated with anadromous fish recovery may lead to negative economic and social impacts to sport-fishing-dependent communities. These communities may lose an important component of their economic base and may need assistance to transition to another non-fishery-dependent job base.

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15. Glossary

Adverse Water Conditions: Water conditions limiting the production of hydroelectric power, either because of low water supply or reduced gross head or both. Also sometimes called critical water conditions.

Automatic Generation Control (AGC): Small, but frequent changes in generation necessary to regulate and transmit energy at 60 cycles per second.

Average Megawatt (aMW): The amount of megawatts averaged over a specified time period.

Average Water Conditions: Precipitation and runoff conditions which provide water for hydroelectric power development approximating the average amount and distribution available over a long time period, usually the period of record.

Avoided Costs: Costs required under the base condition (Alternative 1 – Existing Conditions) that would not be required under Alternatives 2 through 4.

Base Condition: The assumed future conditions from which all alternatives are compared against.

BEA: U.S. Department of Commerce, Bureau of Economic Affairs

Benefit-Transfer: Economic technique used to transfer existing studies, value estimates, and willingness to pay functions, to new policy contexts, sites, and affected populations.

BiOp: Biological Opinion.

BPA: Bonneville Power Administration.

BTU: British Thermal Unit.

Business Sales: Estimated gross receipts received by a business with the exception of those businesses in the trade sector where it is the margin or the value added by that business.

Capability: The maximum load which a generator, turbine, transmission circuit, apparatus, station, or system can supply under specified conditions for a given time interval, without exceeding approved limits of temperature and stress.

Capacity: The load for which a generator, turbine, transformer, transmission circuit, apparatus, station or system is rated. Capacity is also used synonymously with capability. For definitions pertinent to the capacity of a reservoir to store water, see Reservoir Storage Capacity.

> **Dependable Capacity:** The load-carrying ability of a station or system under adverse conditions for the time interval and period specified when related to the characteristics of the load to be supplied. The dependable capacity of a system includes net firm power purchases.
>
> **Hydraulic Capacity:** The maximum flow which a hydroelectric plant can utilize for energy.

Installed Capacity: The sum of the capacities in a powerplant or power system, as shown by the nameplate ratings of similar kinds of apparatus, such as generating units, turbines, or other equipment.

Overload Capacity: The maximum load that a generating unit or other device can carry for a specified period of time under specified conditions when operating beyond its normal rating but within the limits of the manufacturer's guarantee, or, in the case of expiration of the guarantee, within safe limits as determined by the owner.

Peaking Capacity: The maximum peak load that can be supplied by a generating unit, powerplant, or power system in a stated time period. It may be the maximum instantaneous load or the maximum average load over a designated interval of time. Sometimes called peaking capability.

Sustained Peaking Capacity: Capacity that is supported by a sufficient amount of energy to permit it to be fully usable in meeting system loads.

Capacity Value: That portion of the at-site or at-market value of electric power which is assigned to capacity.

Combined Cycle Plant (CC): An electric power plant consisting of a series of combustion turbines with heat extractors on their exhausts.

Combustion Turbine Plant (CT): An electric power plant consisting of natural gas or distillate oil-fired jet engines connected to a generator.

Consumer Surplus: Economic value received above the price actually paid.

Cost Effectiveness Analysis: Identification of the least cost method for providing various levels of output.

Critical Period: The multiple-month period when the limitation of hydroelectric power supply due to the shortage of available water is most critical with respect to system load requirements, as determined from an analysis of the historical streamflow record. The reservoir begins the critical period full; the available storage is fully drafted at one point during the period; and the critical period ends when the storage has completely refilled.

Demand: The rate at which electric energy is delivered to or by a system, part of a system, or piece of equipment, usually expressed in kilowatts or megawatts, for a particular instant or averaged over a designated period of time.

Demand Curve: Identifies quantities of a good or service that will be consumed at different prices.

Drawdown: The distance that the water surface elevation of a storage reservoir is lowered from a given or starting elevation as a result of the withdrawal of water to meet some project purpose (i.e., power generation, creating flood control space, irrigation demand, etc.).

Drawdown Regional Economic Workgroup (DREW): The interagency group developed to estimate the economic and social effects associated with alternatives being studied in the Lower Snake Juvenile Mitigation Feasibility Study.

Duration Curve: A curve of quantities plotted in descending sequential order of magnitude against time intervals for a specified period. The coordinates may be absolute quantities or percentages.

EIA: Energy Information Agency.

EIS: Environmental Impact Statement.

Energy: That which does or is capable of doing work. It is measured in terms of the work it is capable of doing; electric energy is usually measured in kilowatt-hours.

> **Average Annual Energy:** The average amount of energy generated by a hydroelectric project or system over the period of record.
>
> **Firm Energy:** Electric energy which is intended to have assured availability to the customer to meet any or all agreed upon portion of his load requirements.
>
> **Nonfirm Energy:** Electric energy having limited or no assured availability.
>
> **Off-peak Energy:** Electric energy supplied during periods of relatively low system demands.
>
> **On-peak Energy:** Electric energy supplied during periods of relatively high system demands.
>
> **Pumping Energy:** The energy required to pump water from the lower reservoir to the upper reservoir of a pumped-storage project.
>
> **Secondary Energy:** All hydroelectric energy other than primary energy. Secondary energy is generally marketed as non-firm energy.

Environmental Quality (EQ) Account: An accounting stance established by the 1983 U.S. Water Resources Council guidelines. This account is used to display and integrate qualitative information on the effects of the proposed alternatives on significant resources and attributes of the human environment.

Exports: Electric power which is transferred from a given power system to another (usually adjacent) power system. Export power must be included in the given power system's loads.

FERC: Federal Energy Regulatory Commission.

Forebay: The impoundment immediately above a dam or hydroelectric plant intake structure. The term is applicable to all types of hydroelectric developments (i.e., storage, run-of-river and pumped-storage).

Fossil-Fuel Plant: An electric power plant utilizing fossil fuels (coal, lignite, oil, or natural gas) as its source of energy.

Generation: The act or process of producing electric energy from other forms of energy; also, the amount of electric energy so produced.

Generating Unit: A single power-producing unit, comprised of a turbine, generator, and related equipment.

Generator: The electrical equipment in power systems that converts mechanical energy to electrical energy.

Gigawatt: One million kilowatts.

Heat Rate: A measure of generating station thermal efficiency, generally expressed as BTUs per net kilowatt-hour. It is computed by dividing the total BTU content of the fuel burned (or of heat released from a nuclear reactor) by the resulting net kilowatt-hours generated.

IMPLAN (IMpact analysis for PLANning): Input-Output model used to estimate effects of changes in direct benefits and costs on regional economies.

Imports: Electric power which is transferred into a power system from another (usually adjacent) power system. Import power is usually considered to be a generating resource.

Inflow: The rate of water flow into a reservoir or forebay during a specified period.

Input-Output Modeling: A regional economic analysis technique that models the sales flows among industries and government agencies based on historical purchase patterns for each industry and for consumers. This techniques is used to estimate the effects of changes in direct benefits and costs on regional economies.

Intertie: An electrical connection between two utility systems permitting the flow of power in either direction at different times between the two systems.

Kilowatt (kW): The electric unit of power, which equals 1,000 watts or 1.341 horsepower.

Kilowatt-Hour (kWh): The basic unit of electric energy. It equals one kilowatt of power applied for one hour of time.

LPMS: Lock Performance Monitoring System

Load: The amount of electric power delivered at a given point.

> **Intermediate Load:** That portion of the load between the base load and the peaking portion of the load.
>
> **Interruptible Load:** Electric power load which may be curtailed at the supplier's discretion, or in accordance with a contractual agreement.
>
> **Peak Load:** The maximum load in a stated period of time. The peaking portion of the load is that portion of the load that occurs for less than eight hours per day.

Head Loss: Reduction in generating head due to friction in the water passage to the turbine: includes trashrack, intake, and penstock friction losses.

Hydropower Impact Team (HIT): The study team consisting of up to 20 members from Federal and State agencies, Tribes, Northwest Power Planning Council, and several environmental and industry interest groups.

Hydrosim (or HYDSIM): Hydro Simulator Program. A hydro-regulation model used by BPA.

HYSSR: Hydro System Seasonal Regulation Program. A hydro-regulation model used by the Corps of Engineers.

Line Loss: Energy loss and power loss on a transmission or distribution line.

M&I: Municipal and Industrial water users.

Mechanical Availability: The ratio of the number of days in total period minus days out of service due to maintenance and forced outages, to the number of days in the total period.

Megawatt (MW): 1,000 kilowatts.

National Economic Development (NED) Account: The economic account that displays changes in the economic value of the national output of goods and services. The general measurement standard for the value of goods and services is defined as the willingness of users to pay for each increment of output associated with a proposed alternative.

NMFS: National Marine Fisheries Service

NPV: Net Present Value. The adjustment of a stream of investments to a common point in time.

NPPC: Northwest Power Planning Council.

NRSA: Nominal Range Sensitivity Analysis

Nuclear Power Plant: An electric generating station utilizing the energy from a nuclear reactor as the source of power.

O&M: Operation and maintenance.

O&M, R, R: Operation and maintenance, rehabilitation and repair.

Other Social Effects (OSE) Account: An accounting stance established by the 1983 U.S. Water Resources Council guidelines. This account addresses potential effects from perspectives that are relevant to the evaluation process but are not reflected in the NED, RED, or OSE accounts. Categories typically addressed as part of this account include community impacts; life, health, and safety factors; displacement; and long-term productivity.

Outage: The period during which a generating unit, transmission line, or other facility is out of service.

> **Forced Outage:** The shutting down of a generating unit, transmission line, or other facility for emergency reasons.
>
> **Maintenance Outage:** The removal of a generating unit for required maintenance at any time between scheduled outages.
>
> **Scheduled (Planned) Outage:** The shutdown of a generating unit, transmission line, or other facility for inspection or maintenance in accordance with an advance schedule.

Passive Use Value: The value that individuals place on the mere existence of something. Passive use values are the benefit received from simply knowing that the resource exists even if no use is made of it. Also known as existence value.

Period of Record: The historical period for which streamflow records exist.

Personal Income: The income received by all individuals in the economy from all sources. Made up of wages and salaries, proprietors income, rental income, dividends, personal interest income, and the difference between transfer payments (payouts) and personal contributions for social insurance.

Plant Factor: The ratio of the average load on the plant for the period of time considered to the aggregate rating of all the generating equipment installed in the plant.

PNW: Pacific Northwest**.**

Pondage: Reservoir storage capacity of limited magnitude, that provides only daily or weekly regulation of streamflow.

Power: The time rate of transferring energy. Electrical power is measured in kilowatts. The term is also used in the electric power industry to mean inclusively both capacity (power) and energy.

> **Continuous Power:** Hydroelectric power available from a plant on a continuous basis under the most adverse hydraulic conditions contemplated. Same as prime power.
>
> **Firm Power:** Power intended to have assured availability to the customer to meet all or any agreed upon portion of his load requirements.
>
> **Interruptible Power:** Power made available under agreements which permit curtailment or cessation of delivery by the supplier.
>
> **Nonfirm Power:** Power which does not have assured availability to the customer to meet his load requirements.
>
> **Prime Power:** Same as continuous power.
>
> **Seasonal Power:** Power generated or made available to customers only during certain seasons of the year.

Power Benefits: The monetary benefits associated with the output of a hydroelectric plant.

Power Plant (POWERPLANT): A generating station where prime movers (such as turbines), electric generators, and auxiliary equipment for producing electric energy are located.

PSW: Pacific Southwest.

Pumped-Storage Hydroelectric Plant: A hydroelectric power plant that generates electric energy for peak load use by utilizing water pumped into a storage reservoir, usually during off-peak periods**:** The two major types of pumped-storage hydroelectric plants are pump-back and off-stream pumped-storage plants.

Pump-Turbine (Reversible Turbine): A hydraulic turbine, normally installed in a pumped-storage plant, which can be used alternately as a pump and prime mover (turbine).

Ramp Rate: The maximum allowable rate of change in output from a powerplant. The ramp rate is established to prevent undesirable effects due to rapid changes in loading or (in the case of hydroelectric plants) discharge.

Regional Economic Development (RED) Account: The economic account that addresses change in the distribution of regional economic activity. Effects are addressed in terms of changes to regional business sales, employment, and income.

Reserve: The additional capacity of a power system that is used to cover contingencies, including maintenance, forced outages, and abnormal loads.

> **Cold Reserve:** Thermal generating capacity available for service but not maintained at operating temperature.
>
> **Hot Reserve:** Thermal generating capacity maintained at a temperature and condition which will permit it to be placed into service promptly.
>
> **Spinning Reserve:** Generating capacity connected to the bus and ready to take load. It also includes capacity available in generating units which are operating at less than their capability.
>
> **Standby Reserve:** Reserve capacity which can be placed on-line in a matter of minutes. Includes hot reserve capacity, combustion turbines, and most idle hydroelectric capacity.
>
> **System Required Reserve:** The system reserve capacity needed as standby to insure an adequate standard of service.

Rule Curve: A curve or family of curves indicating how a reservoir is to be operated under specific conditions to obtain best or predetermined results. Rule curves can be designated to regulate storage for flood control, hydropower production, and other operating objectives, as well as combinations of objectives.

Runner: The rotating part of a turbine.

Run-of-River Plant: A hydroelectric power plant utilizing pondage or the flow of the stream as it occurs.

SBC: Surface Bypass Collector. A type of fish bypass facility.

SOR: Columbia River System Operation Review

Spill: The discharge of water through gates, spillways, or conduits which bypasses the turbines of a hydroelectric plant.

Station Use: Energy power used in a generating plant as necessary in the production of electricity. It includes energy consumed for plant light, power, and auxiliaries regardless of whether such energy is produced at the plant or comes from another source.

Storage Plant: A hydroelectric plant associated with a reservoir having power storage.

Storage Project: A project with a reservoir of sufficient size to permit carryover from the high-flow season to the low-flow season, and thus to develop a firm flow substantially more than the minimum natural flow. A storage project may have its own powerplant or may be used only for increasing generation at some downstream plant.

Streamflow: The rate at which water passes a given point in a stream, usually expressed in cubic feet per second (cfs).

Natural Streamflow: Streamflow at a given point of an uncontrolled stream, or regulated streamflow which has been adjusted to eliminate the effects of reservoir storage or upstream diversions.

Regulated Streamflow: The controlled rate of flow at a given point during a specified period resulting from reservoir operation.

Supply Curve: Identifies quantities of a good or service that firms will produce at different prices.

Tailrace: The channel or canal that carries water away from a dam. Also sometimes called afterbay.

Tailwater Elevation: The elevation of the water surface downstream from a dam or hydroelectric plant.

Thermal Plant: An electric power plant which derives its energy from a heat source, such as combustion, geothermal water or steam, or nuclear fission. Includes fossil-fuel and nuclear steam plants and combustion turbine and combined cycle plants.

Transmission: The transporting or conveying of electric energy in bulk to a convenient point at which it is subdivided for delivery to the distribution system. Also used as a generic term to indicate the conveying of electric energy over any or all of the paths from source to point of use.

Travel Cost Method (TCM): A technique that uses the actual number of trips taken by an individual as the quantity variable and the visitor's travel cost as the price variable to identify a demand curve for recreation.

TVA: Tennessee Valley Authority.

Watt: The basic electrical unit of power or rate of doing work. The rate of energy transfer equivalent to one ampere flowing under a pressure of one volt at unity power factor. One horsepower is equivalent to approximately 746 watts.

WCSC: Waterborne Commerce Statistics Center

Wheeling: The transfer of power and energy from one utility over the transmission system of a second utility for delivery to a third utility, or to a load of the first utility.

Western System Coordinating Council (WSCC): One of nine regional energy reliability councils that were formed due to a national concern regarding the reliability of interconnected bulk power systems. The WSCC comprises all or part of the 14 Western States and British Columbia, Canada.

Willingness to Pay (WTP): The expressed amount an individual would pay for something. For goods sold in a market, the WTP is the amount actually paid to obtain the good plus an additional amount that an individual would have been willing to pay for the chosen quantity of the good. For non-market goods, WTP is the expressed amount an individual would pay.

WRC (U.S. Water Resources Council) (1983) Guidelines: The Economic and Environmental Principles and Guidelines for Water and related Land Resources Implementation Studies developed by the U.S. Water Resources Council (1983). The analysis presented in this appendix is based on these guidelines.