Chapter 6

Plan Selection and Implementation

6. Plan Selection and Implementation

6.1 Recommended Plan (Preferred Alternative)

Based on a thorough examination of the best available biological, economic, social, and other environmental information, a plan has been identified which is based on the actions described in Alternative 3—Major Systems Improvements. During review of the 2000 Biological Opinions, comments on the Draft FR/EIS, and additional information, the adaptive migration component of Alternative 3 became the focus of the recommended plan (preferred alternative). The alternative analysis and evaluation of impacts in Section 5 includes all components or actions contained in the recommended plan (preferred alternative). Throughout this section, the recommended plan (preferred alternative) is referred to as Alternative 3—Major System Improvements (Adaptive Migration).

Alternative 3—Major System Improvements (Adaptive Migration) combines a series of structural and operational measures intended to improve fish passage through the four lower Snake River dams. This alternative provides the maximum operational flexibility for juvenile fish passage, optimizes in river passage when river conditions are best for fish and optimizes the juvenile transportation program when this operation is best for fish. It also allows for optimized combined passage when necessary for spread-the-risk operation or to conduct needed research. These improvements are not only intended to reduce direct mortality associated with dam passage, but also to reduce stress on juvenile fish, reduce total dissolved gas levels, and improve operational reliability.

The evaluations, analyses, comparisons, and consideration of impacts and effects discussed in the FR/EIS, associated appendices, and supporting research materials and

reports are the basis for selecting the recommended plan (preferred alternative). The key factors supporting the selection of this alternative were:

- High current juvenile and adult salmon and steelhead survival rates through the Lower Snake River Project
- Proposed improvements provide the maximum flexibility of all alternatives in terms of optimizing both in river migration conditions and transport conditions
- Lesser magnitude of uncertainty in current biological information
- Minimal economic impacts to users
- Compatibility with NMFS and USFWS 2000 Biological Opinions
- Minimal effects to other environmental resources.

Other factors considered in this selection include, but were not limited to, those effects associated with social and community resources, Native American Indians, technical feasibility, effectiveness of structural modifications, regional acceptability, public comments, and length of implementation. Summaries of these factors are discussed below. Sensitivity and trade-off analyses were also conducted and considered for each alternative.

It should be noted that Alternative 1—Existing Conditions was eliminated from further consideration because it failed to meet the biological requirements in the NMFS 2000 Biological Opinion. Alternative 2—Maximum Transport of Juvenile Salmon was ranked lowest of all the remaining alternatives because it maximized the collection and transport of juvenile salmon and steelhead in which a major uncertainty exists related to the delayed mortality of transported fish.

Although Alternative 4—Dam Breaching had a number of positive benefits, it was ranked lower than the Alternative 3—Major System Improvements (Adaptive Migration) for the following reasons: determination that breaching is not necessary at this time to recover listed salmon and steelhead stocks (breaching has not been determined necessary at this time by the NMFS 2000 Biological Opinion); maximum negative economic impacts to current system users (i.e., loss of power, navigation, and irrigation); high sediment movement in the short term; uncertainty of possible harmful effects associated with the potential resuspension of contaminants in sediments; highest degree of uncertainty in the implementation and longest period before positive benefits to listed stocks; and most negative impact to minority populations.

Unless a specific citation is provided, information and tables presented in this section were produced by the Study Team based on the corresponding studies and analyses described in this FR/EIS and associated documents.

6.1.1 Description of the Recommended Plan (Preferred Alternative)

The structural and operational measures identified for the recommended plan (preferred alternative) are considered to be technically feasible or implementable, implying that the Corps has the capability to design, construct, and operate these measures. Some of the proposed systems, such as the removable spillway weirs (RSWs), surface bypass collectors (SBCs), and behavioral guidance structures (BGSs), present challenging technical issues - more challenging than the other non-breach alternatives (Alternatives 1

or 2). This is because these improvements are new technologies that have not been fully tested and require significant retrofitting on existing facilities. The basic SBC and BGS prototype development and testing has been completed at Lower Granite. Research has shown the prototype passes a relatively high percentage of fish with a small percentage of river flow. The SBC may also reduce forebay residence time and could reduce stress and mortality relative to other bypass options such as turbine intake screens and conventional spill. This research has provided the information to support the implementability of this technology (see Section 5.5.1.3). The use of these facilities to collect juvenile fish for transport will require high volume dewatering systems. The Corps has experience developing these types of dewatering systems; however, testing for this application is not completed. In addition, an RSW prototype is being installed this year at Lower Granite for testing in 2002.

6.1.1.1 Structural Measures

The structural improvements associated with the recommended plan (preferred alternative) can be placed into two categories. The first category is near-term improvements, consisting of modifications to existing systems using current technology. These require little or no additional study or research. Near-term improvements can be implemented relatively quickly [within the first 5 years after the Record of Decision (ROD)] and this FR/EIS provides National Environmental Policy Act (NEPA) compliance for implementation. The second category is long-term improvements. These improvements require additional evaluation, prototype development, and testing. Therefore, these improvements take more time to put into place. The actual determination on if, where, how, and when these long-term improvements are implemented would be contingent on the prototype testing and evaluation results. Implementation would also be dependent on a continued need for improvements in the hydropower system. Information related to the implementation of these improvements is shown later in this chapter.

Near-term Improvements

- Complete installation of spillway flow deflector at Lower Monumental and Little Goose
- Upgrade auxiliary fish ladder water supply systems at Ice Harbor, Lower Monumental, Little Goose, and Lower Granite
- Modify extended submerged bar screens at Little Goose and Lower Granite
- Use additional barges for transport with upgraded mooring facilities at Lower Granite.

Long-term Improvements

- Install new juvenile facility at Lower Granite
- Install new cylindrical dewatering screens at all dams
- Replace submerged traveling screens (STSs) with ESBSs at Ice Harbor and Lower Monumental
- Install new wet separators at Lower Monumental and Little Goose
- Install turbine improvements (as powerhouses are rehabilitated)

- Install RSWs with or without BGS at all four dams
- Install two-unit powerhouse surface bypass with or without dewatering system at Lower Monumental and Lower Granite
- Build full-length powerhouse occlusion structure at Little Goose.

6.1.1.2 Operational Measures

Existing Operations

Existing operations are identified and described in Section 2 of the FR/EIS. The four lower Snake River dams are run-of-river facilities. They are used for production of power, as a navigation corridor for the inland waterways, for recreation opportunities, as a source of water for irrigation interests, and to support fish and wildlife needs. Each dam operates and maintains both juvenile and adult fish passage facilities. The Lower Snake River Project lands support project operations or recreation facilities, and some are managed as wildlife habitat either for purposes of compensation or good land stewardship. The ongoing monitoring and evaluation programs that exist will continue to be supported based on priorities identified through regional coordination.

The Corps prepares an annual Water Management Plan that covers relevant factors affecting the operation of Federal Columbia River Power System (FCRPS) (including the Lower Snake River Project), such as Federal reservoir and dam operations to augment flows for fish, power generation, turbine outage and spill scheduling, water temperature management control, total dissolved gas (TDG) management, and special operation for research and other purposes. The plan is updated annually by April 15 of each year by the Technical Management Team (TMT). The Corps' in-season decisions on shaping timing and amount) of water releases (flow augmentation, spill, etc.) during the migration and fish passage season and on the juvenile fish transportation program are made after considering recommendations of the TMT. The TMT includes Federal, state, and tribal representatives who meet throughout the year to monitor and evaluate the shaping of available water based on real-time flow and biological information during the fish passage season. The TMT makes recommendations on water management and system operations to the Action Agencies, which include the Corps, BOR, and BPA.

The Corps continues to operate dams and fish passage facilities in accordance with criteria stated in the Corps' Fish Passage Plan (FPP) to provide safe, efficient passage for anadromous fish species listed under Endangered Species Act (ESA), as well as other migratory fish species. The FPP addresses year-round project operations and describes the procedures and criteria to be used when there are emergency deviations from the FPP. The Fish Passage Operation and Management (FPOM) Coordination Team coordinates the implementation of the FPP. This includes potential changes to fishway operating criteria, main unit operating priority, coordination of special operations that must be implemented during the fish passage season, and how to best operate the facilities when some component fails or must be taken out of service during the fish passage season. The Corps provides opportunity for annual review of the FPP by NMFS, other Federal and state agencies, and tribes. The FPP will be revised as appropriate to incorporate operation criteria for fish facility improvements associated with the recommended plan (preferred alternative).

However, if the Corps faces river or facility conditions that require changes in operation, it may implement an action that differs from the planned implementation. The Corps may, on occasion, in coordination with NMFS and USFWS (concerning consistency with biological opinions), adopt operations specifically tailored to address flood control, approved research needs, emergencies, or to meet requirements or operations to maintain other project uses.

Potential Future Operation Changes

There are two principal areas where potential future operation changes for the lower Snake River need to be further investigated. These areas include:

- Develop and implement biological rules for flow augmentation
- Develop and implement biological rules for smolt transportation including optimal spill for salmon.

The Corps plans to coordinate with Federal agencies to establish these specific rules for both smolt transportation and flow augmentation. These rules may change as scientific uncertainty is reduced and coordination continues. These rules will allow the Corps to make adjustments to operational requirements to more effectively minimize stress. The appropriate ESA consultation steps will be taken to ensure compatibility of the final rules with the Biological Opinions.

There are operational considerations for juvenile fish transportation and flow augmentation that need to be established to accompany the structural improvements in the recommended plan (preferred alternative). The evaluation included in this FR/EIS identified periods within and across the juvenile outmigration seasons for each salmonid stock where transportation appears to be more effective (i.e., during years when NMFS flow targets cannot be met). The evaluation also identifies periods within and across the juvenile outmigration seasons for each salmonid stock where cold-water releases from Dworshak Reservoir produce negative responses (i.e., negative effects to growth requirements of rearing wild juvenile Snake River fall chinook salmon). Biologically inappropriate timing of artificial releases of cold water from Dworshak in the North Fork of the Clearwater River can also negatively affect bull trout. Bull trout can be artificially attracted to remain in cooler stream conditions in the North Fork past the time that warmer water in the South Fork would have caused them to migrate upstream.

The benefits of flow augmentation vary depending on the climatic and hydrologic conditions. The ESA-listed salmonid stocks have evolved and adapted their lifestyle survival to riverine ecological conditions formed by geomorphologic processes. As a result, more specific biological rules for flow augmentation beyond simple flow target triggers need to be established in an attempt to maximize juvenile fish survival in the lower Snake River hydrosystem and through the lower Columbia River hydropower system. More specifically, the augmentation flow release timing and duration from Dworshak Reservoir affecting water temperature in the lower Snake River need to be more ecologically aligned with providing for optimum growth during rearing and achieving the highest migration fitness for Snake River fall chinook salmon. Biological rules need to be developed in order to optimize tradeoff effects between the ecological needs of overlapping salmonid stocks and age classes, as well as the physical relationships of adding cold water to Lower Granite Lake during different flow years.

Consistent across these two proposals for development of biological rules for operation of the lower Snake River hydrosystem is the empirically determined optimal effectiveness of spill for fish passage. If RSWs and other fish passage prototypes prove to contribute substantially to smolt survival following several years of research and monitoring, and are implemented, then spill guidelines, spill caps, and shaping may warrant modification. The same will be true following the development of empirically determined biological rule curves for smolt collection and transportation and flow augmentation. The same may also be true if RSWs and other measures prove to reduce dissolved gas to 110 percent and under for voluntary and/or involuntary spill regimes, as long as such structural or operational measures do not negatively affect salmon and steelhead survival. All such operational rule development will continue to be coordinated within the Regional Forum in a manner consistent with the RPA contained in the NMFS 2000 Biological Opinion.

The benefits of juvenile salmonid transportation vary depending on the climatic and hydrologic conditions (such as experienced during water year 2001 drought conditions). As a result, more specific biological rules for smolt collection and transport beyond simple flow target triggers need to be established in an attempt to maximize juvenile fish survival through the hydropower system.

6.1.2 Consistency with Biological Opinions

In a Record of Consultation and Statement of Decision (ROCASOD [Corps, 2001]), dated May 15, 2001, the Corps concurred with NMFS and USFWS determinations that the integrated operation of the FCRPS, in a manner consistent with the NMFS and USFWS 2000 Biological Opinions, including RPA action items, combined with other ongoing and anticipated measures, would likely ensure survival and recovery of listed salmon and steelhead. This includes the operation of the Lower Snake River Project. The NMFS 2000 Biological Opinion concluded that dam breaching on the lower Snake River is not necessary at this time, but reserved this action as a contingency management alternative if the listed stocks continue to decline in the near future (2005 to 2008). The Biological Opinion states:

> "Although breaching is not essential to implementation of the initial actions called for in the RPA which constitute a non-breach approach, the RPA requires that the Action Agencies prepare for the possibility that breaching or other hydropower actions could become necessary." (NMFS 2000 Biological Opinion, Page 9-131.)

The Corps will implement the RPA action items and incidental take statements applicable to the Corps in the NMFS and USFWS 2000 Biological Opinions. These actions include a mixture of system operations, configuration measures, habitat restoration, and continued research and monitoring activities. However, in concurring with the Biological Opinions' conclusions, the Corps has the discretion to implement actions other than those identified in the Biological Opinions with the intent that the alternative measures result in achieving the Biological Opinion performance standards and/or as modified through the Action Agencies' 1- and 5-year implementation plans.

In implementing the Biological Opinions' lower Snake River actions, the Corps will also contribute to the attainment of the goals identified in the *Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery Strategy* [Basinwide Recovery Strategy

(Federal Caucus, 2000)], dated December 2000. This strategy was developed by several Federal agencies (including the Corps) as part of the Federal Caucus and is a comprehensive, long-term plan to recover 12 anadromous fish stocks and other listed species (i.e., bull trout and sturgeon) in the Columbia-Snake River Basins.

Of all the alternatives investigated in the FR/EIS, the recommended plan (preferred alternative) most closely matches the NMFS 2000 Biological Opinion for the Lower Snake River Project. A comparison of the recommended plan (preferred alternative) and the NMFS 2000 Biological Opinion RPA measures is shown in Table 6-1.

Table 6-1. Comparison of Recommended Plan (Preferred Alternative) and NMFS 2000 Biological Opinion

Features	Recommended Plan (Adaptive Migration)	NMFS 2000 Biological Opinion
Structural Modifications		
Flow Deflector Optimization	●	●
Auxiliary Water Supply	●	●
New Juvenile Facility at Lower Granite	●	●
Turbine Rehabilitation	●	●
Additional Barges and Mooring	●	
ESBS		
Ice Harbor	●	
Lower Monumental	●	●
Mods - Little Goose and Lower Granite	●	●
Cylindrical Dewater Screens	●	●
Separator Improvements	●	●
Miscellaneous Improvements	●	●
Removable Spillway Weir	●	●
Behavioral Guidance Structure	●	
Surface Bypass Collection		
Lower Granite with Dewatering	●	
Lower Monumental with Dewatering	●	
Little Goose (Occlusion Only)	●	
Future Structural Changes	●	●
Operational Elements		
Flow Augmentation	●	●
Voluntary Spill (Fish Passage)	●	●
Transport (Spread-the-Risk)	●	●
Future Operational Modifications		
Flow Augmentation Rules (LSR)	●	
Transportation Rules (LSR)	●	
Research, Monitoring, and Evaluation		
All Four LSR Dams	●	●
Other		
Off-site Habitat Mitigation		●
Advanced Planning for Breaching		●

The recommended plan (preferred alternative) incorporates some additional improvements that are not included in the NMFS 2000 Biological Opinion RPA, such as continued research and testing of BGS and SBC technology. The Corps believes the continued work on these improvements is biologically justified. See further discussion on this in Section 6.2.7.

6.1.3 Mitigation

Mitigation measures covering the range of impacts of the selected recommended plan (preferred alternative) are discussed throughout the FR/EIS and associated appendices. For example, various monitoring and evaluation measures are continuous efforts by the Corps to ensure that current and proposed operations or structural modifications are implemented in a manner that minimizes adverse impacts. However, unavoidable adverse impacts (i.e., erosion and sedimentation) result from competing needs among resources, project uses, and the mere fact that the dams and reservoirs exist. Impacts may result from operational changes that disrupt established uses dependent upon certain circumstances within a system. The ability to mitigate some unavoidable adverse impacts is limited due to the physical processes associated with the impact.

Since a portion of the recommended plan (preferred alternative) consists of existing system components, mitigation measures for current operations and structures are included. These measures include modifying dam operations to allow for spill, adjusting Dworshak flow for temperature control, adjusting the timing of barging juvenile salmon, and implementing modifications to structures to reduce negative effects to juveniles (i.e., TDG).

The recommended plan's (preferred alternative's) near- and long-term improvements have been reviewed for ways to mitigate adverse impacts. The impacts of the proposed structures have been found to have positive impacts on the environment (i.e., water quality and fish passage). However, potential impacts have been analyzed and conditions will be included to minimize adverse impacts to the extent possible. For example, the discharge of dredged or fill material into waters of the United States includes the implementation of mitigation measures that relate to placement of sidecast-dredged material, excavation, pre-casting concrete, dewatering areas by a cofferdam/bulkhead, water quality monitoring, actions such as controlling the amount and duration of discharge, and minimization of discharges and the performance of work in the winter months to minimize impacts to water quality. For further details, see Appendix T, Clean Water Act Section 404(b)(1) Evaluation.

In determining the appropriate mitigation measures to implement, the Corps considered the extent to which mitigation for the hydrosystem impacts is already occurring or is planned through other ongoing efforts and programs. Numerous other programs and actions are discussed throughout this document and its associated appendices. For example, the NMFS 2000 Biological Opinion sets forth almost 200 actions relating to the survival and recovery of the salmon. Many of these actions focus not only on the hydropower facilities, but also on habitat, hatcheries, and harvest activities. The Corps and the other Action Agencies have developed implementation plans to address the RPA action items listed in the NMFS and USFWS Biological Opinions.

6.2 Plan Selection Rationale

This section discusses key factors considered in selecting the recommended plan (preferred alternative). Many factors were considered during plan selection and some of the key factors are described in the following subsections.

6.2.1 High Current Juvenile Salmon Survival Rates Through the Lower Snake River Project

The Lower Snake River Project currently has high in river survival rate for juvenile spring/summer chinook salmon and steelhead. This was an important factor when determining what actions to take with four projects affecting only a small portion of a river system troubled with numerous other areas of concern for the salmon.

Snake River fall chinook salmon Lower Snake River Project survival has remained relatively low for in river passage, which is why transport is maximized for this stock. Project survival rates for Snake River spring/summer chinook salmon, fall chinook salmon, and steelhead are shown in Table 6-2. These data were taken from the NMFS 2000 Biological Opinion.

Table 6-2. Juvenile Survival by Dam (Percent Dam and Reservoir Survival)

Year	Lower Granite	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	The Dalles	Bonneville
Snake River Spring/Summer Chinook Salmon								
1994	93.6	83.0	84.7	89.0	85.8	77.3	84.5	82.9
1995	90.6	88.2	92.5	93.6	93.6	85.2	87.2	86.9
1996	97.9	92.6	92.9	87.0	87.0	84.4	86.9	87.0
1997	91.3	94.2	89.4	89.3	89.3	83.3	86.5	86.9
1998	92.4	98.5	85.3	95.7	95.7	82.2	87.7	88.0
1999	94.1	95.0	92.5	95.1	95.1	85.3	89.3	91.1
6-yr avg.	93.3	91.9	89.5	91.6	91.1	82.9	87.0	87.2
Snake River Fall Chinook Salmon								
1994	No data collected in 1994							
1995	66.8	89.0	79.5	87.8	82.0	73.8	81.5	80.4
1996	47.9	89.8	78.2	87.3	82.8	72.7	81.1	79.1
1997	35.3	56.6	64.4	63.5	54.6	34.0	63.9	50.4
1998	55.8	77.1	92.1	87.8	83.0	73.7	81.5	80.2
1999	76.6	66.5	89.0	80.4	74.3	59.5	76.2	70.3
5-yr avg.	56.5	75.8	80.6	81.4	75.3	62.7	76.8	72.1
Snake River Steelhead								
1994	90.0	84.4	89.2	90.8	88.2	81.3	85.8	85.0
1995	94.4	88.9	95.0	92.7	92.6	88.4	88.1	88.7
1996	93.4	93.8	93.7	88.9	88.9	86.0	87.3	87.8
1997	96.3	96.6	90.2	91.3	91.4	85.1	87.0	88.0
1998	92.5	93.0	88.9	89.3	89.3	83.1	89.7	91.8
1999	90.8	92.6	91.5	91.3	91.3	92.0	84.0	81.2
6-yr. avg.	92.9	91.7	91.4	90.7	90.3	85.8	87.0	86.9

Source: NMFS 2000 Biological Opinion, Table 6.2-7.
Values shown are estimates, based on juvenile survival studies by dam rather than adult returns, representing the expected performance of mixed (wild + hatchery) runs. Spring/summer chinook salmon and steelhead are yearling migrants and fall chinook salmon are subyearlings.

Even with the current (1994 to 1999) survival rates averaging 59 to 79 percent (83 to 99 percent per dam) for spring/summer chinook salmon, 8 to 42 percent (34 to 92 percent per dam) for fall chinook salmon; and 62 to 77 percent (81 to 97 percent per dam) for steelhead through this part of the lower Snake River (NMFS 2000 Biological Opinion, Table 6.2-7), future structural efforts to improve the migration is not expected to reverse the overall decline of the listed species. The CRI matrix analyses indicate the improvements in in river survival cannot, by themselves, reverse population declines in Snake River spring/summer chinook salmon. If any one of the considered hydropower alternatives is to reverse the population decline in Snake River spring/summer chinook salmon by itself, it would have to result in the survival of roughly an additional 5 to 10 percent of smolts that are currently dying in the estuary. The Corps is currently testing structural modifications to these dams (i.e., BGS, RSW) that have the potential to improve the passage over spillways. The planned improvements are expected to improve survival and assist in recovery. See Section 6.1.1.1, Structural Measures, for further details.

The PATH analyses suggest that breaching is more likely than any other change in the hydropower system to meet survival and recovery criteria for the listed species across the widest range of assumptions and scenarios. However, the PATH analyses did not determine whether breaching is necessary and/or sufficient for recovery. Under current conditions, focusing on reductions in mortality in the estuarine environment, or in the first year of life, may be more productive. The other areas adversely affecting salmon (habitat, hatchery, harvest) are discussed in the NMFS 2000 Biological Opinion. A key factor of fish survival research is the magnitude of the biological uncertainty. See Section 6.2.2 for further discussion.

6.2.2 Effectiveness of Structural Modifications

Consideration was given to the effectiveness of past efforts by the Corps. Since the 1970s, improvements and structural modifications have greatly reduced rates of decline in the listed species. The data indicate that the past improvements on these four dams have been and continue to be effective.

> "If such improvements *(past harvest, engineering improvements, and transportation program)* had not been made, rates of decline would likely have been 50 to 60 percent annually (Figure 8-9), and spring/summer chinook salmon could have disappeared from the Snake River. Hence, past management actions have reduced in river mortality, but have not reversed population declines (Kareiva et al., 2000)" – Appendix A, Anadromous Fish, page A8-35.

The common question is this: Is there sufficient biological rationale to continue to upgrade these facilities, or should the effort be focused on other projects (i.e., lower Columbia River projects)? The information indicates sufficient rationale to continue with some upgrades, but long-term efforts need to be tested and evaluated in a limited but highly focused timeframe before implementation at the lower Snake River dams. This is reflected in the recommended plan (preferred alternative). The NMFS 2000 Biological Opinion check-in points of 2003 and 2005 may also influence any future decisions for significant structural modifications.

The CRI analysis concluded that further improvements in spill and bypass systems or in transportation are unlikely to be adequate in themselves to rebuild the listed Snake River salmonid populations.

The improvements incorporated into the Adaptive Migration Alternative were formulated to improve survival and perhaps reduce stress in juvenile salmon and steelhead by:

- Maximizing operational flexibility by optimizing in river migration conditions and collection and transport conditions
- Improving the operational reliability of juvenile and adult fish passage facilities
- Reducing detrimental effects of TDG on juveniles by reducing the volume of voluntary spill.

There are several features that are included in the Corps' recommended plan (preferred alternative) that do not appear in the NMFS 2000 Biological Opinion. Most prominent among these are BGSs and SBCs with dewatering to allow for collection and transport at Lower Granite and Lower Monumental Dams. These two dams were chosen for these structures because Lower Granite is the first dam encountered by most outmigrating Snake River juveniles and additional fish enter the system at Lyon's Ferry Fish Hatchery and the Tuccanon River above Lower Monumental Dam. These passage structures, along with RSWs, have potential to improve juvenile fish passage survival and may be necessary in order to obtain the maximum amount of flexibility in the system. Regardless of the outcome of ongoing research to assess the benefits of fish transportation, there will be times when in river migration will be the best option for migrating fish. For example, recent transport research has shown a trend whereby fish that migrate in river tend to return at higher rates during the early part of the outmigration, while fish transported later in the season have a higher survival than in river migrating fish. During times when in river migration is the best strategy, it is desirable to have a bypass system that will pass a relatively large percentage of fish with a comparatively small amount of water. During times when in river migration is desired, the SBC would be shut off and used, along with the BGS, as a powerhouse occlusion device to direct fish to an RSW for passage to the tailrace. When maximum transport is desired, an SBC would be used, along with the existing turbine intake screen system, to maximize collection for transport.

Although the existing turbine intake screen systems currently divert a large percentage of fish, the addition of SBC technology is thought to offer several additional benefits. Prototype testing at Lower Granite revealed that an SBC could increase the percentage of fish collected by 7 to 14 percent for spring outmigrants. In addition to increasing collection efficiency, the SBC is thought to offer a less stressful route of collection and may result in less forebay delay for migrating fish. Fish collected and transported via SBC may experience less differential delayed transportation mortality due to reduced stress during collection. The SBC benefits may be even more dramatic for summer migrants. During testing in 1998, overall passage efficiency was increased by 16 percent with the addition of the BGS and SBC (Adams and Rondorf, 1999).

The RSW is projected to be installed in two spillway bays of all four lower Snake River dams (dependent upon future research on the effectiveness of these structures) to provide in river passage when desired. The RSW concept is being tested at Lower Granite Dam in 2002. If tests are positive, the RSW will pass a large percentage of fish with a

relatively small percentage of water. This will result in reduced dissolved gas levels in the river during periods of low to moderate flows in the spring. Fish passed over an RSW may also experience less stress and forebay delay than those passed through conventional spillways or bypass systems. Existing spillway passage requires fish to sound 50 feet and pass under a tainter gate at high speed, where the fish experience a dramatic pressure change. The RSW is an overflow weir that fish pass over at the same shallow depths at which they are naturally migrating. The RSWs at Lower Granite, Little Goose, and Lower Monumental would be used only when in river migration is desired (or when spread-the-risk strategy is being employed). The RSW at Ice Harbor Dam would be used during most or all of the outmigration since there is no provision for collection and transportation at Ice Harbor Dam.

Due to the presence of the navigation lock on the south side of the river at Little Goose, it was determined that a BGS would not work there. In lieu of a BGS, a "powerhouse occlusion" system could be installed that would discourage fish from entering the turbine intakes and allow them to discover the overflow passage of the RSW when in river passage is desired. The existing turbine intake screen system would be used for collection and transport at Little Goose Dam.

6.2.3 Uncertainty in Current Biological Information

There is a high level of biological uncertainty associated with the biological modeling information available. This magnitude of uncertainty was a key factor in the selection process. NMFS, in Appendix A, Anadromous Fish Modeling, discussed uncertainties and this section describes a few of the uncertainties that are considered to be critical.

The PATH and CRI analyses highlight differential delayed transportation mortality and extra mortality as critical uncertainties in the analyses. The efficiency of dam breaching for spring/summer chinook salmon is strongly affected by these two uncertainties. Dam breaching eliminates smolt transport from Lower Snake River Project, so differential delayed transportation mortality would not exist. Extra mortality would likely persist with breaching and the outmigrant population would be much more susceptible to seasonal flows and other factors.

The CRI analysis also highlighted an additional suite of critical uncertainties due to lack of data, including the possibility of attaining increased productivity with habitat management and of enhancing survival via improved hatchery practices or the control of salmonid predators. This analysis emphasized that apart from uncertainty about the effectiveness of different management actions, there is also uncertainty about the status and trend of wild salmon populations. The reason for this uncertainty involves the contribution hatchery fish make to recruits to natural spawning grounds.

There are a number of possible impacts associated with breaching that should be further addressed if dam breaching is reevaluated. These impacts include the effect on juveniles migrating through the lower Snake River during the same time that large amounts of sediments may also be present due to breaching. The amount of resuspended sediment may also affect adults returning to spawn. The effect of the proposed short-term trap-and-haul program (during dam breaching construction) on the survival of returning adults is yet another uncertainty.

The Corps reviewed, analyzed, and documented the best scientific information available at this time. The Corps has considered the uncertainties associated with the biological information and other information and has determined that there is sufficient information to proceed with selecting the recommended plan (preferred alternative).

6.2.4 Economic Effects

The evaluation of alternatives required a thorough assessment of the costs and benefits associated with each alternative. The most common areas of economic discussion relate to the loss of hydropower production, loss of navigation, loss of water supply, and the projected increase of recreational opportunities under a Alternative 4—Dam Breaching. These and other impacts are discussed in more detail in Chapter 5 of the FR/EIS. The recommended plan (preferred alternative was determined to minimize the net economic impacts in these areas.

In addition, the Basinwide Recovery Strategy, prepared by the Federal Caucus, references breaching on the Lower Snake River Project and states:

> ". . . its high cost could preclude other actions needed throughout the basin. The option of Snake River drawdown ranks as a lower priority than other available options because of the likely long time to implement, narrow benefits, biological uncertainties, and high costs."

6.2.5 NMFS and USFWS 2000 Biological Opinions

One of most critical factors in selecting an alternative was how it fits with the region's ongoing recovery efforts regarding salmon and other listed species. Many of these efforts are described in the NMFS and USFWS 2000 Biological Opinions. The Biological Opinions set forth RPA action items for the Action Agencies to implement these efforts. The alternatives were evaluated for consistency with the RPA action items and the Biological Opinions, in general. The NMFS 2000 Biological Opinion sets forth an aggressive non-breach agenda with almost 200 actions.

Of all the alternatives evaluated in the FR/EIS, the recommended plan (preferred alternative) most closely aligns with the measures in the NMFS 2000 Biological Opinion on the FCRPS for the Lower Snake River Project. For further information on consistency of the recommended plan (preferred alternative) with the Biological Opinions, see Section 6.1.2, Consistency with Biological Opinions.

6.2.6 Environmental Effects

The environmental effects, in addition to effects on anadromous fish, were considered in the selection of the recommended plan (preferred alternative) and are discussed in Section 6.4, Comparison of Alternatives, and in further detail in the rest of this FR/EIS and the appendices. The Summary Comparison chart in Section 6.4.2 shows a composite of the alternatives compared to the Existing Conditions. The environmental resource area that is the most controversial relates to water quality. Several of the issues and concerns involve potential sediment-related problems and the current water temperature and TDG conditions in the lower Snake River. These areas are individually discussed in Section 6.4.2. There is no single equation or formula that can be used to weigh and consider each of these resource areas and decide upon the proper balance or comparison. The degree to which each resource area is affected (directly, indirectly, or cumulatively)

was considered in the selection of the recommended plan (preferred alternative). Also, consistency and compliance with the NMFS and USFWS 2000 Biological Opinions was a critical component considered.

6.2.7 Social, Community, and Native American Indians

The selection of the recommended plan (preferred alternative) included consideration of impacts to the social structure of the project area and the tribal values of local Native American tribes.

Social analysis assessed the effects on the regional areas and local communities. Many factors were considered, such as jobs and environmental justice concerns. Based on the best information available, Adaptive Migration should have minimal overall social and community impacts.

The alternative selection process took into account the Northwest Treaty Tribes' fishing rights, the United States' trust responsibility to Tribes and its responsibility to act in a manner consistent with the trust responsibility. The actions that the Corps will implement under the recommended plan (preferred alternative) are designed to improve fish passage, increase fish survival, and assist in the recovery of the listed salmon species with beneficial results to the Treaty Tribes' fishery and benefits to the Northwest Region as a whole.

6.2.8 Regional Acceptability and Public Comments

The rationale for selecting the recommended plan (preferred alternative) was also based on analyses that addressed whether the alternatives were regionally acceptable and consistent with state and local laws and regulations. The acceptability of this alternative selection by states, other Federal agencies, stakeholders, special interests, local governments, tribes, and the general public was assessed through the public process, wherein comments of the parties were considered. The controversial nature of the alternatives lead to many diverse opinions concerning acceptability. The most common message from comments received was that efforts need to be made in the region to save the salmon from extinction and they need to be made in a timely manner. The second part of that message was there needs to be a solution where both salmon recovery and regional economics associated with hydropower can coexist. Northwest governors and other elected officials strongly support salmon recovery with economic stability. The many stakeholder organizations have definite opinions and either strongly support a non-breach or a breach alternative, as does the general public. The tribes generally support the breaching of these four dams. For review of these comments and responses, see Appendix U, Response to Public Comments. In an environment and societal context as described above, the recommended plan (preferred alternative) will be acceptable to some and not to others. Regarding state or local laws and regulations, the actions in the recommended plan (preferred alternative) are considered to be consistent. See Chapter 9 for more specifics. The most prominent issue relates to the Corps' responsibilities under the Clean Water Act. See the Water Quality Plan discussion in Section 6.5, Implementation, for further details.

6.2.9 Other Considerations

Other important factors that were considered include, but are not limited to:

- How the alternatives affect long-term and short-term productivity
- If there are irreversible and/or irretrievable commitment of resources
- If there are unavoidable adverse impacts
- If mitigation is needed or required
- Whether the best information or science was available
- Which alternative is environmentally preferable
- Whether the recommended plan (preferred alternative) is in accordance with declared policies of NEPA and in compliance with Federal laws and regulations.

Other factors involving technical feasibility were considered. Even though this is a very basic criterion, it is an extremely important one, in that the recommended plan (preferred alternative) must be constructible and implementable. Adaptive Migration as the recommended plan is both of these. Other factors regarding Alternative 4—Dam Breaching involved the ramifications of a lengthy implementation time and the cost of construction.

The rationale for selecting Adaptive Migration is a composite of analyses, information briefings, evaluations, hundreds of years of combined technical expertise, and comments concerning the factors that may or may not be affected by the alternatives discussed in the FR/EIS. The selection of the recommended plan (preferred alternative) resulted from the evolution and development of the extraordinary collection of scientific data and information presented in this FR/EIS, its associated appendices, and supporting research materials and reports. Although not without uncertainties, the information contained herein was the result of a phenomenal effort by thousands of people and, in the Corps' judgment, is the best available science and information to date and contains sufficient rationale for selecting this plan/alternative.

6.3 Plan Selection Process

This FR/EIS identifies a recommended plan (preferred alternative) and makes recommendations on implementation. This recommendation has been through rigorous technical, legal, and policy review and has been determined by the Corps to be consistent with appropriate methodologies, laws, regulations, and policies. However, the actual decision will not be made until a final public and agency review is completed and the comments received are considered in the preparation of a ROD.

The Corps decisionmaking process for civil works water resource projects is well established and hierarchical in nature. Typically, the process works from the bottom up. The initial recommendation contained in this report was made by the Walla Walla District Engineer because the FR/EIS was managed and prepared by the Walla Walla District. It should be noted that the recommended plan (preferred alternative) in this FR/EIS is consistent with existing project authorities. The Corps has the necessary Congressional authority to implement all the measures associated with the recommended plan (preferred alternative) and will not need additional authority.

Following the final public and agency review, the process goes to the Northwestern Division Engineer and, if appropriate, to Corps Headquarters (Chief of Engineers) and the Office of the Secretary of the Army for approval. The Assistant Secretary of the Army has the authority to delegate the development and signing of the ROD at a lower level when Congressional authorization is not necessary. It is assumed that the Northwestern Division Engineer, barring any significant changes in the recommended plan (preferred alternative), will sign the ROD, thereby designating the Division Engineer as the ultimate decisionmaker.

The project team, which assessed the effects and prepared the FR/EIS, has provided updates on the most current science and information throughout the study. This culminated in a number of executive briefings to ensure that the decisionmakers were fully aware of the effects and uncertainties for resources and users.

As noted above, this process incorporated significant input from tribes, agencies, and the public. The process to formulate a recommended plan (preferred alternative) started with the first public scoping meeting in July 1995. Since that time, the exposure to this study has been conducted in a variety of ways, including approximately 225 public meetings, workshops, tribal coordination/consultation meetings, public forums, and public speaking engagements. These meetings not only served to inform the tribes and public but also facilitated input that shaped the alternatives and effects on resource areas used in the selection process. Over 230,000 comment documents were received and reviewed on the Draft FR/EIS, which shows the extent of the interest in this study. The fact that each and every comment was considered before the determination of the recommended plan (preferred alternative) shows the importance of the involvement.

It was recognized early in the process that it was important to offset real or perceived biases internal to the Corps. To accomplish this, the Corps sought specific input from outside the organization on key resource areas. For example:

- Biology—the Corps relied on PATH and the NMFS Science Center for biological modeling to help quantify the biological effectiveness of the alternatives with regard to salmon. The USFWS Coordination Act Report provided extensive information evaluating the effects of alternatives on other fish and wildlife.
- Economic and Social Analysis—the Drawdown Regional Economic Workgroup (DREW) assisted the Corps in identifying important components, methodologies, and assumptions for the analysis.

Although not directly a part of the selection process, quality control and assurance procedures ensured that the information used in the selection process was appropriate and accurate. A multiple-layered approach was used to assure quality control. The key components consisted of the Independent Economic Advisory Board (IEAB) review of the economic and social analysis, an independent (private consultant) review of the engineering analysis for dam breaching, and an overall independent technical Corps review of the entire document. The FR/EIS also went through an intensive internal legal and policy review to ensure that the process was consistent with existing laws, regulations, and Corps policies.

6.4 Comparison of Alternatives

6.4.1 General

The method used to identify a recommended plan (preferred alternative) is similar to an environmental restoration study. The study's objective was to screen and evaluate structural alternative measures to improve migration of juvenile anadromous fish through the Lower Snake River Project. In addition, the results of the study are intended to assist in the recovery of ESA-listed salmon and steelhead stocks. Restoration studies differ from traditional studies only in that not all benefits are expressed in terms of monetary outputs. This is particularly appropriate when dealing with biological outputs related to species listed under the ESA.

Typically, the Corps bases plan selection on the Federal objective established in the Water Resource Council's Economic and Environmental Principles for Water Related Land Resources (February 3, 1983). The Federal objective is to contribute to national economic development (NED) "consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." The intent is to select the plan that maximizes contributions to NED, referred to as the NED plan. This guidance is intended to ensure the development of sound economic and environmental water resource projects. Although a NED plan is not identified here, NED analysis was conducted and NED outputs are recognized. Cost efficiency, using both biological and NED monetary outputs, becomes an important consideration in the selection of a plan that has economic and environmental constancy.

Uncertainty is inherent in any planning effort, especially when the period of analysis spans 100 years as in this FR/EIS. Many of the potential biological, economic, and social effects of the alternatives are not known with certainty. Information might be unavailable, incomprehensive, scientifically unsound, or reflect natural variability in the resource studied. There are also uncertainties in the assumptions and models used to extrapolate this information to future conditions. The relative importance of uncertainties depends on how they influence efforts to compare the potential benefits and costs of the alternative actions. Because of these unknowns, uncertainty in resource valuations was included to reflect lack of knowledge about true values, natural variability, or both.

Selection of a recommended plan (preferred alternative) is based upon the comparison of alternatives or trade-off analysis. This comparison process was developed to be transparent, easy to follow, and easy to understand. In the trade-off analysis, the effects (direct, indirect, and cumulative) associated with each alternative plan are explicitly compared and ranked (best to worst). Once the various differences have been described, it is possible to identify the plans from best to worst. For example, if one plan dominated all others by being the best in all categories, it is the best plan. A plan that is last in all categories is the worst plan. However, if no one plan dominates, this selection and ranking process fundamentally becomes unclear, and the default in this instance is to select the plan that is most consistent with or best supports the NMFS 2000 Biological Opinion RPA.

6.4.2 Trade-Off Analysis

This section summarizes and compares the differences between each alternative plan by each specific resource area. As mentioned earlier, the effects associated with each alternative plan are explicitly compared and ranked (best to worst).

There are dozens of resources and users affected by the various alternative plans. Each alternative studied was evaluated using an interdisciplinary approach, which integrated natural and social sciences, on how it would affect the resources and users of the Lower Snake River Project. These effects were considered and compared as part of this trade-off analysis. The point was to identify the differences among plans. The discussions below explain these differences, their significance, and critical components in the identification of a recommended plan (preferred alternative).

In most cases, the resource and user effects were quantified; however, there was no one unit of measure to quantify all of these effects. Since these units are not all commensurate, the trade-offs associated with the resources and users become an important part of the plan selection process. Some resource effects used intangible or unquantifiable units or scales, such as tribal land use, cultural resources, aesthetics, etc.

6.4.2.1 Aquatic Resources—Anadromous Fish

Aquatic resources are divided into two sections—anadromous fish and resident fish. This section focuses on anadromous fish, specifically the ESA-listed species. A summary comparison of the alternatives with respect to the effects on anadromous fish is shown in Table 6-3.

Endangered and Threatened Salmon Populations

The purpose and need of this study is to improve ESA-listed salmon migration through the Lower Snake River Project and assist with recovery. In order to do this, the actions implemented must be capable of achieving performance goals set forth for these species by the NMFS 2000 Biological Opinion. The identification of a recommended plan (preferred alternative) is extremely difficult because of the problems with quantifying the effects of each alternative due to the uncertainties. Numerous positions exist on the subject; however, the science has not presented an overriding "silver bullet" preference among the alternatives. The uncertainties described by PATH and NMFS, along with the narrow focus of hydropower actions alone without the other Hs, and the modeling process in general, add to the difficulty. It should be noted that, in general, the scientific modeling process uses a wide array of assumptions to characterize non-specific or missing data for biological processes and effects, which compounds uncertainties. The more complex the model, the greater the number of assumptions that must be described and validated. In contrast, a model that is too simple could lack the most important variable or process needed to predict life stage survival or likelihood of recovery.

During the 1970s when all the lower Columbia River and lower and middle Snake River dams (Federal and non-Federal) were completed, the estimated in river survival rate for spring/summer chinook salmon was 5 to 40 percent. However, system survival rates for 1999 indicate in river passage survival has increased to a rate of 45 to 62 percent for spring/summer chinook salmon and 42 to 54 percent for steelhead. This is as high as it was in the 1960s when only four dams (Bonneville, The Dalles, McNary, and Ice Harbor) were in place for Snake River fish to pass on their way to the ocean (NMFS,

1999a). With the addition of the juvenile fish transportation program and structural improvements, direct survival within the hydrosystem increased significantly, particularly within the Lower Snake River Project.

Implementation of numerous measures can account for the improvements seen in survival. These include increased spill, increased flow, the juvenile fish transportation program, operation of turbines at peak efficiencies, flow deflectors, new extended-length screens, modifications to fish bypass facilities, and extended operations of bypass screens. Even with these improvements and the increased numbers of fish being successfully passed to below Bonneville, the numbers of wild adults continue to remain low. Current direct mortality rates cannot explain why wild adult returns are low. As a result, indirect mortality has become a critical factor and uncertainty in hydrosystem migration evaluations.

The Corps supports NMFS' anadromous fish evaluation documented in Appendix A, Anadromous Fish Modeling. As part of this Feasibility Study effort, NMFS primarily utilized the quantitative and qualitative efforts by PATH to analyze a series of alternatives using two passage models to compare passage success through the lower Snake River and one model to analyze the lifecycle of the salmon. NMFS interpreted the information developed by the PATH process, incorporated current (since 1990) empirical research in salmon and steelhead returns, and developed the CRI. Their conclusions are presented in Appendix A, Anadromous Fish Modeling, and summarized below.

The PATH Analyses

The PATH analyses suggest that breaching is more likely than any other change in the hydropower system to meet survival and recovery criteria for the listed species across the widest range of assumptions and scenarios. However, PATH analyses did not determine whether breaching is necessary and/or sufficient for recovery. The critical issue in the PATH conclusion concerns inclusion of: (a) the assumption that transportation of fish in barges leads to a significant differential delayed transportation mortality after the fish are released below Bonneville Dam, and (b) that passage through the hydrosystem by non-transported fish causes a significant extra mortality after fish have passed Bonneville Dam and moved into the estuary and ocean. Refer to Appendix A, Anadromous Fish Modeling, for further details.

The CRI Analyses

To complement the PATH process, NMFS undertook an additional analytical approach referred to as the Cumulative Risk Initiative (CRI). The CRI was intended to focus on areas not addressed by the PATH process. One such area includes providing an estimate of the risk of extinction for index populations. A second area of consideration was a more comprehensive set of potential management actions, which included actions outside the hydrosystem.

Unlike PATH, the CRI analyses suggest that no single management action is likely to result in sufficiently improved conditions for spring/summer chinook salmon. For dam breaching alone to recover spring/summer chinook salmon, it would have to produce improvements in estuarine and early ocean survival substantially (from approximately 2 to 10 percent), which is highly unlikely. The CRI analyses suggest that a combination of

improvements spread throughout the lifecycle and attained by a mixture of different management actions could promote adequate annual population growth for spring/summer chinook salmon. Numerical experiments indicate that small improvements in survival in the first year of life in the freshwater streams and the first year spent in estuarine and ocean areas will yield the greatest rewards in terms of enhanced population growth. Moreover, if many improvements are added together, CRI analyses suggest that annual rates of population growth could be increased enough that stocks of spring/summer chinook salmon could rebuild. The management actions that might produce these improvements include restoring habitat, reducing predation pressure in reservoirs and the estuary, potentially manipulating the time and release position of downstream migrants, improving water quality, mitigating for negative hatchery impacts, continuing harvest restrictions, and dam breaching. However, no single "silver bullet" solution is supported by the data when it comes to spring/summer chinook salmon.

Biological Conclusions

There is some degree of uncertainty associated with the information available to conduct the biological modeling and to predict future outcomes of the analyzed alternatives. The following conclusions are documented in Appendix A, Anadromous Fish Modeling:

- The PATH analyses suggest that breaching is more likely than any other change in the hydropower system to meet survival and recovery criteria for the listed species across the widest range of assumptions and scenarios. However, the PATH analyses did not determine whether breaching is necessary and/or sufficient for recovery.
- The CRI matrix analyses indicate the improvements in in river survival cannot, by themselves, reverse population declines in Snake River spring/summer chinook salmon. However, past improvements have greatly reduced rates of decline. Under current conditions, reductions in mortality on the order of 5 to 10 percent are needed in the estuarine environment or in the first year of life. What this means is that, if the removal of four lower Snake River dams is to reverse the population decline in Snake River spring/summer chinook salmon by itself, it would have to result in the survival of roughly 5 to 10 of every 98 smolts that are currently dying in the estuary.
- The CRI analyses conclude that further improvements in spill and bypass systems or in transportation are unlikely to be adequate in and of themselves to rebuild the threatened and endangered lower Snake River salmonid populations.
- Both PATH and CRI analyses highlight differential delayed transportation mortality and extra mortality as critical uncertainties in the analyses. The efficiency of dam breaching for spring/summer chinook salmon is strongly affected by these two factors.
- The CRI analyses highlight an additional suite of critical uncertainties due to lack of data, including the possibility of attaining increased productivity with habitat management, and enhancing survival via improved hatchery practices or the control of salmonid predators.

Table 6-3. Resource Valuation for Aquatic Resources—Anadromous Fish

				Alternatives [a/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Anadromous							
S/S Chinook Salmon							
Population Growth Index	Lambda[b/, c/]	0.98 to 1.10	> 1.0[d/]	0.98-1.01/ 0.88-1.05	1.03-1.08/ 0.93-1.13	1.03-1.08/ 0.93-1.13	1.04-1.10/ 0.95 1.14
System Juvenile Survival (T)[e/]	Percent[f/]	27.0 to 65.0	100	27-52(50-64)/Lo	35-62 (51-65)/Med	35-62 (51-65)/Med	40.5-63.7(n/a)/Med
System Adult Survival	Percent	83.0 to 86.0	100	83/75-87	86/78.5-90.5	86/78.5-90.5	86/88.0-93.3
Critical Habitat[h/]	Percent Change	-35.0 to 0.0	+100	P: -35 to -15/Hi	p: -35 to -25/Hi	P: -25 to -10/Med	P: -10 to 0.0/Lo
Fall Chinook Salmon							
Population Growth Index	Lambda [b/, c/]	0.87 to 1.05	> 1.0[d/]	0.87-0.92/NAD[g/]	0.93-1.03/NAD	0.93-1.03/NAD	0.95-1.05/NAD
System Juvenile Survival (T)[e/]	Percent[f/]	0.5 to 37.0	100	0.5-16(6-16)/Med	1-22(8-16)/Med	1-22(8-16)/Med	23-37(n/a)/Med
System Adult Survival	Percent	71.0 to 74.0	100	71/60.7-81.3	74/63.7-84.3	74/63.6-84.3	74/77.9-90.2
Critical Habitat[h/]	Percent Change	-45 to 0.0	+100	P: -40 to -20/Hi	P: -45 to -25/Hi	P: -25 to -15/Med	P: -20 to 0.0/Med
	Percent Change	-70 to -10	+100	R: -60 to -40/Med	R: -70 to -50/Hi	R: -40 to -25/Med	R: -30 to -10/Med
	Percent Change	-95 to -10	+100	S: -90 to -90/Lo	S: -95/Lo	S: -90/Lo	S: -20 to -10/Med
Steelhead							
Population Growth Index	Lambda [b/, c/]	0.74 to 0.94	> 1.0[d/]	0.74-0.83/NAD	0.77-0.90/NAD	0.77-0.90/NAD	0.75-0.94/NAD
System Juvenile Survival (T)[e/]	Percent	32.0 to 65.0	100	32-46(45-52)/Med	42-58(46-55)/Med	42-58(46-55)/Med	41-65(n/a)/Hi
System Adult Survival	Percent	77.3 to 80.3	100	77.3/73-79.6	80.3/76-82.6	80.3/76-82.6	80.3/88.4-2.2
Critical Habitat[h/]	Percent Change	-35 to 0.0	+100	P: -35 to -15/Hi	P: -35 to -25/Hi	P: -25 to -10/Med	P: -10 to 0.01/Lo
	Percent Change	-45 to -5	+100	R: -40 to -20/Hi	R: -45 to -25/Hi	R: -25 to -15/Med	R: -10 to -5/Med
Sockeye Salmon	Impacts	Hi, Med, Lo	Lo	Med/Med	Med/Hi	Med/Med-Hi	Lo/Hi
Lamprey	Impacts	Hi, Med, Lo	Lo	Hi/Hi	Hi/Hi	Med/Med	Lo/Lo

a/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a percent with 0% the least uncertainty; or as Hi, Med, Lo, with Lo uncertainty the best; or, in the case of lambda, there was a range of uncertainty around the values presented. The slanted line separates the effect and the uncertainty.

b/ Lambda numbers are based on average lambda of the index stocks as reported in Table 9.7-6, NMFS 2000 Biological Opinion. The low number represents assumption that hatchery origin natural spawners have been 80% effective as wild spawners historically. The high number represents assumption that hatchery-origin natural spawners have been 20% as effective as wild spawners historically, except for the Imnaha (50% as effective). For index stocks, it also includes preliminary 2000 and projected 2001 returns in time series used to estimate lambda.

c/ The range reflects lowest and highest lambda of the index stocks. Uncertainties in lambda do not include uncertainties in D. The uncertainty is based on empirical PIT-tag evaluations for non-breaching alternatives, but based on survival per kilometer estimates for Dam Breaching.

d/ A lambda >1.0 indicates an increasing population growth index; a lambda <1.0 indicates a declining population growth index.

e/ The number outside the parentheses represents percent system juvenile survival without transportation; the number in the parentheses represents percent system juvenile survival with transportation. Ranges come from Table 9.7-5 in NMFS 2000 Biological Opinion.

f/ First number is in river average, parentheses are total system with low and high D. However, for dam breaching there is no D and there is a range for in river survival. See Table 9.7-1 in NMFS 2000 Biological Opinion.

g/ NAD indicates No Available Data. (n/a) indicates not available.

h/ Percent critical habitat is described in terms of passage (P), rearing (R), and spawning (S). The numbers represent a change from pre-dam conditions. The numbers can range from a percent loss (-) in habitat to a percent gain (+) in habitat. Pre-dam condition is represented by 0.0.

- The CRI analyses emphasize that, apart from uncertainty about the effectiveness of different management actions, there is also uncertainty about the status and trend of wild salmon populations. The reason for this most basic uncertainty is uncertainty about the contribution hatchery fish make to recruits to natural spawning grounds.
- There are a number of possible impacts associated with breaching that NMFS has not adequately accounted for in the CRI analysis or other analyses. These include the effect of sediment on not only juveniles migrating out of the lower Snake River while excess sediments are moving out, but also the effect on adults attempting to return up the lower Snake River to spawn, and the effect of the trap-and-haul program on the survival of returning adults during dam breaching construction activities.

The NMFS 2000 Biological Opinion

The NMFS has determined the current operation and configuration of the FCRPS are likely to jeopardize the continued existence of the listed ESUs and adversely modify designated Critical habitat. As a result, the NMFS 2000 Biological Opinion has recommended an RPA which identifies actions that, combined with other ongoing and anticipated measures, will likely ensure survival and recovery.

The following two alternatives are not compatible with implementation of the RPA in NMFS 2000 Biological Opinion:

- Alternative 1—Existing Conditions does not meet non-jeopardy guidelines as set forth in the NMFS 2000 Biological Opinion RPA. NMFS has determined in the 2000 Biological Opinion that the operation and configuration of the FCRPS is likely to jeopardize the continued existence of the Snake River spring/summer chinook salmon, the Snake River fall chinook salmon, the Snake River steelhead, and the Snake River sockeye salmon ESUs and to adversely modify their designated critical habitat.
- Alternative 2—Maximum Transport of Juvenile Salmon does not fulfill the 2000 Biological Opinion RPA hydropower actions performance standards. NMFS has identified a set of hydropower actions that would achieve the FCRPS hydropower performance standards. Included are spillway improvements that will allow for enhanced spill, which leads to continuation of spill at collector projects to maximize the survival rate of in river migrants. Maximum transport calls for minimizing in river migration and eliminating voluntary spill, which conflicts with the hydropower performance standards. In addition, the delayed differential transportation mortality values evaluated in the region have such high uncertainty associated with them that additional data collection and monitoring is needed to resolve the uncertainty.

The USFWS 2000 Biological Opinion

USFWS recommended changes in operation of the FCRPS that were focused on the upper Columbia River due to impacts to bull trout and Kootenai River white sturgeon in the upper reaches of the basin. The USFWS concurred with action agency determination of "not likely to adversely affect" for the listed mammal and plant species. The listed invertebrate species have previously been consulted upon by BOR; however, further discussions will occur between the USFWS and BOR on these species.

Very little is known about the lifecycle requirements for lamprey as associated with reservoirs. The USFWS Coordination Act Report has identified a number of monitoring actions at the dams and has set the need for lamprey research, which will help with understanding the needs of lamprey. However, it is anticipated that a more natural river system would be better for the lamprey. Bull trout are addressed in the following section.

6.4.2.2 Aquatic Resources—Resident Fish

Resident fish were chosen to represent other aquatic resources because they could represent the productivity of the system in terms of biomass, which would be reflective of all aquatic organisms. The results of the various analyses identified that biomass density would likely increase by 60 percent (Table 5.4-8) under Alternative 4—Dam Breaching; however, the total biomass would probably decline because the surface area of the lower Snake River would decrease by about 58 percent (Section 5.4.2.4). The change in biomass between alternatives is negligible, making this resource area not critical to plan selection. However, it is generally anticipated that native species would benefit from dam breaching.

Research concerning non-anadromous ESA-listed species (e.g., bull trout) within the Lower Snake River Project is limited, and further work is needed.

The USFWS 2000 Biological Opinion has identified a number of monitoring actions at the dams and has set the need for bull trout research, which will help with understanding the location and needs of bull trout. However, it is expected that a more natural river system would be better for bull trout. Table 6-4 summarizes resource valuation for aquatic resources.

6.4.2.3 Water Resources

Water is an extremely important resource and its quality is a key factor in formulating a recommended plan (preferred alternative). Elements of water resources that were considered include, but are not limited to, those specifically discussed here: sediment, temperature, dissolved gas, and contaminants. Resource valuation for water resources is presented in Table 6-5.

Table 6-4. Resource Valuation for Aquatic Resources—Resident Fish

				Alternatives [1/]			
	Criteria	Scale	Best	Existing Conditions	Maximum Transport	Adaptive Migration	Dam Breaching
Resident							
Native Species	Native Species	Percent	100	79/Lo	79/Lo	79/Lo	86/Lo
Recreational Fishery	Potential	Hi, Med, Lo	Hi	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo
ESA Fish Species (Bull Trout)	Impact	Hi, Med, Lo	Lo	Lo/Med	Lo/Med	Lo/Med	Lo/Med

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as Hi, Med, Lo, with Lo being the least uncertain. The slanted line separates the effect and the uncertainty.

The effect of sediment is considered significant in the short term under Alternative 4—Dam Breaching. An estimated 50 percent of the 100 to 150 million cubic yards (MCY) of sediment behind the lower Snake River dams would be eroded, resuspended, transported, and re-deposited in Lake Wallula behind McNary Dam. Sediment transfer would be at its highest levels during the first 2 to 3 years following breaching; however, it could continue for up to 10 years after breaching, until the river system stabilizes. The impact of sediment movement in potentially large waves or smaller waves drawn out over time would adversely effect the anadromous fish species in the lower Snake River and potentially those reservoirs below the lower Snake River. Over time, Lake Wallula may require increased dredging operations for the purposes of clearing navigation lanes and water intakes. The non-breach alternatives would continue to have incoming sediment (3 to 4 MCY per year), but would not increase the movement within the lower Snake River system.

The water temperature has historically been seasonally high in the lower Snake River due to high water temperatures contributed by the Salmon, Grande Ronde, and upper Snake Rivers. The number of 20 ^{o}C exceedance days is likely to be similar under all alternatives. The difference between non-breach and breach alternatives is a shift in the temperature regime. The existence of the dams and reservoirs shift, the warming of temperatures a few weeks later into the year than they occurred historically. Pre-reservoir conditions have been documented as having higher maximum temperatures than occurs currently. The temperatures currently do not rise as high but stay warm longer in the summer and fall. Figure 6-1 shows temperature with and without dams since Dworshak flow augmentation.

The cold-water releases from Dworshak Dam have had a cooling effect on temperatures in the upper part of Lower Granite Lake; however, this is not without complications. There are concerns about the negative effect to outmigrating fall chinook salmon in the Clearwater River, which tend to hold rather than migrate because of the cold water augmentation. Dissolved gas would be reduced under Alternative 4—Dam Breaching because of the elimination of all dam-related spill operations (voluntary and involuntary). The occurrence of TDG above 110 percent is expected to be geographically localized and would occur much less frequently and for shorter durations. This benefit to spring/summer chinook salmon is important; however, it is not a strong contributor to survival of migrating salmonids. NMFS continues to affirm in the 2000 Biological Opinion that a spill program, even with occasional concentrations higher than 120 percent TDG in the tailrace, will would increase the survival of migrating salmonids. Both Alternative 2—Maximum Transport and Alternative 3—Major System Improvements (Adaptive Migration) reduce voluntary spill requirements, thus reducing the frequency of exceedence above 110 percent.

Chemicals of concern that are located in the reservoir sediments include total DDT, ammonia, dioxin TEQ, and manganese. As long as these chemicals are not resuspended, as with the non-breach alternatives, there is little concern or effect. However, dam breaching could lead to resuspension. Of the chemicals of concern identified, ammonia could prove to have the greatest toxic effect to the aquatic environment. Other contaminants would be monitored over time due to shifts in land use practices (i.e., changing agriculture products).

Of these four elements measured, dissolved gas and sedimentation may have an effect on selection criteria. Contaminants need to be monitored for conditions under which they can have either harmful or lethal effects. A more comprehensive chemical/contaminant analysis would be required before dam breaching could be implemented. Temperatures in the lower Snake River have historically been warm and the alternatives considered are not believed to alter the historical trend in a significant way.

The Clean Water Act Appendix includes the 404(b)(1) evaluation (Appendix T). Impacts from actions (which include a discharge of dredged or fill material) proposed in the recommended plan (preferred alternative) were analyzed for consistency with the 404(b)(1) guidelines and were found to be consistent.

The most current water resources controversy is regarding the Clean Water Act. This controversy is the focus of a lawsuit, *National Wildlife Federation* v. *U.S. Army Corps of Engineers*, Civ. #99-442-FR (D. Or., 2001). This lawsuit challenges the Corps' Clean Water Act compliance in the Lower Snake River. It is the Corps' belief that its actions are in compliance with the Clean Water Act. Alternative 1—Existing Condition will not change this determination. Alternative 2—Maximum Transport would reduce TDG due to the reduced need for voluntary spill and Adaptive Migration would add structural modifications that would actually improve water quality conditions. Alternative 4—Dam Breaching is the least predictable and further study on water quality parameters would need to be completed before implementation of dam breaching.

6.4.2.4 Air Quality

Of the air quality parameters evaluated, three key areas are included here: fugitive dust emissions, emissions associated with replacement power generation, and changes in transportation-related emissions. For all of these parameters, there would be no change for the non-breach alternatives. Alternative 4—Dam Breaching results in increases in all these areas. Resource valuation for air quality is shown in Table 6-6.

Fugitive dust emissions would occur during dam breaching construction, but this is a short-term effect that occurs in a fairly localized area. Another short-term effect is related to exposure of previously inundated land masses with large amounts of available erodible material. It is estimated that this would result in an overall 1 percent increase of fugitive dust sources. This is not considered to be significant when compared to current background level in this highly agricultural area.

Transportation-related emissions would change very little even though there is a shift in mode of transportation-reduced barge traffic and increased truck and train traffic. The change is considered negligible.

Breaching would result in an estimated increase of 1 percent in carbon dioxide (CO_2) emissions for all regions of the Western System Coordinating Council (includes the western United States and parts of Canada and Mexico). This is associated with replacement power generation facilities. Although a small increase, it remains a concern because of the potential increase in greenhouse gases within the region. The actual siting of power generation facilities can have a more localized effect, but siting cannot be accurately predicted within this study. Because of the potential for replacement power generation facilities to impact regional air quality, air quality resources may somewhat influence the selection criteria.

Table 6-5. Resource Valuation for Water Resources

				Alternatives [1/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Temperature	Days Exceedence	Above 20 °C	0	50-70/10-20%	50-70/10-20%	50-70/10-20%	55-65/10-20%
Dissolved Gases	Days Exceedence	Above 110%	0	130-170/70-80%	30-50/40-50%	30-50/40-50%	0/10%
Sediment							
Short-term (2-5 years)	TSS mg/L	20 - 9,000	0	20-1,000/40-70%	20-1,000/40-70%	20-1,000/ 40-70%	5,000-9,000/40-70%
Long-term	TSS mg/L	20 - 9,000	0	20-1,000/40-70 %	20-1,000/40-70 %	20-1,000/40-70 %	20-1,000/40-70 %
Total Volume Transported	MCY Above Annual Load	0 - 75	0	0/0%	0/0%	0/0%	50-75/10-20%
Contaminants							
DDT	mg/L Resuspended	0 - 1.7	0	0/0%	0/0%	0/0%	1.6-1.7/50-70%
Ammonia	mg/L Resuspended	0 - 5	0	0/0%	0/0%	0/0%	3-5/50-70%
Manganese	mg/L Resuspended	0 - 1,400	0	0/0%	0/0%	0/0%	400-1,400/ 50-70%
Zinc	mg/L Resuspended	0 - 38	0	0/0%	0/0%	0/0%	14-38/50-70%

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a percent with 0% the least uncertainty. The slanted line separates the effect and the uncertainty.

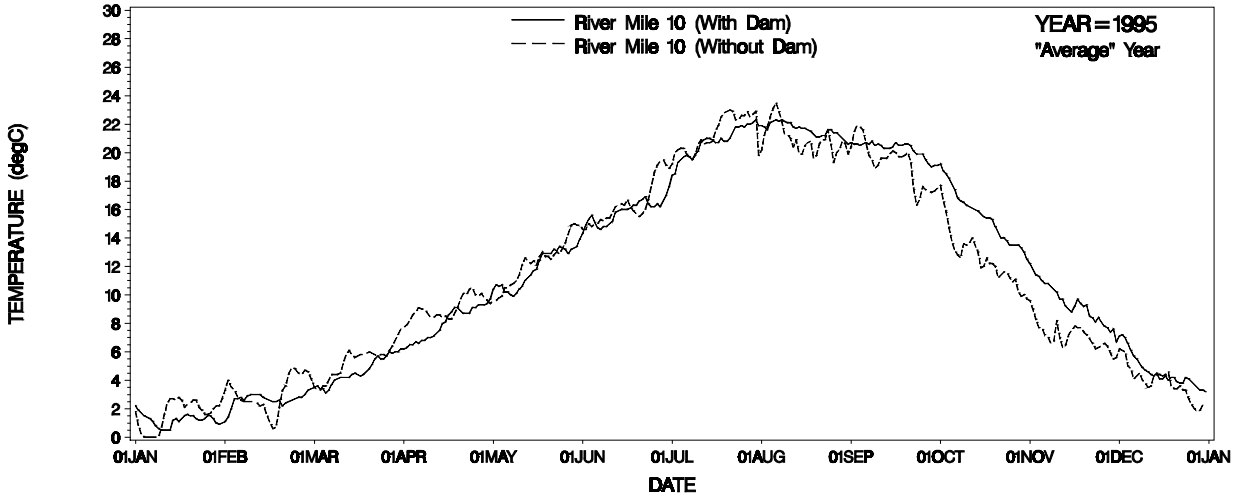

Figure 6-1. Lower Snake River Water Temperatures for an "Average" Water Year at River Mile 10. Predicted By RBM10, with and without Lower Snake River Dams, for Years Since Dworshak Flow Augmentation

Table 6-6. Resource Valuation for Air Quality

				Alternatives [1/]			
	Criteria	Scale	Best	Existing Conditions	Maximum Transport	Adaptive Migration	Dam Breaching
Fugitive Dust	PM_{10}	% Increase	0	0/Lo	0/Lo	0/Lo	1/Med
Greenhouse Gases	CO_2	% Increase	0	0/Lo	0/Lo	0/Lo	1/Lo
Transportation Emissions	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Med/Lo
AAQS	Compliance	Yes, No	Yes	Yes/Med	Yes/Med	Yes/Med	Yes/Med

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as Hi, Med, Lo, with Lo uncertainty the best. The slanted line separates the effect and the uncertainty.

6.4.2.5 Terrestrial Resources

Terrestrial resources are characterized by habitat and wildlife. Both habitat and wildlife effects at the existing dams and reservoirs on the lower Snake River are being mitigated per the existing Comp Plan (Appendix L, Lower Snake River Mitigation History and Status). Mitigation goals are described in terms of habitat units. These habitat units represent habitat quality and quantity prior to the Lower Snake River Project being developed. Under the non-breaching alternatives, mitigation goals would not likely change, nor would the approach to implementation of the goals. Whether full mitigation is likely to occur without additional efforts was considered. Alternative 4—Dam Breaching is thought to be more likely to meet mitigation goals. Resource valuation for terrestrial resources is summarized in Table 6-7.

Table 6-7. Resource Valuation for Terrestrial Resources

				Alternatives [1/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Habitat							
Wetlands	Acres	294 to 963		963	963	963	294
Riparian	Acres	1,804 to 3,285		1,804	1,804	1,804	3,285
Uplands	Acres	18,150 to 30,589		18,150	18,150	18,150	30,589
Wildlife							
Game Birds	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Hi-Lo/Lo-Med
Waterfowl	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Hi-Med/Lo-Med
Shore Birds	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Lo-Med/Lo-Med
Colonial Nesting Birds	Impacts	Hi, Med, Lo	Lo	Hi/Lo	Hi/Lo	Hi/Lo	Med-Hi/Lo-Med
Raptors	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Med-Lo/Lo-Med
Other Non-game Birds	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Hi-Lo/Lo-Med
Mammals	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Hi-Lo/Lo-Med
Amphibians & Reptiles	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Hi-Lo/Lo-Med
ESA Plant Species	Impacts	Hi, Med, Lo	Lo	Hi/Lo	Hi/Lo	Hi/Lo	Med/Lo
ESA Wildlife Species	Impacts	Hi, Med, Lo	Lo	Med/Lo	Med/Lo	Med/Lo	Lo/Lo

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a Hi, Med, Lo, with Lo uncertainty the best. The slanted line separates the effect and the uncertainty.

The change in terrestrial resources between alternatives is not a large one; however, there would be a short-term impact that would take 20+ years to recover from under Alternative 4—Dam Breaching.

Other known non-anadromous ESA-listed wildlife and plant species within the Lower Snake River Project are not anticipated to be further affected by any of the alternatives.

However, the presence of a reservoir does limit habitats conducive to some listed wildlife and plant species. A near-natural river would likely support these listed species better than a reservoir.

6.4.2.6 Cultural Resources

There are numerous cultural resource sites within the Lower Snake River Project. Non-breach alternatives would keep these cultural resource sites inundated and, thereby, protected but not preserved. Depending upon the location of the cultural resources, there are erosive processes and biochemical processes that will continue to degrade the resource with or without dam breaching. In addition, the resource is not accessible for either tribal culture purposes or scientific documentation. Alternative 4—Dam Breaching would have a higher rate of site exposure. Exposure of the sites could lead to vandalism, theft, erosion, bank slumping, lateral displacement, trampling by hoofed animals, climatic cycles, and biochemical soil changes. There are pluses and minuses to both conditions. Resource valuation for cultural resources is summarized in Table 6-8.

Table 6-8. Resource Valuation for Cultural Resources

				Alternatives [1/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Site Access							
Shore Zone/Reservoir Fluctuation Zone	Accessibility	Yes, No	Yes	Yes	Yes	Yes	Yes
Inundation Zone	Accessibility	Yes, No	Yes	No	No	No	Yes
Site Impacts							
Shore Zone	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Lo/Lo
Reservoir Fluctuation Zone	Impacts	Hi, Med, Lo	Lo	Hi/Lo	Hi/Lo	Hi/Lo	Lo/Lo
Inundation Zone	Impacts	Hi, Med, Lo	Lo	Med/Med	Med/Med	Med/Med	Med/Med

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a Hi, Med, Lo, with Lo uncertainty the best. If the first entry is Yes or No, there is no uncertainty identified. The slanted line separates the effect and the uncertainty.

6.4.2.7 Electric Power

The Lower Snake River Project has a peaking capacity of 3,033 megawatts (1,200 megawatts average annual generation), which accounts for approximately 5 percent of the energy produced in the Pacific Northwest. Alternative 2—Maximum Transport and Alternative 3—Major System Improvements (Adaptive Migration) would slightly increase the average annual power generation due to reduced voluntary spill for fish passage purposes. Alternative 4—Dam Breaching would eliminate all power production at these four dams. The average annual cost to replace the foregone power is approximately $270 million (estimated over the economic project life of 100 years). The power economic effects, by alternative, and the associated uncertainties are shown on Table 6-9.

6.4.2.8 Transportation (Navigation)

Approximately 4 million tons of cargo are shipped by barge through the Lower Snake River Project annually. The vast majority (78 percent) are grain products (wheat and barley). The non-breach alternatives would not change this navigation activity. Alternative 4—Dam Breaching would eliminate commercial navigation on the lower Snake River. This would require shifting from barge to truck and rail transportation, resulting in an estimated increase of $38 million in transportation costs annually for the 100-year economic project life. This cost and the associated uncertainties are shown on Table 6-9.

6.4.2.9 Recreation and Tourism

There are 33 developed recreation sites along the lower Snake River reservoirs. Approximately two million visitors currently use these sites annually. The non-breach alternatives would have no effect on recreation. Alternative 4—Dam Breaching would change regional recreation activities, resulting in an estimated $71 million in additional annual benefits for the 100-year economic project life. The recreation economic effects, by alternative, and the associated uncertainties are shown on Table 6-9.

6.4.2.10 Water Supply/Irrigation

There are 12 pumping stations near Ice Harbor Dam that irrigate approximately 35,000 acres. There are 8 other municipal and industrial pumping plants along the Snake River. In addition, some irrigation water comes from wells, which are influenced by the reservoirs. There would be no change to these users with the non-breach alternatives.

Alternative 4—Dam Breaching would result in an average annual economic cost of approximately $15 million due to the elimination and/or modification to these facilities for the 100-year economic project life. The economic effects, by alternative, and the associated uncertainties are shown on Table 6-9.

6.4.2.11 Commercial Harvest

Commercial fishing benefits were estimated as a result of increased fish runs for the various alternative actions. These estimates include the increased tribal commercial harvest as well. Compared to the other economic effects, those related to increased commercial fishing were not considered to be significant, with Alternative 4—Dam

Table 6-9. The NED Economic Valuations [1/]

				Alternatives [2/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Power Production	Minimize Cost	18,191 to 18,471 M	18,191	18,200.00	18,191.50	18,191.50	18,471.00 / 18,451-18,491
Navigation	Minimize Cost	182.40 to 220.20 M	182.4	182.40	182.40	182.40	220.20 / 210.2-237.1
Recreation	Maximize Benefit	51.50 to 121.70 M	121.7	51.50 / 40.8-85.5	52.80 / 41.7-87.5	52.80 / 41.7-87.5	122.75 / 62.5-372.7
Water Supply/Irrigation	Minimize Cost	0 to 15.40 M	0	0.00	0.00	0.00	15.40 / 13.9-16.9
Implement/Avoided Costs	Minimize Cost	84.4 to 110.72M	84.4	87.8 / 83.5-90.7	84.4 / 80.2-88.6	110.72 / 105.2-116.2	103.75 / 92.4-112
Commercial Harvest	Max. Benefit	2.80 to 5.01 M	5.01	2.80	3.14	3.13	5.01
Net [3/]	Minimize Cost		18,341.1	18,415.9 / 18,377.6-18,429.5	18,402.4 / 18,363.5-18,417.7	18,428.7 / 18,388.5-18,445.3	18,683.6 / 18,389.8-18,789.3

1/ These costs have been amortized over a 100-year economic life using a discount rate of 6.875%.
2/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect. The slanted line separates the effect and the uncertainty.
3/ Net costs are a summation of the economic costs minus benefits (recreation and commercial harvest).
M = millions of $

Breaching having approximately a $1 million per year benefit over the non-breaching alternatives. The commercial fishing benefits and related uncertainties are shown on Table 6-9.

6.4.2.12 Implementation and Avoided Costs

Implementation costs include those required to design, construct, and operate any of the alternatives. The avoided costs are those incurred under Alternative 1—Existing Conditions that would be avoided under the other alternatives. These include operation, maintenance, repair, and replacements costs and costs associated with the rehabilitation of existing infrastructure.

These costs have been annualized to make them commensurate with the other economic effects. These costs range from $84 million to $116 million per year over the 100-year economic life of the project. These costs and their uncertainties are shown on Table 6-9.

Costs associated with possible future actions regarding water quality have not been included in either implementation costs or avoided costs and, therefore, are not considered within this section. Water temperature and dissolved gas levels are water quality parameters that can affect fish and are sometimes found in the lower and upper Snake River at levels above state and tribal water quality standards. Until the Corps works through the process of developing a water quality plan and the States complete their TMDL process, it is premature to include costs. However, it is important to disclose publicly that these costs are an issue. Because of this, the costs of concept designs have been carried through the sensitivity discussion in the risk and uncertainty analyses. The average annual costs associated with actions or structural modifications relating to total dissolved gas can range from $1 to $55 million. These added costs would only be attributable to the non-breach alternatives (Alternatives 1 through 3). Regarding temperature, the Corps knows of no other measures to reduce temperature other than what is currently being done with Dworshak flows.

6.4.2.13 Social Effects

Social effects include the impacts caused by actions affecting the social fiber, yet are difficult to quantify in terms of specific dollar value. In addition, Environmental Justice focuses on impacts to low income and minority populations and those impacts are identified in the FR/EIS. Social and community elements were considered with three key areas listed here: community views, impacts to low income and minority populations, and increase in traffic safety. Resource valuation for social resources is shown in Table 6-10.

Six community types within 17 communities were assessed for their perceptions of the future with Alternative 1—Existing Conditions, Alternative 2—Major System Improvements (Adaptive Migration), and Alternative 4—Dam Breaching. Overall, there was significant concern for the negative impacts to people, jobs and wealth, place, and vision and vitality that would accompany Dam Breaching.

In terms of jobs lost and gained, the numbers did not show a significant overall loss of jobs in the regions for Dam Breaching compared to Adaptive Migration. However, the farm workers would take a large decrease in jobs, associated with the possible loss of irrigation along the Ice Harbor reservoir. This is a concern because 84 to 90 percent of the farm workers employed in this area are Hispanic. An estimated 2,000 jobs could be

Table 6-10. Resource Valuation for Social Resources

	Criteria	Scale	Best	Alternatives [1/] Existing Conditions	Maximum Transport	Adaptive Migration	Dam Breaching
Low Income/Minority Populations							
Tribal Members	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Lo/Lo
Farm Workers	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi/Lo
Community Assessments							
Downriver Subregion	Rating	1 to 5	5	4	No Estimate	4	1
Reservoir Subregion	Rating	1 to 5	5	4	No Estimate	4	1
Upriver Subregion	Rating	1 to 5	5	3	No Estimate	2	2 to 4
Southern Idaho Subregion	Rating	1 to 5	5	3	No Estimate	2	2 to 4

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a Hi, Med, Lo, with Lo uncertainty the best. For Community Assessments, uncertainties were not captured. The slanted line separates the effect and the uncertainty.

lost in the long term. Therefore, persons of Hispanic origin would be disproportionately affected.

Another element of social effects is the issue of change in mode of transportation for distribution of commodities if Dam Breaching were implemented. There could be an increase in traffic accidents with the shift of commodities primarily to trucks. Using the annual Washington State estimate for fatalities would result in an increase in 0.06 deaths per year.

The fact that Dam Breaching would disproportionately affect persons of Hispanic origin was considered in the selection of the recommended plan (preferred alternative).

6.4.2.14 Native American Indians (Tribal Values)

The Northwest tribes have historically fished the Columbia River Basin and are concerned about the decreasing fish runs. It is the tribes' position that fish runs would increase with Alternative 4—Dam Breaching. If this were to occur, then the tribes stand to benefit significantly from more harvest, which increases the distribution of salmon as food and expands the fundamental economic base of tribal well-being. The 1998 PATH analyses indicated that there would be increasing numbers of returning fish with both Alternative 2—Major System Improvments (Adaptive Migration) and Alternative 4—Dam Breaching. NMFS CRI analyses estimated the best dam breaching would do is improve salmon population growth by 10 percent over non-breach alternatives, but that would not be enough to prevent extinction of fish runs.

Ceremonial and subsistence harvests, as well as cultural land use, compose this resource area. Cultural land use is related to the ability of the tribe to carry on accustomed activities. Alternative 4—Dam Breaching would expose more land on which to conduct cultural/traditional customs or ceremonies, as well as for hunting and fishing at usual and accustomed locations. Resource valuation for Native American Indians is summarized in Table 6-11.

Table 6-11. Resource Valuation for Native American Indians

	Criteria	# of Fish Scale	Best	Alternatives [1/]			
				Existing Conditions	Maximum Transport	Adaptive Migration[2/]	Dam Breaching
Harvest							
Spring/Summer Chinook Salmon							
0 Year (Baseline)	Wild Fish Returns	284		284	284	No Estimate	284
10 Year (Short-Term)	Wild Fish Returns	615 to 696		655 (130.0)	615 (116.5)	No Estimate	696 (145.1)
50 Year (Long-Term)	Wild Fish Returns	1,183 to 4,471		1,538 (441.5)	1,183 (316.5)	No Estimate	4,471 (1,474.3)
Fall Chinook Salmon							
0 Year (Baseline)	Wild Fish Returns	172		172	172	No Estimate	172
10 Year (Short-Term)	Wild Fish Returns	848 to 1,243		848 (393.0)	848 (393.0)	No Estimate	1,243 (622.7)
50 Year (Long-Term)	Wild Fish Returns	1,086 to 6,745		1,086 (531.4)	1,086 (531.4)	No Estimate	6,745 (3,821.5)
Steelhead							
0 Year (Baseline)	Wild Fish Returns	3,185		3,185	3,185	No Estimate	3,185
10 Year (Short-Term)	Wild Fish Returns	4,253 to 4,795		4,406 (38.3)	4,253 (33.5)	No Estimate	4,795 (50.5)
50 Year (Long-Term)	Wild Fish Returns	5,397 to 11,612		5,899 (85.2)	5,397 (69.5)	No Estimate	11,612 (264.6)
Traditional Places	Accessibility	Hi, Med, Lo	Hi	Med/Lo	Med/Lo	Med/Lo	Hi/Lo

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a Hi, Med, Lo, with Lo uncertainty the best. The slanted line separates the effect and the uncertainty.

2/ Meyer Resources (1999) did not evaluate Alternative 3—Major System Improvements (Adaptive Migration).

6.4.2.15 Geological Resources

Geological resources are described by the likelihood of soil movement either by hill slope sloughing, wave-induced erosion, or embankment failures. Under the non-breach alternatives, the amount of hill slope sloughing would not change. With Alternative 4—Dam Breaching, wave-induced erosion would increase in the short term, contributing to increased total suspended solids (TSS). This would continue until streambank and mudflats begin to revegetate and stabilize. The exposure of 14,000 acres of inundated lands is the largest contributor to wave-induced erosion. However, the greatest concern

is with embankment failure that would occur as a result of dam breaching and the change in pressures associated with highway and railroad embankment exposure. A plan of action has been considered to diminish the problem; however, the period of most concern would be the time between appearance of newly exposed saturated embankments and placement of adequate bank protection. The long-term change in geological resources and its contribution to water resources would stabilize over time; therefore, geology is not a key factor in selection criteria. Resource valuation for geological resources is shown in Table 6-12.

Table 6-12. Resource Valuation for Geological Resources

				Alternatives [1/]			
	Criteria	**Scale**	**Best**	**Existing Conditions**	**Maximum Transport**	**Adaptive Migration**	**Dam Breaching**
Erosion	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi-Med/Med
Embankment Failures	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi/Med
TSS Contribution	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi-Med/Med

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as Hi, Med, Lo, with Lo uncertainty the best. The slanted line separates the effect and the uncertainty.

6.4.2.16 Aesthetic Resources

No strong impacts to the aesthetic resource are expected. There would be significant short-term effects associated with Alternative 4—Dam Breaching, especially during the breaching implementation period. Much of what is considered pleasing or not so pleasing would depend on the values of the user. The long-term effects would be the concrete remnants of the four dams, along with possible abandoned grain elevators and irrigation intakes that would be visible along the shorelines. In addition, the lower Snake River would never be a natural or totally free-flowing river because it would continue to be regulated by dams above the lower Snake River. It would also be controlled by levees or riprap-lined embankments for the protection of transportation infrastructure. Historical records indicate that the river can fluctuate in a natural-like condition more than 20 feet in a high flow year. Resource valuation for aesthetic resources is summarized in Table 6-13.

6.4.2.17 Summary Trade-Off Analysis

The summary effects of the four alternatives have been compared and the differences displayed by resource area, as presented in Table 6-14. A decision model was not used for this trade-off analysis; rather, consideration was given to the amount of uncertainty associated with the values generated for each resource area. Based on the values of the resource and the amount of uncertainty with that value, it was determined which resources would influence the selection. A number of resource areas displayed short-term impacts for Alternative 4—Dam Breaching, which were not an issue with the non-breach alternatives. These short-term effects are also shown on Table 6-14.

Table 6-13. Resource Valuation for Aesthetic Resources

				Alternatives [1/]			
	Criteria	Scale	Best	Existing Conditions	Maximum Transport	Adaptive Migration	Dam Breaching
Physical Factors	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi-Med/Med
Views	Impacts	Hi, Med, Lo	Lo	Lo/Lo	Lo/Lo	Lo/Lo	Hi-Med/Med

1/ The first entry under each alternative references the effect of the alternative on the resource as defined by the Criteria and Scale. The second entry references the uncertainty associated with each effect as a Hi, Med, Lo, with Lo uncertainty the best. The slanted line separates the effect and the uncertainty.

The difference between alternatives is shown relative to Alternative 1—Existing Conditions. The comparison of effects was used to narrow the focus to those that were important or influenced the selection. A total of 25 resource or sub-resource areas and uses were compared. Of those, 8 showed no difference between alternatives or only small, short-term differences. These were determined to be insignificant to the decisions and eliminated from further consideration. Of the remaining 17 resource areas, 14 had significant differences (which are highlighted in bold on Table 6-14). Of these 14, Alternative 2—Major System Improvements (Adaptive Migration) had a slight edge over the other plans, showing positive effects in 5 resources areas and only one negative effect. Alternative 3—Maximum Transport showed only 2 positive resources effects and no negative differences. The negative effects tended to stack up against Alternative 4—Dam Breaching, particularly in the short term. In the long term, Alternative 4—Dam Breaching had positive effects in 6 resource areas and negative effects in 8 other areas. The short-term effects resulted in only 2 positive and 12 negative effects.

Although there was no clear winner (no one plan dominated the resource areas), Alternative 2—Major System Improvements (Adaptive Migration) was slightly better than the other plans. This is particularly true when you factor in some of the key uncertainties.

Alternative 2—Major System Improvements (Adaptive Migration) was also considered to be the most cost-efficient alternative. This was based on a comparison of the anadromous fish biological outputs to the combined economic outputs for the various alternatives. The biological outputs included the population growth indexes (lambdas) and juvenile and adult system survival estimates. The economic outputs included the NED effects on power, transportation, irrigation, implementation/avoided costs, recreation, and commercial harvest. Alternative 3—Maximum Transport may have been considered to be cost efficient; however, it did not meet the basic biological requirements in the NMFS 2000 Biological Opinion and was ranked lower than Alternative 2—Major System Improvements (Adaptive Migration) and Alternative 4—Dam Breaching. Although the biological outputs for Alternative 4—Dam Breaching generally were slightly higher than Alternative 2—Major System Improvements (Adaptive Migration), the economic costs were measurably larger. This made Alternative 4—Dam Breaching less cost efficient than Alternative 2—Major System Improvements (Adaptive Migration).

Table 6-14. Summary Resource Comparisons

Resource List	Alternative 2 Maximum Transport	Alternative 3 Adaptive Migration	Alternative 4 Dam Breaching Short Term	Alternative 4 Dam Breaching Long Term
Aquatic Resources—Anadromous Fish				
Spring/Summer Chinook Salmon Passage	◒	●	○	●
Fall Chinook Salmon Recovery Passage	◒	●	○	●
Steelhead Passage	◒	●	○	●
Sockeye Salmon	◒	●	○	●
Aquatic Resources—Resident Fish				
Resident Fish	◒	◒	○	◒
Lamprey	◒	◒	○	●
Bull Trout	◒	◒	○	●
Water Resources				
Sediment	◒	◒	○	○
Temperature	◒	◒	◒	◒
Dissolved Gas	●	●	●	●
Contaminants	◒	◒	○	◒
Air Quality				
Fugitive Dust Emissions	◒	◒	○	◒
Transportation Emissions	◒	◒	◒	◒
Replacement Power Emissions	◒	◒	○	○
Terrestrial Resources	◒	◒	○	◒
Cultural Resources	◒	◒	◒	◒
Electric Power	●	●	○	○
Transportation (Navigation)	◒	◒	○	○
Recreation and Tourism	◒	◒	○	●
Water Supply/Irrigation	◒	◒	○	○
Commercial Harvest	◒	◒	○	◒
Implementation/Avoided Costs	◒	○	○	○
Native American Indians (Tribal Values)	◒	◒	●	●
Social Effects				
Community Views	◒	◒	○	○
Low Income and Minority Pop.	◒	◒	○	○
Traffic Safety	◒	◒	◒	◒
Geological Resources	◒	◒	○	◒
Aesthetic Resources	◒	◒	○	◒

● A Positive effect

◒ Minimal or No notable change in effect

○ A Negative effect

Bolded resources indicate those that would have the greatest impact or potential effect. Table reflects relative change as compared to Alternative 1—Existing Conditions.

6.4.3 Other Considerations

6.4.3.1 Regional Acceptability

The regional debate on how to recover salmon is highly diversified. The Corps used this diversity as a factor in gauging regional acceptability. When the Draft FR/EIS was released in December 1999 without a recommended plan (preferred alternative), it gave the Corps an opportunity to hear what the region had to say, specifically with regard to each of the four alternatives being proposed. The Corps received an overwhelming response of approximately 230,000 comment documents from throughout the region and across the United States (Appendix U, Response to Public Comments). The general consensus is that efforts need to be made in the region and they need to be made in a timely manner to save the salmon from extinction. The second part of that message was that there needs to be a solution where both salmon recovery and regional economics associated with hydropower can coexist. Regional Governors and other elected officials strongly support salmon recovery with economic stability. The many stakeholder organizations have come out strongly on both sides of the non-breach/breach issue, as has the general public. The tribes generally support the breaching of dams.

The NMFS 2000 Biological Opinion set forth an RPA which, when combined with ongoing and anticipated measures in the Columbia River basin as outlined in the Basinwide Recovery Strategy, is likely to ensure a high probability of survival with a moderate-to-high probability of recovery for each of the listed species. Implementation of the RPA would allow the FCRPS to avoid jeopardizing the continued existence of the listed species or adversely modifying their critical habitat. The NMFS 2000 Biological Opinion did not focus on the need to remove the dams in order for survival and recovery to occur. It did however, reserve the right to reconsider breaching as the option for survival and recovery if the hydropower, harvest, hatchery, and habitat actions described therein do not provide the anticipated survival rate increases, or if subsequent information shows the predicted improvements are inadequate. Although this approach to recovery seems to be acceptable to the region, a recently filed lawsuit challenging the NMFS 2000 Biological Opinion is ongoing.

6.4.3.2 Implementation Duration

The time estimated to implement the various alternatives was another consideration in the selection of a recommended plan (preferred alternative). The actions associated with the non-breach alternatives can be implemented more quickly than Alternative 4—Dam Breaching, even with the recognition that the long-term improvements associated with Alternative 3—Major System Improvements (Adaptive Migration) could take up to 10 years to fully implement. This is due, in part, to the fact that these actions do not require Congressional authorization. In addition to Alternative 4—Dam Breaching having the longest implementation time, this implementation has a high degree of uncertainty related to a high probability of unforeseen construction problems and requirements related to Congressional authorizations and appropriations. Also, it would be years before the benefits of breaching would be realized because of the short-term trap-and-haul requirements during construction and high sediment loads in the river during construction and the first few years of post construction.

6.4.3.3 Short-term Uses and Long-term Productivity

This analysis looked at the relationship between short-term uses of environmental resources and the maintenance and enhancement of long-term productivity. All of the alternatives evaluated would cause some mix of short-term impacts including, but not limited to, soil erosion, dust generation, degradation of water quality, disruption of fish and wildlife habitat, and damage to cultural resources. However, these are expected to be minimal with the non-breach alternatives. In general, the extent to which these would be long-term impacts would depend on how long a given operation or construction would occur. For example, under Alternative 4—Dam Breaching, dust generation is anticipated to be a short-term problem.

The recommended plan (preferred alternative) would produce few short-term impacts beyond what is currently present. However, some beneficial effects on long-term productivity would be in the continued availability of electric power, navigation, and irrigation. The intended benefits to anadromous fish, if realized, would be a long-term productivity gain.

6.4.3.4 Irreversible and/or Irretrievable Commitment of Resources

Irreversible commitments are decisions affecting renewable resources such as soils, wetlands, and riparian areas. Such decisions are considered irreversible because their implementation would further deteriorate a resource to the point that renewal can occur only over a long period, at a great expense, or because they would cause the resource to be destroyed or removed.

Regarding the implementation of the recommended plan (preferred alternative), no impacts are anticipated that would be an irreversible or irretrievable commitment of resources beyond what is currently happening with the existing projects. For example, the loss of soil due to erosion is an irreversible commitment because the current pools have some fluctuations that cause erosion. The recommended plan (preferred alternative) does not impact any wetlands or riparian areas beyond what already occurs.

6.4.3.5 Best Information or Science Available

As discussed previously in this chapter, there are substantial uncertainties and controversy in the scientific information regarding the biology as well as water quality impacts and economics (specifically power, recreation, transportation, passive use). However, it is the best information available to date and is sufficient to support the selection of Alternative 2—Major System Improvements (Adaptive Migration) as the recommended plan (preferred alternative).

6.4.3.6 Environmentally Preferable Alternative

The Council on Environmental Quality (CEQ) identified in 40 CFR §1505.2 requires that, in cases requiring environmental impact statements, identification of an alternative or alternatives that are considered environmentally preferable should be identified. The objective of the Feasibility Study was to screen and evaluate structural alternative measures and identify measures to improve juvenile salmon migration through the Lower Snake River Project. In addition, the measures taken as a result of the study were intended to assist in the recovery of ESA-listed species.

With the addition of improvements outside the scope of this Feasibility Study, it is possible to increase spring/summer chinook population growth according to the CRI analyses. The Federal Caucus has identified a number of such improvement combinations, which are being evaluated within the region and through other avenues such as the NMFS 2000 Biological Opinion and the Federal Caucus' Basinwide Recovery Strategy.

The Corps believes the alternative identified as the environmentally preferred alternative is the one with the greatest biological benefits and the least environmental impacts. Taking into consideration all the alternatives and the uncertainties in the current science, both Adaptive Migration and Alternative 4—Dam Breaching can be identified as environmentally preferred alternatives. Both of these alternatives have negative and positive attributes and short-term and long-term effects.

Short-term and Long-term Effects

Under Adaptive Migration, short-term implementation is presumed to result in near-term biological benefits. These biological benefits, compared to the turmoil the river system would be in immediately after breaching, support Adaptive Migration as an environmentally preferable alternative. However, in looking at the long-term biological benefits for Alternative 4—Dam Breaching (assuming the salmon survive the first few years after a breach), the benefits accrued from a near-natural river system would, in the long run, be more beneficial and could support Alternative 4—Dam Breaching as an environmentally preferable alternative.

Negative and Positive Attributes

Negative and positive attributes revolve around two areas of uncertainty. These include delayed mortality and sedimentation-related impacts. There is a need for continued study to resolve uncertainties.

The NMFS 2000 Biological Opinion has targeted the delayed mortality in salmon recovery for further study. Delayed mortality comes in two forms: the differential delayed mortality (D) of transported fish (compared with in river migrants), and the extra mortality of in river migrants. The estimates generated for D represent the best scientific information available at the time; however, they are based on relatively small numbers of returning adults and have large confidence intervals around each estimate. If future studies identified by the NMFS 2000 Biological Opinion were to document the presence of delayed mortality and to quantify the mortality so the amount of delayed mortality could be assigned unequivocally to the presence of dams, then Alternative 4—Dam Breaching may be better positioned as the best environmentally preferred alternative. To date, that certainty or even a defensible probability is not available. Even though Alternative 2—Major System Improvements (Adaptive Migration) improves on the current approach and more closely aligns with the objectives of the NMFS 2000 Biological Opinion, these uncertainties are a critical factor in determining which alternative is better environmentally.

Another area characterized by uncertainties relates to the sediment movement and resuspension during a breach condition. Several factors related to sediment could influence whether Alternative 4—Dam Breaching is the best environmentally. These include the amount of resuspended sediment that would be present and its chemical

composition. Would there be any contaminants to be concerned with and how would the large amount of TSS affect fish? Can they tolerate those high levels?

Depending on the scientific theory or hypothesis believed to be accurate, both Alternative 2—Major System Improvements (Adaptive Migration) and Alternative 4—Dam Breaching meet the criteria for an environmentally preferable alternative(s).

6.4.3.7 Accordance With Declared Policies of NEPA and Compliance With Federal Laws and Regulations

Compliance with numerous laws and regulations (i.e., Clean Air Act, Fish and Wildlife Coordination Act, Pacific Northwest Electric Power Planning and Conservation Act) are discussed in Chapter 8; however, it is important to discuss briefly the consistency with a few of these laws and regulations in this chapter.

National Environmental Policy Act (NEPA)

The Corps has evaluated the effects of the recommended plan (preferred alternative) utilizing this FR/EIS and associated appendices. The completion of this NEPA process involves printing and distributing the final documents, reviewing final comments, making any necessary modifications, and signing a ROD, if appropriate. The process followed in compiling this FR/EIS has met and, at times, exceeded the requirements set forth in NEPA. See Chapter 8 for further details.

National Historic Preservation Act (NHPA)/Native American Graves Protection and Repatriation Act (NAGPRA)

As part of the Feasibility Study, an evaluation was conducted on the known and potential effects of all alternatives on historic properties pursuant to the National Historic Preservation Act (NHPA), as amended. During the development of the 2001 ROCASOD, consultation occurred with the State Historic Preservation Officers (SHPOs) in the states of Oregon, Idaho, Montana, and Washington regarding the FCRPS. Consultation also occurred with the Advisory Council on Historic Preservation (ACHP) and with the 13 interested and affected tribes. The Corps established Reservoir Cooperating Groups to collectively evaluate the needs and priorities for historic property inventories, evaluations, and site preservation. These Reservoir Cooperating Groups consist of representatives from the Corps, interested and affected tribes, other state and Federal agencies, and any other interested parties. There are currently five Reservoir Cooperating Groups, three of which focus on individual reservoir projects, and two of which focus on multiple reservoir projects. These same Reservoir Cooperating Groups also address the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA) following the procedures described in the U.S. Department of Interior (DOI) implementing regulations for the appropriate repatriation/disposition of Native American remains and objects specified by the NAGPRA.

Specifically, the effects of this particular alternative are being coordinated with the state SHPOs and the tribes. Consultation is to be concluded prior to signing of the ROD.

Clean Water Act

The Clean Water Act Appendix (Appendix T) includes the 404(b)(1) evaluation. Impacts from actions (which include a discharge of dredged or fill material) proposed in the recommended plan (preferred alternative) were analyzed for consistency with the 404(b)(1) guidelines and were found to be consistent.

Litigation is ongoing regarding the compliance with the Clean Water Act and the Lower Snake River Project, *National Wildlife Federation* v. *U.S. Army Corps of Engineers*, Civ. #99-442-FR (D. Or., 2001). The ROCASOD signed by the Northwestern Division Commander on May 15, 2001, and filed with the Court detailed the approach the Corps plans to take regarding water quality issues. It referenced a Water Quality Plan, which will investigate the issues and determine appropriate actions. It is the Corps' belief that its actions are in compliance with the Clean Water Act. See Section 6.5.4, Other Actions/Studies Outside this Process at the end of this chapter for further details.

Endangered Species Act (ESA)

Compliance with ESA and associated consultations with NMFS and USFWS are detailed in the 2001 ROCASOD. Since the majority of the components of the recommended plan (preferred alterative) are within the context of the recent consultation, only a few, if any, of the near-term actions will need to be coordinated with these agencies. However, the majority of the long-term actions will be reviewed for consistency with the ESA and analyzed to determine the need for further consultations.

6.5 Implementation Plan

The NMFS 2000 Biological Opinion outlines an annual process for developing 1- and 5-year implementation plans to achieve FCRPS hydropower performance. These plans also encompass the proposed actions described in the USFWS 2000 Biological Opinion. Included in that process will be the development of the hydropower configuration (capital) projects, most of which are funded and managed by the Corps. Another requirement is to coordinate the development of this "Implementation Plan" through the established Regional Forum, which includes the System Configuration Team. The initial 1-year implementation plan was completed in September 2001 and the 5-year plan is still in draft form.

The majority of the improvements that are part of the recommended plan (preferred alternative) have already been incorporated into the Implementation Plan. The ones that have not been included are: additional barges (with mooring facilities); new ESBSs at Ice Harbor; SBC with dewatering systems; and future operation changes (rules for transport, spill, flow augmentation). The reason these are not included is because they are not part of the NMFS 2000 Biological Opinion. The Corps has reserved the discretion to implement different actions than those identified in the Biological Opinions with the intent that the alternative measures result in achieving the Biological Opinion performance standards and/or as modified through the Action Agencies submittal of the 1- and 5-year implementation plans. These actions will be further coordinated with NMFS and, if determined to be effective in reaching Biological Opinion performance standards, they will be incorporated into this Implementation Plan. Table 6-15 identifies all the proposed improvements, their reference number in the Hydropower Appendix of the Implementation Plan, and an implementation schedule. For more detailed information related to implementation of any of these actions, refer to this appendix.

Many of these improvements require additional prototype testing and evaluation to determine if, where, how, and when they should be implemented on the Lower Snake River Project. This FR/EIS provides only basic NEPA coverage for the recommended plan (preferred alternative) improvements. The Implementation Plan will identify where and what type of supplemental NEPA coverage may be necessary to reflect new information resulting from this testing and evaluation.

6.6 Other Actions/Studies Outside this Process

This section discusses a few future actions/studies that are beyond the scope of this Feasibility Study but are considered to be potential actions traveling an adjacent or separate pathway. Examples of these actions/studies include the repairs needed in the Lower Monumental stilling basin, future powerhouse rehabilitations, a Water Quality Plan, and advanced planning and engineering for preparatory breach actions. Key examples of these future actions/studies follow.

Table 6-15. Relationship of Recommended Plan (Preferred Alternative) Hydrosystem Implementation Plan

Action	Implementation Plan Ref. No.	Implementation Date (FY)	Additional NEPA Coverage
Structural Modifications			
Flow Deflector Optimization			
Lower Monumental	33	2002-2004	EA
Little Goose	34	2002-2005	EA
Auxiliary Water Supply			
Lower Granite	46	2001-2002	Cat-X
Little Goose	47	2002-2003	Cat-X
Lower Monumental	48	2003-2004	Cat-X
Ice Harbor	49	2004-2005	Cat-X
New Juvenile Facility at L. Granite	24	2002-2006	EA
ESBSs			
Mods – L. Goose & L. Granite	14 & 15	2001-2003	Cat-X
Ice Harbor	NA		EA
Lower Monumental	16	2004-2008	EA
Additional Barges & Mooring	NA		EA
Separator Improvements (Rpt Only)	20	2001-2002	Cat-X
Turbine Rehabs. (Rpt Only)	23	2001-2003	EA
Cylindrical Dewater Screens	27	2002	Cat-X
Misc. Improvements	25, 26, 29	2001-2003	Cat-X
RSWs (w or w/o BGSs)	13, 18	2002-2004	EA
SBC w/dewatering			
Lower Granite w/dewatering	NA		EA
Lower Monumental w/dewatering	NA		EA
Little Goose (Occlusion Only)	NA		EA
Operational Improvements			
Flow Augmentation	21	2002-2004	None
Transportation	101	2002-2007	None

FY = Fiscal Year

6.6.1 Water Quality Plan

In developing the 2000 Biological Opinions, NMFS and USFWS, in coordination with EPA, the Corps, BOR, and BPA, considered respective ecological objectives of the ESA and the CWA. In many instances, actions implemented for the conservation of ESA-listed species will also move toward attainment of water quality standards (e.g., reducing TDG and temperature). However, the Corps recognizes that, at least in the short run, there will also be instances where implementation of actions for the conservation of ESA-listed species will result in exceedences of water quality standards. There are also additional actions that are appropriate for addressing water quality, but which are nonessential for the survival and recovery of the listed species and, thus, are not components of the NMFS 2000 Biological Opinion RPA. Any plan to address water quality issues is likely to require lengthy study and implementation exceeding the scope and duration of the NMFS 2000 Biological Opinion.

Therefore, Federal agencies proposed a process to address water quality and included it as Appendix B, Development of a Water Quality Plan for the Columbia River Mainstem: A Federal Agency Proposal, to the NMFS 2000 Biological Opinion. This appendix charts a course for development of a water quality plan for the mainstem Columbia and Snake Rivers to address CWA objectives. The scope of this plan is broader than the FCRPS and would include additional actions to improve mainstem water quality by reducing TDG and temperature. The Corps anticipates that some of these actions must and will be undertaken by entities other than the Federal Action Agencies.

Although Appendix B is not a water quality plan, it provides a procedure for development of a plan and identifies actions the plan would likely contain to move toward attainment of water quality standards for the FCRPS. Appendix B in the 2000 NMFS Biological Opinion refers to items also called for in the RPA for the FCRPS as a nucleus of actions for the water quality plan. These actions enhance the survival and recovery of the listed species and, thus, are components of the RPA. Appendix B also identifies actions for the FCRPS that further CWA objectives but are not also in the RPA. These actions are listed in Table B-3 of Appendix B. These are studies to investigate additional measures to reduce TDG and temperature that may be considered for implementation in the future. These studies are appropriate ESA conservation measures that will require further ESA consultation when they are developed, analyzed, and proposed for implementation. Most importantly, the water quality plan should establish quantifiable TMDL allocations covering temperature and TDG for FCRPS projects on the Columbia and Snake Rivers. It is also critical that any meaningful water quality plan must also include TMDLs for all activities significantly affecting TDG and temperature, not limited to the FCRPS projects. Subject to available funds and Congressional directives, the Corps is committed to implementing Appendix B of the NMFS 2000 Biological Opinion. The Corps will do so by working with the Action Agencies to develop and implement this water quality plan and by undertaking all practicable alternatives to accomplish the TMDL standards in the plan.

In summary, the Corps will seek to harmonize operations to comply with both the ESA requirements, (as reflected by the RPAs recommended by NMFS), and the states' and tribal water quality standards. To the extent this is not possible, the Corps, with NMFS assistance, will seek variances for TDG standards for voluntary fish passage spill. The water quality information the Corps has or develops will be provided to EPA, the states,

and appropriate tribes for their use in developing TMDLs. The Corps will continue to work with the Federal agencies and tribes to consider water quality issues along with ESA actions to benefit listed species, including ESA operations, studies, and construction activities. When the states, tribes, EPA, and other Federal agencies develop additional information, including TMDLs for the Columbia River Basin, the Corps will be able to determine what practicable actions it can take, subject to Congressional directive and appropriations, to achieve compliance with those water quality parameters. Until that time, the Corps, as it has in the past, will provide information on water quality at its dam and reservoir projects covered by the 2000 Biological Opinions in order to assist four Northwest states, tribes, EPA, and other Federal agencies in this process.

6.6.2 Lower Monumental Stilling Basin Repairs

Implementation of a voluntary spill for the fish program in 1994 increased the size of two hydraulic cavitations in the stilling basin at Lower Monumental. These eroded holes exist at the base of the two outside spillway bays that do not have flow deflectors. Spill passage survival of juvenile salmon at Lower Monumental has consistently been lower than at other lower Snake River dams. This was likely influenced by the rough concrete edges and exposed rebar that occurred due to the erosion of these holes. Probability of mortality to spilled fish will increase as the number of fish exposed to these abrasive conditions increase and the size of these holes increase. In addition, dam structural integrity is a concern. In the summer of 2001, emergency provisions that eliminated spill due to dam safety reasons were implemented.

Plans to repair this basin will be included in the Corps' implementation plan for future actions and coordinated through the regional process. Whether it receives a high priority and is funded is yet to be determined.

6.6.3 Powerhouse Rehabilitations

The need for powerhouse rehabilitations is becoming more of a necessity as the powerhouse facilities age. For example, since the Ice Harbor Turbine Unit 5 was out of service for about 1.5 years or two fish migration seasons (due to mandatory repairs), the turbine unit priorities and optimal operation for fish survival became compromised as reliability and flexibility in the powerhouse system decreased. Spill patterns and effective screening units had to be adjusted in an attempt to meet the existing operating criteria. The TDG levels were elevated during the Unit 5 outage due to the loss of powerhouse capacity. This resulted in higher seasonal indirect mortality to spring/summer chinook salmon and steelhead (smolts and adults).

The powerhouse rehabilitations will be considered as a long-term measure and will be implemented as appropriate and as funding become available.

6.6.4 Dredged Material Management Study

The Dredged Material Management Study is currently an ongoing study. It is evaluating alternative programs to maintain the authorized navigation channel and certain public-owned facilities in the lower Snake River and the McNary reservoirs for the next 20 years; evaluating measures to maintain the flow conveyance of the Lower Granite Lake for its remaining economic life (through 2074); and evaluating alternative programs for managing dredged material in a cost-effective, environmentally acceptable, and, wherever possible, beneficial manner.

The Draft Dredged Material Management Plan went out for public review and comment in December 2001.

6.6.5 Lower Snake River Project Management Plan (PMP) for Possible Re-evaluation Study/Supplemental Environmental Impact Statement (SEIS)

In NMFS 2000 Biological Opinion RPA Actions 147 and 148, NMFS requested the Corps (in cooperation with other Federal agencies) to develop a Project Management Plan (PMP) to reevaluate more intensive hydropower-related actions (including breaching) for the four lower Snake River dams:

> "Although breaching is not essential to implementation of the initial actions called for in the RPA which constitute a non-breach approach, the RPA requires that the Action Agencies prepare for the possibility that breaching or other hydropower actions become necessary. These actions will reduce the time needed to seek Congressional authorization, if necessary, and thus reduce the time needed for possible implementation" (NMFS 2000 Biological Opinion, page 9-131).

The PMP is to identify the scope, schedule, costs, tasks, products, and responsibilities for the reevaluation study and supplemental environmental impact statement (SEIS). This PMP will include, but not be limited to, plans to mitigate possible disproportionate impacts to communities, industries, and tribes; detailed water and air quality effects; implementation plans; and a complete public involvement program. The Biological Opinion indicates that the decision to start this reevaluation study/SEIS should result from NMFS check-in process scheduled for 2003, 2005, and 2008 and is expected to take 2 years to complete.

The Biological Opinion also requests the Corps to conduct detailed engineering and design work for improvements recommended in the general reevaluation report and SEIS. The engineering and design work would include only those activities on (or near) the implementation schedule critical path for the recommended actions, up to the award of the first construction contract. For the dam breach recommendation, the critical path activities shall include turbine physical modeling (for use as low level outlets), rock source explorations for embankment erosion protection (riprap), and hydraulic (physical) modeling for the embankment removal and channelization. The Corps plans to go forward with the PMP as stated in the RPA actions.