

the-river plants. The water rights authorize year-round diversions with the conditions described in Section 3.4.2.1.1 and Section 3.4.2.1.2. At Roza, the proposal is to reduce or eliminate diversions for power production during smolt out-migration from April 1 to May 31. At Chandler Power Plant the proposal is to increase the threshold stream flow at which Reclamation reduces diversions from the Yakima River for power production. To the extent either of these proposals is implemented on a long-term or permanent basis, Reclamation's ability to fully exercise its water rights for power production would be reduced. The actions would increase stream flow in the Yakima River bypass reaches, 15 miles at Roza Dam and 12 miles at Chandler Power Plant.

### **Structural Changes to Existing Facilities**

The WIP is operated by the Bureau of Indian Affairs in consultation with the Yakama Nation. The WIP, working with Reclamation, is proposing to change the point of diversion for the Satus diversion at Wapato Dam downstream to a new pump station near Granger. This would require a change in point of diversion for the WIP water right, which would be subject to approval by Ecology and only approved if there would be no unmitigated impacts to other water rights. The KID Pump Exchange Project is currently being reviewed by Ecology and a change in point of diversion for the KID water right would also be required.

### **KRD Canal Modifications to Improve Tributary Flows**

Four tributaries in the KRD have been identified as having instream flow problems: Taneum, Manastash, Big and Little Creeks. One proposal is to modify the KRD Main Canal and South Branch Canal to provide water to water users who divert from the tributaries. In addition it has been suggested that acquiring water from those water users now diverting from the tributaries could improve flows in the tributaries.

Proposals to pipe laterals along the Main Canal and South Branch Canal of KRD and to install a pump station at the tail end of the South Branch Canal would be expected to free capacity in the canals. This would allow KRD to discharge water directly to the creeks or to water users who currently divert from the creek.

For KRD to directly supply water to water users who are now diverting from the creeks would require Ecology's approval to change the point of diversion and source of water under the water rights. The water users, who have confirmed rights to divert from the creeks, would be required to change their point of diversion to KRD's main diversion from the Yakima River. The source would also change from the creek to the Yakima River. KRD and the water right holders would enter into an agreement for KRD to divert and convey water through its system to the individual users. KRD would be authorized to divert additional water from the river to supply the water right holders who change their point of diversion. In the alternative, KRD may allow the individuals to become members of KRD, and KRD would acquire the right to divert and convey the water under KRD's water right.

The potential impacts to the tributaries and the individual water users are positive. There is a potential for impairment of any water rights that have a point of diversion between

KRD's diversion from the Yakima River and the confluence of the tributary with the river. The flow in the river in this reach would be reduced by the additional quantity diverted by KRD.

### **Complete the Wapatox Project**

The proposals include consolidating the Wapatox and Naches-Selah diversions and/or using the Wapatox diversion to supply water to the Yakima treatment plant and the Glead Ditch (see Figure 2-3). Both of these proposals would require changes in the point of diversion of water rights confirmed in the Yakima Adjudication. Both proposals would improve stream flow in the Naches River. Modifying the conveyance system would also have a positive impact on the irrigators' water rights by allowing them access to the full amount of water under their water rights.

#### **5.4.2.3 New Storage Element**

Reclamation's water rights, including those for storage, were confirmed by the Adjudication Court on March 12, 2007. The court quantified Reclamation's storage rights in terms of "total active capacity" with no cap for the annual amount of water that may be stored as Reclamation drafts down the reservoirs and then refills them during the season. Any expansion of existing storage capacity beyond that confirmed by the court and any construction of new storage reservoirs would require a new water right from the state. Reclamation would apply for new water rights under its Withdrawal from Appropriation, which was filed on February 17, 1981, and extended again this year until January 18, 2013. The public notice regarding the request for an extension stated that Reclamation intends to use unappropriated waters to satisfy purposes under YRBWEP and for water storage projects currently authorized or those authorized in the future (Ecology, 2007b).

Construction and operation of new storage facilities would require obtaining a reservoir permit from Ecology (RCW 90.03.370). Applications for reservoir permits are subject to the permitting requirements in RCW 90.03.250 through 90.03.320. Ecology would apply the same four-part test to Reclamation's request for a new water right as it does in deciding whether to issue any new water right. Ecology may only issue a new water right if there is water available, if it would be used for a beneficial use, and if it would not impair existing rights or be detrimental to the public welfare (RCW 90.03.290).

Generally, parties that propose to put stored water to a beneficial use must also file an application for a secondary permit. However, a secondary permit is not required where a water right permit or certificate for the source of the stored water authorizes the beneficial use (RCW 90.03.370(1)(c)). Thus, a secondary permit would not be required for proratable irrigation districts that have water rights to the Yakima River. If water users wish to have additional quantities of water over and above their adjudicated amounts, they would be required to file for a secondary permit.

Expansion and construction of new storage is intended for the multiple purposes of providing a better supply of water for irrigation during drought years, water for future

municipal growth, and improved stream flow. The court confirmed Reclamation's storage rights with the following condition: "Filling, detention, carryover, release and delivery of water to ... Reclamation and entities authorized to receive water from Reclamation." For existing rights in the adjudication, the specific purpose of use for the water is to be described on the diversionary water right certificates of those who receive water from Reclamation. The irrigators who would receive more water during drought years have existing diversionary rights for irrigation. Water for municipal growth may be under existing permits or new municipal water rights. Water released for instream flow would be transferred to the state Trust Water Rights Program and the certificate held by the state (RCW 90.38.040).

### **Bumping Lake Expansion**

The existing water right for Reclamation to store water in Bumping Lake is for a total active capacity of 38,768 acre-feet. The large expansion option would be to store 458,000 acre-feet. The small option would allow storage of 200,000 acre-feet. Operation of the new storage capacity would supply additional water to proratable irrigators in dry years only and to provide additional water for fish to allow flexibility in the system. Examples of how the new storage could be used are listed in Section 2.3.4.1.

The impacts to proratable water rights would be positive. The storage could be used to shape flows in the Yakima and Tieton Rivers to provide better fish habitat. It could also be used to provide pulse flows to assist out-migrating smolts.

### **Wymer Dam**

Storage in a new Wymer reservoir would require Reclamation to obtain a new water right. Until a route for conveying water to a new reservoir is established, specific potential impacts on water rights cannot be determined. However, as explained in Section 5.4.2.3, Ecology may not issue a new water right to Reclamation if it would adversely impact existing water rights or be detrimental to the public welfare. If construction of Wymer reservoir resulted in Reclamation's ability to modify river operations, it could improve instream flow for fish.

### **Ahtanum Creek Watershed Restoration Program, Including Pine Hollow Reservoir**

The impacts to water rights from this option, including Pine Hollow reservoir, were discussed in Ecology's Final Programmatic EIS for the Ahtanum Creek Watershed Restoration Program (Ecology, 2005) (Section 6.13.2). As discussed in the EIS, a new water right would be required to authorize diversion into the reservoir and storage of water. The minimum quantity of water required would be the total amount needed to supply water to the WIP, Johncox Ditch, and Ahtanum Irrigation District water users. The reservoir would allow all water users within the reservoir service area to stop diverting from streams or withdrawing ground water from wells. These changes would require Ecology's approval for a change in point of diversion.

The Adjudication Court has issued rulings since Ecology issued the Final Programmatic EIS for the Ahtanum Creek Watershed Restoration Program that will affect the potential impacts of this alternative. Significantly, the court ruled that the Northside water users do not have a right to divert after July 10 under their existing rights (Supplemental Report of the Court Concerning the Water Rights for Subbasin No. 23 (Ahtanum Creek), Ahtanum Irrigation District, Johncox Ditch Company and United States/Yakama Nation, February 25, 2008). Under this ruling, they would need to apply for a new water right to receive delivery of water from the reservoir after July 10 each year. The court also held that there is no requirement to maintain 0.25 cfs in the stream for non-diversionary stockwater in Bachelor and Hatton Creeks. This means that there is no requirement to divert water from Ahtanum Creek into these creeks after July 10. The court heard exceptions to these and other rulings at a hearing in late October 2008. The court's final decision is anticipated in early 2009.

#### **5.4.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on water rights were described in Section 5.2.5.3 of the January 2008 Draft Planning Report/EIS.

#### **5.4.2.5 Fish Habitat Enhancement Element**

If fish enhancement projects include acquisition of water for instream flow, the discussion in Section 5.4.1 applies. For the reach of the Yakima River from Roza Dam to Prosser Dam, irrigation would occur in winter to saturate floodplains. This would either require acquisition of a new water right or a change in the season of use of an existing irrigation right. As with any new water right or change to a water right, Ecology may not approve the water right or change if it would impair existing water rights.

#### **5.4.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on water rights were described in Section 5.2.5.1 of the January 2008 Draft Planning Report/EIS.

#### **5.4.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on water rights were described in Section 5.2.5.2 of the January 2008 Draft Planning Report/EIS.

### **5.4.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

With respect to water rights, it is anticipated that the Integrated Water Resource Management Alternative would have additive positive impacts to instream flow for fish. New storage to provide additional water for proratables during drought years would also be additive. Because no new water rights may be issued or changes to water rights may be approved that would impair existing rights, the Integrated Water Resource Management Alternative should not have negative impacts on water rights.

#### **5.4.4 Mitigation Measures**

If impacts of new water rights or changes to water rights are identified, the water right may be issued or the change approved if the impact can be mitigated. For example, one alternative is for KRD to divert water at its diversion point on the Yakima River and deliver it to water users on tributaries within the District's service area in lieu of diversions directly from the tributaries. In this case, there would be a corresponding reduction in flow in the Yakima River from KRD's point of diversion downstream to the confluence of the tributaries and an impact on the Yakama Nation's water right to instream flow for fish. However, the Yakama Nation may agree that this impact is mitigated by the increased flow in the tributaries. Whether mitigation is required would be specific to each situation and would be determined during the water rights review process. Additional mitigation measures for potential impacts of water rights or changes to water rights were described in Section 5.2.6 of the January 2008 Draft Planning Report/EIS.

### **5.5 Ground Water**

#### **5.5.1 No Action Alternative**

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin would continue. Deficiencies in irrigation water availability may increase demand on ground water. An increase of land conversion to residential use may result in an increase in new exempt wells, resulting in overuse of ground water. Continued issuance of permits for emergency use of ground water wells in drought years could also result in overuse of ground water. Existing ground water levels and issues would likely persist.

#### **5.5.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

Long-term impacts to ground water may occur during the operation of constructed facilities. Increased recharge to ground water may increase aquifer pressure and result in increased base flows. Decreasing the ground water irrigation demand may increase downstream ground water levels. The ground water impacts for specific projects would be described in detail in future site-specific investigations.

##### **5.5.2.1 Fish Passage Element**

No long-term impacts on ground water are expected from the operation of constructed fish passage facilities.

##### **5.5.2.2 Modifying Existing Structures and Facilities Element**

Releasing additional volumes for stream flow augmentation during dry seasons would have a limited long-term impact on regional ground water conditions. Shallow and ground water in close connection to stream flows could be improved by stream flow augmentation. Improvements in irrigation conveyance facilities would decrease localized

ground water recharge and shallow ground water interception that currently occurs from canal seepage.

### **5.5.2.3 New Storage Element**

Operating new storage would permanently increase ground water levels near new reservoirs. Increased infiltration beneath the reservoir would also occur. The magnitude of impact to water levels would depend on the size and depth, the hydraulic head created, and local hydrogeologic characteristics. Additionally, use of borrow material for construction could locally increase seepage or infiltration rates. Increases in ground water elevation could occur in the immediate vicinity of the reservoir and larger-scale changes in ground water flow patterns are possible. A decreased demand on downstream ground water for irrigation may also increase ground water levels downstream of the storage facility.

### **5.5.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on ground water were described in Section 5.3.2.3 of the January 2008 Draft Planning Report/EIS. Additional analyses that were completed for ground water storage options are included below.

#### **Evaluation of the Potential for Municipal Direct Injection**

To evaluate the potential for utilizing ASR, a three-dimensional ground water flow model was developed of the Ahtanum-Moxee Subbasin in the Yakima Valley. The goal of modeling was to estimate the quantity of recharged water to three injection wells that would: (a) return to the Yakima River; (b) discharge at other hydrologic sinks; or (c) remain in the subsurface in the form of increased ground water storage. The impacts of direct injection for both passive and active recovery are based on the computer simulation of the direct injection of water into the deeper portion of the ground water system of the Ahtanum Valley. The results are summarized below. Details of the modeling and results are described in the Technical Report prepared for the Groundwater Alternative (Ecology, 2009a).

- **Direct Injection.** Direct injection resulted in an immediate increase of aquifer storage and a delayed seepage of water to the stream. After the first annual cycle, 92 percent of the recharged water remained in the aquifer, and the increased seepage rate from the aquifer to the Yakima River above baseline conditions was approximately 0.6 cfs. Direct injection during winter months for 10 years resulted in an increased aquifer storage by approximately 28,600 acre-feet, and a seepage rate of approximately 3 cfs at the end of the 10-year period.
- **Active Recovery.** Active recovery of recharged water on an annual basis resulted in a recovery efficiency of greater than 92 percent. For instance, an injection rate of 8,000 gpm (17.9 cfs) over half a year results in a recoverable volume of approximately 6,000 acre-feet per year, with the remainder of the recharged water that is not recovered seeping out to streamflow.

- **Passive Recovery.** Passive recovery results in a year-round seepage rate approximately equal to the average annual recharge rate once equilibrium is achieved. For instance, extrapolating the model results to an injection rate of 8,000 gpm (17.9 cfs) over half a year results in increased streamflows of approximately 8.9 cfs.

### **Evaluation of the Potential for Regional ASR**

Several large-scale wellfields using wells with high injection and recovery rates (on the order of 2,500 gpm per well) would be used for both injection and recovery. The water stored during the early spring would be pumped out during the summer as a direct offset to TWSA and the water would be pumped into the existing and/or modified canal system. The wellfields could be operated year-after-year to increase the total water supply or only during dry or drought conditions to satisfy junior water rights.

The analysis evaluated the aquifer response to injection and storage from a wellfield injecting approximately 65,000 acre-feet (2,500 gpm per well; 274 cfs per wellfield) over a 120 day period. Predicted water level rises ranging from approximately 100 feet to 800 feet were predicted over the transmissivity and storage estimates incorporated into the final simulation. This suggests that for the conceptualized layout and injection quantities, regional ASR implementation is feasible within the basalt aquifers, provided that optimal hydrogeologic characteristics (sufficient transmissivities, storativities, and suitable aquifer water levels) can be demonstrated as part of more detailed design work.

Predicted water-level increases associated with ASR will vary in response to aquifer and geologic conditions and can affect ultimate storage capacity. It is not possible to simulate these effects with existing data. Evaluation of the effects of hydraulic boundaries would be a critical part of more detailed design analysis for this element.

### **Evaluation of the Potential for Surface Recharge**

Two approaches were used to evaluate the volume and timing of water diverted to an infiltration pond and the subsequent timing and volume of return flow to the stream:

- **Target Return Flow Profile.** This approach identified a desired condition for ground water return flows, and examined the amount of infiltration and total area of infiltration ponds required to achieve the target infiltration profile.
- **Water Supply in Excess of Entitlements and Flow Targets.** This approach used the historical monthly availability of TWSA for the period from 1978 to 2000 to determine in which months there was water in excess of entitlements and flow targets in reservoir storage that could be diverted into infiltration ponds.

The second approach does not account for all operational flows, but is adequate for preliminary analysis. The results of these estimates suggest that an average infiltration capacity of 20 to 60 acre-feet (AF) per acre per month would be reasonable to expect for the study area. Based on these infiltration capacities, an area of 166 to 500 acres of land would be required to infiltrate 10,000 AF of water in one month. Details on the analysis

are provided in the Technical Report on the Groundwater Storage Alternative (Ecology, 2009a).

#### **5.5.2.5 Fish Habitat Enhancement Element**

Alterations in floodplain and off-channel storage connectivity could result in long-term changes to ground water interaction with streams. In general, improvements to fish habitat would also result in improvements to near-channel ground water interaction and connectivity between stream channels and shallow/hyporheic ground water.

#### **5.5.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on ground water were described in Section 5.3.2.1 of the January 2008 Draft Planning Report/EIS for surface recharge and municipal ASR. The analysis of the regional ASR program in Ecology (2009a) predicted water level rises ranging from approximately 100 feet to 800 feet. Ground water elevations near the injection wells and the centrally-located injection wells will have the most near-term, seasonal change. Evaluation of the effects of hydraulic boundaries would be performed as part of more detailed design analysis if this element is carried forward.

Long-term ground water level changes could result from interannual storage that is not recovered during an annual ASR cycle. These changes would accrue slowly from year to year depending on the cumulative amount of water injected to the basalt aquifers and the amount of water recovered from the basalt aquifers. Additional site specific studies would be conducted to more accurately characterize the potential increase in ground water levels, and as appropriate, determine mitigation.

#### **5.5.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on ground water were described in Section 5.3.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.5.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Ground water levels and quantity are expected to increase through additional recharge from storage facilities, riparian enhancements, wetland and wet meadow construction, and from floodplain enhancements. Some localized decreases in recharge are expected from improving conveyance facilities.

### **5.5.4 Mitigation Measures**

Long-term impacts to ground water could be avoided or mitigated by conducting hydrogeological studies prior to the design and using the knowledge gained in the design, construction, and implementation of projects. The benefit of these studies would depend on the type and magnitude of project and the extent of study.

The timing of operational activities could be used to reduce the impact to ground water. Additionally, the use of artificial recharge or withdrawal could be considered as part of the impact management strategy. Monitoring during operations would document the effectiveness of management strategies implemented.

## **5.6 Water Quality**

Water quality can be affected by construction activities, impoundment of water, the depth at which water is withdrawn from reservoirs, and the flow regime. Construction increases the risk of erosion and introduction of contaminants. Impounding water tends to increase water temperatures and can reduce dissolved oxygen (DO) levels. These adverse effects may be transported downstream depending on the level at which water is released from the reservoir. Release of water from the surface of the reservoir tends to transport warm, well oxygenated water downstream. The release of water from deeper in the reservoir can transport cooler, low DO water downstream depending on reservoir conditions. The effects on stream flows would depend on the temperature of water released, solar radiation, and ground water inflow.

### **5.6.1 No Action Alternative**

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin will continue. Existing water quality issues and trends will persist or worsen lacking a comprehensive, integrated management program that provides a system-wide approach. Projects funded and scheduled under the No Action Alternative could have impacts to water quality similar to those described in the following sections. Water quality impacts of those projects would be identified in separate NEPA or SEPA analysis, as appropriate.

### **5.6.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

In general, components of the Integrated Water Resource Management Alternative are intended to provide net water resource benefits, including water quality improvements. However, some impacts could occur. Long-term impacts to water quality that could occur include migration of contaminated soils that are in newly inundated areas to surface or ground water, and leaching and migration of subsurface natural and artificial contaminants. The water quality impacts for specific projects would be described in future site-specific investigations.

#### **5.6.2.1 Fish Passage Element**

Seasonal operation of the constructed fish passage elements could increase the delivery of organic debris, sediment, and nutrients to downstream waters. New spill gates and outflow structures could potentially influence the entrainment of air into water and thereby affect total dissolved gas levels. However, design and operation of these facilities would be aimed at improving fish habitat. Therefore it is unlikely that total dissolved gas levels would be increased to the extent that they would exceed water quality standards or adversely affect fish.

### **5.6.2.2 Modifying Existing Structures and Facilities Element**

Altering stream flows in the Yakima River and its tributaries could seasonally alter stream temperatures and associated DO concentrations. The magnitude of cooling/warming effects and associated changes in DO concentrations would vary depending on the location and season of altered flows. Water quality standards could be exceeded by warmer temperatures or lower DO levels, which could adversely affect fish, especially during spawning and incubation. Increased mainstem flows would provide additional dilution of contaminants.

### **5.6.2.3 New Storage Element**

The extent of impacts associated with new storage would depend on the size and location of the facility. In general, larger projects would have a higher likelihood of causing substantial effects (both positive and negative). For example, expanding Bumping Lake capacity to 450,000 acre-feet would have greater effects than expanding it to 200,000 acre-feet. Long-term impacts could include seasonal increases in downstream sediment loading and gas entrainment, debris impoundment, changes to downstream riparian vegetation, decreased downstream turbidity, increased downstream temperature, increased eutrophication of impounded water, and increased pollutant accumulation in the impounded water.

Long-term water quality improvements from new storage facilities would result from flow releases to meet minimum flow requirements for fish (Reclamation, 1979). However, if downstream flow releases are of a lower quality (e.g., warmer temperature) than existing ground water base flows, discharges could degrade surface water quality. Differences between the chemistry of flow releases and existing ground water could cause chemical reactions that would result in precipitation of minerals, changes to the taste or odor of the water, or biological changes (i.e., coliform, algae, or microbial). Recreational use on the new and/or enlarged reservoirs could also decrease water quality through addition of oils and greases from water craft, nutrients, or invasive aquatic plants introduced by boats.

### **5.6.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on ground water were described in Section 5.6.2.3 of the January 2008 Draft Planning Report/EIS.

### **5.6.2.5 Fish Habitat Enhancement Element**

Inundation of lands for habitat restoration, wetland or wet meadow creation, and floodplain connectivity could result in the introduction of chemical constituents to surface waters. Chemicals deposited in soils during past land use practices may include pesticides, herbicides, fertilizers, endocrine disruptors, hydrocarbons, and other hazardous residues. The impact of potential contaminants would depend on the contaminant concentrations, which are determined primarily by historic land use practices, and the ability of soils to absorb and/or bind contaminants. Free draining gravelly soils, for example, often have less capacity to adsorb some contaminants than

less permeable soils with high organic content. Riparian and wetland habitat enhancements would help remove instream contaminants and cool the water.

#### **5.6.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on ground water were described in Section 5.6.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.6.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on ground water were described in Section 5.6.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.6.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Protection and enhancement benefits to water quality are expected to be based on the extent that implementing the elements as an integrated package improves stream flows. In addition, coordinating the activities under the Integrated Water Resource Management Alternative would facilitate better overall management of water quality from the actions implemented. This is expected to reduce the likelihood and magnitude of water quality impacts in comparison to conducting the individual water resource management elements individually.

### **5.6.4 Mitigation Measures**

Mitigation of the long-term impacts to water quality could include controlling the depth at which water is drafted from reservoirs to minimize increased downstream temperature and decreased DO, allowing reservoir waters to cool by infiltration before recharging surface waters, providing sediment bypass facilities, and implementing nutrient control measures. Natural mixing and dilution could also help mitigate impacts to water quality. Recreational impacts could be minimized by restricting uses. Water quality impacts could further be mitigated through the use of evaluations that consider site-specific characteristics to aid in design and selection for individual improvements to be implemented.

Assessment of potential contaminants in soil prior to inundation would identify problem areas and allow for removal or stabilization of soils and sediments that might affect water quality.

Implementation of long-term management plans addressing water quality, recreation, frequently flooded areas, and riparian and wetland areas would also help maintain and enhance water quality. Monitoring reservoir and downstream water quality would document the effectiveness of water quality management strategies that are implemented.

## **5.7 Hydropower**

### **5.7.1 No Action Alternative**

The No Action Alternative is not expected to have long-term impacts on hydropower because no changes in flow through hydroelectric facilities are currently proposed for the programs listed in Section 2.2.

### **5.7.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

#### **5.7.2.1 Fish Passage Element**

The fish passage element is not expected to have long-term impacts on hydropower because no changes in flow through hydroelectric facilities would occur with this alternative.

#### **5.7.2.2 Modifying Existing Structures and Facilities Element**

The proposal to increase out-migration flow in the Yakima River below Roza Dam during the smolt migration period (April 1 to June 30) would reduce or eliminate power diversions, thereby reducing hydropower production for these three months. The actual reduction of power generated is unknown because the amount of flow desired below Roza Dam is yet to be determined. The rate of reduction of power generated is 10 kWh per cfs reduced each hour (Reclamation, 2002). The reduction in power generated for a range of flow increases from 50 cfs to 300 cfs was estimated by multiplying the rate of power reduction per cfs by the flow increase and length of time the increase occurs. Table 5-15 summarizes the estimated April to June reductions in generation and compares those reductions to the average amount of generation by the Roza Power Plant in April to June and total annual generation. The estimated reduction in power generated would range from 1,092,000 kWh for a 50 cfs flow increase to 6,552,000 kWh for a 300 cfs flow increase. The total annual generation by the power plant averages 55,535,300 kWh.

**Table 5-25 Estimated Reduction in Power Generated for Roza Power Plant**

Increase in Yakima River Flow (cfs)	Reduction in Power Generated (kWh)		
	April	May	June
50	360,000	372,000	360,000
100	720,000	744,000	720,000
150	1,080,000	1,116,000	1,080,000
200	1,440,000	1,488,000	1,440,000
250	1,800,000	1,860,000	1,800,000
300	2,160,000	2,232,000	2,160,000
<i>Average Gross Generation (1981-1999)</i>	<i>6,100,000</i>	<i>7,100,000</i>	<i>7,600,000</i>
<i>Roza Irrigation Pump Requirements (1981-1999)</i>	<i>3,050,000</i>		<i>5,350,000</i>
<i>Annual Average Gross Generation (1981-1999)</i>	<i>55,535,300</i>		
<i>Annual Average Net Marketed Generation (1981-1999)</i>	<i>18,974,100</i>		

Source: Reclamation, 2002

**Subordination of Chandler Power Plant Diversions in Spring**

The proposal to increase the minimum flow level between April and June in the Yakima River below Prosser Dam (currently at 1,000 cfs) would reduce generation at the Chandler Power Plant. The actual reduction of power generated is unknown because the amount of flow increase has not been determined. The rate of reduction of power generated is 10 kWh per cfs reduced each hour (Reclamation, 2002). The reduction in power generated for a range of new minimum flows from 1,100 cfs to 2,000 cfs was estimated by multiplying the rate of power reduction per cfs by the flow increase and length of time the increase occurs. Since minimum flows are not always present, the reduction in power generation was computed to occur only when flows exceeded 1,100 cfs and only up to the amount of flow available for diversion into Chandler Canal for hydropower generation purposes. Table 5-16 summarizes the estimated April through June reductions in generation and compares those reductions to the average amount of generation by the Chandler Power Plant in April through June and total annual generation. The estimated reduction in power generated would range from 236,700 kWh for a new minimum flow level of 1,100 cfs to 2,174,000 kWh for a new minimum flow level of 2,000 cfs. The total annual generation by the power plant averages 49,500,000 kWh. The reduction in power generated is based on an average of flows from 1995-2004.

**Table 5-26 Estimated Reduction in Power Generated for Chandler Power Plant (1995-2004)**

New Minimum Flow Level below Prosser Dam (Apr-Jun) (cfs)	Reduction in Power Generated (kWh)		
	April	May	June
1,100	62,200	66,300	108,200
1,200	132,100	147,900	155,100
1,300	168,300	248,600	202,600
1,400	187,100	347,000	261,200
1,500	212,100	453,400	337,500
1,600	252,100	554,100	416,300
1,700	299,200	659,100	493,300
1,800	348,500	770,200	566,400
1,900	411,000	879,400	637,900
2,000	493,500	974,500	706,000
<i>Average Net Generation (1995-2004)</i>	<i>4,600,000</i>	<i>3,900,000</i>	<i>2,600,000</i>
<i>Average Annual Net Generation (1995-2004)</i>	<i>45,900,000</i>		

Sources: Reclamation, 2002; Reclamation, no date

**Structural Changes to Existing Facilities**

***Wapato Irrigation Project Improvements***

Installing a pumping plant would increase the electricity demand in the area and could slightly reduce hydroelectric generation at the two power plants owned by the Bureau of Indian Affairs and operated by WIP.

***Changes to Chandler Juvenile Bypass Outfall***

This project is not expected to have long-term impacts on hydropower because the project would not change flow through any hydroelectric facility.

***KID Pump Exchange Project***

Installing a pumping plant would increase electricity demand in the area.

**KRD Canal Modifications to Improve Tributary Flows**

***Lateral Piping Projects along the Main Canal and South Branch Canal***

This project is not expected to have long-term impacts on hydropower because the project would not change flow through any hydroelectric facility.

### ***Pumping near Tail End of Canal***

Installing a pumping plant would increase the electricity demand in the area but would not affect hydroelectric generation because the project would not change flow through any hydroelectric facility.

### **Complete the Wapatox Project**

This project is not expected to have long-term impacts on hydropower as the project would not change flow through any hydroelectric facility.

### **5.7.2.3 New Storage Element**

Constructing additional storage may have long-term impacts on hydropower. Additional storage would cause a slight increase in electricity demand from operations; however, these increases are expected to have a negligible impact on hydropower availability. The Wymer reservoir, if fed by a pump station at Thorp, would increase electricity demand. If hydroelectric facilities were added to Wymer, Bumping, or other storage project, this could increase hydroelectric generation in the project area and offset pumping costs. In addition, the increased storage volume available may allow additional diversions into the Roza Power Plant, increasing hydroelectric generation. The hydrologic model showed an increase in generation equivalent to approximately 5 million kWh per year which would likely offset any other subordination impacts of hydroelectric generation at the Roza Power Plant.

Creation of new storage would cause a slight reduction of the amount of hydropower generated at dams on the Columbia River below the confluence of the Yakima River—McNary, John Day, The Dalles, and Bonneville Dams. The impacts would depend on the operation of the new storage, but hydropower generation could decrease in the winter and spring as a new reservoir is filled, and increase in the summer as flow is released out of storage to improve stream flow. If the water stored for irrigation is only used during drought years, a reduction in hydroelectric generation may only occur in years when the reservoir is refilling after being used for irrigation water supply. These changes are expected to be small compared to the current amount of hydropower generation occurring at these four dams.

### **5.7.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on hydropower were described in Section 5.4.2.3 of the January 2008 Draft Planning Report/EIS.

### **5.7.2.5 Fish Habitat Enhancement Element**

This project is not expected to have long-term impacts on hydropower as the project would not change flow through any hydroelectric facility.

### **5.7.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on hydropower were described in Section 5.4.2.1 of the January 2008 Draft Planning Report/EIS.

### **5.7.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on hydropower were described in Section 5.4.2.2 of the January 2008 Draft Planning Report/EIS.

## **5.7.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Implementing the elements under the Integrated Water Resource Management Alternative as an integrated package would result in a combination of effects including a reduction of hydroelectric generation at the Roza and Chandler Power Plants and at the two in-line power plants in the WIP. A slight reduction in hydroelectric generation at dams along the Columbia River would occur when a new reservoir is refilling after the irrigation portion of the water stored is used during a drought year. Additional demand for electricity would occur from some elements of the Integrated Water Resource Management Alternative, including a large pump station to feed Wymer reservoir. The combination of energy recovery at Roza Dam and generation due to improved flows in the Yakima River may offset any impacts from pumping at Thorp and subordination at Roza Dam. If a hydroelectric generation facility is feasible at the new reservoir sites, then the overall effect may be an offset of pumping costs and possibly an increase in hydroelectric generation.

## **5.7.4 Mitigation Measures**

No mitigation measures are proposed because the impacts are not expected to be significant, especially with an offset of pumping costs by an increase in hydroelectric generation at a new reservoir site. Any changes in hydropower generation would be coordinated with Bonneville Power Administration, Reclamation, and other affected agencies.

## **5.8 Vegetation and Wildlife**

### **5.8.1 No Action Alternative**

Some of the individual actions proposed under the No Action Alternative involve riparian vegetation improvement or alteration of wildlife habitats and species using those habitats. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Improved riparian vegetation would result in increased habitat for terrestrial wildlife species. Some projects could reduce the amount of shrub-steppe vegetation, but that impact is expected to be minor because most areas are already disturbed. To the extent that NEPA or SEPA analysis

would be required for these actions, appropriate documentation of the vegetation and wildlife impacts from construction would be prepared separately.

## **5.8.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

### **5.8.2.1 Fish Passage Element**

Construction of fish passage facilities could result in permanent removal of vegetation and displacement of wildlife. However, at Keechulus, Kachess, Cle Elum, and Rimrock Lakes, much of the area where construction would occur is currently absent of vegetation. Structures placed in the drawdown zone of the lakes would not result in vegetation impacts. Construction areas would be adjacent to existing spillways or dam abutments and embankments, where vegetation is nonexistent or limited to grasses. Minor effects to the habitat could occur through the removal of a few mature Douglas fir or other conifers for construction of the adult fish collection facilities and access roads. Conifer removal would be minimized to the extent possible.

According to Reclamation (2008c) the fish passage conduit at Cle Elum Lake would permanently replace about 7,600 square feet of Douglas fir, black cottonwood, lodgepole pine, and chokecherry along with the dirt roadway adjacent to the existing spillway facilities. The adult fish collection facility downstream, adjacent to the Cle Elum River, would permanently eliminate about 23,700 square feet of riparian and second-growth Douglas fir, black cottonwood, lodgepole pine, and chokecherry. About 2,600 feet of existing access roads would be upgraded and 550 feet of new road would be constructed, resulting in some habitat losses.

At Bumping Lake, the construction area lies entirely within the spotted owl Critical Habitat Unit (CHU) Number 6: Southeast Washington Cascades (USFWS, 2008a). The adult fish collection facility including the fish ladder, loading slab, building, fish lock, and holding pool would permanently replace about 19,600 square feet of riparian and second-growth Douglas fir habitat (Reclamation, 2008c). An old-growth stand of western red cedar is present to the northeast of the proposed facility location. The footprint of the fish collection facility has been adjusted to minimize overlap with the stand, but there would be a potential for adversely impacting a small portion of this habitat. The fish passage conduit would be constructed in the dam embankment, across a disturbed area at the foot of the dam and into the river, resulting in the permanent loss of a small stand of trees and riparian vegetation. This would cause minimal impacts to wildlife because the area of impact is small and adjacent suitable habitat is available.

Based on the current level of disturbance at the reservoir dams and the minimal loss of vegetation for fish passage facility construction, impacts to wildlife are anticipated to be minimal at Keechulus, Kachess, Cle Elum, and Rimrock Lakes. Human activities associated with the operation of the juvenile passage intake structures, the adult fish collection facilities, and the trap and haul trucks would increase in the project areas and may result in long-term disturbance to wildlife.

The fish passage element of the program would expand the available fish habitat to higher mountain streams in the Yakima Basin. The reintroduction of anadromous fish would have overall long-term ecosystem benefits by restoring food web interactions between invertebrates, fish and mammals. Migrating, spawning and juvenile fish are a vital forage base for many birds, mammals and other fish. Spawned fish carcasses and eggs are also an important source of nutrient inputs to streams and increase the biomass available to the benthic invertebrate community.

### **5.8.2.2 Modifying Existing Structures and Facilities Element**

The majority of the proposed modifications would result in no impacts to plants and wildlife because they are located in areas already disturbed and developed. Wildlife in the vicinity are accustomed to existing activity levels, which would not change significantly. The piping of the five laterals on the Main Canal and five laterals on the South Branch Canal of the KRD would result in the loss of some temporary ponds and wetlands present along the canal. These artificial wetlands are sustained by leakage from the canal and provide habitat for amphibians, birds and other wildlife. The piping of canals would remove the hydrology source of these wetlands over time and result in a loss of this habitat within this portion of the KRD.

### **5.8.2.3 New Storage Element**

Construction of new storage facilities has the greatest potential for impacts to vegetation and wildlife. A new reservoir would permanently remove vegetation and displace wildlife from the reservoir area. The size and location of the facility would be proportionate to the degree of alteration to wildlife and vegetation communities. Larger facilities are expected to cause greater impacts. Site specific studies of existing vegetation and wildlife species using the reservoir area would be constructed prior to facility design and construction at all proposed facilities.

Construction of a new rock-fill dam downstream of the existing Bumping Lake Dam and enlargement of the reservoir would result in the flooding of forested communities above the current level of Bumping Lake. The expansion would increase the current 1,300-acre reservoir to 4,120 acres under the large option, and 3,500 acres under the small option (Figure 2-4). The forest communities surrounding the lake are second-growth conifer forest supporting a canopy of lodgepole pine, western hemlock, western red cedar, Englemann spruce, and a dense shrub understory. The January 2008 Draft Planning Report/EIS Section 2.9.1 (Reclamation and Ecology, 2008) states that approximately 2,800 acres of terrestrial habitat, including about 1,900 acres of old growth habitat, would be inundated if Bumping Lake were enlarged to a capacity of 400,000 to 458,000 AF.

Forest communities within the expansion zone would be lost over time due to prolonged inundation and replaced by open water. The majority of impacts would occur to forested communities east of the lake and within the Deep Creek drainage area, outside of wilderness areas. If rare plants or rare plant communities are present within the expansion zone, these would be adversely affected. Site specific studies would be necessary to determine if such species are present. Habitats at the lake edge used by

wildlife for nesting or foraging would be lost, but could be replaced in the long-term once vegetation at the new lake edge stabilizes. Mobile wildlife species would be permanently displaced to adjacent suitable habitats. Travel corridors for wildlife would also be impacted by the change in lake level, likely resulting in adverse effects to elk, deer, and small mammals. Loss of forest communities surrounding Bumping Lake could also adversely affect some listed and priority species known to occur in the vicinity, including wolverine, western toad, common loon, and spotted owl. If Bumping Lake or a similar area is selected for new or expanded storage, additional studies would be required to document wildlife species in the area and potential impacts to those species.

Construction of water conveyance routes for the proposed Wymer reservoir, including the North and South Branch Options, could result in vegetation removal. The enlargement of existing canals or construction of new canals would likely permanently remove vegetation. Most of these facilities would be located in already disturbed areas. Impacts to shrub-steppe habitat that could result from construction of the Wymer reservoir were previously evaluated in Section 4.7.2.4 of the January 2008 Draft Planning Report/EIS.

Construction of the storage reservoir in Pine Hollow would result in flooding of the grassy vegetation and replacing an area of disturbed shrub-steppe vegetation with an artificial lake (Ecology, 2005). After construction, the earthen dam would be planted with native vegetation, which would provide improved habitat for wildlife. The reservoir would be drawn down during the summer, leaving exposed mud flats at the upstream end of the reservoir. It is likely that a mix of native and non-native vegetation, including smartweed (*Polygonum sp.*) and cocklebur (*Xanthium sp.*), would colonize the mud flats during the summer. The reservoir would likely provide new habitat for waterfowl species, especially during spring and fall migration. Shorebirds may be attracted to the mud flat areas during fall migration. The loss of riparian vegetation along the Johncox Ditch would result in less protective vegetation cover for wildlife species such as small mammals, birds, and reptiles. The movement of small mammals and reptiles could also be blocked or altered by the new access roads and pipelines.

#### **5.8.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on vegetation and wildlife were described in Section 5.7.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.8.2.5 Fish Habitat Enhancement Element**

The proposed habitat protection, restoration, and enhancement projects would improve native plant diversity and habitat for wildlife. Projects that reconnect side channels and/or create off-channel habitats would increase breeding habitat for amphibians. Stabilizing streambanks and restoring riparian areas would provide functioning habitats for many species of large and small mammals and birds.

#### **5.8.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on vegetation and wildlife were described in Section 5.7.2.1 of the January 2008 Draft Planning Report/EIS.

### **5.8.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on vegetation and wildlife were described in Section 5.7.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.8.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

The integrated elements would result in negative impacts to vegetation and wildlife using the area of a new reservoir or the proposed reservoir expansion adjacent to Bumping Lake. Impacts would be positive for vegetation and terrestrial wildlife along the mainstem and tributaries in the Yakima River basin. An integrated implementation of fish habitat enhancement projects and stream flow improvements would provide greater benefits to riparian vegetation and wildlife than implementing the elements separately because integrated management approaches are more likely to achieve system-wide benefits. Operational and structural changes to existing facilities are not anticipated to result in impacts because construction associated with these elements would occur in previously disturbed areas or built environments.

### **5.8.4 Mitigation Measures**

Mitigation measures for potential impacts to vegetation and wildlife were described in Section 5.7.3 of the January 2008 Draft Planning Report/EIS. The impacts to vegetation and wildlife caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for vegetation removal. The design should incorporate an evaluation of existing wildlife habitats and species in the vicinity and a rare plant survey. Habitat that is determined to be of significant importance (e.g., presence of listed species) should be preserved to the greatest extent possible. Facilities, access roads and staging areas should be located in areas of disturbed vegetation. If intact vegetation is present, the footprint of the facility should be minimized and situated to result in the least amount of disturbance.

Removal of mature trees should be avoided where possible in all construction areas. At Bumping Lake, the known stand of old-growth western red cedar located downstream of Bumping Lake Dam should be flagged by a qualified forester or biologist and protected from disturbance. Staging and stockpile areas should be revegetated after construction. Native plant species appropriate for the vegetation community (e.g., riparian areas) should be used for all proposed restoration

## **5.9 Fish and Aquatic Resources**

### **5.9.1 No Action Alternative**

The No Action Alternative would not include a program of comprehensive, integrated water storage, fish passage, and habitat enhancement actions for the Yakima River basin. This alternative does include continued water conservation, fish recovery, and habitat restoration activities that would be undertaken by various agencies and individual entities in the Yakima River basin. Fish recovery and habitat restoration activities may be

coordinated to some degree under other programs or processes, but may not be integrated with water storage, water conservation, and water management activities being implemented elsewhere in the basin. Without a comprehensive, integrated program, these activities, along with continuing, competing demands on limited water resources, floodplain habitat, and riparian zones, would continue to limit fish restoration opportunities in the Yakima River basin.

## **5.9.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

This section describes the long-term impacts that could be associated with implementation of individual elements under the Integrated Water Resource Management Alternative. This programmatic Supplemental Draft EIS does not evaluate the impacts of any specific project that may be proposed. Projects that could be proposed under this alternative would require additional environmental review depending on the extent of federal or state funding or permitting.

### **5.9.2.1 Fish Passage Element**

The fish passage element of the Integrated Water Resource Management Alternative would address fish passage at existing Yakima River basin reservoirs in the following order of priority: Cle Elum, Bumping, Rimrock, Keechelus, and Kachess. Fish passage improvements would also be considered at Clear Lake Dam in conjunction with fish passage improvements at Rimrock Dam. There are currently no upstream or downstream fish passage facilities at any of the five dams. The lakes and tributaries upstream from these dams formerly supported large runs of anadromous salmonids, and have varying amounts and quality of potential spawning and rearing habitat suitable for anadromous salmon and steelhead. Prior to construction of the dams, non-anadromous fish species traveled back and forth between natural lakes and the river below (Reclamation, 2005a).

In 2005, Reclamation completed an assessment of a range of options and opportunities for providing fish passage and potentially reestablishing populations of anadromous salmonids in some tributaries upstream of Reclamation reservoirs. Based on this initial assessment, Reclamation determined that some form of upstream and downstream passage would be technically feasible at all storage projects. However, it identified the Cle Elum and Bumping River projects as priority drainages for reestablishing fish passage (Reclamation, 2005a).

Section 2.3.2 provides a general description of fish passage options and potential benefits at each of these five Yakima River basin reservoirs. Table 5-17 illustrates the relative benefit or impact to Chinook, coho, sockeye, steelhead, and bull trout life stages by stream reach within the Yakima basin as a result of restoring fish passage at each of the five reservoirs. Fish passage at some or all of the storage dams is said to be a key component for both steelhead and bull trout recovery, as well as for reestablishment of sockeye salmon in the Yakima River basin, and it offers significant benefits to Chinook and coho salmon that are not listed under the Endangered Species Act (ESA) (YBFWRB, 2008).

Based on the Viable Salmonid Population conceptual framework (McElhaney et al., 2000), restoring fish passage at man-made barriers has the potential to contribute to improved abundance, productivity, spatial structure, and diversity for salmonid populations. In the Yakima basin, draft viability criteria for Yakima basin steelhead populations was assigned an abundance/productivity risk of moderate and a spatial structure/diversity risk of moderate for the Satus and Toppenish populations. The Naches population was assigned a high abundance/productivity risk and a spatial structure/diversity risk of moderate. The Upper Yakima population was ranked high for both risk classes (ICTRT, 2007; YBFWRB, 2008). Under these conditions, restoring passage into previously blocked areas of the basin has the potential to significantly contribute to salmonid recovery.





**Table 5-27 Summary of Impacts to Species by Life Stages from Fish Passage Improvements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River	
<b>Spring Chinook</b>																			
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	●	○	○	●	○	○	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	---	---
Smolts	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Fall Chinook</b>																			
Adult Migration	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	○	○	○	○	○	○	○	○	○	○	○
Smolts	---	---	---	---	---	---	---	---	○	○	○	○	○	○	○	○	○	○	○
<b>Coho</b>																			
Adult Migration	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spawning & Incubation	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	---	---
Smolts	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Sockeye</b>																			
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	---	---
<b>Steelhead</b>																			
Adult Migration	○	●	○	○	●	○	○	○	○	○	---	---	○	○	○	○	○	○	○
Spawning & Incubation	○	●	○	○	●	○	○	○	○	○	---	---	○	○	○	○	○	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	---	---
Smolts	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Bull Trout</b>																			
Adult Migration	○	●	○	○	●	○	○	○	---	---	---	○	---	---	---	---	---	---	---
Spawning & Incubation	---	●	○	○	●	○	---	---	---	---	---	○	---	---	---	---	---	---	---
Rearing	---	●	○	○	●	○	---	---	---	---	---	○	---	---	---	---	---	---	---

Symbol      ● High Benefit      ● Medium Benefit      • Low Benefit      ○ No Change or Benefit      --- Not Applicable

Providing fish passage at the dams could increase or enhance populations of upper Yakima basin steelhead, coho salmon, and spring Chinook salmon. Fish passage would restore access to historically occupied habitat which would help restore life history and genetic diversity of salmonids, allow reintroduction of sockeye salmon back into the watersheds where they occurred historically, and reconnect isolated populations of bull trout and other resident fish species. Over time, anadromous salmonids would be expected to recolonize the watersheds upstream from the dams, taking advantage of available spawning and rearing habitat and improving the spatial structure, abundance and productivity of Yakima basin salmonid populations.

Fish biologists have developed quantitative estimates of sockeye and coho production potential upstream of Cle Elum and Bumping Dams to support fish facility construction planning and an anadromous fish reintroduction plan (Grabowski, 2007a, b, c, and d). Estimates for sockeye production in a fish-passable Cle Elum Lake range from 136,296 to 4,582,427 smolts, which could produce an adult return of 30,000 to 50,000 fish (Grabowski, (2007a). Sockeye production in a fish-passable Bumping Lake could range from 43,736 to 1,682,210 smolts, producing about 10,000 to 17,000 adults (Grabowski, 2007b). For coho, using an approach based on available rearing/overwintering habitat, Grabowski (2007c) estimated that 7,458 coho smolts could be produced in Bumping Lake, resulting in a return of approximately 410 adults. Coho smolt production in Cle Elum Lake was estimated at 30,818 coho salmon smolts, resulting in an adult return of 1,588 fish (Grabowski, 2007d). The author noted that significantly more smolts could be produced when using suitable spawning substrate area as a basis for smolt production calculations, but called those estimates optimistic, especially in light of values reported in other literature.

The potential increases or changes to anadromous salmonid production as a result of habitat expansion upstream of other reservoirs have not been calculated. Therefore, the length (in miles) of available and potentially accessible reservoir tributary habitat was previously used as a surrogate for production in the Reclamation Phase I assessment and is now applicable to the other dams where information about detailed production is not available (Reclamation, 2005a). Table 5-18 provides an estimated overall reservoir tributary stream length, in miles, of suitable spawning and rearing habitat that would be potentially accessible to anadromous salmonids if passage were provided at the five dams. The table includes additional detail on individual tributaries to the five reservoirs and the quantity of potentially accessible tributary habitat that would likely be available.



<b>Table 5-28 Potentially Accessible Stream Reaches</b>	
<b>Dams and Tributary Streams<sup>a</sup></b>	<b>Potentially Accessible (miles)</b>
<b>Keechelus Dam</b>	
Meadow Creek	3.9
Gold Creek	7.0
Cold Creek	1.9 <sup>c</sup>
Mill Creek	0.2
Coal Creek	2.5
Townsend Creek	0.2
Total stream length to natural or manmade barrier	13.8
<b>Kachess Dam</b>	
Kachess River	0.5
Box Canyon Creek	1.6
Mineral Creek	0.25
Gale Creek <sup>b</sup>	1.5
Thetis Creek <sup>b</sup>	1.0
Total stream length to natural or manmade barrier	2.4
<b>Cle Elum Dam</b>	
Cle Elum River	21.6
Thorp Creek	0.0
Cooper River	0.6
Waptus River	7.2
Total stream length to natural or manmade barrier	29.4
<b>Bumping Lake Dam</b>	
Bumping River	1.0
Deep Creek	5.0-5.6
Total stream length to natural or manmade barrier	6.0-6.6
<b>Tieton Dam</b>	
South Fork Tieton River	13.5
Short and Dirty Creek	0.1
Corral Creek	2.2
Bear Creek (South Fork Tieton)	0.5
Bear Creek (Rimrock)	3.7
North Fork Tieton River	9.9
Clear Creek	2.0
Indian Creek	4.9
Total stream length to natural or manmade barrier	36.8

**Source: Reclamation, 2005b**

<sup>a</sup> Other tributaries were considered too small or steep to support migratory fish.

<sup>b</sup> Since Gale Creek and Thetis Creek commonly go subsurface, they are not considered as being accessible to anadromous salmonids, and the overall tributary stream length is 2.4 miles.

<sup>c</sup> If barrier at Cold Creek is repaired.



Restoring fish passage at Reclamation reservoirs alone would not be sufficient to restore sustainable salmon and steelhead populations upstream of the reservoirs. The Yakima basin fisheries co-managers—the Yakama Nation and WDFW—have determined that some level of artificial supplementation would be necessary. Considering the significant costs involved in planning, engineering, constructing, operating, and maintaining even temporary fish passage facilities at reservoir dams, the fisheries co-managers and Reclamation determined that waiting for existing fish populations downstream of the dams to colonize or “pioneer” newly accessible upstream habitat would not be acceptable (Reclamation, 2005b). It could take three or four salmon generations (15 to 20 years) or more to realize significant use of habitat above the reservoirs if fish reintroduction, especially for sockeye salmon, is not aided by human intervention.

Supplementation would contribute to recovery of sustainable populations by reintroducing those species extirpated from the Yakima basin with locally adapted broodstock (sockeye and coho salmon) and support the more rapid establishment of fish numbers capable of taking advantage of newly available habitats (Reclamation, 2005a; Reclamation, 2008c). Toward this goal, the fisheries co-managers have developed plans for anadromous fish reintroduction upstream of the dams (Reclamation, 2005b).

The primary benefit to reestablishing anadromous salmonid passage upstream of the dams would be the reintroduction of sockeye salmon, which utilize the lake environment for juvenile rearing. Sockeye were extirpated from the Yakima basin by 1933 and therefore are not listed under ESA. Sockeye salmon apparently played a substantial ecological role in the upper mainstem Yakima River. The available information suggests that the bulk of the sockeye salmon run returned to Cle Elum Lake, Kachess Lake, and Keechelus Lake. Bumping Lake in the Naches River basin was a relatively small contributor to the overall population. The infusion of marine-derived nutrients into the system from these returning sockeye salmon, as well as other salmon species, would have contributed to the overall productivity of the upper mainstem Yakima River for all species. Restoration of these sockeye salmon and other anadromous salmonid runs would help restore some of this historical nutrient input and associated increased productivity. Kokanee occur in all lakes and apparently spawn successfully in tributaries. Some shoreline spawning is believed to occur in at least some of the lakes. Successful kokanee reproduction may indicate that restoration of sockeye salmon might be successful.

Steelhead reintroduction above the dams is considered a “long-term” objective. Steelhead are an ESA-listed species; however, the native, wild stock of steelhead that is currently present in the Yakima basin is not fully utilizing all of the accessible spawning and rearing habitat downstream of the dams. Therefore, the fisheries do-managers have determined that it is premature to attempt to expand their distribution (Reclamation 2005b).

Reintroduction of spring Chinook above Yakima Project storage dams is considered a “long-term” objective because all smolts produced at the Cle Elum Supplementation and Research Facility (CESRF) are fully allocated to a sophisticated experimental design and cannot be used for reintroduction experiments at this time (Reclamation, 2005b).

Bull trout abundance would be expected to expand due to enhanced connectivity and interaction among the presently isolated populations, and expanded foraging and overwintering habitat. Restoring connectivity among presently isolated populations of bull trout would allow for dispersal of fish among local populations, providing a mechanism for supporting weaker populations or restarting those that might become extirpated. It would also allow for gene flow among populations, which would prevent the loss of genetic variation that would insure survival in variable environments and thus decrease the probability of local extirpations.

### **5.9.2.2 Modifying Existing Structures and Facilities Element**

Modifying existing water diversion structures and operations would provide opportunities to improve water supply for irrigation while providing benefits to fish. Operational changes proposed include reducing the amount of water diverted for power generation at the Roza and Chandler Power Plants in spring to increase instream flow and improve smolt out-migration. Structural changes include modifying fish bypass systems and canals, and moving points of diversion to increase flows in reaches of the Yakima River. Historical changes in stream flows related to development of irrigation systems have contributed to the decline of anadromous salmonids in Yakima basin streams (YBFWRB, 2008). Restoring and maintaining appropriate stream flows would improve habitat restoration benefits in tributary reaches that have been negatively impacted by diversion withdrawals or system operations.

Structural and operational changes could improve stream flows and water quality in some reaches. This would benefit adult and juvenile salmonid survival by reducing travel times, and decreasing predation exposure, physical injury, and stress at facilities, thereby reducing smolt mortality. Table 5-29 illustrates the relative benefit or impact to life stages of Chinook, coho, sockeye, steelhead, and bull trout by stream reach within the Yakima basin as a result of modifying existing structures and operations. Operational changes proposed include reducing the amount of water diverted for power generation at the Roza and Chandler Power Plants in spring to increase instream flow and improve smolt out-migration. Structural changes include modifying fish bypass systems and canals, and moving points of diversion to increase flows in reaches of the Yakima River.



**Table 5-29 Summary of Impacts to Species by Life States from Structural Modifications – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			Mainstem Reach
Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River	
<b>Spring Chinook</b>																			
Adult Migration	•	---	○	○	---	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	○	○	---	○	○	---	○	○	---	---	---	---	○	---	---	---	---
Rearing	•	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	---	---	
Smolts	●	---	○	○	---	○	•	○	●	○	○	○	○	•	•	○	○	●	○
<b>Fall Chinook</b>																			
Adult Migration	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	○	○	○	○	•	•	•	○	○	•	○
Smolts	---	---	---	---	---	---	---	---	●	○	○	○	○	•	•	○	○	●	○
<b>Coho</b>																			
Adult Migration	○	---	○	○	---	○	•	○	○	○	○	○	○	○	○	○	○	●	○
Spawning & Incubation	○	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Rearing	●	---	○	○	---	○	●	○	○	○	○	○	•	•	•	○	○	---	---
Smolts	●	---	○	○	---	○	•	○	●	○	○	○	○	•	•	○	○	●	○
<b>Sockeye</b>																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<b>Steelhead</b>																			
Adult Migration	•	---	○	○	---	○	•	○	○	○	---	○	○	○	○	○	○	●	○
Spawning & Incubation	---	---	○	○	---	○	●	○	○	○	---	○	○	○	○	○	○	---	---
Rearing	•	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Smolts	●	---	○	○	---	○	•	○	●	○	○	○	○	•	•	○	○	●	○
<b>Bull Trout</b>																			
Adult Migration	•	○	○	○	○	○	•	○	---	---	---	○	---	---	---	---	---	---	---
Spawning & Incubation	---	○	---	---	○	○	---	○	---	---	---	○	---	---	---	---	---	---	---
Rearing	---	○	○	○	○	○	---	○	---	---	---	○	---	---	---	---	---	---	---

Symbol      ● High Benefit      ● Medium Benefit      • Low Benefit      ○ No Change or Benefit      --- Not Applicable



Improved stream flows as a result of moving the WIP Satus diversion from Wapato Dam downstream to a new pump station near Granger would benefit all salmon and steelhead species and life stages by increasing instream flows in the WIP-diversion-to-Granger reach (25 river miles) during the irrigation season. Improving stream flows in the spring would benefit adult migrants attempting to move upstream and benefit smolts migrating downstream. Both life stages require adequate flows to allow passage and decrease migration times.

KRD canal modifications (piping laterals) would benefit most life stages for spring Chinook, coho, and steelhead in Taneum and Manastash Creeks; adult and juvenile coho and steelhead in Big and Little Creeks; and rearing spring Chinook in Big and Little Creeks. These benefits would result from allowing greater opportunity to augment stream flows in these affected tributaries to the Yakima River during migration, spawning, and rearing periods. The estimated savings of approximately 15 cfs throughout the irrigation season would help address stream flow problems that negatively affect fish passage and survival in the affected reaches. The option of placing a pump station with a pressurized system at the lowest end of the KRD South Branch Canal would provide a slightly greater flow (25 cfs) to augment the affected tributaries, thereby further contributing to improved flow conditions.

Modifying the current configuration of the Chandler Dam juvenile bypass on the lower Yakima River would increase juvenile survival at this structure by improving egress conditions at the bypass exit, thereby reducing predation on juveniles at this facility. This would benefit all species of anadromous salmonids found in the Yakima basin.

Two proposals to reduce or eliminate water diversions for power generation during the spring smolt outmigration season (April 1 to June 30) would increase stream flows in the middle and lower Yakima River reaches. These changes would benefit all species of salmonid smolts in the basin which have their peak migration during this period. The proposals would benefit migrating spring Chinook and coho salmon since their migration period is most specifically tied to April and May. If sockeye are reintroduced in the future, sockeye smolts would also migrate during this period and would benefit from these changes. Age 0 summer and fall Chinook smolt migration peaks in early to mid June and would also benefit from these changes. The System Operations Advisory Committee (SOAC) in the Yakima subbasin has established March 25 to June 30, annually, as the spring smolt outmigration period for its purpose of monitoring and managing the juvenile spring smolt outmigration. SOAC's recommendations for duration of spring flows needed for the purpose of benefitting spring smolt outmigration would be considered when evaluating potential benefits.

Flows diverted to generate power at Roza Dam would instead remain in the Yakima River between Roza Dam and the discharge location 15 miles downstream, benefitting fish use in this mainstem reach. The proposal to increase minimum flows in the reach of the Yakima River affected by operations at the Chandler Power Plant would contribute to improved stream flows in the lower river from Prosser Dam to the power plant return 12 miles downstream. Current operations divert water to run the Chandler Power Plant and maintain minimum flows of 1,000 cfs in this reach. An increase in minimum flows in the

Yakima River during April through June would contribute to improved smolt survival in this lower river reach by reducing travel times, especially in the pool upstream of Chandler Dam, and reducing juvenile entrainment in the power plant diversion. This would reduce mortality rates associated with the canal and the plant outfall.

Modifying the water conveyance system for the Wapatox Project would free up the remainder of the 350 cfs power generation water right owned by Reclamation and augment flow in 7.4 miles of the lower Naches River. This would benefit spring Chinook, coho, and steelhead adult and juvenile migrants spawning and rearing in this reach of the Naches River. If summer Chinook salmon are reintroduced to the basin, they would also benefit from this modification because they are expected to use this reach for spawning and rearing.

Modifying existing water diversion structures and operations alone is likely not sufficient to support the restoration of sustainable salmon and steelhead populations in the Yakima basin. Having appropriate instream flows with acceptable water quality year-round will be critical to salmonid survival. Habitat restoration actions, coupled with restoring fish passage into historic habitat, would be a necessary component of meeting fish survival targets in coordination with modifying existing water diversion structures and operations.

### **5.9.2.3 New Storage Element**

The new storage element of the Integrated Water Resource Management Alternative would address opportunities to expand existing water storage facilities or construct new facilities. New storage would support increased flows for anadromous and resident fish passage and survival during drought years while improving irrigation water supply and future municipal growth.

Section 2.3.4 of this Supplemental Draft EIS describes the proposed storage options, including their potential benefits. Table 5-30 illustrates the relative benefit or impact to life stages of Chinook, coho, sockeye, steelhead, and bull trout by stream reach within the Yakima basin as a result of expanding existing water storage facilities or constructing new facilities.



**Table 5-30 Summary of Impacts to Species by Life Stage from Storage Elements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Upper Yakima River																
	Above Dam		Mainstem Reach	Above Dam		Mainstem Reach		Tributaries		Cle Elum River Basin		Mainstem Reach		Tributaries		Tributaries	
	Above Keechelus Dam	Keechelus Dam to Lake Easton	Above Kachess Dam	Kachess River	Yakima River from Easton to Cle Elum River	Big Creek	Little Creek	Above Cle Elum Dam	Cle Elum River	Yakima River from Cle Elum River to Roza Dam	Teanaway River/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks	
<b>Spring Chinook</b>																	
Adult Migration	---	○	---	---	○	---	---	---	○	○	○	---	---	---	---	---	
Spawning & Incubation	---	○	---	---	○	---	---	---	•	○	○	---	---	---	---	---	
Rearing	---	○	---	---	○	○	○	---	●	•	○	○	○	○	○	○	
Smolts	---	○	---	---	○	○	○	---	○	○	○	○	○	○	○	•	
<b>Fall Chinook</b>																	
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
<b>Coho</b>																	
Adult Migration	---	○	---	○	○	○	○	---	•	○	○	○	○	○	○	○	
Spawning & Incubation	---	○	---	○	○	○	○	---	●	○	○	○	○	○	○	○	
Rearing	---	○	---	○	○	○	○	---	●	•	○	○	○	○	○	○	
Smolts	---	○	---	○	○	○	○	---	○	•	○	○	○	○	○	•	
<b>Sockeye</b>																	
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
<b>Steelhead</b>																	
Adult Migration	---	○	---	---	○	○	○	---	○	○	○	○	○	○	○	○	
Spawning & Incubation	---	○	---	---	○	○	○	---	○	○	○	○	○	○	○	○	
Rearing	---	○	---	---	○	○	○	---	●	○	○	○	○	○	○	○	
Smolts	---	○	---	---	○	○	○	---	○	•	○	○	○	○	○	•	
<b>Bull Trout</b>																	
Adult Migration	○	○	---	---	○	---	---	○	○	○	○	○	○	○	---	○	
Spawning & Incubation	○	○	---	---	---	---	---	○	---	---	○	○	○	○	---	○	
Rearing	○	○	---	○	○	---	---	○	•	•	○	○	○	○	---	○	

**Table 5-30 Summary of Impacts to Species by Life Stage from Storage Elements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River	
<b>Spring Chinook</b>																			
Adult Migration	○	---	•	•	---	○	•	---	•	•	---	---	•	•	○	---	---	○	○
Spawning & Incubation	---	---	○	○	---	○	○	---	○	○	---	---	---	---	○	---	---	---	---
Rearing	○	---	○	○	---	○	•	○	•	○	•	○	○	○	○	○	---	---	
Smolts	•	---	•	•	---	•	•	○	•	•	○	○	•	•	○	○	○	○	
<b>Fall Chinook</b>																			
Adult Migration	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	•	•	○	•	•	•	○	○	○	○	
Smolts	---	---	---	---	---	---	---	---	•	•	○	○	•	•	○	○	○	○	
<b>Coho</b>																			
Adult Migration	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	○	○	
Spawning & Incubation	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	---	---	
Rearing	○	---	•	•	---	○	•	○	•	•	○	●	•	•	○	○	---	---	
Smolts	•	---	•	•	---	•	•	○	•	•	○	○	•	•	○	○	○	○	
<b>Sockeye</b>																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
<b>Steelhead</b>																			
Adult Migration	○	---	•	•	---	○	○	○	○	○	---	○	○	○	○	○	○	○	
Spawning & Incubation	---	---	•	•	---	○	○	○	○	○	---	•	○	○	○	○	---	---	
Rearing	○	---	•	•	---	○	○	○	•	○	●	○	○	○	○	○	---	---	
Smolts	•	---	•	•	---	•	•	○	•	•	○	○	•	•	○	○	○	○	
<b>Bull Trout</b>																			
Adult Migration	○	•	○	○	○	○	○	○	---	---	---	•	---	---	---	---	---	---	
Spawning & Incubation	---	●	○	○	○	○	---	○	---	---	---	○	---	---	---	---	---	---	
Rearing	---	•	•	•	○	○	---	○	---	---	---	•	---	---	---	---	---	---	

Symbol

● High Benefit/● High Impact

● Medium Benefit/● Medium Impact

• Low Benefit/• Low Impact

○ No Change or Benefit

--- Not Applicable

Construction or expansion of storage in the Yakima basin has the potential for both positive and negative impacts to salmonid fish populations. Additional storage would provide flexibility for altering operations among the Yakima basin reservoirs. However, new operations would need to be developed with consideration of the tradeoffs in benefits between species based on the additional water storage available. Constructing the Wymer reservoir could provide opportunities for Reclamation to slightly reduce the impacts of the “flip-flop” operation and benefit salmonids in the Tieton River and the lower Naches River. Expanding storage at Bumping Reservoir would also provide opportunities for Reclamation to increase spring outmigration flows in the Bumping, Naches and Yakima Rivers.

Restoring a more natural fall flow regime in the Tieton and Naches Rivers would benefit juvenile spring Chinook, coho, and steelhead rearing in the affected river reaches. Under current river operations, high flows are produced in the fall by increasing outflow out of Rimrock Lake when water supply is switched between Cle Elum and Rimrock Lakes. The switch in operations is intended to meet downstream water needs in the late irrigation season, and it flushes rearing juvenile steelhead and spring Chinook from the Tieton and lower Naches system.

Concerns exist regarding the potential for negatively affecting what are now mostly unregulated flows in the Naches River basin as a result of expanding water storage. However, the operations proposed for Bumping Lake would account for spring runoff and allow fish managers to time the releases from the reservoir and increase spring flows in drought years, which currently suffer from a severe shortfall in flow. Water would be released from Bumping Reservoir to augment spring flow in the Bumping, Naches and Yakima Rivers below the Parker gage in drought years. This release would increase smolt outmigration flows by 1,000 cfs, a very large increase relative to the flows at the Parker gage during drought years.

Also associated with an increase in storage at Bumping Lake is an increased area of impact. A new dam would inundate approximately 10 miles of perennial and intermittent stream habitat downstream from the existing dam and upstream of the existing reservoir, affecting the aquatic ecosystem and fishery resources. Bull trout inhabit Bumping Lake and its tributaries above Bumping Lake Dam. The inundated area includes portions of Deep Creek and the Bumping River that are designated as critical bull trout habitat (Reclamation and Ecology, 2008). Deep Creek appears to be the primary tributary of Bumping Lake where bull trout spawn. However, the new dam that would be constructed would include fish passage facilities and would open up habitat. The bull trout population previously isolated upstream of the dam would experience restored historic connectivity to other habitats and an increased gene flow among other populations in the Yakima basin (USFWS, 2001b).

Construction of small tributary water storage projects, such as Pine Hollow reservoir on Ahtanum Creek, has the potential to benefit but also negatively impact salmonid populations in the Yakima River basin. If smaller tributary water storage projects were designed like the Pine Hollow reservoir alternative to provide water supply and fish benefits, the impacts to salmonids could be avoided, minimized, and mitigated (Ecology,

2005a). Impacts might include altering the flow regime of a stream such that it negatively affects adult or juvenile migration, spawning, or rearing; blocking fish passage at the dam structure; or inundating spawning or rearing habitat. Benefits of a small storage project to instream flows during late summer or early fall or during drought years may be small. However, if adequate storage existed, fish benefits might include operating the storage facility to provide late season instream flows for rearing juvenile fish downstream of the facility.

#### **5.9.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on fish and aquatic resources were described in Sections 5.8.2.4, 5.9.2.4, and 5.10.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.9.2.5 Fish Habitat Enhancement Element**

Historically, fish habitat in the Yakima River basin has been significantly altered. Properly functioning habitat in the Yakima basin area is characterized by an adequate supply of cool, clear water with minimal fine sediments, channels with stable banks and abundant and appropriate substrates (e.g., spawning gravels for salmonids), and plentiful streamside vegetation. Thus, the emphasis for habitat enhancement projects is placed on restoring and protecting natural channel function and associated habitat, most importantly within the floodplain. Activities could include habitat enhancements such as:

- Reconnecting and reestablishing floodplains and side channels;
- Enhancing and restoring riparian habitat conditions; and
- Increasing channel complexity.

The purpose of the enhancements is to restore or reestablish more natural channel and floodplain conditions for fish and aquatic communities. Therefore, long-term impacts from these projects are expected to be beneficial and to improve overall habitat function.

#### **Anadromous Fish**

Beneficial impacts would occur that are specific to different life history stages of anadromous salmonids using the affected area. These benefits would improve the growth, survival, and abundance of salmonids in various ways. For all anadromous salmonids, incubating eggs and juveniles would benefit from reduced fines in the stream and decreased water temperatures afforded by ample streamside vegetation and stable banks. Rearing juveniles would benefit from the increased prey availability (terrestrial insects) and increased organic matter input resulting from improvements in riparian vegetation. Growth and survival of juveniles would benefit from increased habitat in reconnected side-channels. In addition, juvenile survival would benefit from refuge cover from large woody debris (LWD) or boulder complexes and the increase in quality and quantity of pool habitats formed by these structures.

Survival of all adult life stages would benefit because of increased quality and quantity of holding habitat (pools) for spawners via in-channel LWD and boulders. These structures would also benefit spawning adults because they tend to trap and retain spawning-sized gravels in the reach. Off-channel spawners would benefit via an increase in floodplain and off-channel habitats. In addition, spawner condition would benefit from riparian vegetation enhancement and the related decrease in water temperatures.

The following discusses the benefits of fish habitat enhancement to Yakima and Naches basin salmonids within general river reaches in each basin. Table 5-31 provides a summary of life stages benefits within more detailed reaches in the basins.



**Table 5-31 Summary of Impacts to Species by Life Stage from Fish Habitat Enhancement Elements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Upper Yakima River															
	Above Dam		Mainstem Reach	Above Dam		Mainstem Reach		Tributaries		Cle Elum River Basin		Mainstem Reach		Tributaries		Wilson/Naneum/Cherry/Coleman Creeks
	Above Keechelus Dam	Keechelus Dam to Lake Easton	Above Kachess Dam	Kachess River	Yakima River from Easton to Cle Elum River	Big Creek	Little Creek	Above Cle Elum Dam	Cle Elum River	Yakima River from Cle Elum River to Roza Dam	Teanaway River/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	
<b>Spring Chinook</b>																
Adult Migration	---	•	---	---	•	---	---	---	•	•	●	---	---	---	---	---
Spawning & Incubation	---	•	---	---	•	---	---	---	•	●	●	---	---	---	---	---
Rearing	---	•	---	---	•	•	•	---	●	●	●	•	•	•	•	●
Smolts	---	○	---	---	○	○	○	---	○	○	○	○	○	○	○	○
<b>Fall Chinook</b>																
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<b>Coho</b>																
Adult Migration	---	•	---	○	•	●	●	---	•	•	●	●	●	●	●	●
Spawning & Incubation	---	•	---	○	●	●	●	---	•	●	●	●	●	●	●	●
Rearing	---	•	---	○	●	●	●	---	●	●	●	●	●	●	●	●
Smolts	---	○	---	○	○	○	○	---	○	○	○	○	○	○	○	○
<b>Sockeye</b>																
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<b>Steelhead</b>																
Adult Migration	---	•	---	○	•	●	●	---	•	•	●	●	•	•	●	•
Spawning & Incubation	---	•	---	○	●	●	●	---	●	●	●	●	●	●	●	●
Rearing	---	•	---	○	●	●	●	---	●	●	●	●	●	●	●	●
Smolts	---	○	---	○	○	○	○	---	○	○	○	○	○	○	○	○
<b>Bull Trout</b>																
Adult Migration	○	•	---	---	•	---	---	○	•	•	●	●	●	●	---	●
Spawning & Incubation	○	•	---	---	---	---	---	○	---	---	●	●	●	●	---	●
Rearing	○	•	---	○	●	---	---	○	•	•	●	●	●	●	---	●

**Table 5-31 Summary of Impacts to Species by Life Stage from Fish Habitat Enhancement Elements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River	
<b>Spring Chinook</b>																			
Adult Migration	•	---	•	•	---	•	•	---	•	•	---	---	•	•	•	---	---	○	○
Spawning & Incubation	---	---	•	●	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	•	---	●	●	---	●	●	•	●	●	●	●	•	●	●	•	•	---	---
Smolts	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Fall Chinook</b>																			
Adult Migration	---	---	---	---	---	---	---	---	•	•	---	---	•	●	●	---	---	•	•
Spawning & Incubation	---	---	---	---	---	---	---	---	●	●	---	---	●	●	●	---	---	●	●
Rearing	---	---	---	---	---	---	---	---	●	●	•	•	●	●	●	•	•	●	●
Smolts	---	---	---	---	---	---	---	---	○	○	○	○	○	○	○	○	○	○	○
<b>Coho</b>																			
Adult Migration	•	---	•	•	---	●	●	●	•	•	●	●	●	●	•	●	●	•	•
Spawning & Incubation	●	---	•	●	---	●	●	●	●	●	●	●	○	●	•	●	●	---	---
Rearing	●	---	•	●	---	●	●	●	●	●	●	●	•	●	•	●	●	---	---
Smolts	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Sockeye</b>																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<b>Steelhead</b>																			
Adult Migration	•	---	•	•	---	•	•	•	•	•	---	•	•	•	●	•	•	•	•
Spawning & Incubation	○	---	•	●	---	●	●	●	•	•	---	●	○	○	○	●	●	---	---
Rearing	●	---	•	●	---	●	●	●	●	●	●	●	•	●	●	●	●	---	---
Smolts	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Bull Trout</b>																			
Adult Migration	●	•	•	•	•	•	•	•	---	---	---	●	---	---	---	---	---	---	---
Spawning & Incubation	---	•	•	•	•	•	---	•	---	---	---	●	---	---	---	---	---	---	---
Rearing	---	•	•	•	•	•	---	•	---	---	---	●	---	---	---	---	---	---	---

**Symbol**

● High Benefit

● Medium Benefit

• Low Benefit

○ No Change or Benefit

--- Not Applicable

Habitat enhancement in the upper Yakima River basin from Keechelus Dam to Roza Diversion would benefit spring Chinook, coho, steelhead, and bull trout, which all migrate, spawn, incubate, and rear in this reach or its tributaries. It would also benefit sockeye adults that migrate, spawn, and incubate there. In the middle Yakima Basin from Roza Diversion to Prosser Dam, spring Chinook, fall Chinook, coho, sockeye, steelhead and bull trout, all of which spawn, migrate, incubate, and rear in this reach or its tributaries would benefit. For the lower Yakima River from Prosser Dam to the Columbia River confluence, habitat enhancement would benefit fall Chinook which migrate, spawn, incubate, and rear in this reach. It would also benefit spring Chinook, coho, steelhead, and bull trout that migrate through as adults and rear there as juveniles. Sockeye adults would also benefit because upstream migration occurs there.

In the upper Naches River basin from Bumping Dam to the Tieton River confluence, fish habitat enhancement would benefit spring Chinook, steelhead, and bull trout because adult migration, spawning, incubation, and rearing all occur in this reach or its tributaries. Coho and sockeye adults would also benefit because upstream migration occurs in the reach; sockeye also spawn and incubate there. In the lower reach encompassing the Tieton River confluence to the Yakima River confluence, habitat enhancement would benefit spring Chinook and steelhead because adult migration, spawning, incubation, and rearing all occur in this reach or its tributaries. Coho, sockeye, and bull trout adults would also benefit because upstream migration occurs there.

### **Resident Fish and Aquatic Invertebrates**

Resident fish and aquatic invertebrate communities would receive long-term benefits from habitat enhancement. Resident fish and aquatic invertebrates are discussed as a group here because their habitat needs are highly interconnected. Benefits provided are discussed below, organized by each habitat enhancement type.

Floodplain/side channel reconnection and reestablishment would provide improved connectivity between streams and adjacent riparian areas, floodplains, and uplands. It would also increase floodplain water storage capacity to provide more stable instream flows. This enhancement would reestablish the source for organic matter input and terrestrial insects to support aquatic invertebrate communities and provide prey for resident fish that rely upon these organisms for growth and survival. Rearing habitat for juvenile fish would be increased, as well as refuge habitat for fish seeking protection from high flows. The increase in side channels would also create an increase in spawning habitat for fish and invertebrates that reproduce in these areas.

Riparian habitat enhancement/ restoration would improve native streamside plant communities that provide habitat for assemblages of water-associated insects and invertebrates. It would also increase terrestrial organic matter and insect inputs to streams to support aquatic invertebrate communities that function as fish prey. Restoring vegetative cover along the stream banks would result in reduced water temperatures via minimized solar heating, which would help provide adequate conditions for resident fish and aquatic communities. These plants and trees would also increase bank stability as they protect soils from erosion. When trees senesce and fall into the stream, they would

provide LWD that contributes to an increasingly complex channel form and diverse habitats for resident fish and invertebrates.

Increased channel complexity (LWD, channel reconstruction, boulders, etc.) would result in increased trapping of organic matter to support aquatic invertebrate communities and fish prey. In addition, complex channels would trap more gravels that provide appropriate substrates for these organisms. Diverse channel habitat would also promote increased bank stability and reduced sedimentation due to the structural protection afforded by the LWD and boulder complexes. These complexes would encourage increased scour around the structures, thereby increasing pool quality and quantity. The pools provide refuge habitat for resident fish and invertebrates.

#### **5.9.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on fish and aquatic resources were described in Sections 5.8.2.2, 5.9.2.2, and 5.10.2.2 of the January 2008 Draft Planning Report/EIS.

#### **5.9.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on fish and aquatic resources were described in Sections 5.8.2.3, 5.9.2.3, and 5.10.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.9.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

The most evident long-term impact to fish resources would be the benefits of implementing the fish passage and fish habitat enhancement elements of the Integrated Water Resource Management Alternative. These elements, coupled with modifying existing irrigation supply structures and operations and creating new storage, would address many in-basin factors limiting the restoration of sustainable salmonid fish populations in the Yakima basin. The factors most responsible for limiting salmon, steelhead, and bull trout populations in the Yakima basin vary somewhat between watersheds, but are generally accepted to include an altered hydrograph, high water temperatures, fine sediment, fish passage barriers at Reclamation water storage reservoirs and associated irrigation facilities and operations, loss of floodplain and riparian function, and loss of instream habitat complexity. Thus, long-term impacts of the alternative addressing these factors are primarily expected to be beneficial.

Another long-term beneficial impact would come from implementing artificial supplementation programs for salmonid species consistent with the Anadromous Fish Reintroduction Plan (Reclamation, 2005b) concurrent with providing fish passage at Reclamation reservoirs, enhancing and restoring habitat, and improving opportunities to manage basin water resources to meet aquatic needs. These activities would benefit sockeye and coho salmon populations in the Yakima basin. Similarly, artificial supplementation programs to enhance spring Chinook salmon and summer and fall Chinook-run salmon are being implemented under the Yakima-Klickitat Fisheries Project

by the fisheries co-managers, WDFW and the Yakama Nation. The Chinook enhancement programs have been designed to provide the best opportunity to recolonize habitats in the Yakima basin and to restore sustainable populations. Monitoring and evaluation activities associated with artificial production programs would assist fishery managers with minimizing supplementation program effects on other fish species and natural spawners.

Incorporating these elements into an integrated alternative is also considered the best opportunity to implement successful water storage projects in the Yakima basin to help meet irrigation and municipal water needs during drought years. Identifying and implementing water storage and facility improvement projects that also meet fish management needs is expected to have the highest likelihood of success over the long term. Table 5-32 illustrates the relative impacts or benefits to Chinook, coho, sockeye, steelhead, and bull trout life stages by stream reach as a result of implementing the elements of the Integrated Water Resource Management Alternative—fish passage, modification of existing structures and operations, new storage, and fish habitat enhancements—as an integrated package. The table reflects the discussion in this section and in Section 2.3.1.





**Table 5-32 Summary of Impacts to Species by Life Stage from the Integrated Elements – Upper, Middle, and Lower Yakima River**

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River	
	Naches River Basin																Mainstem Reach	Mainstem Reach
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries		
Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River
<b>Spring Chinook</b>																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	---	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
Rearing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Smolts	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Fall Chinook</b>																		
Adult Migration	---	---	---	---	---	---	---	●	●	---	---	●	●	●	●	●	●	●
Spawning & Incubation	---	---	---	---	---	---	---	○	○	---	---	○	○	○	○	○	○	○
Rearing	---	---	---	---	---	---	---	●	●	●	●	●	●	●	●	●	●	●
Smolts	---	---	---	---	---	---	---	○	○	○	○	○	○	○	○	○	○	○
<b>Coho</b>																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Rearing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Smolts	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Sockeye</b>																		
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○
Spawning & Incubation	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Smolts	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Steelhead</b>																		
Adult Migration	○	○	●	○	●	○	○	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Rearing	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Smolts	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
<b>Bull Trout</b>																		
Adult Migration	○	●	○	○	●	○	○	---	---	---	○	---	---	---	---	---	---	---
Spawning & Incubation	---	○	○	○	○	○	○	---	---	---	○	---	---	---	---	---	---	---
Rearing	---	○	○	○	○	○	○	---	---	---	○	---	---	---	---	---	---	---

**Symbol**      ● High Benefit/● High Impact      ○ Medium Benefit/○ Medium Impact      ● Low Benefit/● Low Impact      ○ No Change or Benefit      --- Not Applicable

## **5.9.4 Mitigation Measures**

As discussed in Sections 5.9.2 and 5.9.3, one of the goals of the Integrated Water Resource Management Alternative is to provide improved habitat and water conditions for fish and aquatic species. The long-term impacts to fish and aquatic species as a result of this alternative would primarily be beneficial to these species and their habitats. Specific projects would be evaluated through applicable environmental review and permitting processes. This evaluation may include review by federal or local scientific review panels and tribal councils as required by the applicable regulatory processes, and depending on funding source requirements. These requirements may stipulate that actions implemented under this alternative should be consistent with the federal, tribal, and regional salmon and steelhead recovery planning and watershed planning efforts. Thus, it is expected that particular mitigation measures would be identified that pertain to long-term impacts from specific proposed activities.

Some unavoidable long-term impacts may occur because some habitats would be negatively impacted in order to positively impact others elsewhere. An example of this is the expansion of water storage at Bumping Dam to benefit downstream flows and fish passage, which would require inundation of existing habitat at the storage site. Another example is the shifting of spring flows in the Naches basin that may result in reduction of fish attraction during salmonid upstream migration to certain streams. In either case, mitigation may be required and could include such actions as artificial spawning channels, constructed riffles, native plant species revegetation/enhancement, or other improvements that would benefit fish and aquatic species. These measures may not be necessary or may be reduced if the action(s) become part of a watershed restoration program that integrates habitat improvement.

## **5.10 Recreational Resources**

### **5.10.1 No Action Alternative**

The No Action Alternative would not result in direct long-term recreational resource impacts in the Yakima River basin. This alternative includes storage modification, supplementation, and fish enhancement projects that would likely be implemented by other agencies and special interest groups. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the recreational resource impacts from these projects would be prepared separately.

### **5.10.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

Long-term impacts would be primarily related to activities that may result in the loss of property used for recreational purposes, and in management and operational changes that alter the flow regime of the systems within the Yakima River basin. These elements are discussed in the following sections, and in Section 5.11.

### **5.10.2.1 Fish Passage Element**

In general, the goal of all projects proposed as part of the fish passage element is to increase the amount of habitat available to fish species within the Yakima River basin by providing passage into areas currently blocked. This, in turn, could benefit recreational resources by increasing the number of areas available for fishing, as well as improving the amount of stock available within the basin. This would be a long-term beneficial impact.

No other long-term impacts to recreational resources are expected from the proposed fish passage element projects.

### **5.10.2.2 Modifying Existing Structures and Facilities Element**

Operational and structural changes at existing facilities would be designed to benefit fish passage and survival rates within the affected reaches. This could be a long-term beneficial impact on recreational fishing opportunities.

No other long-term impacts to recreational resources are expected from modification of existing structures and facilities.

### **5.10.2.3 New Storage Element**

The proposed Bumping Lake expansion would eliminate some recreational facilities in the area (Figure 2-4). All of the lakeshore access and associated facilities (e.g., boat launches and parking), several formal and informal campsites, vacation rentals, trails and trailheads, access roads, and other recreational facilities would be inundated by the expansion of the lake. New recreational facilities would be constructed, but would likely not be completed at the same time the Bumping Lake expansion project is completed. Therefore, recreational facilities would likely be unavailable during the construction years and possibly a year or two after construction completion. The impacts to recreational resources from the proposed expansion of Bumping Lake were further analyzed in the Proposed Bumping Lake Enlargement Final EIS prepared by Reclamation (Reclamation, 1979).

The proposed Pine Hollow reservoir could provide additional recreational opportunities, including boating and fishing (Ecology, 2005). Long-term impacts to recreational facilities for other storage options could be similar to those for the Bumping Lake expansion, though not likely as extensive, as the other proposed options would encompass a smaller area.

Creation of a new reservoir with construction of the Wymer Dam would create new recreational opportunities in that area. Section 4.12.2.4 of the January 2008 Draft Planning Report/EIS (Reclamation and Ecology, 2008) describes in detail the recreational setting for the potential Wymer reservoir. This would be a long-term beneficial impact by supplying new recreational activities.

Existing river operations result in low flows in the upper Naches River basin, specifically the Tieton River, through most of the irrigation season, and then high (essentially bank full) flows in the fall. As described in Section 3.10.1, whitewater rafters use the Class III rapids on the Tieton River that result from the additional water release. Construction of additional storage in the Naches River basin could slightly modify river operations in some years and reduce the higher flows on the Tieton River in the fall. Reduction or elimination of the rapids would constitute an impact to this recreational resource. Modification of river operations could, however, increase recreational fishing opportunities on the mainstem Yakima River during the summer months by reducing flows.

#### **5.10.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on recreational resources were described in Section 5.12.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.10.2.5 Fish Habitat Enhancement Element**

Fish habitat enhancement projects would be designed to increase overall habitat area and fish survival rates within the affected reaches. This could be a long-term beneficial impact on recreational fishing opportunities.

Some of the proposed fish habitat enhancement projects would require the acquisition of land, or the placement of land in easements. This would not necessarily preclude the use of these lands for public access or recreational uses (e.g., fishing); however, the specific uses allowed within each area would be defined as conditions of project permitting.

#### **5.10.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on recreational resources were described in Section 5.12.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.10.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Ground Water Storage Element on recreational resources were described in Section 5.12.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.10.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Implementation of the elements under the Integrated Water Resource Management Alternative would result in long-term impacts to recreational resources. However, recreational resources that are eliminated would be replaced over time. Collectively, the combined elements from the proposed projects would have a beneficial impact by making more of the basin available for recreational opportunities, such as fishing.

#### **5.10.4 Mitigation Measures**

Recreational facilities directly impacted, or eliminated, by implementation of various project components (e.g., the Bumping Lake expansion) would be replaced over time, as described in the Proposed Bumping Lake Enlargement Final EIS (Reclamation, 1979). Coordination between agencies during the planning and design phases would insure that replacement facilities will meet the public's needs and are completed within the shortest timeframe practicable.

### **5.11 Land and Shoreline Use**

#### **5.11.1 No Action Alternative**

The No Action Alternative would not result in direct long-term land use impacts in the Yakima River basin. This alternative includes storage modification, supplementation, and fish enhancement projects that would likely be implemented by other agencies and special interest groups. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the long-term land use impacts of these projects would be prepared separately.

#### **5.11.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

##### **5.11.2.1 Fish Passage Element**

No long-term impacts to land use are expected from the fish passage element projects. None of the proposed projects would require the acquisition of land or a change in land use.

##### **5.11.2.2 Modifying Existing Structures and Facilities Element**

Operational modifications associated with this element would not require a change in land use in the Yakima River basin. Some of the proposed projects, however, would require acquisitions of land or easements, such as for the lateral piping projects associated with the KRD canal modifications. Depending on the current use of the property to be acquired, this may constitute a change in land use.

##### **5.11.2.3 New Storage Element**

Most of the new storage options would require the acquisition of land or easements. For example, if the Pine Hollow reservoir is constructed, the lake site would have to be acquired by the implementing entity (Ecology, 2005). The Bumping Lake inundation area is currently managed by Reclamation and would not require acquisition. However, there are several privately-owned residences on the north shore of Bumping Lake, which would have to be acquired or relocated. Public recreational facilities, such as campgrounds and day-use areas, would also be inundated and would have to be constructed elsewhere. For additional information on recreational impacts, see Section 5.10.2.3 above.

#### **5.11.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on land and shoreline use were described in Section 5.13.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.11.2.5 Fish Habitat Enhancement Element**

Some of the habitat enhancement options would also require the acquisition of property. The agencies sponsoring the individual enhancement projects could also work with property owners to place all or portions of their property in conservation easements. Both acquisition and placement of property in easements would constitute a change in land use.

#### **5.11.2.6 Enhanced Water Conservation Element**

The impacts of the Ground Water Storage Element on land and shoreline use were described in Section 5.12.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.11.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on land and shoreline use were described in Section 5.12.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.11.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Implementation of the elements under the Integrated Water Resource Management Alternative would result in long-term impacts to land use. However, the integrated projects are not expected to have disproportionately larger land use impacts than the individual projects described above.

#### **5.11.4 Mitigation Measures**

If individual projects are chosen that require the acquisition of land, appropriate compensation would be required in accordance with applicable state or federal regulations. Additional environmental analysis would be performed at the time specific projects are identified to determine any further impacts to land use, including compliance with all applicable policies and regulations.

## **5.12 Cultural Resources**

### **5.12.1 No Action Alternative**

Long-term impacts to cultural resources under the No Action Alternative would be similar to those described in Section 5.20.2 of the January 2008 Draft Planning Report/EIS. Projects undertaken by other agencies would undergo separate NEPA or SEPA analysis, as appropriate, and would comply with federal and state regulations that protect historic and cultural resources.

### **5.12.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

The long-term impacts to buried cultural resources from an integrated approach to water supply and fish habitat improvements would largely be related to operation of new facilities or changed water drainage patterns (such as meandering channels, increased/decreased flow). The main long-term impact for most elements would be erosion of cultural deposits.

#### **5.12.2.1 Fish Passage Element**

The long-term impacts to cultural resources from the fish passage improvements might include increased erosion of cultural deposits.

#### **5.12.2.2 Modifying Existing Structures and Facilities Element**

The long-term impacts to cultural resources for this element are considered minimal as any adverse impact would occur during construction.

#### **5.12.2.3 New Storage Element**

##### **General Impacts**

New or expanded storage facilities could adversely impact cultural resources over the long term. The impacts to cultural resources within reservoirs could include destruction or damage of archaeological sites, historic structures, or Traditional Cultural Properties (TCPs). There are generally three zones of impact to cultural resources in storage reservoir settings: the inundation zone, the direct impact (fluctuation or drawdown) zone, and the indirect impact (backshore) zone.

Archaeological sites can be damaged or destroyed through erosion, inundation, chemical weathering, vandalism/artifact collecting, and land development. These impacts often occur in combination. Of these, erosion by wind and water is the most predominant impact (Lenihan et al., 1981). Erosion impacts vary based on the site type, land form, severity of wind and water action, soil structure, and type of cultural resource. Depending on the fluctuation zone of the reservoir (the area between normal high and low water levels) and the angle of the landform slope, sites can slump, be washed out, or suffer bank calving. Inundation impacts cultural sites by making them inaccessible for research. The site may become covered with sediment, although there is some speculation that the sedimentation provides protection to the site. Artifacts and features may be damaged by long-term inundation due to changes in the chemical composition of the surrounding geologic matrix. No detailed studies have been conducted to evaluate the impacts of sedimentation on fragile archaeological deposits.

Chemical weathering impacts to archaeological sites could include damage to organic remains through repeated wetting and drying of archaeological deposits, leading to a loss of scientific potential of sites along reservoir boundaries. This impact is often linked to irrigation-related reservoirs (Galm and Masten, 1988).

Vandalism and artifact collecting could be expected, especially if a new reservoir provides recreational areas. Vandalism includes a range of activities from intentional looting of sites, to off-road vehicle use in culturally sensitive areas, to extended recreational use, which destabilizes soils. With increased boat use, more sites could be accessible and become vulnerable to vandalism. Increased boat use is also likely to increase erosion due to wake action. Rock art is often the target of graffiti. Site erosion often makes sites more susceptible to vandalism by increasing site exposure.

Land development in the areas surrounding a reservoir can include construction of roads and recreational facilities, grazing, agricultural or orchard uses, and increased residential, commercial, or industrial use. Grazing cattle can adversely affect cultural deposits up to a meter below ground surface as cattle come to water's edge to drink and wallow. The impacts to trampled sites are compounded by fluctuations in the shoreline and changes to soil chemistry related to manure.

Historic structures in the inundation and fluctuation zones would likely be removed prior to inundation. Historic structures in the backshore zone could have increased access, which often leads to increased vandalism. The increased proximity of water may adversely impact the significance of the historic structure by altering the integrity of its setting.

TCPs in the inundation zone would become permanently inaccessible. TCPs in the fluctuation zone would likely be so altered that even when exposed, they would lose their characteristics (such as isolation or resource availability), which provide their integrity of setting, feeling, or association. TCPs in the backshore zone may suffer adverse effects due to alteration of the integrity of setting, feeling, or association as well.

### **Specific Impacts on Bumping Lake and Pine Hollow Areas**

At Bumping Lake, features related to the construction of the original dam, historic recreational residences, and recorded precontact archaeological sites are known to be present in the area proposed for expansion. As no formal surveys have been conducted of the area since the early 1990s, it is anticipated that some structures have become eligible for the National Register of Historic Places (i.e., are now older than 50 years). Even those cultural resources that would not be directly impacted by the enlargement of Bumping Lake might be affected in terms of changes to their association, setting, or feeling. Some of these impacts to the original dam may have been addressed in the mid 1990s (Reclamation 1993).

Impacts to historic and cultural resources at the proposed Pine Hollow reservoir were evaluated in the Programmatic EIS on the Ahtanum Creek Watershed Restoration Program (Ecology, 2005). The reservoir area has the potential for buried archaeological deposits, which could be impacted by the reservoir as described above.

#### **5.12.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on cultural resources were described in Section 5.20.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.12.2.5 Fish Habitat Enhancement Element**

Long-term impacts to cultural resources associated with fish habitat enhancements might include increased erosion of cultural deposits.

#### **5.12.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on cultural resources were described in Section 5.20.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.12.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on cultural resources were described in Section 5.12.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.12.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Long-term impacts of integrating the elements of the alternative are not expected to differ from implementing the elements individually. Projects that are implemented as part of a coordinated process might require more scrutiny of cultural resources because of state or federal funding.

#### **5.12.4 Mitigation Measures**

Mitigation measures would be similar to those discussed in Sections 4.20.2.4 and 5.20.3 of the January 2008 Draft Planning Report/EIS. The actual process to be followed to mitigate adverse effects would be determined by the regulatory nexus for the project element. Existing reservoirs within the region have ongoing programs for the life of the project to assure that operational changes, continuing erosion, and new project elements address cultural resources issues. Similar programs should be established at new or expanded reservoirs.

### **5.13 Socioeconomics**

Consistent with the approach used in Section 5.14 of the January 2008 Draft Planning Report/EIS, as well as in Section 4.13, the assessment of long-term socioeconomic impacts and mitigation measures considers potential effects on the supply and value of goods and services derived from the basin's water and related resources, resource-related jobs and incomes, resource-related uncertainty and risk, the distribution of resource-related costs and benefits, and the structure of the economy. This analysis is programmatic, and detailed determination of potential socioeconomic effects would be undertaken as specific projects are proposed.

#### **5.13.1 No Action Alternative**

Under this alternative, the current patterns and trends in the relationship between the basin's natural resources and the state's economy likely would continue into the foreseeable future. Over a long period of time, the socioeconomic characteristics of the

basin's water and related resources, and their interaction with the regional and statewide economies, would reflect future changes in the ecosystem and the economy. These changes could include changes in climate and the ecosystem's responses to the changes, increases in human population and wealth, and adjustments in the demands for water-related goods and services arising from shifts in consumers' preferences.

#### **5.13.1.1 Value of Goods and Services**

All management decisions affecting water and related resources in the basin affect the ability of the ecosystem to produce goods and services. Actions that enhance the overall health of water-related ecosystems in the basin would strengthen their ability to produce multiple goods and services of value to Washingtonians, both those residing locally and those living elsewhere. The goods and services potentially affected by the No Action Alternative are described in Section 3.12.1, and in Section 5.14.1 of the January 2008 Draft Planning Report/EIS. The nature of the potential changes in the value of goods and services that Reclamation could quantify and monetize were described in the discussion of the No Action Alternative, in Section 5.14.2 of the January 2008 Draft Planning Report/EIS. Additional changes in the value of goods and services also likely would occur. Expected reductions in the populations of salmonids, for example, would reduce the value some people place on knowing that the populations will be robust and available for the enjoyment of future generations.

#### **5.13.1.2 Jobs and Incomes**

The future supply of water and related resources under the No Action Alternative likely would influence future levels of jobs and incomes via three mechanisms. One would materialize when resources become inputs to commercial activities, such as irrigated agriculture or water-related tourism. Another would materialize as the supply of water-related amenities, such as recreational opportunities and clean water in the Yakima River and its tributaries, affect the locational decisions of households and businesses, with an increase in the supply increasing the propensity for families and firms to locate nearby. The third mechanism would materialize as elements of the basin's water-related ecosystem affect the cost of living and doing business in the basin. Such impacts might occur, for example, if healthy wetlands and floodplains were to attenuate the extent of the damage resulting from future flood events, or if changes in water quantity or quality in streams were to affect the cost of securing and treating water for municipal and industrial use.

Current trends in jobs and incomes related to the basin's water and related resources likely would continue in the foreseeable future under the No Action Alternative. Total, water-related jobs and incomes would likely increase, both statewide and in the two economic regions that incorporate portions of the Yakima River basin. Section 5.14.1.2 of the January 2008 Draft Planning Report/EIS describes these regions—one centered on the Seattle-Tacoma-Olympia metropolitan areas, and the other centered on Kennewick, Pasco, and Richland. Total jobs and incomes in industries related to farming likely would grow slowly, if at all, although employment and incomes in some parts of the agricultural industry might experience shifts. Expansion of grape and wine production,

for example, might generate growth in related jobs and incomes, while conversion of farmland to urban uses might eliminate jobs and incomes associated with farm production on those lands.

The Yakima River basin contains the full population of Kittitas and Yakima Counties, but only about 25 percent of Benton County’s population. The three counties, respectively, contain about 12, 75, and 13 percent of the basin’s total population (Kent 2004). Washington State’s Office of Financial Management has estimated population and employment trends through 2030, as shown in Table 5-23. The data show that populations in Kittitas, Yakima, and Benton Counties and the State of Washington are expected to follow similar trajectories, with increases projected at around 15–20 percent by 2020 and at about 30-35 percent by 2030, compared to the 2010 estimate. When compared to the same 2010 base year, non-agricultural employment in Washington is projected to grow at rates lower than those of population, increasing by 12 percent by 2020 to almost 3.5 million jobs, and by 25 percent by 2030, to almost 3.8 million jobs. However, for the same time periods, agricultural employment exhibits trends in the opposite direction showing almost no growth, or 0.7 percent, by 2020, and a decline of nearly 50 percent by 2030.

**Table 5-33 Trends in Population and Employment in the Yakima River Basin and State of Washington**

Year	Population				Non-Agricultural Employment	Agricultural Employment
	Benton County	Kittitas County	Yakima County	Washington State	Washington State	Washington State
2010	188,913	43,901	259,917	7,372,751	3,060,800	326,800
2020	218,874	52,265	307,116	8,713,386	3,430,800	329,000
2030	248,358	60,322	352,476	10,026,660	3,835,600	170,900

Source: Office of Financial Management (2008a, 2008b)

Jobs and incomes related to municipal/industrial uses of water and related resources likely would grow, roughly parallel to population and overall economic growth. Jobs and incomes linked to water-related recreation likely would grow, roughly parallel to growth in population and wealth.

**5.13.1.3 Uncertainty and Risk**

Several types of economically important risk and uncertainty associated with the basin’s water and related resources likely would worsen over the long term under the No Action Alternative. The risk of financial losses associated with potential shortfalls in the supply of water for irrigated agriculture likely would increase, as anticipated changes in climate increase the likelihood of low stream flows in late summer (Scott et al., 2007). This risk also would be exacerbated insofar as existing institutional and other barriers to water transfers and conservation persist (described in Section 5.14.1.4 of the January 2008 Draft Planning Report/EIS). These barriers would extend current patterns, with lower-value crops receiving water while higher-value crops go without.

Anticipated changes in climate could heighten other types of risk and uncertainty regarding increased probability of flooding in the winter and spring, higher temperatures and more heat waves, and diminished fish habitat in streams experiencing low and hot flows in late summer (Casola et al., 2005). Reductions in the quality of fish habitat also could raise the probability of adverse impacts on populations of salmon and steelhead and tighter restrictions on commercial and recreational fishing.

Under the No Action Alternative there might also be increased risk and uncertainty associated with potential future conflict over water and related resources. Reductions in fish habitat and in populations of salmon and steelhead, for example, might lead to increased pressure to restrict withdrawals of water for irrigation and to restrict land and water uses likely to have an adverse impact on habitat.

#### **5.13.1.4 Distribution of Costs and Benefits**

The future, long-term distribution of water-related costs and benefits under the No Action Alternative likely would remain similar to what it is today. The overall economic costs to the regional and statewide economies associated with individual uses of water and related resources likely would continue to exceed the financial costs the users, themselves, would incur. Thus, society as a whole would bear some portion of the total economic cost, known as the societal opportunity cost, as individual water users realize the benefits.

Irrigated agriculture likely would continue to account for most of the water withdrawals and consumption in the basin. Therefore, it also would account for most of the private benefits and societal opportunity costs associated with withdrawals and consumption. Other groups with significant private benefits and societal opportunity costs would include municipal and domestic users of water, those who would participate in water-related recreation in the basin, and those who would benefit from actions that protect water-related amenities. Societal opportunity costs would be borne by those who would prefer greater production of other water-related goods and services, such as those associated with fish habitat, wetlands, and native riparian vegetation, and by those who would provide financial resources to support the development and operation/maintenance of specific water uses.

#### **5.13.1.5 Socioeconomic Structure**

Water-related aspects of the basin's economic structure, and its relationship to the overall state economy, likely would experience many long-term changes under the No Action Alternative, in response to changes in the ecosystem, the economy, laws governing resource management, and budgets available for resource managers. Overall, however, the future structure likely would largely resemble what exists currently. The basin likely would continue to produce commercial products, especially crops, derived from its water and related resources. These resources also likely would contribute to the economy by providing amenities that attract households and businesses, and by providing environmental services, such as natural filtration that lessens the costs municipal and industrial users would incur to obtain high-quality water. These impacts would not all occur at the same rate, so incremental shifts in the water-related economic structure likely

would occur. These shifts may or may not stimulate change in the structure of institutions, policies, and programs affecting management of the basin's water and related resources.

### **5.13.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

#### **5.13.2.1 Fish Passage Element**

##### **Value of Goods and Services**

Improving fish passage would increase the long-term value of goods and services to the extent that it would lead to larger or more stable fish populations. Larger fish populations probably would increase the value of goods and services for those who place a value on the continued existence of the fish species; for those who harvest fish commercially, recreationally, or for cultural purposes; or for those who derive recreational value from watching salmon or other species in the water.

Improved fish passage also likely would have collateral effects on the value of other goods and services. Anadromous fish deliver nutrients derived from the ocean to the upstream ecosystem, stimulating growth in trees, birds, and other economically important species. Fish passage improvements may create new recreational opportunities. Some may derive value just from seeing fish bypass what were once insurmountable barriers, or from knowing that adverse impacts of past activities that created a barrier have been reversed.

##### **Jobs and Incomes**

Improvements in fish passage might have long-term impacts on jobs and incomes through several mechanisms. Jobs and incomes related to operation and maintenance would increase to the extent that the fish-passage facilities would have higher labor requirements than the facilities they modify. They would decrease if the reverse proved true. Reclamation (2008c) has estimated that the first-order impact of long-term expenditures associated with a potential fish passage project at Cle Elum Dam would be an increase of five to 12 jobs, and \$100,800 to \$252,200 in labor income. The analysis found that a similar project at Bumping Lake Dam would generate one to two long-term jobs, and \$10,100 to \$30,400 in labor income. These first-order impacts would be offset, more or less, by second-order effects that would materialize, for example, if the new jobs drew workers away from jobs elsewhere in the regional or statewide economies.

Expected increases in fish populations resulting from improved fish passage potentially could increase jobs and incomes associated with recreational and commercial fish harvest. Jobs and incomes with no direct relationship to fish or the fish passage facilities would increase if households and businesses perceive that the resulting impacts on fish populations and the overall natural environment are significant enough to alter their locational decisions. These first-order impacts also likely would be offset, more or less, by second-order impacts.

### **Uncertainty and Risk**

Improving fish passage would reduce risk and uncertainty associated with salmon and steelhead to the extent that it would diminish the likelihood of severe future reductions in fish populations.

### **Distribution of Costs and Benefits**

The long-term costs and benefits of improvements in fish passage likely would not be distributed equally among the same groups. This is especially the case to the extent that the costs would be borne by taxpayers and the benefits would be realized by a subset: those who would enjoy seeing greater fish populations, or catching more fish, for example. The costs and benefits would coincide insofar as taxpayers pay the costs and realize the benefits as nutrients delivered by anadromous fish improve the health of ecosystem resources owned by all citizens.

### **Socioeconomic Structure**

Improvements in fish passage and resulting increases in fish populations likely would boost the recreational fishing industry and other components of the economy related to fish populations.

## **5.13.2.2 Modifying Existing Structures and Facilities Element**

### **Value of Goods and Services**

This element of the Integrated Water Resource Management Alternative likely would change the long-term supply of financial resources, land, and other resources dedicated to the structures as well as the supply of water for irrigation, instream flows, and other goods and services derived from the structures.

### **Jobs and Incomes**

Long-term increases or decreases in expenditures on a modified structure or facility, relative to what would exist otherwise, would respectively increase or decrease jobs and incomes associated with the structure or facility. Similarly, increases or decreases in goods and services derived from the structure or facility—such as fish populations, recreational opportunities, and water for irrigation—likely would have a corresponding impact on jobs and incomes in commercial activities associated with them. In addition, any improvements or deterioration in natural resource amenities that affect the locational decisions of households and businesses also would have long-term impacts on related jobs and incomes. Any changes in the ecosystem's ability to provide goods and services that affect the cost of living and doing business in the region also could affect jobs and incomes.

The initial impacts on jobs and incomes would be dampened to the extent that they trigger offsetting second-order impacts. An initial increase in jobs might, for example,

draw workers from other jobs, which would remain unfilled, so the net impact would be near zero.

### **Uncertainty and Risk**

Projects to modify existing structures and facilities would reduce long-term risk and uncertainty to the extent that they increase the reliability of the future supply of a good or service. Increased reliability in the supply of water for irrigation or instream flow, for example, would diminish the risk and uncertainty associated with the probability that irrigators would have too little water to irrigate crops, or that fish would have poor habitat conditions.

### **Distribution of Costs and Benefits**

The long-term costs and benefits of modifications to existing structures and facilities likely would not be distributed equally among the same groups. This is especially the case to the extent that the costs would be borne by taxpayers and the benefits would be realized by a subset: recreationists who would enjoy larger fish populations, for example. The costs and benefits would coincide insofar as taxpayers pay the costs and realize the benefits of better health for ecosystem resources owned by all citizens.

### **Socioeconomic Structure**

Modifications to structures and facilities likely would boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. The recreational fishing industry would be reinforced, for example, if modifications were to increase fish populations.

#### **5.13.2.3 New Storage Element**

##### **Value of Goods and Services**

This element likely would change the long-term supply of several goods and services derived from the basin's water and related resources. An individual project might, for example, increase the supply of water for irrigated agriculture for some lands at some times, and increase the production of irrigated crops from those lands. New storage also might create new opportunities for recreational activities, such as reservoir-related water sports. The value of an initial increase in the production of some goods and services might be offset by second-order effects. An increase in the production of some crops resulting from new storage might, for example, reduce the price all producers in the state receive for the crop. Some recreationists might take advantage of the recreational opportunities at a new reservoir by reducing their recreational visits to similar sites at other reservoirs, so that the overall amount of recreational activity remains nearly unchanged.

Section 5.14.1.1 of the January 2008 Draft Planning Report/EIS presented general estimates of the value of incremental changes in the supply of water for irrigating crops, municipal/industrial use, and the production of some other goods and services. Section

5.14.2.2 of the January 2008 Draft Planning Report/EIS presented estimates of value derived from observed prices of transactions that transferred water from agricultural use to municipal use or to another agricultural use.

### **Jobs and Incomes**

Long-term expenditures on a new storage facility likely would increase the demand for labor and generate new job opportunities and higher incomes for some workers. Similarly, increases in the supply of goods and services derived from the new storage structure—such as fish populations, recreational opportunities, and water for irrigation—likely would have a corresponding impact on jobs and incomes in commercial activities associated with them. The structure's impacts, positive or negative, on the basin's natural resource amenities that affect the locational decisions of households and businesses would have long-term impacts on related jobs and incomes.

### **Uncertainty and Risk**

The development of new storage would reduce risks and uncertainties to the extent that it would increase the reliability of water to meet specific demands. If a new storage project increased the reliability of water for irrigators during periods when water supplies otherwise would be uncertain or less than irrigators' demands, it likely would induce the irrigators to increase crop production, and reduce the costs they would incur to compensate for risk and uncertainty. If new storage increased the reliability of water supplies to provide fish habitat during periods when stream flows otherwise would be lower and less favorable, then it might increase the habitat's ability to support larger fish populations, and enable fish and water managers to avoid the costs of alternative actions to improve habitat. Increased reliability in the supply of water for municipal/industrial users of water would allow them to avoid the costs of potential future shortages or the costs of finding other means for increasing reliability.

### **Distribution of Costs and Benefits**

The long-term costs and benefits of new storage likely would not be distributed equally among the same groups. This is especially the case to the extent that the costs would be borne by taxpayers and the benefits would be realized by a subset: irrigators who would enjoy a more reliable supply of water, for example. The costs and benefits would coincide insofar as the taxpayers who would pay the costs also would realize the benefits of better health for ecosystem resources owned by all citizens.

### **Socioeconomic Structure**

The development of new storage likely would boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. The affected parts of the agricultural sector would be reinforced, for example, if new storage were to increase the reliability of water supplies for irrigation.

#### **5.13.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on socioeconomics were described in Section 5.14.2.3 of the January 2008 Draft Planning Report/EIS for surface recharge and municipal ASR. The construction costs of the regional ASR approach are expected to range from \$193 million to \$419 million per wellfield depending on the treatment option chosen (new treatment plant or river bank filtration) and the total number of miles of transmission line needed. The cost per acre-foot of water from the regional ASR approach is estimated to range from \$3,000 to \$6,000 dollars per acre-foot of water. The lower costs are associated with river bank filtration as the preferred treatment method.

#### **5.13.2.5 Fish Habitat Enhancement Element**

##### **Value of Goods and Services**

Enhancing fish habitat likely would have a long-term effect on the value of goods and services derived from the basin's water and related resources to the extent that it would increase fish populations. Huppert et al. (2004) estimated the value Washingtonians place on changes in salmon populations at approximately \$715 per fish (2003 dollars). Other studies also provide insight into the potential value of possible increases in salmon and steelhead populations. All estimates are in 2003 dollars. Goodstein and Matson (2007) found that, when households elsewhere were taken into account, the value of marginal increases in salmon populations in the Columbia River basin is \$2,890 per fish. Loomis and White (1996) found that households in the U.S. were willing, on average, to pay \$31 to \$88 per household per year to ensure the survival of Pacific salmon and steelhead. Platt (2008) estimated the average value of recreational and commercial catch of different species originating in the Yakima River basin and found:

- The average recreational value per fish is about \$101 for Chinook and \$118 for coho caught in the ocean; \$304 for all species caught in the lower Columbia River; and \$462 for spring Chinook and \$368 for fall Chinook and coho caught in the Yakima River basin.
- The average commercial profit per fish is about \$26 for Chinook and \$8 for coho caught in the ocean; \$46 for spring Chinook, \$15 for fall Chinook, and \$6 for coho caught by the non-Indian commercial fishery in the lower Columbia River; and \$23 for spring Chinook, \$9 for fall Chinook, and \$3 for coho caught by the Indian commercial fishery in the lower Columbia River.
- The lower-bound average value of fish for Indian ceremonial and subsistence uses (in the Yakima River basin and the Columbia River basin) is about \$28 for spring Chinook, \$11 for fall Chinook, and \$4 for coho.

Enhancing fish habitat might increase the supply of goods and services other than those associated with catching salmon and steelhead. If other fish species were to benefit from the habitat enhancements and stimulate additional recreational fishing activities, for example, the current average value of such activities to those who participate in them is

about \$42 per person per day (Loomis, 2005). If the habitat enhancements were to induce increases in hunting and sightseeing, the current average value of these activities to those who participate in them is about \$35 and \$61 per person per day, respectively.

Habitat enhancements might increase the supply of other goods and services for which there does not exist an estimate of value. This does not mean that the value would be zero, but that analysts have not estimated the value to date. Implementation of the Integrated Water Resource Management Alternative might yield outcomes—improvements in water quality, changes in water-related landscapes, and improvements in the populations of some species—that many Washingtonians would consider to have positive economic value, for example, but there exist no market data or analytical studies that readily indicate the size of the value.

### **Jobs and Incomes**

Fish habitat enhancements might increase or decrease long-term expenditures on the affected land, water, and other resources and, therefore, might lead to a long-term increase or decrease in related jobs and incomes. Enhancement of habitat might, for example, attract more visitors who leave more trash and increase expenditures, jobs, and incomes associated with clean-up. Or, it might expand the ability of wetlands and floodplains to accept high stream flows and reduce expenditures, jobs, and incomes related to downstream flooding.

Changes in commercial fishing, recreational fishing, sightseeing, and other activities that might result from enhanced fish habitat likely would lead to changes in the levels of jobs and incomes associated with these activities. Any changes in natural resource amenities that affect the locational decisions of households and businesses would have long-term impacts on related jobs and incomes.

The initial impacts on jobs and incomes would be dampened to the extent that they would trigger offsetting second-order impacts. An initial increase in jobs might, for example, draw workers from other jobs, which would remain unfilled, so the net impact would be near zero.

### **Uncertainty and Risk**

Enhancing fish habitat would reduce risk and uncertainty associated with salmon and steelhead to the extent that it would diminish the likelihood of future severe reductions in fish populations.

### **Distribution of Costs and Benefits**

The long-term costs and benefits of fish habitat enhancements likely would not be distributed equally among the same groups. This is especially the case to the extent that the costs would be borne by taxpayers and the benefits would be realized by a subset: those in the commercial fishing industry who would enjoy opportunities to increase their catch of salmon and steelhead, for example. The costs and benefits would coincide

insofar as the taxpayers who would pay the costs also would realize the benefits of better health for ecosystem resources owned by all citizens.

### **Socioeconomic Structure**

The enhancement of fish habitat likely would boost those elements of the economy that would enjoy increased fish populations relative to those that would not.

#### **5.13.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on socioeconomics were described in Section 5.14.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.13.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on socioeconomics were described in Section 5.14.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.13.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

The long-term socioeconomic effects of the Integrated Water Resource Management Alternative may differ from the sum of the effects of the individual elements. Differences would arise to the extent that implementing the elements as a package would enable them to interact with one another in their impacts on the supply of goods and services derived from the basin's water and related resources, on resource-related expenditures, on resource-related risk and uncertainty, on the distribution of resource-related costs and benefits, or on the structure of the regional and statewide economies. If they reinforce one another, then the overall effect would be greater than the sum of their individual effects. If they interfere with one another, it would be smaller.

Interactive effects among the individual elements might emerge from sources peripheral to the economy. Biophysical systems might respond differently if the elements were implemented in an integrated manner than if they were implemented separately, for example. Similarly, resource-management systems and funding mechanisms might respond differently, so that the overall socioeconomic effects would be larger or smaller than the sum of the effects of the individual elements. Interactive effects also might occur within the economy itself. Households and businesses, for example, might alter their activities and investment decisions if they perceive that, with the Integrated Water Resource Management Alternative, the likelihood of a change in the supply of economically important goods and services would be significantly different than it would be if the different elements were implemented individually. Further investigation would be required to determine the potential for such interactive effects.

### 5.13.4 Construction Cost Estimate

#### 5.13.4.1 Construction Cost Estimates for the Integrated Water Resource Management Alternative

Construction cost estimates for elements of the Integrated Water Resource Management Alternative were determined from cost estimates from previous studies where available. Costs were assumed to be based on costs as of April 2007 to be consistent with the Planning Report/EIS. When a cost estimate was used, Reclamation’s composite trend of the construction index was applied to convert the previous cost estimate into April 2007 costs. Reclamation’s Construction Cost Trends can be accessed at [http://www.usbr.gov/pmts/estimate/cost\\_trend.html](http://www.usbr.gov/pmts/estimate/cost_trend.html). Table 5-34 presents the values used for construction indices for 1986 to 2008.

**Table 5-34 Construction Index – Composite Trend (1986-2008)**

<b>Year</b>	<b>Construction Index</b>
2008	318
2007	309
2006	303
2005	288
2004	274
2003	250
2002	242
2001	236
2000	233
1999	227
1998	221
1997	218
1996	212
1995	207
1994	199
1993	194
1992	188
1991	185
1990	181
1989	176
1988	168
1987	162
1986	160

The cost estimates for the elements of the Integrated Water Resources Management Alternative are listed in Table 5-35. Not all costs are known and most cost estimates are preliminary. The total estimated costs for the fish passage element are \$243.9 million. The total estimated costs for the Modifying Existing Structures and Operations Element range from \$12 million to an unknown value. Those costs do not include the costs of the KID Pump Exchange Project, which are included in the Enhanced Water Conservation Element. The total estimated costs for the new surface water storage element could range up to \$1.67 billion depending on the number and size of reservoirs constructed. The ground water storage element costs are estimated to range from \$54 million to \$164 million. The total estimated costs for the fish habitat enhancement element range from \$115.8 million to an unknown value. The estimated costs of the Enhanced Water Conservation element are up to \$405 million. The estimated costs of the Market-Based Reallocation of Water Resources Element is \$45 million to \$218 million. Combining the elements of the Integrated Water Resources Management Alternative into a comprehensive program that benefits water supply and fish could cost up to \$2.8 billion if all the elements are implemented. However, not all of the projects are likely to be implemented. Specific projects for implementation will be selected as part of the comprehensive water resource implementation planning process. That process will weigh the costs and benefits of the various fish passage, storage, conservation, water marketing, and habitat restoration projects.

**Table 5-35 Cost Estimates for Elements of the Integrated Water Resource Management Alternative**

Element	Estimated Construction Cost	Construction Duration	Source
<b>Fish Passage</b>			
-Cle Elum Dam	\$93,300,000	3 years	Reclamation, 2008c
-Bumping Dam	\$26,200,000	2 years	Reclamation, 2008c
-Tieton Dam	\$52,600,000	TBD	Reclamation, 2005a
-Keechelus Dam	\$35,900,000	TBD	Reclamation, 2005a
-Kachess Dam	\$35,900,000	TBD	Reclamation, 2005a
<b>Subtotal – Fish Passage Element</b>	<b>\$243,900,000</b>		
<b>Modifying Existing Structures and Operations</b>			
-Operational Changes at Existing Facilities	\$0	0 years	
-Structural Changes to Existing Facilities			
--WIP Granger pump station	TBD	TBD	
--Chandler Dam modifications	TBD	TBD	
-KRD Canal Modifications to Improve Tributary Flows			
--Lateral piping projects along Main Canal and South Branch Canal	\$9,100,000	TBD	CH2M Hill, 1999
--Pumping near tail end of canal	TBD	TBD	
-Complete Wapatox Project	\$2,900,000	TBD	Yakima Steelhead Recovery Plan, 2008
<b>Subtotal - Modifying Existing Structures and Operations</b>	<b>\$12,000,000-unknown</b>		
<b>New Storage</b>			
-Naches River Storage Reservoirs			
--Bumping Lake large expansion	\$315,800,000	6 years	Reclamation, 2006, 1979
--Bumping Lake small expansion	\$213,200,000	4 years	Reclamation, 1986

Element	Estimated Construction Cost	Construction Duration	Source
--Other potential water storage sites	TBD	TBD	
-Wymer Dam (Thorp Pump Station to Canal or Pipeline along KRD North Branch Option)	\$1,200,000,000	10 years	Reclamation, 2006; Montgomery Water Group, 2002
-Ahtanum Creek Watershed Restoration Program, Including Pine Hollow Reservoir	\$151,700,000	TBD	Ecology, 2005a
<b>Subtotal – New Storage (assuming Bumping Lake small expansion to all storage elements with Bumping Lake large expansion)</b>	<b>\$1,667,500,000</b>		
<b>Ground Water Storage</b>			
-Surface Recharge	\$54 to 164,000,000	10-20 years	
-Direct Injection	\$65,000,000	10-20 years	
<b>Fish Habitat Enhancement</b>			
-Yakima and Naches Rivers			
--Yakima River: Keechelus Dam to Roza Dam	\$26,000,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Yakima River: Roza Dam to Prosser Dam	\$20,400,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Yakima River: Prosser Dam to Columbia River	TBD	TBD	
--Naches River: Bumping Dam to Tieton River	\$1,200,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Naches River: Tieton River to Yakima River	\$11,400,000	TBD	Yakima Steelhead Recovery Plan, 2008
-Tributary Habitat Improvements			
--Big Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Cle Elum River	\$150,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Teaway River	\$5,000,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Swauk Creek	\$780,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Taneum Creek	\$6,050,000	TBD	Yakima Steelhead Recovery Plan, 2008

Element	Estimated Construction Cost	Construction Duration	Source
--Jack Creek	\$730,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Indian Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Cherry Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Manastash Creek	\$4,890,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Reecer Creek	\$1,970,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Naneum Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Coleman Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Bumping River	\$1,890,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Coviche Creek	\$4,570,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Wide Hollow Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Toppenish Creek	\$10,350,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Satus Creek	\$20,360,000	TBD	Yakima Steelhead Recovery Plan, 2008
<b>Subtotal – Fish Habitat Enhancement</b>	<b>\$115,800,000-unknown</b>		
<b>Enhanced Water Conservation</b>			
	\$405,000,000	10 years	
<b>Market-Based Reallocation of Water Resources</b>			
Drought years lease	\$45,000,000	1 year	
Non-drought years purchase	Up to \$173,000,000	20-50 years	
<b>TOTAL – Integrated Water Resource Management Alternative</b>	<b>\$2,800,000,000</b>		

TBD = To be determined

The element with the least amount of information available on costs is the fish habitat enhancement element. Costs for habitat restoration projects were obtained from the Yakima Steelhead Recovery Plan (2008); however, the estimates appear to be very preliminary. Table 5-26 presents estimated costs for common items in fish habitat enhancement projects. When more detail is available on fish habitat enhancement projects, these types of unit costs would be applied to quantities estimated for each project to obtain an estimated construction cost. Additional costs such as design, permitting, and administrative costs would also need to be added; those costs can total up to 25 percent of the construction cost.

**Table 5-36 Unit Costs for Common Items in Fish Habitat Enhancement Element**

<b>Item</b>	<b>Units</b>	<b>Unit Cost</b>
Clearing and grubbing	Acre	\$5,000
Coffer dams/fish exclusion at structures	Each	\$10,000
Riprap and boulders	Ton	\$50
LWD pieces placed in structures	Each	\$800
Excavation	Cubic Yard	\$4 to \$12
Stream bed gravel	Cubic Yard	\$10 to \$25
Compost	Cubic Yard	\$60
Seeding	Acre	\$2,500
Bank stabilization	Linear Foot	\$50 to \$250
Channel connectivity	Linear Foot	\$850
Log control weir	Each	\$10,000
Plant removal/control	Acre	\$4,000
Riparian restoration	Square Foot	\$2

Additional analyses of all the elements will be prepared if the projects proceed to a feasibility-level study.

**5.13.4.2 Lost and Gained Revenue from the Integrated Water Resource Management Alternative**

Section 5.7.2.2 described the potential loss of hydroelectric generation that could occur under the modifying existing structures and facilities element, specifically the subordination of Roza Power Plant and Chandler Power Plant diversions during spring months (April-June). An estimate of the lost generation revenue was made using rate tables from BPA’s 2007 Supplemental Wholesale Power Rate Case schedules (BPA, 2008). After comparing the monthly demand rates and monthly energy rates, a rate of 25 mills/kWh (\$0.025/kWh) was selected to represent the amount of revenue lost from reduced hydroelectric generation for this document.

Table 5-37 lists the estimated amount of monthly revenue lost due to Roza Power Plant subordination, and Table 5-38 lists the estimated amount of monthly revenue lost due to Chandler Power Plant subordination for various amounts of flow left instream.

**Table 5-37 Estimated Reduction in Annual Revenue Generated from Roza Power Plant**

Increase in Yakima River Flow (cfs)	Reduction in Revenue Generated			
	April	May	June	Total
50	\$9,000	\$9,300	\$9,000	\$27,300
100	\$18,000	\$18,600	\$18,000	\$54,600
150	\$27,000	\$27,900	\$27,000	\$81,900
200	\$36,000	\$37,200	\$36,000	\$109,200
250	\$45,000	\$46,500	\$45,000	\$136,500
300	\$54,000	\$55,800	\$54,000	\$163,800

**Table 5-38 Estimated Reduction in Annual Revenue Generated from Chandler Power Plant**

New Minimum Flow below Prosser Dam (Apr-Jun) (cfs)	Reduction in Revenue Generated			
	April	May	June	Total
1,100	\$1,600	\$1,700	\$2,700	\$6,000
1,200	\$3,300	\$3,700	\$3,900	\$10,900
1,300	\$4,200	\$6,200	\$5,100	\$15,500
1,400	\$4,700	\$8,700	\$6,500	\$19,900
1,500	\$5,300	\$11,300	\$8,400	\$25,000
1,600	\$6,300	\$13,900	\$10,400	\$30,600
1,700	\$7,500	\$16,500	\$12,300	\$36,300
1,800	\$8,700	\$19,300	\$14,200	\$42,200
1,900	\$10,300	\$22,000	\$15,900	\$48,200
2,000	\$12,300	\$24,400	\$17,700	\$54,400

Note: Current minimum flow below Prosser Dam is 1,000 cfs for April to June time period.

If the Roza Power Plant is subordinated to increase Yakima River flow by 50 cfs in April and May, the loss in annual revenue from hydroelectric generation is estimated to be \$18,300. If the flow is increased to 300 cfs from April to June, the loss in annual revenue is estimated to be \$163,800.

An additional subordination will occur to fill Wymer Reservoir. The hydrologic modeling performed for the Integrated Water Resource Management Alternative showed an average of 15,790 cfs-days (379,000 cfs-hours) diverted by the Thorp pump station into Wymer Reservoir. However that water could be run through a power plant at Wymer Dam to recover the energy used to pump water at Thorp. In addition, the extra water made available through increased storage can be run through the Roza Power Plant. The hydrologic model estimated an additional 21,000 cfs-days (505,316 cfs-hours) will be run through the Roza Power Plant. The value of that hydroelectric generation is \$126,000/year.

If the Chandler Power Plant is subordinated to increase the minimum flow level in the Yakima River below Prosser Dam from 1,000 cfs to 1,100 cfs in April to June, the loss in annual revenue from hydroelectric generation is estimated to be \$6,000. If the minimum flow is increased to 2,000 cfs from April to June, the loss in annual revenue is estimated to be \$54,400.

### **5.13.5 Mitigation Measures**

The type of mitigation needed would be determined by future socioeconomic conditions and the specific steps that would be taken to implement the actions. Mitigation typically would be warranted only insofar as an action would reduce the supply of one set of goods and services (to increase the supply of another) and the reduction harmed one or more individuals, businesses, landowners, or other interest groups. For example, mitigation might involve compensation if the fallowing of land to develop new storage were to render a farmer unable to grow a certain crop. Alternatively, mitigation might involve the provision of substitutes for the reduced goods and services. Additional discussion of mitigation measures for potential socioeconomic impacts were described in Section 5.14.3 of the January 2008 Draft Planning Report/EIS.

## **5.14 Visual Resources**

### **5.14.1 No Action Alternative**

The No Action Alternative includes individual actions that could affect visual resources. Riparian habitat improvements, included in some of these actions, would have a beneficial impact on the visual resource settings. Other projects could also have visual resource impacts, but those impacts would be less obvious because they would be associated with existing facilities. These projects would undergo separate NEPA or SEPA analysis, as appropriate. Because the projects would not be implemented as an integrated program, they have the potential to have greater impacts on visual resources.

### **5.14.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

#### **5.14.2.1 Fish Passage Element**

The proposed fish passage elements would be located in landscape settings where the overall visual character and scenic quality are high. However, the fish passage facilities would be located at existing dams where human activities have reduced the visual character and scenic quality. It is often more difficult to blend or design compatible facilities in such settings without creating a significant change in visual character or reducing scenic quality. The capacity to visually absorb development is primarily dependent on vegetation cover, landform, and existing structures.

Lake and reservoir shorelines generally have a low ability to visually absorb new development due to the availability of uninterrupted views across water (Reclamation, 2008c). However, a major factor influencing the potential visual impact is the level of visual contrast between the proposed new development and the existing elements in the landscape. The existence of Cle Elum, Bumping Lake, Rimrock, Keechelus, and

Kachess Dams, and their related structures, would make new visual intrusions related to implementing fish passage less apparent. Distance is also a strong influence on potential visual impact is reduced if the project is viewed from a distance.

At viewpoints above the dams, and on or adjacent to reservoirs, additional intake structures and conduits for fish passage may be visible. Typical viewpoints are from highways, local roads, shoreline campgrounds, and residences adjacent to or overlooking the reservoirs.

At viewpoints below dams, additional outlets for downstream fish passage and structures for upstream fish passage (barrier, fish ladder, loading slab, building, fish lock, and holding pool) would be visible. Typical viewpoints are from highways, local roads, and riverbanks, where public access exists. The views would generally be fleeting for motorists.

Many of the new and modified facilities would be visible from viewpoints, but would be subordinate in character to the dams. In some cases they would be indistinguishable; in other cases they would be more pronounced. Exterior surfaces would be designed to blend with the surrounding landscape. Reclamation has determined that for Cle Elum and Bumping Lake Dams, the upstream fish passage facilities will be indistinguishable from existing dam features (Reclamation, 2008c). At Cle Elum Dam, the downstream barrier may be visible from the riverbank and at Bumping Lake Dam, the top of the fish handling facility building may be visible from the adjacent Forest Road.

Removal of some second-growth conifer forest and riparian vegetation would be necessary to construct fish collection facilities at some dam sites, which would create a more open setting and potentially increase views into the sites. Development of access roads to new trap and haul facilities would also have the potential to increase views into the sites. For the most part, the new facilities would be introduced into a visual environment already containing several similar facilities, though some impacts would be locally significant.

#### **5.14.2.2 Modifying Existing Structures and Facilities Element**

The fish bypass systems and canal projects would result in smaller scale facilities, though similar types of visual impacts as described above for the fish passage element.

Operational changes at existing facilities would have minimal visual impact. Flows may be increased or decreased in individual reaches, but would be within the range of river levels. Structural changes to existing facilities would include improvements to the Wapato Irrigation Project, and changes to the Chandler juvenile fish bypass outfall. These changes would not cause visual impacts.

Options for modifying the KRD Main Canal and South Branch Canal could result in visual changes related to piping existing open ditches (laterals) and constructing a new pump station on the Yakima River near the tail end of the South Branch Canal. Given the open, agricultural and sparsely developed character of the landscape through which these pipelines would be routed, their long-term visual impact would be minimal. Depending

on the selected location for the new pump station, the visual impact of the facility could be significant on a local scale (i.e., to existing residents in the immediate vicinity or to recreationists on the river).

Completing the Wapatox Project could result in visual changes at a local scale related to modifying the conveyance system or consolidating the Wapatox and Naches-Selah diversions, but would remain within the agricultural and sparsely developed character of the landscape.

#### **5.14.2.3 New Storage Element**

Construction of a new storage facility would result in significant long-term visual impacts to the area. The magnitude of the impact would depend on the proposed location of the facility, the existing character of the surrounding landscape, and the scale of the project. Areas inundated by the reservoir would be permanently removed from the visual landscape; downstream reaches of receiving waters would be altered where the flow regime is altered.

The Bumping Lake expansion would increase the current 1,300-acre reservoir to 4,120 acres under the large option, and 3,500 acres under the small option. The new dam structure under the large option would be 230 feet high, an almost four-fold increase in height over the existing dam. The new dam and expansion of Bumping Lake would significantly and irrevocably affect the visual character of the Bumping Lake valley.

The new dam and expanded reservoir would be visible from viewpoints surrounding the reservoir. Changes to the lake would be particularly evident along the east and southeast areas of the lake from Bumping Lake Dam, south to the Deep Creek drainage area. This area would be inundated and would change from a low-lying, forested upland lake fringe to open water. This change would be perceived as either neutral or positive by some and as adverse by others. The degree of positive versus negative viewer reaction would likely vary by perceived opportunity (e.g., access for various types of recreation and similar pursuits). The dam and expanded reservoir would be visible to trail users from a number of obstructed viewpoints (filtered views through trees) and unobstructed viewpoints in the William O. Douglas Wilderness Area. Viewpoints include trails and lookout points on American Ridge (north of the lake), Nelson's Ridge (south of the lake), and Miner's Ridge (west of the lake). Many of these trail users are in the Wilderness Area because they value natural settings, and they may view the new dam and expanded reservoir as negative.

Modification of river operations in conjunction with storage in the Naches River basin could include changes to canals and ditches in the KRD system, including the KRD Main Canal, North Branch Canal, and South Branch Canal. These changes may be visible from local roads, highways, recreational areas, and residences and could include new, combined or enlarged canals, ditches, siphons, and tunnels. While most of these changes would occur in the vicinity of existing systems, a new canal from Cle Elum Dam to the KRD Main Canal is also included.

One option for filling the proposed Wymer reservoir would require 46 miles of pipeline between Cle Elum Dam and Wymer Dam. With the exception of some above-ground easement appurtenance facilities, this alternative is composed entirely of underground pipelines; the only surface manifestation would be a managed corridor of land along the easement or right-of-way. Management of the corridor would include prohibition of permanent structures, but landscape plantings, agriculture in some form, and/or restored natural vegetation (as appropriate to the environment along the route) would characterize the corridor after construction. Given the open, agricultural, and sparsely developed character of the landscape through which these pipelines would be routed, their long-term visual impact would be minimal.

Pine Hollow reservoir was included in Ecology's Final Programmatic EIS on the Ahtanum Creek Watershed Restoration Program (Ecology, 2005). As described in the EIS, construction of the Pine Hollow reservoir would alter the appearance of the Pine Hollow area. A portion of the grassy, rocky canyon area would be converted to a reservoir with an earthen dam at the western end. The dam would block views from the surrounding ridges down Pine Hollow. When full, the reservoir would resemble a lake that would contrast with the surrounding arid area. Filling and drawing down the reservoir would result in white mineral deposits ("bathtub ring") and exposed mud flats during drawdowns, which would be visible to residents in the Pine Hollow area until the reservoir is refilled in late winter/early spring. The appearance of the Johncox Ditch area would also be altered by the reservoir.

#### **5.14.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on visual resources were described in Section 5.19.2.3 of the January 2008 Draft Planning Report/EIS.

#### **5.14.2.5 Fish Habitat Enhancement Element**

Habitat enhancements, including levee setbacks and riparian plantings, would improve the condition of riparian vegetation and change views of the rivers and creeks. These enhancements would create a more natural visual setting, which would generally be viewed as positive.

#### **5.14.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on visual resources were described in Section 5.19.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.14.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on visual resources were described in Section 5.19.2.2 of the January 2008 Draft Planning Report/EIS.

### **5.14.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

Because the visual impacts of the facilities would be primarily of local scale, no increase or lessening of impacts as a result of the integrated elements is expected. Further, considering the similarity in appearance with existing structures and the fact that the overall complex of facilities at individual project sites would be viewed predominately from a distance, the overall long-term visual resource impact is not expected to be significant.

### **5.14.4 Mitigation Measures**

Disturbed areas below the fish passage facilities would be contoured to blend with adjacent areas to the extent practicable and revegetated with appropriate native plant species. The old-growth western red cedar stand and mature conifers in the area located downstream of Bumping Lake Dam would be protected from disturbance to the extent possible. The visual impacts of fish handling facilities would be reduced using the appropriate paint color to blend with the natural landscape.

New or modified canals, ditches, tunnels, siphons, and appurtenant facilities would be located to minimize their visibility from public areas.

Consultation with the landscape architect for the Okanogan-Wenatchee National Forest in advance of preparing designs will assure the fish passage facilities, storage elements, and restoration of lands disturbed during construction within U.S. Forest Service property will meet the High Scenic Integrity Level (Retention VQO) as much as possible given engineering requirements.

Additional mitigation measures for potential impacts to visual resources were described in Section 5.19.3 of the January 2008 Draft Planning Report/EIS.

## **5.15 Transportation**

### **5.15.1 No Action Alternative**

Long-term transportation associated with the No Action Alternative would be similar to those described in Sections 4.16 and 5.17 of the January 2008 Draft Planning Report/EIS.

### **5.15.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements**

#### **5.15.2.1 Fish Passage Element**

No long-term impacts to transportation are anticipated. The operational requirements of some fish passage projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems. Adult fish would be hauled past dams in trucks on service roads. The hauling operations would last a few weeks each year and would not impact transportation.

### **5.15.2.2 Modifying Existing Structures and Facilities Element**

No long-term impacts to transportation are anticipated from proposed structural modifications. The operational requirements of some canal, pipe, or pump station projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems.

### **5.15.2.3 New Storage Element**

The proposed Bumping Lake expansion would eliminate some lakeshore access and associated facilities (e.g., boat launches and parking), and access roads that provide access to recreational sites and facilities. Access roads that would be inundated include National Forest Development Roads 1800 (from a location south of the Bumping Crossing Campground), 1808, 1809, and 1810. These roads provide access to several trailheads and recreational sites, including Deep Creek Trailhead, Fish Lake Way Trailhead, Swamp Lake Trailhead, Lily Lake Trailhead, Granite Lake, and Copper City, an old mining area.

No public road or rail facilities would be closed or relocated as a result of the proposed new storage projects. The operational requirements of new storage projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems. New access roads could be required to access new storage facilities. Those roads would be maintained by the operating entity of the reservoir. Expansion of Bumping Lake would limit the ability of the U.S. Forest Service to construct new access roads to trailheads that access the William O. Douglas Wilderness Area.

The impacts to transportation resources from the proposed expansion of Bumping Lake were further analyzed in the Proposed Bumping Lake Enlargement Final EIS prepared by Reclamation (Reclamation, 1979). The impacts to recreational sites and facilities are described in Section 5.10.2.3.

### **5.15.2.4 Ground Water Storage Element**

The impacts of the Ground Water Storage Element on transportation were described in Section 5.16.2.3 of the January 2008 Draft Planning Report/EIS.

### **5.15.2.5 Fish Habitat Enhancement Element**

No long-term impacts to transportation are anticipated. The operational requirements of some fish habitat enhancement projects may require infrequent trips by maintenance vehicles and would have no impact on transportation systems.

### **5.15.2.6 Enhanced Water Conservation Element**

The impacts of the Enhanced Water Conservation Element on transportation were described in Section 5.16.2.1 of the January 2008 Draft Planning Report/EIS.

#### **5.15.2.7 Market-based Reallocation of Water Resources Element**

The impacts of the Market-based Reallocation of Water Resources Element on transportation were described in Section 5.16.2.2 of the January 2008 Draft Planning Report/EIS.

#### **5.15.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements**

No long-term impacts to transportation are anticipated beyond those that would occur if the elements were implemented individually.

#### **5.15.4 Mitigation Measures**

Since there would be no long-term impacts to transportation, no mitigation is necessary.

### **5.16 Cumulative Impacts**

The overall cumulative impacts of the Integrated Water Resource Management Alternative are expected to be beneficial, although some localized impacts could occur associated with individual projects. The integrated approach to resolving water resource problems in the Yakima River basin is proposed to provide greater benefits than implementing any one project element alone. A combined package of fish passage, water storage, and habitat enhancement is expected to provide greater benefits to resident and anadromous fish than any one of those elements would individually. Water storage and modifications to existing facilities and operations are expected to provide greater benefits to irrigation and municipal water supply. Integrating improvements to fish habitat and water supply improves the potential for implementing those improvements.

Individual elements of the Integrated Water Resource Management Alternative could cause cumulative impacts when combined with other past, present, and reasonably foreseeable future actions. Building new water storage facilities or expanding existing reservoirs would add to existing impacts in a river basin that has already been extensively dammed. Additional storage facilities could exacerbate the impacts of existing facilities. For example, on-channel storage could add additional impediments to fish passage, increase migration times, and affect downstream water quality. However, any new facility constructed as part of the Integrated Water Resource Management Alternative would include fish passage and fish passage would be installed at existing reservoirs as part of the package. New or expanded reservoirs could inundate terrestrial wildlife habitat and impact plant or wildlife species already in decline.

The Integrated Water Resource Management Alternative is not intended to expand irrigation in the Yakima River basin. However, it would provide a more reliable water supply for prorated users which could encourage farmers to shift to more permanent crops. These changes in agriculture are not expected to add to the decline in shrub-steppe habitat or other important habitat in the basin.

The proposed Integrated Water Resource Management Alternative is intended to have incremental benefits to fish species, including those that are listed as threatened and

endangered. Providing fish passage at the reservoirs and enhancing habitat on the rivers and tributaries in the basin would help reverse environmental damage from the early 1900s. These improvements, combined with improved stream flows, would benefit resident and anadromous in the Yakima River basin and reduce the risks of further decline.

This EIS is the first step in phased review of an Integrated Water Resource Management Alternative. The development of an integrated approach is itself an effort to evaluate and manage water resources on a system-wide basis. This system-wide approach will help to identify impacts at a comprehensive level thus reducing the potential for unintended cumulative impacts. Potential impacts of specific projects that are identified as part of the Integrated Water Resource Management Alternative will undergo additional project-level review when they are identified. The project-level review will identify specific project impacts and ways to avoid or mitigate those impacts. To avoid potential cumulative impacts of the Integrated Water Resource Management Alternative, Ecology will continue to coordinate with the Yakama Nation and local, state, and federal agencies that manage resources in the Yakima River basin.