Chapter 5

# AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES: STATE ALTERNATIVES

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## 5.1 Introduction

This chapter describes the affected environment and environmental consequences associated with the State Alternatives for the Storage Study. For most resource topics, the affected environment described in chapter 4 applies. Where necessary to address the State Alternatives, supplemental information on the affected environment is provided.

In cases where alternatives would have similar impacts on a resource, the analysis is presented for the first alternative and summarized or referenced for subsequent alternatives to eliminate redundancy. Environmental "consequences," "impacts," and "effects" are considered to be synonymous in this document.

The potential impacts of the State Alternatives were evaluated by comparing the expected outcomes of alternatives to the No Action Alternative. The No Action Alternative is described in chapter 2 and includes programs such as water conservation that Reclamation, Ecology, and others plan to implement.

This chapter analyzes potential impacts that could be associated with implementation of the State Alternatives. For the most part, specific projects that would be undertaken have not yet been defined and the details of projects are unknown. For that reason, potential impacts are discussed in general terms and a range of impacts is described based on the nature and magnitude of potential project components that could be implemented.

Many of the specific projects that will be proposed for the State Alternatives would require additional environmental review. Depending on the extent of Federal funding or permitting required for the project, the environmental review could be required under NEPA as well as SEPA. Additional studies will also be required to determine the technical and economic feasibility of some projects. If available, the results of these studies will be included in the Final PR/EIS.

## 5.2 Water Resources

### 5.2.1 Affected Environment – Surface Water

The affected environment for surface water for the Yakima River basin is described in chapter 4.

### 5.2.2 Affected Environment – Water Rights

The centerpiece of the water rights environment in the Yakima basin is the ongoing adjudication of water rights. A water rights adjudication is a court proceeding to establish the title (quiet title) to water rights by determining the validity and extent of existing water rights in a specified area (RCW 90.03.110 to 90.03.240). New water rights are not granted as part of the adjudication process. The Yakima Adjudication, which began in 1977, is a major undertaking in which all rights to surface water in the entire Yakima basin are being adjudicated. The case has been divided into four pathways, including a Major Claimant Pathway for large entities, a Tribal Federal Reserved Water Rights Pathway for the rights of the Yakama Nation, Non-Indian Federal Reserved Water Rights Pathway for water rights held by Federal agencies who manage Federal lands (U.S. Forest Service, U.S. Fish and Wildlife Service), and a Subbasin Pathway for individuals and smaller entities. Reclamation's water rights are State-based water rights and Reclamation is in the Major Claimant Pathway. At the end of the adjudication, Ecology will issue water right certificates for those water rights confirmed by the court. Water rights not confirmed by the court will be extinguished.

Federal tribal reserved water rights are primarily based on the *Winters* Doctrine (*Winters v. United States*, 207 U.S. 564 (1908)). The two main principles of this doctrine are that: 1) when the United States establishes reservations, it implicitly recognized a reservation of water in an amount necessary to fulfill the purposes of the reservation; and 2) the priority date of the water right is the date the reservation was established. Courts have generally held that tribal reservations established in the nineteenth century were primarily intended to give the tribes an agricultural base. Establishment of a tribal reservation may also imply the use of water for long-established aboriginal uses such as fishing and hunting. The priority date for water for such aboriginal uses is time immemorial.

Federal tribal reserved water rights are not subject to relinquishment or abandonment for nonuse. The reserved rights are for potential future use as well as historic use. The future water right for agriculture is defined by the PIA standard—those areas susceptible to sustained irrigation at a reasonable cost. The number of acres included within PIA is the number currently under irrigation plus those susceptible to irrigation but not yet developed.

Federal reserved water rights may be adjudicated in State court under the McCarran Amendment (43 U.S.C. sect. 666(a)). Yakama Nation water rights are

being adjudicated as part of the Yakima Basin Adjudication. The Court confirmed a diminished water right for instream flow for aquatic life in the Final Order Re: Treaty Reserved Water Rights at Usual and Accustomed Fishing Places, March 1, 1995. The priority date of this right is time immemorial. The Court confirmed water rights for irrigation from the mainstem Yakima River based upon Congressional action and Court rulings, and water rights for agriculture from on-reservation streams based upon the PIA standard (CFO: Yakama Indian Nation Water Right, September 12, 1996). The Yakama Nation's water rights to Ahtanum Creek are being decided as part of the proceeding specific to the Ahtanum Subbasin. The Yakama Nation's irrigation rights have a nonproratable priority date of June 9, 1855.

Irrigation districts are public entities formed according to State law. The primary purpose of an irrigation district is to divert and convey water to the water users for irrigation of the lands within the district. An irrigation district may be formed for several purposes, including the construction or purchase of new irrigation works, construction or repair of diversions structures, and contracting with the Federal or State government for irrigation purposes (RCW 87.03.010).

Under Washington law, individual water users within the irrigation district are the owners of the water rights. An irrigation district is a trustee for the water users within the district and is obligated to deliver water to the water users based on their water rights and subject to the bylaws and regulations of the district. For the Yakima Project, Reclamation holds title to the right to store water under State law and the obligation to deliver the water under the terms of its contracts and Acts of Congress. The irrigation district has the right to divert a certain quantity of water and deliver it to the landowners. Reclamation has a nonfiduciary trustee relationship with the districts which in turn have a trustee relationship with the water right owners.

Special provisions apply to transfers of water rights within irrigation districts and between irrigation districts that have formed a Board of Joint Control (RCW 87.80). A change in place of use by one or more water users within an irrigation district does not require Ecology's approval if the water use continues within the irrigation district; the only approval required is from the board of directors of the irrigation district. The same applies to changes in place of use between districts that are members of a Board of Joint Control if the water use continues within the area of jurisdiction of the Board of Joint Control.

Groundwater rights are not being adjudicated in the *Acquavella* adjudication. The relationship between groundwater and surface water is important to managing the water resources and making decisions regarding potential impairment of existing water rights by new rights. In areas where there is hydraulic continuity (an exchange of water between a groundwater system and a surface water body), pumping groundwater may potentially reduce groundwater discharge into surface water, or in extreme cases, divert surface water into a groundwater system, thereby reducing flows in surface waters. This could affect water rights to the

surface waters and instream flows for fish. In the few areas where hydraulic continuity does not exist, groundwater may be withdrawn with no effect on surface waters. Management of surface waters can also affect the groundwater supply. In areas where irrigation occurs, part of the return flow percolates into the ground and recharges the aquifers. If conservation measures are implemented, this may reduce the amount and/or location of recharge to groundwater.

In 1999 Ecology, Reclamation, and the Yakama Nation agreed to study the groundwater resources in the Yakima River basin. The study is intended to better describe the groundwater-surface water link, help determine the potential impact on existing water rights when making water right decisions, support efforts to improve instream flows, and estimate when/where/how much groundwater pumping affects streamflows. Until the study is completed, Ecology is with-holding permits on groundwater applications for new water rights. Ecology may make exceptions for transfers and changes of groundwater rights, public health and safety emergencies, and domestic use from exempt wells (Ecology, 1999).

### 5.2.3 Environmental Consequences – Surface Water

This section measures hydrologic changes to the Yakima River system calculated by the RiverWare model to assess the success of the State Alternatives in meeting the State's goals of improving fisheries, water supply conditions for proratable water users, and providing for future municipal and domestic demands. This section focuses on water quantity; water quality impacts are described in section 5.6. The State Alternatives are compared to the current operation of the Yakima Project and the Joint No Action Alternative. Joint and State Alternatives include future municipal demand so that a direct comparison can be made. Future municipal demand is not included in the No Action Alternative. For the Enhanced Water Conservation Alternative, it was assumed in this analysis that all water conserved would be retained by the implementing agency and no additional instream flow would be provided. For purposes of hydrologic modeling using RiverWare, the conserved water was retained as part of TWSA and no attempt was made to divide the conserved water.

Reclamation quantified the three Storage Study goals, namely improving instream flows and dry year irrigation water supply and meeting future municipal water supply needs in chapter 2. Reclamation developed hydrologic indicators to quantify how well the Joint Alternatives meet the Study Storage goals. Those indicators are explained in chapter 2 and include:

- April-September TWSA
- TWSA Distribution which is comprised of:
  - April-September flow volume downstream from the Parker gage
  - April-September total irrigation and municipal diversions upstream of the Parker gage

  - September 30 reservoir contents
- April-September flow volume at the mouth of the Yakima River
- Irrigation proration level for dry years
- Change in the irrigation delivery shortage for water year 1994
- Changes in instream flow
- Seasonal instream flow volumes

#### *5.2.3.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

This alternative may result in temporary, construction-related impacts to surface waters. For example, construction of canal linings, pipelines, reregulation reservoirs, pump stations and on-farm irrigation improvements have the potential to impact surface water through increased sediment loading during construction. The potential will be a function of the proximity of the project to a water body, the volume of sediment generated, the condition of vegetative buffers between the site and the water body, and the BMPs applied to control that erosion. Inputs of sediment to any water body may increase turbidity until the site is revegetated or construction is completed. Inputs of fine sediment may also affect the substrate condition in streams. The level of impact will vary with the amount of sediment input into the water body.

**Long-Term Impacts**

Table 5.1 is a summary table of the values of the hydrologic indicators described above for the Enhanced Water Conservation Alternative. The values were obtained from RiverWare model runs completed by Reclamation. The values shown in table 5.1 are for the average of the period of 1981 to 2005 and for the worst drought year in recent history, 1994.

***April 1 TWSA Estimate.***—The Enhanced Water Conservation Alternative results in a slightly increased April 1 TWSA (2.86 maf) compared to the current operation (2.82 maf) and the No Action Alternative (2.84 maf). The April 1 TWSA listed in table 5.1 represents the average for the time period of 1981 to 2005. The TWSA for drought years was also determined. Table 5.2 presents the April 1, TWSA for several drought years, including the sequence of drought years from 1992 to 1994. The Enhanced Water Conservation Alternative increases TWSA during drought years by up to 116,700 acre-feet compared to the current operation and 62,700 acre-feet compared to the No Action Alternative. The lowest increase occurs during an extended drought, such as occurred in the 1992-1994 time period. The predicted increase for 1994 is only 8,000 acre-feet compared to the current condition and 12,200 acre-feet compared to the No Action Alternative. The increase in TWSA means additional water supply is available for distribution in the April-September timeframe for that year.

**Table 5.1 Hydrologic indicators for the period of record 1981-2005**

| Hydrologic indicator | Alternative | | |
|---|---|---|---|
| | Current Operation | No Action | Enhanced Water Conservation |
| | Average for water years 1981-2005 (maf) | | |
| April 1 TWSA | 2.82 | 2.84 | 2.86 |
| April-September flow volume at Parker gage | 0.51 | 0.62 | 0.66 |
| April-September diversion volume upstream of Parker gage | 2.02 | 1.91 | 1.85 |
| **September 30 reservoir contents** | 0.27 | 0.30 | 0.32 |
| April-September flow volume at the mouth | 0.85 | 0.86 | 0.95 |
| Irrigation delivery volume | 1.47 | 1.46 | 1.44 |
| | Water year 1994 (maf and percent) | | |
| **Irrigation delivery volume shortage (maf)** | 0.40 | 0.38 | 0.34 |
| **Irrigation proration level** | 28% | 27% | 28% |

**Table 5.2 April 1 TWSA for drought years within the period of record (1981-2005)**

| Alternative | April 1 TWSA (maf) | | | | |
|---|---|---|---|---|---|
| | 1992 | 1993 | 1994 | 2001 | 2005 |
| Current Operation | 2.123 | 2.094 | 1.754 | 1.803 | 1.762 |
| No Action Alternative | 2.159 | 2.110 | 1.750 | 1.857 | 1.845 |
| **Enhanced Water Conservation** | 2.218 | 2.136 | 1.762 | 1.911 | 1.860 |
| Difference between Enhanced Water Conservation and Current Operation | +0.095 | +0.042 | +0.008 | +0.108 | +0.098 |
| Difference between Enhanced Water Conservation and No Action | +0.059 | +0.026 | +0.012 | +0.054 | +0.015 |

***April to September Flow Volume Downstream from the Parker Gage (Instream Flow).***—The Enhanced Water Conservation Alternative shows a slight increase in instream flow downstream from the Parker gage compared to the No Action Alternative and a larger increase compared to current operations. The larger increase compared to current operations is due to the two-thirds allocation of the conservation savings to instream flow in the No Action Alternative (which is part of the Enhanced Water Conservation Alternative) to meet Title XII requirements. Title XII instream flow requirements are described in chapter 2. Two locations (Parker gage and Prosser Diversion Dam) are set as instream flow control points in the Title XII legislation. Target flows at those locations are set based upon the TWSA available during the April-September time period. Table 5.3 provides a comparison of flow volume downstream from the Parker gage for the April to September and the July to September time periods.

**Table 5.3 Flow volume downstream from the Parker gage for April-September and July-September average for period of record (1981-2005)**

| Alternative | Flow volume downstream from the Parker gage (maf) | |
|---|---|---|
| | April-September | July-September |
| Current Operation | 0.51 | 0.09 |
| No Action Alternative | 0.62 | 0.13 |
| **Enhanced Water Conservation** | 0.66 | 0.14 |

The increased April to September flow volume for the Enhanced Water Conservation Alternative is 150,000 acre-feet more than current operation and 40,000 acre-feet more than the No Action Alternative. The increased July to September flow volume is 50,000 acre-feet more than current operation and 10,000 acre-feet more than the No Action Alternative. The increased flow results in a daily average discharge for the July to September period of 745 cfs compared to the current operation daily average discharge of 470 cfs and the No Action Alternative daily average discharge of 720 cfs. Figure 5.1 presents hydrographs of the average daily flows at the Parker gage for the all three alternatives described in table 5.3. The increased instream flow may benefit instream resources as described in sections 5.8 and 5.9.

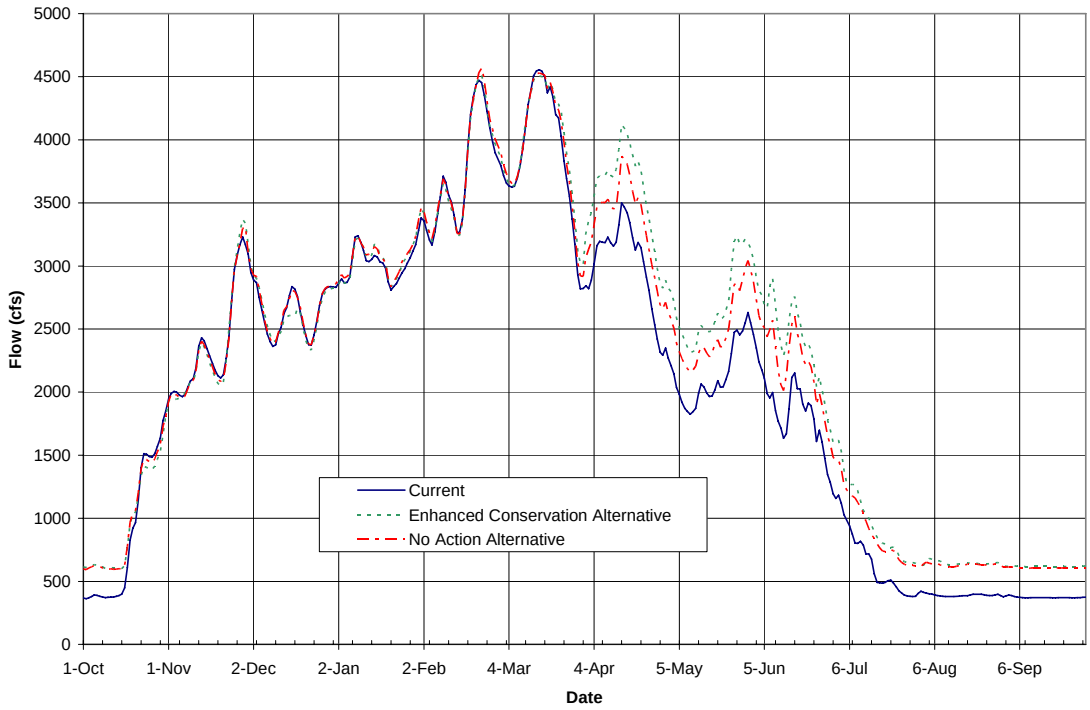



Figure 5.1 Median of daily flows at the Parker gage for period of record (1981-2005).

***April to September Diversion Volume Upstream of the Parker Gage.***—The April to September diversions upstream of the Parker gage are reduced by an average of 170,000 acre-feet over the 25-year period (1981 to 2005) with the Enhanced Water Conservation Alternative compared to the current operation and 60,000 acre-feet compared to the No Action Alternative. The Enhanced Water Conservation Alternative also includes supplying new municipal uses, estimated to be 48,000 acre-feet, upstream of the Parker gage, which the No Action Alternative does not. That volume is included in April-September diversion volume. The reduction in diversions allows remaining flow to be used for instream or other out-of-stream uses.

***September 30 Reservoir Contents.***—The effect on the storage volume contained in the Yakima Project's reservoirs is shown in table 5.1 and 5.4. The Enhanced Water Conservation Alternative slightly increases the volume of storage in Yakima Project reservoirs throughout the irrigation season and maintains a September 30 storage volume averaging 30 percent full, compared to an average under current operation of 25 percent full and 28 percent full for the No Action Alternative. Fuller reservoir levels at the end of the irrigation season are important to improving water supply for the following year if drought conditions occur.

**Table 5.4 Yakima Project reservoir system total contents for the period of record 1981-2005**

| Alternative | Total Reservoir Storage in Yakima Project (maf) | | |
|---|---|---|---|
| | March 31 | June 30 | September 30 |
| Current Operation | 0.60 (56% Full) | 0.91 (85% Full) | 0.27 (25% Full) |
| No Action Alternative | 0.62 (58% Full) | 0.92 (86% Full) | 0.30 (28% Full) |
| Enhanced Water Conservation | 0.64 (60% Full) | 0.93 (88% Full) | 0.32 (30% Full) |

***April to September Flow Volume at the Mouth of the Yakima River.***—The April to September flow volume at the mouth of the Yakima River is increased with the Enhanced Water Conservation Alternative (0.95 maf) compared to the No Action Alternative (0.86 maf) and current operation (0.85 maf). The reason is the Kennewick Irrigation District (KID) Pump Exchange Project which adds a point of diversion for part of KID and part of the Columbia Irrigation District (CID) to the Columbia River below the confluence of the Yakima and Columbia Rivers. The diversion from the Yakima River is decreased by the volume pumped from the Columbia River. The most current plan calls for 155 cfs to be diverted by KID from the Yakima River (instead of the current 334-cfs diversion). The CID would divert 110 cfs from the Yakima River, a reduction of approximately 72 cfs from its current diversion. The increase in average flow in the lower Yakima River would be approximately 250 cfs. A similar increase in instream flow would also occur during drought years. The effect of the increased instream flow is discussed in sections 5.8 and 5.9.

***Irrigation Delivery Volume Shortage and Proration Level.***—Table 5.5 summarizes the irrigation delivery volume shortfall and proration level during drought years. The irrigation proration level during drought years is increased with the Enhanced Water Conservation Alternative with the exception of the last year of an extended drought such as occurred from 1992 to 1994. Under these conditions, the proration level is predicted to equal that of the current operation and 1 percent greater than the No Action Alternative. The primary reason that very little improvement is achieved with the No Action Alternative is the two-thirds allocation of conserved water to instream flow. The additional water conservation included in the Enhance Water Conservation Alternative is still a small percentage of the flow diverted in the Yakima Project. During drought years, it was assumed for the hydrologic modeling that new municipal water supplies would be prorated in the same fashion as proratable water users. If municipal users are given a water right with lower priority than proratables, the water supply for those proratables would increase more than shown in table 5.5. The municipal deliveries used in the hydrologic modeling are 48,000 acre-feet upstream of Parker gage. It was assumed for the modeling that half of the water diverted for municipal uses returns to the river through wastewater discharges or seepage and half is used consumptively. Assuming a 50-percent proration level, approximately 12,000 acre-feet of consumptive use would be available for additional use by proratables. That equates to less than 1 percent of the proratable entitlements of 1.284 maf (table 2.3 in chapter 2).

**Table 5.5 Irrigation delivery volume shortage and proration level for drought years during period of record (1981-2005)**

| | Irrigation delivery volume shortage and percent of water supply for proratable water users | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1992 | | 1993 | | 1994 | | 2001 | | 2005 | |
| Alternative | Volume shortage (maf) | % | Volume shortage (maf) | % | Volume shortage (maf) | % | Volume shortage (maf) | % | Volume shortage (maf) | % |
| Current Operation | 0.14 | 68 | .21 | 56 | 0.40 | 28 | 0.33 | 40 | 0.36 | 38 |
| No Action Alternative | 0.09 | 70 | .17 | 57 | 0.38 | 27 | 0.27 | 44 | 0.29 | 45 |
| Enhanced Water Conservation | 0.02 | 74 | .12 | 60 | 0.34 | 28 | 0.20 | 49 | 0.24 | 47 |
| Difference between Enhanced Water Conservation and Current Operation | +0.12 | +6 | +.09 | +4 | 0.06 | 0 | +0.13 | +9 | +0.12 | +9 |
| Difference between Enhanced Water Conservation and No Action Alternative | +0.07 | +4 | +0.05 | +3 | +0.04 | +1 | +0.07 | +5 | +0.05 | +2 |

Although the modeling predicts a slight increase in proration level, irrigation districts which undertake an aggressive conservation program will require less water to operate and can deliver a greater percentage of water diverted to farmers. The results of the hydrologic modeling indicate the irrigation delivery shortfall is reduced by 60,000 to 130,000 acre-feet during drought years compared to the current operation and 40,000 to 70,000 acre-feet compared to the No Action Alternative. The irrigation delivery shortfall is measured by subtracting the volume of water supplied in a drought year from the average volume of water supplied over the 1980 to 2005 time period. The average volume of water supplied is calculated by RiverWare assuming the conservation measures were in place for the entire period analyzed. As such, there is an improvement in the irrigation delivery shortage indicating that in a dry year more water is being delivered to the farm turnout as the result of the additional water conservation measures included in the Enhanced Water Conservation Alternative.

***Changes in Instream Flow.***—The Title XII target flows downstream from Sunnyside Diversion Dam (at Parker gage) are increased by 136 cfs with the No Action Alternative, resulting in the target flows shown in table 5.6. In addition, there are operational flows of 108 cfs that will result when some entities change their points of diversion from upstream to downstream of Sunnyside Diversion Dam in actions proposed under the No Action Alternative. These instream flow targets would not change with implementation of the Enhanced Water Conservation Alternative as no additional instream flow is assigned to the conservation measures. However instream flows will increase with the Enhanced Water Conservation Alternative as flow currently diverted into the Chandler Canal for the KID will remain instream, the KID and CID diversions from the lower Yakima River are reduced and instream flows in tributaries could improve with implementation of water conservation measures on small ditches.

**Table 5.6 Changes in Title XII target flows downstream from Sunnyside Diversion Dam—current Yakima Project operations to No Action Alternative and State Alternatives**

| TWSA estimate (maf) | | | | Title XII target flow at Parker gage (cfs) | |
|---|---|---|---|---|---|
| April - September | May - September | June - September | July - September | Current | No Action Alternative |
| 3.2 | 2.9 | 2.4 | 1.9 | 600 | 736 |
| 2.9 | 2.65 | 2.2 | 1.7 | 500 | 636 |
| 2.65 | 2.4 | 2.0 | 1.5 | 400 | 536 |
| Less than above | | | | 300 | Varies[1] |

[1] In dry water years, the target flow is 300 cfs, and the 136-cfs increase is adjusted according to the water rights of the entities participating in the Basin Conservation Program. In a dry year such as 1994, the target flow would be 394 cfs.

***Effect on Seasonal Flow Objectives.***—The SSTWG established seasonal flow objectives for the Easton reach, Cle Elum River, Ellensburg River reach, Wapato reach, and the lower Naches River as a means to evaluate the performance of each alternative against a flow regime that would be better for fish than the current operation. The flow regime is similar to an unregulated flow regime. The values for the Umtanum and Parker gages for the Enhanced Water Conservation Alternative are shown in table 5.7, along with a comparison to values calculated for the current conditions, the flow objective, and No Action Alternative. The values shown are for average water years. Figure 5.2 presents a comparison of daily flows at the Umtanum gage (figure 5.1 presented a comparison at the Parker gage). At both locations, the Enhanced Water Conservation Alternative annual streamflow runoff pattern is similar to current flow conditions for the spring, summer, and winter seasons and does not appreciably bring flow conditions toward the flow volume objectives expressed by the SSTWG.

**Table 5.7 Desired spring, summer, and winter flow objectives and alternative-generated seasonal flow volumes expressed in maf for the Umtanum reach and Parker gage**

| Flows | Umtanum | | | Parker | | |
|---|---|---|---|---|---|---|
| | Spring[1] | Summer[2] | Winter[3] | Spring | Summer | Winter |
| Current | 0.676 | 0.620 | 0.379 | 0.659 | 0.138 | 0.694 |
| Objective | 0.742 | 0.305 | 0.380 | 0.750 | 0.317 | 0.699 |
| No Action Alternative | 0.686 | 0.614 | 0.380 | 0.726 | 0.190 | 0.699 |
| Enhanced Water Conservation Alternative | 0.695 | 0.604 | 0.379 | 0.765 | 0.194 | 0.694 |

[1] The desired outcome is to meet or exceed the seasonal spring (March-June) flow objective volume.

[2] The desired outcome is to not exceed, but not fall too far below the summer (July-September) flow objective volume.

[3] The desired outcome is to meet or exceed the seasonal winter (October-February) flow objective volume.

For the Umtanum gage, representing the Ellensburg River reach, the seasonal flow volumes for the Enhanced Water Conservation Alternative were estimated to be:

Spring: 6 percent below the flow objective
Summer: 98 percent above the flow objective
Winter: approximately equal to the flow objective

For the Parker gage representing the Wapato Reach, the seasonal flow volumes for the Enhanced Water Conservation Alternative were estimated to be:

Spring: 2 percent below the flow objective
Summer: 40 percent below the flow objective
Winter: 1 percent below the flow objective

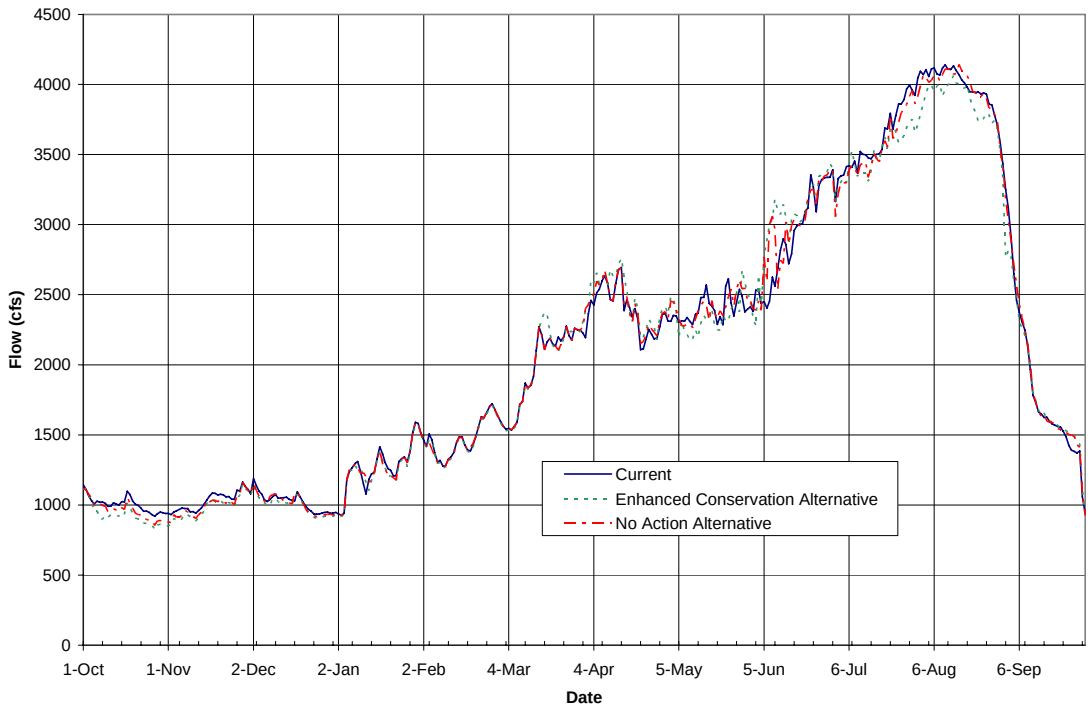



Figure 5.2 Yakima River median of daily flows at Umtanum gage for period of record (1981-2005).

Table 5.8 compares the spring, summer, and winter seasonal percent differences relative to the flow volume objectives for the current condition and No Action and Enhanced Water Conservation Alternatives. The comparison was based on the average water year flow objectives. The Enhanced Water Conservation Alternative better meets flow objectives compared to the current operation and the No Action Alternative, although summer flow volumes are still much greater than the desired target flows.

**Table 5.8 Comparison of the differences relative to the flow objective volume by season for the alternatives—Umtanum and Parker stream gage stations**

| | Spring | | | Summer | | | Winter | | |
|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Current condition** | **No Action Alternative** | **Enhanced Water Conservation Alternative** | **Current condition** | **No Action Alternative** | **Enhanced Water Conservation Alternative** | **Current condition** | **No Action Alternative** | **Enhanced Water Conservation Alternative** |
| Umtanum | -9% | -8% | -6% | 103% | 102% | 98% | 0% | 0% | 0% |
| Parker | -16% | -7% | -2% | -56% | -40% | -39% | -1% | 0% | -1% |

The Enhanced Water Conservation Alternative annual stream runoff pattern is also very similar to the current condition and No Action Alternative runoff patterns. (See figure 5.1 and 5.2.)

#### *5.2.3.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Construction impacts to surface water are expected to be less than those for the No Action and Enhanced Water Conservation Alternative. Existing infrastructure (reservoirs, canals) may be used to physically transfer water from user to user, minimizing the need for construction. Some new infrastructure may be constructed if the reallocation of water results in agricultural development in new areas instead of increasing water supply for existing agriculture. The new infrastructure (likely pipes, pumps and perhaps small storage reservoirs) would have similar types of impacts as described for the Enhanced Water Conservation Alternative but of a lesser scale.

**Long-Term Impacts**

The water marketing alternative is designed to facilitate the transfer of existing water rights to help alleviate shortfalls in water supply for both irrigation and municipal uses. No increases in the overall water supply for the Yakima Project will result and hydrologic conditions described for the No Action Alternative will also represent the overall hydrologic conditions for this alternative. The operations of the Yakima Project and individual irrigation districts or companies will constrain the amount and location of water transferred. For example, the Yakima Project operates reservoirs in both the upper Yakima River basin and in the Naches River basin. Water supply from both locations feeds the major nonproratable water users in Yakima (Sunnyside Valley Irrigation District, Wapato Irrigation Project). Water cannot be transferred from water users in one arm (i.e., the Naches River) to water users upstream in the Kittitas Valley.

Water supply conditions for certain farmers, irrigation district or municipal users can improve with this alternative. It is assumed with this alternative that the increase in water supply for some water users and a decrease for others will still have a positive economic benefit as farms with higher-value crops or municipal users will want to purchase water from farms with lower-value crops with the payment covering the foregone revenue from the farms with lower-value crops. An estimated 200,000 acre-feet of water may need to be transferred within the Yakima basin to meet reliability goals for existing water users with proratable water rights.

#### *5.2.3.3 Groundwater Storage Alternative*

**Construction Impacts**

This alternative may result in temporary, construction-related impacts to surface waters similar to the Enhanced Water Conservation Alternative. For example, construction of injection wells, treatment facilities, infiltration basins, and conveyance lines have the potential to impact surface water through increased sediment loading during construction. The potential will be a function of the proximity of the project to a water body, the volume of sediment generated, the condition of vegetative buffers between the site and the water body, and the BMPs applied to control that erosion.

**Long-Term Impacts**

The Groundwater Storage Alternative is designed to recharge aquifers with either active or passive recovery that would increase streamflow and improve water supply.

With the Groundwater Storage Alternative, the April to September diversions upstream of the Parker gage are increased by an average of 33,000 acre-feet over a 22-year analysis period (1978 to 2000) compared to No Action Alternative. Additional diversion occurs to provide water to surface infiltration facilities during the early summer. During dry years, however, there is little or no additional diversion during months when existing entitlements cannot be met with available storage or natural flow. The increased diversions only occur when there is water available over and above existing entitlements (including Title XII streamflows). A diversion of approximately 6,400 acre-feet for ASR during a 6-month winter time period is also part of this alternative. That diversion equals approximately 18 cfs. A diversion of approximately 6,400 acre-feet for direct injection with passive recovery during a 6-month time period is also part of this alternative. That diversion equals approximately 18 cfs. The diversion would reduce streamflow in the Yakima River bringing the total volume of flow in the winter time closer to flow objectives desired by the SSTWG. The flow objective desired by SSTWG is 490,012 acre-feet at the Parker gage; the No Action Alternative runoff volume is 584,000 acre-feet.

For the Groundwater Storage Alternative, an increase in streamflow would result from return flows from surface recharge facilities and from leakage to shallow unconfined aquifers during ASR injection to deeper aquifers. It is assumed the increased flow would be used to supply municipal demands with the remainder benefiting TWSA for all other water users in the Yakima Project.

The Groundwater Storage Alternative would increase streamflow in the April-September time period by approximately 22,800 to 25,800 acre-feet more than the current operation and the increase in the July-September flow volume is approximately 14,900 to 15,900 acre-feet, both measured at the Parker gage. These are the average return flows from the surface recharge, municipal ASR, and

direct injection with passive recovery alternatives (Ecology, 2007g). In general, the increased flow volumes are lower in dry years and higher in wet years. The estimated water supply provided during a drought year in the April-September time period is 1,600 acre-feet. That smaller increase in water supply would occur because it was assumed that no water would be available for surface recharge or ASR except when all existing entitlements have been met. Therefore, no additional diversion for groundwater storage would occur during drought months. Some leakage from the previous year's infiltration and ASR injection would likely occur, which is the source of the 1,600-acre-foot estimate.

### 5.2.4 Mitigation

More detailed, site-specific studies of the alternatives are required to better determine their impacts and benefits and the amount of mitigation that might be required. Those studies would include seepage studies on irrigation canals that would be lined or piped, operational studies on irrigation facilities to determine the amount of water that could be conserved, groundwater studies to better characterize the amount of water that would return to surface water from Groundwater Storage and studies to better estimate the potential for large-scale water transfers to benefit irrigation water supply for some water users. Additional RiverWare modeling will also be required to better understand the impact on Yakima Project operations. Studies of the impact on return flow from irrigation conservation measures are also recommended to assist Reclamation in modeling the impact of conservation measures.

### 5.2.5 Environmental Consequences – Water Rights

#### *5.2.5.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

No impacts on water rights would be expected from the construction of enhanced conservation measures.

**Long-Term Impacts**

Enhanced conservation will free up water under existing water rights for use by the water right owner and/or potential transfer and reallocation of the saved water. As noted in chapter 3, most of the water saved through conservation projects is nonconsumptive water. Both YRBWEP and State statutes authorizing conservation projects allow the water right holder to retain a portion of the saved water. That water can be used for the same purpose as the original water right. If there is a proposal to transfer the saved water, Ecology will conduct its usual impairment analysis and take into account the fact that the saved water has been nonconsumptively used in the past. To the extent that conservation makes additional water available, it may reduce curtailment of junior water rights during water-short years.

An analysis of the potential impacts from operation of the conservation improvements may arise in two instances. Ecology will investigate potential impairment to existing water rights when a request is made to change the place of use or purpose of use, or the point of diversion of saved water. Additionally, water right owners may bring private actions in court to claim an impairment of their water right due to a reduced availability of water. Water saved through irrigation conservation projects is primarily water that was formerly return flow under a less efficient delivery system. Water users may use return flow that is available and "may obtain a right to return flow provided that flow naturally originated from and returned to a water course within the same watershed. Such rights are … subject to the availability of the water based on the first appropriator's right to make further uses of the water on the lands to which the right is appurtenant" (*Ecology v. Acquavella*, Memorandum Opinion Re: Subbasin Exceptions 1995). For "project water" originating from Reclamation's storage reservoirs, Reclamation has the right to recapture return flow, which is part of TWSA and delivered to downstream project entities. A reduction in return flow is not, however, an impairment of downstream water rights because the water user is not obligated to provide return flow to downstream users (*Burke v. Department of Ecology*, PCHB No. 03-155, July 24, 2004).[1] As a result, although changes in return flow patterns may have an adverse impact on the physical availability of water, they would not have an adverse impact on the legal availability of water, i.e., existing water rights.

Implementation of regional agricultural efficiency improvements could decrease artificial recharge of groundwater. Artificial groundwater recharge caused by leakage from unlined irrigation canals or ditches may be reduced or eliminated should conservation projects include lining of these structures. As noted above, this could have the effect of locally lowering water tables and impair the ability of the owner of a groundwater right to fully exercise his or her water right. The existence and magnitude of these impacts would depend on many factors, including the number and size of irrigation canals and ditches, the degree to which these structures are currently leaking, the amount and efficiency of new lining that may be installed, the depth of the water table, the underlying soil permeability, the amount of recharge from other sources, and the rates of groundwater withdrawal (Ecology, 2003b).

Impacts from municipal and industrial conservation projects would be expected to be neutral or positive to the extent the projects reduce the demand for water and free up more water for instream and out-of-stream uses. Potential negative impacts could arise from changing the place of use, purpose of use or point of diversion of the saved water. The potential adverse impacts should be avoided through Ecology's analysis of the change application.

[1] The Board's decision was upheld on appeal by the *Acquavella* court. The court's decision was appealed to Division 3 of the Court of Appeals, but the appeal was withdrawn.

Irrigation water rights and industrial use water rights, unlike municipal water supply water rights, are subject to relinquishment if all or a portion of the right is not used for 5 successive years without sufficient cause for nonuse (RCW 90.14.160). Thus, if owners of the water right do not beneficially use the saved water in that time period, that portion of the right is subject to relinquishment and would become available instream to the next junior water right owner downstream or to TWSA. If they are not able to beneficially use the water, there is the potential to transfer the water to trust for instream flow or to another user within the 5 years. Municipalities are not subject to relinquishing their municipal water supply purposes water rights for nonuse (RCW 90.14.140(2)(d)). Consequently when a municipality conserves water, it has more water available to serve current and future customers.

Although changes in return flow patterns may have adverse impacts on the physical availability of water, they would not have an adverse impact on the legal availability of water, i.e., water rights.

#### *5.2.5.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

No impacts to water rights are expected from the construction activities that may be required to implement water transfers under the Market-Based Reallocation of Water Resources Alternative.

**Long-Term Impacts**

Market-based reallocation depends on the transfer of existing water rights. By law, all existing water rights, senior and junior, are protected from impairment by any proposed transfer. One of the impediments to an active market is the complexity, cost and length of time for administrative approval of the transfer. Changes to the administrative process have been proposed as part of the six identified alternatives for market-based reallocation of water resources. None of the changes required by the six alternatives would reduce the protection of existing rights. No impacts are anticipated.

#### *5.2.5.3 Groundwater Storage Alternative*

**Construction Impacts**

No impacts to water rights are expected from the construction activities associated with the Groundwater Storage Alternative.

**Long-Term Impacts**

Aquifer storage and recovery (ASR) projects must meet standards for review and mitigation regarding specific issues listed in RCW 90.03.370(2)(a) and defined further in Chapter 173-157 WAC. Both the direct injection and the surface recharge alternatives for groundwater storage qualify as an “underground artificial

storage and recovery project," which includes "any project in which it is intended to artificially store water in the ground through injection, surface spreading and infiltration, or other department-approved method, and to make subsequent use of the stored water" (RCW 90.370(2)(a)(3)). The statute defines "reservoir" to include "any naturally occurring underground geological formation where water is collected and stored for subsequent use as part of an underground artificial storage and recovery project" (RCW 90.03.370). Specifically nothing in the law that authorizes the underground artificial storage and recovery projects changed the requirements to obtain a permit to appropriate or withdraw waters of the State (RCW 90.03.370(4)). A water right to the source water and a reservoir permit would be required for the diversion and storage of the water and for the beneficial use of the water from storage. Given the fact that the project should result in environmental benefits, Ecology should be able give the application priority processing.

Because the projects would require a water right from Ecology and Ecology cannot issue a new water right if it would impair existing rights, there should be no impacts to water rights from the alternatives.

### 5.2.6 Mitigation Measures

Projects anticipated under the Enhanced Water Conservation Alternative would likely cause changes in return flow patterns. Although changes in return flow patterns may have adverse impacts on the physical availability of water, they would not have an adverse impact on the legal availability of water, i.e., water rights, and no mitigation would be required. If Ecology determined that the transfer of the saved water could cause impacts, it would require mitigation of the impacts or deny the transfer. Examples of mitigation measures for new water rights are described in Ecology (2003b).

Water right transfers through a water market or a water bank are the core actions under the Market-Based Reallocation of Water Resources Alternative. Each transfer would have to be approved by Ecology or, as proposed in several of the reallocation alternatives, a water court. Neither Ecology nor a water court is or would be authorized to approve a transfer that would impair existing water rights. To the extent that a proposed transfer would cause impairment the applicant may propose measures to mitigate the impacts.

For the Groundwater Storage Alternative, water right permits and reservoir permits would be required. The mitigation analysis is the same as that for water right transfers under the Market-Based Reallocation of Water Resources Alternative with the additional requirement that a new water right may not be "detrimental to the public welfare" (RCW 90.03.290). Additional protections are provided by the mitigation requirements required by RCW 90.03.370(2)(b) and found in WAC 173-157.

# 5.3 Groundwater Resources

## 5.3.1 Affected Environment

The affected environment for groundwater in the Yakima River basin is described in chapter 4. Groundwater storage facilities could be located throughout the Yakima basin, but would primarily be located in the Ellensburg formation and basalt aquifers.

## 5.3.2 Environmental Consequences

### *5.3.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction associated with conservation projects is not expected to affect groundwater. Construction of any facilities would be limited, not requiring extensive excavation.

**Long-Term Impacts**

The impacts from irrigation conservation and improved efficiency on groundwater would include changes in the timing and volume of irrigation recharge and subsequent groundwater return flow. In general, groundwater recharge from irrigation may decrease, unless the enhanced conservation results in an expansion of irrigated acres using the same amount of water.

Impacts from municipal conservation would depend on whether total consumptive use is changed and whether groundwater demand in the future is changed. Ultimately, it is likely that the same amount of groundwater would be used (up to existing water rights), but conservation efforts may, for example, change the relative magnitude of consumptive use compared to the current condition. In the near term, water conservation could stabilize groundwater levels in the deeper producing aquifers.

### *5.3.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

The only construction associated with the Market-Based Reallocation of Water Resources Alternative would be associated with new irrigation facilities for water rights transferred to new areas. That construction is not expected to affect groundwater.

**Long-Term Impacts**

The quantity and distribution of recharge to shallow aquifers could change. For example, recharge could be reduced if water use is changed from irrigation to domestic or municipal uses.

Increases or decreases in pumping from deeper production aquifers would change the distribution and variability of groundwater level fluctuations. The nature and magnitude of these potential impacts would depend on a number of factors, including where the changes occur and how much water is associated with the reallocation. For example, a change from irrigation to municipal use might change the seasonal profile of water use to a more continuous (rather than seasonal) withdrawal.

#### *5.3.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Limited impacts to groundwater could occur during construction of infiltration basins or treatment facilities. However, the depth of excavation during construction is not expected to extend to the groundwater table and it is not anticipated that dewatering would be required. Site specific studies prior to construction would determine the potential for impacts.

**Long-Term Impacts**

Changes in groundwater elevations and groundwater flow directions in shallow aquifers could occur from surface infiltration. Groundwater elevations near the surface infiltration sites will have the most near-term, seasonal change. The impact of these changes would be generally positive by increasing shallow groundwater discharge to streams. Negative impacts could include waterlogged soils or unwanted shallow groundwater seepage. Long-term groundwater level changes could result from interannual return flows that are stored in the aquifer for a longer period of time. These changes would accrue slowly from year to year depending on the cumulative amount of water infiltrated to shallow aquifers and the ability of the aquifer to discharge that infiltration to the stream in a given year. Site specific investigations prior to facility design would determine the potential for this impact.

Changes in groundwater elevations and groundwater flow directions in deeper aquifers could occur from the ASR component. Groundwater elevations near the injection wells will have the most near-term, seasonal change. The impact of these changes would be generally positive by increasing groundwater levels in deep and/or depleted aquifer zones. Long-term groundwater 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 deeper aquifers and the ability of the aquifer to discharge that infiltration toward a stream. Additional site specific studies would be conducted to more accurately characterize this potential, and as appropriate, determine mitigation.

### 5.3.3 Mitigation

It is anticipated that proper design of the groundwater storage facilities would reduce the potential for impacts such as shallow seepage, water logging of soils, and potential impacts to nearby wells from changes in groundwater hydrographs.

Site specific studies prior to construction would define specific impacts and determine any necessary mitigation.

## 5.4 Hydropower

### 5.4.1 Affected Environment

Six hydroelectric powerplants are located in the Yakima River basin. Two of the plants are owned and operated by Reclamation (Roza and Chandler Powerplants), two are owned and operated by the Yakima-Tieton Irrigation District, and two are owned and operated by BIA in the WIP.

The two Reclamation powerplants are located on the Roza Main Canal and the Chandler Power Canal. The Roza Powerplant is located about 3 miles northeast of Yakima, adjacent to Reclamation's offices. It has a capacity of 12.9 MW. Water is diverted into the canal at Roza Diversion Dam about 10 miles north of the Yakima and returns to the river below the powerplant. Some of the power from the Roza Powerplant is used to operate Roza Irrigation District's pumping plants. When power is being generated, there is a minimum flow target of 400 cfs below the dam. Power generation is terminated when the 400 cfs target cannot be met with the plant operating. This is usually only an issue during flip-flop operations.

The Chandler Powerplant is located in Benton County about 10 miles northeast of Prosser. It has a capacity of 12.0 MW. The Chandler Powerplant uses water diverted down the Chandler Power Canal (diversion capacity is 1,500 cfs) at Prosser Diversion Dam to operate pumps to convey irrigation water across the Yakima River into the Kennewick Main Canal. The residual capacity remaining from irrigation needs, including when the pumps are not run for irrigation is diverted to power production. Power production is subordinated to various flows throughout the year. In the spring, the subordination target is 1,000 cfs over Prosser Diversion Dam through the end of June. During the remainder of the irrigation season, the subordination target is 450 cfs or the YRBWEP Title XII target flow, whichever is higher.

The two powerplants owned by the Yakima-Tieton Irrigation District are in-line plants that take advantage of an all piped system with excess pressure head. The operations of the plants are incidental to the operations of the irrigation district, that is the water is not diverted specifically for power generation, but whatever water is diverted for irrigation is used for power. The two powerplants owned by

the BIA take advantage of canal drops in the gravity irrigation canal system. The operations of the plants are incidental to the operations of the canals.

### 5.4.2 Environmental Consequences

#### *5.4.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

There will be no construction impacts to hydropower from the Enhanced Water Conservation Alternative because construction would not alter streamflows.

**Long-Term Impacts**

The operations of the existing powerplants in the Yakima River basin may be slightly affected by Enhanced Water Conservation Alternative. The potential effects could be a reduced amount of power generation at the BIA powerplants in the WIP in most years if water conservation measures undertaken reduce the flow in the canals and through the powerplants. If flow rates in the canals are maintained to preconservation levels, then no change in power generation would result. A slightly increased amount of power generation could result at those powerplants during drought years as the reliability of water supply increases with the Enhanced Water Conservation Alternative and higher flows could occur in the canals. The additional instream flow provided by the Enhanced Water Conservation Alternative combined with electrification of KID pumps may slightly increase the generation at the Roza and Chandler Powerplants compared to the No Action Alternative.

#### *5.4.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

There would be no construction impacts to hydropower from the Market-Based Reallocation of Water Resources Alternative because construction would not alter streamflows.

**Long-Term Impacts**

The long-term impacts would depend on the location of the lessor and lessee of water. If the transfer of water is to farmers in the WIP during drought years, some increase in hydropower generation is possible for those years. Otherwise, the impacts would not likely be different than the No Action Alternative or the current operation.

#### *5.4.2.3 Groundwater Storage Alternative*

**Construction Impacts**

There would be no construction impacts to hydropower from the Groundwater Storage Alternative because construction would not change streamflows.

**Long-Term Impacts**

There would be no long-term impacts compared to the No Action Alternative and the current operation.

### 5.4.3 Mitigation

No mitigation is proposed for impacts to hydropower from the State Alternatives because the impacts are not expected to be significant.

## 5.5 Sediment Resources

### 5.5.1 Affected Environment

The affected environment for sediment resources is described in chapter 4. Because the specific locations of facilities associated with the State Alternatives are not known at this time, no sediment transport analysis was conducted.

### 5.5.2 Environmental Consequences

Chapter 4 focuses on instream sediment resources; this section will also describe impacts to upland sediment resources from erosion and transport of fine sediments.

#### *5.5.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction of canal lining, pipelines, pump stations, reregulating reservoirs or on-farm irrigation improvements could impact upland sediment resources by disturbing soils and could temporarily increase soil erosion.

**Long-Term Impacts**

The Enhanced Water Conservation Alternative is expected to have similar impacts as the No Action Alternative. Increased flows in some reaches of the Yakima River would increase transport of sand size material but channel morphology would not be impacted. Large floods are needed to transport a significant amount of gravel and change channel morphology. If conservation results in reduced return flows from irrigated areas, sediment transport to streams through irrigation drains could be reduced.

#### *5.5.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Construction of new irrigation facilities that are needed to utilize transferred water could increase soil erosion. The impacts would be similar to those of the Enhanced Water Conservation Alternative, except smaller in scale.

**Long-Term Impacts**

Impacts to channel morphology would be similar to the No Action Alternative. Water transfers could cause changes in land use from irrigated cropland to dryland crops, fallowed land, or urban land. Those land use changes could result in changes in erosion and sediment delivery to streams. Reduced soil erosion could occur off dryland crop areas or fallowed land. Urban uses may decrease soil erosion if areas are paved and landscaped.

#### *5.5.2.3 Groundwater Conservation Alternative*

**Construction Impacts**

Construction of groundwater storage facilities could temporarily increase soil erosion. The construction footprint for ASR facilities will be relatively small. The construction footprint for surface recharge facilities will be larger, potentially greater than 1,000 acres in total, and will have increased potential for increased soil erosion. The infiltration basins may require excavation, which will have an increased potential for soil erosion.

**Long-Term Impacts**

Impacts to channel morphology would be similar to the No Action Alternative. The surface infiltration ponds will be dry during some periods of the year and the pond area would be exposed. Because the ponds will be surrounded by berms, the potential for longer term erosion is minor.

#### *5.5.2.4 Mitigation*

Requirements for erosion control would be defined for each project through review by State and local regulatory agencies. Requirements could include construction BMPs such as the use of straw bales or silt fencing to trap sediments. Any proposed storage projects would undergo further design and geotechnical review and additional project-level environmental review, prior to construction to assess the site's suitability.

Erosion control requirements would reduce sediment production and delivery from required infrastructure associated with each of the State Alternatives, including facilities, roadways, and conveyance structures. The infrastructure would be appropriately designed and projects would have to comply with stream buffer requirements in applicable local critical area ordinances and stormwater requirements. Mitigation measures to reduce erosion could also include watershed restoration activities such as planting vegetation on exposed stream banks and improving the condition of drainage culverts.

Mitigating the risks associated with potential or actual geologic instabilities include performing a geotechnical evaluation of the sediment conditions on potential project sites so that geotechnical considerations are adequately

incorporated into project design. Geotechnical evaluations of potential unstable slopes prior to design will minimize the potential for facilities to be located in unstable areas.

No mitigation is needed for potential impacts to channel morphology because impacts are not expected to be significant.

## 5.6 Water Quality

### 5.6.1 Affected Environment

#### *5.6.1.1 Surface Water*

An overview of the surface water quality in the Yakima basin is provided in chapter 4.

#### *5.6.1.2 Groundwater*

A brief overview of the groundwater quality is provided in chapter 4. Additional information on groundwater quality is available for the Columbia Plateau, Moxee Valley and Ahtanum Valley. Based on the 1994 study of the Columbia Plateau (Whiteman, et al., 1994), groundwater in the basalt units is generally of good quality and suitable for most uses. The dominant water type is calcium magnesium bicarbonate, and sodium bicarbonate is the next most prevalent water type. Sodium bicarbonate waters typically occur in the aquifer system's deeper down-gradient locations. Sodium concentrations increase with residence time in the aquifer system.

The infiltrating surface water transports nitrogen derived from agricultural chemicals into the groundwater (Whiteman, et al., 1994). Long-term nutrient data have been generated by USGS NAQWA efforts. A report, *Nitrate Concentrations in Ground Water of the Central Columbia Plateau* (USGS, 1997) by USGS, presents an overview of nitrate concentrations in the Central Columbia Plateau. Results of sampling 573 wells indicated that land practices are the dominant influence over the distribution and concentration of nitrate in groundwater in this area, and that irrigated agriculture is associated with high nitrate concentrations and high frequency of contamination of groundwater. The USGS Circular, *Water Quality in the Central Columbia Plateau, Washington and Idaho (1992-95)*, discusses the major water quality issues—nitrates, pesticides, sediment, nutrients—in the Central Columbia Plateau (Williamson et al., 1998). Overall, about 20 percent of wells in this study unit exceed the 10-mg/L EPA Maximum Concentration Level (MCL) for nitrate in drinking water. Agricultural return flows, which have high nitrate concentrations, reach streams through the unconfined aquifer causing surface water nitrate concentrations to increase in streams.

Groundwater in the lower Moxee Valley (west of and including Moxee City) typically lies within 5 to 20 feet of the ground surface and has dissolved oxygen concentrations of greater than 5 mg/L in much of the area (Ecology, 2007d). Groundwater samples from wells in this area contained little, if any, measurable iron or manganese. However, they had higher concentrations of nitrate+nitrite-N, total persulfate nitrogen (TPN), total phosphorus (TP), chloride, dissolved organic carbon (DOC), TDS, and conductivity than typically found.

In contrast, the upper Moxee Valley (east of Moxee City) is generally characterized by greater depths to groundwater, finer grained aquifer materials, and much lower dissolved oxygen concentrations (i.e., near 0 mg/L at most wells). Most wells in this area contained elevated concentrations of iron and manganese, but had little, if any, measurable nitrate+nitrite-N or TPN. Numerous wells in the upper valley exceeded the criteria set for secondary protection of drinking water supplies for iron, manganese, TDS, and conductivity. Wells in the upper valley also tended to have lower TP, chloride, DOC, TDS, and conductivity values than wells in the lower valley (Ecology, 2007d).

Groundwater temperatures in the Ahtanum Valley averaged 54.3 °F (12.4 °C) (Ecology, 2003c). This is warmer than the local mean annual air temperature of approximately 50 °F (10 °C) at the Yakima weather monitoring station WSO AP and is likely due to the effect of irrigation during the warmer part of the year (Western Regional Climate Center, 2007). Groundwater temperatures in both the Moxee and Ahtanum valleys followed seasonal air temperature patterns with warmer conditions from June through September and cooler conditions from December through March (Ecology, 2007d; 2003c). The range of measurements for most of the wells in the two valleys varied less than 3 °C, indicating that the groundwater temperature generally remains relatively stable throughout the year.

## 5.6.2 Environmental Consequences

### *5.6.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

This aggressive approach to conserving water in the Yakima basin would likely result in numerous small-scale improvements, which would require construction activities. These improvements could include lining or piping of existing canals, automating canals, constructing reregulating reservoirs, and installing on-farm water conservation improvements.

Currently, it is not possible to determine which of these improvements would be implemented or the location at which they would be implemented. Nonetheless, construction associated with implementing many of these improvements could increase the potential for degradation of water quality. The most likely construction-related impacts would be from introducing sediments to surface waterbodies, which would increase turbidity. Implementation of BMPs, including

the timing of construction and measures that limit erosion and stabilize disturbed areas, is expected to limit adverse effects on water quality to the period of construction and immediately thereafter. Any water quality degradation that does occur is expected to diminish as vegetation becomes established in the disturbed area.

**Long-Term Impacts**

Under this alternative, the primary focus would be improving the efficiency of irrigation systems in the Yakima basin. Between zero and one-third of the amount of conserved water would be left in source streams instead of diverting it for irrigation, municipal supply, and/or industrial use. It is possible that the entire amount of conserved water would remain in the source streams during noncritical years. However, two-thirds to all of the amount of conserved flow would be used by parties with junior water rights during critical years. These varying year-to-year conditions would result in a range of effects on water quality.

The concentration of nutrients in the drains and wasteways as a result of surface and subsurface runoff is a function of the amount of water applied for irrigation. During noncritical years, the amount of water used for irrigation is expected to remain virtually the same as under the No Action Alternative. Since this alternative would not change agricultural water application rates, the amount of nutrients transported from agricultural lands would not be significantly altered. However, groundwater nutrient concentrations would be increased due to less dilution from irrigation system seepage. In contrast, the increased instream flows with virtually the same nutrient loadings to the streams would result in lower nutrient concentrations in the Yakima River and other affected streams in the basin. During critical years, a higher percentage of the conserved water would likely be used for agriculture, which could increase nutrient loadings to streams. However, these increased loadings are expected to be minimal and when considered in combination with the increased instream flows would likely result in minimal increases in nutrient concentrations in the Yakima River and other affected streams.

On-farm conservation measures may reduce loadings of surface water and groundwater pollutants because of improved irrigation practices.

The effects of this alternative on temperature and dissolved oxygen concentrations in surface waters would primarily be a result of changes in streamflows and the subsequent change in dilution effect on current water quality loading, such as agricultural return flows. The magnitude of streamflow increase during July-September is relatively small (0.14 versus 0.15 maf), so negligible effects on water temperature and dissolved oxygen are anticipated.

#### *5.6.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Reallocating water use would not directly result in any substantial construction activities. Therefore, it is not expected to alter the water quality of either groundwater or surface water in comparison to the No Action Alternative.

However, there is a possibility that the availability of water would lead to construction activities associated with the planned use of this water, and hence indirectly affect water quality.

**Long-Term Impacts**

Implementation of water markets and/or water banks has the potential to alter the use of water and thereby alter water quality in the basin. The water quality effects of these alterations would be dependent on the associated volume of water, and its implemented and forgone uses and locations. Generally:

- Increases in agricultural uses would increase the potential for nutrient loadings to associated groundwater and surface water, moderate stream temperatures, and reduce stream dissolved oxygen concentrations.

- Increases in municipal uses could indirectly increase the potential for water quality degradation by supporting increased urban development. The extent and location of any degradation would be dependent on the type and location of treatment facilities used.

- Increases in instream flows would tend to reduce nutrient concentrations, and increase dissolved oxygen concentrations. Effects on the thermal regime would be dependent on the location of increased instream flows. In the upper basin, increased instream flows would tend to reduce stream temperatures. However, increased instream flows in the lower basin may somewhat increase stream temperature.

The relative magnitude of these impacts would depend on the range or increase or decrease in use.

#### *5.6.2.3 Groundwater Storage Alternative*

This alternative considers three different approaches (1) Municipal ASR, (2) Injection with Passive Recovery, and (3) Surface Recharge. A technical evaluation was conducted for each of these alternatives and is provided in Technical Report on Groundwater Storage (Ecology, 2007g).

### Construction Impacts

The effects of construction for this alternative would be dependent on which of the three approaches is implemented. Table 5.9 summarizes which facilities would need to be constructed under each of these approaches. Since the ASR approach would generally use existing facilities, any effects of construction are expected to be from drilling and testing the well that would be used for pumping and recovering water to/from the deep aquifer. Construction-related effects for the Injection with Passive Recovery approach would also be associated with construction of a new water treatment plant and the water transfer system to this plant. The most widespread construction effects would be associated with surface recharge, which would require construction of several ponds and a water transfer system to these ponds.

**Table 5.9 Summary of need for construction associated with three approaches to the Groundwater Storage Alternative**

| Facilities | Municipal ASR | Injection with no recovery | Surface recharge |
|---|---|---|---|
| Treatment plant | Likely use existing facility | Construct new facility | None |
| Water transfer system (canal/piping) | Likely use existing transfer system | Construct new transfer system facilities to be used with existing system | Construct new transfer system facilities to be used with existing system |
| Well development | Construct new well | Construct new well | None |
| Pond construction | None | None | Yes[1] |
| Ongoing ground-disturbing maintenance | Negligible | Negligible | Need for routine maintenance to rejuvenate declining infiltration rates from clogging |

[1] For an infiltration capacity of 10,000 acre-feet/month, 180-550 acres would be needed for surface recharge ponds (Ecology, 2007g). This would require at least 36 ponds if the maximum pond sizes is 5 and at least 9 ponds if the maximum pond size is 20 acres.

*

The primary pathways for construction to affect water quality are the transport of sediments into surface waters and spills of hazardous materials used in the construction equipment. Use of silt curtains, settling ponds, and other BMPs to minimize erosion and runoff of sediment would minimize the potential for increasing suspended sediments and turbidity in water. Fueling construction equipment and maintaining it off-site or in specific areas designed for that purpose would minimize the risk of spilling hazardous materials in the work area and, consequently, avoid degrading the quality of groundwater and surface water near the work area.

Neither the ASR nor Injection with Passive Recovery approach is expected to require ongoing maintenance which would require substantial ground disturbance. However, the Surface Recharge ponds will need ongoing maintenance as clogging reduces their infiltration rates. Maintenance of the ponds is likely to include using

spring-tooth harrows and/or scrapers in the ponds. Use of machinery in the pond would increase the potential for spills of hazardous materials including fuel and oils, although these risks could be minimized by conducting maintenance and fueling of the equipment off-site. Although disturbing the bottom of the ponds would increase the potential for wind to blow sediments from the ponds, it is not expected to result in measurable effects on water quality. As the ponds are filled after maintenance events, turbidity of the inflow would increase, but this would not affect water quality outside the pond since there would not be any runoff from them.

### Long-Term Impacts

***Municipal ASR.***—Under the ASR approach, potable water would be pumped into a deep confined aquifer and recovered later by pumping. Since this approach would have negligible effects on the groundwater table outside of the confined aquifer, it would not have measurable effects on water quality beyond the confined area and thus would also not affect the quality of surface waters. Evaluation of ASR studies indicates that metal concentrations could increase slightly while the water is stored in the deep basalt geologic formation and that the concentration of coliform bacteria, an indicator of human pathogens, could be occasionally increased (Ecology, 2007g). However, these increases are expected to be small enough that they would not require additional treatment for municipal water supply beyond what currently takes place.

***Injection with Passive Recovery.***—Under this approach, potable water would be injected into a deep aquifer that has hydraulic continuity with stream(s) in the Yakima basin. This would increase the groundwater baseline elevations and increase accretion to stream reaches. The specific location of accretion inflows would be dependent on the location of the injection site, and the geology of the area affected would influence any water quality effects experienced. As with the ASR, injection of potable water could slightly increase metal concentrations and the concentration of coliform bacteria in the deep basalt geologic formation. The deep aquifer is expected to have lower nutrient concentrations than the shallow aquifer, which receives nutrient loadings from agricultural use. Therefore, the overall nutrient concentrations of the water accruing to streams is expected to be reduced. We anticipate that accretion flows would generally be cooler than streamflows, and would therefore have a cooling effect on streams. In areas where accretion flows are concentrated, water temperatures could be substantially reduced and may provide localized thermal refugia for aquatic species including salmonids.

***Surface Recharge.***—Under the Surface Recharge approach, water would be ponded in areas near streams in the basin to increase water seeping through alluvial sediments into the Yakima River and/or its tributaries. Changes in groundwater quality in affected shallow aquifers could occur from the infiltration component. Water quality from a controlled infiltration pond (using water from

irrigation canals) is not known, but is expected to be of better quality than what currently occurs from applied irrigation since there will be no fertilizer or herbicide applications. Although specific locations and sizes of surface ponds have not been identified, a study was done to evaluate the potential effects of using this approach (Ecology, 2007g). The results of this evaluation indicate that the recharge water would tend to increase the concentrations of nitrate along with major cations and anions, and that the magnitude of these increases would be dependent on the ratio of the seepage rate and flow in the stream. The temperature of infiltration from a controlled infiltration pond (using water from irrigation canals) is not known, but may be warmer because of solar heating from ponding that may occur. The effect of this infiltration on groundwater temperatures discharging back to streams is expected to be small and therefore surface water temperatures would likely increase slightly.

### 5.6.3 Mitigation

In order to minimize adverse water-quality effects of any selected alternative, site-specific studies could be conducted to determine potential impacts and any appropriate mitigation.

## 5.7 Vegetation and Wildlife

### 5.7.1 Affected Environment

As described in chapter 4, vegetation and wildlife concerns within the study area include the continued loss and degradation of shrub-steppe habitat, the potential disruption and loss of vital movement corridors for local wildlife populations, and potential disturbance to the limited riparian and wetland environments available for wildlife.

#### *5.7.1.1 Shrub-Steppe*

Shrub-steppe vegetation communities were the historically dominant vegetation type in eastern Washington. However, shrub-steppe habitat has been largely lost and degraded over the past century due to agricultural and municipal activities. The shrub-steppe vegetation community supports a diverse array of wildlife species including the greater sage-grouse, a State Threatened and Federal Candidate species.

There are three large blocks of shrub-steppe habitat remaining in the study area: the YTC, a portion of the Yakama Nation Reservation, and the ALE Reserve located on the DOE's Hanford Site (YSFWPB, 2004).

For more detailed information regarding shrub-steppe vegetation, communities within the study area, and wildlife species that utilize this habitat, refer to chapter 4.

#### *5.7.1.2 Movement Corridors*

Movement corridors are important to many species of wildlife. The primary function of a corridor is to provide access and dispersal options for wildlife species between two areas of habitat. Due to extensive land conversion in the study area for agricultural and municipal purposes, available movement corridors for wildlife species are limited. For more detailed descriptions of movement corridors for priority species, such as the greater sage-grouse and elk, within the study area refer to chapter 4.

#### *5.7.1.3 Riparian Areas (Cottonwood Recruitment)*

Riparian areas represent the transition from aquatic to terrestrial environments. Many riverine processes are influenced by the riparian zone, including channel structure, nutrient exchanges, and biological composition. Within the Yakima River basin, the most extensive and well-developed riparian environments are located along the alluvial floodplain of lower river segments with black cottonwood as the dominant tree species. The life history and population dynamics of black cottonwood are tightly bound to evolving river conditions and critical for comprehending the condition of the basin as a whole. For more detailed information regarding the importance of cottonwood recruitment and riparian conditions within the study area, refer to chapter 4.

#### *5.7.1.4 Wetland Abundance and Distribution*

Wetlands are diverse environments that are at least periodically saturated or covered with water. They are extremely important to the proliferation of many aquatic and semi-terrestrial vegetation and wildlife species within the study area. For more information regarding the abundance and distribution of wetlands within the study area, refer to chapter 4.

### 5.7.2 Environmental Consequences

The State Alternatives may require construction of pumping stations, conveyance pipelines, staging areas, access roads, canal lining, or other facilities. Although the specific effects of each of these actions are variable, all are likely to cause both temporary and, to a lesser degree, permanent impacts to vegetation and wildlife.

Impacts to plant communities include disturbance and removal of vegetation during construction of infrastructure. If conveyance lines are needed, vegetation along the conveyance corridor would likely be removed. If the plant communities provide habitat for wildlife, that habitat would be lost. Similarly, wildlife in those habitats, such as birds, small mammals, amphibians or reptiles, could be lost or displaced by construction. Wildlife in the vicinity of construction projects would also be temporarily displaced by noise and construction activities. The magnitude of the impact would vary depending on the existing habitat in the proposed

construction area, the level of wildlife use, the season, and the scale of the proposed construction, but some level of impact is unavoidable.

Impacts to riparian areas, undisturbed shrub-steppe habitats, and areas suitable for listed wildlife species such as the greater sage-grouse would be considered significant. Impacts to disturbed habitats such as agricultural lands and grazed grasslands would be considered less significant.

#### *5.7.2.1 Enhanced Water Conservation Alternative*

The impacts of conservation projects would vary with the type and scale of the project. Small on-farm conservation projects would have few impacts, and larger regional scale projects would have greater impacts to vegetation and wildlife.

**Construction Impacts**

Short-term impacts to vegetation and wildlife would occur during the construction of irrigation system improvements. Piping canals or encasing canal infrastructure beneath the surface would eliminate available open water and locally reduce the extent of riparian vegetation and habitat. Construction impacts caused by lining irrigation canals or field leveling may alter existing vegetation structure and wildlife habitat, potentially displacing wildlife, such as birds, mammals, amphibians, and reptiles. However, conservation improvements are intended to be constructed on land that is already used for agriculture, and impacts to undisturbed shrub-steppe habitat are not anticipated. Construction impacts would also include noise and construction activities that would temporarily displace wildlife.

**Long-Term Impacts**

In the long term, reduced seepage from lined canals could eliminate some vegetated areas. Lining canals may locally dewater wetland and riparian areas associated with these canals. However, from a basin perspective, the Enhanced Water Conservation Alternative may also increase the available water overall and allow water transfers to other areas or uses.

If water rights are transferred to irrigate different lands with the conserved water, vegetation and wildlife habitat could be altered. Conserved water could be transferred for municipal or domestic uses, potentially expanding municipal development or housing and reducing native vegetation and habitat. Such water transfers would most likely occur in areas currently designated for such uses in county and city comprehensive plans. Refer to section 5.13 for a more detailed discussion of potential water transfers for municipal or domestic uses.

Conservation projects could also result in a smaller number of water diversions, ultimately increasing instream flows. Increased streamflows may improve the quality of fish habitat as discussed in sections 5.8 and 5.9. They may also

improve wildlife habitat along open water channels by increasing the overall transitional (riparian) area between aquatic and terrestrial environments.

#### *5.7.2.2 Market-Based Reallocation of Water Resources Alternative*

The Market-Based Reallocation of Water Resources Alternative would not directly impact vegetation or wildlife, but transferred water rights could be used to irrigate different areas. This could potentially reduce the overall area of shrub-steppe and other important habitats within the basin by accelerating or allowing additional conversions of habitat to occur.

**Construction Impacts**

Construction of new diversion structures, pipelines, or canals that result from transfer of water rights to new cropland could have impacts similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

In the long term, water rights transfers could cause changes in land use from irrigated cropland to dry land, fallowed land, or urban land uses. These changes could affect vegetation structure and the distribution of wildlife. Water rights could also be transferred for domestic or municipal uses and expand development into areas designated for such uses in county and/or city comprehensive plans.

If water rights are transferred to municipal or domestic uses, the quantity and distribution of groundwater recharge could be altered. The nature and magnitude of these potential impacts would depend on a number of factors, including the location and scale of changes in water uses.

#### *5.7.2.3 Groundwater Storage Alternative*

The Groundwater Storage Alternative would have both short-term and long-term impacts to vegetation and wildlife. However, negative impacts are anticipated to be limited to the footprint of the required structures for infiltration and injection, as well as ancillary infrastructure including pumping stations, intakes, and conveyance lines.

As stated in section 5.2, injection and infiltration with passive recovery may have a beneficial impact of increasing instream baseflows in the Yakima River and its tributaries, depending on the location of the facilities within the basin. The increased flow may prove beneficial for the further establishment and proliferation of riparian vegetation and the wildlife that utilize riparian habitat.

Infiltration would require the construction of facilities and/or berms to contain water during the infiltration process. Although direct injection would require treatment facilities, it would require more limited construction impacts to

vegetation and wildlife due to the smaller scale of the projects. These facilities would not be located in areas of undisturbed shrub-steppe habitat.

Both Groundwater Storage Alternatives, injection recharge and surface infiltration, are discussed in more detail below.

**Construction Impacts**

***Injection Recharge.***—Short-term impacts to vegetation and wildlife from the construction of required facilities for the ground injection recharge method would be isolated to the limits of construction. Where feasible, the injection facilities, approximately 100 square feet in size, would be located adjacent to existing treatment facilities. If a new treatment facility needs to be constructed, there would be greater potential impacts to vegetation and wildlife, but the impacts would still be limited to the extent of construction. The new facilities would likely be constructed on land that is already disturbed and is appropriately designated for such a use under existing zoning regulations. Specific short-term construction impacts to vegetation and wildlife would be similar to those described for the Enhanced Water Conservation Alternative.

***Surface Infiltration.***—The surface infiltration method would have more extensive short-term impacts than the injection method primarily due to the size of the infiltration basin required. Depending on site conditions and infiltration rates, a range of approximately 25 to 120 infiltration basins up to 20 acres in size would be installed across the Yakima River basin. Short-term impacts would be anticipated within the construction footprint of the infiltration basin, pumps, and along the conveyance line. Although construction impacts would be similar to those described for the Enhanced Water Conservation Alternative, the area of impact for the surface infiltration method is likely much larger.

Potential infiltration sites would likely be located in areas of disturbed or marginal habitat. However, the creation of the infiltration basins would require the removal of vegetation and the excavation of material from the site. The excavated material could be used onsite to construct berms.

**Long-Term Impacts**

***Injection Recharge.***—Operational impacts to vegetation and wildlife would be limited to the footprint of the injection facility and associated infrastructure. Beneficial impacts could arise with a localized increase in groundwater storage and an associated increase in instream flows. This increase could enhance the limited riparian forest within the Yakima River basin, ultimately improving conditions for wildlife that utilize this habitat.

***Surface Infiltration***—Operational impacts to vegetation and wildlife caused by surface infiltration would be limited to the footprint of the infiltration facility and associated infrastructure. Disturbance of soils coupled with an increase in

available water may promote the growth of invasive plant species such as kochia, knapweeds, and various grass species along the edges of the infiltration basin.

The increase in groundwater levels, and the potential increase in instream flows, could enhance the limited riparian forest within the Yakima River basin. Such impacts could ultimately benefit the wildlife such as birds, mammals, reptiles, and amphibians that utilize riparian habitats.

### 5.7.3 Mitigation

The construction 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. In addition, construction BMPs would be followed and disturbed areas would be restored to the maximum extent practicable.

Following construction, it is anticipated that wildlife would return and utilize sites except for inundated areas such as infiltration basins. Active management of disturbed areas would be required to inhibit the establishment and spread of invasive plant species.

## 5.8 Anadromous Fish

### 5.8.1 Affected Environment

Chapter 4 provides information on the status and distribution of anadromous fish and habitat conditions in the Yakima basin. The environmental consequences of the proposed State Alternatives on anadromous fish are very similar to the No Action Alternative. Therefore, consequences from the No Action Alternative are reiterated and discussed in the next sections as they relate to the State Alternatives. These sections further describe the methods and indicators that were used to evaluate these consequences. One element that remains as a data gap is the potential effect of drought years on these indicators.

#### *5.8.1.1 Fish Spawning and Rearing Habitat, Passage*

Fish spawning and rearing habitats as well as fish passage are all affected by the managed flow conditions of the Yakima River. Although there are differences in the resource requirements for various species and life stages of resident and anadromous fishes, there are also similarities.

As described in chapter 4, there are numerous instream and floodplain elements of spawning and rearing habitat that combine to produce a spatially heterogeneous mixture of habitat conditions that are vital to the production and maintenance of native fish assemblages. The interaction of these habitat elements, combined with streamflow and other physiochemical determinants, produce a complex mosaic

under which aquatic species assemblages have evolved and proliferate. For an in-depth discussion of critical issues pertaining to aquatic habitat, such as sediment quantities and distribution, channel conditions, and LWD, refer to chapter 4.

## 5.8.2 Environmental Consequences

As described in detail in chapter 4, the current critical issues for anadromous fish within the Yakima subbasin pertain to the current practices of regulating flows for meeting agricultural and municipal entitlements. Presently, river flows are substantially altered as a result of storing water in reservoirs in the winter and diverting flows in spring, summer, and fall.

The identified critical issues for anadromous salmonids are:

- High summer flows in the upper Yakima and Cle Elum Rivers that reduce suitable rearing habitat for emergent fry and yearlings
- Unnatural and relatively quick changes in streamflow and elevation in both the upper Yakima and Naches Rivers that disrupts habitat
- Reduced stream freshets downstream from the Parker gage impacting smolt outmigration success

Other issues affecting anadromous fish in the Yakima basin are also described in chapter 4. All issues are related to the changes in hydrologic and geomorphological conditions in the Yakima River and its tributaries caused by the intensive hydrologic management of the river system for user entitlements.

### *5.8.2.1 Methods and Assumptions*

**Riverware and Flow Data**

The Riverware model for evaluating flow data relative to anadromous fish was discussed in chapter 4.

**Temperature**

Water temperature for the No Action Alternative for the Yakima River stream reaches between Roza and Prosser Diversion Dams was given in figure 4.12 in chaper 4. These temperature conditions can be expected to be the same for all three State Alternatives. Water quality results at critical locations in the river system are discussed in chapter 4.

**Indicator 1: Summer rearing habitat in the Easton and Ellensburg reaches for spring Chinook and steelhead fry and yearlings**

***Description.***—As previously described in chapter 4, this indicator describes the amount (acres) and percent of juvenile spring Chinook and steelhead summer rearing habitat for the Easton and Ellensburg reaches, which represent the upper

Yakima River where high summer flows occur in important salmonid rearing areas. Of the five reaches that were modeled to describe the flow to fish habitat relationship, these two reaches were selected for this indicator because they are located in the upper Yakima River where high summer flows occur. Habitat amounts for these reaches are expected to be similar for all three State Alternatives as for the No Action Alternative.

***Methods.*—**The DSS model for the Easton and Ellensburg reaches and the 2-D Hydraulic Model were previously described in chapter 4.

**Indicator 2: Flip-flop in both the upper Yakima and Naches Rivers for yearling steelhead and spring Chinook**

***Description.*—**As previously described in chapter 4, the second measurement for this indicator is the pre and post flip flop average median streamflows for the Easton, Ellensburg, and lower Naches River reaches, which provides some context for daily streamflows just prior to and after flip-flop and the absolute change in magnitude in streamflows pre- and post flip-flop. Flow measurements for flip flop are expected to be similar for all three State Alternatives as for the No Action Alternative.

***Method.*—**The Riverware model and use of streamflow data for this indicator was previously described in chapter 4.

**Indicator 3: Spring Flow Downstream from the Parker Gage**

***Description*—**As previously described in chapter 4, this indicator measures the volume (acre-feet) of water that flows downstream from the Parker gage during the spring season of March through June based on average daily flows generated by the Riverware model. For the No Action Alternative, the spring season water volume is compared to the desired flow objective (chapter 4) and is expressed as a percentage above or below the flow objective. Spring flow downstream from the Parker gage is expected to be similar for all three State Alternatives as for the No Action Alternative.

***Method.*—**The DSS model and use of streamflow data for this indicator was previously described in chapter 4.

**Indicator 4: July-September Flow Downstream from the Parker Gage**

***Description.*—**As previously described in chapter 4, the DSS model was used to estimate the average amount of coho rearing habitat in the Wapato reach for the summer period of July through September, and habitat quantity for the No Action Alternative was recorded. Summer flow downstream from the Parker gage and the corresponding habitat amount is expected to be similar for all three State Alternatives as for the No Action Alternative.

***Method.*—**The DSS model and use of streamflow data for this indicator was previously described in chapter 4.

**Indicator 5: Estimated Anadromous Fish Population Size**

***Description.***—For Reclamation's alternatives, the EDT-projected numerical response of the anadromous fish populations to the three alternatives relative to the No Action Alternative provides a way to estimate the anadromous fishery benefits across the alternatives. For State Alternatives, no EDT modeling was performed because flows in the Yakima River as a result of the proposed alternatives would not be significantly different than the No Action Alternative.

Table 5.10 summarizes the effects of the State Alternatives on the selected indicators for spring Chinook and steelhead.

**Table 5.10 Summary of analyses for State Alternatives: Yakima River Basin Water Storage Study PR/EIS**

| Alternatives | |
|---|---|
| **Resource indicator** | **State alternatives (Same as No Action Alternative)** |
| **High summer flows in the upper Yakima and Cle Elum Rivers (acres of available habitat)** | |
| | **Easton Reach Area (acre)** |
| Steelhead fry | 4.1 |
| Steelhead yearling | 57.9 |
| Spring Chinook fry | 2.5 |
| Spring Chinook yearling | 47.9 |
| | **Ellensburg Reach Area (acre)** |
| Steelhead fry | 2.2 |
| Steelhead yearling | 20.2 |
| Spring Chinook fry | 1.7 |
| Spring Chinook yearling | 14.9 |
| **Flip flop (rate of change during flip flop) (average cfs/day between August 15th to September 14th)** | |
| Easton | -8 cfs |
| Ellensburg | -78 cfs |
| Lower Naches | 34 cfs |
| Reduced spring freshets downstream from the Parker gage. (Percent difference in spring season flow between the alternative and flow objective ( If >=0 then flow objective reached) | |
| | -7% |
| Stream run-off timing | Not applicable |
| **Summer flows downstream from the Parker gage (acres of available habitat)** | |
| | **Area (acre)** |
| Coho yearling | 63.7 |

**Indicator Findings**

The Enhanced Water Conservation Alternative will result in a modest increase in river flow as compared to the No Action Alternative, but not an increase in flow which would change impact conclusions.

The Market-Based Reallocation of Water Resources Alternative would have impacts similar to the No Action Alternative wherein the hydrograph is little changed from existing conditions. Winter and spring flows throughout the systems are essentially unchanged as a result of water conservation under this alternative. Summer flows do increase slightly, in some reaches, mostly downstream from the Parker gage, as water which currently is released from storage and diverted downstream for irrigation remains instream to meet the higher flow targets. The magnitude of the streamflow changes varies by reach. At the Parker gage, the increase is estimated at 136 cfs in average or wetter years and about 90 cfs in dry years. Because the flow regime under this alternative is essentially unchanged from existing conditions, the indicators discussed under the Enhanced Water Conservation Alternative are linked to flows that generally reflect the current condition.

**Indicator 1: Summer rearing habitat in the Easton and Ellensburg reach for spring Chinook and steelhead fry and yearlings.** The habitat quantity amounts for each reach and species/life stage is presented in table 4.25 in chapter 4 for the No Action Alternative; these amounts would be similar for the State Alternatives. These values are essentially unchanged from the current condition.

**Indicator 2: Flip-flop in both the upper Yakima and Naches Rivers for yearling steelhead and spring Chinook.** Flows in the Easton reach drop by about 8 cfs per day during the flip flop season from mid-August to mid-September. At the same time flows in the Ellensburg reach are dropping by 78 cfs/day while flows in the lower Naches River go up by about 34 cfs/day (table 4.26). On average, flows in the Easton reach drop from about 572 to 328 cfs, while flows downstream in the Ellensburg reach, which is affected significantly by Cle Elum Lake release that does not affect Easton, drop from about 3,860 to 1,506 cfs. On the lower Naches River, flows rise from about 612 cfs to 1,628 cfs as releases from Rimrock Lake are ramped up.

The average rate of change in daily flow for the No Action Alternative and the current condition was nearly the same for all three reaches; indicating no change with this alternative. Therefore, no change is expected in the biological consequence to anadromous salmonids by the State Alternatives as compared to the current condition.

**Indicator 3: Early Spring/Fall Flow Downstream from the Parker Gage.** Increased flow downstream from the Parker gage is considered beneficial to improve anadromous salmon habitat through the middle and lower Yakima River.

Moreover, the March – June timeframe is especially important for salmon given its timing coincident with smolt outmigration and the resulting benefit to smolt survival.

The median early spring season (March-June) flow downstream from the Parker gage for the No Action Alternative is 2,274 cfs which is an increase in flow of 292 cfs over the current condition (1,983 cfs). Table 5.11 provides a comparison of flow volume downstream from the Parker gage for the March to June, July to October, and November to February time periods.

**Table 5.11 Median seasonal flow volume downstream from the Parker gage, 1981-2005**

| Alternative | Flow volume downstream from the Parker gage (maf)) | | |
|---|---|---|---|
| | Mar – Jun | Jul – Oct | Nov – Feb |
| Current Operation | 0.60 | 0.12 | 0.59 |
| No Action Alternative | 0.66 | 0.17 | 0.58 |
| Enhanced Water Conservation | 0.72 | 0.18 | 0.58 |

The No Action Alternative and the Enhanced Water Conservation Alternative show increases in instream flow downstream from the Parker gage compared to current operation for most of the months evaluated. The increased March to June flow volume for the Enhanced Water Conservation Alternative is 107,000 acre-feet more than current operation and 40,000 acre-feet more than the No Action Alternative while the increased July to October flow volume is 59,000 acre-feet more than current operation and 4,000 acre-feet more than the No Action Alternative. The increased flow results in an increase in daily average discharge for these months compared to the current operation and No Action Alternative, which will benefit instream resources, as described in sections 5.8 and 5.9.

**Indicator 4: Late Spring/Fall Flow Downstream from the Parker gage.**
*July – September Flow (Fish Habitat Area)*
The median July - September flow downstream from the Parker gage for the No Action Alternative is 642 cfs, which is an improvement of 333 cfs over the current condition (309 cfs). However, based on the flow-to-habitat relationship for coho yearlings, the result is a net decrease of approximately 4.8 acres in the amount of available summer rearing habitat (figure 5.3). This decrease is the result of habitat loss in the main channel (7.9 acres) as channel velocity increases as a result of increased flow that is not compensated for by an increase in side channel habitat (3.1 acres) because the flow threshold that results in the watering-up of side channels has not been realized. Overall habitat amount begins to increase again at 750 cfs. These conditions would be expected to be the same for the State Alternatives.

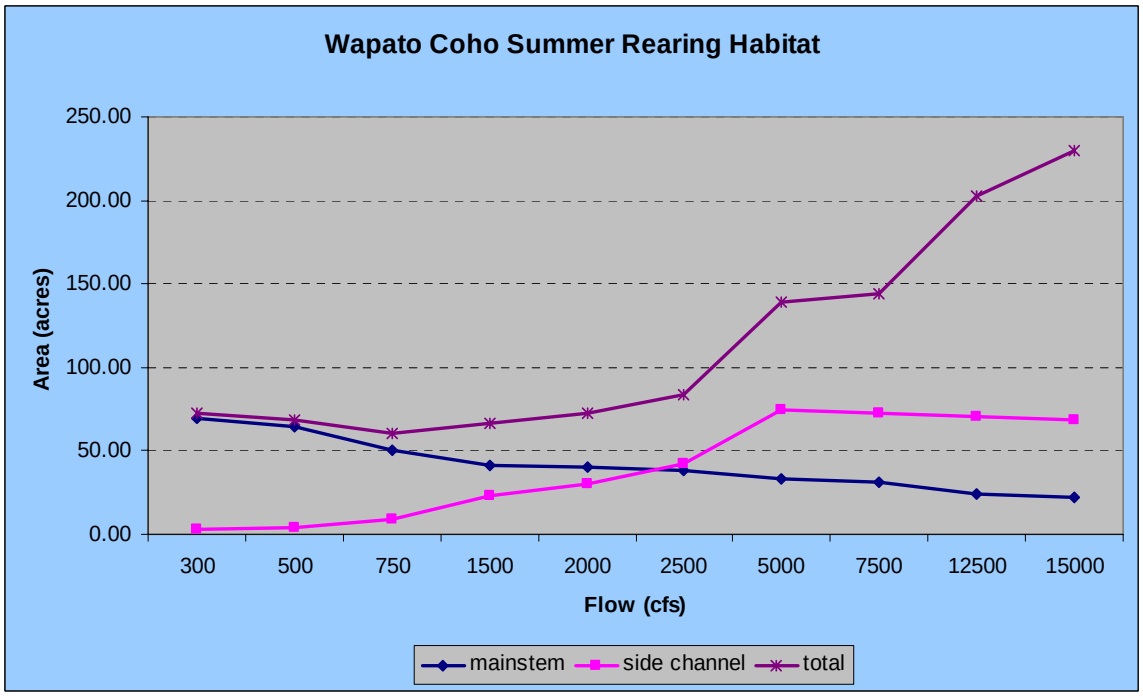



Figure 5.3 Relationship of coho summer yearling habitat amount to flow for the Wapato reach.

*April – September Flow (Instream Flow)*

Both the No Action Alternative and the Enhanced Water Conservation Alternative show increases in instream flow downstream from the Parker gage compared to the current operation. The reason is the two-thirds allocation of the conservation savings to instream flow in the No Action Alternative to meet Title XII requirements. Title XII instream flow requirements are described in chapter 2. Two locations (Sunnyside Diversion Dam and Prosser Diversion Dam) are set as instream flow control points in the Title XII legislation. Target flows at those locations are set based upon the TWSA available during the April-September time period. Table 5.12 provides a comparison of flow volume downstream from the Parker gage for the April to September and the July to September time periods.

**Table 5.12 Flow volume downstream from the Parker gage for April-September and July-September, average 1981-2005**

| Alternative | Flow volume downstream from the Parker gage (maf) | |
|---|---|---|
| | April-September | July-September |
| Current Operation | 0.51 | 0.09 |
| No Action Alternative | 0.62 | 0.13 |
| Enhanced Water Conservation | 0.66 | 0.14 |

The increased April to September flow volume for the Enhanced Water Conservation Alternative is 150,000 acre-feet more than the current operation and 40,000 acre-feet more than the No Action Alternative. The increased July to September flow volume is 50,000 acre-feet more than the current operation and 10,000 acre-feet more than the No Action Alternative. The median flow for the Enhanced Water Conservation Alternative for the July-September time period is 654 cfs, compared to 642 cfs for the No Action Alternative and 333 cfs for the current condition. Figure 5.1 presents hydrographs of the median of daily flows at the Parker gage for the all three alternatives described in table 5.12. The increased instream flow will benefit instream resources as described in sections 5.8 and 5.9.

***Indicator 5: Estimated Anadromous Fish Population Size.*** The Enhanced Water Conservation Alternative is expected to result in salmon and steelhead population sizes similar to those estimated for the No Action Alternative. Table 5.13 presents the estimated population size for spring and fall Chinook, coho, and steelhead for the No Action Alternative. These population size estimates do not include the contribution of hatchery produced fish and exclude harvest, and the estimates are based on the naturally produced fish determined from the quantity and quality of habitat.

**Table 5.13 Estimated average annual fish escapement (includes harvest) numbers (natural and hatchery) based on the EDT and AHA models for the No Action Alternative**

| Species | No Action Alternative |
|---|---|
| Spring Chinook | 7,189 |
| Fall Chinook | 6,893 |
| Coho | 8,475 |
| Steelhead | 2,700 |

### *5.8.2.2 Enhanced Water Conservation Alternative*

The impacts to anadromous fish associated with this alternative are anticipated to be minimal.

#### Construction Impacts

Short term and temporary construction impacts that alter the conditions of aquatic habitat for some organisms would occur during the construction or modification of diversion and conveyance infrastructure, but the overall impact is anticipated to be minor relative to the quality and amount of aquatic habitat found within the Yakima system. Impacts caused from construction and field leveling activities may also alter aquatic conditions by temporarily increasing sedimentation (turbidity) in adjoining waters, but these impacts are anticipated to be temporary.

**Long-Term Impacts**

Long-term impacts may result in reduced and/or more efficient diversion practices with potential to increase streamflows from an increase in groundwater discharge during low water periods. Depending on the timing and location of the increased flows, they could benefit anadromous and resident fish species. Reservoir levels may change from existing if conservation allows water to be stored in the reservoir for a longer period of time before being released.

#### *5.8.2.3 Market-Based Reallocation of Water Resources Alternative*

Water rights transfers associated with the Market-Based Reallocation of Water Resources Alternative are not expected to have a substantial impact on aquatic resources within the Yakima River basin.

**Construction Impacts**

Minor impacts from construction activities with this alternative are similar to those described for the Enhanced Water Conservation Alternative above. These impacts are anticipated to be temporary and isolated to areas within the boundaries of construction, similar to those described for the Enhanced Water Conservation Alternative. However, less construction is expected for this alternative than for the Enhanced Water Conservation Alternative. Mitigation for any impacts caused by construction under this alternative would be similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

In the long term, if water rights are transferred to instream uses, streamflows may increase. Depending on the timing and location of the increased flows, anadromous and resident fish species could benefit. Higher flows will likely increase aquatic habitat conditions for fish and other organisms by increasing overall area and improving water quality conditions (e.g., temperature).

#### *5.8.2.4 Groundwater Storage Alternative*

**Construction Impacts**

Short term construction related impacts from the Groundwater Storage Alternative are expected to be minimal and similar to those described above for the Enhanced Water Conservation Alternative. Most infiltration and injection facilities will be located away from streams; however screened intake and conveyance infrastructure would be located within aquatic and riparian areas. Some delivery facilities could be located in riparian areas, but only minor, temporary construction impacts (e.g., sedimentation) are anticipated.

**Long-Term Impacts**

In the long term, groundwater storage has the potential to provide several beneficial impacts to aquatic organisms within the Yakima River system. Water

injected or infiltrated into area aquifers, over the long term, may become part of the natural groundwater system that would potentially seep back into the river (surface) system through groundwater seeps. Groundwater seeps are often associated with geological structures, such as faults or fold structures. Recharge of cold surface water during the winter at certain geologic structures may increase the flux of cold water to streams at existing areas of groundwater discharge. This would benefit cold water fish and other organisms, like salmonids, that utilize the Yakima River system. In addition, groundwater storage may be used to supplement streamflows. Depending on the timing and location of the returned flows, aquatic species may benefit.

Further, water quality of return flows is expected to be better (i.e., cooler and cleaner) than ambient conditions. Direct injection to augment streamflows can provide refugia (cool groundwater inflow) for aquatic species in streams.

### 5.8.3 Mitigation

The following measures will be implemented to reduce short term impacts of construction activities to anadromous fish:

- Implement construction BMPs to avoid and minimize potential construction impacts, including erosion and sedimentation, accidental and incidental discharge of pollutants (Spill Prevention, Containment, and Control Plan), and dewatering and discharge of dewatering water.
- Provide treatment of construction dewatering discharges, such as sediment removal or filtration, as necessary, before the release of such water to wetlands or streams.
- Comply with applicable Federal, State, and local environmental regulations to mitigate potential impacts to sensitive areas, including streams, buffers, and wetlands.
- Restore disturbed areas to the maximum extent possible.
- Construction work windows for special-status fish would be followed as required by State and Federal agencies such as WDFW, NOAA Fisheries, and/or USFWS to avoid critical periods (i.e., breeding/spawning, migration).
- Also see the mitigation measures under Water Resources, section 5.2 and Sediment Resources, section 5.5.

# 5.9 Resident Fish

## 5.9.1 Affected Environment

Chapter 4 previously provided information on extent of the affected area for State Alternatives for resident fish, as well as status and distribution of resident fish and habitat conditions in the affected area. The environmental consequences of the proposed State Alternatives on resident fish are very similar to the No Action Alternative. Therefore, consequences from the No Action Alternative are reiterated and discussed in the next sections as they relate to the State Alternatives. These sections further describe the methods and indicators that were used to evaluate these consequences. One element that remains as a data gap is the potential effect of drought years on these indicators.

## 5.9.2 Environmental Consequences

Similar to anadromous fish, and as described in detail in chapter 4, the existing critical issues for resident fish within the Yakima subbasin pertain to the current practices of regulating flows for meeting agricultural and municipal entitlements.

Additional identified critical issues for resident fish are:

- Reservoir operation affects resident fish by affecting the productivity of the reservoirs for fish and their food base
- Water level regulation in reservoirs affects access from the reservoir to tributary spawning streams for resident fish.

### *5.9.2.1 Methods and Assumptions*

**Temperature**

Water temperature for the No Action Alternative for the Yakima River stream reaches between Roza and Prosser Diversion Dams was given in figure 4.12 in chapter 4. These temperature conditions can be expected to be the same for all three State Alternatives. Results at critical locations in the river system are discussed in chapter 4, “Water Quality.”

**Indicator 1— Summer rearing habitat in the Easton, Ellensburg and lower Naches River reaches for rainbow trout and bull trout.**

Refer to chapter 4 for a complete description of this indicator since they are similar in methodology. The only differences are that the fry and sub-yearling life stage time periods for rainbow trout and bull trout are different than for steelhead and spring Chinook because of differences in their life cycles. It should be mentioned that there are few records of bull trout residing in the three reaches evaluated for this indicator. And there is no evidence that a viable spawning population exists in these reaches, though occasional spawning nests have been observed over the years. The lifestage time periods used to estimate the amount

of fry and sub-yearling habitat in the Easton, Ellensburg, and lower Naches River reaches were as follows:

- Rainbow trout fry- July 1st through August 30th
- Rainbow trout sub-yearling- September 1st through September 30th
- Bull trout fry- April 1st through June 30th
- Bull trout sub-yearling- June 1st through September 30th

**Indicator 2: Flip-flop in both the upper Yakima and Naches Rivers**
This indicator applies similarly to anadromous and resident fishes. A complete description of this indicator is discussed in chapter 4.

**Indicator 3: Reservoir Operations**
As described in chapter 4, the DSS and Riverware models were used to calculate the average number of annual days the critical threshold volume is not exceeded for Kachess Lake, Keechelus Lake and Rimrock Lake, and the average elevation for these reservoirs over a number of years. This indicator calculated the percent change of each Reclamation alternative to the No Action Alternative. This percent change is expected to be the same as the No Action Alternative for the Market-Based Reallocation of Water Resources and Groundwater Storage Alternatives. For the Enhanced Water Conservation Alternative, average elevations are slightly but not significantly above the current condition and No Action conditions for most reservoirs (table 5.14). This small change in elevation could create a slight increase in bull trout access to tributary spawning habitats.

Table 5.15 summarizes the effects of the State Alternatives on the selected indicators for rainbow trout and bull trout.

**Table 5.14 Average elevation at existing Yakima basin reservoirs from July 15 to September 15, 1981 – 2005**

| | Kachess Lake elevation in feet (% change from Current Condition) | Keechelus Lake elevation in feet (% change from Current Condition) | Rimrock Lake elevation in feet (% change from Current Condition) |
|---|---|---|---|
| Current Condition | 2,248.9 | 2466.6 | 2,909.2 |
| State Alternative 1: Enhanced Water Conservation | 2,251.1 (0.1) | 2,468.3 (<0.1) | 2,909.7 (<0.1) |
| No Action Alternative | 2,250.9 (<0.1) | 2,467.9 (<0.1) | 2,909.9 (<0.1) |

**Table 5.15 Comparative analysis of State Alternatives: Yakima River Basin Water Storage Study PR/EIS**

| Alternatives | |
|---|---|
| **Resource indicator** | **State alternatives (same as No Action Alternative)** |
| **Summer flows in the upper Yakima and Lower Naches Rivers (acres of available habitat)** | |
| **Easton reach** | |
| Rainbow trout fry | 5.2 |
| Rainbow trout yearling | 57.2 |
| Bull trout yearling | 61.9 |
| **Ellensburg reach** | |
| Rainbow trout fry | 2.5 |
| Rainbow trout yearling | 19.9 |
| Bull trout yearling | 20.5 |
| **Lower Naches** | |
| Rainbow trout fry | 4.3 |
| Rainbow trout yearling | 45.9 |
| Bull trout yearling | 64.8 |
| **Bull trout spawner upmigration at reservoirs (inseason days impassible)** | |
| Kachess Lake | 18 |
| Keechelus Lake | 37 |
| Rimrock Lake | 3 |
| **Reservoir elevation during bull trout spawning migration (July 15 – September 15)** | |
| Kachess Lake | 2,248.4 ft |
| Keechelus Lake | 2,467.3 ft |
| Rimrock Lake | 2,909.9 ft |

## Indicator Findings

***Indicator 1:*** Summer rearing habitat in the Easton, Ellensburg and lower Naches River reaches for rainbow trout and bull trout. −The habitat quantity amounts for each reach and species/life stage is presented in table 5.15 for the No Action Alternative; these amounts would be the same for the State Alternatives. These values are essentially unchanged from the current condition. Only habitat changes near or greater than 10% are discussed in the text, but all values are reported in table 5.15.

***Indicator 2: Flip-flop in both the upper Yakima and Naches Rivers.*** −The results are the same as discussed for anadromous fish in chapter 4. No change is expected in the biological consequence to resident fish by the State Alternatives compared to the current condition.

***Indicator 3: Reservoir operations.*** − The average annual number of days with a critical threshold reservoir volume for bull trout spawners for the No Action Alternative is Kachess Lake, 18 days; Keechelus Lake, 37 days; and Rimrock

Lake, 3 days (table 5.6). The average reservoir elevations for the period coinciding with bull trout spawner migration for all the alternatives are shown in table 5.15. The average reservoir elevation for No Action were Kachess Lake, 2,248.4 feet; Keechelus Lake, 2,467.3 feet; and Rimrock Lake 2,909.9 feet. These conditions would be expected to be the same for the State Alternatives.

#### *5.9.2.2 Enhanced Water Conservation Alternative*

The impacts of this alternative to resident fish would be similar to those described under anadromous fish.

#### *5.9.2.3 Market-Based Water Reallocation of Water Resources Alternative*

The impacts of this alternative to resident fish would be similar to those described under anadromous fish.

#### *5.9.2.4 Groundwater Storage Alternative*

The impacts of this alternative to resident fish would be similar to those described under anadromous fish.

### 5.9.3 Mitigation

Mitigation measures for resident fish would be similar to those described under Anadromous Fish.

## 5.10 Aquatic Invertebrates

### 5.10.1 Affected Environment

A thorough description of the complex and variable invertebrate population responses to regulated river systems such as the Yakima is provided in chapter 4. Conditions that may influence the aquatic invertebrate communities within the Yakima system correspond directly to flow controls related to municipal and agricultural entitlements and flow diversions.

### 5.10.2 Environmental Consequences

#### *5.10.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Impacts related to construction associated with the Enhanced Water Conservation Alternative are anticipated to be minor and isolated to areas adjacent to or immediately downstream of any new intake or outlet structures related to irrigation improvements.

**Long-Term Impacts**

Aquatic invertebrate communities are dynamic and adaptive to changing environmental conditions. As stated in chapter 4, high quality resilient invertebrate communities exist in the upper Yakima River basin under the altered flow regimes associated with flip-flop operations (Cuffney et al., 1997; Stanford et al., 2002; Nelson, 2004; Reclamation, unpublished data). Limited data appear to indicate some impairment to aquatic invertebrates in downstream sites. Cuffney et al. (1997) describe sites along the mainstem Yakima between the Umtanum and Parker gages as containing moderately impaired communities. The potential for increased flows from conservation practices would likely beneficially impact the conditions of aquatic invertebrate communities within the Yakima River basin; however due to the many environmental factors that influence these communities, no definitive impacts can be quantified with available information.

#### *5.10.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Impacts related to construction under this alternative would be similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

Long-term impacts would be similar to those described for the Enhanced Water Conservation Alternative.

#### *5.10.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Impacts related to construction under this alternative would be similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

Long-term impacts would be similar to those described for the Enhanced Water Conservation Alternative.

### 5.10.3 Mitigation

No mitigation measures are required as impacts to aquatic invertebrate populations are anticipated to be minor, or in the long-term, potentially beneficial.

# 5.11 Threatened and Endangered Species

## 5.11.1 Affected Environment

A comprehensive description of special status species potentially occupying or using upland, wetland, and aquatic sites within the project area is provided in chapter 4, and will not be repeated here. For a species and status list, refer to the "Threatened and Endangered Species" section in chapter 4.

## 5.11.2 Environmental Consequences

### *5.11.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Although anticipated to be negligible, any impacts to threatened and endangered species from this alternative would be similar to those for Vegetation and Wildlife, Anadromous Fish, and Resident Fish described in sections 5.7, 5.8, and 5.9, respectively.

**Long-Term Impacts**

Over the long term, the Enhanced Water Conservation Alternative could benefit threatened and endangered aquatic species such as steelhead and bull trout by increasing flow during critical life history stages. Monitoring would be needed to determine if such effects occur and are measurable.

### *5.11.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Although not anticipated, any potential impacts to threatened and endangered species from this alternative would be similar to those for Vegetation and Wildlife, Anadromous Fish, and Resident Fish described in sections 5.7, 5.8, and 5.9 respectively.

**Long-Term Impacts**

Potential long-term beneficial effects from the increase in streamflows during critical life history stages for listed aquatic species within the study area would be similar to the Enhanced Water Conservation Alternative.

### *5.11.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Although anticipated to be negligible and isolated, any impacts to threatened and endangered species from this alternative would be similar to those for Vegetation and Wildlife, Anadromous Fish, and Resident Fish described in sections 5.7, 5.8, and 5.9 respectively.

**Long-Term Impacts**

Potential long-term beneficial effects from the increase in streamflows during critical life history stages for listed aquatic species within the study area would be similar to the Enhanced Water Conservation Alternative.

### 5.11.3 Mitigation

Negative impacts to federally and State-listed species are not anticipated from the implementation of the State Alternatives. However, any short-term disturbances from construction or operational impacts would have mitigation measures similar to those for Vegetation and Wildlife, Anadromous Fish, and Resident Fish described in sections 5.7, 5.8, and 5.9 respectively.

## 5.12 Recreational Resources

### 5.12.1 Affected Environment

The major locations for water-based recreation in the Yakima River basin are the five headwater reservoirs (figure 4.18 in chapter 4) and the mainstems of the Yakima, Tieton, and Naches Rivers. These water bodies provide opportunities for lake boating, rafting, kayaking, canoeing, fishing, hiking, camping, picnicking, swimming, and wildlife viewing. Water levels affect the type and quality of recreation on the basin's lakes and rivers. Additional information on recreational resources is provided in chapter 4.

### 5.12.2 Environmental Consequences

#### *5.12.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction of conservation projects is unlikely to affect recreation because it is not expected to occur in or adjacent to recreation areas.

**Long-Term Impacts**

Conservation may increase streamflows in some reaches, but it is not expected to affect streamflows to the extent that boating or shoreline recreation would be impacted. Depending on the timing and volume of increased streamflows, they may improve the health of streams and riparian zones and provide increased opportunities for wildlife watching and camping. Increased flows may also improve fish habitat and increase fishing opportunities. Municipal water conservation projects could benefit municipal recreation facilities, for example, by providing additional water for irrigating playfields.

#### *5.12.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Construction for the Market-Based Reallocation of Water Resources Alternative would be limited to new irrigation facilities if water rights are transferred to irrigate different areas. Construction is unlikely to impact recreation resources, because it would not occur in or adjacent to recreation areas.

**Long-Term Impacts**

Because the extent and location of water transfers is unknown, it is not possible to quantitatively evaluate changes in streamflows. However, water transfers are not expected to result in streamflow changes that would affect recreation.

#### *5.12.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction of groundwater storage facilities is not expected to occur in or adjacent to recreation facilities; therefore, no construction impacts are anticipated.

**Long-Term Impacts**

No long-term impacts to recreation resources are expected as a result of groundwater storage. Groundwater storage would increase streamflows both upstream of and downstream from the Parker gage. The effect of these streamflow increases are expected to be similar to those for the Enhanced Water Conservation Alternative.

### 5.12.3 Mitigation

Because no significant impacts to recreation resources are anticipated, no mitigation measures are proposed.

## 5.13 Land and Shoreline Use

### 5.13.1 Affected Environment

#### *5.13.1.1 Current Land Use*

Land use in the project area is diverse, ranging from protected wilderness to intensive agriculture to areas of relatively dense urban development. Private ownership totals 32 percent or over 1.2 million acres of the 4 million acres in the Yakima River basin (YSFWPB, 2004). However, the single largest landowner is the U.S Government with 1.5 million acres or 38 percent of the land area. Most of the Federal land is within the Wenatchee National Forest (WNF) in the upper portion of the Yakima River basin. The national forest area is managed for multiple uses, including commercial timber production and recreation. Private forest lands are also common in these mountainous areas.

Other large Federal land holdings include the U.S. Army Yakima Training Center (YTC), the Hanford Site, and BLM lands. Other public ownership (State, county, and local governments) totals over 400,000 acres.

The Yakama Nation Reservation covers 1,573 square miles (1,371,918 acres) in southern Yakima County and a smaller part of Klickitat County. The Yakama Nation and its members have over 880,000 acres held in trust; only a small portion is deeded land (YSFWPB, 2004).

Less than 60 square miles (1 percent) of the 6,150 square miles of the Yakima River basin has been converted to urban/suburban development. Significant urban areas include Cle Elum, Ellensburg, Selah, Yakima/Union Gap, Toppenish, Sunnyside, Grandview, Prosser, and the Tri-Cities. These urbanized areas host much of the project area's population, as well as its manufacturing, commercial, and service industry base. Though a minor portion of the total basin area, urban/suburban development and its associated infrastructure, such as roads, railroads, dikes and levees, have a disproportionate impact on aquatic and terrestrial habitats (YSFWPB, 2004).

Rangelands (2,900 square miles) are primarily used and managed for grazing, military training, wildlife habitat, and tribal cultural activities. The 2,200 square miles of forested areas in the northern and western portions of the basin are primarily used and managed for timber harvest, water quality, fish and wildlife habitat, grazing, tribal cultural activities, and recreation. About one-fourth of the forested area is designated as wilderness. The 1,000 square miles of irrigated agriculture includes pasture, orchards, grapes, hops, and field crops (see figure 5.4). Diverse recreational activities, including hunting, fishing, and camping, occur across much of the project area (YSFWPB, 2004).

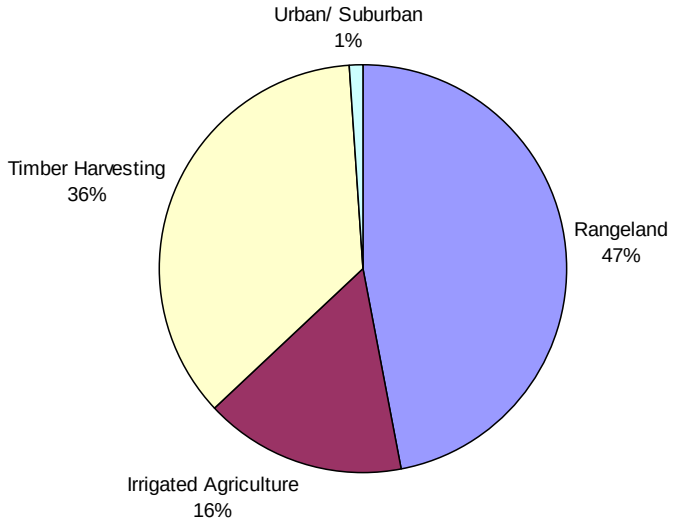



Figure 5.4 General land use types and percent distribution within the project area (YSFWPB, 2004).

#### *5.13.1.2 Shoreline Management Act, 1972*

Many of the activities that would emerge from the State Alternatives have the potential to impact waterways in the basin that are considered shorelines of the State. These shorelines are governed under shoreline master programs developed under the authority of the SMA, which was established in 1972 (Chapter 90.58 RCW, WAC 173-18). Local shoreline master programs, which must be approved by Ecology, are intended to protect shoreline ecology, public access, and water dependent uses and to require mitigation of impacts where appropriate.

Under the SMA, "shorelines of the state" are the total of all "shorelines" and "shorelines of statewide significance" within the State (RCW 90.58.030(2)(c). "Shorelines" is defined in the SMA as:

> *…all of the water areas of the state, including reservoirs, and their associated shorelands, together with the lands underlying them; except (i) shorelines of statewide significance; (ii) shorelines on segments of streams upstream of a point where the mean annual flow is twenty cubic feet per second or less and the wetlands associated with such upstream segments; and (iii) shorelines on lakes less than twenty acres in size and wetlands associated with such small lakes;…* (RCW 90.58.030(2)(d).

"Shorelines of statewide significance" within the project area include the following water bodies and the land within 200 feet of the ordinary high water mark:

> *Those lakes, whether natural, artificial, or a combination thereof, with a surface acreage of one thousand acres or more measured at the ordinary high water mark; Those natural rivers or segments thereof as follows: … Any [rivers] east of the crest of the Cascade range downstream of a point where the annual flow is measured at two hundred cubic feet per second or more, or those portions of rivers east of the crest of the Cascade range downstream from the first three hundred square miles of drainage area, whichever is longer;…* (RCW 90.58.030(2)e).

Tables 5.16 and 5.17 show the streams and lakes within the project area that are under regulated by the SMA (WAC 173-18).

**Table 5.16 Rivers and streams protected under the SMA**

| | |
|---|---|
| **Benton County (WAC 173-18-070)** | |
| Yakima River | From Benton-Yakima County line (Sec.7, T8N, R24E) downstream to mouth on Columbia River Sec.19, T9N, R29E). |
| **Yakima County (WAC 173-18-430)** | |
| Ahtanum Creek | From confluence of North and South Forks of Ahtanum Creek (Sec.17, T12N, R16E) downstream to mouth at Yakima River (Sec.17, T12N, R19E) excluding those reaches within Yakima Indian Reservation |
| Ahtanum Creek (North Fork) | From confluence of Ahtanum Creek North Fork and Ahtanum Creek Middle Fork (Sec.24, T12N, R14E) downstream to confluence with S. Fork of Ahtanum Creek (Sec.17, T12N, R16E) |
| Ahtanum Creek (South Fork) | From confluence of unnamed creek and Ahtanum Creek South Fork (Sec.24, T12N, R15E) downstream to confluence with N. Fork of Ahtanum Creek. |
| Swauk Creek | From the boundary (Sec.10, T20N, R17E) downstream (excluding all Federal lands) to confluence with Yakima River (Sec.20, T19N, R17E). |
| Cowiche Creek (South Fork) | From an approximate point (NW1/4 of NE1/4 Sec.33, T14N, R16E) downstream through Cowiche Creek to confluence with Naches River (Sec.9, T13N, R18E). |
| Bumping River | From U.S.G.S. gaging station (Sec.23, T16N, R12E) downstream to confluence with Naches and Little Naches Rivers (Sec.4, T17N, R14E). Excluding Federal lands. |
| Little Naches River | From confluence of N. Fork and M. Fork Little Naches River (Sec.36, T19N, R12E) downstream to confluence with Naches River (Sec.4, T17N, R14E). Excluding Federal lands. |
| Naches River | From confluence of Little Naches River and Bumping River (Sec.4, T17N, R14E) downstream to confluence with Yakima River (Sec.12, T13N, R18E). Excluding Federal lands. |
| Rattlesnake Creek | From Snoqualmie National Forest boundary (Sec.6, T15N, R15E) downstream to mouth at Naches River (Sec.3, same township). |
| Tieton River | From west section line (Sec.29, T14N, R15E) downstream to confluence with Naches River (Sec.35, T15N, R16E). Excluding Federal lands. |
| Tieton River (South Fork) | From the south section line (Sec.23, T12N, R12E) downstream to mouth at Rimrock Lake (Sec.7, T13N, R14E). Excluding Federal lands. |
| Yakima River | From the Kittitas County line (Sec.33, T15N, R19E) downstream, excluding all Federal lands and Yakima Indian Reservation, to Benton County line (Sec.7, T8N, R24E). |
| **Kittitas County (WAC 173-18-230)** | |
| Big Creek | From the WNF boundary (Sec.35, T20N, R13E) downstream (excluding Federal lands) to confluence with Yakima River (Sec.21, T20N, R14E). |
| Cabin Creek | From WNF boundary (Sec.19, T20N, R13E) downstream to confluence with Yakima River (Sec.9, T20N, R13E). |
| Cle Elum River | From the WNF boundary crossing Cle Elum Lake (Sec.33, 34 & 35, T21N, R14E) downstream to confluence with Yakima River (Sec.32, T20N, R15E). |
| Kachess River | From the WNF boundary (Sec.3, T20N, R13E) downstream through Lake Easton State Park and to confluence with Yakima River (same section). |
| Little Creek | From the WNF boundary (Sec.33, T20N, R14E) (excluding all Federal lands) downstream to confluence with Yakima River (Sec.22, T20N, R14E) |

**Table 5.16 Rivers and streams protected under the SMA (continued)**

| Kittitas County (WAC 173-18-230) (continued) | |
|---|---|
| | |
| Log Creek | From confluence of Log Creek and unnamed creek (NW1/4, SW1/4 Sec.31, T20N, R13E) downstream to confluence with Cabin Creek (Sec.19, T20N, R13E) |
| Manastash Creek | From confluence of N. and S. Forks Manastash Creek (Sec.17, T17N, R17E) downstream to confluence with Yakima River (Sec.4, T17N, R18E) |
| Manastash Creek (South Fork) | From the WNF boundary (Sec.31, T18N, R16E) downstream to confluence with Manastash Creek (Sec.17, T17N, R17E). |
| Taneum Creek | From WNF boundary (Sec.30, T19N, R16E) downstream (excluding all Federal lands) to mouth on Yakima River (Sec.33, T19N, R17E). |
| Teanaway River | From the confluence of the M. Fork and the W. Fork Teanaway River (Sec.6, T20N, R16E) downstream to Yakima River (Sec.3, T19N, R16E). |
| Teanaway River (Middle Fork) | From the WNF boundary (Sec.15, T21N, R15E) downstream to confluence with Teanaway River (Sec.6, T20N, R16E). |
| Teanaway River (North Fork) | From the WNF boundary (Sec.4, T21N, R16E) downstream (excluding all Federal lands) to the Teanaway River (Sec.6, T20N, R16E). |
| Teanaway River (West Fork) | From the WNF boundary (Sec.30, T21N, R15E) downstream (excluding all Federal lands) to the Teanaway River (Sec.6, T20N, R16E). |
| Wilson Creek | From confluence with Naneum Creek (Sec.30, T17N, R19E) downstream to confluence with Yakima River (Sec.31, T17N, R19E). |
| Yakima River | From the WNF boundary (Sec.15, T21N, R12E) downstream (excluding all Federal lands) to the Yakima Co. line (Sec.33, T15N, R19E). |

**Table 5.17 Lakes protected under the SMA 1972**

| Name | Location | Area (Acres) | Use[1] |
|---|---|---|---|
| ***Benton County (WAC 173-20-090)*** | | | |
| No Lakes in Project Area | | | |
| ***Kittitas County (WAC 173-20-400)*** | | | |
| Manastash Lake | Sec. 3, T17N, R15E | 23.5 | R |
| Lake Easton | Sec. 11, T20N, R13E | 237.6 | R, I |
| Lost Lake | Sec. 3, T21N, R11E | 144.8 | R |
| Cooper Lake | Sec. 2, T22N, R13E | 119.7 | R |
| Tucquala Lake | Sec. 3, T23N, R14E | 63 | R |
| Unnamed Lakes | Sec. 14, T21N, R12E | 60 | R |
| ***Lakes of Statewide Significance (WAC 173-20-400)*** | | | |
| Cle Elum Lake | Sec. 10, T15N, R23E | 4810.0 | R, I |
| Keechelus Lake | Sec. 12, T21N, R11E | 2560.0 | R, I |
| Kachess Lake | Sec. 34, T21, R13E | 4540.0 | R, I |
| ***Yakima County (WAC173-20-800)*** | | | |
| Byron Ponds (Res.) | Sec. 12, T8N, R23E | 50 | R |
| Horseshoe Pond | Sec. 22, T9N, R22N | 59 | R |

**Table 5.17 Lakes protected under the SMA 1972 (continued)**

| Name | Location | Area (Acres) | Use[1] |
|---|---|---|---|
| ***Yakima County (WAC173-20-800) (continued)*** | | | |
| Morgan Pond | Sec. 25, T9N, R22E | 24.6 | R |
| Giffin Lake | Sec. 26, T9N, R22E | 104.8 | R |
| Oleys Lake | Sec. 7, T9N, R22E | 35.4 | R |
| Freeway Lake | Sec. 7, T13n, R19E | 23.2 | R |
| Wenas Lake | Sec. 2, T15N, R17E | 61.4 | R, I |
| Unnamed Lake | Sec. 31, T14N, R19E | 22.3 | R |
| Unnamed Lake | Sec. 11, T13N, R18E | 21.4 | R |
| Unnamed Lake | Sec. 11, T13N, R18E | 21.3 | R |

[1]R = Recreation – wildlife, general public use, beautification, fishing, etc.; I = Irrigation (WAC 173-20-040).

#### *5.13.1.3 Tribal and Federal Lands*

As mentioned above, the Federal Government controls and manages a substantial area of land in the project area, including forests, rangeland, national parks, the Army's YTC, and other lands. Federal activities on these lands are not subject to the local regulations or the SMA, but Federal policies generally direct that activities of the Federal Government should be consistent with local regulations to the extent feasible within the mission of each agency.

Substantial portions of the project area, 1,573 square miles, are lands reserved under treaty with the Yakama Nation. These areas are not subject to any State regulations. Each tribe or confederation of tribes enacts its own laws to control land use and protect natural resources on lands within the reservation.

### 5.13.2 Environmental Consequences

The State Alternatives are not anticipated to have significant impacts to land uses. No significant impacts to shoreline use are anticipated from any of the State Alternatives.

#### *5.13.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Agricultural conservation efforts are not expected to have any substantial impact on land use. Improvements to irrigation systems would be confined to lands already designated for agriculture.

**Long-Term Impacts**

Although conservation may allow the irrigation of additional lands, those lands are expected to be in areas that are zoned agricultural. No people would

be displaced as a result of conservation improvements. Some existing irrigation facilities may be demolished and replaced.

By increasing the reliability of irrigation supplies, it is expected that enhanced water conservation would improve the viability of existing agricultural operations and reduce the potential conversion of agricultural land to other uses. Municipal conservation facilities could include water reclamation and reuse facilities that must be designed and sited according to local comprehensive plan and zoning regulations.

Some new and/or replaced irrigation facilities such as intakes and conveyance infrastructure may be located within shoreline areas, but the short- and long-term impacts are not anticipated to be substantial. As project types and locations are more clearly refined, specific impacts to shoreline areas can be more fully quantified.

#### *5.13.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Like the Enhanced Water Conservation Alternative, a Market-Based Reallocation of Water Resources Alternative is not expected to have substantial short-term impacts to land use.

**Long-Term Impacts**

In the long term, transfers of water rights may result in changes in land use, both in the areas where the water rights originated and in the recipient areas. These transfers may influence development in urban areas and may contribute to the conversion of farm uses to urban or domestic uses. Transfers of water from agricultural lands may increase fallow lands that otherwise would have supported irrigated crops. On the other hand, transfers that improve the reliability of an irrigation water supply may help keep some properties in agricultural use that otherwise would be converted to urban uses. Transferred water rights may be used to irrigate different areas and expand agricultural land uses. This expansion is expected to occur in areas already designated for agricultural use. No people would be displaced and no structures would be removed.

Transfers from out-of-stream uses to instream uses may reduce the water available for future urban, industrial, and agricultural development.

Similar to the Enhanced Water Conservation Alternative, some new and/or replaced irrigation facilities such as intakes and conveyance infrastructure may be located within shoreline areas, but impacts are not anticipated to be substantial. As project types and locations are more clearly refined, specific impacts to shoreline areas can be more fully quantified.

#### *5.13.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Like the Enhanced Water Conservation Alternative, the Groundwater Storage Alternative is not expected to have substantial short-term impacts to land use.

**Long-Term Impacts**

Groundwater storage projects would require land for infiltration or injection sites and treatment facilities; sites may range from approximately 1 to 20 acres in size. The land would be purchased from willing sellers or obtained through acquisition following applicable State and Federal regulations.

Injection facilities would be sited with existing treatment facilities where possible. New facilities could be controversial if they are located adjacent to urban or housing areas. The location of any facilities would comply with comprehensive plan and zoning designations, where possible, but in some cases where no alternative exists, changes in zoning may be required. Any proposed zoning modifications would be conducted in accordance with all applicable local requirements, including public notification requirements.

Intake, conveyance, and discharge infrastructure associated with the Groundwater Storage Alternative may be located within shoreline areas, but the short- and long-term impacts are not anticipated to be substantial. As project types and locations are more clearly refined, specific impacts to shoreline areas can be more fully quantified.

### 5.13.3 Mitigation

Short-term, construction impacts to land use are not anticipated in association with the implementation of any of the State Alternatives; therefore no mitigation would be required.

Any required property acquisition would be negotiated with each property owner on a case-by-case basis, and every attempt would be made to minimize adverse impacts to property owners. Property acquisition procedures would be coordinated with other appropriate entities in the Yakima River basin, including the United States and Washington State.

## 5.14 Socioeconomics

Implementation of the three State Alternatives would result in impacts to socioeconomic resources. These impacts would be different from those that would result from constructing a dam or reservoir, but impacts would occur for all alternatives, as described below.

### 5.14.1 Affected Environment

The proposed State Alternatives might affect five distinct components of socioeconomic conditions in Washington:

- The value of water-related goods and services
- The level and composition of jobs and incomes
- The distribution among different groups of the costs and benefits resulting from management of water resources
- The socioeconomic structure
- Economic uncertainty and risk

These components are briefly described below; additional discussion is included in the Technical Report on Socioeconomics (Ecology, 2007i).

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

Water and related resources are economically important when, as part of an ecosystem, they produce goods and services that benefit people, impose costs on them, or both (NRC, 2005). The State Alternatives would affect socioeconomic conditions in the basin by altering the supply and, hence, the value of individual goods and services derived from the basin's water resources. They also would affect the basin's economy by altering the amount of money spent in the basin. An increase would be a benefit for the basin's economy, a decrease would be a cost. A broader State or national perspective is likely to yield a different accounting, insofar as benefits (costs) within the basin might be offset by costs (benefits) elsewhere. An increase in the income from crops produced in the basin, for example, might induce offsetting reductions in the income from crops produced in other basins within Washington or in other States.

Water and related resources in the Yakima River basin produce many goods and services, but there exists no accounting of their overall value. Economists have, however, estimated for the larger Columbia River Basin the value of marginal (incremental) changes in the supply of water to produce some crops and a few other goods and services. Table 5-18 shows, by major irrigated crop, farmers' average gross and net (revenues minus production costs) economic returns early this decade (Huppert et al., 2004). Both types of return per acre varied widely, indicating that opportunities exist to increase the value of water-related goods and services by shifting water from lower-value to higher-value crops.

**Table 5.18 Farmers' average economic returns for irrigated crops in the Columbia River Basin, by crop**

| | Hay | Orchards | Vegetables | Other | Potatoes | Wheat |
|---|---|---|---|---|---|---|
| | | | **Per acre** | | | |
| Gross economic return | $877 | $5,485 | $1,408 | $961 | $3,122 | $344 |
| Net economic return | -$25 | $312 | $276 | -$271 | $464 | -$99 |
| | | | **Per acre-foot of water** | | | |
| Net economic return | -$5 | $82 | $89 | -$91 | $147 | -$34 |

Source: Huppert et al., 2004.

A simulation of drought conditions, in which the supply of water to irrigators with proratable water rights would be 50 percent of their entitlement, found that shifting water from irrigating lower-valued crops to irrigating higher-valued crops, under conditions that existed in the mid 1990s, would have increased the gross value of irrigated crops produced in the Yakima River basin by $150 to $350 per acre-foot of water (Scott et al., 2004). Fallowing a field capable of growing a lower-value crop, such as hay, and reallocating the water to grow a higher-value crop might have increased the total, gross value of irrigated crops by more than $400 per acre.

Table 5-19 shows there probably are opportunities to increase the value of water-related goods and services other than crops. The data in the table report recent estimates of the marginal value of several water-related goods and services in the Columbia River Basin. The top portion focuses on irrigation and assumes marginal, or incremental, changes would have the same characteristics as current averages. From a farmer's perspective the value of a marginal change in the supply of irrigation water, which equals the net return on irrigated crops, ranges from negative $91 to positive $147 per acre-foot (Huppert et al., 2004). From a Statewide perspective, however, the marginal value of water used for irrigation in the Columbia River Basin is far different: it ranges from negative $60 to negative $70 per acre-foot (Williams and Capps, Jr., 2005). The value is negative because, if individual farmers increased their production, they would drive down the prices and, therefore, earnings for all farmers.

The middle rows of table 5-19 show the estimated, marginal value per acre-foot of water for municipal use, hydropower, navigation, general recreation, waste assimilation, and ecosystem functions. The estimate for municipal use exceeds the others, indicating that, as municipal demand grows, the overall value of water-related goods and services could be increased by shifting water from any of the other uses to this one. The hydropower values represent all the electricity that would be generated from McNary Dam downstream. The estimates for navigation, recreation, and waste assimilation are typical for the region and are not site-specific. The estimate for ecosystem functions represents the marginal value of water protected or acquired for environmental purposes.

**Table 5.19 Estimates of marginal value of selected water-related variables (as reported by each source)**

| Variable | Marginal Value | Source |
|---|---|---|
| Water for irrigation, local perspective | ($91) – $147/acre-ft | Huppert et al., 2004 |
| Water for irrigation, State perspective | ($60) – ($70)/acre-ft | Williams and Capps, Jr., 2005 |
| Water for municipal or industrial use | $65 – $452/acre-ft | Ecology, 2004 |
| Water for hydropower (McNary Dam downstream) | $7.46/acre-ft | Huppert et al., 2004 |
| Water for navigation | $5.60/acre-ft | NRC, 2004 |
| Water for general recreation | $7.70 – $130/acre-ft | NRC, 2004 |
| Water for waste assimilation | $0.20–$0.28/acre-ft | NRC, 2004 |
| Water for ecosystem functions | $21/acre-ft | Brown, 2004 |

The marginal value of water that produces other goods and services could be substantial, but reliable estimates are not available. The full value of a use would reflect not just the value of water to the user but also the value of the impacts on others, which economists call externalities or spillover effects. With some exceptions, the demand for water-related goods and services likely will increase as the population grows and becomes wealthier, and as the economy expands.

#### *5.14.1.2 Jobs and Incomes*

Water and related resources influence jobs and incomes through three mechanisms:

- Providing goods and services that are inputs to commercial activities;
- Producing goods and services that create a quality of life that influences the location decisions of households and businesses; and
- Providing other valuable ecosystem goods and services.

Impacts on jobs and incomes would materialize in the context of the two, distinct regional markets for labor and local commerce that split the Yakima River basin, with Kittitas County connected more closely to the Seattle-Tacoma-Olympia metropolitan centers, and the rest of the basin connected more closely to the Kennewick-Richland-Pasco centers (Johnson and Kort, 2004). Agriculture is the largest commercial user of water in the basin, but its share of jobs and personal income has been declining for several decades (U.S. Department of Commerce, 2006). Quality-of-life impacts materialize when amenities, such as water-related recreational opportunities, induce households and businesses to locate nearby. Some water-related goods and services can influence jobs and incomes even though they are not direct inputs for commerce or amenities for households. Wetlands and floodplains, for example, can influence the risk of flood damage and, therefore, the cost of living and doing business in downstream communities (Daily, 1997).

A recent estimate of agricultural employment in the Columbia River Basin provides a context for anticipating the potential impacts of changes in water use in the Yakima River basin, indicating that permanently shifting 1,000 acre-feet of water into (out of) irrigation would increase (decrease) employment directly linked to the agricultural industry by about 18 jobs, and related, Statewide employment by about 45 jobs (Huppert et al., 2004). Any such increases or decreases in employment probably would be accompanied by tradeoffs in jobs associated with alternative uses of water. Additional research is needed to determine the full impacts on jobs and incomes associated with changes in water use in the Yakima River basin.

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

The costs and benefits of water-management decisions are sometimes not distributed equally among different groups. Decisions affecting salmon and steelhead, for example, can have important distributional effects governed by treaties, laws, and regulations (Independent Economic Analysis Board, 2005). Also important is the unequal distribution resulting whenever those who enjoy the benefits of a good or service do not bear the full costs of its production. This outcome, which can arise from the fixed allocation of water to water-right holders without regard for the impacts on others, subsidies, the emission of pollutants, and other factors. It also encourages the beneficiaries to consume the goods and services beyond optimal levels (U.S. Army Corps of Engineers, 1991).

#### *5.14.1.4 Socioeconomic Structure*

Many aspects of economic activity and social organization in the basin have long been tied directly to water. Harvest of salmon and steelhead has provided a cultural focus and the basis for much economic activity for the members of tribal groups, commercial fisheries, and recreational fisheries (Fluharty, 2000). Irrigation has enabled the expansion of agriculture and hydropower has flowed to homes and business throughout the Western States. Water for municipal and industrial uses supports urban development.

An important element of the socioeconomic structure is the State's water-right system, which gives priority on a first-come basis. For further explanation of this system, see section 5.2.5.

Federal laws and regulations play a major role in the management of the basin's water. Federal guidelines limit use of Federal funds for water resource projects that would provide no net benefit to the national economy and indicate there generally would be no net benefit from expenditures that would increase the supply of crops, such as rice, cotton, corn, soybeans, wheat, milo, barley, oats, hay, and pasture, that are grown in large quantities throughout the Nation (U.S. Water Resources Council, 1983).

The voluntary transfer of water—through donation, conservation, lease, or purchase—from one place, type, and time of use to another has long been seen as necessary to reduce the economic damage from drought, offset the adverse impacts of water withdrawals on streamflows, increase water-related economic benefits and jobs, and provide water for new demands. It also is possible for a private or public entity to purchase land to gain control over the appurtenant water right, and then redirect the water to another type of use.

Many transfers have occurred within the basin's irrigation districts. Each non-Federal district may approve temporary or permanent transfers within its boundaries that alter the place of use. A district may, itself, own or lease water rights, with the water to be used within its boundaries, and each non-Federal district has authority to sell or lease water rights to entities within and outside the district's boundaries.

Local water managers perceive that Reclamation has, in essence, operated a water bank in the basin since 1905 (Roundtable Associates, 2003). Reclamation also has limited authority to support market-related transactions by others that would increase water conservation, increase instream flows beneficial to salmon and other species, and augment the supply of water for out-of-stream uses. Transactions can have diverse characteristics, and have included exchanges between Reclamation and individual cities, or transfers by water-right holders to the State's Trust Water Program, and others.

**Barriers to Water Transfers**

Several aspects of the socioeconomic structure that shape the relationship between water and the economy impede water transfers. Many potential sellers and potential buyers are not fully aware of the mechanics and economic opportunities associated with transfers, and no permanent set of institutions exists to facilitate transfers and, thereby, build familiarity and trust. Instead, ad hoc efforts to promote transfers have had intermittent and limited success. For example, in 2005, a drought year, Ecology implemented a market-like mechanism, inviting water-right holders to indicate their willingness to lease their water right to Ecology, and it received and completed transactions on 27 offers, totaling 4,764.6 acre-feet (Ecology, 2006b). A similar invitation in 2007 elicited no valid responses, and a preliminary, follow-up investigation found water-right holders cited these reasons for not responding:

- They have little trust in Ecology,
- They were not expecting and/or did not understand the 2007 invitation,
- They did not see an imperative to consider transfers in a nondrought year,
- They disagree with Ecology's efforts to increase instream flows, or

- The value they place on continuing to exercise their water rights to irrigate their lands exceeds the amount they perceived they would have received from leasing them to Ecology.

Additional barriers arise because a proposal to transfer water triggers a process that allows all interested parties to review the proposal, gives anyone that feels it would cause harm to present evidence, and calls for a court to review all evidence before making a ruling. To expedite this process, Ecology, Reclamation, the Yakama Nation, WDFW, Service, and NOAA Fisheries have established the WTWG, which provides voluntary, expedited review of proposed transfers by these agencies, irrigation districts, and others. The group can recommend court approval of proposals that satisfy six criteria:

- The proposed transfer would have a neutral effect on the TWSA in the basin;
- The proposed transfer would not increase consumptive use;
- The water would have been used, but for the transfer;
- The transfer would adhere to a specific delivery schedule;
- The transfer would not adversely affect instream flow; and
- The transfer would satisfy operational considerations for the Yakima Project.

The physical facilities and operational requirements of the water management system also can impede water transfers. Transfers must be accommodated by the operational constraints of the Yakima Project and, perhaps, by one or more irrigation districts. Reclamation has obligations to manage the Project according to protocols and Federal reclamation laws and to ensure that instream flows meet established targets. Irrigation districts typically seek to keep water levels high in their systems during the irrigation season to maintain the systems' integrity and to move water efficiently. Some districts have policies that can restrict the transfer of water elsewhere or from irrigation to other uses. Overall, the system has only a limited capacity to accommodate transfers that would send water to a point of diversion upstream.

Similar factors can impede conservation. State law requires water-right holders to use water beneficially or relinquish their right to the water and some fear that, if they acknowledge that an opportunity to conserve water exists, this may be seen as an indication that they are not putting the water to beneficial use and trigger actions that would lead to relinquishment. Other limitations can arise if a farmer, irrigation district, or municipal/industrial water user lacks sufficient financial resources to implement conservation measures (NRC, 2004; Schaible, 2000).

#### *5.14.1.5 Uncertainty and Risk*

Risk is the probability that a decision will generate an outcome less desirable than intended. Sometimes it can be quantified, but often it remains uncertain. Uncertainty and risk are economically undesirable, and, all else equal, decisions that reduce them are preferred over those that do not. Major concerns about risk and uncertainty have been expressed regarding habitat for salmon and steelhead, especially during critical times and conditions, and for irrigators, especially during times of drought for those who have invested in orchards and other perennial crops (Huppert et al., 2004; NRC, 2004). The greatest risk and uncertainty occurs during periods of drought.

Additional uncertainty and risk accompany anticipated changes in climate, which some research indicates may raise air temperatures and diminish runoff in spring and summer in the Yakima River basin, reducing the availability of water to meet the demands for irrigation, instream flows, and other uses (Mastin and Sharp, 2006). Such findings indicate there may be increased risks associated with droughts, and particularly the risks associated with high-value water uses, such as instream flows to provide habitat for at-risk fish and other aquatic species, and irrigation to sustain perennial crops. As these risks rise, the potential gains from transferring water from lower-value uses to higher-value uses in an expeditious manner, via conservation, groundwater storage, and/or market-based reallocation of water may also rise.

### 5.14.2 Environmental Consequences

All three of the State Alternatives have the potential to increase the value of the goods and services society derives from the basin's water and related resources. Each alternative probably would have a positive impact on the jobs and incomes of those directly associated with it, but the impacts on the overall economy are likely to be mixed: in general shifting water from lower-value to higher-value uses would boost the economy, but some sectors and individuals associated with goods and services whose supply would decline might be adversely affected. Each of the alternatives could affect the distribution of costs and benefits associated with the basin's water resources and alter the relationship between the resources and the economy, with the actual effects determined by how the alternative would be implemented. Each of the alternatives likely would reduce uncertainty and risk associated with the basin's water resources, by improving the supply of water available to produce higher-value goods and services.

#### *5.14.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

The construction costs of enhanced conservation projects are estimated to be approximately $405 million, in 2007 dollars. The scope and design of specific projects would determine their costs, benefits, and net benefits (or net costs); their

impacts on jobs and income; the distribution of costs and benefits; their interaction with the economy; and the levels of risk and uncertainty they would generate for affected parties. The expenditure of funds on conservation projects would generate some jobs and incomes, but these would be offset, locally, Statewide, or nationally, to the extent that the funds would not be spent on other things in the basin, State, or Nation. Short-term impacts also may arise from the adoption of conservation technologies, such as drip irrigation, and/or changes in behaviour, such as relying on scientific measurements of soil moisture before irrigating a field.

**Long-Term Impacts**

A general assessment of conservation indicates that irrigation-related conservation projects and programs in the region, if implemented wisely, probably would yield substantial net economic benefits (Schaible, 2000). Research elsewhere shows similar benefits from potential urban conservation projects and programs (Gleick et al., 2003; NRC, 2004). The Enhanced Water Conservation Alternative is intended yield net economic gains sooner rather than later, by lowering legal, financial, and/or institutional barriers that otherwise would impede the extent and speed of conservation efforts in the basin.

The scope and design of specific demand-management programs and investments in infrastructure would determine their costs, benefits, and net benefits (or net costs); their impacts on jobs and income; the distribution of costs and benefits; their interaction with the economy; and the levels of risk and uncertainty they would generate for affected parties. Substantial expansion in conservation activity probably would require overcoming the legal, financial, and other hurdles that have impeded conservation in the past. This might occur by using public funds to diminish the financial risk a water-right holder would face by undertaking a conservation investment, or by reducing the likelihood that, by accepting public funds for a conservation project, a farmer would have to relinquish control over some of the saved water to be used as instream flow.

With enhanced water conservation, an existing set of goods and services would be produced with less water and the conserved water would be used to produce a new set of goods and services. The value of the new set of goods and services will depend on the circumstances of each specific conservation project or program. The value of marginal (incremental) changes in the supply of water to produce different goods and services is discussed in section 5.14.1.

Enhanced conservation projects and programs would have distributional effects if their benefits would accrue to one group while their costs would be borne by another. General taxpayers might incur some or all of the costs of a project, for example, but the benefits would accrue to the farmer(s) who would realize an increase in the supply of water for irrigation and to anglers and others who would enjoy the benefits of increased streamflows and improved habitat for salmon.

Enhanced conservation projects and programs probably would not alter the general structure of the economic activity and social organization linked to the basin's water resources. They might reduce uncertainty and risk associated with the movement of water resources through the basin by reducing the amount of water that would percolate into the ground and later appear somewhere else and, instead, increase the likelihood that the water would be more directly controlled by water managers.

#### *5.14.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

The only construction activities involved with this alternative would be the construction of new irrigation facilities where water rights are transferred to irrigate different areas. The impacts for new construction would be similar to the Enhanced Water Conservation Alternative, but on a smaller scale.

**Long-Term Impacts**

Market-based transfers of water likely would increase the economic well-being of those who participate in them because a transaction would occur only if both the buyer and the seller expected it to be beneficial. Transactions also probably would increase the value of goods and services directly derived from water resources, because those derived by the buyer would have greater value than those forgone by the seller. The regional economic effects of water transfers probably would be discernible only if the transactions altered a large enough portion of a given activity at a specific place and time in the basin to alter the overall structure of related activities. For example, transfers that markedly improved stream-related recreational opportunities and other amenities might trigger noticeable adjustments in economic activity and housing patterns by influencing the location decisions of households that place a high value on the amenities.

Under current laws and regulations, a proposed water transfer would receive approval from the court and Reclamation only where it would have no detrimental effect on other water rights or on the operation of the Yakima Project. In most instances, water to be transferred would come from someone who has the right to divert a quantity of water from a stream at a given place and given time and to consume a portion, with an obligation to return the remainder back to the stream. If water were transferred to another party, the user no longer would divert the water at that time and place. The portion of the water that otherwise would have been return flow would, instead, continue downstream only as far as the next diversion point for another water right. The portion that otherwise would have been consumed would flow downstream to the mouth of the river (and to the mouth of the Columbia River), if it is being converted to instream flow, or to the new diversion point, if it is being converted to an out-of-stream use.

There is insufficient information available to quantify the amount, location, timing, and changes in water use that will be seen in the basin. The available information does, however, provide useful insights.

The potential size of irrigator-to-irrigator trades in the basin is illustrated by an analysis of the cropping patterns and economic conditions of the mid-1990s (Scott et al., 2004). It found that, during drought years, farmers in the basin seek to transfer water from lower-value crops (mint, asparagus, sweet corn, other vegetables, alfalfa hay, other hay, wheat, other grain, pasture, and miscellaneous crops) to higher-value crops (apples, other tree crops, grapes, hops, and timothy hay). It reported the data in table 5.20, showing the amount of water typically used in each of the basin's major irrigation districts to irrigate each category of crop. With the exception of Roza and Tieton Irrigation Districts, the amount used to irrigate low-value crops exceeded the amount used to irrigate high-value crops.

**Table 5.20 Typical on-farm demand for water to irrigate high- and low-value crops, by irrigation district (acre-feet per year, April-September)**

| Crop | Roza | Kittitas | Sunnyside | Tieton | Wapato | Kennewick | Total |
|---|---|---|---|---|---|---|---|
| High Value[1] | 190,680 | 73,785 | 148,670 | 97,620 | 112.400 | 8,320 | 560,415 |
| Low Value[2] | 91,495 | 147,765 | 252,766 | 17,573 | 293,420 | 23,445 | 897,518 |
| Total | 282,175 | 221,550 | 401,436 | 115,193 | 405,820 | 31,765 | 1,457,939 |

Source: Scott et al., 2004.

[1] Apples, other tree crops, grapes, hops, and timothy hay.

[2] Mint, asparagus, sweet corn, other vegetables, alfalfa hay, other hay, wheat, other grain, pasture, and miscellaneous.

The analysis found that, during a drought year in which water deliveries to proratable irrigators would be half of the entitlements, proratable irrigators growing higher-value crops might seek as much as 205,000 acre-feet of water to fill the gap. To obtain the water, they might pay $200 per acre-foot, on average, or $40 million total, to obtain water from farmers that otherwise would irrigate lower-value crops. The increase in the value of their crops would be offset by the loss of output on lands left fallow by sellers of water, and the net increase in crop value would be about $20 million. This net increase would be about 1.5 percent of the total value of all farm products in the basin, and about 6.6 percent of farmers' total net farm income in the basin. Insofar as farmers with proratable water rights grow about two-thirds of the basin's higher-valued crops, they likely would realize most of the direct benefits of the transfers (Scott et al., 2004).

An earlier analysis examined the crop patterns, irrigation patterns, prices, and other conditions of the late 1980s and early 1990s, and concluded that almost 100,000 acre-feet of water could be leased from such lands during a typical year

for about $30 per acre-foot, in the dollars of the early 1990s, and an additional 150,000 acre-feet could be leased for about $50 to $60 per acre-foot (Willey and Diamant, 1994).

These findings roughly indicate the water that might be available in the basin for instream flows, and the potential costs to obtain it. They do not, however, account for operational factors that might interfere with the potential transfers. Nor do they account for changes in market conditions that have occurred over the past 15 years or so or that might occur in the future, changes in climate, or other factors that might affect the economic feasibility and impacts of future water transfers. Thus, to detail the potential for future market-related transfers, further investigation is needed to discern the current and anticipated future amounts of the water used to irrigate low-value crops, the location of this water, the potential compensation required to induce farmers to relinquish, and the operational feasibility of each potential transfer.

Too few transactions have occurred in the basin to provide a reliable basis for determining what the prices of transactions might be in the future. Table 5.21, however, illustrates the prices that might materialize in the Yakima River basin by providing a rough overview of the prices of transactions that have taken place throughout the Western States between 1987 and 2005. The transactions reported in table 5.21 come from both drought and nondrought years; transactions in drought years are expected to have higher prices than those in nondrought years. Most of the transactions have occurred in other States, primarily California and Colorado, at prices higher than those seen in Washington. The data in table 5.21 show several patterns. Buyers pay more to purchase than to lease water, presumably because a purchase provides greater assurance that water will be available in the future. Urban buyers have paid more than farmers for water.

**Table 5.21 Representative water transfer prices (per acre-foot per year) in Western States, 1987-2005, by sector**

| | Agriculture-to-urban | | Agriculture-to-agriculture | |
|---|---|---|---|---|
| | Leases | Sales | Leases | Sales |
| Mean Price | $114 | $4,366 | $29 | $1,747 |
| Median Price | $40 | $2,643 | $10 | $1,235 |
| Number of Observations | 189 | 1,013 | 178 | 169 |

Source: Brewer et al., 2007.

Trends and patterns in the number, type, and location of future water transfers will be influenced by numerous factors that shape the demand for and supply of water. These include, but are not limited to, the incidence and severity of drought, the reliability of drought forecasts, population and economic growth in the basin and among outside groups with an interest in the basin's water resources, and trends in the population of salmon and other species dependent on instream flows. The evolution in transfers also will be influenced by social and institutional factors that affect parties' willingness to participate in transactions.

Growth in the number of transactions will occur only as more parties see that participating in them is likely to yield sufficient economic gain that it warrants the time and effort required to make them work.

The information presented above indicates that the Market-Based Reallocation of Water Resources Alternative has the potential to yield economic benefits, both to participants in water transfers and to the basin's overall economy. Increases in the number of transfers and the amount of water transferred are likely to occur only slowly, however, unless the legal, economic, and socio-cultural barriers to transfers are overcome (Roundtable Associates, no date). Both public and private efforts to lower the barriers have occurred in the basin, seeking to accelerate the review process, provide funding to lease or purchase water rights, and make more people aware of transactional opportunities. Significant increase in transfers probably could not occur unless Ecology received additional funding to process them and/or processing responsibility were shifted to another entity (Roundtable Associates, no date). Additional public funding probably would be required to facilitate more transfers, insofar as they would require more effort by Ecology, Reclamation, and the court to execute their responsibilities to see that the transfers comply with existing laws and regulations.

The value of transactions during future drought years could total $45 million, assuming transactions would affect the flow of 225,000 acre-feet of water and the average value of each transaction would be $200 per acre-foot. The overall value of water transactions over the next 20-50 years could total up to $173 million. This estimate assumes transactions aimed at increasing instream flows would total 1,000 to 14,000 acre-feet of water per year, transactions for irrigation would total 10,000 to 20,000 acre-feet per year, and transactions to increase municipal water supplies would total up to 40,000 acre-feet per year, at prices ranging from $250 to $4,400 per acre-foot. Further research is required to determine in greater detail how the different approaches to lowering barriers would affect costs and benefits, jobs and incomes, the distribution of impacts, the socioeconomic structure, and uncertainty and risk.

#### *5.14.2.3 Groundwater Storage Alternative*

**Construction Impacts**

With the surface recharge approach, construction costs over 10-20 years would total $54 million to $164 million. With direct injection, the total construction costs would be $65 million over the same period.

**Long-Term Impacts**

The costs and benefits of storing water underground would be determined by several factors. The overall costs would be determined largely by the individual costs of acquiring and protecting the sites and constructing and operating the facilities. The costs of electricity and labor are likely to be major components of

the operating costs. Also important will be the opportunity costs of the water, land, and other resources that would be used by this alternative, e.g., the value of the water-related goods and services that otherwise would be produced but would be lost when water is injected underground.

The benefits would be determined by the willingness of users to pay for the goods and services that would be derived from the water. The water might provide services similar to insurance when it lies underground, insofar as it would be available to satisfy unmet demands. In addition, it might actually flow to the surface and/or be retrieved and produce goods and services, such as aquatic habitat, irrigation, or water for municipal-industrial uses. See section 5.14.1 for a discussion of the potential willingness to pay for the marginal value of additional supplies of water. All else equal, the greater the uncertainty regarding the ability of surface water flows to meet future demands, the greater would be the benefits of storing water underground so it would be available to meet unmet demands. It might produce other goods and services on its own, by migrating close to the surface, or close enough to the surface, to provide goods and services associated with wetlands, increased instream flows, etc. Stored water that migrated to a stream might provide water quality benefits by cooling streamflows, for example. Additional water when it is retrieved from storage (or when it leaks into surface water). All else being equal, the greater the uncertainty regarding the availability of water to be stored and, once stored, its availability to be retrieved, the greater would be the costs and the smaller would be the benefits.

Further research is required to describe cost options and their respective impacts on economic benefits, jobs and incomes, the distribution of impacts, socioeconomic structure, and uncertainty and risk.

***Summary of Costs for the State Alternatives.—***Table 5.22 summarizes the estimated costs associated with the State Alternatives and the potential flows that could result from each alternative.

### 5.14.3 Mitigation Measures

The type of mitigation, if any, that would be appropriate for each of the alternatives would be determined by future socioeconomic conditions and by the specific steps that would be taken to implement the alternative. Mitigation typically would be warranted only insofar as an alternative 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 group. Mitigation might involve compensation, by providing unemployment benefits if the fallowing of land were to cause farm workers to lose their jobs, for example. Or, it might involve the provision of substitutes for the reduced goods and services. If construction associated with aquifer storage and recovery were to impinge on existing habitat or infrastructure roads, for example, replacements might be built.

**Table 5.22 Cost comparison of State Alternatives**

| Alternatives | | Construction cost | Construction duration | Cost per acre/foot for instream flow |
|---|---|---|---|---|
| No Action | | | | |
| Enhanced Water Conservation | | $405 million | 10 years | [1]$10,125 |
| Market-Based Reallocation of Water Resources[2] | Drought years lease[3] | $45 million | 1 Year | N/A |
| | Nondrought years purchase[3] | Up to $173 million | 20–50 years | [4] $250–$4,400 |
| Groundwater Storage Alternative | Surface recharge | $54 – 164 million | 10-20 years | $1,190 – 3,636/acre-feet |
| | Direct injection[5] | $65 million[5] | 10-20 years | $5,078 |

| Alternatives | | Instream flows during average year (acre-feet at Parker gage) | Cost per acre-foot for irrigation and municipal supply during drought year (1994) | Irrigation supply during drought year (1994)(acre-feet, above Parker gage) | Municipal supply during drought year (1994) (acre-feet above Parker gage) |
|---|---|---|---|---|---|
| No Action | | | | | |
| Enhanced Water Conservation | | 40,000 | $7,860 | 20,000 | 13,400 |
| Market-Based Reallocation of Water Resources[2] | Drought years lease[3] | N/A | $200 | 200,000 | 20,000 |
| | Nondrought years purchase[3] | 7,000 –14,000 | $2880 -$3,460 | 10,000–20,000 | Up to 40,000 |
| Groundwater Storage Alternative | Surface recharge | 33,000 | N/A | N/A | N/A |
| | Direct injection [5] | 6,400 | $5,078 | N/A | 6,400 |

[1] The Enhanced Water Conservation Alternative is not configured to substantially increase instream flow as the No Action Alternative provides a much greater instream flow benefit at the Parker gage compared to the current condition.

[2] We estimate the cost of this alternative for two general scenarios: drought years in which parties would seek to lease water, and nondrought years in which parties would seek to purchase water rights. Implementation of this alternative would not entail construction; the figures reported reflect the amounts lessees/buyers would pay lessors/sellers.

[3] Assumptions: The cost per acre-foot will roughly equal the average cost of water leased during the 2005 drought. The amount shown for irrigation approximates the amount needed, after taking into account the effects of enhanced conservation, to yield a 70 percent proration level for proratable irrigators during drought years. Roughly 40,000 acre-feet of new urban demand will materialize in areas with surface-water shortages during drought years but only half of this demand will be satisfied during these years.

[4] Assumptions: The lower bound of the cost per acre-foot reflects the recent purchase of water rights by Washington Water Trust; the upper bound reflects the mean cost of recent urban water purchases in Western States. The lower bound of the amount of water for instream flows reflects the amount Reclamation, Ecology, and others purchased since 1999; the upper bound is twice this amount. The amount of water purchased for irrigation equals 5–10 percent of the drought-year leases, and roughly 10-20 percent of the water applied to lower-valued crops in the basin in the early 1990s. New urban demand will require roughly 48,000 acre-feet per year of water upstream of the Parker gage. The total cost equals the midpoint of the price range, $2,345 per acre-foot, times the upper bound of the sum of the amounts shown, 74,000 acre-feet.

[5] Time lags between the time of direct injection and increased availability of water (e.g., seepage back to streams) vary dependent upon the target aquifer and mode of operation. Benefits and costs are based on equilibrium between recharge and active/passive recovery (i.e., beneficial effects may not be realized until several decades after implementation of a direct injection recharge, dependent upon the target aquifer).

# 5.15 Public Services and Utilities

The Yakima River basin is a large region that consists of expansive rural areas, a few small towns and cities, and urban development concentrated around Ellensburg, Yakima, and the Tri-Cities. The basin also features major regional water supply systems for irrigation and municipal uses. This section discusses water supply and regional water use, public services, and public utilities. Hydropower is discussed in section 5.4.

## 5.15.1 Affected Environment

### *5.15.1.1 Water Supply and Regional Water Use*

Potable water supply is provided by public and private water systems and individual wells. Within the basin, approximately 60,000 households are served by public and private water systems, while approximately 51,000 households are served by individual wells (Reclamation, 2006b). Most of the irrigation water is supplied by irrigation districts and ditch companies through diversions from the Yakima River and its tributaries. Reclamation operates the Yakima Project, which stores water for mainstem Yakima and Naches River water users. An estimated 465,400 acres of irrigable land is served by the Yakima Project (see chapter 1). A much smaller amount is diverted or pumped from groundwater by individual water users.

### *5.15.1.2 Public Services*

Public services in the Yakima River basin are provided by tribal, Federal, State, county, and local governments, as well as by volunteer fire departments and other volunteer groups in many areas, especially rural areas. Services include emergency fire and police services, education, health services, recreation programs, and other services.

### *5.15.1.3 Public Utilities*

Public utilities in the Yakima River basin are provided by a combination of tribal, county, city, special purpose district, and private suppliers. Wastewater and solid waste utilities are provided by counties and cities. In some cases wastewater treatment is provided by private treatment facilities serving individual developments outside urban areas. In most rural areas, wastewater treatment is provided through individual private septic systems. Electricity is provided by the private utilities Puget Sound Energy and PacifiCorp, and PUDs Kittitas County P.U.D. #1 and Benton Rural Electric Association.

## 5.15.2 Environmental Consequences

Substantial impacts to public services and utilities are not anticipated from any of the State Alternatives.

#### *5.15.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction along roadways associated with irrigation improvements under the Enhanced Water Conservation Alternative could cause temporary disruption of utilities and increased response time for police and fire emergency services. However, any disruptions would be coordinated with local services and utilities and would be scheduled to minimize impacts.

**Long-Term Impacts**

Conservation and efficiency measures, such as lining or piping irrigation ditches, would result in cost impacts to irrigation districts and companies. It is anticipated that the costs would be shared between Ecology, Reclamation and water users with the majority of the costs borne by Ecology. Some of the costs would be absorbed by the irrigation districts and companies, causing increased rates.

Conservation measures could reduce energy consumption in some areas over time by reducing the volume of water that needs to be pumped to irrigate a given area. However, some of the conservation measures (KID, CID) entail construction of new pumping plants to allow water to remain instream in the Yakima River. Those plants will increase the overall amount of energy consumed.

On-farm conservation measures would have minimal impacts on public services and utilities. Some measures, such as conversion to sprinkler irrigation or automated systems, may consume additional electricity. Conservation measures, such as more efficient irrigation application rates that result in less return flow, could reduce water reaching lakes and rivers as return flow, which could affect other water users' ability to provide adequate water.

Municipal conservation programs, including the development of reclamation and reuse facilities, could require additional investments by local utilities and increased rates in the short term. However, over the long term, conservation programs could reduce costs of providing municipal water as the cost of new water supplies increases. Enhanced water conservation may improve the reliability of public water supplies.

#### *5.15.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Construction impacts associated with irrigation improvements are similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

A market-based water allocation system would incur costs for implementation and administration. It is expected that at least a portion of those costs would be borne

by the State. Transfers from irrigation uses to domestic uses may cause increased demands for municipal services if development increases. Water right transfers may create a source to improve the reliability of public water supplies.

#### *5.15.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction impacts to public services and utilities associated with building infiltration ponds, injection wells, and conveyance infrastructure under the Groundwater Storage Alternative are similar to those described for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

Groundwater storage would require additional costs for treatment and operation. It is assumed that these costs would be borne by State or Federal agencies. Additional power would be required for pumping, injection, and treatment. Groundwater storage may provide a source of water to increase the reliability of public water supplies.

### 5.15.3 Mitigation

The following measures could be used to avoid impacts to public services and utilities during construction:

- Provide public notification of proposed construction activities, including the timing of construction, to all local service providers and schools within the immediate vicinity of any facilities or infrastructure projects.

- Plan construction traffic routing to maintain free-flowing traffic conditions and minimize potential increases in response times for emergency vehicles. Develop construction traffic plans in accordance with local requirements to ensure emergency service providers identify emergency access routes that are to be maintained during construction activities.

- Coordinate with local utility service providers to assist in utility locations, if applicable, and to identify specific mitigation measures to minimize impacts to utility purveyors.

Coordination would occur with local utility purveyors to identify other specific mitigation measures to minimize impacts.

# 5.16 Transportation

## 5.16.1 Affected Environment

Agricultural irrigation in the Yakima River basin occurs primarily along rivers and tributaries in lower elevation areas. Some of these agricultural areas are adjacent to major highways in the basin. Most agricultural lands are located along the rural, local road system.

Major highways in the Yakima River basin include I-90 and I-82, Federal Highways 97 and 12, and State and local Highways 10, 821, 410, 24, 240, and 241 (see figure 5.5). In addition, there are a number of local roads that serve the rural areas of the basin. The Burlington Northern (BN) Railroad runs through the basin. The rail route is generally parallel to I-90 in the upper basin, west of the Yakima River through the Yakima River Canyon (parallel to Highway 821), and parallel to I-82 toward the Tri-Cities area.

## 5.16.2 Environmental Consequences

### *5.16.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction of facilities to improve water conservation could have minor, short-term impacts on highways in the Yakima River basin. Where canals or other delivery systems are located adjacent to roadways, there could be temporary disruptions of traffic. Piping of canals could require that culverts be installed or replaced under roadways. There would be increased traffic on roadways with worker traffic, equipment, and deliveries. The degree of impact depends, in part, on the current level of service on potentially affected roads. Because most irrigated lands are located on local, rural roads with limited traffic, only minor impacts are anticipated. Construction impacts may also occur if conserved water results in water rights being transferred to irrigate different areas. The impacts of constructing new delivery systems would be similar to those for constructing water conservation projects.

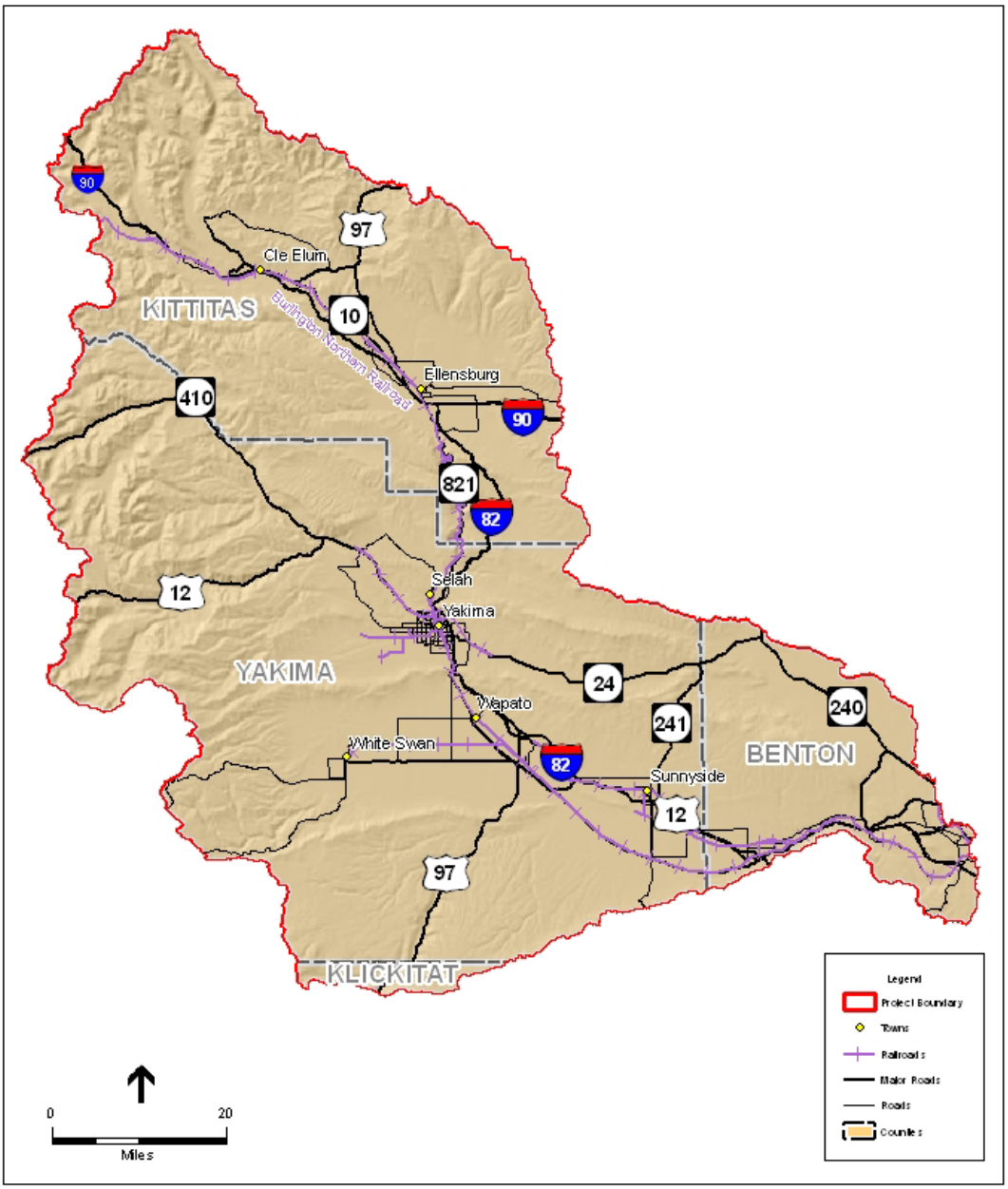
**Long-Term Impacts**

No long-term impacts to transportation are anticipated. Operation of conservation projects would require only infrequent trips by maintenance vehicles and would have no impact on transportation systems.

### *5.16.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

The only construction associated with the Market-Based Reallocation of Water Alternative would be if irrigation facilities are constructed to supply new areas where water rights have been transferred. These impacts would be similar to




SOURCE: WSDOT, 1997 (rail); ESRI, 2005 (roads)

Yakima River Basin Water Storage Feasibility Study PR/EIS .207369

**Figure 5.4**
Major Transportation Routes
Yakima River Basin, Washington

Figure 5.5 Major transportation routes.

those for the Enhanced Water Conservation Alternative except on a smaller scale. Mitigation measures for construction would be similar to those for the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

Water banks or water transfers would not by themselves affect transportation. In areas where new irrigation facilities are installed, maintenance vehicles would make infrequent trips. If the area is not currently in agricultural use, there would be increased vehicle trips by agricultural equipment.

#### *5.16.2.3 Groundwater Storage Alternative*

**Construction Impacts**

The construction of infiltration and injection facilities for groundwater storage projects would temporarily increase trips by worker vehicles, construction equipment, and material delivery on adjacent roadways. If treatment facilities are required for injection facilities, construction would generate more traffic than the infiltration facilities. Depending on the location of the infiltration and injection facilities, new access roads may need to be constructed.

Conveyance facilities would be required to convey water from the Yakima River to the injection or infiltration site. Where groundwater is actively recovered, pipelines would also be required to convey the water from the recovery well to the municipal supply system. In some cases, these conveyance facilities may cross existing roads. If the conveyance lines cross major highways, they would likely be installed by boring under the highway to minimize traffic impacts. On minor highways, the conveyance lines would be installed by a cut and cover method that would require temporary lane closures.

**Long-Term Impacts**

No long-term impacts to transportation are anticipated from the Groundwater Storage Alternative. The infiltration and injection facilities would require only infrequent trips by maintenance vehicles.

### 5.16.3 Mitigation

Mitigation measures to reduce construction impacts to transportation would be similar for all three alternatives. Mitigation would include maintaining access to properties, installing signage, marking detour routes, and providing information to the public.

Since there would be no long-term impacts to transportation from the three State Alternatives, no mitigation is necessary.

# 5.17 Air Quality

## 5.17.1 Affected Environment

The Affected Environment and applicable regulations for air quality for the State Alternatives is described in chapter 4. Primary sources of air pollutants in the Yakima basin are vehicular emissions and windblown dust from agricultural activities. Some residential wood burning and industrial emissions occur, primarily in urban areas. The Yakima River basin experiences frequent strong winds, primarily from the northwest. These winds, combined with the fine sediments in the area increase the potential for windblown dust. Air quality in the Yakima River basin is well within the standards for pollutants.

The State of Washington, through the Department of Ecology, regulates fugitive dust emissions by requiring that "the owner or operator of a source of fugitive dust shall take reasonable precautions to prevent fugitive dust from becoming airborne and shall maintain and operate the source to minimize emissions" (Ecology, 2002a). The Benton County Clean Air Authority (BCAA) regulates air quality in Benton County and has established a Fugitive Dust Policy to reduce dust emissions. The Yakima Regional Clean Air Authority requires Dust Control Plans for projects in Yakima County. Kittitas and Franklin Counties do not have similar regulatory agencies, but they are subject to Ecology regulations.

## 5.17.2 Environmental Consequences

### *5.17.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction of agricultural conservation projects could cause increases in fugitive dust from disturbed soils and increased vehicle and equipment emissions. These impacts are expected to be minor and temporary.

**Long-Term Impacts**

No emissions would be associated with operation of agricultural conservation projects. Municipal conservation projects may include the use of reclaimed water. Reclaimed water will be treated and is not expected to produce odors.

### *5.17.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

If water rights are transferred to irrigate different areas, the construction of new water delivery systems would have minor and temporary impacts similar to those of the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

The only operational impacts to air quality expected from market-based water reallocation would increase dust if fields are fallowed.

#### *5.17.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction of groundwater storage facilities would have minor and temporary impacts similar to those of the Enhanced Water Conservation Alternative. If excavation is required for the infiltration basins, there would be an increased potential for fugitive dust during excavation.

**Long-Term Impacts**

The groundwater infiltration basins would be dry during certain periods of the year. The exposed ground could increase the potential for windblown dust. The extent of the increased dust would depend on the location of the basins and the amount of wind dispersal that would occur at specific site.

The groundwater storage facilities would require electric pumps, which would not produce emissions. If generators are used for back up power supplies, there would be increased emissions during those periods when backup power is needed. Those emissions would be temporary since the generators would only be used in emergencies.

### 5.17.3 Mitigation

Mitigation measures that could be used to reduce construction impacts for all State Alternatives include:

- Complying with applicable dust control policies and plans;
- Spraying dry soil with water to reduce dust;
- Minimizing idling of equipment when not in use;
- Covering dirt and gravel piles; and
- Sweeping roadways to reduce mud and dust.

Dust control plans could be developed to mitigate the impacts of increased dust from fallow fields and dry infiltration basins. Measures to reduce dust could include installing plantings around the infiltration basins and planting drought-tolerant plants in fallow areas. No mitigation measures are required for the temporary emissions from back up generators.

# 5.18 Noise

## 5.18.1 Affected Environment

The affected environment for noise is similar to that described in chapter 4. Projects associated with the State Alternatives would primarily be located in rural areas. Ambient noise sources in these areas consist of vehicular noise, power tools and mechanical equipment, and livestock. Some groundwater storage facilities could be located within city limits where ambient noise sources would include commercial, industrial, and residential activities.

## 5.18.2 Environmental Consequences

### *5.18.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction associated with conservation projects would temporarily increase noise levels in the project area. Noise sources would include increased vehicular traffic, heavy equipment, and the hauling of construction materials. These impacts would be short-term, likely lasting a few weeks. Construction activities are exempt from Ecology noise ordinances that apply to the project area.

**Long-Term Impacts**

The operation of conservation projects is not expected to generate increased noise.

### *5.18.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Under the Market-Based Reallocation of Water Resources Alternative, noise impacts would occur only if construction were required in order to apply transferred water rights to new areas. The construction impacts would be similar to those described for the Enhanced Water Conservation Alternative but smaller in scale.

**Long-Term Impacts**

The Market-Based Reallocation of Water Resources Alternative would not generate increased long-term noise.

### *5.18.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction impacts associated with the Groundwater Storage Alternative would be similar to those of the Enhanced Water Conservation Alternative. Construction of groundwater storage facilities located in incorporated areas would

be subject to the jurisdiction's noise regulations. Construction projects are exempt from noise regulations during specified hours (generally 7 a.m. to 10 p.m.).

**Long-Term Impacts**

Pumps used at the groundwater storage facilities would generate noise, but the noise would be minimal and likely undetectable off-site. No other long-term noise impacts would be associated with groundwater storage.

### 5.18.3 Mitigation

Construction noise impacts for all State Alternatives could be mitigated by limiting construction hours, using equipment with mufflers or noise control, and situating noise-generating equipment away from houses. For groundwater storage facilities located within city limits, projects would comply with applicable construction noise hours.

No mitigation measures would be required for operation of any of the State Alternatives.

## 5.19 Visual Resources

### 5.19.1 Affected Environment

The Yakima River basin in Central Washington is located on the arid side of the Cascade Range. The headwaters of the Yakima River are located in the forested areas of the Cascades. The river flows generally northwest to southeast to its mouth at the Columbia River. The river valley is broad and flat and surrounded by a series of ridges. In places the river cuts through these ridges. Agriculture is a major land use in the Yakima River valley, and views on the valley floor are primarily of agricultural fields with irrigation canals. Vegetation on the surrounding ridges is mainly grasses and shrubs. These ridges are brown most of the year and contrast with the green, irrigated portions of the valley floor. In the lower valley, near Yakima, Mount Rainier and Mount Adams are visible in places. In the upper valley, urban areas are limited to Ellensburg. In the lower valley a string of towns extends from the City of Yakima to Grandview. The major urban area of the Tri-Cities is located at the mouth of the river.

Projects associated with the State Alternatives would mainly be located in the rural portions of the Yakima River basin. Visual resources in those areas are characterized by agricultural fields with irrigation canals. Some of the irrigation canals support riparian vegetation.

## 5.19.2 Environmental Consequences

### *5.19.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Conservation projects would consist of improvements to existing irrigation systems in rural areas. No significant changes to visual resources are anticipated with most conservation projects. Construction equipment and activities would temporarily alter, but not obstruct, views.

**Long-Term Impacts**

The improved irrigation systems would be visually similar to existing systems. The exceptions would be where riparian vegetation is removed and where open canals or ditches are piped. The removal of riparian vegetation would reduce water losses from canals, but would change visual resources. Piping of canals or ditches would be a visual change from open water with a stream-like appearance to a pipe.

Most of the conservation projects would be visible only from the local area and would be viewed primarily by local farmers or ranchers. Some of the major delivery canals in the Yakima River basin are visible from major highways. Piping or lining of these canals would be visible to people driving through the basin, but the views would be for a few seconds or minutes.

### *5.19.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

If water rights are transferred to new areas, the construction of new irrigation facilities would be similar to the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

The Market-Based Reallocation of Water Resources Alternative would have no direct effects on visual resources. However, reallocation could result in land use changes that would alter visual landscapes. Water right transfers could result in expanding irrigation to new areas, changing agricultural uses to urban or domestic uses, or fallowing some fields. All would result in changes to the visual landscape, which some people may view as negative. Irrigated agriculture would be expanded into areas that are zoned for agriculture. Visual changes would be limited to changes in crop types and the addition of irrigation facilities, but the overall visual landscape would not be altered. Water transferred to urban or domestic uses would also be applied in areas that are designated for those uses. Some people may view a fallow field as potential wildlife habitat, while others may feel that such areas are unkempt and overgrown. Without weed control, fallowed fields could be invaded by weedy species.

#### *5.19.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction impacts associated with groundwater storage facilities would be similar to those of the Enhanced Water Conservation Alternative.

**Long-Term Impacts**

Groundwater storage facilities would change the visual landscape in their immediate areas. Infiltration sites would change from dry areas to basins that hold water. The basins could be as large as 20 acres. Injection facilities would be housed in pump houses similar to wells and have minimal visual impacts. The treatment facilities associated with infiltration would be housed in buildings that would alter the local visual landscape if located in rural areas; however, the impacts are not expected to be significant.

Injection and treatment facilities would be sited with existing treatment facilities where possible. Most conveyance lines would be underground. However, the intake lines would require pump facilities adjacent to the water source. This would consist of a pump house, power supply, and intake pipe. The facilities would be fenced. Depending on the location, the intake facilities would be visible from adjacent roadways and from boats on the river. All impacts would be localized and would affect a limited number of individuals; largely those people who live in or travel through the local area.

### 5.19.3 Mitigation Measures

No mitigation measures are proposed for construction impacts of any of the State Alternatives because the impacts are not expected to be significant. There would be no long-term impacts associated with the Enhanced Water Conservation Alternative, and therefore no mitigation is proposed.

The potential impacts associated with the Market-Based Reallocation of Water Resources Alternative would be mitigated by compliance with existing zoning and other regulations. The new uses supplied by water rights transfers would be located in areas that are designated for those uses. The counties in the Yakima River basin have weed control districts or ordinances that could be used to enforce weed control on fallow land. Ordinances could also be adopted or conditions added to transfer agreements to require planting of fallowed fields to reduce the growth of noxious weeds.

The visual impacts of groundwater storage facilities could be mitigated by using building colors that blend with the surrounding environment and plantings that screen the pump and injection facilities. Building colors could also help reduce the visual impacts of intake facilities. These areas and infiltration basins could also be screened with riparian plantings to make them less visible to the public.

# 5.20 Cultural Resources

Analysis of the impacts of the three proposed State Alternatives on cultural resources is based on a review of the known impacts to cultural resources on similar types of projects. A cultural resources overview of an area this large will necessarily be cursory. Some of the projects proposed by the State under this SEPA EIS will require additional review. Ultimately the specific projects will require a more detailed cultural resource analysis, including fieldwork.

Analysis of cultural resources for the Joint Alternatives was reviewed as part of the analysis of the State Alternative methods. Cultural resources are evaluated under different regulations for the Joint and State Alternatives. The State Alternatives are mainly evaluated under SEPA. Additionally, Washington State EO 05-05 establishes a review process by DAHP and affected tribes for capital projects or land acquisition proposed by State agencies; Ecology will initiate the project review process for the State Alternatives with DAHP once an alternative(s) is selected for more detailed analysis.

SEPA requires that cultural resources within a proposed project area must be identified, and that measures must be proposed to reduce or control impacts on these resources. Under SEPA, DAHP provides formal opinions on the significance of sites and the impact of the proposed projects on such sites. Other State laws governing cultural resources protect Native American graves (RCW 27.44), abandoned historic cemeteries (RCW 68.60), and archaeological sites (RCW 27.53). These laws contain clauses regarding the inadvertent discovery of cultural resources during activities such as construction.

The Joint Alternatives are evaluated under the NHPA, as well as EO 13007 (Indian Sacred Sites). Other Federal laws also may apply including the Native American Graves Protection and Repatriation Act (P.L. 101-601), the Archaeological Resources Protection Act (16 USC 470aa-470mm), and the American Indian Religious Freedom Act (42 USC §§ 1996, 1996a).

## 5.20.1 Affected Environment

General background on the Affected Environment is described in chapter 4, addressing Historic Resources and Indian Sacred Sites the Joint Alternatives.

## 5.20.2 Environmental Consequences

### *5.20.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Any on-farm conservation which involves ground disturbing activities has the potential to impact cultural resources. These include any new construction, such as ponds and conveyance lines. Overall, the impact to cultural resources

from enhanced water conservation efforts is expected to be low to moderate, depending on the scale of the conservation measures.

One of the projected aspects of enhanced water conservation is the efficiency based improvement of existing agricultural irrigation systems. Improvements to agricultural infrastructure have the potential to impact cultural resources in two ways. The first potential impact involves the replacement or modification of historic farm infrastructure, i.e., any building or modified landscape greater than 50 years old. Disturbed or modified farm infrastructure will have to be evaluated as to its age and potential historical significance depending on State or Federal involvement. For example, projects on private property supported by grants from the Natural Resources Conservation Services would be subject to the NHPA and would likely require at least archival review of the project for cultural resources and probably field work as well.

Secondly, any new construction associated with this alternative has the potential to impact both above ground and underground cultural resources located within their footprint. Impacts to cultural resources from municipal conservation might be expected if there are replacements to in-use historic-age water management infrastructure, as well as if there is ground-disturbing construction for new facilities. Furthermore, large scale changes to existing farm infrastructure would have the potential impact of diminishing the integrity of setting and location for historic age cultural resources in the vicinity.

**Long-Term Impacts**

The long-term impacts of this Enhanced Water Conservation Alternative to cultural resources could include modified patterns of modern human activity, and potentially altered stream or spring flows. If modern patterns of human activity are substantially changed, then surficial cultural resources within these areas are prone to impact from relic collecting and site disturbance.

#### *5.20.2.2 Market-Based Reallocation of Water Resources*

**Construction Impacts**

No impacts to cultural resources are anticipated due to the Market-Based Reallocation of Water Resources Alternative as this alternative consists primarily of transfer of water rights and not actual transfer of water to new uses. In cases where additional water is transferred for agricultural uses, it is assumed the land will already be in agriculture providing no significant change to the current condition.

**Long-Term Impacts**

Long-term impacts under the Market-Based Reallocation of Water Resources would be similar to those discussed for the Enhanced Water Conservation Alternative. By transferring water from lower value to higher value uses, this

alternative may result in more intensive agricultural activity in some areas. There also may be increased pressure to transfer water to higher value residential or commercial uses. All land use changes would take place consistent with adopted land use plans and zoning codes. Any shift to a more intense activity that would result in excavation would be subject to site-specific evaluations to determine the potential to affect cultural resources.

#### *5.20.2.3 Groundwater Storage*

**Construction Impacts**

The Groundwater Storage Alternative has the potential to impact cultural resource properties located within the footprint of any new ground-disturbing construction activities, including but not limited to: surface infiltration reservoirs, subsurface injection sites, water treatment sites, conveyance lines, access roads, electrical transmission corridors, and staging areas. Impacts are specific to these areas, and stem from the disturbance of *in situ* cultural resources. One moderating factor is that the types of landforms expected to be selected for groundwater storage infrastructure will be mainly located away from significant streams and rivers, areas which typically have fewer cultural resources than areas nearer perennial water sources. Only intake facilities are proposed at rivers. If alternative site locations are feasible, then complete avoidance of significant cultural resources may be possible.

**Long-Term Impacts**

Surface infiltration reservoirs are large facilities, and have the potential to adversely modify traditional cultural landscapes. This could have a negative impact on the integrity of setting and feeling of nearby archaeological sites and could also interfere with Traditional Cultural Properties (TCPs). Increased localized streamflow volume increases the potential for erosion of stream-side archaeological sites. However, restoring historic streams, springs, or seeps associated with historically significant areas like TCPs may actually increase their integrity. Overall, the impact to cultural resources from the Groundwater Storage Alternative is expected to be low to moderate.

### 5.20.3 Mitigation Measures

Depending on the funding source and degree of Federal involvement and permitting, the Section 106 process would need to be followed for the State Alternatives, including archival research, intensive cultural resource survey, NRHP site and district evaluation, general Cultural Resources Management Plans (CRMPs), site specific Historic Property Treatment Plans (HPTPs), NRHP eligibility testing, nature and extent testing, data recovery, and synthetic documentation. For projects that do not require compliance with NHPA, any inadvertent discovery of cultural resources on private land would be subject to

RCW 27.53 and RCW 27.44 which protect cultural resources and Indian burials on private land from being “knowingly” disturbed.

The construction of new infrastructure or renovation of existing infrastructure could require additional environmental review depending on the scale and location of the project, after which the exact mitigation measures would be developed in coordination with DAHP, the affected tribes, and other interested parties. Ecology will develop a CRMP for the Enhanced Water Conservation Alternative in consultation with interested parties. The CRMP will support the goals of the conservation alternative while ensuring appropriate cultural resources management. The CRMP will outline efforts to identify cultural resources in the project area, develop a review process for planned actions, outline potential mitigation measures, and include processes to identify and resolve conflicts.

Mitigation measures could include archaeological remote sensing during planning to allow avoidance; excavation of archaeological sites that would be adversely affected by the projects; documentation of historic structures; site protection/stabilization, including site burial, use of filter fabrics, revegetation, site armoring, and other measures; efforts to reduce vandalism through public education, fencing, or site surveillance; and archaeological monitoring during construction (Draper 1992; Lenihan et al. 1981). Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt and DAHP and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area.

Mitigation measures for TCPs would need to be determined in consultation with the appropriate cultural group. Because TCPs contribute to the maintenance of a culture, mitigation efforts may include documentation of the significance of the place through oral histories or recording traditional storytellers. It is important to note that it is not always possible to mitigate adverse effects to TCPs.

The Groundwater Storage Alternative is the most likely of the State Alternatives to impact cultural resources. Additional review including field investigations would be required once specific locations are identified.

## 5.21 Public Health and Safety

This section discusses public health and safety in terms of two issues relevant to storage projects: hazardous and toxic materials and potential for mosquito breeding.

### 5.21.1 Affected Environment

General background on public health issues, including information on mosquito-borne diseases is described in chapter 4. Projects implemented as part of the State Alternatives would be located primarily in rural areas. The potential for encountering hazardous materials in these areas would be more limited than in developed areas. However, agricultural chemicals or petroleum products could have been stored in areas that will be disturbed during construction. The Yakima River basin is arid with limited areas of standing water suitable for mosquito breeding. However, standing water created by existing irrigation systems could be used for mosquito breeding.

### 5.21.2 Environmental Consequences – Hazardous Materials

#### *5.21.2.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Hazardous or toxic materials could be encountered during construction of conservation projects. Most projects would be located in areas that have already been disturbed during previous construction, reducing the potential for encountering unknown hazardous materials. In areas where land use practices or other activities are known to have the potential for contamination, additional site-specific evaluations would be conducted prior to construction.

**Long-Term Impacts**

Operation of the conservation projects would not require or disturb any hazardous or toxic materials.

#### *5.21.2.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Hazardous or toxic materials could be encountered during construction of new irrigation facilities if water rights are transferred to irrigate different areas. However, the potential for this is expected to be small because most of these areas have been used for agricultural, and would not likely be subject to contamination. Additional evaluations may need to be conducted if construction is proposed near chemical storage areas, vehicle maintenance and storage areas, or other locations where hazardous chemicals could be concentrated.

**Long-Term Impacts**

If new areas are irrigated, agricultural chemicals could be applied to new areas, but those chemicals would be used in compliance with applicable regulations and are not expected to create hazards.

#### *5.21.2.3 Groundwater Storage Alternative*

**Construction Impacts**

Construction of facilities for groundwater storage could disturb areas of toxic or hazardous material. Because the facilities would be constructed in rural areas, the potential for encountering contamination is limited. However, additional studies may be required if construction is proposed in or near areas used for chemical storage, vehicle maintenance and storage, or other areas with intense chemical use. During facility siting, onsite investigations would be conducted to determine the feasibility of the site for recharge including the potential to encounter contaminated soils or groundwater. Facilities will be sited to avoid these areas to the greatest extent possible.

**Long-Term Impacts**

Treatment facilities for direct injection would require storage of chemicals onsite. Those chemicals would be stored and handled in accordance with applicable local, State, and Federal regulations including the Uniform Fire Code and the Model Toxics Control Act. The potential for spills or leaks of hazardous materials would be minor.

### 5.21.3 Mitigation

For all State Alternatives, mitigation measures to minimize impacts from hazardous and toxic materials during construction include:

- Site-specific investigations will be conducted prior to construction to identify potential constraints to the site, including contaminated soils or groundwater.
- Construction excavations will be observed for potential contamination. If field personnel observe onsite contamination, specific mitigation measures would be developed based on the magnitude of contamination identified.
- Construction plans will include provisions for contractors to follow if unanticipated contamination is discovered.
- Spill Prevention Control and Countermeasures (SPCC) Plans would be developed to identify emergency measures to be employed to prevent the accidental release of contaminants into the environment.

No mitigation measures are proposed for long-term impacts of the State Alternatives because the impacts are not expected to be significant.

## 5.21.4 Environmental Consequences – Mosquitoes

### *5.21.4.1 Enhanced Water Conservation Alternative*

**Construction Impacts**

Construction activities are not expected to increase breeding areas for mosquitoes. Additional pooling or ponding of water will not occur and may be reduced from existing conditions.

**Long-Term Impacts**

The Enhanced Water Conservation Alternative is not expected to increase the breeding areas for mosquitoes and reduced water seepage may decrease the breeding area by reducing or eliminating areas of leakage. Conservation projects would not increase areas of standing water. Lining and piping canals would reduce the available area for mosquito breeding. The removal of riparian vegetation along canals may also reduce the potential for mosquito breeding by reducing leakage. On-farm irrigation improvements may include ponds to capture and reuse tail water. Water is not expected to remain in the ponds long enough to provide breeding habitat.

### *5.21.4.2 Market-Based Reallocation of Water Resources Alternative*

**Construction Impacts**

Construction of new irrigation facilities would not create new mosquito breeding areas, as these facilities will mostly be piping or conveyance facilities with no areas of standing water.

**Long-Term Impacts**

Water transfers associated with water banks or water marketing would not directly affect mosquito breeding. New irrigation systems constructed for water rights transferred to irrigate different areas are not expected to create substantial areas of standing water that would increase mosquito breeding habitat. However, new canals could create small areas of standing water. These areas may require observation to ensure that mosquito breeding does not occur.

### *5.21.4.3 Groundwater Storage Alternative*

No impacts associated with mosquitoes are expected from direct injection methods of groundwater storage. However, the infiltration method will require a series of large basins to store water for infiltration. These basins could create mosquito breeding areas, but they are not expected to have stable water levels for a long enough period of time to create mosquito problems. Operation of the ponds will be monitored for the potential to enhance mosquito breeding.

### 5.21.5 Mitigation

Although no significant impacts are expected with any of the State Alternatives, an insect control program could be developed to mitigate the potential for increased mosquito breeding. Increased awareness by the agricultural community and irrigation facility operators will reduce the potential to create standing water.

## 5.22 Cumulative Impacts

Cumulative impacts associated with the State Alternatives vary according to the alternative, as described below.

The Enhanced Water Conservation Alternative would require minimal construction, but could result in cumulative economic as well as land use impacts. As with all the State Alternatives, this alternative involves transferring water from a lower value use to a higher valued use. This would lead to a shift in the timing of supply of water by reducing the amount of water that otherwise would percolate into the ground and reemerge as surface water some days or weeks later. This timing change could lead to a change in cropping patterns for those who experience improved irrigation reliability. A change in cropping patterns could result in a conversion of fallow or unused farmlands into more actively managed areas, which could contribute to a regional trend of reducing remaining undeveloped areas, which can provide habitat. In terms of potential economic impacts, the Enhanced Water Conservation Alternative would require initial financial investment as well as ongoing operational expenses; these expenses would be assumed to improve water supply reliability that would generate economic benefits during subsequent years. The anticipated funding for this alternative assumes the majority of the funding would be provided by Ecology with the remainder coming from other funding sources; implementation would add to Ecology's funding obligations and would place an additional administrative burden on Ecology staff. For local jurisdictions, funding for the conservation program would compete with the numerous other local funding needs. Money used for implementing the Enhanced Water Conservation Alternative would not be available for other public funding needs.

Implementing the Market-Based Reallocation of Water Resources Alternative would also result in a transfer of water from lower-valued uses to higher valued uses, with accompanying economic impacts and potential shifts in land use activities. Options for implementing this alternative include establishing a private nonprofit or for-profit entity, or working within established institutions such as the TWRP. All of these options require increased administrative costs for the implementing/administering entity. If these options are funded within existing publicly-funded institutions such as Ecology, additional funding sources will be required to shoulder the increased administrative burden. These additional funding needs will compete with numerous other funding needs for publicly

funded institutions, as well as costs to improve habitat for fish and other project-related objectives. If a private entity manages the administration of the water banking/water market approach, the price of water would likely rise. This could result in providing water to those willing to pay the highest price, which could result in a shift away from agriculture and toward municipal, industrial and commercial users, such as residential developers. Because of the market-based pricing, this alternative has the greatest potential for this type of cumulative land use impacts among the State Alternatives. Complying with adopted land use plans and policies within local jurisdictions would minimize this potential.

The Groundwater Storage Alternative would shift the supply of water resources, removing water from lower-valued instream flows when water is abundant in winter months, storing it underground, and withdrawing it to increase the supply of water available for higher-valued uses when water is scarce in summer months. This alternative would require financial investment for construction of recharge ponds, as well as ongoing operational costs. The construction of recharge ponds would permanently commit the acreage associated with the ponds (approximately 20 acres per pond) to recharge basins, removing these sites as habitat or agricultural areas. The large number of potential ponds could cumulatively contribute to long-term losses in both of these land use types. The cost of this alternative will likely be borne in large part by the public, which would, as described for the other State Alternatives, result in competing demands for increasingly limited public funding.

Implementing any of the State Alternatives would result in water being shifted from the production of lower-value goods and services to the production of higher-value goods and services. The shift in the production of water-related goods and services might alter the pattern of related economic activity. A shift in the production of irrigated crops from one area to another, and from one crop to another, for example, might alter the pattern of farm-related traffic, and the pattern of food processing activities. Such shifts could economically strand plant, equipment, and infrastructure associated with the lower-valued crops. Conversely, they might cause excess wear and tear on the plant, equipment, and infrastructure associated with the higher-value crops. Similar effects might occur with the transfer of water to produce goods and services other than irrigated crops.

The fields that otherwise would produce the lower-value goods and services would be left fallow or converted to other uses. When a landowner sells the water rights appurtenant to a parcel, the market value of that parcel might rise or fall, depending on the new use of the land. Such a rise or fall might have a parallel impact on the property taxes local governments receive from the land.

Ecology would work to minimize potential cumulative impacts to land uses by continuing to coordinate with tribes and local, State, and Federal agencies. Any

development that occurs as a result of more reliable water supplies would comply with local planning and zoning regulations, in accordance with adopted land use and planning polices.