Chapter 3

STATE ALTERNATIVES

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3.1 Introduction

3.1.1 Alternatives Development

This chapter describes the alternatives that Ecology is considering under its authority to evaluate both storage and nonstorage alternatives to improve flows in the Yakima River basin. These alternatives are outside the authority and scope of Reclamation's Storage Study and are described and evaluated separately as "State Alternatives."

Reclamation's authority for the Storage Study is limited to a Black Rock Alternative and other storage options in the Yakima River basin. Ecology and Reclamation are jointly considering these Joint Alternatives. As described in chapter 1, Ecology is evaluating a broader range of alternatives to meet the requirements of SEPA. For the purposes of SEPA, the alternatives are not limited to storage options or storage facilities located in the Yakima River basin. Another difference between the Joint Alternatives and the State Alternatives is that the Joint Alternatives apply only to irrigation districts in the Yakima Project. The State Alternatives apply to individual irrigators, all irrigation districts, and municipal and industrial users.

In December 2006, Reclamation and Ecology initiated scoping for the combined NEPA/SEPA EIS on the Storage Study. A number of scoping comments requested that Ecology consider nonstorage alternatives to fulfill its obligations under SEPA to identify reasonable alternatives in the EIS. Ecology determined that the objectives of the Yakima Storage Study are to provide additional water supplies for anadromous fish and agricultural irrigation, as well as to provide water for municipal growth. Based on these objectives and the scoping comments, Ecology decided to evaluate three additional State Alternatives in the EIS. These alternatives are:

- Alternative 1: Enhanced Water Conservation Alternative to implement water conservation measures in the basin;
- Alternative 2: Market-Based Reallocation of Water Resources Alternative that includes water transfers and water banking; and
- Alternative 3: Groundwater Storage Alternative that includes both active aquifer storage and recharge, and passive recharge.

In addition, Ecology considered including sites from the Columbia River Mainstem Off-Channel Storage Study to supplement water supplies in the Yakima

River basin. However, as described in section 3.5, that alternative is not being carried forward at this time because further study of storage in the Columbia River Basin has not been authorized, and it would be speculative to carry forward such an alternative at this time. The No Action Alternative, required to be considered under both NEPA and SEPA, is described in chapter 2 and the description is not repeated in this chapter. The analysis of the State Alternatives compares the proposed actions to the No Action Alternative.

The three State Alternatives are described below. Impacts of the State Alternatives are evaluated in chapter 5.

3.1.2 Summary of Alternative Results

The purposes of the State Alternatives are to improve water supply and water allocation in the Yakima River basin and specifically to meet the congressional goals of:

- Improving fish habitat
- Improving water supply for irrigation
- Meeting future municipal needs

It is not anticipated that any one State Alternative would meet all of the Storage Study goals (chapter 1) in all parts of the basin all of the time. Each of the goals has different requirements for quantity of water, place of use, and season of use. The goal for the proratable irrigation districts is 896,000 acre-feet of water for irrigation during a dry year. The cabin owners who hold post-1905 water rights have a need for approximately 500 acre-feet of municipal supply in the upper watershed during the irrigation season in dry years. Growing cities need water year-round for municipal supply. Additional water for instream flow is most valuable in tributaries within the system and in the upper reaches of the mainstem Yakima River. Each of the State Alternatives has the potential capacity to meet some of the goals more than others. Therefore, it is likely that the State Alternatives could be used in combination to meet specific goals or individually to address specific water allocation problems. For example, the Enhanced Water Conservation Alternative may supply instream flows in a specific reach or improve water supply for some proratable irrigation rights; the Market-Based Reallocation of Water Resources Alternative may supply water for instream flows and for the cabin owners; and the Groundwater Storage Alternative may supply municipal needs.

The Enhanced Conservation Alternative will slightly improve instream flow and water supply conditions during drought years. It can also meet future municipal demands during most years. For example, instream flow in the Yakima River (measured at the Parker gage) would increase by 40,000 acre-feet on average. Water supplies for proratable water users would increase by 20,000 acre-feet

during a severe drought year such as occurred in 1994. An additional municipal water supply of 13,400 acre-feet upstream of the Parker gage could be provided in a drought year such as occurred in 1994.

The Market-Based Reallocation of Water Resources Alternative would not increase the overall water supply in the Yakima River Basin, but could supply some municipal and irrigation water needs. It may improve instream flow in some reaches, depending on the location of transfers. It is estimated that approximately 225,000 acre-feet of water could be transferred during a typical drought year to meet proratable water users' demands. During non-drought years, water transfers could improve streamflow, meet municipal demands and provide some water for irrigation. However, the water supplied would be obtained from existing uses.

The Groundwater Storage Alternative would slightly improve streamflow in the Yakima River during the April-September time period and provide water for future municipal demands, instream flow or irrigation. The water supply for those needs would increase by 22,800 to 25,800 acre-feet per year on average during the April-September time period. This alternative would require water withdrawals from the Yakima River to supply the groundwater storage projects so a decrease in flow of 33,000 acre-feet per year on average would also occur, but only when flow is available for diversion. During a drought year when no flow is available for diversion, some groundwater return flow, approximately 1,600 acre-feet, would still occur and slightly increase water supply.

3.1.3 Consumptive versus Nonconsumptive Use of Water

Consumptive and nonconsumptive use are important considerations in water conservation programs, water transfers, and water markets and banking. Defining consumptive use is an important consideration for the Enhanced Water Conservation and the Market-Based Reallocation of Water Alternatives.

For a use of water involving a diversion from a source, a portion of the water withdrawn is consumed or lost to further use, primarily through evaporation. Examples of consumptive use within irrigation delivery systems include evaporation from open canals and drains, and evapotranspiration (ET) from vegetation growing along canal banks. For on-farm water use, consumptive use includes crop ET, evaporation of water sprayed into the air (spray evaporative loss), evaporation from the plant canopy (canopy loss), and water blown off of the irrigated property (wind drift) (Ecology, 2005a).

A nonconsumptive use is defined by Ecology regulation as water that is not diverted from a source or that is diverted and used without diminishment of the source. Examples of nonconsumptive uses include seepage and return flow from an irrigation canal and percolation from farmlands where water in excess of ET is

applied to fields. An example of a nonconsumptive use when water is not removed from the source is hydroelectric generation at a dam.

A water use may also be consumptive to a specific reach of a stream when water is diverted, used, and returned to the same source at a point downstream that is not in close proximity to the point of diversion. The segment of the stream between the point of withdrawal and the point of discharge is called the bypass reach. An example is a hydroelectric project that diverts the source into a canal that carries the water to a generating station, then returns it to the source some distance downstream.

The consumptive and nonconsumptive portions of a water right are important when determining how much water can be transferred or reallocated from a water conservation or water transfer project. Ecology has published guidance on determining irrigation efficiency and crop consumptive use (Ecology, 2005a). Typically the consumptive use portion of a water right can be transferred or reallocated from one water user to another within the Yakima River basin with conditions as to the location of transfers, effect on streamflow, and operations of the Yakima Project.

Transfers of the nonconsumptive portion of a water right are more difficult because each must be “water budget” neutral, that is, it must not increase consumptive use (unless offset by other water provided). In addition, each transfer cannot impair water rights, including instream flow water rights, in the bypass reach between the locations of the original and new points of diversion.

3.2 Alternative 1 - Enhanced Water Conservation

3.2.1 Description

The Enhanced Water Conservation Alternative is an aggressive program of water conservation measures to improve basin water supply without constructing additional large water storage reservoirs. The alternative includes conservation measures for irrigation district infrastructure improvements, on-farm conservation and irrigation efficiency improvements, municipal conservation, and commercial and industrial conservation.

Specific water conservation measures include lining or piping existing canals, automating canals, constructing reregulating reservoirs on irrigation canals, improving water measurement and accounting systems, installing on-farm water conservation improvements, and other measures. Municipal, commercial, and industrial conservation measures include improvements to infrastructure, household conservation programs, changes in commercial and industrial practices, and the use of reclaimed water.

Most of the projects proposed for the Enhanced Water Conservation Alternative involve reducing seepage and return flow which are nonconsumptive uses of water when viewed in terms of the entire river basin. They are consumptive uses when viewed reach by reach. Only a small amount of the water that will be conserved can be attributed to consumptive uses. However, the Yakima Project has some flexibility in its operation and can allow some redistribution of water within the basin. The challenge is balancing the reduced seepage and return flow from conservation projects with the potential effects on downstream water users and instream flows. For that reason, water conservation projects in lower basin locations such as Roza Irrigation District, Sunnyside Valley Irrigation District, and Wapato Irrigation District may be the focus for water conservation as long as projects to mitigate for reduced streamflow and water supply and to improve water quality below the Parker gage are completed.

3.2.2 Enhanced Water Conservation Projects

Agricultural water conservation measures included in the Enhanced Water Conservation Alternative have been identified in currently published Water Conservation Plans or other documents prepared by irrigation districts, conservation districts, or State and Federal entities. Specific projects are listed in the following tables. Table 3.1 provides a list of potential water conservation projects for water users that divert from the Yakima River, table 3.2 provides a list of potential water conservation projects for water users that divert from the Naches River. Other water conservation opportunities have been identified and are described in the Technical Report on the Enhanced Water Conservation Alternative (Ecology, 2007f). These other conservation opportunities were not analyzed in this study as the RiverWare model works with mainstem water users along the Yakima and Naches Rivers and not the tributaries. However the volume of water represented by the additional conservation projects is small compared to the volumes shown in tables 3.1 and 3.2 and would not change the findings of this report.

Table 3.1 Conserved water resulting from enhanced water conservation measures – Yakima River water users

Entity	Action	Conserved water					
		Flow (cfs)			Volume (acre-feet)		
		Seepage	Reduced spill	Total	Seepage	Reduced spill	Total
Kittitas Reclamation District	Lining/piping	5.5		5.5	2,000		2,000
Westside Irrigation	Lining/piping	1.7		1.7	600		600

Table 3.1 Conserved water resulting from enhanced water conservation measures – Yakima River water users (continued)

Entity	Action	Conserved water					
		Flow (cfs)			Volume (acre-feet)		
		Seepage	Reduced spill	Total	Seepage	Reduced spill	Total
Westside Irrigation	On-farm conservation	9.1		9.1	3,300		3,300
Ellensburg Water Company	On-farm conservation	19.6		19.6	7,100		7,100
Cascade Irrigation District	On-farm conservation	24.8		24.8	9,000		9,000
Cascade Irrigation District	Variable pump installation and tailwater reuse		5.8	5.8		2,088	2,.88
Bull Canal Company	Lining/piping	1.8		1.8	639		639
Bull Canal Company	On-farm conservation	1.9		1.9	680		680
Union Gap Irrigation District	Automation		0.6	0.6		200	200
Wapato Irrigation Project	Lining/piping	101.4		101.4	36,800		36,800
Wapato Irrigation Project	On-farm conservation	89.5		89.5	32,500		32,500
Wapato Irrigation Project	Automation		40.5	40.5		14,700	14,700
Wapato Irrigation Project	Storage/ reregulation					700	700
Sunnyside Valley Irrigation District	Lining/piping	11.7		11.7	4,265		4,265
Kennewick Irrigation District	Pump exchange			[1]178			64,500
Kiona Irrigation District	Lining/piping	41.2		41.2	439		4,124
Columbia Irrigation District	Lining/piping and pump exchange			[1]72			26,000

[1] Conserved flow and volume results from change in point of diversion from Yakima River to Columbia River along with some reduced seepage from replacing canals.

Table 3.2 Conserved water resulting from enhanced water conservation measures – Naches River water users

Entity	Action	Conserved water					
		Flow (cfs)			Volume (acre-feet)		
		Seepage	Reduced spill	Total	Seepage	Reduced spill	Total
Nile Valley Ditch Association	Lining/piping	1.1	–	1.1	395		395
Naches-Selah Irrigation District	Lining/piping	23.9	–	23.9	8,675		8,675
South Naches Irrigation District	Lining/piping	26.8	–	26.8	9,733		9,733
Gleed Ditch Company	Lining/piping	0.3	–	0.3	100		100
Yakima Valley Canal Company	Lining/piping	1.4	–	1.4	500		500
Naches and Cowiche Canal Company	Lining/piping	1.7	–	1.7	600		600

The Enhanced Water Conservation Alternative assumes that the conservation measures would be funded through State and Federal sources as well as local sources.

An additional water conservation project on the mainstem Yakima River has been identified but not analyzed for this report. The largest potential project is a pump back project on the lower Yakima River where water would be pumped into the lower Sunnyside Valley Irrigation District or Roza Irrigation District canals. This project may be feasible because of the increased instream flow present from implementation of the YRBWEP and the reduced diversions by Kennewick Irrigation District and Columbia Irrigation District for the projects shown in table 3.1. If feasible, the project may supply up to 200 cfs (72,000 acre-feet on an annual basis) back to the Sunnyside and Roza Canals. The project was not further analyzed at this time because of uncertainty of impacts to fisheries in the lower Yakima River. Further study of the feasibility of the project is recommended prior to selecting conservation projects to implement.

3.2.3 Comparison to the No Action Alternative

Both the No Action Alternative (chapter 2) and the Enhanced Water Conservation Alternative include conservation measures. The conservation measures included in the No Action Alternative are measures that will be implemented under the Yakima River Basin Water Enhancement Program. The Enhanced Water Conservation Alternative represents more aggressive implementation of conservation and differs from the No Action Alternative as follows:

- Conservation measures proposed under YRBWEP will be implemented. The Enhanced Water Conservation Alternative includes other conservation projects and municipal, industrial, and commercial conservation projects.

- Under YRBWEP, two-thirds of the conserved water resulting from a conservation measure is assigned to instream flows, and it is assumed to remain in the river from the implementing entity's point of diversion to the last point of operational discharge from its water delivery system. One-third of the conserved water is retained by the implementing entity for irrigation use. Under YRBWEP, two-thirds of the implementation cost of conservation measures will be federally funded by Reclamation, and one-third will be funded equally by a non-Federal entity (Ecology) and the implementing entity. A "cost ceiling" was established for the Federal funds of $67.5 million (in 1990 dollars) and is subject to increase by applicable cost indices. (The 2007 Federal cost ceiling is $115 million.)

- For the Enhanced Water Conservation Alternative two options are being considered:

    - Two-thirds of the conserved water may be retained by the implementing entity for irrigation or municipal and industrial use, while one-third is assumed to remain in the river from the implementing entity's point of diversion to the last point of operational discharge from its water delivery system; or

    - All of the conserved water would be retained by the implementing entity for irrigation or municipal and industrial use.

For the Enhanced Water Conservation Alternative, it is assumed that at least two-thirds of the implementation cost would be funded by Ecology without Federal funds, with the remainder funded by the implementing entity. No specific cost ceiling has been established for the Enhanced Water Conservation Alternative. For this analysis it was assumed that conserved water would become part of the TWSA to be managed by Reclamation for all water users. The assignment of benefits of conserved water will likely depend on the funding source and will be determined during the implementation phase.

The total estimated cost in 2007 dollars is $405 million. The cost may change as feasibility studies progress and some projects are found to be either not feasible or the benefits not sufficient to support the cost.

3.3 Alternative 2 – Market-Based Reallocation of Water Resources

3.3.1 Description

The Market-Based Reallocation of Water Resources Alternative proposes to reallocate water resources through a water market and/or water bank to improve water supply in the Yakima River basin. The alternative intends to:

- Increase the overall value of the goods and services derived from the basin's water resources, by reallocating water from low-value to high-value uses.
- Reduce the delay and cost of transactions that reallocate water resources.
- Ensure that, before transactions are completed, appropriate consideration is given to the potential impacts on third parties.
- This alternative proposes both water marketing and water banking options to facilitate water transfers and reallocate water resources. There is no one accepted definition of water markets or water banking. For the purposes of this alternative, the term "water market" refers to an institutional process designed to facilitate the voluntary transfer of water rights from a willing buyer to a willing seller on a permanent or temporary basis. The term "water bank" means an institution designed to (1) accept deposit of a water use entitlement, which will not be used by the water right owner during the time it is in the bank, and (2) make the entitlement available for withdrawal by the water right owner/depositor or another entity (Mentor and Morin, 2007).

The primary difference between a water market and a water bank is that in a water market, a water right holder is seeking a direct transaction with someone who wants to buy or lease his or her water. In a water bank, a water right holder deposits the water right into the bank on a permanent or temporary basis, and the bank makes the water available to a third party. The transactions in a water bank are between the water right holder and the bank on the one hand, and the bank and the third party on the other hand. The bank may pool water rights deposited by multiple water right holders to make larger blocks of water available for sale or lease. Another important distinction is that water rights listed in a market continue to be used pending a transaction to sell or lease the right. Water rights deposited to a bank are not beneficially used while they are on deposit and therefore, they must be protected from relinquishment.

3.3.2 Water Banks and Water Markets in Washington

To date, formal water marketing in Washington has been limited. Purchases and leases of water rights on a permanent or temporary basis occur regularly throughout the State. Many of the temporary leases are undertaken by non-profit groups such as the Washington Water Trust or Washington Rivers Conservancy to benefit instream flows. Ecology and Reclamation implemented an emergency leasing program in the Yakima River basin during the 2001 drought. In 2003, the Washington Legislature provided authority for water banking in the Yakima River basin using the Trust Water Rights Program (Chapter 90.42 RCW). Under this authority, Ecology conducted reverse auctions in the Yakima Basin in 2005 and 2007.

Beginning with the 2001 drought, the use of the State's Trust Water Right Program has evolved substantially to meet the needs of existing and prospective water users (Ecology, 2006b). Experience to date indicates that reallocation of existing water rights has taken place in five fairly distinct categories:

1. Drought-year transfers of a single season duration;
2. Drought-year mitigation banks;
3. Leases and purchases for environmental purposes;
4. Transfers and mitigation banking for post-1905 domestic and municipal water users; and
5. Transfers and mitigation banking for prospective domestic and municipal purposes.

To comply with requirements of the water banking legislation, Ecology prepared reports to the legislature in 2004 and 2006 (Ecology and WestWater Research, 2004; Ecology, 2006b). The 2004 report summarizes the status of water banking in western states and describes the considerations for developing a successful water bank. The 2006 report included a summary of statutory challenges to water banking in Washington.

3.3.3 Development of Options for the Market-Based Reallocation of Water Resources Alternative

Because the State has limited experience and success with water markets and water banks, Ecology determined that a broad range of options should be considered for the Market-Based Reallocation of Water Resources Alternative. The options presented in this EIS provide Ecology with the opportunity to evaluate a variety of options for administering and operating water markets or banks. The options include those for both water markets and water banks to allow additional flexibility in developing a reallocation system.

Ecology developed the options for the Market-Based Reallocation of Water Resources Alternative using information from the 2004 and 2006 legislative reports and a review of literature on existing water markets in the West. Key considerations in developing the options were elements for administering the market or bank and changes that would be required to existing Washington water law. A detailed report on developing the options is presented in the Technical Report on the Market-Based Reallocation of Water Resources Alternative (Ecology, 2007h).

Development of the Market-Based Reallocation of Water Resources Alternative considered both the administrative structure of the water market or water bank and issues and concerns specific to implementing such a program in Washington. Both are briefly described below and are addressed in more detail in the Technical Report (Ecology, 2007h).

3.3.3.1 Administrative Structure of Water Markets and Water Banks

There are a variety of administrative considerations in developing water markets and water banks. Considerations include:

- Organization structure and function. A key to successful markets is the availability of information. Options for providing information include information clearinghouse, brokerage, and providing technical support. Means must also be provided to verify that transactions have occurred and comply with the terms of the contract.

- Administrator. A successful administrator must have the trust of all the users and the expertise to provide the structure and functions of the market or bank.

- Price. Because potential buyers and sellers may not know of one another or have enough information about costs, an important function of a water market or bank is the distribution of information regarding the water available for sale or lease, the price attached to each, and details of prior transactions.

- Who can buy/lease or sell/lease water. The goal of a water market or water bank will determine who should be allowed to participate. The market or bank can be restricted to those who already hold water rights or could be open to anyone desiring water.

3.3.3.2 Issues and Concerns with Market-Based Reallocation of Water Resources in Washington

An important element for the success of water markets and water banks is a system that not only allows, but facilitates and encourages water transfers through such mechanisms. In Washington the key issues to facilitate reallocation are:

- Laws and Rules Governing Transfers of Water Rights. Transfers of water rights are subject to statutory requirements (RCW 90.03.380) and transfers into and out of the Trust Water Rights Program (TWRP) have additional requirements (Chapters 90.38 and 90.40 RCW). The time to process water right transfers under these requirements is seen as an impediment to successful markets and banks. Streamlining the process may require changes in legislation and agencies rules, policies, and procedures.

- Who Evaluates the Water Rights Transfer? Government approval of a water right transfer has been identified as a serious impediment to successful water markets and water banks with the blame placed on processes that are slow, costly, and burdensome (Ecology 2007h). In Washington, Ecology evaluates a water rights transfer. Until the Yakima River basin adjudication is complete, the Yakima Superior Court evaluates temporary transfers. Federal laws and Reclamation water contracts add a layer of complexity.

- Timing of Evaluation. In the past, Ecology's review process has slowed the transfer of water rights. Legislation that established a separate review process for new water rights and water rights changes and other administrative changes have reduced the review time. Additional changes could be made to separate the review process for transfers through a water market or bank.

- Transaction Costs. Transaction costs include processing time and the expenses parties incur to overcome the complexity of completing a deal. Buyers and sellers can be discouraged if they perceive the transactions costs are too high. The Yakima Transfer Working Group has helped reduced some of the transaction costs in the Yakima basin. Other changes such as improved publicizing of markets and prices could further reduce real and perceived transaction costs.

- Third-Party Impacts. The impacts of water transfers on third parties is a major concern with water markets and water banking and may present the greatest impediment to successful water markets and banks (MacDonnell, 1995). RCW 90.38.380 requires that a transfer may not impair other existing water rights. Other third-party impacts, including public interest values such as the viability of a particular industry or the prosperity of a community, are not considered when surface water transfers are evaluated. Ecology could seek legislative changes to require consideration of the public interest in the evaluation of water right transfers.

- Who Do You Trust? Lack of trust in the entity administering water markets and water banks is a potential impediment to reallocation, especially when the entity that administers the transfers is the same entity that regulates water rights. Ecology has acknowledged that some

landowners lack trust in the agency (Ecology, 2006b). Ecology may be able to overcome this problem through education and other efforts. An alternative solution to this problem is to allow non-regulatory entities to provide education on water transfer opportunities, to conduct confidential evaluations of water rights, and possibly to administer a water market or water bank.

- Irrigation Districts and Water Right Transfers. Irrigation districts play a major role in the allocation of water in the Yakima River basin. Districts are allowed to make some water transfers within irrigation districts without Ecology approval and may form a Board of Joint Control between districts to allow transfers between those districts. Irrigation districts can prevent the transfer of water outside the district and this has been identified as a barrier to water right transfers. If this is identified as a problem in the Yakima basin, Ecology could seek legislation that requires irrigation districts that object to a transfer to demonstrate that the transfer would adversely affect the delivery of water or the financial integrity of the district.

3.3.4 Market-Based Reallocation of Water Resources Alternative Options

Based on the evaluation of potential water markets and water banks presented in Technical Report (Ecology 2007h), Ecology is considering two options for implementing water marketing and four options for water banking in the Yakima River basin. Alternatives 2A and 2C are based on existing laws and structures with some suggestions for streamlining and efficiency. Alternatives 2B, 2D, 2E, and 2F call for substantial changes to the existing laws and structures. Alternatives 2E and 2F are options for creating water banks to facilitate transfers within and from irrigation districts.

3.3.4.1 Alternative 2A: Water Market Using Existing Authority

The Water Market Using Existing Authority option would bring sellers and buyers together and operate under existing laws and regulations regarding water right transfers with noted changes to improve efficiency. The market would be administered by a private nonprofit entity that would operate solely as a clearinghouse. The administrator would post information about the water rights of willing sellers and information about water rights that willing buyers are looking for. Information would include the location of the water right, the elements of the right including quantity, point of diversion, place of use, purpose of use, season of use, and priority date.

Additional characteristics of the Water Market Using Existing Authority Alternative include:

- The market would accept a water right for posting based on evidence of confirmation by the Yakima Superior Court through the adjudication. If more than 5 years have passed since entry of the Conditional Final Order for the water right, a water right evaluated by a Certified Water Rights Examiner would be accepted for posting. Legislation would be required to authorize the certification of water rights examiners.

- The administrator would conduct outreach and education regarding the market and opportunities it provides. The administrator would also track all transactions carried out through the market to provide others with information about previous transactions.

- The market would be restricted to buyers/lessees who hold current water rights that do not provide adequate water for the purpose for which they were issued and to those acquiring water for instream flow.

- Prices would be determined by market forces and negotiations between buyers and sellers. A transaction fee would be charged to help fund the administration of the market.

The water right transfer process would be based on existing statutes, implemented in slightly different ways from Ecology's current practices. Currently, the primary statutory requirement for transfers is that a transfer may not impair any existing water rights. Because the extent and validity of the rights would have been determined by the Yakima Superior Court or by a Certified Water Rights Examiner, the determination of potential injury from the transfer would be limited to the consumptive use analysis. Legislation is required to simplify this analysis and make the process more transparent. To facilitate implementation, Ecology should also amend its rule to create a separate line for processing applications to transfer water rights that are being acquired through the market. This would provide an incentive to conduct transactions through the market.

3.3.4.2 Alternative 2B: Open Water Market

This alternative provides the framework for a more open and active market. The market would offer more services to sellers and buyers, and the transfer approval process would require legislative changes. The administrator of this market would operate not only as an information clearinghouse similar to Alternative 2A, but also as a broker to oversee the mechanics of the transaction. This function is analogous to a real estate broker in that the administrator would help sellers post and price water for sale or lease and help buyers find water on the market that meets their needs. The administrator would offer technical support to move the transfer through the regulatory process. The administrator would also offer verification services to confirm that the seller no longer uses the right, the buyer received it, and both parties complied with the contract.

There are two options for administering and funding this market. One would be for a private, nonprofit organization to administer the market (like Alternative 2A), with operation of the market funded by transaction fees. A second option would be for a private, for-profit entity to administer the market and charge commissions as well as fees on transactions, including perhaps a use fee for water transferred through the market. The price for water would be market-driven, and anyone could buy or lease water through the market regardless of whether they currently have water rights.

The most significant difference from Alternative 2A would be the process for review and approval of the water right transfer. Under the Open Water Market Alternative, Washington State would adopt the "Colorado process" for use in the Yakima River basin. In Colorado, water courts are district courts, similar to Washington's superior courts. The water courts conduct general business of the district court but also specialize in water cases. An application to transfer a water right is submitted to the court, which assigns it to the water referee. The referee investigates the truth of the statements in the application and any statements in opposition. The referee also consults with the division engineer for the region where the court operates. The advantage of this system is that the water rights transfers would be reviewed by a body that would be independent of Ecology and other regulatory agencies and have no responsibility for regulating the use of water rights.

3.3.4.3 Alternative 2C: Water Banking Using Existing Trust Water Rights Program

Under this alternative, the existing TWRP would function as the water bank. Under the TWRP, water rights can be temporarily or permanently transferred to trust. Those water rights that are temporarily transferred to trust may be withdrawn by the depositor for his or her own use or may be transferred to another person or entity. Those water rights permanently transferred to trust are either to be used according to the terms of the transfer or may be used by Ecology for any recognized beneficial use. Significantly, a water right is protected from relinquishment as long as it is in trust (RCW 90.38.040(6)). RCW 90.42.100 specifically authorizes Ecology to use the TWRP for water banking purposes in the Yakima River basin.

Ecology is authorized to acquire water rights, including storage rights, by purchase, lease, donation or other means, except condemnation, on a temporary or permanent basis (RCW 90.38.020(1)(a),(3)). When the TWRP is used as a bank, Ecology is the banker and can use the water itself or make it directly available to third parties.

The use of the TWRP suffers from some of the problems that have reduced the success of other water banks. In particular the requirements for approval of water right transfers can be complex and time consuming. When a water right is

transferred to the TWRP for administration for water banking purposes, the water right is reviewed under RCW 90.03.380 both at the time it is transferred into trust, and in some situations, when the right is transferred out of trust (RCW 90.42.110). The application for the transfer into trust "must indicate the reach or reaches of the stream where the trust water right will be established before the transfer of the water right to the TWRP" and "identify any reasonably foreseeable future temporary or permanent beneficial uses for which the water right may be used by a third party upon transfer from the TWRP." If the future place of use or other elements of the water right are not identified when the right goes into trust, "another review under RCW 90.03.380 will be necessary at the time of a proposed transfer from the trust water [rights] program" (RCW 90.42.110).

3.3.4.4 Alternative 2D: Nonregulatory Water Bank

Under this alternative, a bank would be formed outside of the TWRP. The bank could be administered by a private, nongovernmental entity (a nonprofit or for-profit organization) or by a nonregulatory governmental agency. The bank could offer a standing price for the purchase of water rights and for temporary deposits of water rights to be made available for lease, or the price could be negotiated on a case-by-case basis. The water right holder would be compensated regardless of whether the bank was able to sell or lease the rights and regardless of the price the bank received. Because the water rights would not be used while on deposit with the bank, legislative changes would be required to protect the rights from relinquishment.

The extent and validity of the right would be established prior to deposit to the bank. As with Alternative 2A: Water Market Using Existing Authority, a water right confirmed in the adjudication within 5 years of deposit would be accepted as confirmed by the court. If more than 5 years had passed, the right could be certified by a Certified Water Rights Examiner.

The transfer of the water right would be reviewed at the time the water right is sold or leased from the bank. Because the extent and validity of the right would be established prior to deposit with the bank, the review of the transfer would be limited to the issue of impairment. The review could be conducted by Ecology as explained for Alternative 2A, or through a water court as recommended in Alternative 2B. Whichever approach is chosen, the goal would be to simplify the transfer process and create certainty and trust. As for the market alternatives, water right transfers from the bank to a third party would be processed through a separate line that would allow priority processing.

3.3.4.5 Alternative 2E: Drought Year Transfers Outside of Irrigation Districts

This alternative is intended to free up transfers of water outside of an irrigation district during drought years. Under current law, Ecology must receive the concurrence of an irrigation district where water is proposed to be transferred outside of the district (RCW 90.03.380(2)). Under this alternative, irrigation districts would be required to allow transfer up to 30 percent of the total water supply allotted to the district in years when the State declares a drought under RCW 43.83B.405. A system would be established to allow a member of the district to petition for the temporary transfer of water under their water right to Reclamation to be managed as part of TWSA. The member would fallow the acres associated with the transferred water. The member would be paid by Reclamation, Ecology or a water bank established for that purpose, who would in turn be paid by the recipient of the transferred water. Prices would be set by a process, yet to be determined, that may have Reclamation, Ecology or a water bank setting fixed prices or the different parties negotiating prices specific to individual transactions.

3.3.4.6 Alternative 2F: Irrigation District Bank

Under this alternative, an irrigation district would act as a water bank during both good water years and years of drought. The difference from Alternative 2E is that the district would act as the bank rather than Reclamation or Ecology. A district would send out a call for water to their members at a fixed price. Water right holders within the district would decide to fallow all or a portion of their land for all or a portion of the irrigation season and bank their water with the district. The district could pool the banked water and identify blocks of water that they are willing to sell to junior districts or others. By selling large blocks the districts would have more pricing power. The districts would take a portion of the selling price and manage water use.

3.4 Alternative 3 – Groundwater Storage

3.4.1 Description

The Groundwater Storage Alternative proposes to use surface water to recharge (replenish) aquifers and use the natural storage capacity of geologic formations to store water for later recovery and use. Typically aquifers would be recharged with surface water during high flow periods. The stored water would be used to supply out-of-stream uses, increase streamflows through increased groundwater discharge, and/or replenish depleted groundwater storage. The source water is expected to be surface water from the Yakima River or one of its tributaries. A water right would be required to divert water from the river or a tributary and to store the water in a reservoir, including an underground geological formation. RCW 90.03.370. A new water right may not be granted if it would impair

existing rights, including Reclamation's water rights for the Yakima Project. New or existing infrastructure (canals or pipelines) would be used to convey this water to the recharge site. The availability of water would be a function of seasonal timing and location within the Yakima River basin.

Groundwater storage is achieved by recharging water to the deep (confined) and shallow (unconfined) portions of the aquifer system. There are two distinct methods of recharge:

- **Injection Recharge (Direct Injection with Active or Passive Recovery).** This method injects water via wells and targets deeper confined aquifers. The injected water would be actively recovered via wells or passively recovered through natural discharge to streams.

- **Surface Recharge with Passive Recovery.** This method distributes water at the ground surface, which then infiltrates to a shallow unconfined aquifer and naturally discharges to streams or springs.

3.4.1.1 Injection Recharge

Injection recharge is a method that injects water via wells into a deep aquifer. The injected water may be recovered actively or passively depending on the objective of the recharge. Municipal aquifer storage and recovery (ASR) is the term used when the stored groundwater is actively recovered for potable uses. When the storage is allowed to discharge naturally, it is called injection with passive recovery. Both methods of recovery are included in this alternative.

Municipal Aquifer Storage and Recovery

ASR systems inject water via wells into aquifers during periods of excess capacity and withdraw the water for municipal supply during periods of peak demand or limited supply. Figure 3.1 shows a typical configuration of an ASR system. In Washington State, ASR systems are regulated under WAC 173-157. Because the source water must meet water quality standards for potable water, the water is obtained from conventional drinking water treatment plants or from groundwater wells. ASR systems require recharge/recovery wells and conveyance infrastructure to transport the water from the source to the recharge well, and from the recovery well to the municipal supply.

Injection with Passive Recovery

Direct injection can also be used to store water in the aquifer with passive recovery (figure 3.1). Under this option, potable water would be injected into an aquifer during periods of excess capacity, but the water would become part of the natural groundwater system, remain in the aquifer, and flow to natural discharge areas (i.e., streams or springs). The water would be passively recovered when it reaches the stream and would be available for instream or out-of-stream uses.

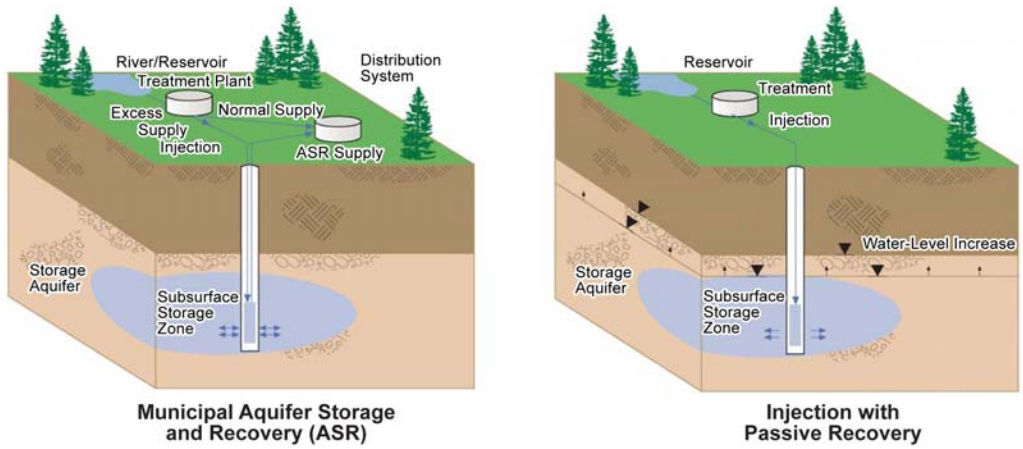

Figure 3.1 Injection recharge.

Injection into a deep aquifer results in a longer lag time (interannual retention) between injection and when the water reaches natural discharge areas. This interannual retention time provides a more constant discharge of recharged water to streams and other discharge areas. Injection to shallower portions of the aquifer system provides shorter lag times between the time of recharge and the time of peak return flows.

Injection with passive recovery would require treatment facilities, injection wells, and conveyance infrastructure to transport the water from the source (similar to facilities needed for municipal ASR). However, no conveyance system would be required to transport water to the place of use.

Potential Locations

Candidate sites evaluated for municipal ASR include the cities of Yakima (Ahtanum Valley), Ellensburg (Kittitas Valley) and Kennewick (Lower Valley). Sites evaluated for direct injection with passive recovery include the Black Rock-Moxee Valley and the Lower Yakima Valley immediately downstream of Union Gap. Direct injection of water at the headwaters of the Lower Yakima Valley (i.e., immediately below the Parker gage) could offset the small municipal users throughout the Lower Valley. Water recharged to the Upper Ellensburg Formation by direct injection may be passively recovered by seepage back to streams. Such seepage may be used to mitigate impacts from junior water users by increasing streamflows.

Specific sites for municipal ASR would be selected at a future time if the Groundwater Storage Alternative is carried forward. Additional site-specific studies would be required to identify specific sites.

Direct Injection Analysis

To evaluate the potential for utilizing ASR, a three-dimensional groundwater flow model was developed of the Ahtanum-Moxee Subbasin in the Yakima Valley. The goal of modeling was to estimate the quantity of recharged water to three injection wells that would: (a) return to the Yakima River; (b) discharge at other hydrologic sinks; or (c) remain in the subsurface in the form of increased groundwater storage. The impacts of direct injection for both passive and active recovery are based on the computer simulation of the direct injection of water into the deeper portion of the groundwater system of the Ahtanum Valley. The results are summarized below. Details of the modeling and results are described in the Technical Report for the Groundwater Alternative (Ecology, 2007g).

- **Direct Injection**. Direct injection resulted in an immediate increase of aquifer storage and a delayed seepage of water to the stream. After the first annual cycle, 92 percent of the recharged water remained in the aquifer, and the increased seepage rate from the aquifer to the Yakima River above baseline conditions was approximately 0.6 cfs. Direct injection during winter months for 10 years resulted in an increased aquifer storage by approximately 28,600 acre-feet, and a seepage rate of approximately 3 cfs at the end of the 10-year period.

- **Active Recovery**. Active recovery of recharged water on an annual basis resulted in a recovery efficiency of greater than 92 percent. For instance, an injection rate of 8,000 gpm over half a year results in a recoverable volume of approximately 6,000 acre-feet per year, with the remainder of the recharged water that is not recovered seeping out to streamflow.

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

The costs associated with a direct injection program include infrastructure associated with obtaining recharge water (e.g., surface water treatment facilities or river bank filtration wells), transmission pipelines, injection wells, and additional costs (permitting, operations and maintenance, land acquisitions for facilities). The total cost for the sites above Parker gage is estimated to be $65 million based on the assumptions described in the Technical Report (Ecology, 2007g). Unit costs used to develop the cost estimate include $1 million per 1 mgd capacity of a treatment plant, $500,000 per well for a river bank filtration well, $1 million per mile of transmission pipelines, and $2 million per direct injection well.

Surface Recharge with Passive Recovery

Surface recharge with passive recovery involves diverting and infiltrating surface water into a recharge basin during periods of high streamflow and allowing it to discharge naturally back to a stream (figure 3.2). The natural discharge back to the stream is termed passive recovery because the water is available for instream and out-of-stream uses when it reaches the stream. The infiltration sites would be located so that the timing of return flow to a stream corresponds to periods of low flow. The source of the infiltration water would be direct surface diversion from a river or irrigation canal, or reclaimed water treated to standards for recharge. Surface recharge systems are intended to recharge water before lower streamflow conditions occur.

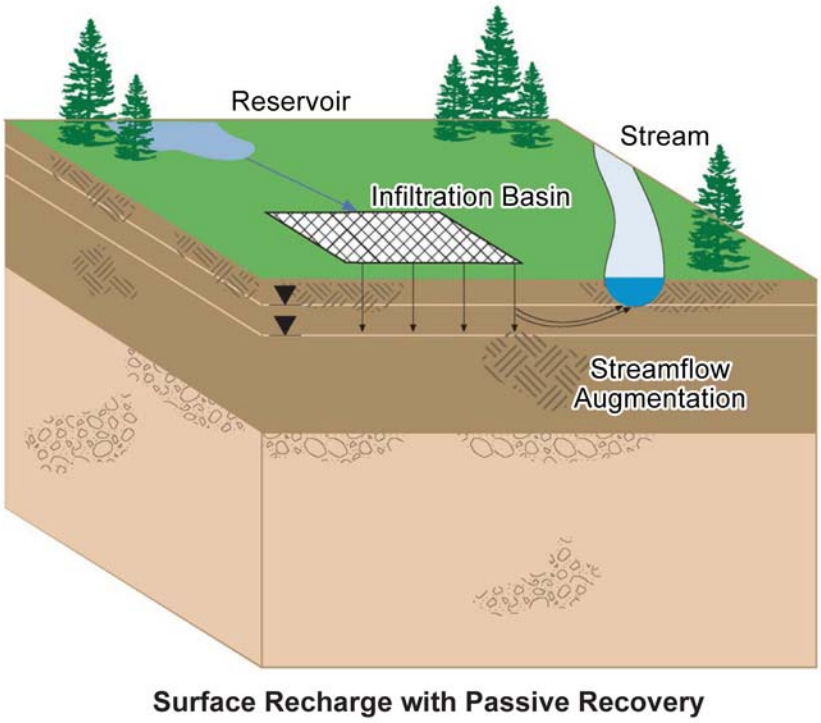

Figure 3.2 Surface recharge.

Potential Locations for Surface Recharge

Specific sites were not identified for surface recharge locations because of the lack of site-specific hydrogeologic data. Instead a map of the possible locations for sites was developed that could be used with more site-specific data. A detailed discussion of the methods and analysis are provided in the Technical Report on the Groundwater Storage Alternative (Ecology, 2007g). The specific number of surface recharge facilities has not been determined, but could range from more than 30 small basins to less than 10 larger basins.

The surface recharge facilities would be located in the shallow alluvium and unconsolidated sediments in the Yakima River basin to maximize aquifer storage and transmission of groundwater. Surface recharge facilities may require conveyance facilities to move water from the source to the infiltration basin. Pumping may be required to move the water through the canal system if a gravity canal system is not feasible.

Surface Recharge Analysis

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

- **Target Return Flow Profile.** This approach identified a desired condition for groundwater return flows, and examined the amount of infiltration and total area of infiltration ponds required to achieve the target infiltration profile.

- **Water Supply in Excess of Entitlements and Flow Targets.** This approach used the historical monthly availability of TWSA for the period from 1978 to 2000 to determine in which months there was water in excess of entitlements and flow targets in reservoir storage that could be diverted into infiltration ponds.

The results of these estimates suggest that an average infiltration capacity of 20 to 60 acre-feet per acre per month would be reasonable to expect for the study area. Based on these infiltration capacities, an area of 166 to 500 acres of land would be required to infiltrate 10,000 acre-feet of water in 1 month. Details on the analysis are provided in the *Technical Report on the Groundwater Storage Alternative* (Ecology, 2007g).

The costs associated with surface recharge sites will be highly variable depending on the location and design of the infiltration facilities. Rather than conduct a detailed engineering cost breakdown, costs were estimated using a comparison with five Central Arizona Project recharge facilities. Based on the assumptions summarized in the Technical Report (Ecology, 2007g), total construction costs could range from $50 million to $100 million, with an expected cost of $89 million.

3.5 Comparative Evaluation of State Alternatives

The impacts of the three State Alternatives are described in chapter 5 and summarized in table 3.3.

Table 3.3 Impacts summary

Element of the environment	Enhanced Conservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources			
Surface water *Construction* *Long-term* *Mitigation*	There is potential to increase sediment loading to surface water bodies during construction. Long-term impacts may include an increase in streamflow in the stream being diverted from along with a reduction in return flow from reduced seepage in other streams. The reduction in return flow may reduce base flows in streams. 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. Mitigation of construction impacts can be achieved through construction related BMPs. Long-term impacts can be mitigated by ensuring the net effect of the project is beneficial.	Construction and long-term impacts and mitigation measures would be similar to that of Enhanced Conservation, but of a lesser magnitude.	Construction impacts would be similar to those described under Enhanced Conservation. Changes in flow and temperature would occur when flow is diverted for recharge. Flows will decrease when water is diverted and increase when the stored water reaches the river. Increased discharge to seeps, springs, and surface water would occur. Construction and long-term mitigation measures would be similar to those described for Enhanced Conservation.
Water rights *Construction* *Long-term* *Mitigation*	No construction impacts to water rights would occur. In the long term, conservation may free up water under existing water rights for potential transfer and reallocation. Additional water may be available, which may reduce curtailment of junior water rights during water-short years. Proposed projects must meet State standards for review and mitigation regarding specific issues listed in RCW 90.03.370(2)(a) and defined further in Chapter 173-157 WAC.	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 administrative approval of the transfer. Some of the water marketing and water banking alternatives propose changes to the review of transfers. To the extent the law is changed to facilitate transfers through markets, there may be additional impacts to water rights. Proposed projects must meet the same standards as described for the Enhanced Conservation Alternative.	Construction and long-term impacts and mitigation measures would be similar to those described under Enhanced Conservation.

Table 3.3 Impacts summary (continued)

Element of the environment	Enhanced Conservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources (continued)			
Groundwater *Construction* *Long-term* *Mitigation*	Construction impacts are not anticipated. Long-term impacts may include changes in the level, gradient, recharge and discharge rates, and contaminant introduction. Impacts may be mitigated by conducting appropriate hydrogeological studies prior to project implementation.	Construction impacts are not anticipated. Long-term impacts and mitigation measures would be similar to those described under Enhanced Conservation. Mitigation measures would be similar to those described under Enhanced Conservation.	Limited construction impacts would be associated with the development of groundwater storage facilities including infiltration basins and treatment facilities; however construction is not expected to extend to the groundwater table and dewatering is not anticipated. Long-term impacts and mitigation measures would be similar, but possibly greater than, those described under Enhanced Conservation.
Hydropower *Construction* *Long-term* *Mitigation*	Construction impacts are not anticipated, because construction activities will not impact streamflows. Conservation may result in reduced power generation at the BIA plants during most years, but may be improved during drought years.	Similar to the Enhanced Conservation Alternative, no construction impacts are anticipated. Long-term impacts would depend on the location of the transfers. If water is transferred to the WIP, some increase in hydropower may occur. No mitigation would be required.	No construction impacts are anticipated. There would be no long-term impacts to hydropower generation. No mitigation would be required.
Sediment *Construction* *Long-term* *Mitigation*	Construction could temporarily increase rates of sediment erosion. There would be no long-term impacts to channel morphology. Mitigation measures would include the implementation of BMPs including the timing of construction, and measures that limit erosion and stabilize degraded conditions.	Impacts and mitigation would be similar to those described under the Enhanced Water Conservation Alternative. In the long-term, changed land uses could cause increased or decreased erosion depending on the new land use. No mitigation would be required.	Impacts and mitigation would be similar to those described under Enhanced Conservation.
Water quality *Construction* *Long-term* *Mitigation*	There is potential to increase sediment loading to surface water bodies during construction. Long-term impacts may include increased dissolved oxygen, reduced stream temperatures and increased pollutant concentrations in runoff. Mitigation for construction impacts would be similar to the preventive measures described under Sediment.	Construction impacts would be similar to those described under the Enhanced Water Conservation Alternative, but to a lesser degree. Long-term impacts from water transfers are not known. Water quality parameters (including temperature) may improve or degrade depending on the type of land use the water is transferred to, and the volume and location of water transferred.	Construction impacts would be similar to those described under Enhanced Conservation. Changes in groundwater quality could occur, but these changes are not expected to be significant. Mitigation for construction impacts would be similar to the preventive measures described under Sediment.

Table 3.3 Impacts summary (continued)

Element of the environment	Enhanced onservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources (continued)			
Water quality (continued) *Construction* *Long-term* *Mitigation*		Mitigation for construction impacts would be similar to the preventive measures described under Sediment.	
Vegetation and wildlife *Construction* *Long-term* *Mitigation*	Construction impacts from irrigation improvements may alter existing vegetation structure and the distribution of habitat potentially disrupting wildlife. Construction impacts would also include noise and activities that would temporarily displace wildlife. Over the long term, reduced seepage and water rights transfers may alter the distribution of vegetation and wildlife. Mitigation measures for construction impacts would be alleviated by siting and designing facilities to minimize the need for vegetation removal. These measures would also include the application of construction BMPs, and the restoration of disturbed areas.	Construction impacts and mitigation measures would be similar to those described under Enhanced Conservation, except to a lesser degree. In the long-term, water rights transfers may impact land use ultimately altering vegetation structure and wildlife habitat distribution in some areas. Mitigation measures for construction impacts would be similar to those described under Enhanced Conservation.	Construction impacts would be similar to those described under Enhanced Conservation. Over the long-term, groundwater levels would rise, which may affect vegetation communities and wildlife habitat in some areas. This could have both positive and negative impacts. Mitigation measures for construction impacts would be similar to those described under Enhanced Conservation.
Anadromous fish *Construction* *Long-term* *Mitigation*	There is potential to increase sediment loading to surface water bodies during construction. Long-term impacts associated with the potential increase in streamflow would be considered beneficial. Mitigation for construction impacts would be similar to the measures described for Sediment. Additional mitigation measures for impacts to Anadromous Fish are listed in chapter 5.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree.	Construction impacts and mitigation measures would be similar to those described under Enhanced Conservation. In the long-term, groundwater storage is expected to benefit anadromous fish and other aquatic organisms by potentially improving base flows and providing influxes of cold water.
Resident fish *Construction* *Long-term* *Mitigation*	Construction and long-term impacts are similar to those described for anadromous fish. Applicable mitigation measures for impacts to resident fish are listed in chapter 5.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.

Table 3.3 Impacts summary (continued)

Element of the environment	Enhanced Conservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources (continued)			
Aquatic invertebrates *Construction* *Long-term* *Mitigation*	Construction impacts are anticipated to be minor and isolated to areas adjacent to instream disturbances. Long-term impacts may include changes to the community composition of aquatic invertebrates due to potential increases in streamflows, and site specific alterations created during the enhancement irrigation infrastructure. Project-specific studies would be required to determine potential impacts to aquatic invertebrates.	Construction and long-term impacts and mitigation would be similar to those described under Enhanced Water Conservation.	Construction and long-term impacts and mitigation would be similar to those described under Enhanced Water Conservation.
Threatened and endangered species *Construction* *Long-term* *Mitigation*	Construction and long-term impacts would be similar to those described for Anadromous Fish and Vegetation and Wildlife. Mitigation measures would be similar to those described for Anadromous Fish and Vegetation and Wildlife.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.
Recreation *Construction* *Long-term* *Mitigation*	Impacts to recreation from construction are not expected. Conservation may increase streamflows in some reaches, but not to the extent that recreation would be impacted. No mitigation would be required.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.
Land use and shorelines *Construction* *Long-term* *Mitigation*	Impacts to land use from construction are not expected. Improvements to irrigation efficiency could reduce the potential conversion of agricultural lands to other uses. No mitigation would be required.	Construction impacts would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree. Transfers of water rights may result in changes in land use intensity. Whether development intensity increases or decreases is dependent on currently unspecified transfers. Impacts to land use would be mitigated by compliance with existing land use and zoning regulations.	Construction impacts would be similar to those described under the Enhanced Water Conservation Alternative. Acquisition and/or special management of lands in the vicinity of the infiltration or injection areas may be required. Property would be purchased from willing sellers or acquired according to applicable State and Federal regulations.

Table 3.3 Impacts summary (continued)

Element of the environment	Enhanced Conservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources (continued)			
Socioeconomics *Construction* *Long-term* *Mitigation*	The scope and design of specific projects would determine their short-term costs and benefits on socioeconomic factors. In the long term, this alternative is intended to 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. Mitigation, if any, would be determined by future socio-economic conditions. Measures may include, but would not be limited to compensation and /or replacement of lost goods and services.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. In the long-term, transfers of water would likely 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.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. In the long-term, increases in groundwater levels could alter the production of goods and services near wetland, floodplain, and riparian areas.
Public services and utilities *Construction* *Long-term* *Mitigation*	Construction along roadways could cause temporary disruption of utilities and increased response time for police and fire emergencies. Over the long-term, conservation programs would reduce overall expenditures on public services and utilities. Mitigation measures designed to avoid impacts during construction are listed in chapter 5.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. In the long-term, this alternative would incur costs for implementation and administration; however, water rights transfers have potential to improve the reliability of irrigation supplies.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. In the long-term, groundwater storage would require additional costs for treatment and operation.
Transportation *Construction* *Long-term* *Mitigation*	Construction impacts could include temporary disruption of traffic depending on project site locations. No long-term impacts are anticipated. Mitigation would include maintaining access to properties, installing signage, and providing information to the public.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative, except to a lesser degree.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.
Air Quality *Construction* *Long-Term* *Mitigation*	Construction impacts would include increases in fugitive dust from disturbed soils and increased emissions. No long-term impacts are anticipated. Mitigation measures are listed in chapter 5.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Long-term impacts would not affect air quality unless water transfers create fallow field conditions increasing the potential for fugitive dust.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Long-term impacts would not affect air quality unless infiltration basins go dry, increasing the potential for fugitive dust.

Table 3.3 Impacts Summary (continued)

Element of the Environment	Enhanced Conservation	Market-Based Reallocation of Water Resources	Groundwater Storage
Water resources (continued)			
Noise *Construction* *Long-Term* *Mitigation*	Noise sources would temporarily increase during construction activities. No long-term impacts are anticipated. No mitigation measures are required.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Pumps used at storage facilities would generate noise during operations, but the noise would be minimal and likely undetectable offsite.
Visual *Construction* *Long-Term* *Mitigation*	Construction equipment and activities would temporarily alter, but not obstruct, views. Conservation projects would alter to the long-term views of the landscape, but impacts are anticipated to be limited. No mitigation measures are required.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Long-term impacts to visual resources from land type conversion would depend on the type and amount converted land.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Long-term impacts to visual resources from the develop-ment of infiltration and well facilities would depend on location and size of the facilities.
Cultural *Construction* *Long-Term* *Mitigation*	Any construction that involves ground disturbing activities has the potential to impact cultural resources. In the long-term, human activity patterns may be altered by conservation projects resulting in relic collecting and site disturbance. Ecology would initiate additional cultural resource surveys when specific projects are identified.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.	Construction impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative. Increasing groundwater levels may affect the preservation of buried organic materials or the soil chemistry of buried cultural resources. Groundwater storage is not likely to other-wise adversely affect cultural resources during construction or over the long-term.
Public Health and Safety *Construction* *Long-Term* *Mitigation*	Construction activities are not anticipated to significantly impact public health and safety. No significant long-term impacts are anticipated. Mitigation measures are listed in chapter 5.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.	Construction and long-term impacts and mitigation measures would be similar to those described under the Enhanced Water Conservation Alternative.

3.6 Other Alternatives Considered but Eliminated from Further Study

Ecology considered using water from a site identified in the Columbia River Mainstem Off-Channel Storage Study to augment supply in the Yakima River basin. The *Appraisal Evaluation of Columbia River Mainstem Off-Channel*

Storage Options (Reclamation and Ecology, 2007) evaluated four off-channel sites. The study recommended the Crab Creek site for further evaluation. The Crab Creek site is located on Lower Crab Creek, which discharges to the Columbia River on the east bank between Wanapum and Priest Rapids Dams. The Appraisal Evaluation indicated that Crab Creek is a viable option that could supply enough water to supplement supply in the Yakima River basin.

Although the project seems viable, Ecology decided not to carry it forward at this time. There is no congressional authorization for a feasibility study of the project, and it would be speculative to assume that the project would go forward. Also, since no feasibility study has been done on the Columbia River off-channel options, it would not be possible to analyze these options in a way comparable to the Black Rock or Wymer Alternatives. If Congress authorizes additional study of the Crab Creek site, Ecology may reconsider the off-channel alternative.