Technical Memorandum
Yakima River Basin Watershed Plan

Water Use Efficiency in the Agricultural Sector

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Prepared by:

Montgomery Water Group, Inc.
620 Kirkland Way, Suite 202
PO Box 2517
Kirkland, WA 98083

(425) 827-3243

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1.0 Introduction

Improvements in water-use efficiency are one strategy that can help to optimize available water resources in the Yakima River Basin. This technical memorandum describes how water-use efficiency measures apply to agricultural water use in the Basin, and assesses the potential benefits with respect to the Planning Objectives of the Yakima River Basin Watershed Planning Unit. Water-use efficiency efforts in the municipal sector will be addressed separately, in a different technical memorandum that focuses on municipal, industrial and rural domestic water supply. Additional technical memoranda are being prepared to address other strategies, such as water-rights transfers and water storage improvements.

In the Yakima River Basin, agricultural water-efficiency initiatives can be categorized in two main groups. First, there are measures implemented by the irrigation districts, which obtain water under contract from the U.S. Bureau of Reclamation (USBR) and deliver it to individual water users within district boundaries. Second, there are "on-farm" measures implemented by water users themselves, whether within or outside an irrigation district. Both of these categories will be covered in this technical memorandum.

The water use efficiency measures presented in this section can contribute in various ways to the Planning Objectives identified by the Planning Unit[1]. Some types of measures extend available water supplies either on farm or for a district, thereby contributing to the objective of improving the reliability of water supply for agriculture. Measures may result in reduced diversions from a given reach of the Yakima mainstem, with attendant benefits to instream flow. On-farm measures may reduce soil erosion, thereby improving water quality in drains and the main stem. However, not all water-use efficiency measures deliver these benefits equally. The specific benefits depend on the type of measure implemented, and its location within the basin.

2.0 Summary of Findings

Irrigation districts in the Yakima River Basin have proposed a range of water-use efficiency projects for their irrigation water delivery systems, primarily under the auspices of the Yakima River Basin Water Enhancement Project. The total cost of the projects listed in district Water Conservation Plans total approximately $400 million.

[1] See Phase 3 Scoping Matrix, October 18, 2000.

In addition to improvements in efficiency of the delivery systems operated by irrigation districts, individual landowners can implement water-use efficiency measures to reduce on-farm usage. On-farm improvements typically include replacement of rill irrigation with pressurized spray systems, microspray or drip systems; installation of soil moisture sensors and improvements in on-farm irrigation scheduling.

Efforts to improve water-use efficiency in the agricultural sector contribute to several of the Planning Objectives identified by the Yakima River Basin Planning Unit. Table 2-1 presents a summary of potential benefits and implementation factors for the water use and on-farm efficiency measures examined. A more detailed discussion of the potential benefits is contained in Sections 5 and 6 of this memorandum.

The water-use efficiency measures generally provide low to medium benefits to instream flows (13 out of 15 projects), water quality (12 out of 15 projects) and improvement to reliability of water supply for agriculture (all 15 projects). The benefit to instream flow depends on the project's location within the Yakima River and the amount of water potentially saved. For example, on the mainstem Yakima River two projects with large benefits to instream flow are the Columbia Irrigation District and Kennewick Irrigation District projects. For those projects a substantial flow will be left instream in the lower Yakima River by changing the District's point of diversion from the Yakima River to the Columbia River. An improvement or benefit to water quality generally follows an increase in instream flow. The greater the instream flow increase in areas with water quality problems, the greater the water quality benefits. The lower Yakima River is an area where water quality and instream flow conditions can be substantially improved with that project. In other areas, such as the Yakima River between Cle Elum and Sunnyside Dam, an issue for much of the irrigation season is a flow regime that has high flows. Therefore actions that increase flows during the irrigation season in that reach do not provide a benefit to the river system.

A low to medium benefit to improving the reliability of water supply results because other water users rely on the return flows from farms and irrigation districts, as well as ground water that infiltrates during the irrigation season, for their own source of supply. As districts or farmers become more efficient, their return flows and/or ground water infiltration is diminished. For example, the USBR estimates the volume of return flow that is useable for water supply to be approximately 350,000 AF in a low runoff year (Watershed Assessment Yakima River Basin, EES, 2001). That return flow volume is about 18% of the Total Water Supply Available (TWSA) in low water years. If the return flow volume is reduced, the water needed by other users still must be released from storage to fulfill their irrigation requirements. Therefore, while many water-use efficiency measures in the agricultural sector cause changes in the timing or location of flows, they may offer a relatively minor opportunity to reduce the total quantity of water needed for irrigation supply. In this way, conservation is a very different strategy from storage.

The water-use efficiency measures may have a negative effect on aquifer levels, as seepage from canals and farms would be reduced. The cycle of seepage and return flow is important in areas such as the Kittitas Valley where discharge from the groundwater system that is supplied by seepage is an important part of the water supply for water users in the lower Yakima River valley as well as local groundwater users. The effect on local groundwater users is discussed in a

separate Technical Memo titled "Issues Related to Management of Groundwater Supplies" (EES, 2002). The groundwater return flow typically does not return instantaneously to a stream but contributes flow with a time delay ranging from days to months because of the slower travel time through groundwater compared to surface water.

The cycle of seepage and return flow has existed since the inception of irrigation in the Yakima River Basin. The present-day system of diverting and using water is dependent on that cycle. The return flow may have beneficial effects on late summer, fall or winter streamflow by increasing flow during low-flow periods and moderating temperatures in streams.

The Water Conservation Program under the Yakima River Basin Water Enhancement Project (YRBWEP) has a goal of achieving 165,000 acre-feet (AF) of saved water by the eighth year (2002). Although conservation plans have been prepared by several irrigation districts, none of the projects have been implemented, and no water saved, as of year 2001 under the YRBWEP. The USBR has provided no implementation funds since the program was passed into law in 1994. The primary issues that have prevented more progress in implementation appear to be the potential relinquishment of water after efficiency measures are implemented and diversion reduction agreements that are required by the USBR that may not be beneficial to irrigation districts in the Basin. In addition, the USBR appears to be focusing its resources on negotiating and completing purchases of water rights to increase instream flow, rather than conservation measures, at this time.

A limited number of water use efficiency measures have been implemented recently by Irrigation Districts with funding separate from the YRBWEP. An example is the Kiona Irrigation District rehabilitation project, which was completed in 1996 with state and federal funding through the Department of Ecology (Ecology) and Federal Emergency Management Agency (FEMA). For that project the District was converted to a pressurized pipe system fed by a pump intake on the Yakima River. The existing gravity intake and portions of the canal system were washed out in the February 1996 flood creating the need for replacement to a more efficient system. Other Districts, such as the Sunnyside and Roza Irrigation Districts have been replacing laterals with pipelines and installing new control structures and SCADA systems to provide better operation of main canals using funding outside of YRBWEP.

Table 2-1
Water Use Efficiency Strategies
Potential Benefits and Implementation Considerations

Water Use Efficiency Projects	Potential Benefits to Planning Unit Objectives[1]					Implementation Factors		
	Irrigation Supply	Municipal, Industrial, Domestic Supply	Instream Flow	Aquifer Water Levels	Surface Water Quality	Relative Cost (per AF)	Implementation Complexity	Technical Complexity
1. Kittitas Reclamation District	◒	---	◒	●	◒	◒	◒	◒
2. Roza ID	◒	---	◒	●	◒	◒	◒	◒
3. Roza-Sunnyside Board of Joint Control	◒	---	◒	●	◒	◒	◒	◒
4. Selah-Moxee ID/Moxee ID	◒	---	◒	●	◒	●	◒	◒
5. Ahtanum ID[2]	◒	---	◒	●	◒	◒	◒	◒
6. Union Gap ID/Fowler Ditch Co.	◒	---	◒	●	◒	●	◒	◒
7. Wapato Irrigation Project	◒	---	◒	●	◒	●	◒	◒
8. Outlook ID	◒	---	◒	●	◒	◒	◒	◒
9. South Naches ID	◒	---	◒	●	◒	◒	◒	◒
10. Naches-Selah ID	◒	---	◒	●	◒	◒	◒	◒
11. Yakima-Tieton ID	◒	---	◒	---	◒	○	◒	◒
12. Benton ID	◒	---	◒	●	◒	◒	◒	◒
13. Columbia ID	◒	---	○	---	○	◒	◒	◒
14. Kennewick ID	◒	---	○	---	○	●	◒	◒
15. On-Farm Efficiency Measures	◒	---	◒	●	○	◒	◒	◒

[1]For complete statement of objectives, see Phase 3 Scoping Matrix, dated October 18, 2000
[2]Instream flow benefit to Ahtanum Creek

Key to Symbols		
Symbol	**Benefit Columns**	**Implementation Columns**
○	Large benefit	Low cost or complexity
◒	Low to medium benefit	Medium cost or complexity
●	Negative impact	High cost or complexity
---	Not applicable	Not applicable

3.0 Types of Water Use Efficiency Measures

A number of types of water use efficiency measures may be suitable for irrigators in the Yakima River basin. Table 3-1 lists the types of measures and their potential effects. The table shows two categories of measures: those implemented by irrigation districts, and those implemented by farmers or landowners. Irrigation districts divert and deliver water supplies, but the water is actually put to use on the farm. The water-efficiency techniques and effects applicable to districts are substantially different from those at the farm level.

Most of the measures result in a reduction of the volume of water needed to operate an irrigation district or an individual farm, provided sufficient water is available to meet irrigation water demands. The measures result in a different pattern of diversions and return flows, seepage, and reservoir releases. The measures have a potentially small effect on the total amount of water needed in the Yakima Project system during years without proration. During years of proration, there is likely no net effect on the total amount of water needed in the Yakima Project system. While this may still offer benefits, particularly for instream flows and water quality, the effects must be examined on a case-by-case basis.

The effects of water-use efficiency measures will also differ depending on whether they involve proratable or non-proratable entitlements. In irrigation districts that depend primarily on proratable entitlements, water-use efficiency measures will not reduce diversions during dry years, since diversions in dry years are determined by water availability rather than by district operations. In contrast, for non-proratable districts, which receive full supply even in dry years, water-use efficiency measures could potentially reduce diversions in all years.

The same conclusions can also be reached for non-Yakima Project water users, such as those in tributary basins.

Further information on implementation of water use efficiency measures in the Yakima Basin is provided in Sections 5 and 6, and Appendix A.

Table 3-1
Types of Water Use Efficiency Measures

Water Use Efficiency Measure	Potential Effects
Irrigation District Measures	
Lining or piping gravity canals and laterals or installing pressurized irrigation water delivery systems	Lining or piping canals and laterals (either gravity or pressurized) reduces seepage from irrigation facilities. Can reduce diversions but may have negative impact on local ground water supplies and ground water returns to surface waters.
Tailwater or drainage pump-back stations	Tailwater or drainage pump-back stations can reuse irrigation water and improve water quality by reducing tailwater discharge and discharge from drains into streams and rivers. Can reduce overall diversions, but also reduces return flows.
Canal automation and re-regulation reservoirs	Can reduce spills and improve management of water supply for farmers and irrigation districts, making more of the water diverted available for use within the district
Improved water measurement and accounting	Improved water measurement and accounting can improve the management of water supply for irrigation districts.
On-farm Measures	
On-farm improvements, such as pressurized irrigation systems, microspray or drip systems, soil moisture sensors, and irrigation scheduling	On-farm improvements and irrigation scheduling can increase irrigation efficiencies and improve management of water supply for irrigation districts and water users. On-farm improvements may reduce erosion with consequent improvement in water quality of return flows. May have negative impact on local ground water supplies and ground water returns to surface waters.
On-farm ponds to capture and reuse tailwater	Can reduce tailwater, increasing on-farm efficiency. May reduce erosion with subsequent improvement in water quality of return flows.

4.0 Applicable Programs

4.1 Yakima River Basin Water Enhancement Program

Title XII of Public Law 103-434 authorized the Secretary of Interior, acting through the USBR, to establish and administer the Yakima River Basin Water Conservation Program, in consultation with the State of Washington, the Yakama Indian Nation, the Yakima River basin irrigators, and other interested parties. Title XII is considered to be Phase II of the Yakima River Basin Water Enhancement Project (YRBWEP).

Title XII section 1201 states:

> The purposes of Title XII are:
>
> (1) to protect, mitigate, and enhance fish and wildlife through improved water management; improved instream flows; improved water quality; protection, creation and enhancement of wetlands; and by other appropriate means of habitat improvement;
>
> (2) to improve the reliability of water supply for irrigation;
>
> (3) to authorize a Yakima River Basin Water Conservation Program that will improve the efficiency of water delivery and use; enhance basin water supplies; improve water quality; protect, create and enhance wetlands; and determine the amount of basin water needs that can be met by water conservation measures;
>
> (4) to realize sufficient water savings from the Yakima River Water Conservation Program so that not less than 40,000 acre feet of water savings per year are achieved by the end of the fourth year [1998] of the Basin Conservation Program, and not less than 110,000 acre feet of water savings per year are achieved by the end of the eighth year [2002] of the program, to protect and enhance fish and wildlife resources; and not less than 55,000 acre feet of water saving per year are achieved by the end of the eighth year [2002] of the program for availability for irrigation;
>
> (5) to encourage voluntary transactions among public and private entities which result in the implementation of water conservation measures, practices, and facilities; and
>
> (6) to provide for the implementation by the Yakama Indian Nation at its sole discretion of (A) an irrigation demonstration project on the Yakama Indian Reservation using water savings from system improvements to the Wapato Irrigation Project, and (B) a Toppenish Creek corridor enhancement project integrating agricultural, fish, wildlife and culture resources.

Through the YRBWEP Conservation Program, grants are available to eligible entities (e.g. irrigation districts) that fulfill requirements such as furnishing all surface water delivery systems with volumetric measuring devices within 5 years and completing agreements that conserved water cannot be used to expand irrigation. Exceptions for the Yakama Indian Nation are provided.

The Conservation Program is structured in four phases:

Phase	Funding Formula
1. Development of water conservation plans;	50% state grant (not to exceed $200,000 per recipient), 50% federal grant, with any residual paid locally
2. Feasibility investigation of specific water conservation measures;	50% state grant (sum of 1 and 2 not to exceed $200,000 per recipient), 20% local (after deducting state funds), with residual paid by federal grant
3. Implementation; and	17.5% state grant, 17.5% local match, and 65% federal grant
4. Post-implementation monitoring and evaluation	17.5% state grant, 17.5% local match, and 65% federal grant

The measures eligible for funding under the Conservation Program include, among others:

- conveyance and distribution system monitoring,
- automation of water conveyance system,
- water measuring or metering devices and equipment,
- lining and piping of water conveyance and distribution systems,
- on-district storage,
- electrification of hydraulic turbines,
- tail-water recycling,
- consolidation of irrigation systems,
- irrigation scheduling, and
- improvement of on-farm water application systems.

The testing of innovative water conservation measures is also encouraged such as water right transfers, water banking, dry year options, the sale and leasing of water, and other allocation tools.

The water savings that result from the program will be directed towards all purposes of the Yakima Project. However, based on the water savings goals identified in Title XII, USBR is requiring 65% of the water saved through water use efficiency measures be used for instream flows, while 35% of the saved water will remain available for irrigation. Diversion reduction agreements are required of participants in the program.

To date, six Water Conservation Plans consistent with Phase 1 of the program have been developed by irrigation districts. Other districts have prepared plans with funding from Ecology or from other USBR funding programs. Feasibility investigations (phase 2) are under way by some districts for efficiency measures recommended in the Plans. The USBR has provided no implementation funds (phase 3) since the program was passed into law in 1994 (see Section 7.2). Therefore, none of the 165,000 acre-feet savings per year envisioned in Title XII have been achieved to date.

The primary issues that have prevented more progress in implementation appear to be the potential relinquishment of water after efficiency measures are implemented and diversion reduction agreements that are required by the USBR that may not be beneficial to irrigation districts in the basin (see further discussion in Section 7). In addition the USBR appears to be focusing its resources on negotiating and completing purchases of water rights to increase instream flow rather than conservation measures, at the present time.

4.2 Referendum 38

The Referendum 38 program was established by Ecology to provide grants and loans covering rehabilitation, improvement, and construction of agricultural water supply facilities for agricultural use alone or in combination with fishery, recreational, or other beneficial uses of water. The program is described in Chapter 173-170 of the Washington Administrative Code (WAC). An objective of the Referendum 38 program is to provide state assistance to public bodies engaged in irrigation to improve their efficiency of water use.

Financial assistance was made available through Referendum 38 for planning, implementation, emergency projects, small parcel projects, and fisheries and recreational facilities. The maximum amount of financial assistance includes $200,000 per applicant for planning, and $1.5 million per applicant for implementation.

Generally, in the Yakima Basin Ecology has used Referendum 38 money to contribute to the YRBWEP Conservation Program. Ecology has funded the completion of eight Water Conservation Plans in the Yakima basin under the Referendum 38 program separately from the USBR (see discussion of irrigation district water conservation plans in Appendix A.

4.3 Centennial Clean Water Program

The Centennial Clean Water Program is administered by Ecology to achieve improvements to water quality. This program has been used recently to fund on-farm improvements in the Sunnyside Valley (SVID) and Roza Irrigation Districts (RID). In

2001, $10 million was allocated to provide loans to SVID and RID farmers to implement on-farm improvements such as conversion from rill to pressurized sprinkler systems. The loans are low interest rate loans, 1.5% in 2001 for a 10-year loan term.

4.4 Other Programs

Other programs that may be available to improve water use efficiencies include those offered by Bonneville Power Administration (BPA), the Natural Resources Conservation Service (NRCS), and local Conservation Districts. BPA is responsible for implementation of fish and wildlife enhancement projects in the Columbia River basin and is very active in the Yakima Watershed. A recent project funded by BPA was purchase of pressurized sprinkler systems in the Teanaway River basin to improve on-farm efficiencies and increase instream flow in the Teanaway River.

The NRCS and Conservation Districts work together and are also very active in improving water use efficiencies. Their programs are primarily directed at individual farmers and on-farm efficiency projects. They typically engage in educational and training programs, technical assistance, and cost-sharing programs to implement efficiency measures. The Conservation Districts located in the Yakima River watershed include the Kittitas County Conservation District, the North Yakima Conservation District, the South Yakima Conservation District, and the Benton Conservation District.

An example of a program used in those Districts is the Environmental Quality Incentives Program (EQIP). The EQIP was created in the 1996 Farm Bill to provide a voluntary conservation program to address significant natural resource needs and objectives. The EQIP can provide funding assistance for installation of on-farm water use efficiency projects.

5.0 Potential Water Use Efficiency Measures for Irrigation Districts

Water use efficiency strategies proposed by irrigation districts within the Yakima River Basin are assessed in this section. The water use efficiency strategies were compiled from Water Conservation Plans prepared by the Districts under YRBWEP, Referendum 38 and other programs. The Districts were also consulted to ensure the projects are up-to-date as of the time this Technical Memorandum was prepared. The projects included in this section are generally related to the conveyance systems operated by districts. On-farm measures are discussed separately, in Section 6.0.

5.1 Existing Water Loss Data from Irrigation Districts

This section provides background information on the volume of existing water losses due to operational spill, seepage and evaporation in irrigation districts. The information is useful in understanding the volume of diversions that could potentially be reduced through implementation of water use efficiency projects, provided the irrigation district has a full water supply. The annual loss estimates due to operational spill, seepage and evaporation for each irrigation district were summarized in the *Watershed Assessment Yakima River Basin* (Economic and Engineering Services, Inc. et al., January 2001),

based on review of individual district water conservation plans. The estimates of annual diversions and losses were updated for this technical memorandum to include more recent data and data from other irrigation districts. That data is summarized in Table 5-1. All except one of the irrigation districts listed in Table 5-1 divert from either the Yakima or Naches River and receive water from the Yakima Project operated by the USBR. The Ahtanum Irrigation District diverts water from Ahtanum Creek and does not receive water from the Yakima Project. Some of the estimates of seepage and evaporation are listed separately, while others were presented together in the districts' Water Conservation Plans.

Of the irrigation districts for which data is available, the gross diversion is approximately 1.7 million acre feet (MAF) per year on average. An estimated 174,000 acre-feet per year (AFY) (approximately 10% of diversions) is lost from canals and laterals to operational spill, while an estimated 250,000 AFY (15% of diversions) is lost from canals and laterals to seepage and evaporation. Data from the Wapato Irrigation Project is also listed in Table 5-1. Its diversions are approximately 621,000 AFY with losses estimated to be 244,000 AFY (39%). Those losses are not directly comparable to other losses shown in the table as they include on-farm seepage losses.

Table 5-1
Available Seepage and Loss Data for Irrigation Districts

Irrigation District	Average Diversion (AF)	Estimated Losses (AF)		
		Operational Spill	Seepage	Evaporation
Kittitas Reclamation District	310,453	17,075	85,377	
Roza ID	364,138[1]	40,010	104,157	
Sunnyside Valley ID[2]	437,374	45,328	20,601	
Selah - Moxee ID	13,903[3]	695	3,476	
	22,590[4]	1,130	5,648	
Ahtanum ID	22,595[5]	5,648	Not Itemized Separately	
Union Gap ID	16,007[6]	1,601	4,001	
Fowler Ditch Company	5,787[6]	289	1,447	
Outlook ID	16,549[7]	827	1,655	
South Naches ID	23,835	12,468	Not Itemized Separately	
Naches-Selah ID[8]	45,569	3,190	12,303	
Yakima-Tieton ID	82,200	2,466-4,110	0	0
Benton ID	22,341[7]	7,011	2,982	792
Columbia ID	64,051	12,067	10,000	
Kennewick ID	96,679	26,836	14,138	734
Kiona ID	9,763	0	0	0
Subtotal	1,715,724	172,954-174,954	250,038	
Wapato Irrigation Project	620,955[9]	244,000[10]		

Footnotes:

(1) Roza Canal diversion from the Yakima River from 1998 plan
(2) Sunnyside Canal data as stated in the Board's 1998 plan
(3) Moxee Canal and Hubbard Ditch diversion from the Yakima River from the 1995 plan. Water is now temporarily delivered to Moxee-Hubbard from a pump station on a USBR wasteway.
(4) Selah - Moxee Canal diversion from the Yakima River from the 1995 plan
(5) Maximum allowable volume of surface and groundwater
(6) Calculated gross annual water requirement
(7) Outlook ID and Benton ID diversion volumes included in SVID diversion volume, not included in the diversion volume subtotal
(8) Naches-Selah diverts water from the Naches River
(9) Main Canal and Old Reservation Canal
(10) Not itemized separately. Includes operational spill, seepage and evaporation losses, and on-farm losses. WIP losses are not directly comparable to losses experienced by other irrigation districts, because the WIP figures include on-farm losses, while figures for other irrigation districts do not include this component.

5.2 Summary of Water Conservation Projects Proposed by Irrigation Districts

Under the YRBWEP, Referendum 38 or other initiatives, various irrigation districts in the Yakima Basin have proposed water use efficiency projects. Table 5-2 presents a summary of the water use efficiency measures proposed by the irrigation districts listed in the previous section. The potential water saved on an annual basis and the estimated costs of each district's preferred alternative are summarized in Table 5-2. Those costs are estimated capital (construction) costs and do not include annual Operations & Maintenance (O&M) costs. More detailed discussion of the various irrigation districts' projects is provided in Appendix A.

The total estimated capital cost of the water use efficiency projects listed in Tables 5-2 and 5-3 is $406 million. The cost per acre-foot per year of water saved for the projects listed in Table 5-2 ranges from $173 to $4,164. A value of the cost per acre-foot per year of water saved was used to provide a preliminary comparison of the different projects. The costs do not include O&M costs and are therefore a very preliminary comparison. More detailed economic studies would be required to evaluate and compare the project costs and benefits over a long time period.

Table 5-3 presents a summary of the irrigation districts' preferred alternatives grouped by subarea. The potential amount of water saved in the Upper Yakima subarea (Kittitas Valley) is 48,500 AFY. The potential amount of water saved in the Middle Yakima subarea (includes diversions from Roza Irrigation District downstream to Columbia Irrigation District) is 155,100 AFY. The potential amount of water saved in the Lower Yakima subarea (includes Columbia Irrigation District and Kennewick Irrigation District) is 315,900 AFY. Projects in the Naches subarea (includes South Naches Irrigation District, Naches-Selah Irrigation District, and Yakima-Tieton Irrigation District) can potentially save 20,500 AFY. The aggregate cost per subarea varies from $210 per AFY in the Lower Yakima subarea to $1,800 per AFY in the Middle Yakima subarea.

As stated in previous sections, a reduction in water use by an irrigation district does not result in a direct increase in water supply for other users. Flow lost through seepage and spills is a source of supply for downstream water users; therefore a reduction in seepage and spill may change the timing and volume of water released from Yakima Project reservoirs to meet irrigation demands in downstream areas.

The Kiona Irrigation District constructed a new pressurized system in 1996 with emergency funding secured through FEMA and Ecology (see Section 2.12 in Appendix A). This project is not summarized in Table 5-2.

Table 5-2
Water Use Efficiency Projects Summary

Name of Irrigation District	Preferred Efficiency Measures [1]	Total Potential Amount Saved (AFY)	Total Capital Cost Estimate	Capital Cost Per AFY
Kittitas Reclamation District	Alternative 1	48,493	$36,910,641	$761
Roza ID	Preferred measures	48,415	$61,488,000	$1,270
Sunnyside Valley ID/Board of Joint Control	First tier measures: Option 1	40,336	$59,950,900	$1,486
Selah-Moxee ID	Alternative I Modified	11,400	$20,472,000	$1,796
Ahtanum ID	Alternative 2	8,564	$5,856,000	$684
Union Gap ID/Fowler Ditch Company	Alternative 1	7,338	$30,555,450	$4,164
Outlook ID	Preferred Alternative, Six Phases	4,265	$736,000	$173
South Naches ID	Alternative 3	13,000	$5,400,000	$415
Naches-Selah ID	Alternative 2	5,923	$15,880,000	$2,681
Yakima-Tieton ID	First Tier	1,600	$290,000	$181
Benton ID	Program 6	12,519	$13,326,000	$1,062
Columbia ID	Three Recommended Projects	68,238	$12,902,000	$189
Kennewick ID	First Tier	247,708	$54,275,600	$219
Wapato Irrigation Project	First tier measures	22,300	$87,480,000	$3,923

Source: Conservation Plans prepared by irrigation districts (See bibliography).
AFY = acre-feet per year.

[1] For details on measures, see Appendix A.

Table 5-3
Water Use Efficiency Projects Summary by Subarea

Subarea	Irrigation Districts	Total Potential Amount Saved (AFY)	Total Capital Cost Estimate	Capital Cost Per AFY
Upper Yakima	Kittitas Reclamation District	48,500	$36,911,000	$760
Middle Yakima	Roza ID, Wapato Irrigation Project, SVID, Benton ID, Selah-Moxee ID, Ahtanum ID, Union Gap ID/Fowler Ditch Co, Outlook ID	155,100	$279,864,000	$1,800
Naches	South Naches ID, Naches-Selah ID, Yakima-Tieton ID	20,500	$21,570,000	$1,050
Lower Yakima	Columbia ID, Kennewick ID	315,900	$67,178,000	$210
Total	All projects combined	540,000	$405,523,000	$750

AFY = acre-feet per year.

In the Upper Yakima subarea, 48,500 AFY of water savings were identified by the Kittitas Reclamation District. Much of the water potentially saved in that subarea would return to surface water and the Yakima River shortly, within a few hours or months depending on the location of the project. That return flow is part of downstream water supplies and may need to be supplied from storage if reduced in that subarea.

In the Middle Yakima subarea, projects with a total potential water savings of 155,100 AFY were identified. These projects, if implemented would likely result in reduced flow in the reach of Yakima River downstream of the Sunnyside Dam (Parker), since most of the return flow from these districts occurs downstream of Sunnyside Dam. Another potential effect would be on the Columbia Irrigation District and Kennewick Irrigation District. Both of those districts rely on return flows from the Middle Yakima subarea and would have decreased water supplies if significant water use efficiency projects were implemented in that subarea.

In the Lower Yakima subarea, the Columbia Irrigation District and the Kennewick Irrigation District are proposing a pump exchange project to reduce or eliminate their diversions from the Yakima River and supplant that water with Columbia River water pumped into a new piped delivery system. The water saved is estimated to be 315,900 AFY, which would improve instream flow and water quality in the lower Yakima River. However, that water saved would not improve the reliability of water supply for upstream water users as the districts have proratable entitlements and the USBR does not operate the Yakima Project to provide flow for those districts. The USBR operates the system to ensure a target instream flow is met below Sunnyside Dam.

In the Naches subarea, three irrigation districts identified projects with a total potential water savings of 20,500 AFY. Seepage from the districts' canals likely returns to the Yakima River within a short time because of the canals proximity to the Naches River. That seepage could also be a source of supply for several of the irrigation districts located in the Middle Yakima subarea.

5.3 Benefits to Various Objectives Defined by Planning Unit

As noted previously, water-use efficiency measures implemented by irrigation districts offer different types of benefits, depending on the type and location of the project proposed. For purposes of this technical memorandum, it is important to understand how various types of projects contribute to the Planning Objectives established by the Yakima River Basin Watershed Planning Unit.[2]

Based on a qualitative review of the projects described in Appendix A, a general assessment of how different types of projects undertaken by irrigation districts may relate to the Planning Objectives was prepared. The results of this qualitative evaluation are shown in Table 2-1 (see Section 2, Summary of Findings). This evaluation was not intended to serve as the basis for specific decisions by USBR or other entities with regard to the projects proposed. It is intended solely to be used by the Yakima River Basin Watershed Planning Unit to better understand the relative benefits of water-use efficiency strategies, in comparison with other strategies under consideration in the context of the Yakima River Basin Watershed Plan. More detailed analyses (such as hydrologic modeling, instream flow studies, etc.) are needed of the water-use efficiency strategies to provide better descriptions of how they will meet the Planning Unit objectives.

A discussion of the qualitative ranking of water use efficiency measures in terms of Planning Objectives follows. It should be noted that the benefits to fish habitat are not assessed separately for the proposed water use efficiency projects. This is because the primary benefits to habitat are expected to occur through benefits to flow and water quality, which are discussed independently in this section (see below).

Improve the reliability of surface water supply for irrigation use. Most of the water use efficiency measures will likely have a medium to low benefit for improving the reliability of irrigation water supply. The reason is the water saved is most likely a source of water supply for downstream water users and the potential volume of water saved is still a small portion of the water supply needed to meet irrigation water demands during a water short year. The benefit to reliability of water supply for irrigation is probably greater for efficiency measures implemented in irrigation districts located in the Middle Yakima subarea. The reason is seepage occurring in that subarea reaches the Yakima River below Sunnyside Dam, the control point for the Yakima Project operated by the USBR. With a smaller volume of diversions in that reach, more water should be available for water users located upstream of Sunnyside Dam. The availability will depend on reservoir levels as the saved water will need to be kept in storage for release when needed by other irrigation districts. Water use efficiency measures implemented by Districts

[2] See Phase 3 Scoping Matrix, October 18, 2000.

with proratable entitlements will accrue greater benefits to their own reliability of water supply as they will be able to operate with smaller diversions, stretching their water supplies during years with proration.

Improve instream flows for all uses with emphasis on improving fish habitat. The benefits to water quality and fisheries resources from saved water is an important factor. The water use efficiency measures implemented generally have a beneficial effect on the environment and ecology of the hydrologic system, and contribute to recovery of threatened and endangered species in the basin.

Based on the assessment of potential benefits presented in Table 2-1, it appears that many of the water use efficiency projects that have been proposed will yield benefits in this arena, if they are funded and implemented. However, there are some important limitations on these benefits. Where diversions needed by an irrigation district or private landowner can be reduced during some years or all years, instream flows may increase, but typically only in the reach between the diverter's headgates and the place(s) where return flows return to the source water. The length of these reaches range from a few hundred feet for a small landowner, to upwards of 50 miles for some of the large irrigation districts. Moreover, this effect will occur only during those months that water is diverted (e.g. April – September). While increased instream flows may be beneficial, the actual benefits depend on when and where they occur, and on complex interactions among channel morphology, the life stage of the particular organisms affected, and other factors.

The benefits to instream flow objectives vary by location in the basin and the volume of water saved. The greatest benefits to instream flow will accrue from the Columbia and Kennewick Irrigation Districts' proposed projects which will change the point of diversion from the Yakima River to the Columbia River leaving a large volume of water in the Yakima River that will be available for instream flow[3]. Other water use efficiency projects may benefit instream flow, especially if part of the saved water is dedicated to instream flow as a requirement of receiving funding to implement the projects. All but the Columbia and Kennewick Irrigation District projects were rated with low to medium benefit to instream flow.

Protect, improve and sustain ground water quantity and pumping levels of aquifers for the benefit of current and future use. The potential effects on aquifer water levels will be mostly negative, in localized areas, as the water use efficiency measures will reduce seepage and aquifer recharge. As aquifer recharge is reduced, water levels may fall in some areas.

[3] The KID Pump Exchange Project is both a water use efficiency project and a project using a new source of water transferred from the Columbia River. It was decided to include the project in this Technical Memo instead of others as it fit in well with the other water-use efficiency projects.

Protect surface water from contamination. The benefits to surface water quality are medium to low for all district projects listed except the Kennewick and Columbia Irrigation Districts. For those projects the increased instream flow in the Yakima River should improve water quality conditions in the lower Yakima River. For the other districts proposing projects to reduce operational spill a medium benefit was assigned as the reduction in spill may reduce sediment loading from drains.

The relative costs of the water use efficiency strategies are generally medium to high. Implementation and technical complexity are generally estimated to be medium. Each of these ratings is considered relative to the cost and complexity of alternative strategies, such as storage, water-rights transfers, and development of alternative sources of supply.

6.0 Potential On-farm Water Use Efficiency Measures

On-farm measures represent a different category of water-use efficiency measures, compared with the irrigation district projects discussed in Section 5.0. Typical on-farm measures were listed previously, in Table 3-1. These water-use efficiency measures are implemented by individual farmers or landowners, and are highly dependent on the types of crops being grown at a given time, expectations regarding crop rotation, market conditions and associated investment decisions. In some cases, on-farm measures are implemented by farmers or landowners within an irrigation district. However, these measures are equally applicable to farmers on land outside irrigation districts, including in tributary basins that do not rely on the mainstem Yakima River system or the USBR Yakima Project.

On-farm projects are not eligible for funding from YRBWEP, but may receive both funding and technical assistance from other federal, state and local programs, such as the Centennial Clean Water Fund, Conservation District, NRCS, and Bonneville Power Administration programs.

Potential water savings from implementation of on-farm efficiency measures is difficult to quantify as the existing quantities of water that are consumptively used compared to the quantities of water that are applied on-farm is not known. Assumptions can be made regarding the quantity of water that is currently applied and the existing irrigation efficiency. For example, assuming on-farm efficiency measures are applied to water users that obtain surface water from the Yakima Project in the middle and lower Yakima River basin, an estimate of water savings can be made. The middle and lower Yakima Basin was selected for this calculation as much of the seepage from farms in the Upper Yakima River basin likely returns to the Yakima River within a few months and is a source of supply for water users in the middle and lower Yakima River Basin.

The estimated delivery to farms in the Middle and Lower Yakima subareas was listed in Table 3-16 of the *Yakima River Basin Watershed Assessment*. That volume is 1,427,000 AF. Assuming an existing on-farm efficiency of 70%, for all farms in that area the total consumptive use is estimated to be 999,000 AF (0.70 x 1,427,000 AF). The remainder, or 428,100 AF, is lost to seepage, tailwater, and inefficiencies in applying water to fields. Assuming the total consumptive use is constant, the reduction in water use when on-farm

efficiencies are increased can be calculated. The water savings for 5% and 10% increases in on-farm efficiencies are estimated to be 95,000 AF and 178,000 AF, respectively. The potential on-farm water savings are summarized in Table 6-1. The precise values of those water savings are not known and the estimated values should be considered illustrative, order-of-magnitude values.

Table 6-1
Potential On-Farm Savings in the Middle and Lower Yakima River Subareas

On-Farm Efficiency Increase	Estimated Consumptive Use (AF)	Total On-Farm Efficiency	Delivery to Farms (AF)	Estimated Water Savings (AF)
No Increase (Existing Condition)	999,000	70%	1,427,000	N/A
5%	999,000	75%	1,332,000	95,000
10%	999,000	80%	1,249,000	178,000

The discussion above focused on farmers who use surface water for irrigation. Ground water is also used for irrigation and on-farm measures also apply to those water users. However ground water users are typically more efficient than surface water users because of the energy cost associated with pumping ground water supplies. Therefore, potential water savings from ground water users is expected to be less than for surface water users.

Since the types of projects implemented by individual farmers and landowners are different from the projects implemented by irrigation districts, their benefits are also different. A general assessment of the potential benefits of on-farm projects as a whole with respect to the Planning Objectives of the Planning Unit is shown in Table 2-1. In general the on-farm efficiency measures will have a low to medium benefit for irrigation water supplies, although it will depend on the measures implemented. A low to medium benefit to instream flows is expected. A negative effect on aquifer water levels could occur as seepage is reduced.

A large benefit to surface water quality is expected. Where on-farm techniques are used to reduce application of water, runoff, erosion, and loading of undesirable water quality constituents to nearby surface waters can be reduced. This can improve water quality, particularly with respect to those parameters that are correlated with suspended sediments (e.g. turbidity, temperature, some nutrients, some pesticides, and coliform bacteria). This, in turn will provide benefits to fish and wildlife.

6.1 Conversion of surface water supplied irrigation to groundwater-supplied irrigation.

This strategy consists of constructing groundwater wells to provide irrigation water to farms in lieu of water supplied from surface water diversions. Since this would likely occur on a farm-by-farm basis, it is included in this section on on-farm measures. The potential benefit of these types of projects derives from eliminating surface water diversions and the associated seepage and leakage from gravity irrigation canals thereby

leaving the previously diverted flow instream to benefit fisheries and instream resources. Another potential benefit from using groundwater is a potentially reduced or lagged effect on surface water flow from groundwater pumping compared to diverting even a smaller amount of surface water.

The costs of this strategy depends on the depth of the well (and groundwater), the number of wells required to replace a surface water diversion and the long-term pumping costs to lift water to the farming area.

This success of this strategy depends on an ample supply of groundwater and its applicability will depend on the size of irrigated area converting to groundwater and the aquifer yield. Generally, the area that the strategy is most effective for is situated in a floodplain area with high yield aquifers and low pumping head from the groundwater table to the farm. Generally, smaller farms can use this strategy, as well yields, even in floodplain aquifers, generally do not exceed 1,000 gallons per minute over an extended period. That pumping rate can supply a farm of about approximately 100 acres. The strategy should also be combined with on-farm water conservation measures, such as pressurized sprinklers. Without on-farm conservation measures the pumping costs would likely be much higher than a system supplied by gravity and surface water.

This strategy has been used in Washington State. An example is in the Methow River basin between the towns of Twisp and Carlton, where a number of irrigators drilled wells to replace an unreliable surface water supply. The supply was unreliable because of extensive leakage from the canals serving the irrigators. The Washington State Department of Ecology allowed this practice and assisted the irrigators by processing water right change applications to transfer surface water rights they held to groundwater rights.

7.0 Issues Needing to be Addressed

A number of issues affect the incentives on behalf of irrigation districts and water users for undertaking water-use efficiency projects. These issues are discussed in this section.

7.1 Relinquishment of Saved Water

Implementation of water-efficiency measures as a water management tool in the Yakima River Basin has been hindered in the past by concerns over the possibility that investments in water-use efficiency would inadvertently lead to relinquishment of some portion of a water user's water rights. State law provides that:

Any person entitled to divert or withdraw waters of the state…who abandons the same, or who voluntarily fails, without sufficient cause, to beneficially use all or any part of said right to divert or withdraw for any period of five successive years after July 1, 1967, shall relinquish such right or portion thereof, and said right or portion thereof shall revert to the

state, and the waters affected by said right shall become available for appropriation….(RCW 90.14.160-180).

The law provides a number of exceptions to the relinquishment provision. For example, water claimed for power development purposes, for standby or reserve water supply to be used in time of drought, for municipal supply purposes, and for certain other purposes are not subject to relinquishment. In addition, a water user may claim "sufficient cause" to excuse nonuse of water. These sufficient causes are specifically listed in the law, and include causes such as drought or other unavailability of water, and active service in the armed forces, among others (RCW 90.14.140).

In recent years, many agricultural water users have indicated concern that water-efficiency measures that reduce diversions or withdrawals could be viewed by the State and courts as a failure to beneficially use a part of their water right, and could therefore lead to relinquishment of that part of the water right. This concern was heightened by a recent court decision in the *Acquavella* proceedings, involving the Yakima-Tieton Irrigation District.

Additional items were added to RCW 90.14.140 as "sufficient causes" during the 2001 Legislative Session. These are directly related to irrigation activities and include:

> (1) Temporarily reduced water need for irrigation use where such reduction is due to varying weather conditions, including but not limited to precipitation and temperature, that warranted the reduction in water use, so long as the water user's diversion and delivery facilities are maintained in good operating condition consistent with beneficial use of the full amount of the water right;
>
> (2) Temporarily reduced diversions or withdrawals of irrigation water directly resulting from the provisions of a contract or similar agreement in which a supplier of electricity buys back electricity from the water right holder and the electricity is needed for the diversion or withdrawal or for the use of the water diverted or withdrawn for irrigation purposes;
>
> (3) Water conservation measures implemented under the Yakima River basin water enhancement project, so long as the conserved water is reallocated in accordance with the provisions of P.L. 103- 434;
>
> (4) Reliance by an irrigation water user on the transitory presence of return flows in lieu of diversion or withdrawal of water from the primary source of supply, if such return flows are measured or reliably estimated using a scientific methodology generally accepted as reliable within the scientific community; or
>
> (5) The reduced use of irrigation water resulting from crop rotation. For purposes of this subsection, crop rotation means the temporary change in the type of crops grown resulting from the exercise of generally recognized sound farming practices. Unused water resulting from crop rotation will not be relinquished if the remaining portion of the water continues to be beneficially used.

The third of these items would appear to reduce concerns regarding relinquishment, for those YRBWEP projects that meet the conditions of this provision. Some concern may remain with respect to the exact meaning of the "reallocation" condition.

Irrigators considering water-efficiency measures outside the framework of YRBWEP still face the same issues with regard to potential relinquishment. This would apply, for example, to irrigators who do not receive water from USBR, or who irrigate a portion of their land with non-USBR water. Many irrigators in this situation are likely to remain reluctant to undertake water-use efficiency projects.

Diversion Reduction Agreements Under YRBWEP

Among irrigation districts involved in YRBWEP, recent discussions with USBR involving water-use efficiency have centered on "Diversion Reduction Agreements" proposed by the USBR. These agreements would define how water saved due to water-efficiency measures would be counted with respect to allowable diversions by each district involved. At this time, no diversion reduction agreement has been completed, and discussions are ongoing. If such agreements are developed, their terms will affect the incentives or disincentives irrigation districts have with regard to` water-use efficiency measures.

Relationship of Crop Rotation to Water-use Efficiency

The issue of crop rotation was also addressed by the 2001 Legislature (see item #5 above). When producers shift from one crop to another, the techniques for delivering water to the crop may also change, and this can affect the quantity of water delivered. Modifications of irrigation techniques are also one important class of water-efficiency measures. Therefore there is a link between crop type and water-use efficiency. Due to changing market conditions and other considerations, producers may change from one type of crop to another, and back again, over a series of growing seasons. An effective strategy to encourage water-use efficiency should include provisions that allow flexibility to respond to market conditions, without relinquishing water rights. The 2001 changes in the law appear to support this.

7.2 Federal Approval and Appropriations

For projects proposed under YRBWEP, federal action is needed before projects can be implemented. First, the USBR needs to complete its review and take action on approving projects for implementation. Second, the USBR and each irrigation district need to negotiate and execute a Diversion Reduction Agreement, as discussed above (see Section 7.1). Third, these projects need to be identified in the USBR's budget submitted to Congress. Finally, the funds need to be appropriated by Congress and released by the Bureau to the irrigation district that proposed the project.

Section 5.2 summarizes a number of water conservation measures that have been proposed by various irrigation districts. The total cost of the measures is in the range of $400 million. Funding for implementation is critical as the financial capacity of irrigation districts to undertake those projects is very limited. The cost of the water use efficiency measures far exceeds the amount of money authorized by Congress under PL 103-434. Under the cost-sharing arrangements of YRBWEP, both federal and state appropriations will be required to implement these projects.

At this time, the USBR has not approved implementation nor submitted a budget request for any of the projects included in irrigation district conservation plans. In part this may be due to the issues discussed previously in Section 7.1. To the extent that recent state legislation has reduced irrigation district concerns with regard to relinquishment, it may now be easier to negotiate Diversion Reduction Agreements. However, these negotiations require a considerable effort on the part of Bureau and irrigation district managers, and must compete with other activities and priorities. Successful completion of the federal process leading to appropriations and release of funds will require the irrigation districts, the USBR, and the State of Washington to place a high priority on advancing the Yakima River Basin Water Conservation Program to its implementation phase.

7.3 Potential Effect on Return Flows and Groundwater Levels

As stated previously, water "lost" within an irrigation system (e.g. an irrigation district) is typically not depleted when the entire Yakima River system is considered. This is because:

(1) much of the water lost from a single district through spills in their irrigation canal system returns to the river via irrigation drains; and

(2) much of the water lost through seepage in a district's irrigation canal system seeps into the ground, enters the shallow ground water system, and then returns to the river after a short time (e.g. days to months); and

(3) much of the water applied to fields in excess of crop requirements either seeps into the ground and returns to the river after a short time or runs off and returns to the river via irrigation drains.

This is an important consideration in reviewing opportunities for water-use efficiency, because both return flows and seepage provide a source of supply to other water users, either downstream or relying on shallow ground water supplies. For example, in the Kittitas Valley discharge from the groundwater system that is supplied by seepage is an important part of the water supply for water users in the lower Yakima River valley.

Ground water users relying on seepage to maintain shallow ground water levels include irrigators with groundwater rights, small public water systems that rely on shallow ground water, and domestic water users with individual household wells. If the source of water for those users is diminished, they may need to drill a deeper well or obtain a source of water from elsewhere. The cumulative effect of reducing seepage is also an issue, as long-term reductions in groundwater levels may result.

Other potential effects may include reduced discharge to wetlands that rely in whole or in part on artificial irrigation-induced seepage, and reduced discharge to small streams that convey tailwater from canals or seepage away from canals and irrigated farmlands.

Because of these potentially harmful impacts on other water users, wetlands and streams, a careful review of the effects of water efficiency projects is needed before implementing those projects.

7.4 Impacts on Energy Supply

Impacts on regional energy supplies is an issue that has received increased attention since the 2000/2001 drought and energy crisis. Several water use efficiency measures proposed by irrigation districts (such as the Kennewick pump exchange project) would require new pumping facilities with substantial energy demands. The Kennewick Irrigation District estimated the annual pumping cost to be $2.1 million for the pump exchange project. Due to the high costs to pump substantial volumes of water, districts such as the Kennewick Irrigation District do not want to incur the annual operations cost and hope to have all or part of those costs paid by federal agencies such as BPA in exchange for improving instream flow. Those energy costs would then be paid by the region's rate payers and the energy used to pump water would not be available for use in the region or for sale outside the region.

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Appendix A - Water Use Efficiency Strategies Proposed by Irrigation Districts

February 20, 2002

Prepared by:

Montgomery Water Group
620 Kirkland Way
PO Box 2517
Kirkland, WA 98083
(425) 827-3243

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Tables

1.0 Introduction

Water conservation plans from irrigation districts within the Yakima River Basin were reviewed to identify and summarize projects that would improve the water use efficiency of irrigation districts. These projects generally apply to conveyance systems rather than on-farm measures that could be completed by individual farmers. Implementing water use efficiency measures can reduce the volume of water lost to operational spills, seepage, and evaporation in the conveyance systems. This, in turn, can reduce the volume of water diverted by the irrigation district. The reduction in diversions may result in increased instream flow or an improvement in reliability of water supply for irrigation districts. The effects of the water use efficiency measure depend on its location within the Yakima River basin and other factors. Those effects are discussed in the main body of this technical memorandum.

2.0 Potential Water Use Efficiency Measures for Irrigation Districts

This section describes the potential water use efficiency measures for each irrigation district, for which information is available. Capital (construction) costs are provided for the water-use efficiency projects and O&M costs are provided where available. The costs provided are preliminary estimates and will require additional engineering analyses to confirm or refine.

2.1 Kittitas Reclamation District

The Kittitas Reclamation District (KRD) has 59,122 classified irrigable acres in the upper Yakima Basin in the Kittitas Valley near Ellensburg, South Cle Elum, Thorp, and Kittitas. The KRD diverts an average of 310,453 AF from the Yakima River each year. The estimated operational spill is 5.5 percent (17,075 AFY), and loss to seepage and evaporation is 27.5 percent (85,377 AFY). The diversion and loss volumes were reported in the *Kittitas Reclamation District Water Conservation Plan* (CH2M Hill, February 1999). The existing KRD canal system is approximately 90 percent unlined earthen canal, and 10 percent concrete lined.

Opportunities for improvements to the water supply and distribution system efficiencies are explored in the 1999 KRD plan. The preferred improvement project was identified as Alternative 1. The improvements include pipeline upgrades at 18 selected laterals and 2 sub-laterals, construction of two re-regulation reservoirs with automation located near the North (Johnson) and South (Page Canyon) Branch Canals, telemetry and automation of the Wippel Pumping Plant, and flow control structures downstream. Reregulation reservoirs are used to dampen the fluctuations in canal flows. When there is excess water in the canal, water would be stored in the reservoirs. During low flow periods, water is released from the reservoir. Reregulation reservoirs can reduce spills on the canal.

The Page Canyon Reregulation Reservoir would have a maximum storage capacity of 125 acre-feet (AF). A 200 hp pump station will be located at the base of the dam on the downhill side. The Johnson Reregulation reservoir will be located just north of the Johnson Siphon near the North Branch Canal and have a maximum storage capacity of 124 AF. It will be similar to the Page Canyon Reregulation reservoir except that the pump station will consist of three centrifugal pumps rated at a total of 50 cfs.

The total amount of water potentially saved is 48,493 AF at a cost of $36,910,641(1998 dollars), or $761 per AF. These conceptual cost estimates include construction, contingency, tax, engineering, legal, and administrative fees, and are considered to be order-of-magnitude costs. The costs were identified by the KRD to have an estimated accuracy of + 50 % to – 30 %. The costs do not include feasibility study costs. The costs and amount of water saved are itemized for each measure in Table 2-1.

Table 2-1
Kittitas Reclamation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Page Canyon Reservoir with automation	1,496	$1,480,253	$989
Johnson Reservoir with automation	4,295	$1,005,195	$234
Piping and flow control upgrades	30,200	$34,425,193	$806
Automation of Wippel pumping plant	12,502	Included above	Included above
Total	48,493	$36,910,641	$761

The proposed project will have an estimate annual pumping cost of approximately $20,000 with the addition of two new pump stations at the two re-regulation reservoirs and with the new pump at the Wippel Pumping Plant.

Third party impacts to downstream users in the KRD service was not accounted for in this study. Use of KRD laterals for flood, conveyance, tailwater, or stormwater, may be affected since some open canals would be piped.

2.2 Roza Irrigation District

The Roza Irrigation District (RID) is located in the lower Yakima River Basin and serves 72,000 acres. Irrigation water is diverted into the Roza Canal from the Yakima River at the Roza Diversion Dam located near the Kittitas-Yakima County line. Water is delivered by gravity to 45,000 acres below the main canal. Water is pumped to the remaining 27,000 acres by 18 pumping plants. The Roza Canal diverts an average of 364,138 AFY from March through October. This average was based on USBR recorded billing records for the period 1970 to 1995, excluding the water short years of 1973, 1977, 1979, 1987, 1988, 1992, 1993, and 1994. The average operational spill on the main canal and laterals are 33,358 AFY and 6,652 AFY, respectively. The average seepage and evaporation losses are 66,482 AFY in the main canal and 37,675 AFY in the laterals. The average losses were based on the period between 1980 and 1989, excluding 1987. All of the yearly average data were reported in RID's 1998 plan.

Water use efficiency measures were identified in the *Roza Irrigation District Comprehensive Water Conservation Plan Report* (Roza Irrigation District, June 1998). The preferred system improvements and rehabilitation plan consist of five components: enclosed conduit systems on gravity laterals, enclosed conduit systems on pump laterals, canal automation and main canal gauging, reregulation reservoirs, and lining portions on the main canal. Off-line storage at four sites was also investigated as a potential efficiency measure, but was not found to be economically feasible at this time.

Implementation of some of the efficiency measures has already started, and the projects are estimated to be completed in 2017. Enclosed gravity lateral construction has been ongoing since 1983 and is 60 percent complete (as of June 1998). Once the gravity laterals are complete, the district will begin enclosing the pump laterals. This would also require the automation of the pumping plant operation. Construction of check structures for canal automation began in 1992 and five structures were in place by January 1997. Construction is expected to continue until the main canal is fully automated. Two reregulation reservoirs were constructed on wasteway 6 and 7 in 1988 and 1994, respectively. A third large reregulation reservoir is planned upstream of wasteway 5 at the mid system. Portions of the main canal have been lined and the lining is expected to continue on an as-needed basis to stop area specific leaks, protect the integrity of the existing system, and to prevent problems with seepage encroaching on farmland.

The total potential reduction in diversions is 59,964 AFY after project implementation. This total includes 11,549 AF of water saved with wasteway 6 and 7 reregulation reservoirs that are already in use. The magnitude of savings will reach this amount when all reregulation reservoirs are in operation and to a lesser degree until then. The costs and water savings for the improvements are itemized in Table 2-2. All of the cost estimates are for the total project in 1992 dollars. Cost estimates are based on the assumption that RID would construct the projects. If design and construction were contracted out, the cost could increase by 40 percent or more. Operation and maintenance cost is expected to increase by $447,862 by 2017 not including power cost.

Project construction is intended to continue at the present rate assuming the same relative amount of grant funding can be procured. If funding decreases, then the projects will be scaled back. State funding under Referendum 38 has been exhausted, but the district is still committed to approximately $1,000,000 annually for improvements. Potential sources of funding include increased assessments and YRBWEP. If YRBWEP funding for the reregulation reservoir at wasteway 5 is secured, a contractor would be hired to design the impoundment structure. RID staff would conduct compliance studies, penstock and pumping plant design and construction, inspection, and the overall contract administration.

Table 2-2
Roza Irrigation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Enclosed conduit on gravity laterals	20,798	$15,868,000	$1,980
Enclosed conduit on pumped laterals	Included above	$25,320,000	Included above
Canal automation	13,866	$4,800,000	$346
Reregulation reservoir at wasteway 5	13,751	$15,500,000	$1,127
Lining main canal sections	Not Estimated	$1,845,000	Not Applicable
Total (Does not include canal lining)	48,415	$61,488,000	$1,270
Total (Including wasteway 6 and 7 reregulation reservoirs)	59,964	Not Available	Not Available

The reregulation reservoir at wasteway 5 would result in a net increase in wetlands along the shoreline and channel. Diversion reduction agreements will not be explored at this time, but may be discussed by the time the YRBWEP funding contract negotiations are initiated.

The RID is also considering water use efficiency measures proposed for facilities owned by Sunnyside Valley Irrigation District (SVID) and operated by the Roza-Sunnyside Board of Joint Control (Board). The Board is a joint management entity for irrigation canals owned and operated by RID and SVID. The Board will provide a means for transferring water saved in SVID canals to the RID. The potential Board projects are described in the following section in conjunction with SVID projects.

2.3 Sunnyside Valley Irrigation District/Roza-Sunnyside Board of Joint Control

The SVID serves approximately 88,500 acres of irrigable land in the Yakima Valley and in the vicinity of the communities of Zillah, Sunnyside, Granger, Mabton, Grandview, and Prosser. The Sunnyside Canal, with a total service area of 103,600 acres, serves the SVID and other entities. The various entities receiving water from the Sunnyside Canal are collectively referred to as the Sunnyside Division of the Yakima Project. These entities include the SVID, Granger Irrigation District, Grandview Irrigation District, Benton Irrigation District, Konewock Ditch Company, Piety Flat Ditch Company, City of Zillah, Town of Granger, City of Sunnyside, City of Grandview, and the City of Prosser.

The Sunnyside Canal diverts an annual average of 437,374 AF of water from the Yakima River at the Sunnyside Dam (CH2M Hill, April 1998). This average was based on diversion records for the period between 1970 to 1994, excluding the water short years of 1973, 1977, 1979, 1987, 1988, 1992, 1993, and 1994. The average operational spill is 25,328 AFY and the seepage and evaporation loss is 20,601. These averages were based on measurements from 1981 through 1993 (CH2M Hill, April 1998). The canal extends about 60 miles to the west boundary of Benton Irrigation District. The earthen canal parallels and serves lands generally north and east of the Yakima River, and also areas south of the river near Mabton, Grandview, and Prosser. There are 27 check structures due to the steep gradient of the canal. The district operates two pumping plants, Orchard Avenue and Grandridge pumping plants. The plants supply lands above gravity flow of the distribution system.

A water conservation plan was completed by the SVID, CH2M Hill, and Economic and Engineering Services in 1992. It is titled *Water Conservation Study for Sunnyside Valley Irrigation District and the Joint Use Facilities of the Sunnyside Division* (December 1992). Eight project areas were considered in the study, and three areas were elected for more detailed study: main canal automation, equalizing reservoirs, and lateral piping. The recommended water use efficiency measures were refined in the *Sunnyside Valley Irrigation District Water Conservation Projects Preliminary Design Report* (April 1995) by J-U-B Engineers, Inc. The Tier One projects were further described in the *Comprehensive Water Conservation Plan* (CWCP) revised draft prepared in 1996 by SVID. That plan was not reviewed for this technical memorandum.

RID prepared a separate water conservation plan in 1998, which was summarized in Section 2.2. The *Roza-Sunnyside Board of Joint Control Water Conservation Plan* prepared by CH2M Hill in April 1998, noted differences in the cost and water savings estimated in the draft 1996 CWCP and J-U-B's 1995 report. The Board then contracted UMA Consultants, MSO Technologies, and Keller-Bliesner Engineering to review the proposed water conservation measures and to accurately describe the anticipated water savings and cost.

The purpose of the feasibility study completed in 2000 was to substantiate the water savings and to improve on the accuracy of cost estimates of the structural components proposed in the Plan. The *Roza-Sunnyside Board of Joint Control Water Conservation Program Tier One Feasibility Study* (UMA Consultants et al., March 2000) is the source of the following information. The focus of the report is measures in the SVID. This report recommended two options for consideration in the Tier One program.

Both options of the First Tier measures include the addition of main canal equalizing reservoirs, Sunnyside Canal automation, and installation of buried piping on selected SVID laterals. The difference between the two options is that in Option 2, only 4 lateral pipeline projects are suggested instead of seven. The total amount of water saved in Option 1 is 40,336 AF at a total project cost of $59,950,900 ($1,486 per AF in 2000 dollars). The total amount of water saved for Option 2 is 36,289 AF at a total cost of $43,250,000 ($1,192 per AF). These costs include contingency allowances covering administration and legal during construction, feasibility level estimating accuracy, sales

tax on materials, engineering services during design and construction, and environmental mitigation (estimated cost $100,000). Operation and maintenance costs were not estimated for the project.

Three reregulation reservoirs along the Sunnyside Canal are proposed: a 480 AF reservoir at mile 23.70, a 336 AF reservoir at mile 37.25, and a 491 AF reservoir at mile 37.25. A gas pipeline would need to be moved from the mile 23.70 site, and a cost estimate was secured for that element. A fourth reservoir site at mile 44.9 may be used to replace the mile 37.25 site if the subsurface soils and hydrogeology are not suitable for the reservoir. Full lining of the reservoir bases was recommended and is reflected in the cost. Full lining may not be required after a detailed subsurface investigation is conducted.

The drop structures on the Sunnyside Canal are expected to need replacement with new reinforced concrete check drops and a new electrically powered automated gate control system. Automation of the three reservoirs and new check drop structures is proposed with SCADA. Seven laterals are proposed for new piping in Option 1. They include: Rocky Ford, Ryder, Mathieson, Lateral 22.56, Lateral 51.18, Lateral 51.36, and Lateral 51.87. Option 2 eliminates three lateral pipeline projects: Rocky Ford, Ryder, and Lateral 51.36. The costs and water savings for the improvements are itemized in Table 2-3. The projects listed in the table are currently under review by SVID and the Bureau of Reclamation and the implementation program may change.

The O&M and electrical costs of the proposed measures were not refined in the 2000 or 1995 reports, but were reported in the 1992 Water Conservation Study in 1992 dollars. The annual O&M and electrical cost after project implementation of the closed pipe system, canal automation, and equalizing reservoirs is estimated to be $185,579, $82,738, and $17,821, respectively.

The proposed reservoirs could cover wetlands at each site, but if managed properly, they could replace the functions lost in the degraded pasture wetland they cover. Wetlands that are dependant on seepage from irrigation ditches may be lost after the proposed piping. The automation of the main canal is not expected to have a major impact on wetlands in the district. Impacts to adjacent wetlands during construction would be minimized with best management practices as much as possible.

The SVID discussed two options for potential disposition of the water saved as a result of the projects in the 1992 study. One option is to retain the water rights as a standby or reserve water supply for use in periods of drought or other low flow times. Under this option, the balance of water not used by SVID benefits other diverters and instream flows. The other option is to transfer rights to others for irrigation or beneficial uses. Potential benefactors of the transferred rights include Ecology, USBR, the general public, and various other compatible beneficial uses.

The SVID proposes a financial program to implement the project that relies on revenues/assessments and state and federal grants. The SVID does not propose to utilize bonds for funding of capital improvements.

Table 2-3
Sunnyside Valley Irrigation District
Preferred Water Use Efficiency Projects

Option	Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
1	Re-regulation Reservoirs	29,162	$15,780,700	$1,117
	Main Canal Structures/SCADA	Included above	$16,794,200	Included above
	7 Lateral Piping Projects	7,494	$27,039,700	$3,608
	Mile 59.3 Hydraulic Pump Replacement	3,680	$236,300	$64
1	Total[(1)]	40,336	$59,950,900	$1,486
2	Re-regulation Reservoirs	28,583	$15,780,700	$1,140
	Main Canal Structures/SCADA	Included above	$16,794,200	Included above
	4 Lateral Piping Projects	4,026	$10,336,000	$6,013
	Mile 59.3 Hydraulic Pump Replacement	3,680	$236,300	$64
2	Total[(1)]	36,289	$43,247,200	$1,192

Footnote:
Total includes $100,000 for environmental mitigation costs

2.4 Selah - Moxee Irrigation District

The Selah -Moxee Irrigation District (SMID) which includes the former Moxee Irrigation District is located east of the City of Yakima in north central Yakima County. The district serves 7,847 acres split into two segments by the Yakima Ridge and is connected by a tunnel. The district irrigates about 7,403 acres.

The water supply is derived almost entirely from two sources. The first source is a Yakima River diversion located downstream of the Roza Dam, between the dam and the mouth of the Naches River, at approximately river mile 123.95. Another diversion was located about 8 miles downstream from the confluence of the Yakima and Naches Rivers, at approximately river mile 116.02. That diversion was washed out during a recent flood and a temporary pump station on a USBR wasteway has been serving the Moxee-Hubbard Canal since 2000 (Jerry Helde, pers. comm. 2001). Some water is also delivered to the district from a pump station on the Moxee Drain and a few private wells.

Periodically, a significant quantity of water enters the Selah and Moxee Canal through return flows from the Roza Irrigation District. These return flows are estimated at 3,200 AFY.

Three canals operating in the SMID are the Selah and Moxee Canal, Moxee Canal, and the Hubbard Ditch. The average diversion to the Selah and Moxee Canal is 22,590 AF annually (1988 to 1994). The average diversion to the Moxee Canal and Hubbard Ditch was 13,903 AF annually (1988 to 1992), and is now reduced by approximately 50 percent with the temporary pump station in use. The average losses estimated in the 1995 plan were 25 percent in seepage and evaporation loss and 5 percent in operational spills.

Water use efficiency measures were identified in the *Selah-Moxee Irrigation District Comprehensive Water Conservation Plan* (CH2M Hill, September 1995). The preferred alternative was identified as Alternative 2. The water efficiency measures were reevaluated and refined in a letter from SMID to the USBR dated September 13, 2000. The modified Alternative 1 was identified as the current preferred alternative. Alternative 1 Modified provides for the construction of a concrete lined canal and a gravity-pressurized pipeline system with new laterals, pipelines, and turnouts. The source of supply would be the existing SMID diversion at Yakima River Mile 123.95.

Under the preferred alternative, future diversions would increase in order to compensate for the volume of water that is currently provided by return flows (3,200 AFY). The total amount of water saved with Alternative 1 Modified is estimated to be 11,400 AF at a cost of $20,472,000 or $1,796 per AF (2000 dollars). SMID stated that an additional 3,400 AFY of water savings would results if they were able to divert their full adjudicated water right. The cost includes construction, sales tax, contingencies, engineering, legal, and administrative fees. Costs needed for any easements or rights-of-way are not included. The costs and water savings for the improvements are itemized in Table 2-4.

Table 2-4
Selah-Moxee Irrigation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Upgrade to a gravity-pressurized pipeline system and concrete line East Selah Canal	11,400	$20,472,000	$1,796

Electrical demands would be reduced because the need for on-farm booster pumps would be reduced. Overall, a net energy saving of 2,696,600 kWh per irrigation season would occur with the project.

2.5 Ahtanum Irrigation District

The Ahtanum Irrigation District (AID) is located in the west central portion of Yakima County, immediately southwest of the City of Yakima and directly west of the City of Union Gap. The AID is approximately 1 mile wide by 17 miles long and lies parallel to and north of Ahtanum Creek. The AID boundary encloses 10,321 acres, with an assessed area of 8,285, but serves irrigation water to approximately 5,470 acres.

Irrigation water for the AID is diverted from Ahtanum Creek. This is supplemented by private groundwater wells for 4,943 acres. Approximately 954 acres of land in the AID is irrigated with groundwater wells and stock water only. The AID uses natural stream channels for its main distribution, including: North Fork, South Fork, and main stem of Ahtanum Creek, Bachelor Creek, and Hatton Creek. An unquantified and variable supply of water from the Yakima-Tieton Irrigation District (YTID) drainage is used by the AID. Since the YTID converted to a totally enclosed system in 1986, flows to the AID are so minimal they are considered negligible. This water is not part of their entitlement. The maximum allowable volume of surface and groundwater diverted is 22,595 AFY and the system conveyance loss is estimated at 25 percent (5,648 AF). These estimates were presented in the 1996 plan.

The preferred alternative for water use efficiency was identified in the *Ahtanum Irrigation District Comprehensive Water Conservation Plan* (North Yakima Conservation District and CH2M Hill, March 1996) to be Alternative 2. This alternative would provide for the piping for the main stem of the AID delivery system from the Bachelor Creek diversion to the eastern edge of the AID near Goodman Road. Water pressurized by gravity (higher elevation of intake relative to service area) would be served to about 4,209 acres of the AID, while those water users within 1.6 miles downstream of the Bachelor Creek diversion would receive partially pressurized water. Water users above the Bachelor Creek diversion would receive retrofitted delivery turnouts with new flow measurement devices. The proposed implementation schedule was divided into three tiers.

Although there would be no reduction in water diversion, a total of 8,564 AF in reduced gross water requirement will be seen with improvements. The increased efficiency would increase the water delivered to the farm for crop production. The demand on the groundwater supply would be reduced. A savings of 2.74 million kWh of electrical energy would be obtained with the project. The total cost of the preferred alternative is $5,856,000 (1995 dollars). These costs include construction, contingency, sales tax, engineering, legal, and administrative fees. The costs and water savings for the improvements are itemized in Table 2-5.

Table 2-5
Ahtanum Irrigation District
Preferred Water Use Efficiency Projects

Tier	Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
1	Retro-Fitted Delivery Structures	8,564	$57,500	$684
2	Pipeline within 1.6 miles of Diversion	Included above	$1,291,500	Included above
3	Pipeline beyond 1.6 miles of Diversion	Included above	$4,507,000	Included above
Total		8,564	$5,856,000	$684

Although several siting studies had been completed to locate a suitable site for a reservoir within the AID, details for a storage option were not pursued or made part of the preferred alternative presented in the 1996 water conservation plan. The plan stated that the preferred project would provide the necessary efficiency measures and facilities that would make construction of a storage facility more feasible in the future. Since then, the AID proposed a storage measure summarized in the *Pine Hollow Reservoir Project Overview* (January 2000). Details of this option are described in a separate technical memorandum.

2.6 Union Gap Irrigation District/Fowler Ditch Company

The Union Gap Irrigation District (UGID) and Fowler Ditch Company (FDC) are served by the same conveyance system that receives water from the Yakima River. Some amount of water enters the UGID through return flows from the Selah - Moxee Irrigation District and the Roza Irrigation District. The service areas are split by the Rattlesnake Hills at Union Gap in north central Yakima County. The UGID service area is 2,953 acres bounded on the north by Union Gap and on the south by the town of Zillah. The service for the FDC is 2,037 acres beginning east of Yakima and extends south to Union Gap. The UGID irrigates 2,793 acres out of the 2900.85 acres assessed. The gross annual water requirement calculated for the UGID and FDC is 16,007 AF and 5,787, respectively. The total is 21,794 annually to meet the irrigation needs consistently. The UGID and FDC operational losses were estimated to be 10 percent and 5 percent, respectively, while the conveyance losses were estimated at 25 percent. These estimates were presented in the 1999 plan.

The preferred alternative for water use efficiency was identified in the *Union Gap Irrigation District Water Conservation Plan* (CH2M Hill, April 1999) to be Alternative 1. This alternative includes the construction of a gravity flow, low pressure concrete

pipeline for the FDC service area within the existing diversion and headworks. Immediately downstream of the FDC service area a booster pump station would pressurize the water suitable for sprinkler application for the UGID service area. Water would continue to be drawn from the Yakima River through the existing headworks (river mile 115), fishscreen, and measuring weir.

The estimated water saved with Alternative 1 is 7,338 AF at a total project cost of $30,555,450 (1999 dollars) or $4,164 per AF. The cost includes construction, contingency, sales tax, engineering, administrative, and legal fees. The estimates do not include and cost for construction easements and rights-of way. The project would reduce energy consumption by eliminating individual booster pumps used on farms in the UGID. The reductions would be about 1,790,000 kWh per season, or about $50,000 per year. Savings attributed to the elimination of individual booster pump maintenance costs are estimated to be approximately $30,000 per year. The proposed project could return as much as 4,892 AF of water to the Yakima River (14.3 cfs in July). The costs and water savings for the improvements are itemized in Table 2-6.

Table 2-6
Union Gap Irrigation District/Fowler Ditch Company
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Piping and Installation	7,338	$28,735,011	$4,164
Pump Station	Included above	$1,820,438	Included above
Total	7,338	$30,555,450	$4,164

2.7 Outlook Irrigation District

The Outlook Irrigation District (OID) merged with SVID in July 2001. This section describes the former OID facilities and proposed improvements. The OID is located approximately four miles northwest of the City of Sunnyside in Yakima County, in the lower Yakima River valley. The district is bounded on the north by the Roza Irrigation District and on the south by the Sunnyside Valley Irrigation District. It is one of six operating units within the Sunnyside Division of the USBR's Yakima Project. The OID irrigates 4,613 acres out of the 4,661 acres of land within its boundaries. The average annual diversion from the Sunnyside Canals is 16,549 AF for the period of record 1982 to 1992. The Sunnyside Canal diverts water from the Yakima River. The OID operational spill is estimated to be 5 percent (827 AF) and the conveyance losses are 10 percent (1,655 AF), as reported in the 1995 plan.

The Preferred Alternative for water use efficiency was identified in the *Outlook Irrigation District Comprehensive Water Conservation Plan* (CH2M Hill, November

1995). The Preferred Alternative includes reconstruction of the sublateral delivery facilities and hydroturbine rehabilitation. The existing sublateral system would be upgraded to a totally enclosed gravity-pressure delivery system. The OID has been upgrading about 2 miles of deteriorated sublateral pipelines per year since 1985. The schedule for project implementation was divided into six phases over five years. The amount of water saved after the construction phases are complete is estimated at 3,236 AF. The potential amount of water saved 10 years after completion of construction is 4,265 AF annually with a total cost of $736,000 (1995 dollars), or $173 per AF. The cost includes tax, contingencies, and engineering, legal, and administrative fees. The costs and water savings for the improvements are itemized in Table 2-7.

The proposed improvements are not expected to significantly reduce energy use other than less energy will be consumed as a result of water conservation practices. Lower maintenance cost associated with the elimination of sublateral pipe cleaning and weir box patrolling is expected but not quantified.

Table 2-7
Outlook Irrigation District
Preferred Water Use Efficiency Projects

Phase	Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
I	East Lateral 3.21 Sublateral Piping	4,265	$198,800	$173
II	East Lateral 2.10 Sublateral Piping	Included above	$174,300	-
III	East Lateral 4.80 Sublateral Piping	Included above	$44,800	-
III	East Lateral 4.81 Sublateral Piping	Included above	$10,000	-
IV	West lateral 2.15 Sublateral Piping	Included above	$75,200	-
IV	East Lateral 5.16 Sublateral Piping	Included above	$61,500	-
V	West Lateral 1.61 Sublateral Piping	Included above	$71,100	-
V	560-hp Hydroturbine Pump Rehabilitation	Included above	$44,400	-
VI	West Lateral 1.75 Sublateral Piping	Included above	$25,200	-
VI	West Lateral 2.76 Sublateral Piping	Included above	$30,700	-
Total		4,265	$736,000	$173

2.8 South Naches Irrigation District

The South Naches Irrigation District is located in the northern part of Yakima County. Water is diverted at two locations on the Naches River to irrigate approximately 1,811 acres out of 2,607 acres within the district boundary. Operational spills are returned to the Naches River. The average annual diversion at the South Naches and Foster-Natchez diversions is 23,835 AF. The estimated conveyance loss is 12,468 AFY and includes physical and operational losses. These data were reported in the1994 plan.

The proposed improvements are specified in the *South Naches Comprehensive Water Conservation Plan* (North Yakima Conservation District and CH2M Hill, February 1994). The proposed improvements are to replace the existing canal system with a pressure pipeline system. The preferred alternative (Alternative 3) was selected out of four alternative pipeline configurations. This would require a new diversion and main, pump station at the upper end of the system near the South Naches Road bridge. The new diversion would be a single facility consisting of a wet well adjacent to the river with screened opening on the river side. The new fish screen would limit the loss of juvenile anadromous fish in the canals. Three vertical turbine pumps located on top of the wet well and one small remote booster station would be used to provide sprinkler pressure throughout the system. Conveyance losses would be reduced by the pressure pipeline system. All of the on-farm deliveries would be metered.

The proposed measures would reduce the amount of water diverted by 13,000 AF annually. The estimated construction cost is $5,400,000, or $415 per AF (1994 dollars). This cost includes capital cost, contingency, tax, engineering, administration, and legal fees. The annual O&M cost is $155,000 not including bond repayment. The costs and water savings for the improvements are itemized in Table 2-8.

Table 2-8
South Naches Irrigation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Upgrade to Pressure Pipeline System	13,000	$5,400,000	$415

Some shallow wells may have a reduced capacity after the ditches are piped. The project would result in the loss of 9.06 acres of wetlands. There are 5.16 acres associated with open water, with a remaining 3.9 acres net associated wetland loss.

Possible funding sources for this project include a $1,500,000 Referendum 38 grant and a $200,000 Centennial Clean Water Fund grant from Ecology, $870,000 from the BPA,

$2,830,000 in additional grants and loans (including Washington State Revolving Fund for Water Pollution Control and YRBWEP), and assessment rates at $100 per acre.

2.9 Naches-Selah Irrigation District

The Naches-Selah Irrigation District (NSID) is located between the City of Naches and the City of Selah. The district serves 13,000 acres in parts of Yakima County in the upper Naches Valley and serves the Selah area between the lower Naches Valley and the Wenas Valley. The total assessed area total is 10,886.51 acres.

The NSID's water for irrigation is supplied by a diversion from the Naches River. The diversion is a rock and gravel structure located approximately 0.7 miles west of the intersection of US Route 12 and State Highway 410 in the Upper Naches Valley. This is supplemented during periods of water shortage by a groundwater well. The average annual water diversion is 45,569 AF for the period from 1982 to 1992. The average estimated operational spill is 7 percent (3,190 AF), while the conveyance losses are 27 percent (12,303 AF). The volumes are reported in the 1996 plan.

Water use efficiency measures were identified in the *Naches-Selah Irrigation District Comprehensive Water Conservation Plan* (CH2M Hill, September 1995). Alternative 2 was selected as the preferred alternative. This project includes upgrades to the existing conveyance system by lining and/or rehabilitating selected portions of the main canal, piping selected sections of the lateral conveyance network, providing new turnouts and upgrading pipe pressure classes in selected distribution networks to handle the additional water pressure, and make provisions for collecting accurate water measurement data. Six phases of implementation were identified to complete the construction of Alternative 2 over a 15-year period of time.

The cost of installation and rehabilitation for the main canal and laterals are presented in Table 2-9. The other tasks to be implemented include reconstructing the Wilkinson Siphon, replacing the Bailey and Total Flumes, relocating the point of diversion, rehabilitation of the Rowe spillway, and install a tunnel monitoring system. The cost for the other tasks in the alternative is also listed in the table. The total amount of water saved is potentially 5,923 AF at a cost of $15,880,000 (1995 dollars) or $2,681 per AF. The costs include sales tax, contingencies, and engineering. Costs for easements and rights-of-way were not included.

The elimination of on-farm pumps in some areas will save the water users about 2.5 million kWh of electrical energy consumption per irrigation season. The project has the potential to be expanded into a more comprehensive program in greater size and scope.

A total of about 2.5 acres of wetlands and/or wildlife habitat will be affected by the project. About 1.5 acre of palustrine open water wetlands will be lost at completion of the improvements project. This loss is a direct result of replacing the open ditch system on Laterals #1 and #2 with a piped system.

Table 2-9
Naches-Selah Irrigation District
Preferred Water Use Efficiency Projects

Preferred Conservation Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Main Canal Lining and Rehabilitation	4,385	$4,548,999	$1,037
Lateral #1 Pipeline Installation	157	$1,389,465	$8,850
Lateral #2 Pipe Installation and Rehabilitation	476	$818,949	$1,720
Lateral #3 Pipe Installation and Rehabilitation	905	$1,639,491	$1,812
Other Tasks (siphon, flumes, diversion, spillway, tunnel monitoring system)	Included above	$7,482,129	-
Total	5,923	$15,880,000	$2,681

Possible sources of funding identified for the proposed project include $1,500,000 from Referendum 38, and $14,380,000 from increased assessments. Other potential funding sources have been identified by NSID include YRBWEP, the State Revolving Fund, the USBR, BPA, and the Yakima County Public Works Department.

2.10 Yakima-Tieton Irrigation District

The Yakima-Tieton Irrigation District (YTID) is located in Yakima County. The 27,900-acre district is west of the city of Yakima between the Naches River and Ahtanum Creek. Water use efficiency measures were identified in the *Draft Yakima-Tieton Irrigation District Water Conservation Plan* (Montgomery Water Group, June 2000). The YTID operates the Tieton Division of the USBR's Yakima Project.

Irrigation water for the YTID is diverted from the Tieton River at the Tieton Diversion Dam, about 5 miles downstream of Rimrock Lake. The average diversion at Tieton Dam from 1990 to 1999 was 82,200 AFY, with a peak diversion of 91,744 AF in 1999. The average operational spills are estimated between 3 and 5 percent (2,466 and 4,110 AF), as reported in the 2000 draft plan.

The diverted water flows through the Main Canal and into a reservoir formed by French Canyon Dam. Water flows out of the reservoir into a pressure distribution system to serve the water users. The closed pipe system is 85 percent gravity-pressurized and 15 percent pressurized by six pumping plants. The YTID also diverts some water from the North Fork Cowiche Creek. That entitlement is for 908 AFY, but the diversion data were not available.

The recommended projects were divided into two tiers based on timing of implementation. The proposed implementation schedule for the first tier is within 5 years and the second tier starts after 5 years. Most of the measures evaluated would provide an indirect water savings and increase reliability of the system. The amount of water potentially saved was not measurable for most of the measures investigated.

First Tier projects include upgrades to the French Canyon Reservoir, upgrade the Main Canal, implement a GIS mapping program, install remote monitoring, and education. The total estimated cost for first tier projects is $290,000.

Second Tier projects include the installation of a variable frequency drive at Scenic Height pump station, construction of SCADA systems, and construction of a Main Canal spillway with remote operation. The cost for second tier projects range from $484,000 and $734,000. The cost estimates are in 2000 dollars and include construction, sales tax, engineering, and contingencies. The costs and water savings for the improvements are itemized in Table 2-10.

Table 2-10
Yakima-Tieton Irrigation District
Preferred Water Use Efficiency Projects

Tier	Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
1	Flumes/flowmeter at French Canyon Reservoir	1,600	$80,500	$5
1	Upgrade Main Canal	Indirect	$55,000	*
1	GIS Mapping Program	Indirect	$135,000	-
1	Remote Monitoring Station	Indirect	$16,600	-
1	Education	Indirect	$2000	-
1	Total	1,600	$290,000	$181
2	Install Variable Frequency Drive	Indirect	$50,000	-
2	SCADA Systems	Indirect	$50,000 ea	-
2	Additional Spillway with Remote Operation	Indirect	$384,000	-

The YTID proposed cost sharing with the USBR to implement the projects. This would cost the district $145,000 over the first 5 years for First Tier projects.

2.11 Benton Irrigation District

The Benton Irrigation District (BID) is located in Benton County at the eastern end of the Yakima Valley. The district provides service to 4,630 irrigable acres. Water is delivered to the BID main canal via the SVID Main Canal that diverts water from the Yakima River at Sunnyside Dam. The BID is bordered on the east by Kiona Irrigation District. The Chandler Canal and the Yakima River flow between the BID and the Kennewick Irrigation District to the south. The average annual diversion from the Yakima River with respect to BID diversions is 22,341 AF, excluding water short years (1973, 1977, 1979, 1987, 1988, 1992, 1993, and 1994) for the period from 1973 to 1993. The average operational spill from the canals and lateral is 7,011 AFY. The annual seepage and evaporation losses are 2,982 AF and 792 AF, respectively. The annual water balance was reported in the 2000 plan.

The preferred alternative was detailed in the *Benton County Irrigation District Water Conservation Plan* (Davids Engineering, March 2000). Seven efficiency improvements were reviewed and evaluated by the BID board of directors, and the pressurized system conversion (Program 6) was initially selected as the preferred alternative. Two other alternatives, Programs 3B and 5, were also identified for detailed analysis to enable the Board to make a final selection.

Program 6 would entail abandoning the existing BID system and constructing a new pump-pressurized system. This program requires relocation of the diversion from Sunnyside Diversion Dam. The layout has not been finalized yet, but two new pump stations are anticipated. One would divert water from the Chandler Canal and serve the area west of Corral Creek. The second pump station would serve the area located on the east side of Corral Creek. The diversion point has not been determined yet, but sites near the southern end of Whan Road and near the new Kiona Irrigation District river pump station are being considered. Complementary measures would also be implemented as part of any program. These measures include: water measurement and accounting system, on-farm water management, water pricing structure, and supervisory control and data acquisition. The construction cost for implementing this program is $9,518,000 (1999 dollars) with an annual water savings of 12,519 AF. The total loaded cost (including contingencies, escalation and engineering and other services during construction) is $13.3 million ($1,062 per AF of water). The costs and water savings for the improvements are itemized in Table 2-11.

The estimated average annual groundwater recharge is 2,652 AF from main canal seepage and 330 AF from lateral seepage. Deep percolation from the irrigated land is approximately 2,876 AF. The recharge volume from the main canal and the laterals would likely be reduced under Program 6.

Table 2-11
Benton Irrigation District
Preferred Water Use Efficiency Projects

Preferred Conservation Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
BID Diversion Relocation	4,373	$13,326,000 total for project	$1,062 total for project
Main Canal Piping	5,890		
BID Lateral Piping	522		
On-Farm Conservation	1,734		
Other complementary measures	Indirect		
Total	12,519	$13,326,000	$1,062

The current O&M expenditure for the BID was approximated at $60,000 on average. Non-energy O&M cost for Program 6 was estimated to be $40,000, or $20,000 less than the current cost. The BID would be removed from the Board of Control with this program. While the Board of Control assessment cost is eliminated, the cost of attorney fees would be assumed at $10,000. The total annual operating budget with the selected program would increase $142,132 to $522,691 (1999 dollars). This includes all O&M, capital repayment, energy costs, and Bureau of Reclamation storage costs.

Sources of funding to implement the program may include: bonds, funding programs through Ecology (The Centennial Clean Water Fund, the State Revolving Loan Fund, and the Section 319 Nonpoint Source grants Program), the BPA Columbia Basin Fish and Wildlife Program, and YRBWEP.

2.12 Kiona Irrigation District

The Kiona Irrigation District (KiID) is located in the lower Yakima River watershed near Benton City. The KiID irrigates 1,144 acres within the 1,177-acre boundary. The KiID is bounded on the south and east by the Yakima River and on the north and west by the Benton Irrigation District.

Historically, the KiID diverted water from the Yakima River near river mile 35 and also received return flows from Benton Irrigation District and Roza Irrigation District to the Kiona Canal through a diversion on Corral Creek. Historical flow measurements of the KiID diversion were not available. The calculated gross water requirement is 20,023 AFY, as reported in the *Kiona Irrigation District Comprehensive Water Conservation Plan* (CH2M Hill, February 1996).

A new pressurized system was built in 1996 following the large February 1996 flood that destroyed KiID's intake and portions of the main canal. The system has a new pump station on the Yakima River and piping through the district, which eliminated seepage loss. The current diversions average 9,763 AFY. The cost of the new pressurized system was over $3,000,000 (personal communication L. Deckert 2001). Emergency funding was secured through FEMA and Ecology. The new system diverts approximately half of the calculated gross annual water requirement reported in the 1996 plan.

2.13 Columbia Irrigation District

The Columbia Irrigation District (CID) is located in Benton County and irrigates 11,035 acres out of approximately 15,000 acres in Richland, West Richland, Kennewick, and Finley. Currently, water is diverted from the Yakima River at Wanawish (formerly Horn Rapids) Dam (river mile 18) into the CID main canal. The average annual diversion for the period from 1910 to 1995 is 89,000 AF, but the average annual diversion for the more recent period from 1980 to 1995 is only 64,051 AF. The operational spill reported in base year 1987, was 12,067 AF. The estimated water loss due to seepage and evaporation/transpiration is 10,000 AFY. These volumes were reported in the 1996 plan.

The proposed projects are described in the *Columbia Irrigation District Comprehensive Water Conservation Plan* (J-U-B Engineers, October 1996). The plan recommends four water use efficiency measures (Proposal #1, #4A, #5, and #3).

After the Water Conservation Plan was prepared, a number of changes occurred in the CID, including reconstruction of Wanawish Dam (formerly Horn Rapids Dam) in 1997. These changes led to a revision of water use efficiency projects outlined by SCM Consultants in 1999. Three projects were identified; 1) relocate a portion of the diversion to Columbia River, 2) pipe and pressurize Laterals 1 and 2, and 3) concrete line portions of the main canal.

Relocating a portion of CID's diversion to the Columbia River would be completed in conjunction with the Kennewick Irrigation District's Columbia River Pump Exchange Project (See Section 2.14). The estimated amount of water savings to the Yakima River is 43,663 AF annually. Furthermore, the CID's total annual diversion would be reduced by up to 4,196 AF. The CID's participation in this project is contingent on them not having to participate in the annual electrical and operation and maintenance cost of the pumping facilities. These costs would need to be funded by another entity such as the BPA.

Piping and pressurizing Laterals 1 and 2 could eliminate the loss to seepage, evaporation, and operational spills. In addition, flow meters would be installed at turnouts as a means of managing water deliveries and limiting users to their water right volume. The last proposal would include lining 15.9 miles of the main canal with concrete. With the new dam in place, the CID will likely continue to use the main canal to serve areas west of the intersection of I-182 and the main canal. In addition, proposed Columbia River Pump Exchange Project would discharge water into the main canal. The first 9.6 miles of the main canal, below Wanawish Dam, and the 6.3 miles immediately downstream of the

proposed discharge point for water from the Columbia River are the reaches proposed to be lined with concrete.

The total potential water saved with the proposed measures is 68,238 AF, with a total cost of $12,902,000 (1999 dollars) or $189 per AF. The costs include construction, contingency, engineering, and sales tax. The cost per acre-foot of water savings was calculated using the reduction in diversions from the Yakima River combined with the reduced seepage loss from District facilities. The CID proposed measures cost and conservation itemization is listed in Table 2-12.

Table 2-12
Columbia Irrigation District
Preferred Water Use Efficiency Projects

Proposal No.	Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
1	Diversion at Columbia River	43,663	$4,125,600	$94
2	Laterals No. 1 and 2 Pressurized Pipeline	16,106	$8,471,100	$526
3	Main Canal Concrete Lining			
	9.6 mile segment	5,142	$5,193,800	$1,010
	6.3 mile segment	3,327	$3,111,500	$935
Total		68,238	$12,902,000	$189

By supplying a reliable surface water irrigation source to users, it is possible to preempt the use of groundwater as a source of irrigation water, and save this water for domestic purposes. Proposed water saving measures that eliminate seepage losses and/or water discharges may adversely affect some wetlands located near the CID's canals.

Portions of water saved may be retained within the CID to augment supply for existing lands in the district, while some portion may be transferred to outside the CID (including the State Trust Water Fund). The CID intends to negotiate in good faith with Ecology and other interested entities in the disposition of net waters saved from implemented projects. Potential sources of funding identified for the proposed projects include increased assessment rates, YRBWEP funding and BPA and other grants.

2.14 Kennewick Irrigation District

The Kennewick Irrigation District (KID) is located in Benton County near the confluence of the Columbia River, Snake River, and the Yakima River. KID diverts water from the

Yakima River at river mile 47.1 and spills water at the end of the system to the Columbia River near river mile 317.5. The KID irrigates 26,441 acres out of the 55,000 acre total area. KID's service area includes portions of Richland, West Richland, and Kennewick. These cities and surrounding areas have experienced considerable growth and in 1998 approximately 15,800 parcels were assessed. The KID diverts an annual average of 96,679 AF for the period of 1970 to 1994, not including water short years (1973, 1977, 1979, 1987, 1988, 1992, 1993, and 1994). This does not include the volume the KID receives from the CID. The estimated amount of water the CID diverts and conveys to the KID is approximately 2,000 AFY.

Five proposed measures were presented in the *Kennewick Irrigation District Draft Water Conservation Plan* (SCM Consultants, June 1999). The five proposed measures are prioritized into three tiers based on their implementation schedule. First tier measures are proposed for implementation within five years, second tier measures are proposed for implementation within 10 years, and third tier measures are proposed for implementation in subsequent years. Canal lining and piping is an on going part of the capital improvement budget and is included in all three tiers.

The first tier includes measures one and two. The first measure is the Columbia River Pump Exchange Project (CRPEP). This would involve construction of a Columbia River pump station and pipeline to convey water to the end of the main canal. This measure would also provide pipe and pumping facilities to deliver water from the Columbia River to areas upstream of the proposed pipeline discharge. This measure would allow service to the entire district from the Columbia River and would abandon the current Yakima River diversion at Prosser Dam.

The CRPEP would leave an annual average of 217,867 AF of additional water in the Yakima River between Prosser Dam (river mile 47.1) and Chandler Power and Pumping Plant (river mile 35.8) and an annual average of 121,037 AF of additional water in the Yakima River from Chandler downstream to the Columbia River. The project would also reduce the KID's average annual diversion by 27,726 AF. The canal seepage losses supplying the shallow aquifer would be reduced approximately 10,168 AFY. The combined seepage, evaporation and operational spills saved by the project total 29,178 AF of water per year. The water saved in the Yakima watershed with the CRPEP is assumed to be the average annual diversion from the Yakima River plus the reduced losses, when combined is 247,045 AF.

The estimated cost of the CRPEP is $51.9M and includes easement acquisition, electrical service, contingency, sales tax, and engineering. The annual O&M costs for the CRPEP is $2.9M, which includes $2.1M in electricity costs and $332,000 in contributions to an equipment replacement fund.

The second measure proposed in the KID is lining for five canal segments and piping for three canal segments. The project involves canal lining projects on the Main Canal, Badger East Lateral, Highlift Canal, and division IV Canal. Canal piping projects on the Highland Feeder 3.3 Lateral, Division IV Canal, and Amon Pump 1.9 Lateral are also proposed. The O&M cost for measure two is not expected to differ for the current cost.

The total cost of the proposed first tier measure is $54,275,600 (1999 dollars), or $219 per AF. The cost and water savings for each measure is itemized in Table 2-13.

The City of Kennewick uses two Ranney wells for potable water that pump water from a shallow aquifer adjacent to the Columbia River. Future water conservation improvements might reduce recharge to the shallow aquifer and may impact the wells. The reduction in recharge could cause reduced water levels and higher nitrate concentrations. This may force the City to deepen the wells. As the water surface elevation of the shallow aquifer is reduced, the wells may also begin to draw water from the Columbia River.

Wetlands located along canals will be affected by canal piping. Mitigation for loss of wetland area may be required, but costs have not been estimated yet.

Table 2-13
Kennewick Irrigation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Save (AF)	Capital Cost Estimate	Capital Cost per AF
Columbia River Pump Exchange	247,045	$51,857,000	$210
Canal Lining and Piping	663	$2,418,600	$3,648
Total	247,708	$54,275,600	$219

The KID does not anticipate to provide funding for the CRPEP above current expenses incurred to operate Chandler Power and Pumping Plant and any reduction in expenses resulting from canal piping. The existing KID capital improvement budget is adequate to fund the KID's share of measure 2. All other expenses for the projects were assumed to be paid for by Referendum 38 funding.

2.15 Wapato Irrigation Project

The Wapato Irrigation Project (WIP) is located within Yakama Nation (YN) in the lower Yakima River Basin. It is bounded by Ahtanum Creek to the north, the Yakima River to the east, and the Satus Pump Canal and the Unit 1 and 2 Pump Canals to the south and west. The WIP service area encompasses 142,000 acres of land for irrigation, with 110,000 to 120,000 acres actively irrigated. Although YRBWEP is not planning for water resource management in the YN, we have included the WIP proposed improvements in this section because they receive water from the Yakima Project.

The WIP receives most of its irrigation water from the Yakima River at the Wapato Diversion Dam. Water is diverted to the Main Canal and then delivered to the Wapato Unit through Laterals 1, 2, 3, and 4. The Bench Unit also receives water from the Main Canal through the Unit 1 Pump Canal and the Main Canal Extension. Water from Toppenish Creek is pumped by the Unit 2 Pump Plant to the Unit 2 Pump Canal. Return

flows from the Wapato and Bench Units supply almost all of the water used by the Satus Unit. Most of the return flows from the Satus Unit return to the Yakima River without reuse. The average annual diversion from the Yakima River is 620,955 AF for the period between 1970 and 1994, excluding water short years. The total diversion is sum of the Main Canal Diversion and the Old Reservation Canal Diversion. The average loss, including on-farm losses, is 244,000 AFY. The water budget numbers were reported in the1999 plan.

The proposed improvement measures are detailed in the *Irrigation Water Conservation and Management Plan for the Wapato Irrigation Project Draft* (Natural Resources Consulting Engineers, May 1999). The Water Conservation Plan is composed of three tiers of proposed improvements or measures. The First Tier is to be implemented within five years, the Second Tier within 10 years, and the Third Tier in subsequent years.

The First Tier measures include rehabilitation of electrical and pumping systems, replace Main Canal water control structures, Unit 2 Feeder Canal improvements, install turnout measurement devices and structures, canal water level control, automation of pumping plants, improve Track Lateral and Lateral 4 Extension, Unit 1 pipeline, Satus 3 pipe and regulating reservoir, Satus 2 canal improvement and regulating reservoir, and Satus East and West lateral improvements. Education and management are also included in the proposed improvements.

The proposed improvements may also allow 10,000 to 16,000 acres of marginal/idle land to come into production. Land that currently lies idle because the current supply of water is unreliable would require up to 64,000 AFY of increased delivery if it came into production. Turning 16,400 acres of land into production would cost $4,920,000.

The potential amount of water saved with First Tier measures is 22,300 AF with a total cost of $87,480,000 (1999 dollars), or $3,923 per AF. The total amount of water saved was reduced by 64,000 AF of water that would be used to irrigate marginal/idle land after implementation of the proposed improvements (Case 1). If the future irrigated acreage remains constant (Case 2), then 86,300 AF of water is saved. The cost estimates include construction, engineering, and contingencies. The water conservation plan states that after the proposed measures are in place, the volume of water available for the Irrigation Demonstration Project at the Main Diversion are 19,200 and 49,200 AFY for Case 1 and Case 2, respectively. The volume of water saved from the Unit 2 Feeder Canal is earmarked for agricultural use to offset the YIN water in Toppenish Creek, Satus Creek and the area's other waterways that is already dedicated to fish and wildlife enhancement, protection and mitigation. The costs and water savings for the improvements are itemized in Table 2-14.

Some of the proposed measures will reduce O&M costs, such as: rehabilitation or replacement of facilities, improved water measurement, canal automation, piping of canals, laterals, and sub-laterals, and lining of canals and laterals. Other water conservation measures may increase O&M costs, such as: providing equitable distribution of water, sponsoring and supporting informational and educational programs to promote efficient use of water, operation of storage reservoirs, and an improved water

accounting system. The estimated annual O&M cost for the First Tier measures is $341,500.

Table 2-14
Wapato Irrigation District
Preferred Water Use Efficiency Projects

Preferred Efficiency Measures	Potential Amount Saved (AF)	Capital Cost Estimate	Capital Cost per AF
Rehabilitate Electrical and Pump Systems	Not estimated	$16,610,000	-
Main Canal Control Structures	Minor	$1,110,000	-
Unit 2 Feeder Canal	Toppenish Creek	$920,000	-
Turnout Measurement Devices	14,700	$5,200,000	$354
Water Measurement Structures	Minor	$770,000	-
Canal Water Level Control	Included elsewhere	$1,740,000	-
Automation of Pumping Plants	Included elsewhere	-	-
Track Lateral Improvements	5,100	$5,040,000	$988
Lateral 4 Extension Improvements	3,400	$3,300,000	$971
Unit 1 (East Highline) Pipeline	700	$1,400,000	$2,000
Satus 3 Piped Distribution System	15,900	$11,280,000	$709
Satus 2 Canal Improvements	8,500	$5,990,000	$705
Satus East and West Lateral Improvements	4,600	$3,380,000	$735
Satus 2 Regulating Reservoir	900	$1,030,000	$1,144
Satus 3 Regulating Reservoir	Included elsewhere	$680,000	-
Improved On-Farm Water Conservation	32,500	$16,730,000	$515
Marginal/Idle Land	(64,000)	$4,920,000	-
Other Measures (Education, Management and Staffing, Water Conservation Advisory Board, etc)	Not Measured	$7,380,000	-
Total	22,300	$87,480,000	$3,923

The proposed measures will eliminate 240 miles of earthen canals and the associated riparian habitat. Incidental wetlands and vegetation dependant on the canal seepage and spills will be impacted.

The conserved water could be used to: 1) increase in-stream flows and restore/create wetlands, 2) improve regional irrigation water supply reliability, and 3) expand the WIP's irrigated land base (limited to the YIN lands under their demonstration project). The proposed allocation of the conserved water for each use was not proposed.

YRBWEP authorized $23 million for planning and implementation of system improvements to the WIP and $8.5 million for the design and construction of the Yakama Indian Reservation Irrigation Demonstration Project. In addition, YRBWEP authorized $1.5 million for the Toppenish Creek Corridor Project.