

Technical Memorandum (DRAFT)

Yakima River Basin Study



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From: Bob Montgomery (Anchor QEA)
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Title: Agricultural Water Conservation (Task 4.12)
CC: Yakima Basin Study Workgroup
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1.0 Agricultural Water Conservation Measures

Agricultural water conservation measures are described in this section for irrigation water delivery systems (canals and laterals) and on-farm systems (irrigation types such as rill, sprinkler and drip). Potential water conservation measures include lining or piping existing canals or laterals, constructing reregulation reservoirs on irrigation canals, installing gates and automation on irrigation canals, improving water measurement and accounting systems, installing higher efficiency sprinkler systems, implementing irrigation water management practices and other measures to reduce seepage, evaporation and operational spills. This memorandum describes the components of water conservation projects proposed in the Yakima River Basin study and their estimated water savings. A discussion of potential benefits to instream flow and water supply as well as the estimated cost is provided as a basis for selecting a program of water conservation projects to analyze with the hydrologic model.

1.1 Water Conservation Measures Previously Identified

Water conservation projects were previously identified in the Final Planning Report/Environmental Impact Statement Yakima River Basin Water Storage Feasibility Study (Water Storage Feasibility Study) (Reclamation 2008) and Final Environmental Impact Statement Yakima River Basin Integrated Water Resource Management Alternative (Integrated Water Resource Management Alternative) (Ecology, 2009).

In the Water Storage Feasibility Study, the No Action Alternative described a series of water conservation projects that Reclamation intended to represent the most likely future that would be expected in absence of constructing additional water storage. Those projects would mostly be implemented under YRBWEP. Projects in seven different irrigation districts were identified (Table 2.5 of Water Storage Feasibility Study). The projects included piping and lining, reregulation reservoirs and changes in points of diversion to improve instream flow.

In the Integrated Water Resource Management Alternative, a more aggressive approach to implementing water conservation projects was identified. The Enhanced Water Conservation Element described additional projects, beyond those identified by Reclamation as part of their No Action Alternative. The projects were identified by reviewing all published water conservation plans for irrigation districts in the Yakima River basin and contacting irrigation and conservation districts as well as state and federal agencies to identify potential water

conservation projects. A description of that process is contained in Technical Report on the Enhanced Water Conservation Alternative (Ecology, 2007). For that alternative, projects in 18 irrigation districts or companies were identified with a total estimated cost of over \$400 million. The types of projects are similar to those proposed by Reclamation, except that on-farm water conservation measures are also included in some irrigation districts. Table 2-3 of the Integrated Water Resource Management Alternative contains a list of Ecology's Enhanced Water Conservation projects.

Both the No Action Alternative and the Enhanced Water Conservation Alternative were previously modeled using the RiverWare hydrologic model. The results from modeling those alternatives are described in the Water Storage Feasibility Study and the Integrated Water Resource Management Alternative.

A presentation to the YRBWEP Workgroup of the Enhanced Water Conservation Alternative was made in 2009. The Workgroup commented that the list of water conservation projects contained in that alternative may change as detailed feasibility studies are performed and priorities change. The Workgroup wanted the list of conservation projects to be used as a placeholder with the intent to identify a level of funding for water conservation projects that will result in water supply and instream flow benefits. A process similar to that followed by the Conservation Workgroup would be followed to determine which projects would be funded under this program once funding is secured.

1.2 Water Conservation Measures Proposed for Yakima River Basin Study

The projects described in the No Action Alternative in the Water Storage Feasibility Study and the Enhanced Water Conservation Alternative in the Integrated Water Resource Management Alternative were further reviewed to refine the projects that should be listed under the No Action Scenario for this study and the projects that are recommended to be included in the Enhanced Water Conservation Scenario in this study.

1.2.1 No Action Scenario Projects

The projects that are under consideration to be funded through Phase II of YRBWEP were obtained from Reclamation and are presented in Table 1. The list is slightly different from the list contained in the EIS for the Water Storage Feasibility Study, because Reclamation and the irrigation districts are refining the projects and determining which projects to implement. Discussions were held with the Hydrologic Modeling Subcommittee of the Yakima River Basin Study Workgroup to determine which of the water conservation projects listed in Table 1 should be included in the No Action Scenario. The criteria used to determine if a project belongs in the No Action Scenario list are:

- Has the project been planned and designed through processes outside of this Basin Study?
- Is the project authorized and has identified funding for implementation?
- Is the project scheduled for implementation?

Table 1
YRBWEP Phase II Projects

Entity	Project Description	Conserved water					
		Volume (acre-feet)			Flow (cfs)		
		Total	Instream	Irrigation	Total	Instream	Irrigation
Projects with implementation agreements							
Sunnyside Division Board of Control	System improvements (Phase I)	29,100	19,400	9,700	80	54	26
	System improvements (Phase II)	25,480	17,000	8,480	70	47	23
Benton Irrigation District	Change in diversion for 72 river miles	21,000	21,000	0	58	58	0
	System Improvements & carriage water for 8 river miles	6,870	5,420	1,450	19	15	4
Projects with feasibility investigation agreements							
Roza Irrigation District ¹	System improvements - re-regulation reservoir	13,700	9,200	4,500	37	26	11
Kennewick Irrigation District	System improvements - re-regulation reservoirs and lateral piping	28,190	18,800	9,390	78	52	26
Projects with high interest from entity							
Roza Irrigation District	System improvements with "pay as you go approach"	46,200	N/A	46,200	128	N/A	128
Wapato Irrigation Project	Change in diversion for Satus Area	N/A	N/A	N/A	50	50	0
Naches-Selah Irrigation District	System improvements - re-regulation reservoir and lateral piping	15,000	10,000	5,000	42	28	14
Projects with limited interest for YRBWEP funding by entity							
Kittitas Reclamation District	System improvements	48,600	32,400	16,200	135	90	45
Union Gap Irrigation District	System improvements - lateral piping	5,600	3,700	1,900	15	10	5

¹ Implementation probably would require Congressional approval of technical changes to legislation

Notes: Instream – water savings that will be added to instream flow

Irrigation – water savings that will be added to irrigation supply during drought years

Source: Reclamation, 2009

In discussions with the subcommittee, the available funding for YRBWEP through Reclamation was described as the limiting factor in the implementation of the projects in Table 1. A shorter list of projects was then developed for the No Action Scenario that accounted for the potential funding limitations. Table 2 summarizes that list. The remainder of the projects that were previously in the No Action Alternative were then moved to the Enhanced Water Conservation Scenario.

Table 2
No Action Scenario Projects

Entity	Project Description	Water Conservation (ac-ft, except where noted)		
		Total	Instream	Irrigation
Sunnyside Division	System Improvements (Phase I)	29,100	19,400	9,700
	System Improvements (Phase II)	25,480	17,000	8,480
Benton Irrigation District	Change in diversion	21,000	21,000	-
	System Improvements	6,870	5,420	1,450
Wapato Irrigation Project	Change in diversion	50 cfs	50 cfs	-

1.2.2 *Enhanced Water Conservation Scenario Projects*

The remaining projects from Table 1 and the Enhanced Water Conservation Alternative from the Integrated Water Resource Management Alternative were combined and are shown in Table 3.

From that list, projects were evaluated and ranked by the following criteria:

- Type of water rights holder. Water conservation projects in districts with proratable entitlements were ranked higher than projects in districts with non-proratable entitlements. This will allow districts with shortfalls in drought years to better manage water use and provide a greater proportion of water diverted to crops.
- Reach benefits. Water conservation projects that result in improvements in instream flow in high priority reaches were ranked higher than other projects.
- Cost. Water conservation projects with a lower cost per acre-foot of water savings were ranked higher than conservation projects with a higher cost per acre-foot of water savings.

Table 3
Remaining Projects Not Included in No Action Scenario

Entity	Project Description	Water Conservation (ac-ft/yr)
Wapato Irrigation Project	Bench Unit Re-regulation Reservoir (370 AF)	700
Wapato Irrigation Project	Equip turnout with water measuring devices (2,500 total)	9,800
Kittitas Reclamation District	Piping high-loss laterals (53 mi), 2 re-regulation reservoirs, and North & South Branch Canal automation	40,735
Wapato Irrigation Project	Satus East and Satus West Canal lining	4,600
Kittitas Reclamation District	Replace leaky Main Canal lining	2,000
Wapato Irrigation Project	Lateral 4 Extension lining and corresponding sub-laterals lining or piping	3,400
Wapato Irrigation Project	Track Lateral lining and water structure replacement	5,100
Wapato Irrigation Project	Spencer Lateral improvement (10.5 mi)	1,300
Wapato Irrigation Project	Voluntary incentive-based irrigation improvement program	11,375
Wapato Irrigation Project	East Highline Canal lining or piping (12,000 ft)	700
Wapato Irrigation Project	West Highline Canal lining (24.5 mi)	2,950
Wapato Irrigation Project	Unit 2 Pump Canal lining (15 mi)	2,600
Wapato Irrigation Project	Island lateral and sub-lateral lining (10 mi)	750
Wapato Irrigation Project	Main Extension Canal lining (73 mi)	3,600
Wapato Irrigation Project	Replace Unit 1 piped laterals (32 mi)	800
Wapato Irrigation Project	Replace Unit 2 piped laterals (32 mi)	500
Wapato Irrigation Project	Replace existing check structures	minor
Wapato Irrigation Project	Construct water measurement devices	minor
Kennewick Irrigation District	Columbia River Pump Exchange	64,500
Cascade Irrigation District	Johnson Drain Pump & Variable Frequency Drive Installation	2,088
Outlook Irrigation District (SVID)	Pipe former Outlook Irrigation District (5 mi)	4,265
Westside Irrigation	Canal piping (2 mi)	600
Bull Canal Company	Canal piping (4,800 ft)	639

Entity	Project Description	Water Conservation (ac-ft/yr)
South Naches Irrigation District	Pressure distribution system conversion	9,733
Naches-Selah Irrigation District	Change point of diversion to Wapatox Ditch diversion	15,000
Union Gap Irrigation District	Canal piping (4 mi)	200
Ellensburg Water Company	Rill to sprinkler conversion (7,100 ac)	5,325
Cascade Irrigation District	Rill to sprinkler conversion (9,000 ac)	6,750
Westside Irrigation	Rill to sprinkler conversion (3,300 ac)	2,475
Bull Canal Company	Rill to sprinkler conversion (680 ac)	510
Naches and Cowiche Canal Company	Pipe ditch to current points of use (5.5 mi)	600
Yakima Valley Canal Company	Pipe ditch to current points of use (15 mi)	500
Gleed Ditch Company	Pipe ditch to current points of use (6.5 mi)	100
Kiona Irrigation District	Complete pressurized system conversion	4,124
Nile Valley Ditch Association	Canal piping (300 ac)	395
Columbia Irrigation District	Columbia River Pump Exchange, Main Canal lining (16 mi), Lateral 1 & 2 piping	26,000
Union Gap Irrigation District	Construct pump station to move point of diversion 11 mi downstream	5,600
Roza Irrigation District	System Improvements – Re-regulation reservoir	13,700
Roza Irrigation District	System Improvements – “Pay as you go”	46,200
Naches-Selah Irrigation District	System Improvements – Re-regulation reservoir and lateral piping	18,200

Table 4 presents a summary of the ranking process.

Table 4
Proposed Ranking of Enhanced Water Conservation Projects

Entity	Project Description	Priority Reach Benefits	Proratable Water User	Non-proratable Water User	Water Conservation (ac-ft/yr)	Cost (2007 \$)	Cost/AF (\$)
Wapato Irrigation Project	Bench Unit Re-regulation Reservoir (370 AF)	✓	✓	✓	700	571,000	816
Wapato Irrigation Project	Equip turnouts with water measuring devices (2,500 total)	✓	✓	✓	9,800	8,110,000	828
Kittitas Reclamation District	Piping high-loss laterals (53 mi), 2 re-regulation reservoirs, and North & South Branch Canal automation	✓	✓		40,735	43,197,000	1,060
Wapato Irrigation Project	Satus East and Satus West Canal lining	✓	✓	✓	4,600	6,315,000	1,373
Kittitas Reclamation District	Replace leaky Main Canal lining	✓	✓		2,000	3,110,000	1,555
Roza Irrigation District	System Improvements – “Pay as you go”	✓	✓		46,200	75,320,000	1,630
Wapato Irrigation Project	Lateral 4 Extension lining and corresponding sub-laterals lining or piping	✓	✓	✓	3,400	6,171,000	1,815
Wapato Irrigation Project	Track Lateral lining and water structure replacement	✓	✓	✓	5,100	9,412,000	1,845
Roza Irrigation District	System Improvements – Re-regulation reservoir	✓	✓		13,700	25,750,000	1,880
Wapato Irrigation Project	Spencer Lateral improvement (10.5 mi)	✓	✓	✓	1,300	2,612,000	2,009
Wapato Irrigation Project	Voluntary incentive-based irrigation improvement program	✓	✓	✓	11,375	23,392,000	2,056
Wapato Irrigation Project	East Highline Canal lining or piping (12,000 ft)	✓	✓	✓	700	2,612,000	3,731
Wapato Irrigation Project	West Highline Canal lining (24.5 mi)	✓	✓	✓	2,950	16,822,000	5,702

Entity	Project Description	Priority Reach Benefits	Proratable Water User	Non-proratable Water User	Water Conservation (ac-ft/yr)	Cost (2007 \$)	Cost/AF (\$)
Wapato Irrigation Project	Unit 2 Pump Canal lining (15 mi)	✓	✓	✓	2,600	16,261,000	6,254
Wapato Irrigation Project	Island lateral and sub-lateral lining (10 mi)	✓	✓	✓	750	4,777,000	6,369
Wapato Irrigation Project	Main Extension Canal lining (73 mi)	✓	✓	✓	3,600	40,878,000	11,355
Wapato Irrigation Project	Replace Unit 1 piped laterals (32 mi)	✓	✓	✓	800	10,405,000	13,006
Wapato Irrigation Project	Replace Unit 2 piped laterals (32 mi)	✓	✓	✓	500	11,634,000	23,268
Wapato Irrigation Project	Replace existing check structures	✓	✓	✓	minor	1,586,000	NA
Wapato Irrigation Project	Construct water measurement devices	✓	✓	✓	minor	1,586,000	NA
Cascade Irrigation District	Johnson Drain Pump & Variable Frequency Drive Installation	✓		✓	2,088	342,000	164
Outlook Irrigation District (SVID)	Pipe former Outlook Irrigation District (5 mi)	✓	✓ ¹	✓	4,265	1,401,000	328
Westside Irrigation	Canal piping (2 mi)	✓	✓ ¹	✓	600	456,000	760
Bull Canal Company	Canal piping (4,800 ft)	✓		✓	639	560,000	876
South Naches Irrigation District	Pressure distribution system conversion	✓		✓	9,733	10,029,000	1,030
Naches-Selah Irrigation District	Change point of diversion to Wapatox Ditch diversion	✓	✓ ¹	✓	15,000	17,500,000	1,167
Naches-Selah Irrigation District	System Improvements – Re-regulation reservoir and lateral piping	✓	✓ ¹	✓	18,200	29,189,000	1,603
Union Gap Irrigation District	Canal piping (4 mi)	✓	✓ ¹	✓	200	518,000	2,590
Ellensburg Water Company	Rill to sprinkler conversion (7,100 ac)	✓		✓	5,325	18,405,000	3,456

Entity	Project Description	Priority Reach Benefits	Proratable Water User	Non-proratable Water User	Water Conservation (ac-ft/yr)	Cost (2007 \$)	Cost/AF (\$)
Cascade Irrigation District	Rill to sprinkler conversion (9,000 ac)	✓		✓	6,750	23,331,000	3,456
Westside Irrigation	Rill to sprinkler conversion (3,300 ac)	✓	✓ ¹	✓	2,475	8,555,000	3,457
Bull Canal Company	Rill to sprinkler conversion (680 ac)	✓		✓	510	1,763,000	3,457
Projects listed above are recommended to be included in Enhanced Water Conservation Scenario. Projects listed below are not.							
Naches and Cowiche Canal Company	Pipe ditch to current points of use (5.5 mi)	✓		✓	600	15,554,000	25,923
Yakima Valley Canal Company	Pipe ditch to current points of use (15 mi)	✓	✓ ¹	✓	500	25,923,000	51,846
Gleed Ditch Company	Pipe ditch to current points of use (6.5 mi)	✓		✓	100	5,185,000	51,850
Kennewick Irrigation District	Columbia River Pump Exchange		✓	✓	64,500	53,873,000	835
Kiona Irrigation District	Complete pressurized system conversion			✓	4,124	4,754,000	1,153
Nile Valley Ditch Association	Canal piping (300 ac)			✓	395	518,000	1,311
Columbia Irrigation District	Columbia River Pump Exchange, Main Canal lining (16 mi), Lateral 1 & 2 piping			✓	26,000	36,776,000	1,414
Union Gap Irrigation District	Construct pump station to move point of diversion 11 mi downstream		✓ ¹	✓	5,600	16,500,000	2,946

¹ - Water user has both non-proratable and proratable entitlements (mostly non-proratable) and was grouped with other non-proratable water users.

A suggested cut-off of projects is shown in Table 4; those projects above the cut-off line would comprise the Enhanced Water Conservation Scenario. The projects in that scenario have a total cost of \$423 million. The estimated total water savings are 216,600 acre-feet however those savings are not cumulative because water conservation projects reduce the amount of return flow to surface water. That return flow is a source of supply for downstream water users. In addition, the water savings are estimated for years when the water users have a full water supply. In drought years, the water savings will be reduced as less water is conveyed through irrigation systems and less water is applied to farms reducing seepage and other losses. The Yakima RiverWare hydrologic model will be used to test the effectiveness of the projects contained in Table 4 and to determine the flow benefits to priority reaches.

The Enhanced Water Conservation Scenario represents our best estimate of water savings that are reasonably obtainable through an aggressive agricultural water conservation program. The projects actually implemented will be determined through detailed feasibility studies and evaluation by the Yakima River Basin Conservation Advisory Group (CAG), a workgroup comprised of representatives from Reclamation, Ecology, irrigation districts and fisheries agencies to advise on implementation of the Yakima River Basin Conservation Program (YRBWEP Phase II). Other projects may be added to this list as they are identified.

1.2.3 Other Water Conservation Projects

Besides the No Action and Enhanced Water Conservation scenarios, other smaller water conservation efforts will be ongoing that are paid for outside of funding secured for this program. Those efforts will include on-farm irrigation improvements such as conversion to higher efficiency sprinklers or drip irrigation. The on-farm improvements have been occurring for decades and are one of the reasons for reduced diversions by irrigation entities that are shown in Figure 1 of the draft Technical Memorandum Water Needs for Out-of-Stream Uses (Water Needs Tech Memo) (HDR, Anchor QEA July 2010). The motivation for on-farm water conservation improvements include planting new crops (i.e. wine grapes, new orchards), reducing energy use, better control of fertilizer and chemical application, a need to reduce sediment runoff and improve water quality, to improve instream flow in tributaries and to improve the reliability of available water supplies.

Tables 11 and 12 of the Water Needs Tech Memo provide estimates of irrigation type by district in the Yakima Project. Roza farmers are estimated to have approximately 90% of the total acreage in sprinkler or drip systems. Although SVID has a smaller percentage of acreage sprinkler or drip irrigated (68%), they are currently installing new piped lateral systems which will deliver pressurized water to much of their acreage. That will facilitate conversion to higher efficiency irrigation systems. In the YTID, over 90% of the acreage is estimated to be sprinkler irrigated, which corresponds to the percentage of acreage in orchards which typically use higher efficiency irrigation systems. In WIP, approximately 55% of the acreage is sprinkler or drip irrigated. However additional water conserved on-farm in WIP may not result in corresponding reduction in diversion requirements because return flow is a supply to other WIP farmers. This issue was reviewed in Priority Irrigation Water Conservation and Management Measures Plan for the Wapato Irrigation Project (NRCE 2002) and it was estimated that a diversion reduction of

only 0.2 acre-feet per acre improved (11,375 ac-ft for 55,750 acres improved) would result. During drought years, the water savings would be reduced as less water is applied to fields.

In KRD, only 20% of the acreage is irrigated with sprinkler or drip systems. However return flow from KRD farms flows back to the Yakima River and is a source of supply for water users downstream of the Kittitas Valley. A reduction in seepage on KRD farms would not improve water supply conditions in the basin.

Outside of the Yakima Project, it is estimated that 75% of irrigated acreage is sprinkler or drip irrigated. Approximately 95% of the gravity (rill) irrigated acreage outside of the Yakima Project is located in Kittitas County and return flow from that acreage is a source of supply for water users downstream of the Kittitas Valley. A reduction of seepage on those farms would not improve water supply conditions in the basin. However in the Kittitas Valley, on-farm water conservation improvements could have large benefits to instream flow in tributaries.