Yakima River Basin Study

Municipal and Domestic Water Conservation Technical Memorandum

U.S. Bureau of Reclamation
Contract No. 08CA10677A ID/IQ, Task 4.11

Prepared by

HDR Engineering, Inc

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office

State of Washington
Department of Ecology
Office of Columbia River

March 2011

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Appendix A – Conservation Measure Definitions

1.0 Introduction

This technical memorandum describes the potential for municipal and domestic conservation as part of the Yakima River Basin Integrated Water Resources Management Plan (Integrated Plan). It includes the following:

- A summary of conservation characteristics in the municipal and domestic sector
- A description of the two scenarios used by the HDR study team for modeling (Future without Integrated Plan and Comprehensive Basin-wide Conservation)
- Estimates of the potential range of water savings under those scenarios
- An estimate of the reduction in consumptive use based on total water conserved
- Recommendations for how to move forward with conservation measures under the Integrated Plan.

Costs of these scenarios have not yet been analyzed in detail. However it is anticipated that an effective basin-wide water conservation program for municipal and domestic uses may cost between $0.5 and 1.5 million per year on an ongoing basis.

The recommendations call for an Advisory Committee to work with local government elected officials and representatives of applicable State and Federal agencies to further define an appropriate program and determine conditions for accessing new supplies created for municipal and domestic water users under the Integrated Plan.

2.0 Background

Over the past 20 years many communities in the western United States have adopted water conservation programs aimed at reducing use of potable water supplies. The most advanced and comprehensive programs have been developed for large cities such as Albuquerque, Austin, Denver, Las Vegas, Los Angeles, Portland and Seattle. It is relatively uncommon for smaller cities and towns (population less than 25,000) to have detailed conservation programs due to lack of staff and program resources. Domestic well users outside municipal systems typically have not been identified for water conservation programs in Washington or other states.

The Washington State Legislature passed the Municipal Water Law in 2003, which led to adoption of Municipal Water Use Efficiency requirements by the Washington State Department of Health (WSDOH). These requirements, contained in various subsections of Chapter 246-290 of the Washington Administrative Code, took effect in 2007. Under these regulations, municipal water suppliers must adopt water conservation goals, document a water-use efficiency program in their water system planning documents, and report annually to WSDOH. They are required to meter water production and water delivered to individual customers, while limiting system leakage and other losses to a maximum of 10% of water produced.

Several communities in the Yakima Basin have recently adopted conservation goals and identified actions to achieve their goals under the State requirements. While there are many variations, municipal water conservation actions can be generally categorized as follows:

- Supply-side actions to reduce water losses from distribution piping, manage water main flushing programs used to maintain water quality, and control un-metered uses such as construction site activities.

- Distribution of water-efficient equipment for indoor uses such as low-flow toilets, showerheads, faucets and clothes washers.
- Public education, voluntary customer audits, and incentives to encourage design of water-efficient landscapes, careful use of irrigation water by municipal customers, and installation of efficient lawn-irrigation equipment.
- Implementation of water-rate structures that encourage customers to limit their water use. The most common of these are inclined-block rate structures (cost rises as consumption increases) and rates that are higher in summer than other months. Water-efficiency objectives must be balanced against the need for rate structures that provide revenue stability and comply with other state and local requirements.
- Mandated plumbing codes (typically federal and/or state) prohibiting sale of indoor plumbing equipment that does not meet defined standards. Washington State's plumbing code includes efficiency standards for toilets, urinals, showerheads and faucets. State or federal actions may add new code requirements in the future.

The plumbing code is statewide and affects all municipal system customers and homes with domestic wells. Other program elements listed above are developed locally and can vary considerably from one community to another.

The most effective water conservation programs involve careful program design, consistent investment, and sustained public outreach. A variety of social factors affect conservation practices, including awareness of water scarcity, receptiveness to government-sponsored programs, and the cost of water in relation to household income.

3.0 Modeling Approach

HDR has developed a quantitative model designed to assess potential water savings from municipal conservation programs. The model focuses on standard uses by customers, and does not address water system "supply-side" actions, since the savings from supply-side actions vary substantially across water systems. It allows users to enter data on population, households and businesses for a given region, select particular conservation actions, and define expected participation rates by water users. The model then estimates total water savings and associated costs. Participation rates, which are a key factor in the model, were used to analyze scenarios for the 2010 Yakima River Basin Study. In addition to municipal water systems, this assessment addresses homes with their own domestic wells.

The Yakima River Basin includes many communities with differing goals and programs. Instead of characterizing individual community conservation programs, this analysis applies a standard set of assumptions basin-wide. However, data on current conservation programs from eight municipal water systems within the basin was used to estimate current levels of conservation implementation.

3.1 Scenarios Modeled

This section describes the two alternative scenarios (Future without Integrated Plan scenario and Comprehensive Basin-wide Conservation scenario) that were used by the HDR study team for modeling. HDR previously outlined these scenarios in a technical memorandum that was distributed to the Out-of-Stream Water Needs Subcommittee and the YRBWEP workgroup. Appendix A provides details of specific water conservation measures that were modeled.

Scenario 1: Future Without Integrated Plan (FWIP)

The Future Without Integrated Plan (FWIP) means there would be no federal/state action under the Integrated Plan to address water conservation for municipal water systems and domestic wells. However, this does not mean that current conditions will remain static over the 50-year period being used for the study. The following assumptions were used under the FWIP scenario:

- Current societal trends continue to make consumers and business owners more aware of resource scarcity and receptive to water conservation practices. This includes generational change over the 50-year study period.
- Equipment manufacturers continue to improve technology of plumbing devices, appliances, and commercial equipment, leading to gradual improvement in water-use efficiency over 50 years.
- Current Washington State plumbing code requirements for water use efficiency stay the same.
- In response to WSDOH requirements, local municipal water systems become somewhat more active in promoting water conservation. However, these programs will not be coordinated across the basin and will not include domestic well owners.

Table 1 shows detailed assumptions and participation rates that were used to model Scenario 1. The participation rates address only "target" customers, meaning households or businesses that have the relevant type of water use for a given conservation action. Participation rates are assumed to increase between 2010 and 2060, due to the factors listed above.

Table 1. Scenario 1 – Future Without Integrated Plan (FWIP) Assumptions and Participation Rates

Participation Rate by Customer Category*
(SF = Single Family Households; MF = Multifamily Households; NR = Non-Residential)

CONSERVATION MEASURE	FIRST YEAR OF PLANNING PERIOD 2011			LAST YEAR OF PLANNING PERIOD 2060		
	SF	MF	NR	SF	MF	NR
Efficient Clothes Washers	5%	5%	5%	75%	75%	75%
Bathroom Faucet Aerators – 0.5 gallons per minute	5%	5%	5%	25%	25%	100%
Showerhead – 1.5 gallons per minute	5%	5%	5%	25%	25%	25%
High-Efficiency Toilets – 1.28 gallons per flush	1%	1%	1%	25%	25%	25%
Urinals – 0.5 gallons per flush	N/A	N/A	5%	N/A	N/A	10%
Kitchen Spray Valve – 1.25 gallons per minute	N/A	N/A	5%	N/A	N/A	90%
Faucets – Decrease Use	5%	5%	N/A	5%	5%	N/A
Showerheads – Decrease Use	5%	5%	N/A	5%	5%	N/A
Toilets – Leak Detection	5%	5%	N/A	15%	15%	N/A
Toilets – Decrease Flushes	1%	1%	N/A	1%	1%	N/A
Irrigation Controllers – Evapotranspiration (ET) Model	0%	5%	5%	25%	25%	25%
Outdoor Irrigation Kits	5%	N/A	N/A	15%	N/A	N/A
Outdoor Audit	N/A	1%	1%	N/A	5%	5%
Lawn Replacement	5%	5%	N/A	5%	5%	N/A

*Percent of target customers that participate in water conservation programs.
Behavior measures are *italicized.*
N/A = Not applicable in this customer category..
Note 1: Participation rates for 2010 are based on qualitative information provided to the study team by municipal water systems in the Yakima Basin in May 2010.
Note 2: Under Scenario 1, participation rates at 2030 will be estimated as 40% of the change in participation rates from 2010 to 2060 (20 years of the 50-year period represents 40% of the time period).
Note 3: Future trends due to improvements in equipment technology have been assumed to be more powerful than trends that change personal behavior by consumers.

Scenario 2: Comprehensive Basin-Wide Conservation Scenario

Scenario 2 explores a hypothetical question: If the communities and residential population of the Yakima River Basin adopted common, basin-wide practices promoting a high degree of municipal and domestic water efficiency, how much water would be saved, and how much would it cost?

This scenario estimates the upper-end of water savings that could be achieved. Assumptions for this scenario include the following:

- Societal and market trends will develop in the same ways described under Scenario 1.
- Over the 50-year period, Washington State plumbing code requirements will become more stringent, requiring greater efficiencies in more kinds of plumbing equipment, water-using appliances, and landscape irrigation systems.
- Local municipal water systems will become much more active in promoting water conservation. Programs will be coordinated across the Yakima Basin and will provide conservation services to domestic well owners and municipal water system customers. (At this time, implementation considerations and funding options for this scenario have not been explored).

Table 2 shows detailed assumptions and participation rates that were used to model Scenario 2. Participation rates between 2010 and 2060 are increased substantially over those in Scenario 1 due to the higher level of conservation implementation activity assumed for Scenario 2.

Table 2. Scenario 2 – Comprehensive Conservation Scenario Assumptions and Participation Rates

Participation Rate by Customer Category*

(SF = Single Family Households; MF = Multifamily Households; NR = Non-Residential)

CONSERVATION MEASURE	FIRST YEAR OF PLANNING PERIOD 2011			LAST YEAR OF PLANNING PERIOD 2060		
	SF	MF	NR	SF	MF	NR
Efficient Clothes Washers	5%	5%	5%	90%	90%	90%
Bathroom Faucet Aerators – 0.5 gallons per minute	5%	5%	5%	90%	90%	100%
Showerhead – 1.5 gallons per minute	5%	5%	5%	90%	90%	90%
High Efficiency Toilets – 1.28 gallons per flush	1%	1%	1%	90%	90%	90%
Urinals – 0.5 gallons per flush	N/A	N/A	5%	N/A	N/A	90%
Kitchen Spray Valve – 1.25 gallons per minute	N/A	N/A	5%	N/A	N/A	90%
Faucets – Decrease Use	5%	5%	N/A	50%	50%	N/A
Showerheads – Decrease Use	5%	5%	N/A	50%	50%	N/A
Toilets – Leak Detection	5%	5%	N/A	50%	50%	N/A
Toilets – Decrease Flushes	1%	1%	N/A	50%	50%	N/A
Irrigation Controllers – Evapotranspiration (ET) Model	0%	5%	5%	90%	90%	90%
Outdoor Irrigation Kits	5%	N/A	N/A	90%	N/A	N/A
Outdoor Audit	N/A	1%	1%	N/A	90%	90%
Lawn Replacement	5%	5%	N/A	50%	50%	N/A

*Percent of target customers that participate in water conservation programs.
Behavior measures are *italicized.*
N/A = Not applicable in this customer category.
Note 1: Participation rates for 2010 are based on qualitative information provided to the study team by municipal water systems in the Yakima Basin in May 2010.
Note 2: For Scenario 2, participation rates at 2030 will be more accelerated than Scenario 1: they will be estimated as 60% of the change in participation rates from 2010 to 2060.
Note 3: Future trends due to improvements in equipment technology have been assumed to be more powerful than trends that change personal behavior by consumers.

3.2 Modeling Results

The tables in this section show modeling results of the two scenarios for the year 2060. Table 3 shows the FWIP scenario is estimated to reduce total municipal water use by approximately 3.4 million gallons per day (mgd) in the non-irrigation months, and 7.1 mgd during irrigation season. Table 4 shows the Comprehensive Basin-Wide Conservation scenario is estimated to reduce water use by 8.7 mgd in the non-irrigation months and 37 mgd during irrigation season.

Comparisons of water savings under the two scenarios are shown in units of millions of gallons per day (Table 5) and acre-feet per year (Table 6). The difference between the two scenarios represents the added effect of water conservation under the Comprehensive Conservation scenario – a total of about 19,600 acre-feet during irrigation season and 2,500 acre-feet during the remainder of the year.

Table 3. Water Conservation Savings at Year 2060 – FWIP Scenario

CONSERVATION MEASURE gpf = gallons per flush gpm = gallons per minute ET = Evapotranspiration	CUSTOMER CATEGORY SF = Single Family Households MF = Multifamily Households NR = Non-Residential	SAVINGS GENERATED BY CUSTOMERS	WATER SAVINGS AT FULL IMPLEMENTATION	
			NON-IRRIGATION SEASON (gallons per day)	IRRIGATION SEASON (gallons per day)
Indoor Measures				
High-Efficiency Toilets – 1.28 gpf	SF	47,467	545,936	545,936
High-Efficiency Toilets – 1.28 gpf	MF	4,671	38,302	38,302
High-Efficiency Toilets – 1.28 gpf	NR	1,984	99,200	99,200
Urinals – 0.5 gpf Models	NR	609	10,171	10,171
Toilets – Leak Detection	SF	8,310	177,014	177,014
Toilets – Leak Detection	MF	823	12,510	12,510
Clothes Washers	SF	92,327	1,449,660	1,449,660
Clothes Washers – In Unit	MF	4,178	46,794	46,794
Clothes Washers – Common Area	MF	5,013	56,146	56,146
Clothes Washers – Commercial	NR	42	56,448	56,448
Faucets – 0.5 gpm Bathroom Aerators	SF	34,162	355,285	355,285
Faucets – 0.5 gpm Bathroom Aerators	MF	3,362	16,138	16,138
Faucets – 0.5 gpm Bathroom Aerators	NR	407	13,554	13,554
Showerhead 1.5 gpm	SF	34,162	372,413	372,413
Showerhead 1.5 gpm	MF	3,362	26,224	26,224
Showerhead 1.5 gpm	NR	71	27,690	27,690
Pre-Rinse Spray Valves – 1.25 gpm	NR	343	40,543	40,543
Faucets – Decrease Use	SF	6,667	26,010	26,010
Faucets – Decrease Use	MF	658	1,184	1,184
Showerheads – Decrease Use	SF	6,667	16,677	16,677
Showerheads – Decrease Use	MF	658	1,184	1,184
Toilets – Decrease Flushes	SF	1,390	4,311	4,311
Toilets – Decrease Flushes	MF	137	301	301
Outdoor Measures				
Irrigation Controllers – ET Model	SF	14,651	0	1,046,919
Irrigation Controllers – ET Model	MF	323	0	49,088
Irrigation Controllers – ET Model	NR	518	0	89,898
Outdoor Irrigation Kits	SF	11,159	0	265,801
Outdoor Audit	MF	17	0	2,584
Outdoor Audit	NR	27	0	4,686
Lawn Replacement	SF	5,667	0	2,159,746
Lawn Replacement	MF	92	0	74,497
Seasonal Water Savings			3,393,693	7,086,912
Total Annual Water Savings[1]	2,025 Million Gallons (6,218 Acre-Feet)			

[1]Calculated using irrigation season of 7 months (213 days), consistent with municipal use patterns obtained in this study.

Table 4. Water Conservation Savings at Year 2060 – Comprehensive Conservation Scenario

CONSERVATION MEASURE gpf = gallons per flush gpm = gallons per minute ET = Evapotranspiration	CUSTOMER CATEGORY SF = Single Family Households MF = Multifamily Households NR = Non-Residential	SAVINGS GENERATED BY CUSTOMERS	WATER SAVINGS AT FULL IMPLEMENTATION	
			NON-IRRIGATION SEASON (gallons per day)	IRRIGATION SEASON (gallons per day)
Indoor Measures				
High-Efficiency Toilets – 1.28 gpf	SF	170,881	1,965,366	1,965,366
High-Efficiency Toilets – 1.28 gpf	MF	16,815	137,883	137,883
High-Efficiency Toilets – 1.28 gpf	NR	7,142	357,100	357,100
Urinals – 0.5 gpf Models	NR	5,483	91,574	91,574
Toilets – Leak Detection	SF	27,701	590,069	590,069
Toilets – Leak Detection	MF	2,744	41,709	41,709
Clothes Washers	SF	110,793	1,739,602	1,739,602
Clothes Washers – In Unit	MF	5,013	56,146	56,146
Clothes Washers – Common Area	MF	5,013	56,146	56,146
Clothes Washers – Commercial	NR	50	67,200	67,200
Faucets – 0.5 gpm Bathroom Aerators	SF	122,982	1,279,013	1,279,013
Faucets – 0.5 gpm Bathroom Aerators	MF	12,102	58,090	58,090
Faucets – 0.5 gpm Bathroom Aerators	NR	366	12,188	12,188
Showerhead 1.5 gpm	SF	122,982	1,340,672	1,340,672
Showerhead 1.5 gpm	MF	12,102	94,396	94,396
Showerhead 1.5 gpm	NR	257	100,230	100,230
Pre-Rinse Spray Valves – 1.25 gpm	NR	343	40,543	40,543
Faucets – Decrease Use	SF	66,672	260,112	260,112
Faucets – Decrease Use	MF	6,585	11,853	11,853
Showerheads – Decrease Use	SF	66,672	166,771	166,771
Showerheads – Decrease Use	MF	6,585	11,853	11,853
Toilets – Decrease Flushes	SF	69,479	215,480	215,480
Toilets – Decrease Flushes	MF	6,862	15,096	15,096
Outdoor Measures				
Irrigation Controllers – ET Model	SF	52,743	0	3,768,867
Irrigation Controllers – ET Model	MF	1,163	0	176,748
Irrigation Controllers – ET Model	NR	1,864	0	323,493
Outdoor Irrigation Kits	SF	66,956	0	1,594,852
Outdoor Audit	MF	303	0	46,049
Outdoor Audit	NR	486	0	84,344
Lawn Replacement	SF	56,671	0	21,597,839
Lawn Replacement	MF	922	0	746,593
Seasonal Water Savings			8,709,090	37,047,876
Total Annual Water Savings[1]	9,215 Million Gallons(28,290 Acre-Feet)			

[1]Calculated using irrigation season of 7 months (213 days), consistent with municipal use patterns obtained in this study.

Table 5. Comparison of Water Conservation Scenarios at Year 2060 (Millions of Gallons Per Day)

	FWIP SCENARIO	COMPREHENSIVE CONSERVATION SCENARIO	INCREASED SAVINGS FROM COMPREHENSIVE SCENARIO
Year-round	5.5	25.2	19.7
Non-Irrigation Season	3.4	8.7	5.3
Irrigation Season	7.1	37.0	29.9

Note: For values in millions of gallons per day, the year-round value is a weighted average of the two seasonal values (weighted by 213 days for irrigation season and 152 days non-irrigation season).

Table 6. Comparison of Water Conservation Scenarios at Year 2060 (Acre-Feet Per Year)

	FWIP SCENARIO	COMPREHENSIVE CONSERVATION SCENARIO	INCREASED SAVINGS FROM COMPREHENSIVE SCENARIO
Year-round	6,200	28,300	22,100
Non-Irrigation Season	1,600	4,100	2,500
Irrigation Season	4,600	24,200	19,600

Note: For values in acre-feet, the year-round value is the sum of the two seasonal values.

The estimates in the tables above are for year 2060. To generate an estimate of water saved by 2030, the following assumptions were made:

- FWIP Scenario: 40% of the savings will be achieved by 2030
- Comprehensive Conservation Scenario: 60% of the savings will be achieved by 2030

Nearly half the water saved under the Comprehensive Basin-Wide Conservation scenario during irrigation season is contributed by a single measure: replacing irrigated lawns and landscaping with drought-tolerant landscaping materials that reduce outdoor water use by 80%. As shown in Table 2, the Comprehensive Conservation scenario assumes that the percentage of Yakima Basin residents who have drought-tolerant landscaping will increase from an estimated 5% currently to 50% by 2060.

3.3 Estimated Effect of Conservation on Consumptive Uses

Indoor Uses – Most of the water conservation measures listed in Tables 3 and 4 affect indoor usage for which the water conserved previously drained to septic or wastewater collection systems. Those water savings affect non-consumptive uses, and therefore offer little benefit to the overall water balance of the Yakima Basin and Yakima River. However, it is assumed that perhaps 3% of those savings affect consumptive use, primarily due to reduced evaporation from showering, clothes washing, and faucet use.

Outdoor Uses – A substantial portion of the savings in outdoor usage reduces consumptive use. Irrigation water applied to urban or residential landscapes can be divided into three categories: 1) water that evaporates in the air or from the ground surface before seeping into the ground (consumptive); 2) water that reaches the root zone and is taken up by plants (consumptive); and 3) water that passes through the root zone and returns to shallow groundwater systems (non-consumptive). Measures that substantially eliminate water-intensive landscape materials, such as turf, offer savings in consumptive categories 1 and 2. Measures that retain the same landscape materials, but improve management of irrigation, offer savings primarily in consumptive category 1. (Category 3 was not given further consideration because it is non-consumptive).

For this analysis, it is assumed that 60% of the total water saved by measures that reduce water-intensive landscape materials can be counted as consumptive savings. It is assumed that only 30% of the total water saved by other outdoor measures can be counted as consumptive savings. Applying these factors, Tables 7 through 10 show the estimated reduction in consumptive water use from the two scenarios analyzed. The consumptive-use percentages used in these tables are gross estimates based on very limited information. Further literature review or field measurements could be used to improve these estimates.

Table 7. Consumptive Savings from Conservation Measures

CONSERVATION MEASURES MODELED	PERCENT CONSIDERED CONSUMPTIVE
Lawn Replacement	60%
Irrigation Controllers – ET Model	30%
Outdoor Irrigation Kits	30%
Outdoor Audit	30%
All Indoor Measures	3%

Table 8. Estimate of Consumptive Use Reduction from FWIP Scenario

	GALLONS PER DAY	GALLONS PER YEAR	ACRE-FEET PER YEAR
Total water saved from lawn replacement	2,234,000	402,120,000	1,200
Consumptive portion	1,340,000	241,200,000	700
Total water saved from other outdoor measures	1,459,000	262,620,000	800
Consumptive portion	438,000	78,840,000	200
Total water saved from all indoor measures	3,394,000	1,238,810,000	3,800
Consumptive portion	102,000	37,230,000	100
Total consumptive savings1	N/A	357,270,000	1,100

Note: Values in gallons per day are seasonal for the outdoor measures, but year-round for the indoor measures. To convert to values in gallons per year they are multiplied by 180 days for outdoor measures and 365 days for indoor measures.
[1]Total consumptive savings does not equal sum of values above due to rounding.

Table 9. Estimate of Consumptive Use Reduction from Comprehensive Conservation Scenario

	GALLONS PER DAY	GALLONS PER YEAR	ACRE-FEET PER YEAR
Total water saved from lawn replacement	22,344,000	4,021,920,000	12,300
Consumptive portion	13,406,000	2,413,080,000	7,400
Total water saved from other outdoor measures	5,994,000	1,078,920,000	3,300
Consumptive portion	1,798,000	323,640,000	1,000
Total water saved from all indoor measures	8,709,000	3,178,785,000	9,800
Consumptive portion	261,000	95,265,000	300
Total consumptive savings	N/A	2,831,985,000	8,700

See note on Table 8.

Table 10. Estimated Consumptive-Use Savings from Conservation Scenarios (Acre-Feet Per Year)

	FWIP Scenario	Comprehensive Conservation Scenario	Increased Savings from Comprehensive Conservation Scenario
Consumptive Use Reduction	1,100	8,700	7,600

3.4 Supply-Side Actions

The tables discussed above relate to conservation actions by households and businesses. Water can also be saved by municipal water systems through supply-side actions that reduce water leakage from distribution piping systems and by managing other water losses and system uses. This category of water savings does not apply to individual domestic wells since they are not served by municipal piping systems.

Public water systems are required to report estimated water losses to WSDOH annually. HDR reviewed estimates for 2008 and 2009 reported by the eight public water systems serving the six largest cities in the Yakima Basin. Estimates ranged from approximately 2% to 27% of total production, with a median loss of 12%. The largest public water system (City of Yakima) reported the highest value. Operators of this and other systems reporting the higher percentages indicated that these higher values are due in part to meter inaccuracy. For this analysis, it was assumed that 12% represents the average level of water loss from public water systems across the basin.

For the FWIP scenario, it was assumed that all water systems reduce their water losses to a level of 10% or less, matching current Washington State standards. This means that savings achieved will be 2% of total production (12% - 10% = 2%). For the Comprehensive Basin-Wide Conservation scenario it was assumed that additional supply-side actions will reduce losses to an average of 8% of water produced across the basin. This represents savings of 4% (12% - 8% = 4%). Both of these percentages were applied to forecasted municipal water production for 2030, and were held constant to 2060.

Under a separate subtask of the Yakima River Basin Study, HDR developed a projection of water use by municipal systems at year 2060. Table 11 lists the water savings estimated for supply-side actions using the assumptions stated above. It was assumed that 75% of the savings in 2060 would be achieved by 2030.

Table 11. Potential Water Savings from Supply-Side Actions (Acre-Feet Per Year)

YEAR	FORECAST PRODUCTION FROM MUNICIPAL SYSTEMS (MEDIUM FORECAST)	FWIP SCENARIO WATER SAVINGS	COMPREHENSIVE CONSERVATION SCENARIO WATER SAVINGS	DIFFERENCE (ADDED BENEFIT OF COMPREHENSIVE CONSERVATION SCENARIO)
2030	75,000	1,500	3,000	1,500
2060	101,000	2,000	4,000	2,000

The water saved from supply-side actions is primarily non-consumptive because it is largely a reduction of leakage into the ground from distribution piping systems. Water that leaks from pipes recharges shallow aquifers and eventually returns to the Yakima River system.

Table 12 shows the total savings from the consumer and supply-side conservation measures discussed above (note this is total water saved, not consumptive water saved).

Table 12. Potential Water Savings from Consumer Measures and Supply-Side Actions (Acre-Feet Per Year)

YEAR	FORECAST MUNICIPAL AND DOMESTIC NEEDS	FWIP SCENARIO COMBINED WATER SAVINGS	COMPREHENSIVE CONSERVATION SCENARIO COMBINED WATER SAVINGS	DIFFERENCE (ADDED BENEFIT OF COMPREHENSIVE CONSERVATION SCENARIO)
2030	121,000	4,000	20,000	16,000
2060	163,000	8,200	32,300	24,100

4.0 Potential Costs and Water Rates

Costs of conservation actions include replacement of inefficient equipment with water-saving equipment; replacement of landscaping materials; improvement of soils in urban and domestic landscapes; and programs to educate water users on conservation practices. Some cost savings occur due to reduced energy for heating water in homes and businesses; reduced use of chemicals and fertilizers on lawns and landscapes; and reduced pumping and treatment costs for municipal and domestic water supply.

A detailed assessment of costs of the conservation scenarios has not been performed. However, based on a preliminary assessment, the net cost ranges from tens of millions for the FWIP scenario to more than $100 million for the Comprehensive Basin-Wide Conservation scenario over the 50-year time period considered.

Rate structures (pricing) were not modeled directly in the analysis. However, it is assumed that under the Comprehensive Basin-Wide Conservation scenario, water rates will provide economic incentives for customers to manage their water use carefully. This is one common method used by municipal water systems to increase participation rates to the levels shown in Table 2.

5.0 Recommendations

The Out-of-Stream Water Needs Subcommittee of the YRBWEP Workgroup reviewed the information provided in Sections 1 through 5 above. The two scenarios discussed were intended to describe a wide range of potential conservation activity, water savings and costs. Rather than selecting either one of these scenarios, the Subcommittee recommended the following actions comprise the Municipal and Domestic Water Conservation element of the Integrated Water Resources Management Plan:

1. **Convene a multi-stakeholder Advisory Committee**, including local and environmental stakeholders, on municipal and domestic water conservation to organize outreach to local elected officials and provide liaison with Reclamation, Washington State Department of Ecology and Washington State Department of Health. Achieving effective and efficient compliance with current State requirements for water use efficiency could be a near-term objective (1 – 2 years); while generating support to go beyond the minimum state requirements could be a longer-range objective (2 – 5 years).
2. For purposes of this recommendation, **"municipal and domestic" water usage includes** water delivered by public water systems regulated by the State Department of Health, water used by individual homeowners served by "exempt" wells; water used by commercial or industrial facilities, and water delivered by irrigation entities for purposes of outdoor landscape irrigation in developed areas of the Yakima Basin. It includes residential, commercial, industrial and urban recreational uses of water such as parks, ballfields, and golf courses.

3. The Advisory Committee identified above should focus particular attention on education, incentives and other measures to **encourage residential and commercial users to improve efficiency of landscape irrigation, where the source of supply is agricultural irrigation canals or ditches.** This includes residential and urban lands within irrigation districts, as well as other lands where dual water delivery systems are present (potable water delivered separately from landscape irrigation water).

4. Since much of the water used in the municipal and domestic sectors is used non-consumptively and returns quickly to the Yakima River and its tributaries, **the primary focus should be on improving the efficiency of consumptive uses.** This approach will achieve the greatest value for dollars invested in water conservation.

5. Establish best practice **standards for accessing the new supply developed through the Integrated Plan and dedicated to municipal use and municipal/domestic mitigation**. For example, to be eligible for access to the new supply, communities served by public water systems or irrigation districts may need to:

   - Use piped distribution systems for water delivery to serve new subdivisions, including water delivered for outdoor landscape irrigation.
   - Implement rate structures that encourage water conservation;
   - Meet targets (to be defined by the Advisory Committee) for reducing water use per capita by 2020 and 2030. These targets should take into account the analysis of water conservation potential carried out as part of the Yakima Basin Study, and should aim for the higher end of potential water savings where feasible, and as rapidly as feasible, over the 50-year time frame evaluated in that analysis. (The higher end of potential water savings represented total per capita use reductions of approximately 17% by 2030 and 20% by 2060);
   - Meet the State-required standard for water loss of 10% or less; and/or
   - Offer a comprehensive menu of conservation program options for their customers or constituents. These options should be updated regularly to reflect modern, state-of-the-art technologies in common use throughout the western states, currently and in the future.

   The Advisory Committee should also recommend appropriate conditions for accessing the new supply that would apply to homeowners or developers seeking mitigation water for homes supplied by individual household wells.

6. As part of the Integrated Plan, **create a fund** to promote water use efficiency basin-wide using voluntary, incentive-based programs. Focus on outdoor uses as top priority. Funding would need to be on the order of $0.5M to $1.5M per year in order to make substantial progress.

   - Option 1: Administer basin-wide to gain economies of scale.
   - Option 2: Competitive grants to local communities for their own programs.

7. Assuming Reclamation is granted authority to store or deliver water for municipal and domestic purposes, **Reclamation should use contracts for the new block of supply for municipal and domestic use or mitigation to implement the provisions of Item No. 5 above (**i.e. standards for accessing the new supply created by the Integrated Plan).

6.0 List of Preparers

NAME	BACKGROUND	RESPONSIBILITY
HDR Engineering, Inc.		
Andrew Graham	Water Resources Planner	Author
Joe Miller	Water Resources Planner	Analyst
Kelly O'Rourke	Water Resources Planner	Quality Control review

Appendix A
Conservation Measure Definitions

The 17 conservation measures described below were selected for this study because they 1) are the measures most commonly implemented both nationally and in the Pacific Northwest, 2) typically have the highest customer acceptance levels, 3) typically are the most cost-effective measures, and 4) do not overlap with each other in terms of water savings achieved. These measures include:

- **Clothes Washers – Efficient Residential Capacity (In Unit)**: Provide partial rebates to replace less efficient residential-capacity clothes washers (located in housing units) with more efficient models. The participation rate for this measure was set at 25%.
- **Clothes Washers – Efficient Residential Capacity (Common Area)**: Provide partial rebates to replace less efficient residential-capacity clothes washers (in common laundry areas) with more efficient models. The participation rate for this measure was set at 25%.
- **Clothes Washers – Efficient Commercial Capacity**: Provide partial rebates to replace less efficient commercial-capacity clothes washers with more efficient models. The participation rate for this measure was set at 25%.
- **Faucets – 0.5 Gallon-Per Minute (gpm) Bathroom Aerators (Residential)**: Provide free 0.5-gpm bathroom faucet aerators, which for the residential customer category is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 10%.
    - **Faucets - 0.5 gpm Bathroom Aerators (Non-Residential)*:*** Provide free 0.5 gpm bathroom faucet aerators, which for the non-residential customer category is the maximum allowed under the plumbing code. Brings non-code customers up to code. The participation rate for this measure was set at 30%.
    - **Faucets - Decrease Use*:*** Encourage customers to reduce unnecessary faucet use, such as running the water while brushing teeth, thereby reducing combined bathroom and kitchen faucet use by 10%. The participation rate for this measure was set at 10%.
    - **Showerhead 1.5 gpm*:*** Provide free 1.5 gpm showerheads, which is more efficient than the maximum of 2.5 gpm allowed under the plumbing code. The participation rate for this measure was set at 25%.
    - **Showerheads - Decrease Use*:*** Encourage customers to reduce showering time by 10%. The participation rate for this measure was set at 10%.
    - **Pre-Rinse Spray Valves - 1.25 gpm*:*** Provide free, direct installation of 1.25 gpm pre-rinse spray valves, which is more efficient than the maximum of 1.6 gpm allowed under the plumbing code. Pre-rinse spray valves are used in commercial kitchens to rinse dishes prior to loading into dishwashers**.** The participation rate for this measure was set at 95%.
- **Toilets – 1.28 Gallon-Per-Flush (gpf) High-Efficiency Toilets (HET)*:*** Provide partial rebates to install High Efficiency Toilets (HETs), which is better than the maximum of 1.6 gpf allowed under the plumbing code. HETs are defined as toilets flushing at a maximum of 1.28 gpf. HETs include both dual flush toilets and pressure assist tank style toilets. The participation rate for this measure was set at 10%.

- **Toilets - Decrease Flushes*:*** Encourage customers to reduce unnecessary toilet flushing, such as flushing trash, thereby reducing toilet flushes by 10%. The participation rate for this measure was set at 10%.
- **Toilets - Leak Detection*:*** Provide free toilet leak detection dye tablets to determine if toilets leak and provide information on how to fix leaks. The participation rate for this measure was set at 25%.
- **Urinals - 0.5 gpf Models*:*** Provide partial rebates to install 0.5 gpf urinals, which is better than the maximum of 1.0 gpf allowed under the plumbing code. The participation rate for this measure was set at 25%.

- **Irrigation Controllers – Evapotranspiration (ET) Model:** Provide partial rebates for evapotranspiration (ET) based irrigation controllers, which link irrigation to weather conditions. The participation rate for this measure was set at 25%.
  - **Lawn Replacement*:*** Replace most landscape turf with landscape materials that require minimal irrigation. This may include a combination of low-water using plants; hardscaping or sand/gravel cover; and small turf areas sited strategically on the property. It should be noted that this does not eliminate lawn watering completely. Some irrigation will still be needed, but the total quantity can be cut by an assumed 80%.
  - **Outdoor Audit*:*** Provide free irrigation audits to improve the efficiency of irrigation systems. Efficiencies can be achieved through hardware improvements or operational changes. The audits are performed by a contracted professional landscape irrigation auditor. The participation rate for this measure was set at 25%.
  - **Outdoor Irrigation Kits*:*** Provide free outdoor irrigation kits with devices and information to improve the irrigation efficiency of manual irrigation techniques. Kits typically include items such as a watering timer and shut-off device, a spring-loaded hose nozzle, a rain gauge, hose washers, and a conservation brochure. The participation rate for this measure was set at 25%.