Draft Results, Water Needs Assessment

July 14, 2010

Table 1. Yakima Project Estimated Irrigated Acreage, Crop Irrigation Requirements, and On-Farm Losses

District	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Irrigated Acreage (ac)	55,516	72,491	109,115	99,243	25,878	18,441
Crop Irrigation Requirement (ac-ft/ac)	2.50	2.97	2.78	2.72	3.48	2.96
Application Loss (ac-ft/ac)	1.03	0.55	0.73	0.68	0.70	0.37
Evaporation Loss (ac-ft/ac)	0.23	0.34	0.29	0.30	0.46	0.34
Total On-Farm Delivery Needs (ac-ft/ac)	3.77	3.86	3.80	3.70	4.64	3.68

Table 2. Yakima Project Preliminary Water Balance

Division	KRD	Roza	WIP	Sunnyside	Tieton	Kennewick
Average Non-Drought Diversions (1990-2009)	**285,983**	**319,670**	**560,081**	**429,122**	**79,029**	**99,519**
Estimated Conveyance Losses	94,374		156,823	49,349	3,951	40,604
Estimated Deliveries to Farms	**191,609**		**403,258**	**379,773**	**75,077**	**58,915**
Estimated Crop Irrigation Requirement	138,977	215,340	303,790	269,910	90,129	54,550
Estimated On-Farm Application Loss	57,377	39,548	79,878	67,764	18,089	6,874
Estimated On-Farm Evaporation Loss	12,735	24,748	31,249	29,510	11,803	6,355
Estimated Total On-Farm Delivery Needs	**209,089**	**279,635**	**414,917**	**367,184**	**120,022**	**67,779**

Note: All values in acre-feet

Table 2a. Yakima Project Preliminary Water Balance (Revised)

Division	KRD	WIP	Sunnyside	Kennewick
Average Non-Drought Diversions (1990-2009)	**285,983**	**560,081**	**429,122**	**99,519**
Estimated Conveyance Losses	94,374	156,823	49,349	40,604
Estimated Deliveries to Farms	**191,609**	**403,258**	**379,773**	**58,915**
Estimated Crop Irrigation Requirement	138,977	303,790	269,910	54,550
Estimated On-Farm Application Loss	57,377	79,878	67,764	6,874
Estimated On-Farm Evaporation Loss	12,735	31,249	29,510	6,355
Estimated Total On-Farm Delivery Needs	**209,089**	**414,917**	**367,184**	**67,779**

Note: All values in acre-feet

Table 2b. Yakima Project Preliminary Water Balance (Revised)

Division	Roza	Tieton
Average Non-Drought Diversions (1990-2009)	**319,670**	**79,029**
Estimated Conveyance Losses	111,565	3,951
Estimated Deliveries to Farms	**208,105**	**75,077**
Estimated Crop Irrigation Requirement	160,256	56,379
Estimated On-Farm Application Loss	29,431	11,315
Estimated On-Farm Evaporation Loss	18,417	7,383

Notes: All values in acre-feet
On-farm losses and crop irrigation requirement are based on percentage of deliveries to farms

Table 3. Comparison of Drought Year Diversions to Average Non-Drought Diversions

Division	KRD	Roza	WIP
Shortfall between Drought Year 2001 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of May 1, 2001	156,814	138,903	150,006
Shortfall between Drought Year 2005 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of April 6, 2005	142,943	125,683	135,999

Note: All values in acre-feet

Table 4. Comparison of Drought Year Diversions to 100 Percent of Non-Proratable and 70 Percent of Proratable Entitlements

Division	KRD	Roza	WIP
Shortfall between Drought Year 2001 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of May 1, 2001	112,497	99,520	126,492
Shortfall between Drought Year 2005 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of April 6, 2005	89,498	79,339	122,009

Note: All values in acre-feet

Table 5. Net Irrigation Season Requirement - Medium Forecast (AFY)

	2010	2030	2060	2010-2060 Change
Growth-Based Demand	91,000	121,000	163,000	72,000
Less Conservation Trends (No-Action) (1)	0	4,000	8,200	
Less Land Conversion Effect (2)	0	11,000	22,000	
Adjusted Demand	**91,000**	**106,000**	**132,800**	**41,800**
Less Return Flow (estimated) (3)	54,600	63,600	79,680	
Net Consumptive Use	**36,400**	**42,400**	**53,120**	**16,720**
Less Off-Season Consumptive Use (4)	10,920	12,720	15,936	
Irrigation Season Consumptive use	**25,480**	**29,680**	**37,184**	**11,704**
Quantity Below Parker (5)				3,433
Quantity Above Parker (5)				8,271

(1) From municipal/domestic conservation analysis (Task 4.11).
(2) See assessment of land conversion from agricultural use to urban use.
(3) Return flow estimated at 60%
(4) Calculated from monthly production records provided by Yakima, Ellensburg, Nob Hill, Prosser and Toppenish.
(5) Based on current water use estimates broken down by county and by water system (assumed 1/3 of Yakima Co. Population in served by small systems and domestic wells are below Parker; 2/3 above Parker).

Table 6. Yakima Project Entitlements above Parker Gage

Irrigation Entity	Proratable Entitlements (AF)	Non-Proratable Entitlements (AF)	Total Entitlements (AF)
Wapato Division	350,000	305,613	655,613
Sunnyside Division	142,684	315,836	458,520
Roza Division	375,000	0	375,000
Kittitas Reclamation District	336,000	0	336,000
Tieton Division	38,181	75,865	114,046
Naches Selah Irrigation District	4,486	49,658	54,144
Cascade Ditch	0	49,525	49,525
Ellensburg Town Ditch	0	47,758	47,758
Westside Irrigation Company	8,200	31,128	39,328
Selah Moxee Irrigation District	4,281	27,493	31,774
Congdon Ditch	4,305	23,720	28,025
Union Gap Irrigation District	4,606	20,697	25,303
South Naches Ditch	0	22,946	22,946
Gleed Ditch	0	22,819	22,819
Wapatox Ditch	0	20,230	20,230
Fruitvale Ditch	0	17,708	17,708
Old Union Ditch	0	17,675	17,675
Naches Cowiche Ditch	0	15,096	15,096
Woldale Ditch	0	12,973	12,973
Hubbard Ditch	0	11,165	11,165
City of Yakima Irrigation	1,500	8,805	10,305
Others	13,950	122,456	136,406
Total	**1,283,193**	**1,219,166**	**2,502,359**

Note: Entitlements are being verified with final Acquavella adjudication rulings

Table 7. Yakima Project Divisions Annual Surface Water Diversions

Division	Kittitas	Roza	Wapato	Sunnyside	Tieton	Kennewick	Total
Entitlements (April - October)	336,000	375,000	655,613	458,520	114,049	109,275	**2,048,457**
Peak Year Diversion (1990-2009)	323,158	385,914	666,474	460,892	88,097	109,616	
Average Non-Drought Diversions (1990-2009)	285,983	319,670	560,081	429,122	79,029	99,519	**1,773,403**
Drought Year 2001 Diversions	122,997	170,325	405,360	347,116	75,474	84,773	**1,206,045**
Drought Year 2005 Diversions	144,918	196,771	428,837	332,660	75,304	75,153	**1,253,642**

Note: All values in acre-feet

Figure 1. Annual Yakima Project Diversions above Parker Gage (1950-2009)

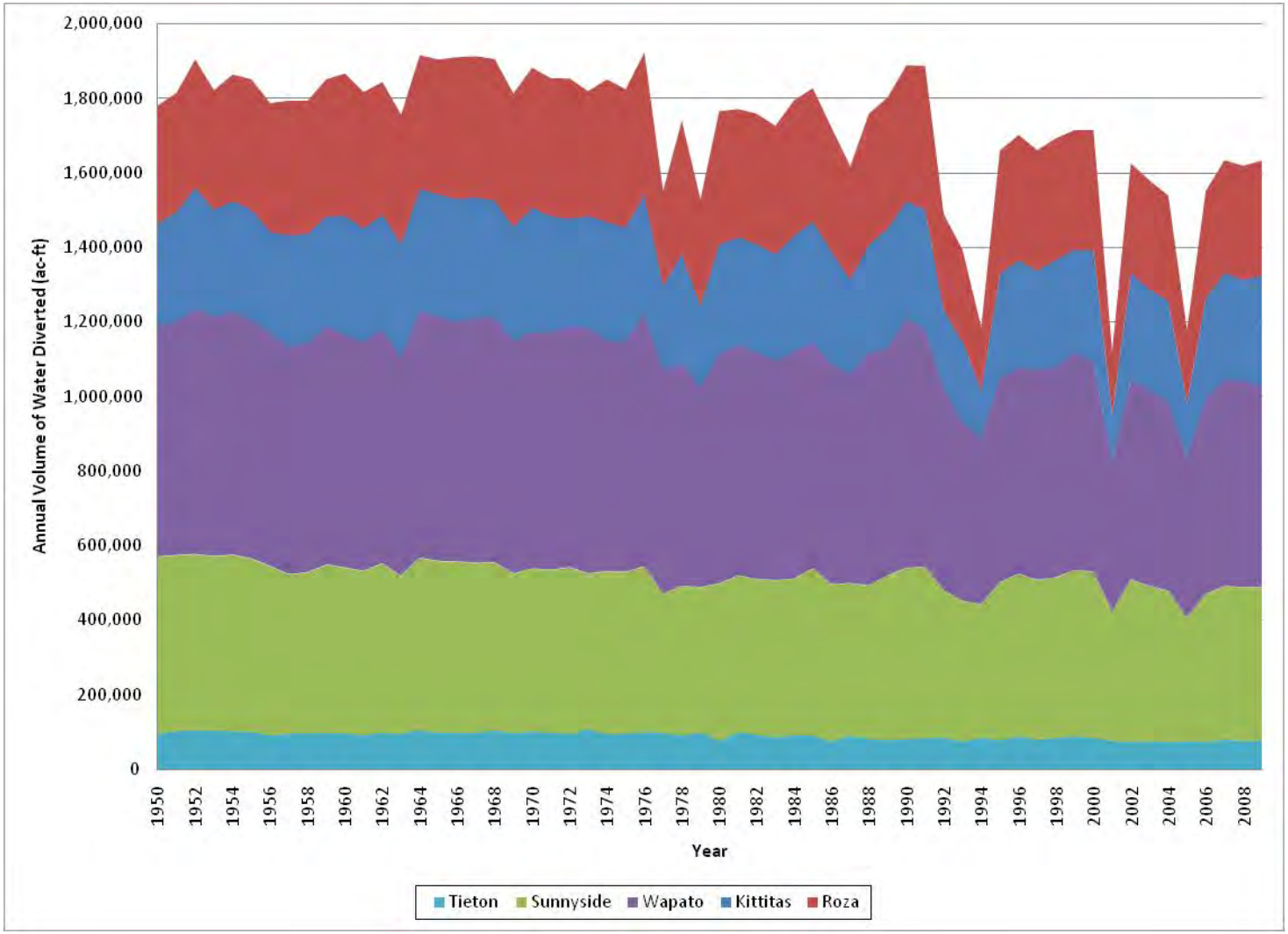

Table 8. Irrigated Acreage Comparison

District (Year of Most Recent Data Received)	KRD (1993)	Roza (2010)	WIP (2006)	Sunnyside (2006)	Yakima-Tieton (1994)	Kennewick (1998)
WSDA Data Irrigated Acreage	38,545	60,036	94,727	51,270	16,983	8,669
District Data Irrigated Acreage	55,516	72,491	109,115	99,243	25,878	18,441
Difference	-16,971	-12,455	-14,388	-47,973	-8,895	-9,772
% Difference	-30.6%	-17.2%	-13.2%	-48.3%	-34.4%	-53.0%

Table 9. Yakima Project Crop Summary – WSDA Data

Crop Group	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Orchard	527	26,034	11,535	8,120	15,248	1,998
Hay/Silage	24,661	3,739	14,421	8,618	900	1,502
Cereal Grain	2,413	3,749	32,372	11,864	16	1,168
Vineyard	9	18,865	4,167	11,397	7	1,973
Hops	0	2,789	12,839	5,452	0	0
Non-Crop	9,320	224	1,821	587	220	686
Vegetable	976	906	5,886	1,612	0	840
Mint	0	108	7,862	887	0	0
Other	639	3,622	3,824	2,733	592	502
Total	**38,545**	**60,036**	**94,727**	**51,270**	**16,983**	**8,669**

Note: All values in acres

Table 10. Yakima Project Crop Summary – District Survey Data

Crop Group	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Orchard		26,622	11,287	10,321		
Hay/Silage		4,261	23,333	21,257		
Cereal Grain		5,606	15,543	1,215		
Vineyard		18,734	4,425	12,469		
Hops		7,619	8,982	6,323		
Non-Crop		7,760	9,575	44,166		
Vegetable		465	11,609	2,012		
Mint		315	7,494	1,480		
Other		1,108	17,025	0		
Total		**72,491**	**109,115**	**99,243**		

Note: All values in acres

Table 11. Yakima Project Irrigation Type Summary – WSDA Data

Irrigation Type	KRD	Roza	WIP	Sunnyside	Tieton	Kennewick
Rill	25,817 (67.0%)	4,280 (7.1%)	37,212 (39.3%)	16,960 (33.1%)	205 (1.2%)	179 (2.1%)
Sprinkler	885 (2.3%)	34,104 (56.8%)	13,865 (14.6%)	15,929 (31.1%)	15,587 (91.8%)	2,740 (31.6%)
Drip	183 (0.5%)	13,697 (22.8%)	13,193 (13.9%)	5,328 (10.4%)	354 (2.1%)	2,098 (24.2%)
Wheel Line	3,172 (8.2%)	2,889 (4.8%)	17,841 (18.8%)	6,533 (12.7%)	456 (2.7%)	319 (3.7%)
Center Pivot	4,034 (10.5%)	3,597 (6.0%)	10,332 (10.9%)	5,482 (10.7%)	0 (0.0%)	2,828 (32.6%)
Other	4,453 (11.6%)	1,469 (2.4%)	2,283 (2.4%)	1,038 (2.0%)	382 (2.2%)	506 (5.8%)

Note: All values in acres

Table 12. Yakima Project Irrigation Type Summary – District Survey Data

Irrigation Type	KRD	Roza	WIP	Sunnyside	Tieton	Kennewick
Rill		2,983 (4.1%)		31,758 (32.0%)		
Sprinkler		50,545 (69.7%)		64,509 (65.0%)		
Drip		18,963 (26.2%)		2,977 (3.0%)		

Note: All values in acres

Table 13. Crop Irrigation Requirement Stations for Yakima Project

District	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Station Used	Ellensburg	Sunnyside	Wapato	Sunnyside	Yakima	Richland

Table 14. Crop Irrigation Requirement Comparison

District (Year of Most Recent Data Received)	KRD	Roza (2010)	WIP (2006)	Sunnyside (2006)	Tieton	Kennewick
Using WSDA Data	2.50	2.97	2.78	2.72	3.48	2.96
Using District Data		2.92	2.85	2.63		
Difference		0.05	-0.07	0.09		
% Difference		1.7%	-2.5%	3.4%		

Note: All values in acre-feet per acre

Table 15. Irrigation Efficiencies

Irrigation Type	% Application Efficiency	% Total Evaporated	% Total Consumed	% Return Flow
Rill	65	5	70	30
Sprinkler	75	10	85	15
Drip	88	5	93	7
Wheel Line	75	10	85	15
Center Pivot	85	12	97	3
Flood	50	5	55	45
Big Gun	65	10	75	25
Hand	90	10	100	0

Note: Percentages are based upon total volume of water delivered to farms

Table 16. Estimated On-Farm Water Needs

Division	KRD	Roza	WIP	Sunnyside	Tieton	Kennewick
Crop Irrigation Requirement	2.50	2.97	2.78	2.72	3.48	2.96
Application Loss	1.03	0.55	0.73	0.68	0.70	0.37
Evaporation Loss	0.23	0.34	0.29	0.30	0.46	0.34
Total On-Farm Delivery Needs	3.77	3.86	3.80	3.70	4.64	3.68

Note: All values in acre-feet per acre

Table 17. On-Farm Water Needs

Division	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Estimated Crop Irrigation Requirement	138,977	215,340	303,790	269,910	90,129	54,550
Estimated On-Farm Application Loss	57,377	39,548	79,878	67,764	18,089	6,874
Estimated On-Farm Evaporation Loss	12,735	24,748	31,249	29,510	11,803	6,355
Estimated Total On-Farm Delivery Needs	**209,089**	**279,635**	**414,917**	**367,184**	**120,022**	**67,779**

Note: All values in acre-feet

Table 18. Yakima Project Conveyance Loss Estimates

District	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Estimated Seepage/Evaporation Loss (% of diversion)	27.5%		20.0%		0.0%	14.5%
Estimated Operational Spills (% of diversion)	5.5%		8.0%		5.0%	26.3%
Total Conveyance Losses (% of diversion)	33.0%		28.0%	11.5%	5.0%	40.8%
Notes	Based on most recent WCP (1999)		Based on most recent WCP (1999)	Stated in District Survey	Based on most recent WCP (2000)	Based on most recent WCP (1999)

Table 19. Yakima Project Divisions Conveyance Losses

Division	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Average Non-Drought Diversions (1990-2009)	285,983	319,670	560,081	429,122	79,029	99,519
Estimated Conveyance Losses	94,374		156,823	49,349	3,951	40,604
Estimated Deliveries to Farms	191,609		403,258	379,773	75,077	58,915

Note: All values in acre-feet

Table 18. Yakima Project Conveyance Loss Estimates (Revised)

District	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Estimated Seepage/Evaporation Loss (% of diversion)	27.5%	24.3%	20.0%		0.0%	14.5%
Estimated Operational Spills (% of diversion)	5.5%	10.6%	8.0%		5.0%	26.3%
Total Conveyance Losses (% of diversion)	33.0%	34.9%	28.0%	11.5%	5.0%	40.8%
Notes	Based on most recent WCP (1999)	Based on 2006 to 2009 MWDs	Based on most recent WCP (1999)	Stated in District Survey	Based on most recent WCP (2000)	Based on most recent WCP (1999)

Table 19. Yakima Project Divisions Conveyance Losses (Revised)

Division	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Average Non-Drought Diversions (1990-2009)	285,983	319,670	560,081	429,122	79,029	99,519
Estimated Conveyance Losses	94,374	111,565	156,823	49,349	3,951	40,604
Estimated Deliveries to Farms	191,609	208,105	403,258	379,773	75,077	58,915

Note: All values in acre-feet

Table 20. Yakima Project Divisions Preliminary Water Balance

Division	KRD	Roza	WIP	Sunnyside	Tieton	Kennewick
Average Non-Drought Diversions (1990-2009)	**285,983**	**319,670**	**560,081**	**429,122**	**79,029**	**99,519**
Estimated Conveyance Losses	94,374		156,823	49,349	3,951	40,604
Estimated Deliveries to Farms	**191,609**		**403,258**	**379,773**	**75,077**	**58,915**
Estimated Crop Irrigation Requirement	138,977	215,340	303,790	269,910	90,129	54,550
Estimated On-Farm Application Loss	57,377	39,548	79,878	67,764	18,089	6,874
Estimated On-Farm Evaporation Loss	12,735	24,748	31,249	29,510	11,803	6,355
Estimated Total On-Farm Delivery Needs	**209,089**	**279,635**	**414,917**	**367,184**	**120,022**	**67,779**
Difference between Diversions and Estimated CIR+Losses (acre-feet)	*-17,480*		*-11,659*	*12,589*	*-44,944*	*-8,864*
Difference in Diversions and Estimated CIR+Losses (%)	-6.1%		-2.1%	2.9%	-56.9%	-8.9%

Note: All values in acre-feet

Table 20a. Yakima Project Divisions Preliminary Water Balance (Revised)

Division	KRD	WIP	Sunnyside	Kennewick
Average Non-Drought Diversions (1990-2009)	**285,983**	**560,081**	**429,122**	**99,519**
Estimated Conveyance Losses	94,374	156,823	49,349	40,604
Estimated Deliveries to Farms	**191,609**	**403,258**	**379,773**	**58,915**
Estimated Crop Irrigation Requirement	138,977	303,790	269,910	54,550
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Estimated Total On-Farm Delivery Needs	**209,089**	**414,917**	**367,184**	**67,779**
Difference between Diversions and Estimated CIR+Losses (acre-feet)	*-17,480*	*-11,659*	*12,589*	*-8,864*
Difference in Diversions and Estimated CIR+Losses (%)	-6.1%	-2.1%	2.9%	-8.9%

Note: All values in acre-feet

Table 20b. Yakima Project Divisions Preliminary Water Balance (Revised)

Division	Roza	Tieton
Average Non-Drought Diversions (1990-2009)	**319,670**	**79,029**
Estimated Conveyance Losses	111,565	3,951
Estimated Deliveries to Farms	**208,105**	**75,077**
Estimated Crop Irrigation Requirement	160,256	56,379
Estimated On-Farm Application Loss	29,431	11,315
Estimated On-Farm Evaporation Loss	18,417	7,383

Note: All values in acre-feet
On-farm losses and crop irrigation requirement
are based on percentage of deliveries to farms

Table 21. Pro-ratable Water Rights above Parker Gage

Irrigation Districts	Pro-ratable Entitlements (ac-ft)	% of Total Pro-ratable Entitlements	% of Total Pro-ratable Entitlements Not Including Sunnyside and Yakima-Tieton
Roza	375,000	29%	34%
WIP	350,000	27%	32%
KRD	336,000	26%	31%
Subtotal	***1,061,000***	***83%***	***96%***
Sunnyside	142,684	11%	
Yakima-Tieton	38,181	3%	
Subtotal	***1,241,865***	***97%***	
Non-Division Entitlements	41,328	3%	***4%***
Total	**1,283,193**	**100%**	**100%**

Figure 2. KRD Diversion Comparison
Average Non-Drought Years (1990-2009) vs. Drought Year (2001)

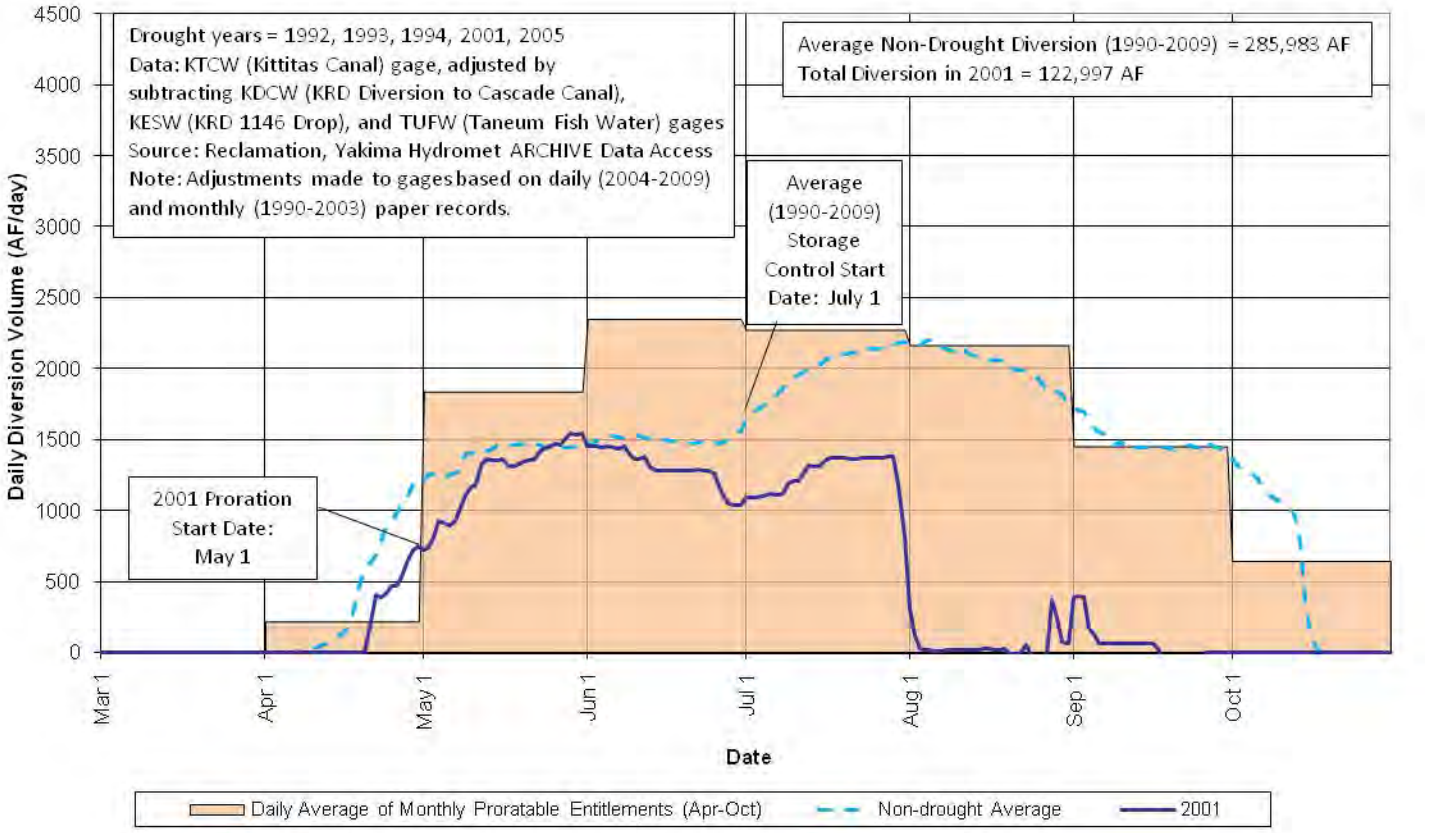


Figure 3. Roza Irrigation District Diversion Comparison
Average Non-Drought Years (1990 – 2009) vs. Drought Year 2001

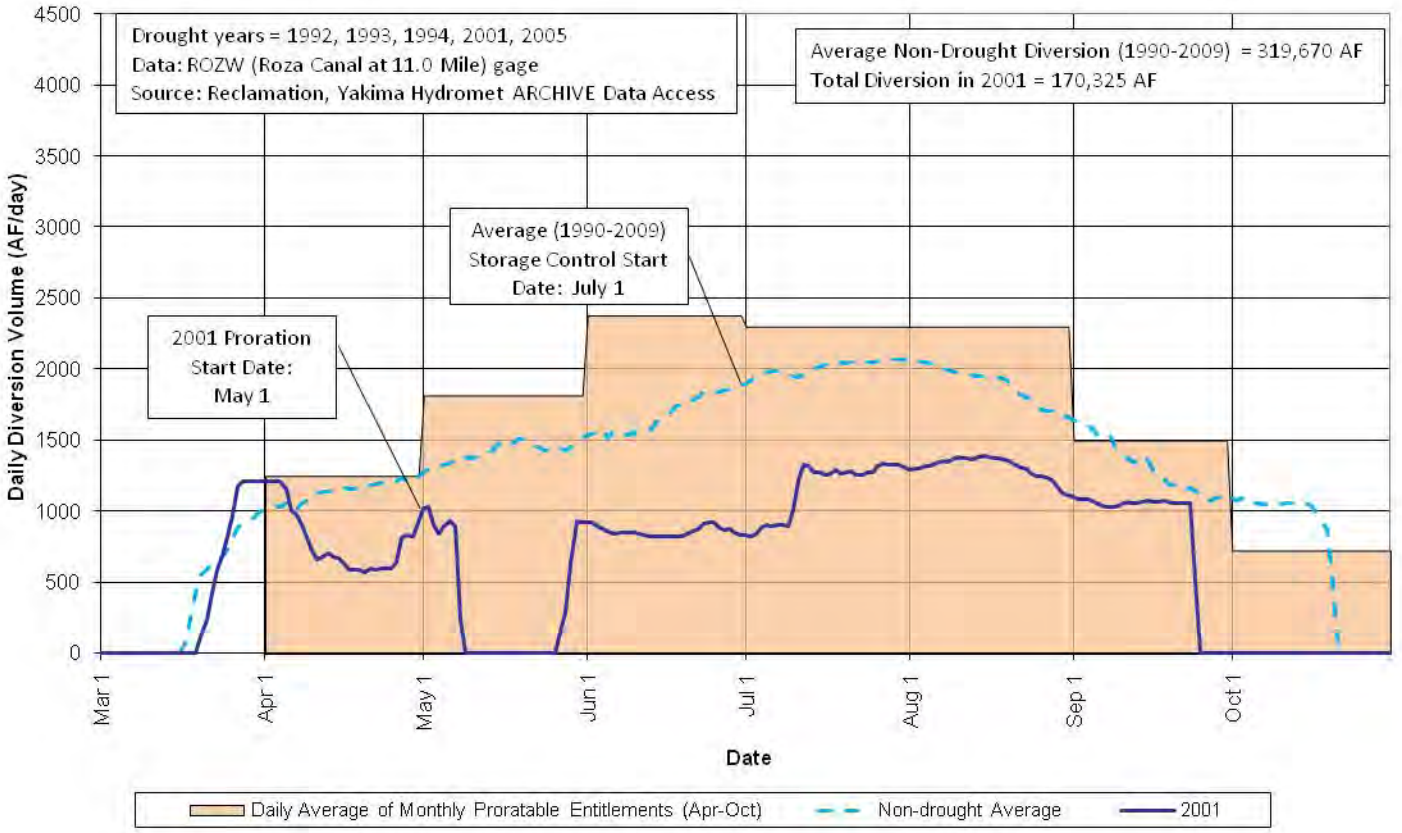


Figure 4. WIP Diversion Comparison
Average Non-Drought Years (1990 – 2009) vs. Drought Year 2001

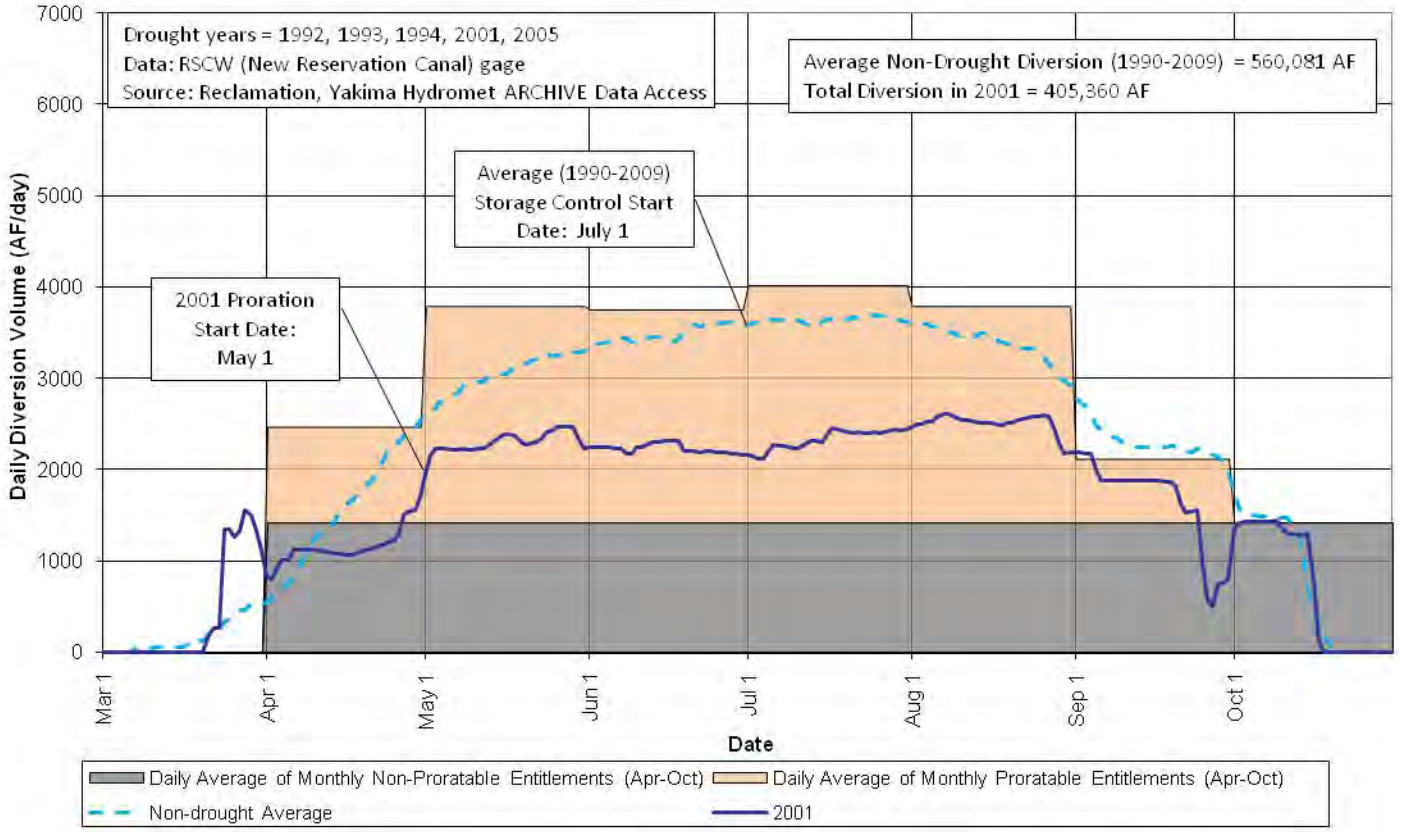


Table 22. Comparison of Drought Year Diversions to Average Non-Drought Diversions

Division	KRD	Roza	WIP
Shortfall between Drought Year 2001 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of May 1, 2001	156,814	138,903	150,006
Shortfall between Drought Year 2005 and Average Non-Drought Diversions (1990-2009) Measured after Proration Date of April 6, 2005	142,943	125,683	135,999

Note: All values in acre-feet

Figure 5. KRD Monthly Diversion Shortfall Comparison
Average Non-Drought Years (1990 – 2009) vs. Drought Year 2001

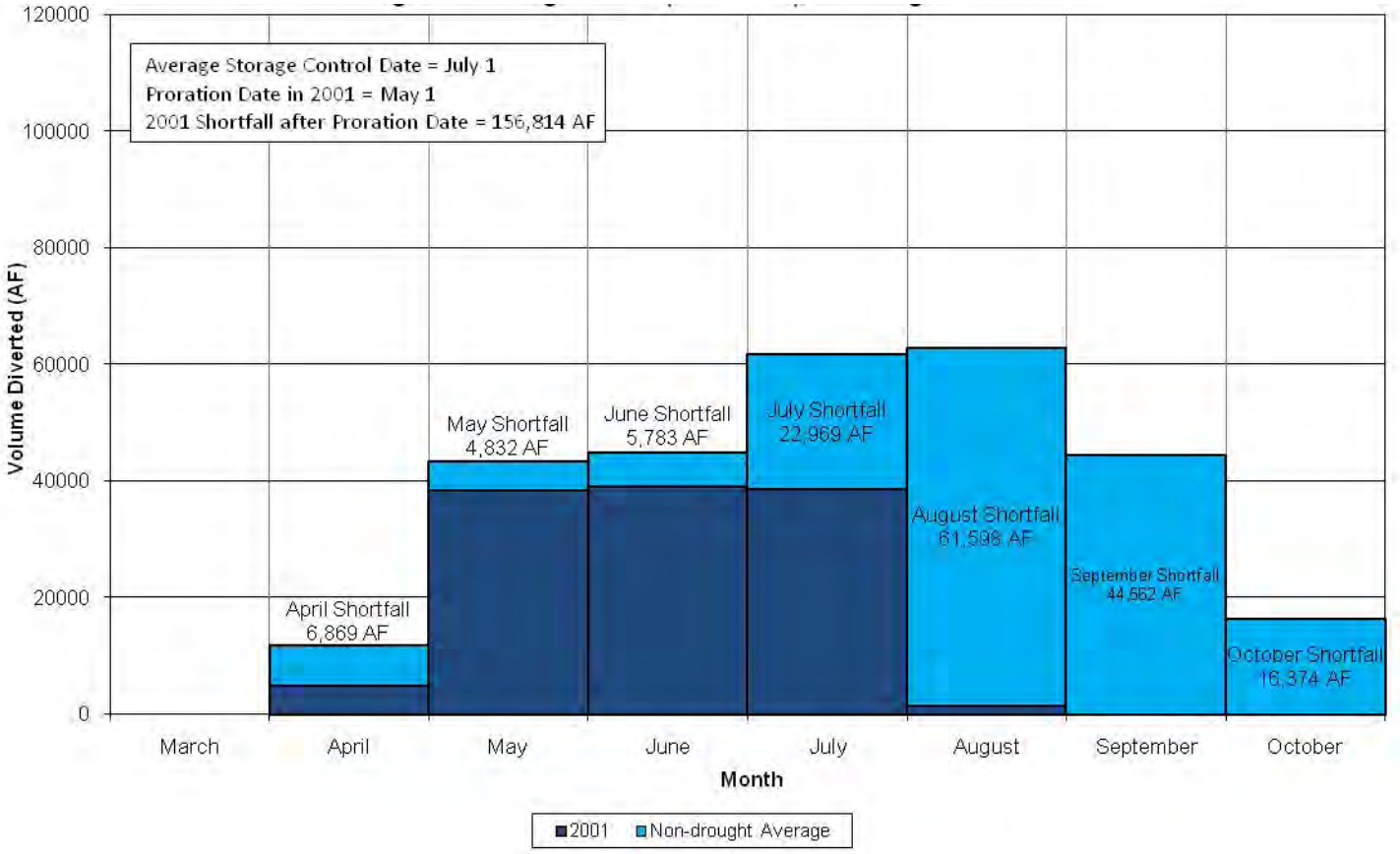


Figure 6. Roza Irrigation District Monthly Diversion Shortfall Comparison
Average Non-Drought Years (1990 – 2009) vs. Drought Year 2001

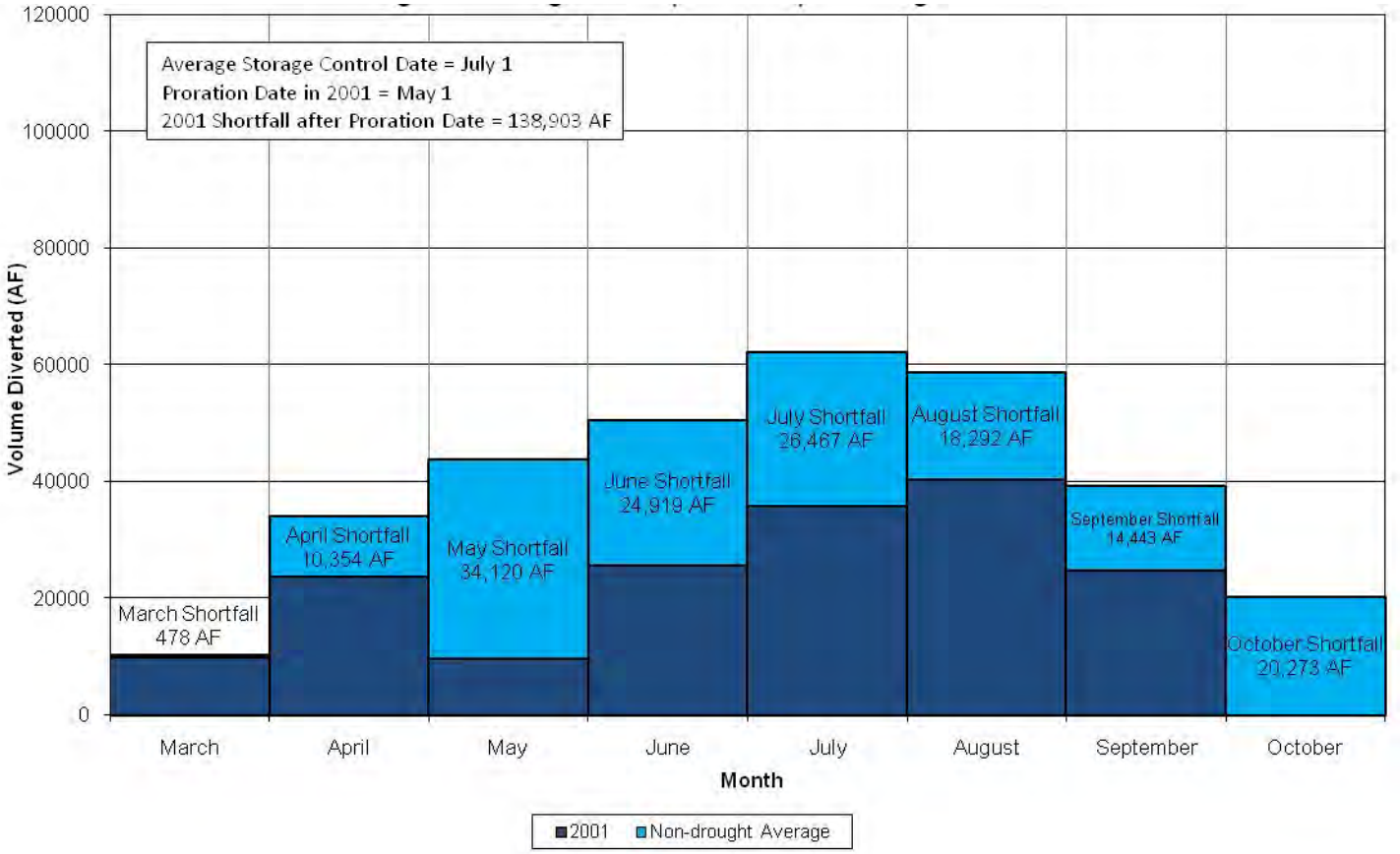


Figure 7. WIP Monthly Diversion Shortfall Comparison
Average Non-Drought Years (1990 – 2009) vs. Drought Year 2001

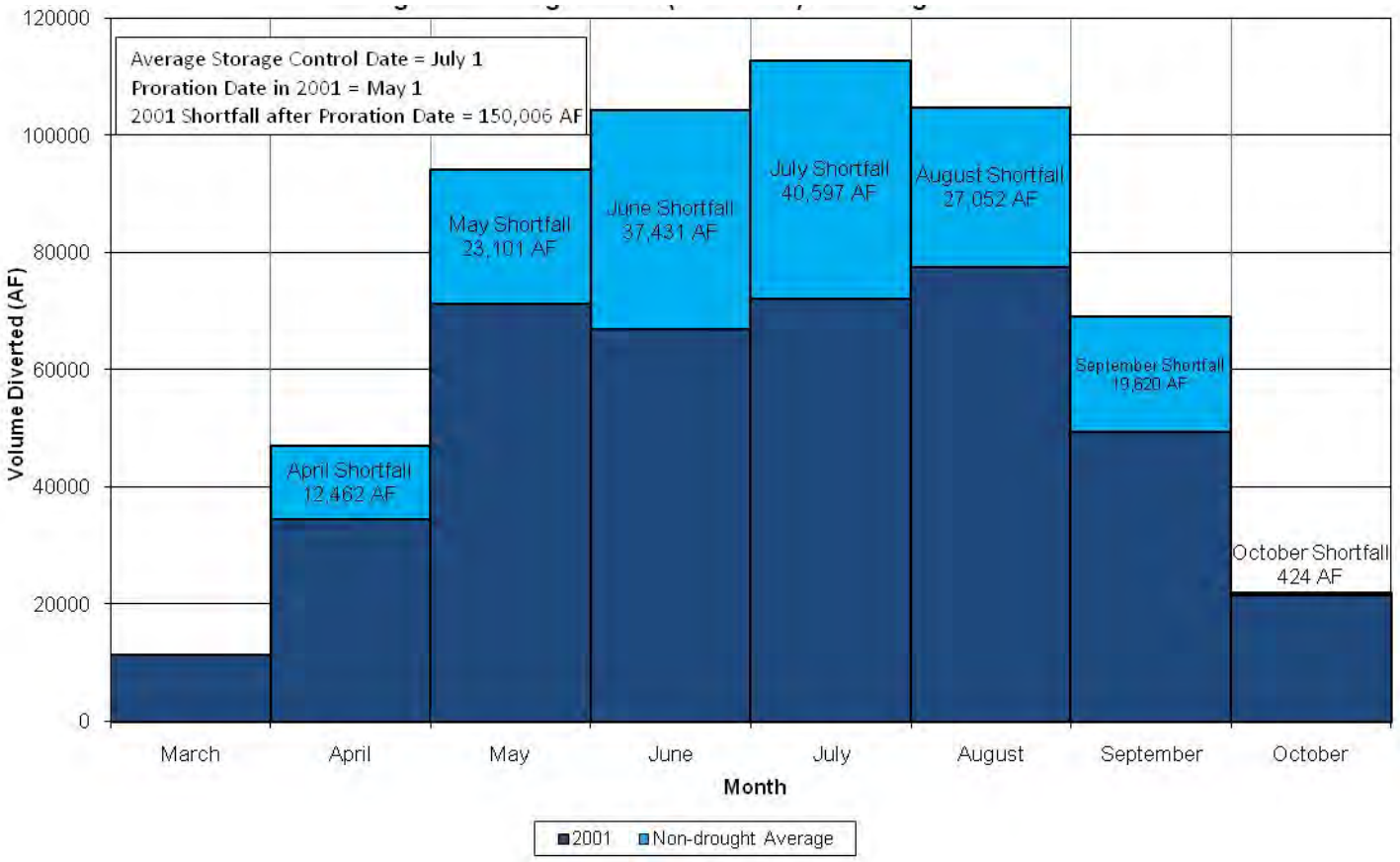


Table 23. Comparison of Drought Year Diversions to 100 Percent of Non-Proratable and 70 Percent of Proratable Entitlements

Division	KRD	Roza	WIP
Shortfall between Drought Year 2001 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of May 1, 2001	112,497	99,520	126,492
Shortfall between Drought Year 2005 and (100% of Non-Proratable Entitlements + 70% of Proratable Entitlements) Measured after Proration Date of April 6, 2005	89,498	79,339	122,009

Note: All values in acre-feet

Figure 8. KRD Monthly Diversion Shortfall Comparison
70 Percent of Entitlement vs. Drought Year 2001

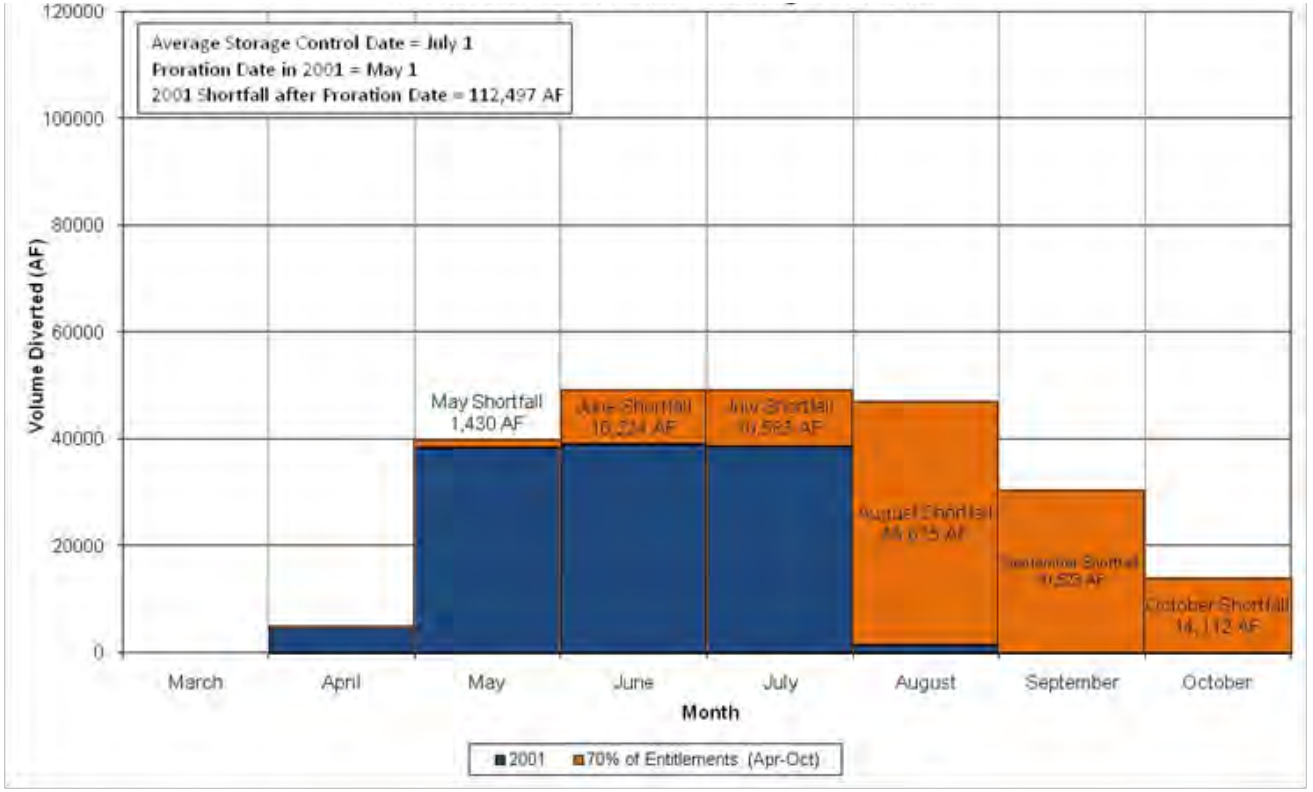


Figure 9. Roza Irrigation District Monthly Diversion Shortfall Comparison
70 Percent of Entitlement vs. Drought Year 2001

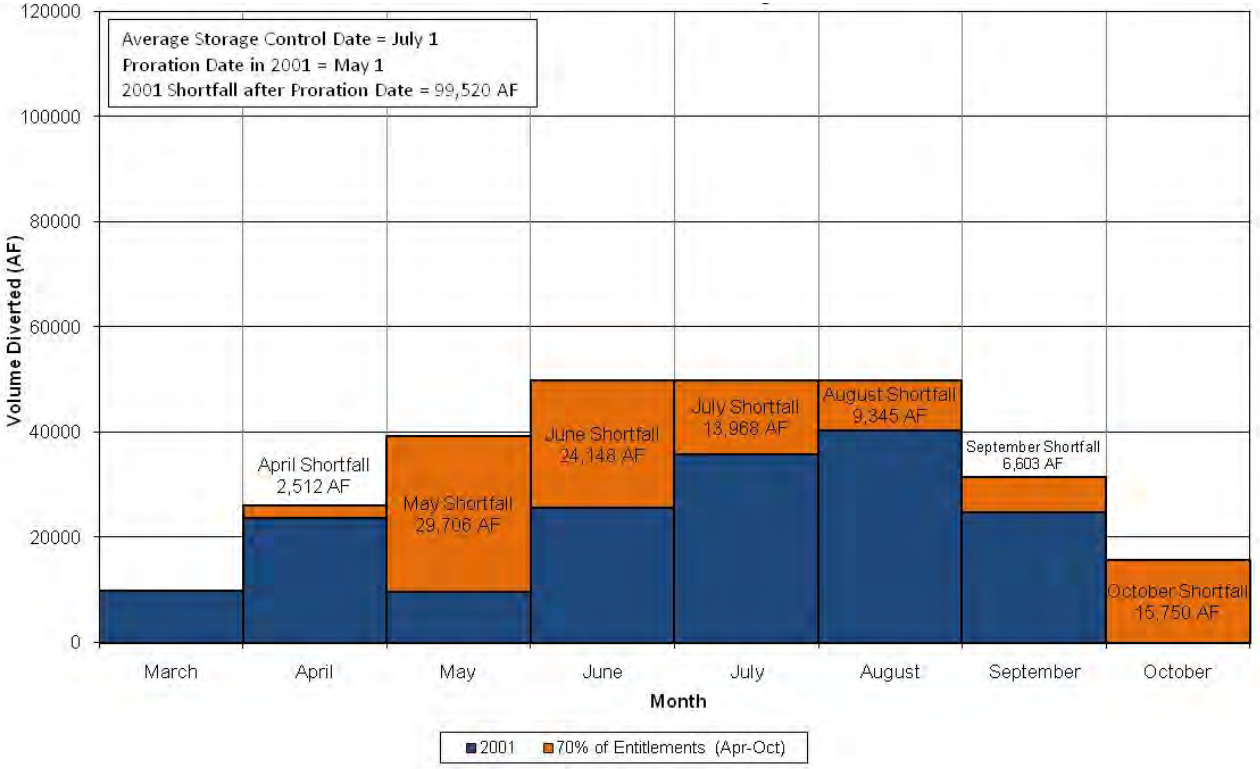


Figure 10. WIP Monthly Diversion Shortfall Comparison
70 Percent of Entitlement vs. Drought Year 2001

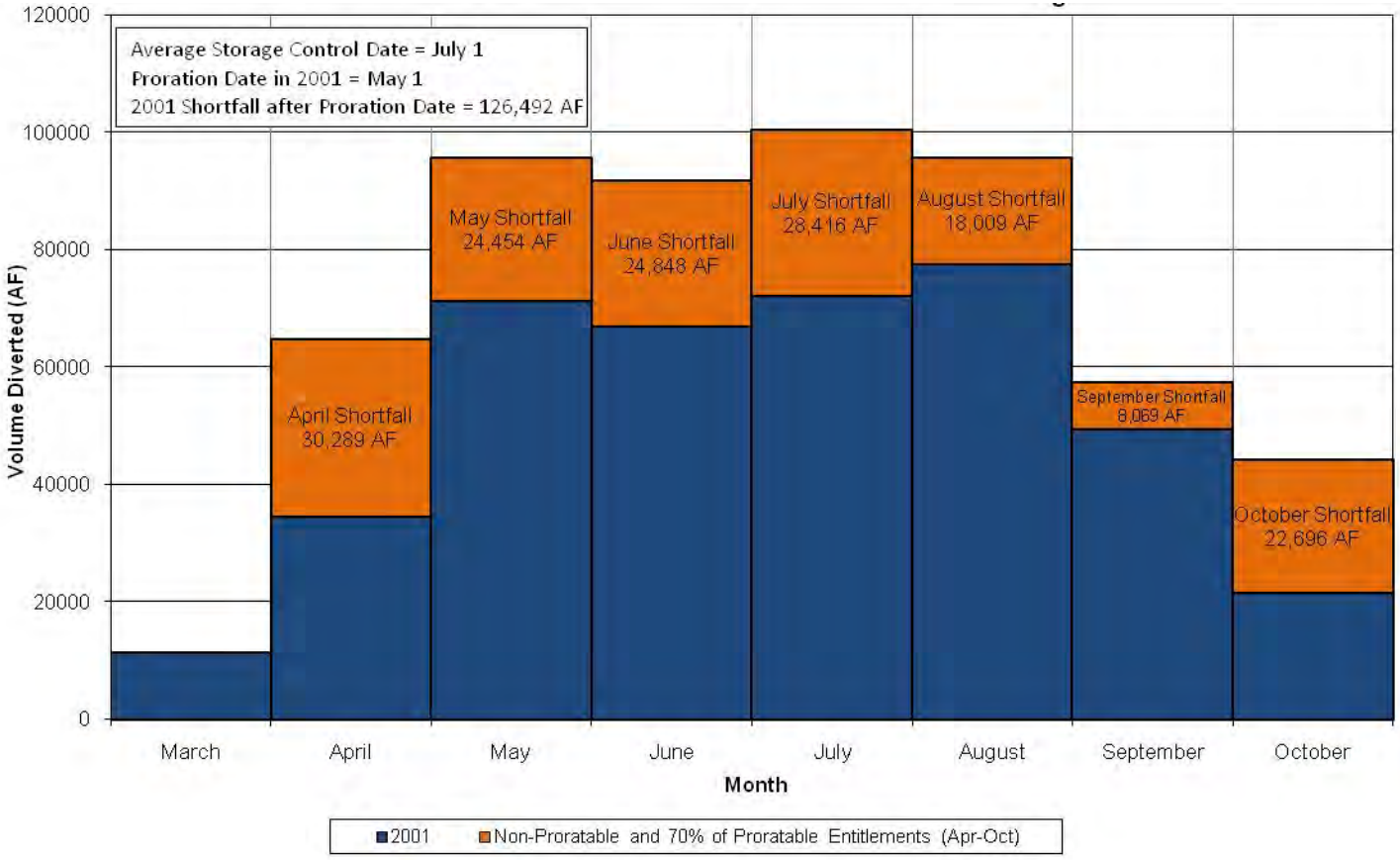


Table 24. Estimated Non-Federal Agricultural Irrigation

Geographic Area	Acres Irrigated (1, 2)			Estimated Annual Diversions		
	Surface Water	Groundwater - Primary	Total	Surface Water	Groundwater - Primary	Total
	Acres	Acres	Acres	Acre-Feet	Acre-Feet	Acre-Feet
Non-Federal District						
Above Parker	18,492	0	18,492	125,454	0	125,454
Below Parker	2,534	0	2,534	15,823	0	15,823
Naches River	4,903	0	4,903	33,665	0	33,665
Subtotal Non-Federal District	*25,930*	*0*	*25,930*	*174,942*	*0*	*174,942*
Outside District						
Above Parker	18,450	21,221	39,671	127,582	81,854	209,436
Below Parker	8,114	16,703	24,817	46,060	65,947	112,007
Naches River	0	3,086	3,086	0	13,302	13,302
Subtotal Outside Districts	*26,564*	*41,010*	*67,574*	*173,642*	*161,102*	*334,745*
Total Non-Federal (lands from WSDOA)	**52,494**	**41,010**	**93,503**	**348,584**	**161,102**	**509,687**
Total Non-Federal (Adjusted for Missing Lands) (3)	**60,368**	**47,161**	**107,529**	**400,872**	**185,268**	**586,140**

(1) Excludes All Acreage Inside of the Federal Project Irrigation Districts
(2) Excludes fields with Irrigation types of "None" and "N/A".
(3) Based on comparison of WSDOA lands in GIS with aerial imagery, it is estimated that 15% of irrigated agricultural lands were not captured in the WSDOA irrigated cropland geodatabase. A 15% adjustment is made here

Table 25. Estimated Population Served by Public Water Systems, Six Largest Cities

System	Population Served [1]
Yakima Area:	
Yakima Water & Irrigation	65,000
Nob Hill Water	26,400
Terrace Heights (Yak. Co.)	3,900
Yakima Area Subtotal:	*95,300*
Ellensburg Water Dept	17,200
City of Sunnyside	15,300
City of Toppenish	9,400
City of Grandview	9,200
City of Prosser	5,100
Total:	**151,500**

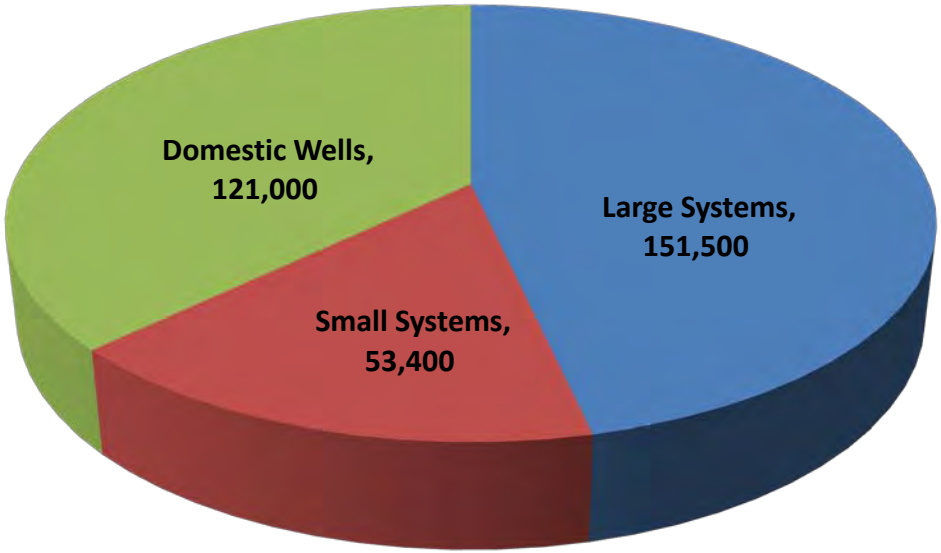
(1) Source: 2009 Water Facilities Inventory forms submitted to Washington State Department of Health

Table 26. Estimated Population Served, by County and by Service Category

County/Category	Population Served
Benton County (w/in Basin)	
Large Public Systems	5,100
Small Systems	8,400
Domestic Wells	13,000
Benton Co. Total	*26,500*
Kittitas County	
Large Public Systems	17,200
Small Systems	7,900
Domestic Wells	19,000
Kittitas Co. Total	*44,100*
Yakima County	
Large Public Systems	129,200
Small Systems	37,100
Domestic Wells	89,000
Yakima Co. Total	*255,300*
Large Systems	**151,500**
Small Systems	**53,400**
Domestic Wells	**121,000**
Total Basin Population	**325,900**

Source: Large Systems from Water Facilities Inventory forms submitted to DOH (2009). Small systems from DOH Database. Domestic wells estimated by subtracting other categories from total county populations.

Figure 11. Yakima Basin Population by Type of Water Service



Total Basin Population: 326,000

Table 27. County Population Projections

	2010	2025
Benton County (1)		
Cities	9,447	11,700
Unincorporated	16,852	24,400
Total	26,299	36,100
Kittitas County (2)		
Cities	31,389	37,758
Unincorporated	12,512	15,052
Total	43,901	52,810
Yakima County (3)		
Cities	156,600	202,260
Unincorporated	98,989	123,994
Total	255,589	326,254
Basin Total	**326,000**	**415,000**

(1) Benton County Comprehensive Plan, 2006. Chapter 4 Appendix: Item 4. In-Basin population from email received from Benton County planning department, June 9, 2010.
(2) Kittitas County Community Development Services. Frequently asked questions from May/June Open House, 2006. 2025 Projections
(3) Yakima County Plan 2015, 1997- Updated in 2007. Chapter V: Table V-4.

Table 28. Extension of Population Forecasts to 2060 (Low, Medium and High)[1]

	2010	2025	2030	2040	2050	2060
Low			428,000	450,000	473,000	497,000
Medium	326,000	415,000	438,000	484,000	535,000	590,000
High			448,000	520,000	603,000	700,000

Growth rates applied by HDR for years after 2025:
Low 0.5%; Medium 1.0%; High 1.5%.

Figure 12. Basin Population Forecast Extended to 2060

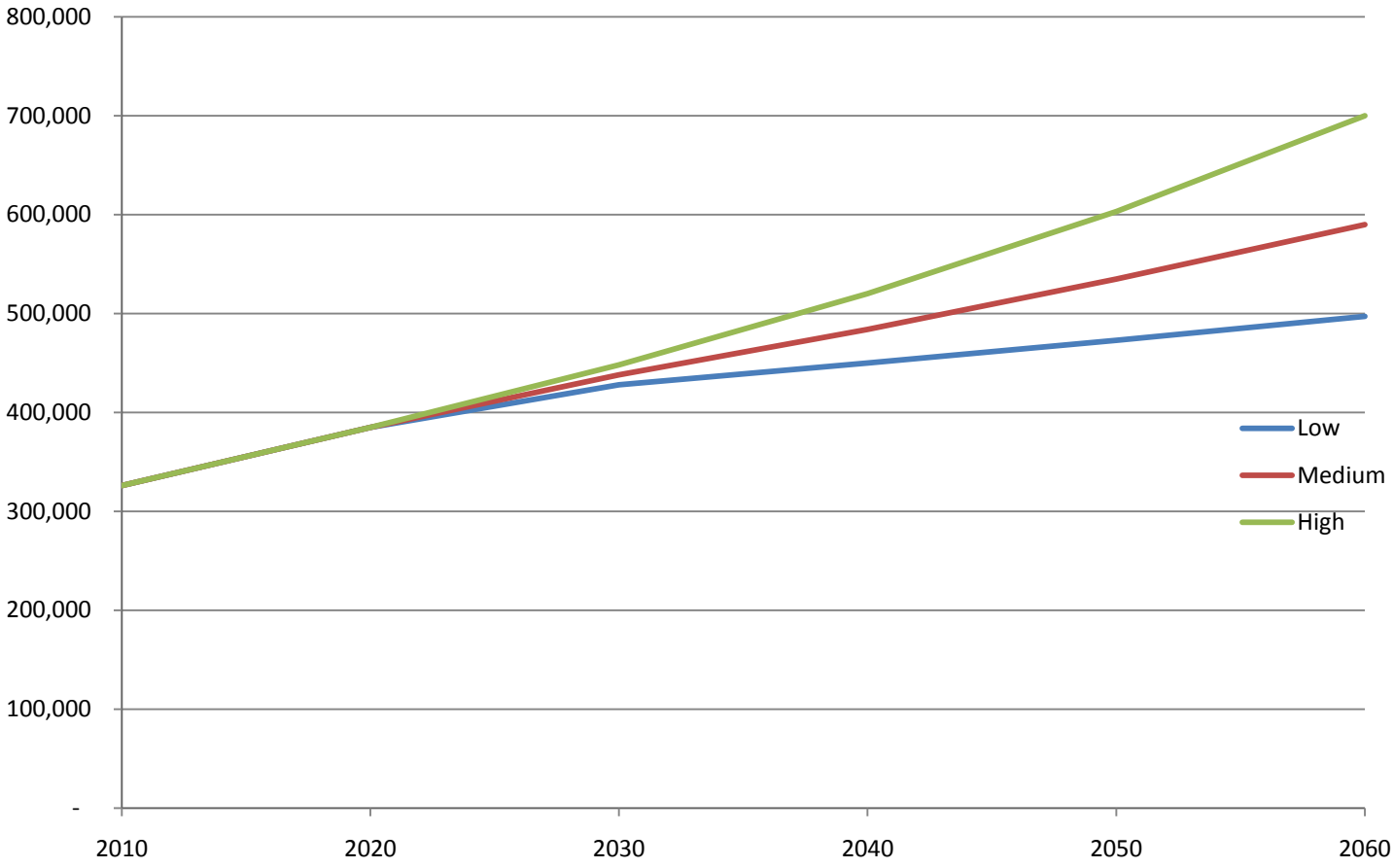


Table 29. 2008 Municipal Use – Eight Large Water Systems

Municipal- Eight Large Water Systems - Potable [1]	(MGY)	(AFY)
City of Yakima Water Division	4,649	14,269
Ellensburg	1,545	4,742
Nob Hill Water Association	1,388	4,261
Sunnyside	889	2,728
Prosser	842	2,586
Grandview	623	1,912
Toppenish	607	1,863
Yakima County- Terrace Heights	296	909
Subtotal	**10,840**	**33,269**
Municipal- City of Yakima Irrigation Systems [2]		
City of Yakima- General Irrigation System	1,207	4,475
Fruitvale Irrigation System (the 50% used by City residents)	1,408	4,571
Subtotal	**2,615**	**8,026**
Total	**13,455**	**42,315**

MGY = Million Gallons per year; AFY = Acre-feet per year

(1) 2008 reported numbers from annual water use reports submitted to DOH and/or HDR survey.

(2) Data reported by City of Yakima water and irrigation department, in response to HDR survey.

Figure 13. Estimates of Per Capita Use in Yakima Basin Municipal and Domestic Supplies

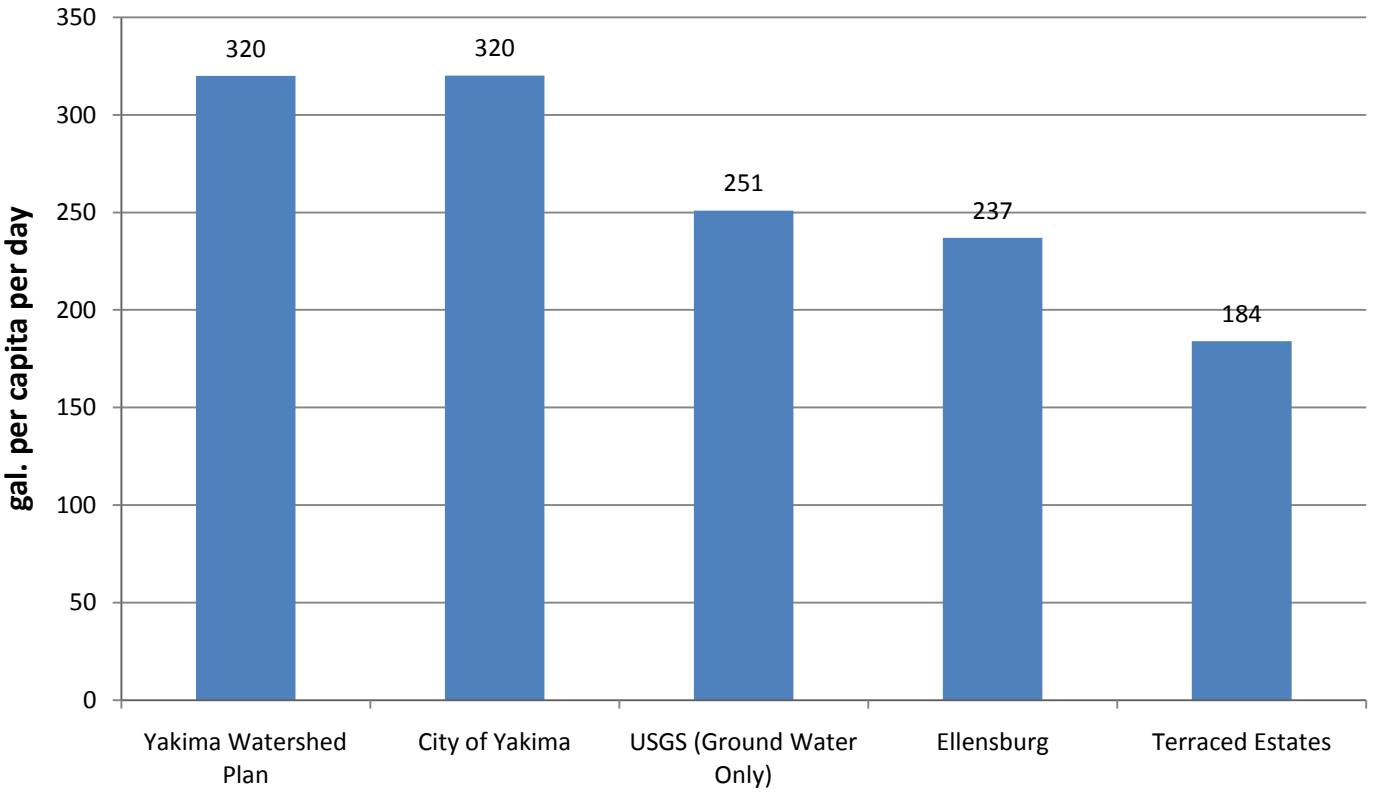
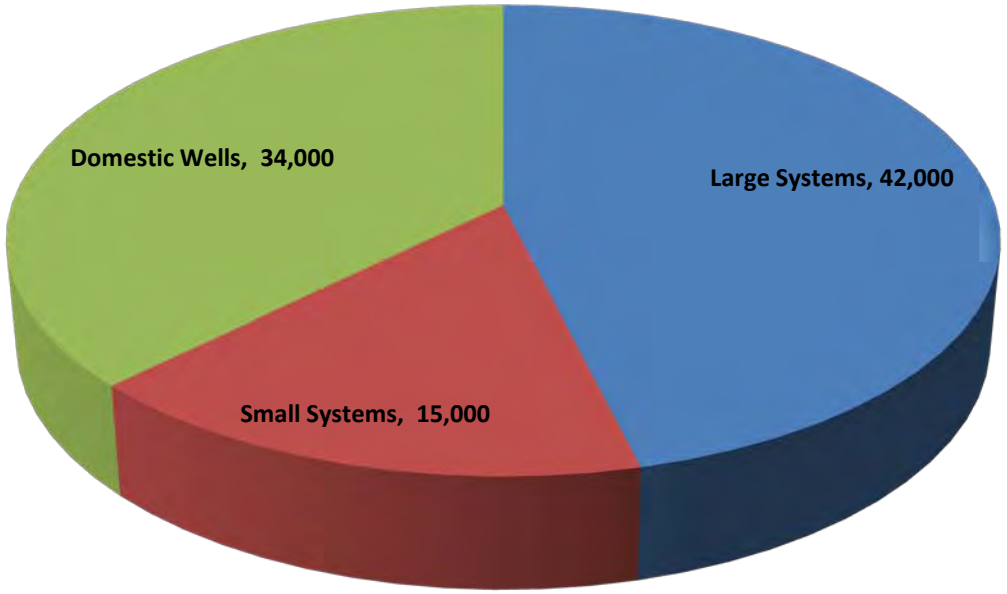


Table 30. Per Capita Use Estimates from Other Locations

Northwest[1]		California[2]	
Moscow	159	Los Angeles	142
Cheney	206	San Diego	157
Bend	267	Bakersfield	279
Spokane	271	Sacramento	279
Walla Walla	300	Fresno	354

1. Northwest values obtained from Moscow, Cheney and Bend water master plans; and calculated for two other cities from data reported to DOH in WFI and annual performance reports.
2. California values obtained from California Water Plan, Update 2009 (California DWR Bulletin 160-09).

Figure 14 . Estimate of Current Municipal and Domestic Water Uses (Acre-Feet per Year in 2010)



Total Estimated Use: 91,000 Acre-Feet

Table 31. Water Use Estimates – Small Systems and Domestic Wells

	MGY	AFY
Smaller Municipal Systems (1)	4,873	14,955
Domestic Wells (2)	11,041	33,887

MGY = Million Gallons per year; AFY = Acre-feet per year
(1) Population from DOH records times Basin-wide estimate of per capita water use.
(2) Estimated population times Basin-wide estimate of per capita water use.

Table 32. Growth-Adjusted Change in Municipal and Domestic Needs 2010-2060 (AFY)

	2010	2020	2030	2040	2050	2060	2010-2060 Change
Low	90,000	104,000	118,000	124,000	130,000	137,000	46,000
Medium	91,000	106,000	121,000	134,000	148,000	163,000	72,000
High	90,000	107,000	124,000	144,000	167,000	193,000	102,000

Figure 15. Growth-Adjusted Change in Municipal and Domestic Use (AFY)

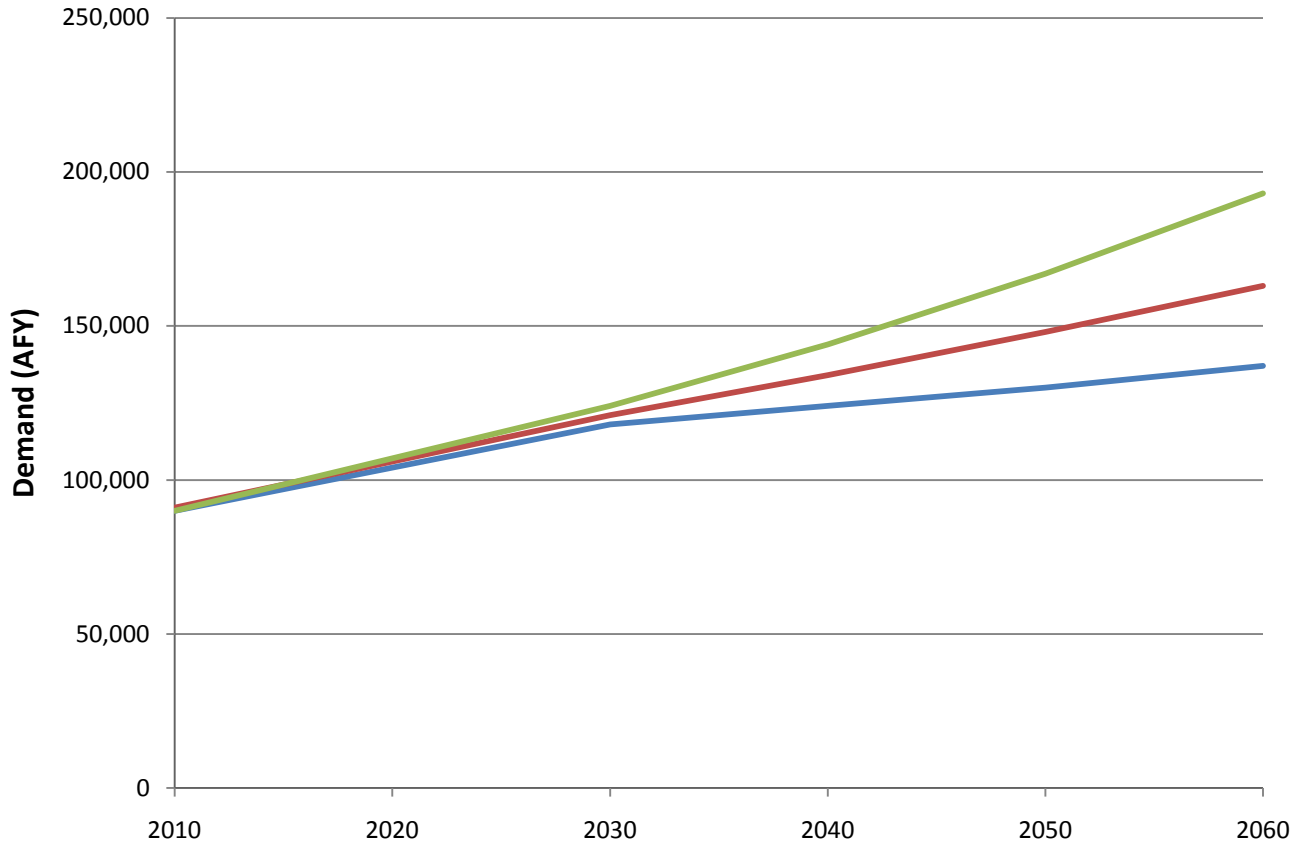


Table 33. Medium Forecast by Category of Use (AFY)

	2010	2030	2060	2010-2060 Change
Large Systems	42,000	56,000	76,000	34,000
Small Systems	15,000	20,000	27,000	12,000
Domestic Wells	34,000	45,000	60,000	26,000
Total	91,000	121,000	163,000	**72,000**

Based on growth rates only. Does not consider water conservation, offsets due to agricultural land conversion climate change or other factors.

Table 34. Net Irrigation Season Requirement - Medium Forecast (AFY)

	2010	2030	2060	2010-2060 Change
Growth-Based Demand	91,000	121,000	163,000	72,000
Less Conservation Trends (No-Action) (1)	0	4,000	8,200	
Less Land Conversion Effect (2)	0	11,000	22,000	
Adjusted Demand	**91,000**	**106,000**	**132,800**	**41,800**
Less Return Flow (estimated)(3)	54,600	63,600	79,680	
Net Consumptive Use	**36,400**	**42,400**	**53,120**	**16,720**
Less Off-Season Consumptive Use (4)	10,920	12,720	15,936	
Irrigation Season Consumptive use	**25,480**	**29,680**	**37,184**	**11,704**
Quantity Below Parker (5)				3,433
Quantity Above Parker (5)				8,271
(Irrigation season consumptive use can be reduced further with conservation actions)				

(1) From municipal/domestic conservation analysis (Task 4.11).
(2) See assessment of land conversion from agricultural use to urban use.
(3) Return flow estimated at 60% based on professional judgment from experience with water and wastewater systems. This is considered a conservative estimate (percentage may be higher).
(4) Calculated from monthly production records provided by Yakima, Ellensburg, Nob Hill, Prosser and Toppenish.
(5) Based on current water use estimates broken down by county and by water system (assumed 1/3 of Yakima Co. Population in served by small systems and domestic wells are below Parker; 2/3 above Parker).

Table 35. Estimated Effect of Land Conversion on Water Needs

	Farm Land Inside UGB (acres)	Land Converted for Urban Uses (acres)	Water Used for Farm Irrigation [3] (AFY)	Water Used for New Developments [4] (AFY)	Total Water Need on These Lands (AFY)
Current Conditions	21,000	0	84,000	0	**84,000**
2030 Conditions [1]	14,000	7,000	56,000	16,800	**72,800**
Change from 2010 to 2030					11,200
2060 Conditions [2]	7,000	14,000	28,000	33,600	**61,600**
Change from 2010 to 2060					22,400

1. Assumed one-third of acreage is converted by 2030.
2. Assumes two thirds of acreage is converted by 2060.
3. Using 4.0 acre-feet per acre, from analysis of agricultural lands.
4. Using 2.4 acre-feet per acre, based on average results from two separate methods documented in text.

Table 36. Other Uses of Water in the Yakima River Basin

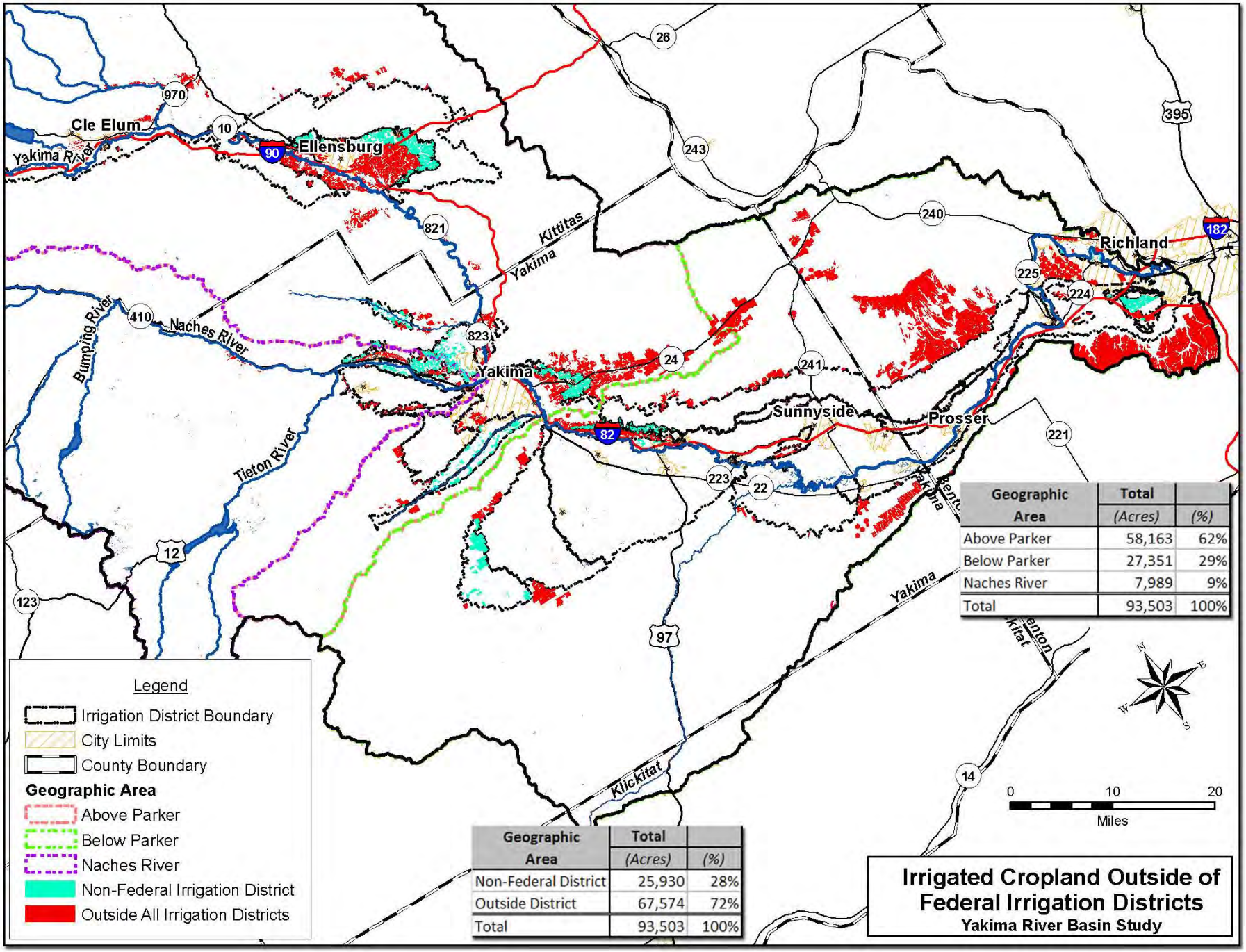
Use	Estimated Quantity (AFY)
Fish & Wildlife (GW) [1]	9,000
Commercial/Industrial (GW) [1]	7,000
Livestock (GW) [1]	7,000
Non-Community Public Water Systems [2]	3,000
Livestock (SW)	Unknown

GW = Ground Water; SW = Surface Water

(1) Estimates of Ground-Water Pumpage from the Yakima River Basin Aquifer System, Washington, 1960-2000 (USGS SIR 2005-5205, April 2009).

(2) Based on DOH records. Analyzed in Watershed Assessment, Yakima River Basin, Table 4-3 (Yakima River Basin Watershed Planning Unit and TCWRA, January 2001).

Appendix A
Agricultural Uses Supplied by Non-Federal Sources



Geographic Area	Total (Acres)	(%)
Above Parker	58,163	62%
Below Parker	27,351	29%
Naches River	7,989	9%
Total	93,503	100%

Geographic Area	Total (Acres)	(%)
Non-Federal District	25,930	28%
Outside District	67,574	72%
Total	93,503	100%

Irrigated Cropland Outside of Federal Irrigation Districts

Yakima River Basin Study

Federal and Non-federal Acreage

The tables below provide a summary of the crop acreage identified in the Yakima basin by location within federally-supplied districts, other districts, or outside all districts.

The first table presents the acreage with irrigation type "none" (e.g., not irrigated in 2008); irrigated acreage, and the total acreage. The yellow highlight in the center columns of the first table indicates the acreage that was included in the analysis of non-federal irrigation demand (a different approach was used to estimate federal project demand as described elsewhere in this report).

The second table presents a summary of the irrigated acreage (yellow highlighted columns from first table) by number and percentage.

Estimated Acreage by Irrigation District & Federal Project Location									
	Acres with Irrigation Type = "None" or "#N/A"			Acres with Specified Irrigation Type			Total Acres		
Geographic Area	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)
Non-Federal District	1,463	0	1,463	25,930	0	25,930	27,393	0	27,393
Federal District	4,824	0	4,824	265,408	0	265,408	270,232	0	270,232
Outside District	44,115	26,713	70,828	26,564	41,010	67,574	70,679	67,723	138,401
Total	50,402	26,713	77,115	317,901	41,010	358,911	368,303	67,723	436,026

Non-Federal Acreage by Project/District Location (Excluding NONE)		
Geographic Area	Total	
	(Acres)	(%)
Federal District	265,408	74%
Non-Federal District	25,930	7%
Outside District	67,574	19%
Total	358,911	100%

Acreage Irrigated by Non-Federal Sources

The tables below provide a summary of the non-federally supplied crop acreage by diversion sources above and below Parker and in the Naches River Basin.

The first table presents the acreage with irrigation type "none" (e.g., not irrigated in 2008); irrigated acreage, and the total acreage. The yellow highlight in the center columns of the first table indicates the acreage that was included in the characterization of non-federal irrigation demand.

The second table presents a summary of the yellow highlighted columns from first table by number and percentage.

Estimated Acreage by Diversion Source (Excluding Federal Project)									
	Acres with Irrigation Type = "None"			Acres with Specified Irrigation Type			Total Acres		
Geographic Area	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)
Above Parker	4,182	2,143	6,325	36,942	21,221	58,163	41,124	23,364	64,488
Below Parker	40,820	24,302	65,122	10,649	16,703	27,351	51,468	41,005	92,473
Naches River	577	268	844	4,903	3,086	7,989	5,480	3,354	8,833
Total	45,578	26,713	72,291	52,494	41,010	93,503	98,072	67,723	165,794

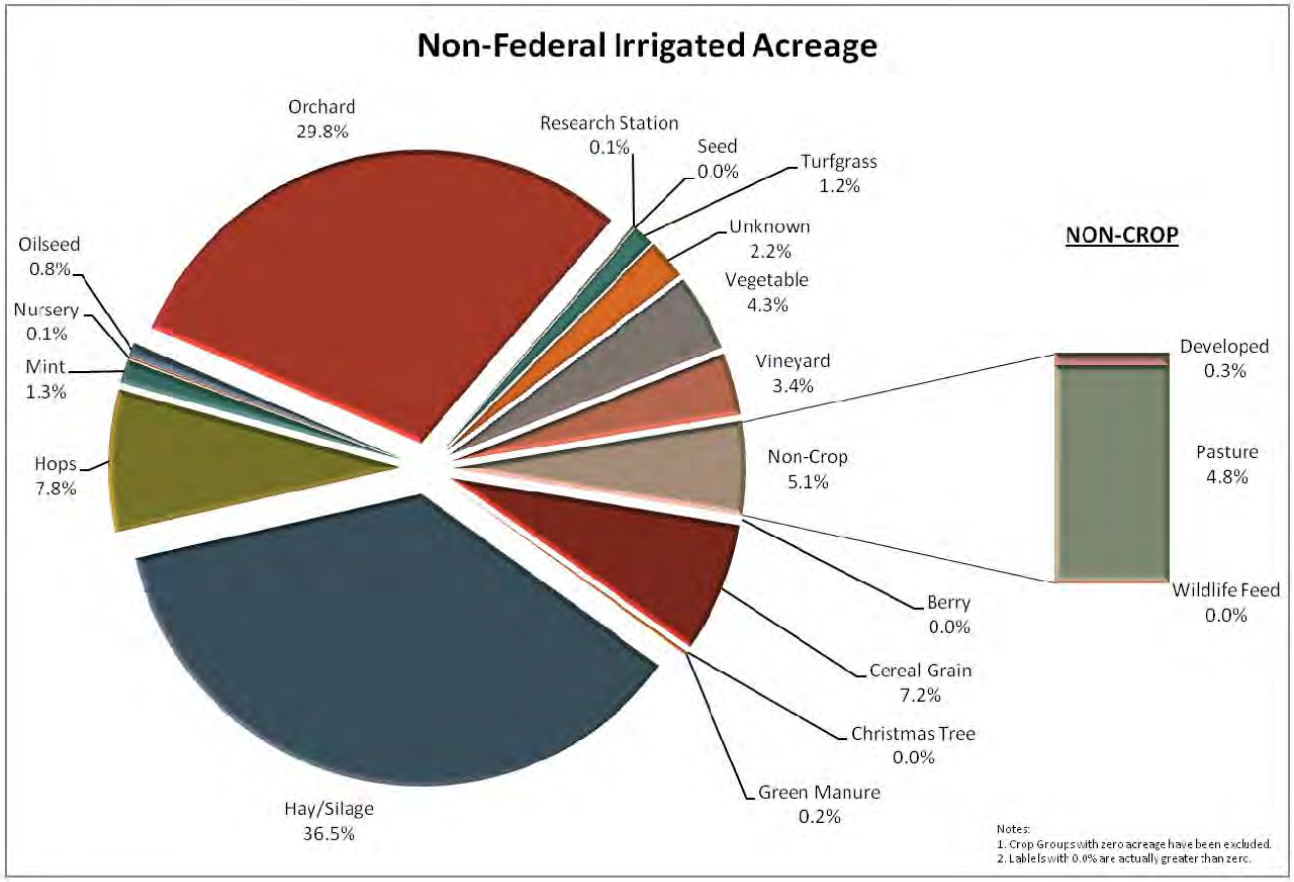
Note: Excludes All Acreage Inside of the Federal Project

Non-Federal Acreage by Diversion Source (Excluding NONE)		
Geographic Area	Total	
	(Acres)	(%)
Above Parker	58,163	62%
Below Parker	27,351	29%
Naches River	7,989	9%
Total	93,503	100%

Note: Excludes All Acreage Inside of the Federal Project.
Excludes Acreage with Irrigation Method of "NONE".

Crop Types

The pie graph presents a summary of the crop types found in the non-federally supplied irrigated acreage.



Non-federal Irrigation Demand – Annual

The table below summarizes the estimated annual irrigation demand for non-federal irrigated acreage, including acreage within districts that do not receive federal supplies and acreage outside all districts. The demands for each location are then shown by diversion source (above and below Parker and Naches River basin).

Non-Federal Acreage, Requirements, Losses and Diversions															
	Acres Irrigated			Annual Irrigation Requirement			Annual Irrigation Efficiency Loss			Annual Conveyance Efficiency Loss			Estimated Annual Diversions		
Geographic Area	Surface Water (Acres)	Groundwater - Primary (Acres)	Total (Acres)	Surface Water (Acre-Feet)	Groundwater - Primary (Acre-Feet)	Total (Acre-Feet)	Surface Water (Acre-Feet)	Groundwater - Primary (Acre-Feet)	Total (Acre-Feet)	Surface Water (Acre-Feet)	Groundwater - Primary (Acre-Feet)	Total (Acre-Feet)	Surface Water (Acre-Feet)	Groundwater - Primary (Acre-Feet)	Total (Acre-Feet)
Non-Federal District															
Above Parker	18,492	0	18,492	52,293	0	52,293	29,252	0	29,252	43,909	0	43,909	125,454	0	125,454
Below Parker	2,534	0	2,534	8,117	0	8,117	2,168	0	2,168	5,538	0	5,538	15,823	0	15,823
Naches River	4,903	0	4,903	16,510	0	16,510	5,372	0	5,372	11,783	0	11,783	33,665	0	33,665
Subtotal Non-Federal District	25,930	0	25,930	76,920	0	76,920	36,792	0	36,792	61,230	0	61,230	174,942	0	174,942
Outside District															
Above Parker	18,450	21,221	39,671	45,772	61,581	107,353	37,156	20,273	57,429	44,654	0	44,654	127,582	81,854	209,436
Below Parker	8,114	16,703	24,817	23,878	50,769	74,647	6,061	15,178	21,239	16,121	0	16,121	46,060	65,947	112,007
Naches River	0	3,086	3,086	0	9,955	9,955	0	3,347	3,347	0	0	0	0	13,302	13,302
Subtotal Outside District	26,564	41,010	67,574	69,651	122,304	191,955	43,217	38,798	82,015	60,775	0	60,775	173,642	161,102	334,745
Total Non-Federal	52,494	41,010	93,503	146,571	122,304	268,875	80,009	38,798	118,808	122,005	0	122,005	348,584	161,102	509,687

Note: 1. Excludes All Acreage Inside of the Federal Project

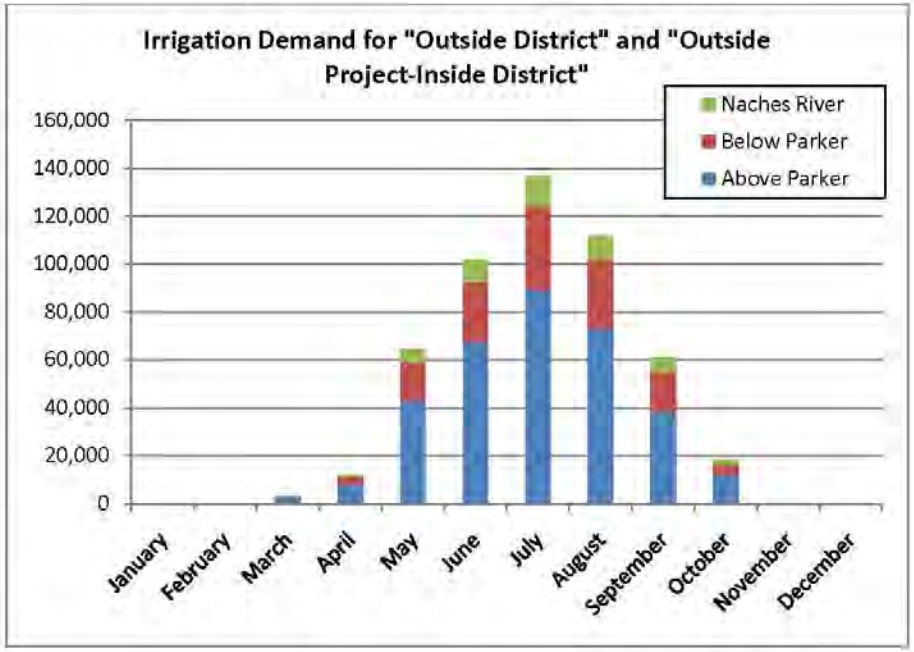
2. Excludes fields with irrigation types of "None" and "N/A".

Non-federal Irrigation Demand - monthly

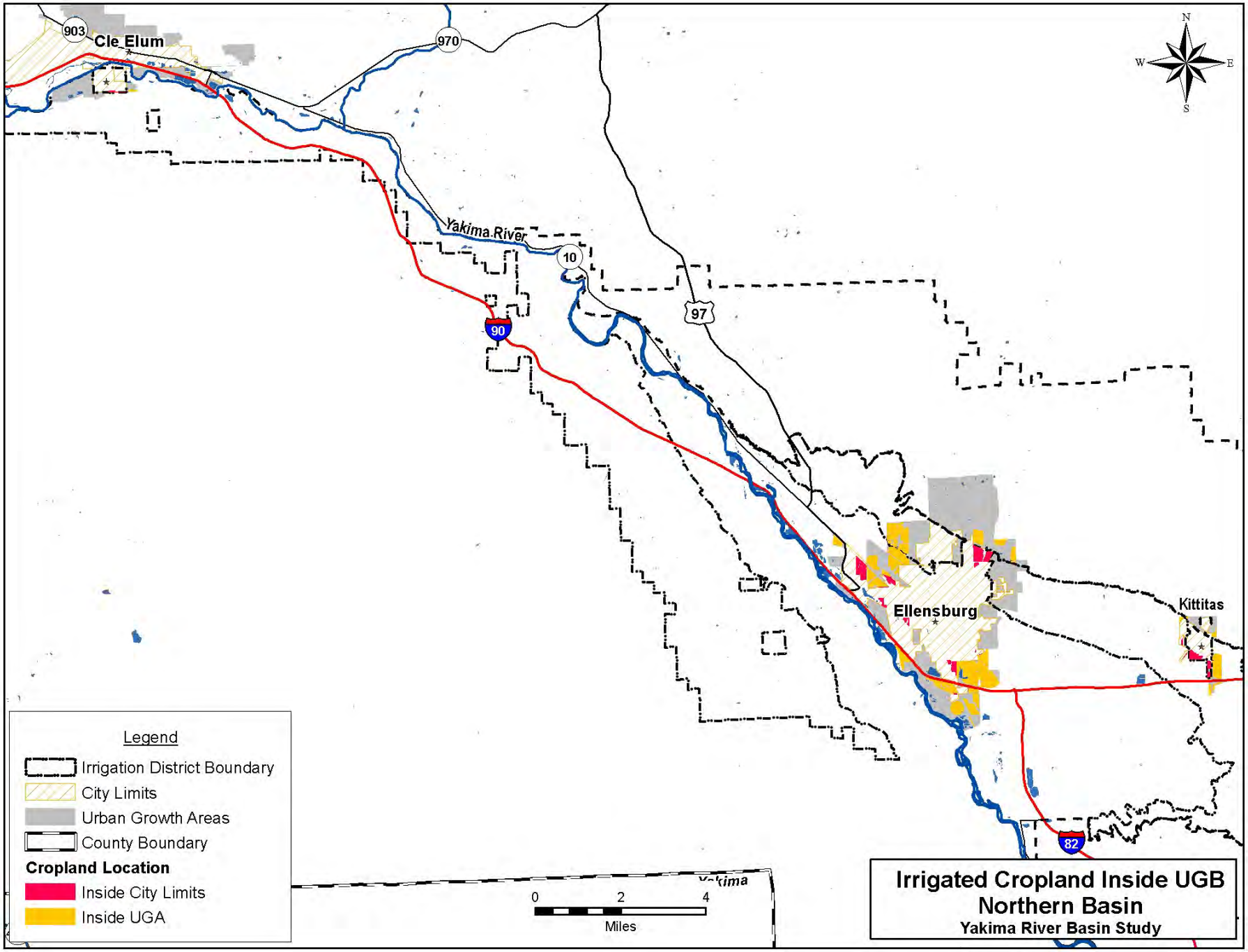
The table and graph below summarize the estimated monthly non-federal irrigation demand by diversion source (above and below Parker and Naches River basin).

Estimated Monthly Non-Project Diversion and Acreage by Diversion Source (Excludes All Acreage Inside of the Federal Project)																
	Acres Irrigated			Estimated Diversion												
Geographic Area	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	January (Acre-Feet)	February (Acre-Feet)	March (Acre-Feet)	April (Acre-Feet)	May (Acre-Feet)	June (Acre-Feet)	July (Acre-Feet)	August (Acre-Feet)	September (Acre-Feet)	October (Acre-Feet)	November (Acre-Feet)	December (Acre-Feet)	Total (Acre-Feet)
Above Parker	36,942	21,221	58,163	0	0	2,780	8,145	43,191	67,603	89,513	73,080	38,668	11,910	0	0	334,890
Below Parker	10,649	16,703	27,351	0	0	454	2,925	15,715	24,903	34,581	28,404	16,077	4,772	0	0	127,830
Naches River	4,903	3,086	7,989	0	0	83	740	5,678	9,134	12,842	10,340	6,363	1,788	0	0	46,967
Total	52,494	41,010	93,503	0	0	3,316	11,810	64,584	101,640	136,936	111,823	61,108	18,470	0	0	509,687

Note: Excludes All Acreage Inside of the Federal Project
2. Excludes fields with Irrigation types of "None" and "N/A".



Appendix B
Land Conversion Calculations


903
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Yakima River
10
90
97
Ellensburg
Kittitas
82
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Legend
Irrigation District Boundary
City Limits
Urban Growth Areas
County Boundary
Cropland Location
Inside City Limits
Inside UGA
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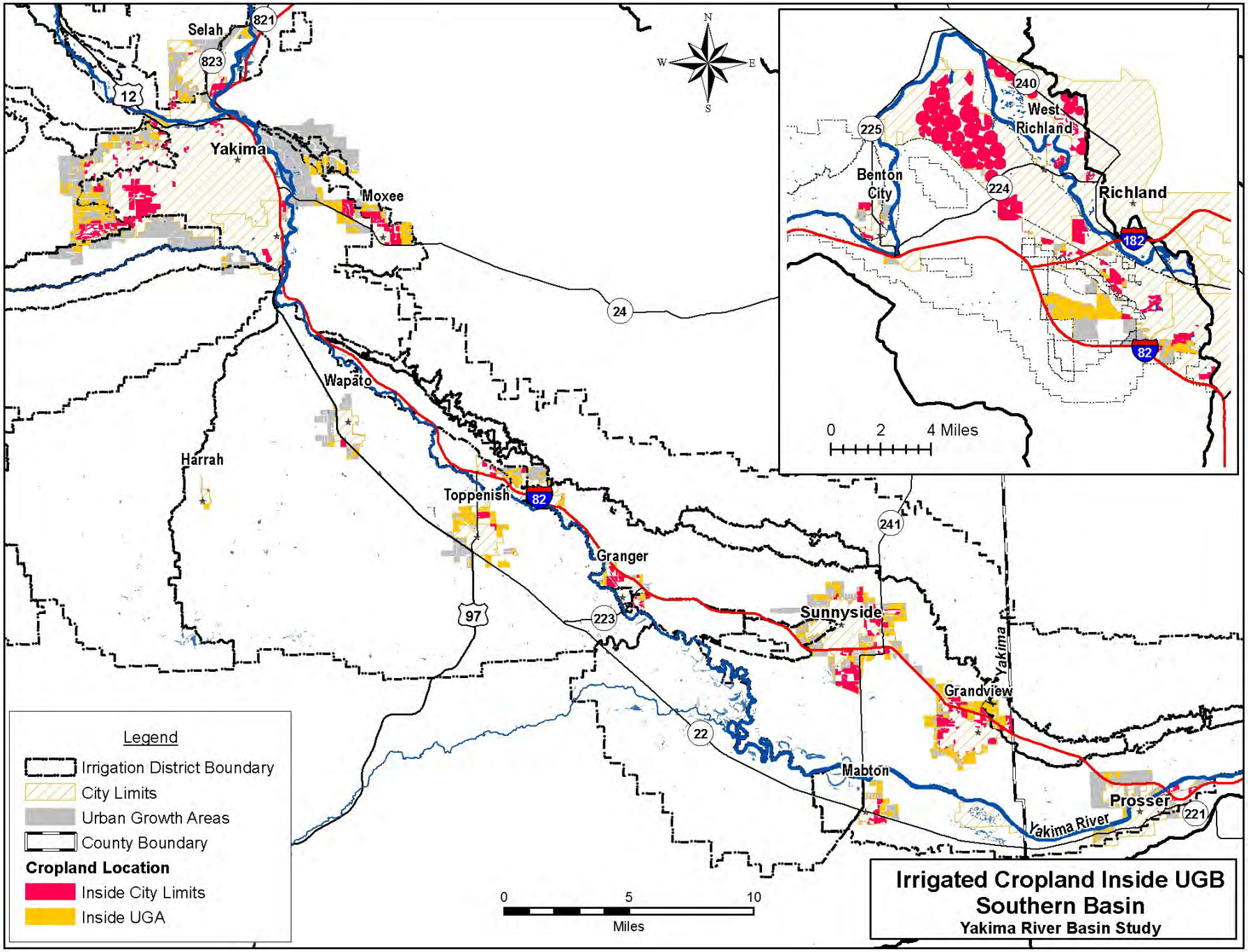
Northern Basin
Yakima River Basin Study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Yakima
Moxee
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Wapato
Harrah
Toppenish
82
Granger
97
223
241
Sunnyside
Yakima
Grandview
22
Mabton
Prosser
221
Yakima River
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W
E
S
240
West Richland
225
Benton City
224
Richland
182
82
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Legend
Irrigation District Boundary
City Limits
Urban Growth Areas
County Boundary
Cropland Location
Inside City Limits
Inside UGA
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Miles
Irrigated Cropland Inside UGB
Southern Basin
Yakima River Basin Study

Acreage within Urban Growth Boundaries (UGBs)

The tables below summarize the irrigated acreage located within the urban growth boundaries (UGBs) of the cities and counties in the Yakima basin. This analysis includes irrigated lands located within city limits and within city- or county-designated urban growth areas (UGAs). The tables compare acreage in UGAs, city limits, and rural areas outside any UGAs.

The first table presents the acreage with irrigation type "none" (e.g., not irrigated in 2008); irrigated acreage, and the total acreage. The yellow highlight in the center columns of the first table indicates the irrigated acreage. Acreage inside UGA and inside City limits was considered in the assessment of potential conversion to urban uses.

The second table presents a summary of the irrigated acreage (yellow highlighted columns from first table) by number and percentage.

Estimated Acreage by UGA and City Limit Location									
	Acres with Irrigation Type = "None" or "#N/A"			Acres with Specified Irrigation Type			Total Acres		
Geographic Area	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)	Surface Water (Acres)	Ground Water - Primary (Acres)	Total (Acres)
Inside UGA	318	109	427	7,938	1,083	9,021	8,256	1,192	9,448
Inside City Limits	619	177	796	8,769	3,230	12,000	9,388	3,407	12,795
Rural	49,465	26,427	75,893	301,194	36,696	337,891	350,659	63,124	413,783
Total	50,402	26,713	77,115	317,901	41,010	358,911	368,303	67,723	436,026

Acreage by UGA/City Limit Location (Excluding NONE)		
Geographic Area	Total	
	(Acres)	(%)
Inside UGA	9,021	3%
Inside City Limits	12,000	3%
Rural	337,891	94%
Total	358,911	100%

Note: Excludes Acreage with Irrigation Method of "NONE".

Current Agricultural Application within UGBs

The table presents the current estimated irrigation application (excluding conveyance losses) for irrigated areas by location (federal district, non-federal district, and outside all districts) for four UGB areas (1.) Ellensburg, 2.) Yakima, 3.) Richland/West Richland, 4.) and all other jurisdictions).

Estimated Acreage and Application by Destination Irrigation District & Federal Project for UGA and City Limits												
	Acres Irrigated			Annual Irrigation Requirement			Annual Irrigation Efficiency Loss			Estimated Annual Application		
Geographic Area	Surface Water (Acres)	Groundwater - Primary (Acres)	Total (Acres)	Surface Water (Acre Feet)	Groundwater - Primary (Acre Feet)	Total (Acre Feet)	Surface Water (Acre Feet)	Groundwater - Primary (Acre Feet)	Total (Acre Feet)	Surface Water (Acre Feet)	Groundwater - Primary (Acre Feet)	Total (Acre Feet)
Non-Federal District												
Ellensburg (UGA and City Limits)	138	0	138	205	0	205	205	0	205	410	0	410
Yakima (UGA and City Limits)	398	0	398	1,215	0	1,215	414	0	414	1,630	0	1,630
Richland (UGA and City Limits)[3]	1,152	0	1,152	3,519	0	3,519	1,002	0	1,002	4,520	0	4,520
All Other (UGA and City Limits)	964	0	964	2,620	0	2,620	952	0	952	3,573	0	3,573
Subtotal	2,653	0	2,653	7,559	0	7,559	2,573	0	2,573	10,133	0	10,133
Federal District												
Ellensburg (UGA and City Limits)	97	0	97	262	0	262	228	0	228	490	0	490
Yakima (UGA and City Limits)	1,324	0	1,324	4,921	0	4,921	1,726	0	1,726	6,647	0	6,647
Richland (UGA and City Limits)[3]	626	0	626	1,810	0	1,810	539	0	539	2,349	0	2,349
All Other (UGA and City Limits)	6,888	0	6,888	18,019	0	18,019	9,907	0	9,907	27,926	0	27,926
Subtotal	8,936	0	8,936	25,013	0	25,013	12,400	0	12,400	37,413	0	37,413
Outside District												
Ellensburg (UGA and City Limits)	856	91	947	1,974	209	2,184	1,562	166	1,728	3,536	375	3,912
Yakima (UGA and City Limits)	0	1,440	1,440	0	4,303	4,303	0	1,400	1,400	0	5,703	5,703
Richland (UGA and City Limits)[3]	4,214	1,642	5,856	12,562	4,894	17,456	3,224	1,256	4,480	15,787	6,150	21,936
All Other (UGA and City Limits)	47	1,141	1,188	128	3,310	3,438	121	1,172	1,294	249	4,482	4,732
Subtotal	5,118	4,313	9,431	14,665	12,716	27,381	4,908	3,994	8,902	19,572	16,710	36,283
Total												
Ellensburg (UGA and City Limits)	1,092	91	1,182	2,442	209	2,651	1,995	166	2,161	4,437	375	4,812
Yakima (UGA and City Limits)	1,723	1,440	3,163	6,137	4,303	10,439	2,140	1,400	3,540	8,277	5,703	13,980
Richland (UGA and City Limits)[3]	5,993	1,642	7,634	17,891	4,894	22,785	4,765	1,256	6,021	22,656	6,150	28,806
All Other (UGA and City Limits)	7,900	1,141	9,041	20,768	3,310	24,078	10,981	1,172	12,153	31,748	4,482	36,231
Grand Total	16,707	4,313	21,020	47,237	12,716	59,953	19,881	3,994	23,875	67,117	16,710	83,828

Note: 1. Excludes Annual Conveyance Efficiency Losses.

2. Excludes fields with irrigation types of "None" and "#N/A".

3. Includes both Richland and West Richland

Urban Conversion of Agricultural Land – Method 1

The tables below present two methods used to estimate potential change in water use due to future conversion of agricultural land to urban uses. It was assumed that 1/3 of the irrigated acreage within UGBs would be converted by 2030, and 2/3 would be converted by 2060.

The first method used an average residential density of 4 dwelling units per acre to estimate future urban water use.

Estimated Domestic Use with Conversion of Existing Crop Land in Cities and Urban Growth Areas

Geographic Area	Current			Future Use Assumptions				2030 Forecast					2060 Forecast				
	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Agricultural Use Per Acre (Acre-Feet/Acre)	Housing Density (Dwelling Units (DU)/Acre)	Domestic Use Per Unit (gallons/ DU/day)	Domestic Use Per Acre (Acre-Feet / Acre)	Change in Use Per Acre with Urban Conversion (Acre-Feet / Acre)	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Converted Acreage (1/3 of Irrigated Acres) (Acres)	Annual Domestic Water Use (Acre-Feet)	Change in Water Use from Current (Acre-Feet)	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Converted Acreage (2/3 of Irrigated Acres) (Acres)	Annual Domestic Water Use (Acre-Feet)	Change in Water Use from Current (Acre-Feet)
Non-Federal District																	
Ellensburg (UGA and City Limits)	138	410	2.97	4.0	700	3.14	0.17	92	274	46	144	8	46	137	92	289	15
Yakima (UGA and City Limits)	398	1,630	4.09	4.0	700	3.14	-0.95	266	1,086	133	416	-127	133	543	266	833	-254
Richland (UGA and City Limits)[3]	1,152	4,520	3.92	4.0	700	3.14	-0.79	768	3,013	384	1,204	-302	384	1,507	768	2,409	-605
All Other (UGA and City Limits)	964	3,573	3.70	4.0	700	3.14	-0.57	643	2,382	321	1,008	-183	321	1,191	643	2,017	-365
Subtotal	2,653	10,133	3.82	n/a	n/a	3.14	-0.68	1,769	6,755	884	2,773	-604	884	3,378	1,769	5,547	-1,208
Federal District																	
Ellensburg (UGA and City Limits)	97	490	5.05	4.0	700	3.14	-1.91	65	327	32	101	-62	32	163	65	203	-124
Yakima (UGA and City Limits)	1,324	6,647	5.02	4.0	700	3.14	-1.88	883	4,431	441	1,384	-831	441	2,216	883	2,769	-1,662
Richland (UGA and City Limits)[3]	626	2,349	3.75	4.0	700	3.14	-0.61	418	1,566	209	655	-128	209	783	418	1,310	-256
All Other (UGA and City Limits)	6,888	27,926	4.05	4.0	700	3.14	-0.92	4,592	18,618	2,296	7,202	-2,107	2,296	9,309	4,592	14,403	-4,214
Subtotal	8,936	37,413	4.19	n/a	n/a	3.14	-1.05	5,957	24,942	2,979	9,342	-3,128	2,979	12,471	5,957	18,685	-6,257
Outside District																	
Ellensburg (UGA and City Limits)	947	3,912	4.13	4.0	700	3.14	-0.99	632	2,608	316	990	-313	316	1,304	632	1,981	-627
Yakima (UGA and City Limits)	1,440	5,703	3.96	4.0	700	3.14	-0.82	960	3,802	480	1,505	-396	480	1,901	960	3,011	-791
Richland (UGA and City Limits)[3]	5,856	21,936	3.75	4.0	700	3.14	-0.61	3,904	14,624	1,952	6,122	-1,190	1,952	7,312	3,904	12,244	-2,380
All Other (UGA and City Limits)	1,188	4,732	3.98	4.0	700	3.14	-0.85	792	3,154	396	1,242	-335	396	1,577	792	2,484	-670
Subtotal	9,431	36,283	3.85	n/a	n/a	3.14	-0.71	6,288	24,189	3,144	9,860	-2,234	3,144	12,094	6,288	19,720	-4,468
Total																	
Ellensburg (UGA and City Limits)	1,182	4,812	4.07	n/a	n/a	3.14	-0.93	788	3,208	394	1,236	-368	394	1,604	788	2,472	-735
Yakima (UGA and City Limits)	3,163	13,980	4.42	n/a	n/a	3.14	-1.28	2,108	9,320	1,054	3,306	-1,354	1,054	4,660	2,108	6,613	-2,707
Richland (UGA and City Limits)[3]	7,634	28,806	3.77	n/a	n/a	3.14	-0.64	5,090	19,204	2,545	7,981	-1,620	2,545	9,602	5,090	15,963	-3,241
All Other (UGA and City Limits)	9,041	36,231	4.01	n/a	n/a	3.14	-0.87	6,027	24,154	3,014	9,452	-2,625	3,014	12,077	6,027	18,904	-5,250
Grand Total	21,020	83,828	3.99	n/a	n/a	3.14	-0.85	14,014	55,885	7,007	21,976	-5,967	7,007	27,943	14,014	43,952	-11,933

Note: 1. Excludes Annual Conveyance Efficiency Losses.

2. Excludes fields with Irrigation types of "None" and "N/A".

3. Includes both Richland and West Richland

Urban Conversion of Agricultural Land – Method 2

Method 2 used the current average water use per acre in Yakima and Ellensburg, estimated at 1.65 acre feet per acre, to estimate future water use.

Estimated Domestic Use with Conversion of Existing Crop Land in Cities and Urban Growth Areas															
	Current			Future Use Assumptions		2030 Forecast					2060 Forecast				
Geographic Area	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Agricultural Use Per Acre (Acre-Feet/Acre)	Domestic Use Per Acre (Acre-Feet / Acre)	Change in Domestic Use Per Acre (Acre-Feet / Acre)	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Converted Acreage (1/3 of Irrigated Acres) (Acres)	Annual Domestic Water Use (Acre-Feet)	Change in Water Use from Current (Acre-Feet)	Acres Irrigated (Acres)	Agricultural Application (Acre-Feet)	Converted Acreage (2/3 of Irrigated Acres) (Acres)	Annual Domestic Water Use (Acre-Feet)	Change in Water Use from Current (Acre-Feet)
Non-Federal District															
Ellensburg (UGA and City Limits)	138	410	2.97	1.65	-1.32	92	274	46	76	-61	46	137	92	152	-122
Yakima (UGA and City Limits)	398	1,630	4.09	1.65	-2.44	266	1,086	133	219	-324	133	543	266	438	-648
Richland (UGA and City Limits)[3]	1,152	4,520	3.92	1.65	-2.27	768	3,013	384	634	-873	384	1,507	768	1,267	-1,746
All Other (UGA and City Limits)	964	3,573	3.70	1.65	-2.05	643	2,382	321	530	-660	321	1,191	643	1,061	-1,321
Subtotal	2,653	10,133	3.82	1.65	-2.17	1,769	6,755	884	1,459	-1,918	884	3,378	1,769	2,918	-3,837
Federal District															
Ellensburg (UGA and City Limits)	97	490	5.05	1.65	-3.40	65	327	32	53	-110	32	163	65	107	-220
Yakima (UGA and City Limits)	1,324	6,647	5.02	1.65	-3.37	883	4,431	441	728	-1,487	441	2,216	883	1,457	-2,975
Richland (UGA and City Limits)[3]	626	2,349	3.75	1.65	-2.10	418	1,566	209	345	-438	209	783	418	689	-877
All Other (UGA and City Limits)	6,888	27,926	4.05	1.65	-2.40	4,592	18,618	2,296	3,789	-5,520	2,296	9,309	4,592	7,577	-11,040
Subtotal	8,936	37,413	4.19	1.65	-2.54	5,957	24,942	2,979	4,915	-7,556	2,979	12,471	5,957	9,830	-15,112
Outside District															
Ellensburg (UGA and City Limits)	947	3,912	4.13	1.65	-2.48	632	2,608	316	521	-783	316	1,304	632	1,042	-1,566
Yakima (UGA and City Limits)	1,440	5,703	3.96	1.65	-2.31	960	3,802	480	792	-1,109	480	1,901	960	1,584	-2,218
Richland (UGA and City Limits)[3]	5,856	21,936	3.75	1.65	-2.10	3,904	14,624	1,952	3,221	-4,091	1,952	7,312	3,904	6,442	-8,183
All Other (UGA and City Limits)	1,188	4,732	3.98	1.65	-2.33	792	3,154	396	653	-924	396	1,577	792	1,307	-1,847
Subtotal	9,431	36,283	3.85	1.65	-2.20	6,288	24,189	3,144	5,187	-6,907	4,192	12,094	6,288	10,374	-13,814
Total															
Ellensburg (UGA and City Limits)	1,182	4,812	4.07	1.65	-2.42	788	3,208	394	650	-954	394	1,604	788	1,301	-1,907
Yakima (UGA and City Limits)	3,163	13,980	4.42	1.65	-2.77	2,108	9,320	1,054	1,739	-2,921	1,054	4,660	2,108	3,479	-5,841
Richland (UGA and City Limits)[3]	7,634	28,806	3.77	1.65	-2.12	5,090	19,204	2,545	4,199	-5,403	2,545	9,602	5,090	8,398	-10,806
All Other (UGA and City Limits)	9,041	36,231	4.01	1.65	-2.36	6,027	24,154	3,014	4,973	-7,104	3,014	12,077	6,027	9,945	-14,209
Grand Total	21,020	83,828	3.99	1.65	-2.34	14,014	55,885	7,007	11,561	-16,382	7,007	27,943	14,014	23,122	-32,763

Note: 1. Excludes Annual Conveyance Efficiency Losses.

2. Excludes fields with Irrigation types of "None" and "N/A".

3. Includes both Richland and West Richland

Summary of Yakima Project Losses (Average)

	KRD	Roza	WIP	Sunnyside	Yakima -Tieton	Kennewick	Total
Average Non-Drought Diversions (1990-2009)	285,983	319,670	560,081	429,122	79,029	99,519	**1,773,403**
Estimated Conveyance Losses	94,374	111,565	156,823	49,349	3,951	40,604	**456,666**
Estimated Conveyance Losses (%)	33.0%	34.9%	28.0%	11.5%	5.0%	40.8%	**25.8%**
Estimated On-Farm Application Loss (Return Flow)	57,377	29,431	79,878	67,764	11,315	6,874	**252,639**
Estimated On-Farm Evaporation Loss	12,735	18,417	31,249	29,510	7,383	6,355	**105,649**

Note: All values in acre-feet

Yakima Project On-Farm Irrigation Types (%)

Type	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick
Rill	67.0%	7.1%	39.3%	33.1%	1.2%	2.1%
Sprinkler	2.3%	56.8%	14.6%	31.1%	91.8%	31.6%
Drip	0.5%	22.8%	13.9%	10.4%	2.1%	24.2%
Center Pivot	10.5%	6.0%	10.9%	10.7%	0.0%	32.6%
Wheel Line	8.2%	4.8%	18.8%	12.7%	2.7%	3.7%
Other	11.6%	2.4%	2.4%	2.0%	2.2%	5.8%

Note: All percentages based on WSDA survey data

Yakima Project On-Farm Irrigation Types (acre-feet)

Type	KRD	Roza	WIP	Sunnyside	Yakima-Tieton	Kennewick	Total
Rill	37,184	5,168	42,864	32,828	313	381	**118,739**
Sprinkler	1,275	41,179	15,971	30,834	23,749	5,828	**118,836**
Drip	263	16,538	15,197	10,314	540	4,462	**47,315**
Center Pivot	5,811	4,343	11,901	10,611	0	6,015	**38,681**
Wheel Line	4,569	3,489	20,551	12,647	695	679	**42,628**
Other	6,414	1,774	2,630	2,009	582	1,077	**14,486**
Total	**55,516**	**72,491**	**109,115**	**99,243**	**25,878**	**18,441**	**380,684**

Note: Total acreage based on district data

Theoretical Water Savings from On-farm Conservation

	WIP Application Losses	WIP Evaporation Losses	WIP On-Farm Losses	Sunnyside Application Losses	Sunnyside Evaporation Losses	Sunnyside On-Farm Losses	Total On-Farm Losses
Estimated Current Losses	79,878	31,249	111,128	67,764	29,510	97,274	208,401
Losses Assuming 80% of Rill is converted to Sprinkler	56,740	35,558	92,298	50,614	32,781	83,395	175,693
Difference (Water Savings)	**23,139**	**-4,309**	**18,830**	**17,150**	**-3,271**	**13,879**	**32,709**
Losses Assuming 50% of Rill is converted to Sprinkler	65,469	34,467	99,936	56,569	32,781	89,349	189,285
Difference (Water Savings)	**14,409**	**-3,217**	**11,192**	**11,196**	**-3,271**	**7,924**	**19,116**

Note: All values in acre-feet

Irrigation Efficiencies

Irrigation Type	% Application Efficiency	% Total Evaporated	% Total Consumed	% Return Flow
Rill	65	5	70	30
Sprinkler	75	10	85	15
Drip	88	5	93	7
Wheel Line	75	10	85	15
Center Pivot	85	12	97	3
Flood	50	5	55	45
Big Gun	65	10	75	25
Hand	90	10	100	0

Note: Percentages are based upon total volume of water delivered to farms

Flow Changes from Water Conservation Projects during Average Years within the Irrigation Season

Project # (2009)	Project # (Enhanced Conservation Alternative, 2008)	Entity	Yakima River Reaches										Tributaries				
			Keechelus to Easton	Easton Reach	Cle Elum to Teanaway	Teanaway to Roza	Roza to Naches	Naches to Parker	Wapato Reach	Toppenish to Prosser	Chandler Reach	Lower Yakima River	Kachess River	Cle Elum River	Naches River - Bumping to Tieton	Tieton River	Naches River - Tieton to Yakima
Y-1	YRBWEP	Sunnyside Division	-	-	-	-	-	-	+	+			-	-			
Y-2	YRBWEP	Sunnyside Division	-	-	-	-	-	-	+	+			-	-			
Y-3	YRBWEP	Benton Irrigation District							+	+	+						
EC-1	YRBWEP	Kittitas Reclamation District	-	+	+	+							-	-			
EC-2	1	Kittitas Reclamation District	-	+	+	+							-	-			
EC-3&4	2-4	Westside Irrigation	-	-	-	+							-	-			
EC-5	5-6	Ellensburg Water Company	-	-	-	+							-	-			
EC-6&7	7-9	Cascade Irrigation District	-	-	-	+							-	-			
EC-8&9	10-12	Bull Canal Company	-	-	-	+							-	-			
EC-10	YRBWEP	Roza Irrigation District	-	-	-	-	+	+	+	+	+		-	-			
EC-11	YRBWEP	Union Gap Irrigation District					+						-	-			
EC-12	13	Union Gap Irrigation District	-	-	-	-	-	+	+	+	+		-	-	-	-	-
EC-13	YRBWEP	Wapato Irrigation Project							+								
EC-14 to 23	14-23	Wapato Irrigation Project	-	-	-	-	-	-	+	+			-	-	-	-	-
EC-24	30	Sunnyside Valley Irrigation District	-	-	-	-	-	-	+	+	+		-	-	-	-	-
EC-25	31	Kiona Irrigation District										+					
EC-26	36	Nile Valley Ditch Association													+		
EC-27	37-43	Naches-Selah Irrigation District													+		+
EC-28	YRBWEP	Naches-Selah Irrigation District													+		
EC-29	44	South Naches Irrigation District													+		+
	24-29	Wapato Irrigation Project	-	-	-	-	-	-	+								
	32-34	Columbia Irrigation District										+					
	35	Kennewick Irrigation District									+	+					
	45	Gleed Ditch Company														-	+
	46	Yakima Valley Canal Company														-	+
	47	Naches and Cowiche Canal Company														-	+
	YRBWEP	Roza Irrigation District	-	-	-	-	+	+	+	+	+		-	-			
	YRBWEP	Wapato Irrigation Project	-	-	-	-	-	-	+	+			-	-	-	-	-

Note: = high priority reach per Instream Flow subcommittee