APPENDIX O

REGIONAL WATER FORECAST AND CONSERVATION PLAN

Regional Water Forecast and Conservation Plan

City of Kennewick
City of Pasco
City of Richland
City of West Richland

January 2016

Prepared By RH2 Engineering, Inc., Richland, Washington

Regional Water Forecast and Conservation Plan

City of Kennewick

City of Pasco

City of Richland

City of West Richland

January 2016

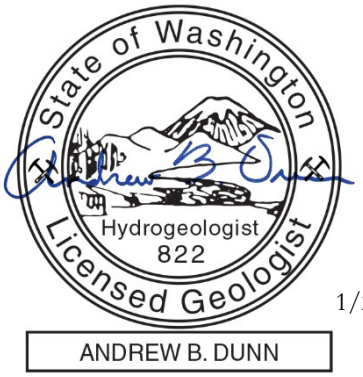
Prepared by RH2 Engineering, Inc.

Prepared for the City of Kennewick.

Note: This Plan was completed under the direct supervision of the following Licensed Professional Engineers registered in the State of Washington.

1/28/2016

1/28/2016



1/28/2016

City of Kennewick
Regional Water Forecast and Conservation Plan
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Introduction and Background

AUTHORIZATION AND PURPOSE

The Cities of Kennewick, Pasco, Richland, and West Richland authorized RH2 Engineering, Inc., (RH2) to prepare this Regional Water Forecast and Conservation Plan (RWFCP) to update the 2010 version of the RWFCP. These four cities share the Quad City Water Right (QCWR) issued under Surface Water Permit No. S4-30976P on September 15, 2003. This updated RWFCP combines the water conservation and demand projection data presented in each city's individual water system plan, and presents them in one document. Additionally, the purpose of this RWFCP is as follows:

- To describe the local area geology, climate, population, and municipal subdivisions;
- To summarize the municipal water rights for each city and the mechanisms for transmitting regional supplies to each city;
- To describe existing and proposed water conservation measures within each jurisdiction and regionally;
- To perform a water balance and determine net consumptive use within the municipal service areas;
- To tabulate the 2021 (6-year) and 2035 (20-year) allocation of the QCWR and where it is anticipated to be used; and
- To describe mitigation required by each city based on the allocation of the QCWR.

Combining the water conservation plans for the quad cities in this document will provide consistency with the Settlement Agreement terms of the QCWR, assist in ensuring a reliable future water supply for the region, and protect fish, wildlife, and the environment. Effective water conservation and efficiency plans can delay the need for new or replacement water system infrastructure within the existing quad cities water systems. Each city recognizes that water is a valuable and essential natural resource that needs to be used wisely, and the individual water use efficiency plans for each city meet or exceed the current Washington State Department of Health (DOH) requirements.

Water supply to the quad cities is provided by surface water treatment plants, Ranney collector wells, and groundwater wells. Each city has a variety of additive and non-additive water rights that define the quantity of water that can be used to supply each water system. The majority of the future water supply to each city will be regulated by the QCWR, which permits a maximum instantaneous use of 178 cubic feet per second (cfs), and an annual use of 96,619 acre-feet per year (afy). An initial 10 cfs (instantaneous) and 7,227 afy (annual) portion of the QCWR has been distributed evenly between the four cities, with a priority date of June 24, 1980. Additional quantities of water may be made available following review of this or subsequent RWFCPs, which are required to be updated on a 6-year basis, as described in the water right permit presented as **Appendix A**.

SUMMARY OF PLAN CONTENTS

A brief summary of the content of each chapter in this RWFCP is as follows.

- **Chapter 1** introduces the reader to the purpose of the RWFCP and its organization.
- **Chapter 2** presents a description of the local area geology, climate, population, and municipal subdivisions.
- **Chapter 3** presents the conservation program components.
- **Chapter 4** presents the regional joint use strategy for the QCWR.

DEFINITION OF TERMS

The following terms are used throughout this RWFCP.

Consumption: The true volume of water used by a water system's customers. The volume is measured at each customer's connection to the distribution system.

Demand: The quantity of water required from a water supply source over a period of time necessary to meet the needs of domestic, commercial, industrial, and public uses, and to provide enough water to supply fire fighting, system losses, and miscellaneous water uses. Demands are normally discussed in terms of flow rate, such as million gallons per day (MGD) or gallons per minute (gpm), and are described in terms of a volume of water delivered during a certain time period. Flow rates pertinent to the analysis and design of water systems are:

- **Average Day Demand (ADD):** The total amount of water delivered to the system in a year divided by the number of days in the year;
- **Maximum Day Demand (MDD):** The maximum amount of water delivered to the system during a 24-hour time period of a given year; and
- **Peak Hour Demand (PHD):** The maximum amount of water delivered to the system, excluding fire flow, during a 1-hour time period of a given year. A system's PHD usually occurs during the same day as the MDD.

Distribution System Leakage (DSL): Water that is measured as going into the distribution system but not metered as going out of the system.

Potable: Water suitable for human consumption.

Purveyor: An agency, subdivision of the state, municipal corporation, firm, company, mutual or cooperative association, institution, partnership, or persons or other entity owning or operating a public water system. Purveyor also means the authorized agents of such entities.

Supply: Water that is delivered to a water system by one or more supply facilities, which may consist of supply stations, booster pump stations, springs, and wells.

Storage: Water that is "stored" in a reservoir to supplement the supply facilities of a system and provide water supply for emergency conditions.

Area Description

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INTRODUCTION

This chapter provides a thorough description of the quad cities area, specifically including the Cities of Kennewick, Pasco, Richland, and West Richland.

GEOLOGY AND CLIMATE

The Cities of Kennewick, Pasco, Richland, and West Richland, referred to herein as the quad cities, are located in the Columbia Basin, approximately at the confluence of the Columbia, Snake, and Yakima rivers, in southcentral Washington. Columbia River basalts lie beneath the quad cities, which stretch from Idaho, through Oregon and Washington, to the Pacific Ocean. The topography of the quad cities area varies greatly, with low elevations of approximately 320 feet above mean sea level adjacent to the Columbia River, and high elevations of approximately 3,000 feet above mean sea level at the top of surrounding peaks.

The climate is semi-arid with precipitation arriving in the spring and fall as rain, and falling in the winter as snow. The summers are warm and dry. The climatic data for the City of Kennewick, which is representative of the quad cities, is shown in **Table 2-1**.

Table 2-1
Historical Climatic Data

Year	Temperature (°F)			Annual Rainfall (inches)
	Annual Average	Annual High	Annual Low	
1995	55	100	9	10.81
1996	53	104	-11	13.66
1997	55	103	13	7.80
1998	57	108	7	7.58
1999	56	101	25	4.05
2000	54	104	18	9.04
2001	55	102	22	6.16
2002	55	106	22	5.32
2003	57	107	15	6.81
2004	56	103	-6	5.23
2005	55	102	10	6.85
2006	56	109	13	10.18
2007	55	105	10	5.73
2008	54	104	3	6.24
2009	54	105	5	6.72
2010	55	101	5	12.05
2011	54	99	11	5.24
2012	56	105	15	9.44
2013	55	108	10	5.49
2014	57	108	9	5.59

POPULATION

The quad cities have experienced rapid population growth and extensive physical development in recent years. The populations of Kennewick, Pasco, Richland, and West Richland increased approximately 24, 35, 16, and 26 percent, respectively, between 2007 and 2014. Historical and projected future growth for Kennewick, Richland, and West Richland was presented in Benton County's *2013 Comprehensive Plan* update through 2034, and for Pasco in Franklin County's *2008 Comprehensive Plan* through 2030. These projections, which are shown in **Table 2-2**, include the population within the city limits, as well as the unincorporated areas of each city's urban growth area (UGA). Population projections beyond 2034 for Kennewick, Richland, and West Richland were assumed to occur at an average annual growth rate that is the same as the 2029 to 2034 projections for each city. Pasco provided the projected 2035 city limit population. The population projections for Kennewick, Pasco, and Richland are in accordance with each city's current comprehensive plan. West Richland's comprehensive plan projections are more aggressive than the Benton County's projections. Future calculations and analyses will be based on West Richland's more aggressive comprehensive plan and water system plan population projections for conservatism.

Table 2-2
Historical and Population Projections for Each City

Description	Year	Kennewick	Pasco	Richland	West Richland	Total
City Population						
Historical	2007	62,520	50,210	45,070	10,850	168,650
Historical	2010	73,917	59,781	48,058	11,811	193,567
Base Year	2014	77,700	67,770	52,090	13,620	211,180
+6 Years	2021	86,444	78,898	60,254	14,550	240,145
+20 Years	2035	103,931	101,153	76,581	16,410	298,075
Water Service Area Population						
Historical	2007	67,871	54,060	45,409	10,850	178,190
Historical	2010	70,286	61,221	50,047	11,965	193,520
Base Year	2014	74,720	70,770	56,232	13,626	215,347
+6 Years	2021	83,319	80,224	62,133	18,509	244,185
+20 Years	2035	101,160	111,862	73,700	25,308	312,030

The actual number of people served by each city's water system is different than the population within each city. Projected future growth for each city's water service area is shown in the bottom portion of **Table 2-2**. The projected water service area population data is presented in each city's existing water system plan, through either 2029 or 2030. The water service area projections beyond these years were assumed to occur at an average annual growth rate that is the same as the preceding years. The projections for Kennewick, Pasco, and Richland's water service area are in accordance with the current Benton and Franklin County planning documents. West Richland's projections, presented in the 2013 update to the West Richland comprehensive plan, are more aggressive than the Benton County's projections. The water service area projections for each city will be used to calculate the future water demands of each water system.

COMPOSITION OF CUSTOMERS SERVED

In 2014, Kennewick provided water service to 23,205 connections; Pasco to 18,643 connections; Richland to 18,414 connections; and West Richland to 4,472 connections, as shown in **Table 2-3**.

Of the 64,734 connections served in all four water systems in 2014, 55,700 connections (86 percent) were single-family residential customers, 2,273 connections (4 percent) were multi-family residential customers, 5,406 connections (8 percent) were commercial and industrial customers, and 1,355 connections (2 percent) were municipal, educational, and all other land use types. Information regarding the number of multi-family residential units served was not immediately available from each city; therefore, a breakdown of the single- and multi-family residential population was not considered in this study.

Table 2-3
2014 Connections by Customer Class

City/Service Area	Single-family Residential	Multi-family Residential	Commericial/ Industrial	Municipal/ Educational/Other	Total
Kennewick	19,540	1,220	2,274	170	**23,205**
Pasco	16,142	492	1,493	516	**18,643**
Richland	15,807	468	1,510	629	**18,414**
West Richland	4,210	93	129	40	**4,472**
Total	**55,700**	**2,273**	**5,406**	**1,355**	**64,734**

MUNICIPAL WATER SYSTEMS AND IRRIGATION DISTRICTS

City of Kennewick

Kennewick's potable water system is supplied by two Ranney collector wells on Clover Island, which have an existing combined capacity of approximately 10,417 gallons per minute (gpm) (15 million gallons per day (MGD)), and by the city's Columbia River Water Treatment Plant (WTP), which also has an existing capacity of 10,417 gpm (15 MGD), with the infrastructure to be expanded to 30 MGD in the future.

Kennewick also operates two wells in Columbia Park: the Kiwanis Well is a 25 gpm well used for irrigation in the park; and the Columbia Park Campground Well is a 70 gpm well that is a separate water system used to supply a seasonal campground.

Separate irrigation systems operated by the Kennewick Irrigation District (KID) and Columbia Irrigation District (CID) are available for some of Kennewick's potable water system customers. Potable water is used for irrigation by Kennewick customers outside of KID and CID's operating areas.

City of Pasco

Pasco's potable water system is supplied by two Columbia River WTPs. The Butterfield WTP has an existing capacity of 19,444 gpm (28 MGD), and the West Pasco WTP has an existing capacity of 4,200 gpm (6 MGD).

In addition to the potable water system, Pasco operates a separate irrigation system supplied by Columbia River surface water and multiple groundwater wells to provide irrigation water to some potable water customers. Franklin County Irrigation District No. 1 also operates a separate irrigation system to provide irrigation water to some of Pasco's potable water system customers. Potable water is used for irrigation by Pasco customers in areas without separate irrigation systems.

City of Richland

Richland's main source of potable water supply is the 36 MGD Columbia River WTP, with five other well fields providing additional supply. Water is pumped from the Columbia River to the WTP and to the North Richland Well Field (NRW). At the NRW the water is used for aquifer recharge before being repumped to the treatment and distribution systems. Richland also operates well pumps at the Columbia, Duke, and Wellsian well fields, which pump naturally occurring groundwater into Richland's water system. The total treatment capacity of Richland's water system is 36,900 gpm (53.1 MGD).

In addition to the potable water system, Richland operates two separate irrigation systems that supply irrigation water to some customers within the city limits. Badger Mountain Irrigation District (BMID), KID, and CID also operate separate irrigation systems to provide irrigation water to some of Richland's potable water system customers. A small percentage of Richland potable water system customers are also served by private irrigation systems. Potable water is used for irrigation by Richland customers in areas without separate irrigation systems.

City of West Richland

West Richland's potable water system is supplied by six groundwater wells and an intertie with Richland's water system. The existing pumping capacity of West Richland's non-emergency wells is approximately 4,860 gpm (7 MGD). An intertie with Richland's water system is used to meet the peak demands of the system during the summer months. The current joint contract allows up to 2,500 gpm (3.6 MGD) of water from Richland's water system, but the cities have planned for as much as 5,000 gpm to be transferred from Richland to West Richland's water system through this intertie. The intertie is located at the intersection of Kennedy Road and Arena Road.

Separate irrigation systems operated by KID and CID, as well as private irrigation systems, supply irrigation water to some West Richland potable water system customers. Potable water is used for irrigation by West Richland customers in areas without separate irrigation systems.

MUNICIPAL WATER RIGHTS

The Cities of Kennewick, Pasco, Richland, and West Richland share the Quad City Water Right (QCWR) issued under Surface Water Permit No. S4-30976P on September 15, 2003. This water right permits a maximum instantaneous use of 178 cubic feet per second (cfs), and an annual use of 96,619 acre-feet per year (afy). An initial 10 cfs (instantaneous) and 7,227 afy (annual) portion of the QCWR has been distributed evenly between the four cities, with a priority date of June 24, 1980. Additional quantities of water may be made available following review of this and subsequent RWFCPs, which are updated on a 6-year interval, as described in the water right permit. A summary of the potable water rights evaluation for each city, both with and without the QCWR, is shown in **Table 2-4**. Standalone irrigation water rights are not included in the values presented in **Table 2-4**, and water utilized by the standalone irrigation systems operated by the Cities of Pasco and Richland are not included in future projections. The water rights evaluation presented in Richland's water system plan included four categories: potable non-additive, potable additive, potable claims, and other sources. These categories are presented in **Table 2-4** for consistency with Richland's water system plan.

Table 2-4
Existing Water Rights

Description[1]	Existing Water Rights		
	Maximum Qi		Maximum Qa
	(gpm)	(cfs)	(afy)
Kennewick Municipal without QCWR[2]	***44,850***	***99.93***	***16,200.00***
Kennewick Domestic with QCWR[3]	45,972	102.43	18,006.75
Kennewick Irrigation	100	0.22	7.20
Kennewick Total Water Rights[4]	46,072	102.65	18,013.95
Pasco Domestic without QCWR[2]	***16,784***	***37.40***	***7,849.00***
Pasco Domestic with QCWR[3]	17,906	39.89	9,655.75
Pasco Irrigation	17,164	38.24	7,152.80
Pasco Total Water Rights[4]	35,070	78.14	16,808.55
Richland Municipal without QCWR[5]	***42,664***	***95.06***	***33,141.20***
Richland Domestic with QCWR[3]	43,786	97.56	34,947.95
Richland Other	27,129	60.44	14,148.92
Richland Total Water Rights[4]	70,915	158.00	49,096.87
West Richland Domestic without QCWR[5]	***7,420***	***16.53***	***4,661.00***
West Richland Domestic with QCWR[3]	8,542	19.03	6,467.75
West Richland Irrigation	200	0.45	150.00
West Richland Total Water Rights[4]	8,742	19.48	6,617.75
Municipal Total without QCWR	***111,718***	***248.91***	***61,851.20***

(1) Water rights descriptions (municipal, domestic, irrigation, and other) for each city are consistent with the descriptions presented in water rights documents.

(2) Pre-QCWR municipal/domestic annual volume of Kennewick and Pasco consistent with 2009 RWFCP Table 2-4.

(3) QCWR split evenly for each City resulting in 1,122 gpm (2.5 cfs) and 1,806.75 afy shown for each city.

(4) All water rights held by each city are suitable for municipal water supply purposes. The water rights are broken down in this table for consistency with each city's water rights documents.

(5) Pre-QCWR municipal/domestic annual volume of Richland and West Richland inconsistent with 2009 RWFCP Table 2-4, which showed a higher water right value for both cities.

Richland and West Richland have a wholesale water service agreement that states that Richland will withdraw, treat, and pump West Richland's portion of the QCWR. The official agreement can be found in **Appendix B**.

Conservation Program Components

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INTRODUCTION

Throughout the past 10 years, beginning with the quad cities *2005 Interim Regional Water Forecast and Conservation Plan* (RWFCP), the Cities of Kennewick, Pasco, Richland, and West Richland have implemented water conservation plans to ensure that the region has a reliable supply of water and is using water in an efficient manner. The quad cities have been implementing individual water use efficiency programs since 2007 that comply with the Washington State Department of Health Water Use Efficiency (WUE) Rule. Additionally, the RWFCP serves as a combined and unified WUE program for the quad cities to ensure that WUE is a key component in the regional supply and demand strategy.

The Washington State Department of Health (DOH) implemented the WUE Rule, effective on January 22, 2007, as required by the Municipal Water Supply – Efficiency Requirements Act, also known as the Municipal Water Law, passed by the Washington State Legislature in September 2003. The intent of this rule is to help reduce the demand that growing communities, agriculture, and industry have placed on our state's water resources, and to better manage these resources for fish and other wildlife. Municipal water suppliers are obligated under the WUE Rule to enhance the efficient use of water by the system and/or its consumers.

The WUE Rule applies to all municipal water suppliers and requires suppliers to:

- Develop WUE goals through a public process and report annually on their performance;
- Maintain distribution system leakage at or below 10 percent of production based on a 3-year rolling average;
- Meter all existing and new service connections;
- Collect production and consumption data, calculate distribution system leakage (DSL), and forecast demands;
- Evaluate WUE measures; and
- Implement a WUE program.

WATER USE EFFICIENCY GOALS AND OBJECTIVES

The original combined WUE goals and objectives of the quad cities, developed in the 2005 Interim RWFCP, have proven to be effective and will continue to be met through implementation of the WUE measures in each city's WUE program. These goals and objectives, as most recently presented in the 2008 RWFCP, are as follows.

- Inform customers of simple, effective water wise activities.
- Develop a regional marketing campaign.

- Encourage customers to reduce water waste and become more water wise.
- Encourage commercial, industrial, and residential customers to use water wisely.
- Ensure all municipal activities and programs are water wise.
- Encourage wise water use to irrigate large park-like areas.
- Measure the net consumptive water use from the Columbia River.
- Perform a water balance for the region every 6 years as part of each city's comprehensive water system plan updates.
- Focus conservation program on using water efficiently.

The proposed goals and objectives of each city's currently-adopted or proposed WUE programs consist of the following.

City of Kennewick

- Maintain annual average demand per capita below 170 gallons per day (gpd), based on the 6-year period between 2008 and 2013.

City of Pasco

- Supply-side goals
    - Maintain DSL at 8 percent or less on an annual basis.
    - Develop an integrated water shortage and drought response plan by 2018.
    - Continue with regular water meter replacement program.
    - Implement installation of "Smart Meters".
- Demand-side goals
    - Maintain average demand per ERU at 470 gpd per ERU, excluding DSL through 2020.
    - Develop a large water user water audit program by December 31, 2018.
    - Encourage the utilization of xeriscaping and specialized turf seed mixes to lower irrigation water consumption.
    - Continue to offer Pasco residents retrofit kits that include low flow shower heads, toilet tank displacement bags, leak detection tablets, and other water use efficiency measures. The City will phase out this residential retrofit program before the next planning cycle as the City is close to reaching saturation of its target audience.
    - Continue to perform WUE education in the Pasco School District.

- Continue to promote public education on conservation through annual consumer confidence reports, customer billing statements, and other educational materials.

City of Richland

- Maintain DSL at 10 percent or less on an annual basis.
- Promote education on water conservation.
- Offer a residential retrofit program for the public.
- Consider a conservation rate in a water rate study.
- Maintain the average demand per equivalent residential unit (ERU) at 534 gpd per ERU.

City of West Richland

- Maintain DSL at 10 percent or less based on a 3-year rolling average.
- Maintain average demand per ERU at 455 gpd per ERU through 2022.

CONSERVATION MEASURES

Each city's evaluation of WUE measures and selected levels of implementation are presented within this section. The measures fall within three categories of implementation: 1) mandatory measures that must be implemented; 2) measures that must be evaluated; and 3) additional measures selected by the city that must be either evaluated or implemented.

Based on the number of each city's water service connections in 2014 (as presented in **Chapter 2**), Kennewick, Pasco, and Richland must evaluate or implement at least nine WUE measures, and West Richland must evaluate or implement at least six WUE measures. Measures that are mandatory cannot be credited towards the system's WUE measures. **Table 3-1** shows each city's compliance with the mandatory implementation and evaluation measures, as well as the WUE measures currently implemented by each city. As can be seen in **Table 3-1**, each city implements more than the required number of WUE measures, as many of the implemented measures apply to all four customer classes.

Table 3-1
WUE Measures

WUE Measure	Kennewick				Pasco				Richland				West Richland			
Mandatory WUE Measures																
Source Meters Installed	✓				✓				✓				✓			
Service Meters Installed	✓				✓				✓				✓			
Meter Calibration Compliance	✓				✓				✓				✓			
Water Loss Control Action Plan	Not Applicable				Not Applicable				Not Applicable				Not Applicable			
Customer Education	✓				✓				✓				✓			
WUE Measures That Must Be Evaluated																
Rate Structure	✓				✓				✓				✓			
Reclamation Opportunities	✓				✓				✓				✓			
Selected WUE Measures																
Customer Class	**SF**	**MF**	**CI**	**MEO**	**SF**	**MF**	**CI**	**MEO**	**SF**	**MF**	**CI**	**MEO**	**SF**	**MF**	**CI**	**MEO**
Plumbing Retrofit Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Displays at Fairs and Events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water Use Audits			✓				✓				✓					
School Outreach	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water Bill Showing Consumption History	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Irrigation Management												✓				
Using Reclaimed Water							✓									
Total Selected WUE Measures	**17**				**18**				**18**				**16**			

SF = Single-family Residential
MF = Multi-family Residential
CI = Commerical/Industrial
MEO = Municipal/Institutional/Other

Mandatory Measures

Source Meters

The volume of water produced by the each system's sources must be measured using a source meter or other meter installed upstream of the distribution system. Source meters are currently installed and operating at each city's sources. If any new sources are installed in the future, they will be equipped with a source meter. A description of each city's source meter testing and repair history and protocols is as follows.

- Kennewick tests source meters for proper operation on an annual basis, and calibrates the meters if needed. In 2014, the city verified that the source meters at the Ranney collectors and the Kennewick Water Treatment Plant met American Water Works Association standards.

- Pasco calibrates all source meters every 5 years. All West Pasco Water Treatment Plant source meters were calibrated in 2014. Butterfield Water Treatment Plant raw water meters were replaced in 2014, and finished water meters were replaced in 2011.
- Richland services all source meters on an annual basis, and performs repairs if needed. Two source meters are scheduled for replacement in winter 2015.
- West Richland tests source meters for proper operation on an annual basis, and calibrates the meters if needed. In 2014, West Richland calibrated source meters at Wells 1, 2, 7, and 9.

Service Meters

All public water systems that supply water for municipal purposes must install individual service meters for all water users. Service meters are currently installed and operating at all connections throughout each city's distribution system. All future connections that are installed or activated will be equipped with a service meter.

Meter Calibration – Large Meters (2-inch and Larger)

The cities must calibrate and maintain meters based on generally accepted industry standards and manufacturer information. A description of each city's large meter testing and repair history and protocols is as follows.

- Kennewick has tested all large meters on an annual basis over the last 5 years. As of 2014, 87 large meters were installed in Kennewick's water system. Of the 87 large meters, 83 met the 95 percent or better accuracy target over the three flow ranges (low, medium, and high) used in the tests. Meters not meeting this goal were repaired, replaced, or scheduled for replacement.
- Pasco tests all large meters on a regular schedule, consistent with generally accepted industry standards and manufacturer information. As of 2014, 321 large meters were installed in Pasco's water system. Pasco replaces meters outside of the regular testing schedule if they are discovered to be leaking, have stopped reading, or if the dial has rolled over two or more times.
- Richland tests all 2-inch meters every 4 years, and all 3-inch meters every 2 years. Meters not meeting generally accepted industry or manufacturer standards are replaced or scheduled for replacement.
- West Richland tests all large meters based on manufacturer recommendations. As of 2014, eight large meters were installed in West Richland's water system.

Meter Calibration – Small Meters (Less than 2-inch)

Each city has procedures to test the performance of small meters and to repair and replace the meters if they are found not to be within generally accepted industry standards and manufacturer information. A description of each city's small meter testing and repair history and protocols is as follows.

- Kennewick repairs or replaces small meters if they are discovered to be defective or not properly measuring water use. Kennewick periodically replaces old meters with meters compatible with an automatic read system.
- Pasco repairs or replaces small meters on a recurring 10-year schedule, consistent with manufacturer recommendations.
- Richland repairs of replaces small meters if they are discovered to be defective or not properly measuring water use. All small meters originally installed prior to 1990 have been replaced. No small meters installed prior to 1990 are currently installed in Richland's water system.
- West Richland repairs or replaces small meters if they are discovered to be defective or not properly measuring water use.

Water Loss Control Action Plan

To control leakage, systems that do not meet the distribution system leakage (DSL) standard must implement a Water Loss Control Action Plan (WLCAP). Each city's rolling 3-year average DSL is below 10.0 percent in 2014, based on the 3-year period of 2012 through 2014. Therefore, a WLCAP is not required to be implemented.

Customer Education

Annual customer education regarding the importance of using water efficiently is a required element of all WUE programs. Customer education is provided in each city's annual Consumer Confidence Report (CCR) to customers and includes information on the system's DSL, progress towards meeting WUE goals, and tips for customers on using water more efficiently.

Measures That Must Be Evaluated

Rate Structure

A rate structure that encourages WUE and provides economic incentives to conserve water must be evaluated by each city, but is not required to be implemented. Each city's current utility rates are designed to discourage excessive water use, with additional charges applied to customers that use more water than allocated within a base allotment.

Reclamation Opportunities

Each city has evaluated reclamation opportunities, and Pasco currently uses reclaimed water to irrigate city-owned agricultural land. A description of each city's evaluation and implementation of reclaimed water use is as follows.

- Kennewick has evaluated using reclaimed water based on the existing wastewater treatment plant effluent quality (Class D – Reclaimed Water), but no reclaimed water is currently used within Kennewick's water service area.
- Pasco uses reclaimed water from food processors to irrigate city-owned agricultural land. Pasco continues to evaluate additional uses for reclaimed water within its water service area.

- Richland has evaluated using reclaimed water to irrigate golf courses and parks adjacent to the wastewater treatment plant. However, Richland has existing irrigation rights from the Columbia River through a separate non-potable system; using reclaimed water is not cost effective in comparison. The non-potable systems are in place and have very low relative costs.
- West Richland has evaluated using reclaimed water within its water service area, including for irrigation of the golf course adjacent to the wastewater treatment plant. However, it has been determined that using reclaimed water is not currently cost effective.

Selected Measures

Each city has chosen to implement a variety of WUE measures in addition to those that are mandatory or required to be evaluated. Many of the measures are implemented for multiple customer classes.

Plumbing Retrofit Program

Each city currently distributes water conservation items to all customer classes, including low flow showerheads, kitchen and bathroom faucet aerators, and toilet dye kits, at no cost to the customers. The program has had mixed success, especially in West Richland, where a majority of structures were constructed after 1993 when the updated plumbing code required water conservation fixtures for new construction.

Displays at Fairs and Events

Each city currently participates in WUE education by providing information on city websites and in educational brochures and displays at the annual Benton-Franklin County Fair. Additionally, Pasco provides educational brochures and displays at the annual Home and Garden Show, which is attended by customers living in all four cities.

Water Use Audits

Each city currently has an audit program for large commercial and industrial users. Additionally, Richland performs audits for city-owned facilities connected to the potable water system.

School Outreach

Schools within each city are provided WUE education programs presented through partnerships with the Benton-Franklin Health Department and the Franklin Conservation District. These outreach programs helps students and teachers learn about water quality and WUE. Richland also provides an environmental education school outreach program relating to municipal operations and the environment.

Water Bill Showing Consumption History

Each city currently shows consumption history charts and information on water bills for all customer classes.

Irrigation Management

Richland has installed a centralized irrigation computer system that communicates via radio to automatically shut down laterals or systems that have received programmed volumes of water, sends alarms in the event of unexpected flows or malfunctions, and remotely controls system flows based on weather conditions.

WUE PROGRAM DATA COLLECTION, ANALYSIS, AND EVALUATION

One way to evaluate the WUE program's effectiveness is through a regional water balance, which measures net consumptive use. This net consumptive use is the volume of water that is not returned to the supply sources, and is therefore "consumed" by water system customers. The value of the net consumptive use is found from the difference in production volumes and return flow volumes, as measured by source and customer meters. Additional unmetered data is included in the water balance, such as return flows from septic systems, irrigation water, and water loss within the water system. Estimates have been made to approximate the return flows for these unmetered cases. The 2014 regional water balance is shown in **Table 3-2**, and a more detailed water balance for each city is shown in **Table 3-3**.

Table 3-2
2014 Regional Water Balance

Description	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
Source of Supply Meter Readings (MG)													
Kennewick (Includes Recharge Volume)	184.56	166.90	214.35	352.29	450.54	515.32	562.79	510.48	404.38	299.41	193.09	192.84	4,046.97
Pasco	187.90	170.70	217.10	341.00	445.60	538.20	650.50	647.90	560.80	416.20	225.10	196.50	4,597.50
Richland - WTP Influent	213.22	180.63	263.47	485.63	695.98	805.12	981.22	872.84	718.91	472.07	220.77	197.19	6,107.06
Richland - Raw Water for Recharge	0.00	0.00	0.00	0.00	455.40	440.60	439.90	434.85	417.40	427.00	34.36	0.00	2,649.51
West Richland	19.09	12.52	21.07	53.50	71.10	74.53	91.78	89.82	74.97	48.63	28.94	27.93	613.89
West Richland - Intertie	0.00	12.79	25.79	32.18	41.22	58.77	71.81	51.36	44.64	21.77	2.62	4.09	367.02
Total Supply	**604.77**	**543.54**	**741.79**	**1,264.60**	**2,159.84**	**2,432.55**	**2,798.01**	**2,607.26**	**2,221.09**	**1,685.09**	**704.88**	**618.55**	**18,381.95**
Non-revenue Water Use (MG)													
Kennewick (Includes Recharge Volume)	4.43	13.35	1.23	19.02	33.01	43.71	20.76	0.29	1.35	0.61	3.71	0.18	141.65
Pasco	7.90	7.50	11.10	14.50	16.80	23.60	25.70	25.30	23.00	16.50	6.40	5.80	184.10
Richland	12.12	12.16	15.42	22.77	19.55	15.37	22.53	12.68	19.75	12.56	6.20	7.41	178.53
West Richland	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	4.83
Total Non-revenue Water Use	**24.85**	**33.41**	**28.16**	**56.69**	**69.76**	**83.08**	**69.39**	**38.68**	**44.51**	**30.07**	**16.71**	**13.79**	**509.11**
Billable Water Use (MG)													
Kennewick	194.83	178.92	182.12	207.37	255.05	521.34	521.34	598.65	402.48	474.30	285.26	196.45	4,018.12
Pasco	186.00	179.90	168.70	196.20	317.20	404.60	533.90	585.30	628.90	570.90	428.60	238.70	4,438.90
Richland - within City	187.36	155.93	167.58	423.86	528.38	597.72	866.31	779.49	743.81	559.36	247.31	174.03	5,431.13
Richland - to West Richland	13.73	12.80	25.80	23.19	41.24	58.80	71.84	51.38	44.66	21.78	2.62	1.09	368.92
West Richland	26.64	27.06	18.88	46.18	84.46	118.41	124.43	149.66	135.00	92.63	40.70	28.75	892.79
Total Billable Water Use	**608.56**	**554.61**	**563.08**	**896.81**	**1,226.33**	**1,700.86**	**2,117.82**	**2,164.48**	**1,954.85**	**1,718.96**	**1,004.48**	**639.02**	**15,149.87**
Total Authorized Consumption (MG)													
Kennewick	199.26	192.27	183.35	226.39	288.06	565.05	542.10	598.94	403.83	474.91	288.97	196.63	4,159.77
Pasco	193.90	187.40	179.80	210.70	334.00	428.20	559.60	610.60	651.90	587.40	435.00	244.50	4,623.00
Richland	213.21	180.88	208.81	469.83	589.17	671.88	960.68	843.55	808.22	593.70	256.13	182.53	5,978.58
West Richland	27.04	27.46	19.28	46.58	84.87	118.81	124.83	150.07	135.40	93.03	41.10	29.15	897.62
Non-revenue + Billable Water Use	**633.41**	**588.01**	**591.24**	**953.50**	**1,296.09**	**1,783.95**	**2,187.21**	**2,203.16**	**1,999.35**	**1,749.04**	**1,021.19**	**652.81**	**15,658.97**
Distribution System Leakage (MG)													
Kennewick	(14.70)	(25.37)	31.00	125.90	162.48	(49.74)	20.69	(88.46)	0.54	(175.49)	(95.87)	(3.79)	(112.80)
Pasco	(6.00)	(16.70)	37.30	130.30	111.60	110.00	90.90	37.30	(91.10)	(171.20)	(209.90)	(48.00)	(25.50)
Richland	0.01	(0.25)	54.66	15.81	106.81	133.24	20.54	29.29	(89.31)	(121.63)	(35.36)	14.66	128.47
West Richland	(7.96)	(2.15)	27.58	39.09	27.45	14.49	38.76	(8.88)	(15.79)	(22.63)	(9.55)	2.86	83.28
Total DSL (MG)	**(28.64)**	**(44.47)**	**150.55**	**311.10**	**408.35**	**208.00**	**170.89**	**(30.76)**	**(195.66)**	**(490.95)**	**(350.68)**	**(34.26)**	**73.46**
Total DSL (%)	**(4.74%)**	**(8.18%)**	**20.30%**	**24.60%**	**18.91%**	**8.55%**	**6.11%**	**(1.18%)**	**(8.81%)**	**(29.14%)**	**(49.75%)**	**(5.54%)**	**0.40%**
Population													
Retail Water Service Area	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347	215,347
City Limits Only	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180	211,180
Connections by Customer Class													
Single-family Residential	38,926	39,120	39,209	39,265	39,372	39,387	39,549	39,548	39,608	39,704	39,665	39,736	55,700
Multi-family Residential	2,269	2,274	2,272	2,276	2,272	2,273	2,274	2,275	2,273	2,273	2,277	2,280	2,273
Commercial/Industrial	3,851	3,854	3,863	3,872	3,888	3,885	3,897	3,903	3,913	3,924	3,955	3,942	5,406
Municipal/Educational/Other	2,209	2,808	2,813	2,818	2,842	2,840	2,832	2,842	2,845	2,847	2,888	2,900	1,355
Total Connections	**47,255**	**48,056**	**48,157**	**48,231**	**48,374**	**48,385**	**48,552**	**48,568**	**48,639**	**48,748**	**48,785**	**48,858**	**64,734**
McNary Pool Return Flows (MG)													
Wastewater Treatment Plant	470.74	424.48	470.89	471.15	502.63	501.68	540.55	548.80	522.87	519.79	475.52	483.60	5,932.70
Septic Systems	24.12	24.23	24.21	24.24	24.21	24.25	24.26	24.26	24.27	24.24	24.13	24.21	290.63
City Irrigation	0.00	0.00	0.00	31.34	53.26	67.59	85.84	76.59	58.21	31.01	0.00	0.00	403.84
Unaccounted-for Water Return	(11.46)	(17.79)	60.22	124.44	163.34	83.20	68.36	(12.30)	(78.27)	(196.38)	(140.27)	(13.71)	29.38
Source Backflow	11.81	10.72	16.72	25.00	25.70	33.02	36.21	34.54	30.97	22.55	10.01	9.25	266.50
Infiltration and Recharge	0.00	0.00	0.94	18.70	485.40	483.60	453.60	434.85	417.40	427.00	34.36	0.00	2,755.84
Total Return Flows	**495.21**	**441.64**	**572.97**	**694.87**	**1,254.55**	**1,193.34**	**1,208.82**	**1,106.72**	**975.45**	**828.21**	**403.75**	**503.35**	**9,678.89**
Net Withdrawals and Consumption													
Net Withdrawals (MG)	109.56	101.90	168.81	569.73	905.29	1,239.21	1,589.18	1,500.53	1,245.64	856.88	301.12	115.20	8,703.05
Net Consumption	18%	19%	23%	45%	42%	51%	57%	58%	56%	51%	43%	19%	47%

Table 3-3
2014 Water Balance by City

Description	Kennewick			Pasco			Richland			West Richland			Quad Cities Combined Total		
	February	July	Annual	February	July	Annual	February	July	Annual	February	July	Annual	Low	High	Annual
Withdrawals (MG)															
Surface Water	166.90	553.94	3,977.94	170.70	650.50	4,597.50	173.35	1,154.01	7,162.49	0.00	0.00	0.00	510.95	2,358.46	15,737.92
Ground Water	0.00	8.85	69.04	0.00	0.00	0.00	7.28	267.11	1,594.08	12.52	91.78	613.89	19.80	367.74	2,277.00
Intertie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.79	71.81	367.02	12.79	71.81	367.02
Withdrawal Total	**166.90**	**562.79**	**4,046.97**	**170.70**	**650.50**	**4,597.50**	**180.63**	**1,421.12**	**8,756.57**	**25.31**	**163.59**	**980.91**	**543.54**	**2,798.01**	**18,381.95**
Returns (MG)															
Wastewater Treatment Plant	137.70	185.32	1,955.10	115.29	147.34	1,642.84	152.51	184.73	2,079.20	18.98	23.15	255.55	424.48	540.55	5,932.70
Septic Systems	15.52	15.52	186.30	5.52	5.52	66.18	0.38	0.38	4.59	2.80	2.84	33.56	24.23	24.26	290.63
City Irrigation	0.00	18.56	87.86	0.00	22.48	109.85	0.00	38.19	175.76	0.00	6.61	30.37	0.00	85.84	403.84
Unaccounted-for Water Return	---	---	(45.12)	---	---	(10.20)	---	---	51.39	---	---	33.31	---	---	29.38
Source Backflow	---	---	---	7.30	25.40	181.50	3.42	10.81	85.00	---	---	---	10.72	36.21	266.50
Infiltration and Recharge	0.00	13.70	106.33	---	---	---	0.00	439.90	2,649.51	---	---	---	0.00	453.60	2,755.84
Returns Total	**153.23**	**233.11**	**2,290.47**	**128.10**	**200.73**	**1,990.17**	**156.32**	**674.01**	**5,045.45**	**21.78**	**32.61**	**352.80**	**459.43**	**1,140.47**	**9,678.89**
Net Consumption															
Net Consumption (MG)	13.68	329.68	1,756.50	42.60	449.77	2,607.33	24.31	747.11	3,711.11	3.52	130.98	628.11	84.11	1,657.54	8,703.05
Net Consumption	8%	59%	43%	25%	69%	57%	13%	53%	42%	14%	80%	64%	15%	59%	47%

The net consumption of the four water systems is 47 percent based on 2014 water system data, compared to 48 percent based on the 2007 water system data presented in the 2009 RWFCP. The net consumption is presented for each month of 2014, but is typically analyzed on an annual basis to eliminate monthly inconsistencies with meter reading dates and for comparison with annual water rights. A definition of each water balance component is as follows.

Source of Supply Meter Readings – Volume of water supplied to each water system as measured with a source meter. The water produced by each city's sources, the volume of water transferred to and from each city via an intertie connection, the volume of water Kennewick uses for aquifer recharge, and the volume of water Richland uses for groundwater infiltration is presented individually for each city in **Table 3-2**. Total supply to all four cities in 2014 was 18,381,950,000 gallons.

Non-revenue Water Use – Volume of water supplied to each water system for an authorized, but non-revenue use, such as fire hydrant usage, water main flushing, and filter backwashing. Although real losses from the distribution system, such as reservoir overflows and leaking water main, should be tracked for accounting purposes, these losses must be considered leakage, and not non-revenue water use. Each city has an ongoing leak detection program to identify and fix water system leaks in an effort to minimize DSL. Total non-revenue water use for all four cities in 2014 was 509,110,000 gallons.

Billable Water Use – Volume of water used by all customers of each water system, as measured by the customers' meters. Total billable water use in all four cities in 2014 was 15,149,870,000 gallons.

Total Authorized Consumption – Sum of billable and non-revenue water use. Total authorized consumption in all four cities in 2014 was 15,658,970,000 gallons.

Distribution System Leakage – Difference between the total supply and total authorized consumption is the amount of DSL. Total DSL in all four cities in 2014 was 73,460,000 gallons, which equates to 0.40 percent of the total supply. Kennewick's DSL includes the volume of water used for groundwater recharge because this water is conveyed through the city's distribution system to the recharge location. Richland's DSL does not include the volume of water used for groundwater infiltration because raw water from the Columbia River is pumped directly to the city's infiltration basins, and the water does not enter the distribution system. The 2014 and historical DSL percentages for each city's water system is shown in **Table 3-4**.

Table 3-4
Distribution System Leakage

	Year			
Water System	2000 [1]	2004 [1]	2007 [1]	2014
Kennewick	7.1%	8.0%	5.9%	(2.8%)
Pasco	8.1%	5.0%	4.2%	(0.6%)
Richland	27.2%	9.5%	4.4%	2.1%
West Richland	30.0%	14.0%	1.8%	8.5%

(1) Reproduced from Table 3-4 in the 2009 RWFCP.

Population – Each city's retail water service area and city limits population is presented in **Table 3-2**. The total population served by the four cities in 2014 was 215,347.

Connections by Customer Class – Number of water service connections within each customer class. The total number of water service connections in all four cities in 2014 was 64,734.

McNary Pool Return Flows – Volume of water supply returned to the McNary Pool, including wastewater treatment plant (WWTP) effluent, filter backwashing, irrigation infiltration, and septic system draining. A description of each return flow element is as follows.

- WWTP Effluent – Volume of water discharged by each city's WWTP. Kennewick, Pasco, and Richland's WWTPs discharge into the Columbia River (McNary Pool), and West Richland's WWTP discharges into the Yakima River just upstream of the McNary Pool.

- Septic Systems – Volume of water discharged from septic drain fields and returned to the McNary Pool. The return flow from septic tanks was calculated based on the winter-time ratio of WWTP effluent water to total water consumption, which was calculated to be 82 percent. The septic system return flow is calculated as 82 percent of the winter-time single-family residential consumption, as measured by each city's customer meters. The resulting septic system return flow in 2014 is estimated to be 290,630,000 gallons.

  It was assumed that the septic system return flows were consistent year-round, and therefore the winter-time return flows calculated based on the preceding equation were assumed to be the same septic system return flows that occur during the other seasons. The resulting septic system return flow in 2014 is estimated to be approximately 24 million gallons (MG) per month, or 294 MG on an annual basis.

  The septic system return flow calculations were compared with the return flow calculation methods presented in *Return Flow to Ground Water from Onsite Wastewater Systems*, prepared by the New Mexico Environment Department[1]. Two calculation methods were presented in this evaluation. Applying these calculation methods to the quad cities, the resulting septic system return flows are calculated as 306 MG and 338 MG based on 2014 data. These results are very similar to the results calculated based on the quad cities actual WWTP effluent and water consumption data. The septic system return flows were assumed to be 290,630,000 gallons for conservatism and to better represent the local data and conditions.

- City Irrigation – Volume of water returned to the McNary Pool through infiltration of irrigation water. The average supply during non-irrigation months (November through March) was applied to the supply of the irrigation months (April through October) to estimate the volume of water used for irrigation. Based on the 2009 RWFCP and the *2006 Tri-Cities Urban Area Landscape Irrigation Plan*, 5 percent of irrigation supply is estimated to return to the McNary Pool. Each city's irrigation return flows shown in **Table 3-2** are based on 5 percent of the 2014 irrigation supply returning to the McNary Pool.

[1] McQuillan, D.M. and Bassett. 2009. Return Flow to Ground Water from Onsite Wastewater Systems. 18th Annual NOWRA Technical Conference and Expo, April 6-9, 2009, Milwaukee, Wisconsin.
https://www.env.nm.gov/fod/LiquidWaste/documents/McQuillanandBassettNOWRA09.pdf

- Unaccounted-for Water Return – Volume of DSL that leaks into aquifers that are under the influence of surface water and ultimately return to the McNary Pool. Consistent with the 2009 RWFCP, 40 percent of all DSL was assumed to return to the McNary Pool.
- Source Backflow – Volume of water used to backwash filters at each city's supply sources. Kennewick's backwashing water is discharged to the wastewater system, and is considered within the WWTP effluent values. West Richland does not have a surface water source and therefore does not have filter backwash volumes. Pasco and Richland's filter backwashing at surface water treatment plants is included in this category.
- Infiltration and Recharge – Volume of water used by Kennewick and Richland for groundwater recharge and infiltration, respectively.

The resulting 47 percent net consumption in 2014 is consistent with the 48 percent net consumption value calculated for 2007 in the 2009 RWFCP. The cities will continue to evaluate the performance of the individual WUE programs and implemented measures by analyzing demand data and determining the long-term trend towards reducing water usage per equivalent residential unit (ERU) and meeting WUE goals. Source meter records will be reviewed on an annual basis to determine the effectiveness of each of the implemented WUE measures and to determine if the estimated water savings are being met. If the results of the program monitoring show that WUE goals for water use per ERU are not being met, more rigorous program implementation or additional program items will be considered.

The cities will continue to provide WUE performance reports to the consumers in the annual consumer confidence reports, and will detail the results of water use monitoring and progress towards achieving each system's WUE goals.

Regional Joint Use Strategy

4

AGREEMENT ON WATER RIGHTS CONDITIONS

The Cities of Kennewick, Pasco, Richland, and West Richland signed a Memorandum of Understanding with the Washington State Department of Ecology (Ecology) on July 15, 1999, to manage the existing domestic water rights of the four individual cities as well as the regional Quad City Water Right (QCWR), which, after the cities entered into a Settlement Agreement (shown in **Appendix C**) with Ecology and the Center for Law and Policy (CELP) on August 19, 2003, was ultimately issued under Surface Water Permit No. S4-30976P on September 15, 2003. The permit contains many requirements, one of which is the preparation of this Regional Water Forecast and Conservation Plan update.

Prior to issuance of the QCWR, minimal collaboration took place between the four cities for water system planning purposes, with coordination typically taking place only during planning or design of a joint-use facility. As a result of issuance of the QCWR and the Settlement Agreement, the cities agreed to integrate future water system hydraulics to minimize capital improvements and to facilitate regionally-efficient water systems. The cities also agreed to voluntarily relinquish selected individual city water rights and to withdraw some pending water right applications in the spirit of utilizing the QCWR to meet future water system demands.

The cities, Ecology, and CELP participated in identifying which individual city water rights, combined with the QCWR, are anticipated to be necessary to meet the forecasted water demands of each city.

The QCWR includes a provision requiring that all consumptive use under this water right be fully mitigated when flows in the Columbia River do not meet specific target flows. The cities have developed and implemented procedures for complying with the mitigation provision. A copy of the BiOp compliance procedures are shown in **Appendix D**.

HISTORICAL QCWR ALLOCATION AND USE

INITIAL QCWR HISTORY

The QCWR permit was issued on September 15, 2003. While this permit identified a total allocation of 178 cubic feet per second (cfs) and 96,619 acre-feet per year (afy), this instantaneous rate and annual volume were projected to meet the needs of the cities through 2051. The permit was written in such a way that the allocation would be distributed in phases, once there was adequate mitigation in place and a demand demonstrated, the next phase would be authorized. Ecology agreed to provide the first phase of mitigation, which was based on the use being 80-percent consumptive, which meant that the mitigation totaled 8 cfs and 5,781.6 afy. With Ecology's mitigation agreement, an initial phase of 10 cfs and 7,227 afy of the QCWR was authorized to be diverted by the four cities, with a priority date of June 24, 1980 (consistent with the water reserved in the John Day/McNary Pools reach for municipal supply, as specified in WAC 173-531A-050(3)). The

cities agreed to divide the initial allocation evenly, with 2.5 cfs and 1,806.75 afy allocated to each city. The initial allocation allowed some of the cities to resolve existing and near-term water right deficiencies.

As part of the QCWR allocation, Ecology was required to provide the water right mitigation for the Phase 1 authorization, with the cities required to procure water rights to mitigate their consumptive use for future QCWR phases of authorization.

RECENT QCWR CHANGES

Ecology procured the Buckley and Byerly water rights for mitigation, but these water rights only accounted for 7 cfs and 1,767.23 afy of the full mitigation requirement, which left a deficit of 1 cfs and 4,013.37 afy. The Simplot water rights that were mentioned in the report of examination (ROE) (identified as the Grandview Farm Water Right Certificates and Permit) were not able to be acquired by Ecology. Failure to acquire the Simplot water rights meant that Ecology had not fulfilled its mitigation requirement for the first phase of municipal supply under the permit.

In 2006, Ecology instituted the Lake Roosevelt Incremental Storage Release Program, through the newly formed Office of Columbia River, which allowed for the issuance of up to 25,000 afy in municipal and industrial water rights for water right applicants located downstream of Grand Coulee Dam, and that could prove that the tapped water was in hydraulic connection with the Columbia River. The perpetual cost of this water is $35 per afy, and is billed, based on the annual volume of water allocated, as opposed to the annual volume of water actually used. The cities and Ecology entered into a memorandum of agreement (MOA) in December 2011 that intended to resolve the remaining uncertainty in the 2003 Settlement Agreement and QCWR permit provisions (**Appendix E**). This report contains the mutual agreement and understanding of the provisions of the QCWR with respect to the mitigation provided by Ecology and the consumptive use under the water right that needed to be mitigated.

Ecology agreed that it would provide at least 8 cfs and 5,781.6 afy of mitigation, which was the previously-calculated mitigation needed for the original municipal allocation of 10 cfs and 7,227 afy, based on 80-percent consumptive use.

In the 2011 MOA, Ecology agreed to make 13.25 cfs and 4,014.37 afy available from the Lake Roosevelt program to fulfill its mitigation obligation of 5,781.6 afy under the QCWR. According to the 2011 MOA, the Lake Roosevelt mitigation water is available for mitigation for the months of April through August. Ecology and the cities agree that the Lake Roosevelt water, combined with the Buckley and Byerly water rights, fulfill the mitigation requirement promised by Ecology when the permit issued.

The 2011 MOA documented the consumptive use, that needed to be mitigated, was reduced from 80 percent, as had been indicated in the permit, to 60 percent, based on data that had been presented in the 2008 Regional Water Forecast and Conservation Plan (RWFCP). The reduction in consumptive use from 80 percent to 60 percent had the effect of reducing the rate and volume of mitigation needed to cover the initial QCWR phase of 10 cfs and 7,227 afy that was allocated to the cities for municipal supply under the permit from 8 cfs and 5,781.6 afy to 6 cfs and 4,336.2 afy. According to the 2011 MOA, this leaves 2 cfs and 1,445.4 afy of Lake Roosevelt water available to mitigate Phase 2 of the municipal allocation. It should be noted that the instantaneous rate needed to produce 1,445.4 afy over the months of April through August is actually 4.77 cfs. The cities have

assumed that the mention of 2 cfs being available for Phase 2 is a minimum, and that the actual rate available is at least 4.77 cfs, since it is the rate that is physically necessary.

The MOA states that Ecology will be responsible for paying for the Lake Roosevelt water used to mitigate the first phase of municipal use ($35 per af per year * 2,568.97 af equals $89,913.95 per year), whereas the cities will be responsible for paying for any of the Lake Roosevelt water used to mitigate future phases of the municipal allocation. At a cost of $35 per afy, the cost to the cities of the Lake Roosevelt water that has already been set aside by Ecology, but that is beyond the mitigation requirement for Phase 1, will be $50,589 per year (($35 per af per year * 1,445.4 af equals $50,589 per year), and it will provide the cities with an additional 2,409 afy of water for municipal use (1,445.4 afy / 60 percent consumptive = 2,409 afy).

On November 28, 2011, the cities jointly filed water right application S4-33044. This application requests 165 cfs and 86,983 afy of water from the same points of diversion identified under the QCWR (S4-30976P). This application was filed to cover the as-of-yet unmitigated municipal allocation that was made under the QCWR. If the cities decide to have this application processed, they could have Ecology process the application in the Lake Roosevelt Incremental Storage Release queue with the other qualifying applications. Issuance of a mitigated water right in this manner would mean that the cities would have to pay Ecology for the entire water right, not just the consumptively-used portion. So, if the cities wanted an additional 4,000 afy of water (1,000 afy per city) the annual cost of that water right would be $140,000, as opposed to the potential cost of 60 percent of that, or $84,000 per year, if it is used to mitigate consumptive use under the existing QCWR.

MITIGATION DOCUMENTATION

The cities document the mitigation requirements on a monthly basis for compliance with the Columbia River BiOp. Historical QCWR mitigation requirements are shown for 2011 through 2014 in **Table 4-1** and **Chart 4-1**. The total available mitigation volume increased beginning in 2012, based on the procurement of the Lake Roosevelt water for mitigation. The Buckley, Byerly, and the Phase 1 Lake Roosevelt mitigation water rights have provided sufficient mitigation water for all months between 2012 and 2014. The 2008 RWFCP presented retroactive mitigation compliance reviews for 2005 and 2007, which are presented in **Table 4-2** and **Chart 4-2**, for reference.

Table 4-1
2011 to 2014 QCWR Phase 1 Mitigation Requirements

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (CF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation			
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Total Phase 1 Mitigation (AF)
2011									
January	19.40	12.76	6.64	0	0.00	0.00	22.47	0.00	22.47
February	19.44	12.79	6.65	0	0.00	0.00	20.30	0.00	20.30
March	20.93	13.76	7.17	0	0.00	0.00	22.47	0.00	22.47
April	0.13	0.05	0.08	10	0.80	187.35	18.40	0.00	205.75
May	0.21	0.05	0.16	9	1.44	406.95	19.02	0.00	425.97
June	0.27	0.07	0.20	0	0.00	299.97	18.40	0.00	318.37
July	3.53	0.85	2.68	0	0.00	21.78	14.32	0.00	36.10
August	5.04	1.21	3.83	11	42.13	0.00	14.49	0.00	14.49
September	34.43	8.29	26.14	0	0.00	251.46	14.02	0.00	265.48
October	37.66	13.90	23.76	0	0.00	355.61	22.22	0.00	377.83
November	21.97	14.19	7.78	3	23.34	13.46	21.75	0.00	35.21
December	18.71	12.08	6.63	0	0.00	0.00	22.47	0.00	22.47
Total					**67.71**				**1,766.91**
2012									
January	0.00	0.00	0.00	2	0.00	0.00	22.47	0.00	22.47
February	0.00	0.00	0.00	0	0.00	0.00	20.30	0.00	20.30
March	0.00	0.00	0.00	0	0.00	0.00	22.47	0.00	22.47
April	26.80	10.29	16.51	0	0.00	187.35	18.40	503.72	709.47
May	39.02	9.85	29.17	0	0.00	406.95	19.02	520.51	946.48
June	41.75	10.53	31.22	0	0.00	299.97	18.40	503.72	822.09
July	40.54	10.23	30.31	0	0.00	21.78	14.32	520.51	556.61
August	23.22	5.86	17.36	12	208.32	0.00	14.49	520.51	535.00
September	11.14	2.81	8.33	0	0.00	251.46	14.02	0.00	265.48
October	6.61	2.54	4.07	9	36.63	355.61	22.22	0.00	377.83
November	0.00	0.00	0.00	5	0.00	13.46	21.75	0.00	35.21
December	0.00	0.00	0.00	0	0.00	0.00	22.47	0.00	22.47
Total					**244.95**				**4,335.88**
2013									
January	0.00	0.00	0.00	0	0.00	0.00	22.47	0.00	22.47
February	0.00	0.00	0.00	0	0.00	0.00	20.30	0.00	20.30
March	0.00	0.00	0.00	1	0.00	0.00	22.47	0.00	22.47
April	33.83	12.73	21.10	7	147.70	187.35	18.40	503.72	709.47
May	43.37	10.24	33.13	1	33.13	406.95	19.02	520.51	946.48
June	53.08	12.54	40.54	4	162.16	299.97	18.40	503.72	822.09
July	21.01	4.96	16.05	14	224.70	21.78	14.32	520.51	556.61
August	17.62	4.16	13.46	31	417.26	0.00	14.49	520.51	535.00
September	17.79	4.20	13.59	3	40.77	251.46	14.02	0.00	265.48
October	0.37	0.14	0.23	0	0.00	355.61	22.22	0.00	377.83
November	0.00	0.00	0.00	19	0.00	13.46	21.75	0.00	35.21
December	0.00	0.00	0.00	0	0.00	0.00	22.47	0.00	22.47
Total					**1,025.72**				**4,335.88**
2014									
January	1.39	0.96	0.43	2	0.86	0.00	22.47	0.00	22.47
February	1.40	0.99	0.41	0	0.00	0.00	20.30	0.00	20.30
March	9.55	6.76	2.79	0	0.00	0.00	22.47	0.00	22.47
April	17.90	6.36	11.54	0	0.00	187.35	18.40	503.72	709.47
May	18.57	4.37	14.20	0	0.00	406.95	19.02	520.51	946.48
June	19.83	4.67	15.16	0	0.00	299.97	18.40	503.72	822.09
July	23.03	5.42	17.61	0	0.00	21.78	14.32	520.51	556.61
August	21.23	5.00	16.23	12	194.76	0.00	14.49	520.51	535.00
September	19.03	4.48	14.55	0	0.00	251.46	14.02	0.00	265.48
October	9.29	3.30	5.99	9	53.91	355.61	22.22	0.00	377.83
November	0.27	0.19	0.08	5	0.40	13.46	21.75	0.00	35.21
December	0.40	0.29	0.11	0	0.00	0.00	22.47	0.00	22.47
Total					**249.93**				**4,335.88**

Chart 4-1
2011 to 2014 QCWR Phase 1 Mitigation Requirements

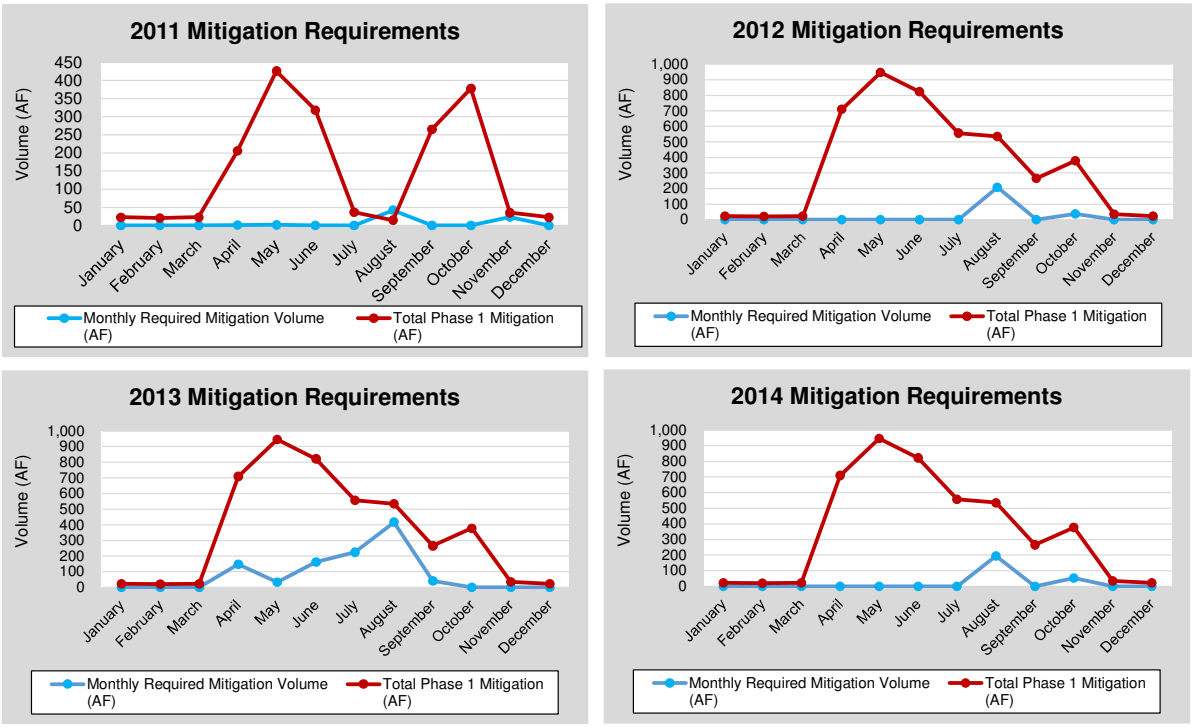
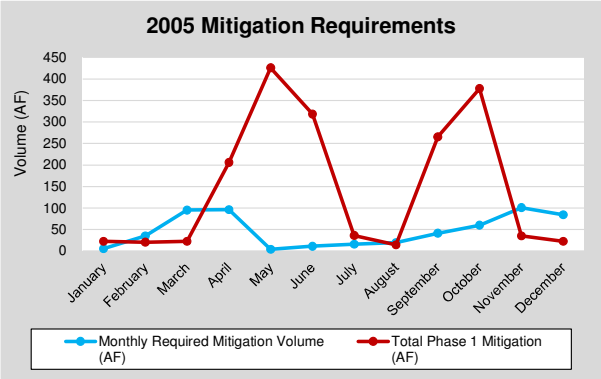
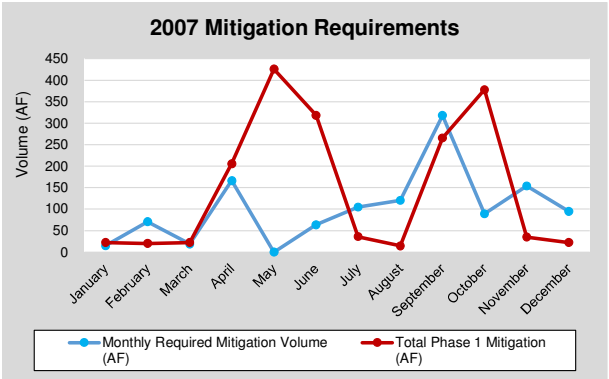


Table 4-2
2005 and 2007 QCWR Phase 1 Mitigation Requirements

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (CF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation			
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Total Phase 1 Mitigation (AF)
2005									
January	16.01	10.90	5.11	1	5.11	0.00	22.47	0.00	22.47
February	15.81	10.77	5.04	7	35.28	0.00	20.30	0.00	20.30
March	21.32	14.52	6.80	14	95.20	0.00	22.47	0.00	22.47
April	8.40	4.03	4.37	22	96.14	187.35	18.40	0.00	205.75
May	0.35	0.00	0.35	11	3.85	406.95	19.02	0.00	425.97
June	0.42	0.00	0.42	26	10.92	299.97	18.40	0.00	318.37
July	0.66	0.00	0.66	24	15.84	21.78	14.32	0.00	36.10
August	0.63	0.00	0.63	31	19.53	0.00	14.49	0.00	14.49
September	7.55	2.41	5.14	8	41.12	251.46	14.02	0.00	265.48
October	28.99	14.00	14.99	4	59.96	355.61	22.22	0.00	377.83
November	16.61	11.31	5.30	19	100.70	13.46	21.75	0.00	35.21
December	15.52	10.57	4.95	17	84.15	0.00	22.47	0.00	22.47
Total					**567.80**				**1,766.91**
2007									
January	15.68	10.68	5.00	3	15.00	0.00	22.47	0.00	22.47
February	15.85	10.79	5.06	14	70.84	0.00	20.30	0.00	20.30
March	19.62	13.34	6.28	3	18.84	0.00	22.47	0.00	22.47
April	17.87	8.64	9.23	18	166.14	187.35	18.40	0.00	205.75
May	0.23	0.00	0.23	0	0.00	406.95	19.02	0.00	425.97
June	4.44	0.70	3.74	17	63.58	299.97	18.40	0.00	318.37
July	4.59	0.70	3.89	27	105.03	21.78	14.32	0.00	36.10
August	4.58	0.70	3.88	31	120.28	0.00	14.49	0.00	14.49
September	33.12	10.39	22.73	14	318.22	251.46	14.02	0.00	265.48
October	34.60	16.76	17.84	5	89.20	355.61	22.22	0.00	377.83
November	17.86	12.16	5.70	27	153.90	13.46	21.75	0.00	35.21
December	15.69	10.69	5.00	19	95.00	0.00	22.47	0.00	22.47
Total					**1,216.03**				**1,766.91**

Chart 4-2
2005 and 2007 QCWR Phase 1 Mitigation Requirements





INITIAL QCWR WATER USE PLAN

Each city has prepared a preliminary plan for utilizing the initial QCWR allocation within their own water systems. A summary of each city's historical use of the QCWR water is presented in the subsequent section, and **Table 4-3** presents the annual water volume diverted by each city from 2011 through 2014 that counts toward the QCWR. These values were calculated on an annual basis by the cities based on assumptions and understandings that the cities no longer deem applicable for future water use. The diversion volumes presented in **Table 4-3** have not been revised to reflect the cities revised water use strategy in order to provide consistency with historical reports provided by the cities to regulatory agencies.

Table 4-3
QCWR Annual Diversions

City/Service Area	QCWR Annual Diversion Volume (AF)			
	2011	2012	2013	2014
Kennewick	0.00	0.00	0.00	0.00
Pasco	5,077.68	5,282.02	5,013.86	3,059.04
Richland	71.04	82.89	180.43	109.10
West Richland	369.05	416.70	500.65	1,168.46
Total	**5,517.77**	**5,781.61**	**5,694.94**	**4,336.60**

City of Kennewick

The City of Kennewick's (Kennewick) individual water rights have been sufficient to meet the needs of the water system, and therefore Kennewick has not diverted any QCWR water. Kennewick has completed construction of an aquifer storage and recovery (ASR) project, and is currently performing cycle testing and finalizing permitting of the ASR well with Ecology. The ASR well allows Kennewick to store water in an underground aquifer during non-peak demand periods when mitigation is minimal or not required. Kennewick can then pump the water out of the aquifer and into the water system during high demand periods without requiring mitigation. To be conservative, the ASR project has not been included as a future supply at this point since it is not yet fully authorized.

City of Pasco

The City of Pasco's (Pasco) individual water rights are not sufficient to meet recent water demands. Pasco, therefore, relies on the inclusion of the QCWR to provide adequate water rights to meet the water system's demand requirements. Prior to issuance of the QCWR in 2003, Pasco did not have sufficient water rights to meet the 2003 water demands of the system. Pasco continues to maximize the use of their individual water rights in an attempt to minimize the use of the QCWR and to minimize the impact on the Columbia River instream flows. Examples of Pasco's attempts at minimizing QCWR water right utilization includes the use of reclaimed water at a Pasco-owned agricultural property, and the use of groundwater wells for outdoor residential irrigation.

City of Richland

The City of Richland's (Richland) individual water rights are currently sufficient to meet recent water demands, but small quantities of QCWR water have been assigned to the city's historical supply for accounting purposes. Richland has limited the use of QCWR water through the use of an aggressive leak-elimination program that included the replacement of 82 miles of thin-walled steel water main. Richland also has separate, non-potable, irrigation systems in portions of the retail water service area that utilize irrigation water rights, providing Richland the flexibility to maximize the use of the existing potable water rights for potable water needs.

City of West Richland

The City of West Richland's (West Richland) individual water rights are currently sufficient to meet recent water demands. For accounting purposes, the cities have historically considered supply to West Richland via the Intertie Booster Pump Station (BPS) to be QCWR water instead of being considered from Richland's individual water rights. The cities plan to begin using Richland's water rights to supply West Richland via the Intertie BPS to maximize the availability of the QCWR for the region. West Richland has limited the use of QCWR water with the implementation of an aggressive water use efficiency (WUE) program and improvements to the overall water system management strategy.

PROJECTED QCWR ALLOCATION AND USE

FUTURE WATER DEMANDS

Table 4-4 presents the projected 6- and 20-year supply projections for each city, based on the 2014 per-capita demands for each city, and the projected population data from **Chapter 2**. The actual 2014 supply without groundwater infiltration and recharge volumes is also shown in **Table 4-4** for comparison purposes.

Table 4-4
Future Water Supply Projections

Description	Kennewick	Pasco	Richland	West Richland
2014				
Water Service Population	74,720	70,770	56,232	13,626
Total Supply (gallons)[1]	3,871,602,000	4,597,500,000	6,022,058,000	980,906,000
Supply per Capita (gallons/year)	51,815	64,964	107,093	71,988
2021				
Water Service Population	83,319	80,224	62,133	18,509
Total Supply (gallons)[1]	4,317,154,535	5,211,669,351	6,654,037,924	1,332,422,512
Supply per Capita (gallons/year)	51,815	64,964	107,093	71,988
2035				
Water Service Population	101,160	111,862	73,700	25,308
Total Supply (gallons)[1]	5,241,622,024	7,266,999,364	7,892,756,941	1,821,845,065
Supply per Capita (gallons/year)	51,815	64,964	107,093	71,988

(1) Kennewick and Richland supply does not include groundwater infiltration or recharge volumes, as these volumes were assumed to be independent of actual supply per capita.

The projected maximum day demand (MDD) for each city was also calculated, based on the peaking factors presented in each city's water system plan, and is shown in **Table 4-5**. The resulting 6- and 20-year MDDs are compared with each city's instantaneous water right in a subsequent section of this chapter. The calculated 2014 MDDs are shown in **Table 4-5,** for comparison.

Table 4-5
Maximum Day Demand Projections

Description	Kennewick	Pasco	Richland	West Richland
Peaking Factors				
Maximum Day Demand / Average Day Demand	1.79	2.11	2.00	2.49
2014				
Average Day Demand (gpm)	7,366	8,747	11,457	1,866
Maximum Day Demand (gpm)	13,185	18,456	22,915	4,647
Maximum Day Demand (cfs)	29.38	41.12	51.05	10.35
2021				
Average Day Demand (gpm)	8,214	9,916	12,660	2,535
Maximum Day Demand (gpm)	14,703	20,922	25,320	6,312
Maximum Day Demand (cfs)	32.76	46.61	56.41	14.06
2035				
Average Day Demand (gpm)	9,973	13,826	15,017	3,466
Maximum Day Demand (gpm)	17,851	29,173	30,033	8,631
Maximum Day Demand (cfs)	39.77	65.00	66.91	19.23

WATER RIGHTS EVALUATION

Annual Water Rights

An evaluation of each city's existing water rights was performed to determine the sufficiency of the water rights to meet both existing and future water demands. **Table 4-6** compares each city's annual supply volume (presented in **Table 4-4**) with each city's annual water right (presented in **Chapter 2**). The QCWR diversion volumes presented in **Table 4-6** are based on the cities revised water use strategy, which differs from the past strategy which resulted in the QCWR diversion volumes presented in **Table 4-3**. The cities revised strategy consists of utilizing city-held water rights on an annual and instantaneous basis prior to utilizing the QCWR in order to reduce the need for additional QCWR volumes and to reduce the mitigation requirements associated with utilizing the QCWR. As shown in **Table 4-6**, Kennewick, Richland, and West Richland have sufficient annual water rights to meet the 2014 through 2021 demands of their customers. In 2014, Pasco had a 6,260 acre-feet (AF) deficiency that was met by utilizing the QCWR. In 2021, Pasco is projected to have an 8,145 AF annual water right deficit, which exceeds the Phase 1 QCWR volume of 7,227 AF, resulting in an annual water right deficiency of 918 AF if Pasco is allotted the entirety of the Phase 1 QCWR.

Table 4-6
Annual Water Rights Evaluation

Description	Kennewick	Pasco	Richland	West Richland	Total
2014 [1]					
Annual Supply Volume (AF)	11,882	14,109	18,481	3,010	---
Annual Water Right (City Rights Only) (AF)	16,200	7,849	33,141	4,661	---
QCWR Needed to Meet Annual Supply Volume (AF)	0	6,260	0	0	6,260
QCWR Available (AF)	0	6,260	0	0	7,227
Surplus (or Deficient) Water Rights (AF)	0	0	0	0	967
2021					
Annual Supply Volume (AF)	13,249	15,994	20,421	4,089	---
Annual Water Right (City Rights Only) (AF)	16,200	7,849	33,141	4,661	---
QCWR Needed to Meet Annual Supply Volume (AF)	0	8,145	0	0	8,145
QCWR Available (AF)	0	7,227	0	0	7,227
Surplus (or Deficient) Water Rights (AF)	0	(918)	0	0	(918)
2035					
Annual Supply Volume (AF)	16,086	22,302	24,222	5,591	---
Annual Water Right (City Rights Only) (AF)	16,200	7,849	33,141	4,661	---
QCWR Needed to Meet Annual Supply Volume (AF)	0	14,453	0	930	15,383
QCWR Available (AF)	0	6,297	0	930	7,227
Surplus (or Deficient) Water Rights (AF)	0	(8,156)	0	0	(8,156)

(1) Richland and West Richland's QCWR volume assumed to be zero due to the surplus of each city's existing water rights, instead of each city utilizing a portion of the QCWR for accounting purposes, as has been historically reported and shown in Table 4-3.

In 2035, Kennewick and Richland are projected to have annual demands that can be met by its existing annual water rights. West Richland has a projected annual water rights deficiency of 930 AF, which is less than West Richland's portion of the initial increment of the QCWR (1,806.75 AF per city). Therefore, West Richland's 2035 projected demands can be met by utilizing the necessary volume of the QCWR. The remaining QCWR volume of 6,297 AF is shown in **Table 4-6** as being applied to Pasco's water rights, resulting in an annual water deficiency of 8,156 AF in 2035.

Instantaneous Water Rights

Table 4-7 compares each city's MDD (presented in **Table 4-5**), with each city's instantaneous water right limit (presented in **Chapter 2**). As shown in **Table 4-7**, Kennewick, Richland, and West Richland have sufficient instantaneous water rights to meet the 2014 and 2021 MDDs of their customers. In 2014, Pasco had a 3.73 cfs deficiency that was met by utilizing the QCWR. In 2021, Pasco is projected to have a 9.22 cfs deficiency, which can also be met by utilizing the QCWR.

Table 4-7
Instantaneous Water Rights Evaluation

Description	Kennewick	Pasco	Richland	West Richland	Total
2014 [1]					
Maximum Day Demand (cfs)	29.38	41.12	51.05	10.35	---
Instantaneous Water Right (City Rights Only) (cfs)	99.93	37.40	95.06	16.53	---
QCWR Needed to Meet Maximum Day Demand (cfs)	0.00	3.73	0.00	0.00	3.73
QCWR Available (cfs)	0.00	3.73	0.00	0.00	10.00
Surplus (or Deficient) Water Rights (cfs)	0.00	0.00	0.00	0.00	6.27
2021					
Maximum Day Demand (cfs)	32.76	46.61	56.41	14.06	---
Instantaneous Water Right (City Rights Only) (cfs)	99.93	37.40	95.06	16.53	---
QCWR Needed to Meet Maximum Day Demand (cfs)	0.00	9.22	0.00	0.00	9.22
QCWR Available (cfs)	0.00	9.22	0.00	0.00	10.00
Surplus (or Deficient) Water Rights (cfs)	0.00	0.00	0.00	0.00	0.78
2035					
Maximum Day Demand (cfs)	39.77	65.00	66.91	19.23	---
Instantaneous Water Right (City Rights Only) (cfs)	99.93	37.40	95.06	16.53	---
QCWR Needed to Meet Maximum Day Demand (cfs)	0.00	27.60	0.00	2.70	30.30
QCWR Available (cfs)	0.00	7.30	0.00	2.70	10.00
Surplus (or Deficient) Water Rights (cfs)	0.00	(20.30)	0.00	0.00	(20.30)

(1) Richland and West Richland's QCWR volume assumed to be zero due to the surplus of each city's existing water rights, instead of each city utilizing a portion of the QCWR for accounting purposes, as has been historically reported and shown in Table 4-3.

In 2035, Kennewick and Richland are projected to have sufficient instantaneous water rights to meet the projected MDDs of their systems. Pasco and West Richland are projected to have 27.60 and 2.70 cfs instantaneous water right deficiencies, respectively. Each city's portion of the initial increment of QCWR is 2.5 cfs per city. With this initial increment allocated to Pasco and West Richland, Pasco is projected to have a 25.10 cfs deficiency and West Richland is projected to have a 0.20 cfs deficiency. The unused 5.0 cfs (2.5 cfs each) from Kennewick and Richland can be credited toward Pasco and West Richland's deficiencies, resulting in West Richland's instantaneous water rights needs being met, and Pasco's instantaneous water right deficiency being reduced to 20.30 cfs, as shown in **Table 4-7**.

FUTURE MITIGATION

When the QCWR was originally issued, the average annual consumptive use estimate was 80 percent. As specified in the 2011 MOA, and supported by the 2008 RWFCP, the consumptive-use estimate used for planning purposes was lowered to 60 percent. **Chapter 3** presents calculations showing the consumptive use by the cities. Based on these calculations, the consumptive use is 47 percent for the cities. The data presented in **Chapter 3** supports continuing to use 60 percent as the average annual consumptive-use rate for mitigation calculations within this RWFCP and over the next 6-year period.

While the previous plan identified a habitat conservation project in the Amon Creek basin, the cities decided that was not a sufficient form of mitigation, and so it has been removed from consideration in this RWFCP update.

Per the January 2008 Memorandum of Understanding between Ecology and Kennewick, Ecology will obtain funding from the Columbia River Management Program toward Kennewick's ASR project in order to provide additional water storage along the Columbia River to capture water during high-flow periods in the river, and reduce the water need during low-flow periods in order to enhance instream flows for endangered and protected species. State money contributed toward Kennewick's ASR project will also serve to partially mitigate Kennewick's portion of the initial increment (2.5 cfs of the initial 10 cfs) of the QCWR that Ecology is responsible for mitigating. Since the ASR permit has not been finalized yet, this will not be included in the calculations for the next 6-year period.

Ecology provided two mitigation alternatives for the cities to evaluate. The two alternatives reflect differences in how the Buckley and Byerley water rights are accounted for throughout the year. Alternative 1 is the original mitigation alternative presented by Ecology, which uses the Buckley and Byerley monthly breakdown from Appendix A of the MOA (**Appendix E**). Alternative 1 mitigation is presented for the historical mitigation calculations in **Tables 4-1** and **4-2**. Alternative 2 uses the Buckley and Byerley monthly breakdown from a table titled "Amended Appendix A" of the MOA, which was obtained from Ecology on November 15, 2015, and is presented as **Appendix F** of this plan. The mitigation required for each alternative is calculated in the following sections for the 6 and 20-year planning periods.

Projected 2021 Mitigation

Tables 4-6 and **4-7** identify the projected 2021 QCWR usage as 8,145 afy (annual) and 9.22 cfs (instantaneous). Although the projected 2021 annual QCWR needs exceed the initial 7,227 afy allotment, 8,145 afy was used to calculate the projected mitigation requirements for conservatism, should additional QCWR be issued.

Projected 2021 Mitigation – Alternative 1 (Original)

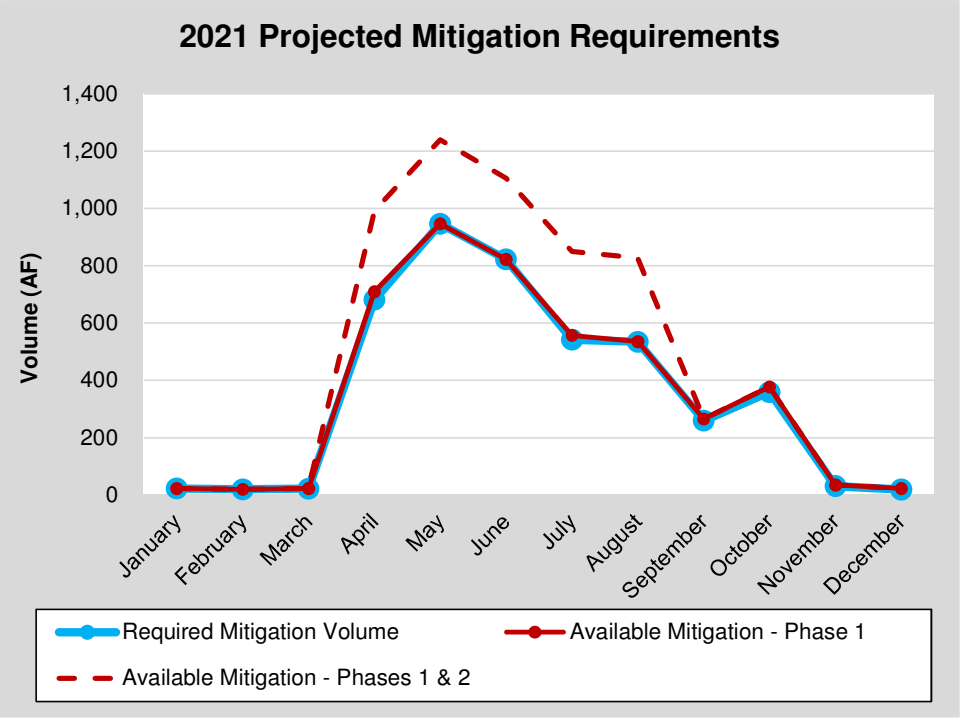
The mitigation volume available within Alternative 1 decreases between the spring and fall months. The mitigation required, if 8,145 afy of QCWR is diverted in 2021, is presented in **Table 4-8** and **Chart 4-3**. Buckley and Byerly mitigation volumes are shown in **Table 4-8**, as is the Phase 1 Lake Roosevelt mitigation volume, which does not require payment from the cities. As described previously in this chapter, additional Lake Roosevelt mitigation water is available for purchase by the cities at a rate of $35 per afy. The additional Lake Roosevelt mitigation volume available for purchase is shown with a dashed line in **Chart 4-3**. The results of the projected 2021 Alternative 1 mitigation calculations indicate sufficient mitigation volume is available in each month if each city's existing annual water rights are allocated strategically to result in nearly-full utilization of the mitigation available each month. Based on the calculations presented in **Table 4-8**, Phase 2 Lake Roosevelt mitigation water will not be required in 2021.

Table 4-8
Projected 2021 Mitigation Volumes – Alternative 1

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (AF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation				Mitigation Difference (Available - Required)[1] (AF)
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Available Mitigation (AF)	
2021 Projections										
January	4.12	2.52	1.60	14	22.41	0.00	22.47	0.00	22.47	0.06
February	3.46	2.11	1.34	15	20.17	0.00	20.30	0.00	20.30	0.13
March	2.04	1.25	0.79	28	22.21	0.00	22.47	0.00	22.47	0.26
April	39.54	16.83	22.71	30	681.33	187.35	18.40	503.72	709.47	28.14
May	48.62	18.10	30.52	31	946.17	406.95	19.02	520.51	946.48	0.31
June	43.64	16.25	27.40	30	821.96	299.97	18.40	503.72	822.09	0.13
July	27.84	10.36	17.48	31	541.77	21.78	14.63	520.51	556.92	15.15
August	27.48	10.23	17.25	31	534.83	0.00	14.49	520.51	535.00	0.17
September	25.86	9.63	16.24	16	259.80	251.46	14.02	0.00	265.48	5.68
October	39.06	16.63	22.43	16	358.95	355.61	22.22	0.00	377.83	18.88
November	2.94	1.79	1.14	27	30.82	13.46	21.75	0.00	35.21	4.39
December	2.08	1.27	0.81	24	19.44	0.00	22.47	0.00	22.47	3.03
Total					**4,259.86**				**4,336.19**	**0.00**

(1) The total mitigation difference only includes months requiring mitigation in excess of the mitigation available in Phase 1 (i.e. negative values in the mitigation difference column).

Chart 4-3
Projected 2021 Mitigation Volumes – Alternative 1



A description of each column in **Table 4-8** is as follows:

Daily Diverted Volume – The calculated average day diversion of QCWR water from the four cities. This volume is calculated for each city, based on the projected QCWR water used by each city to meet the projected monthly supply. For each month in 2021, Kennewick, Richland, and West Richland are projected to not use any QCWR water. Pasco's projected use of the QCWR water was based on diverting QCWR volumes that result in nearly-full utilization of the mitigation available each month.

Daily Return Volume – The calculated daily return volume is based on the product of the monthly QCWR diverted volume and a monthly return flow percentage calculated individually for each city. These monthly return flow percentages are calculated for each season, based on the 2014 supply and return volumes for each city presented in **Chapter 3**, and are shown in **Table 4-9**.

Table 4-9
Seasonal Return Flow Percentages

City	Winter	Spring and Fall	Summer
Kennewick	81.5%	53.8%	43.3%
Pasco	61.1%	42.6%	37.2%
Richland	81.3%	36.1%	28.9%
West Richland	78.9%	37.6%	25.7%

(1) Winter months include January, February, March, November, and December.
(2) Spring and Fall months include April and October.
(3) Summer months include May through September.

Daily Volume Difference – The calculated difference between the diverted and return volumes.

Days to be Mitigated – The number of days requiring mitigation, which is described in the BiOp Compliance Procedures, and is based on the seasonal instream flows at Bonneville (November 1 through April 9) and McNary Dams (April 10 through October 31). The estimated number of days requiring mitigation for the future mitigation calculations was assumed to be the same as the number of days requiring mitigation in 2001, which has been the year with the most mitigation days required since 2000, and is also consistent with the calculations presented in the 2008 RWFCP. As shown in **Table 4-1**, the number of days requiring mitigation between 2011 and 2014 has been much less than was required in 2001.

Monthly Required Mitigation Volume – The calculated product of the volume difference and the days to be mitigated columns.

Buckley, Byerly, and Lake Roosevelt Mitigation – Volume of water available for mitigation from each source. Includes only Phase 1 of the Lake Roosevelt Mitigation, which requires no monthly or annual payments from the cities.

Available Mitigation – Sum of the Buckley, Byerly, and Lake Roosevelt mitigation columns.

Mitigation Difference – The calculated difference between the available mitigation and the required mitigation volumes.

Projected 2021 Mitigation – Alternative 2 (Amended)

The mitigation volume available within Alternative 2 is approximately constant throughout the spring and summer months, with less mitigation volume available in the fall months compared to Alternative 1. The total mitigation available for Alternative 2 is approximately 4 afy greater than that

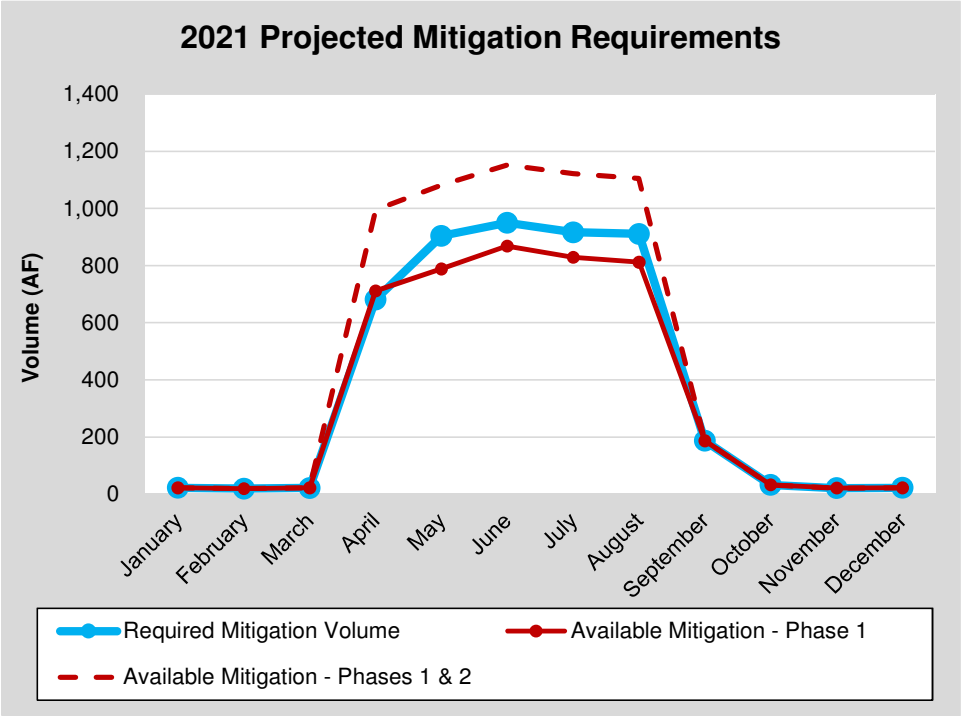
of Alternative 1. The mitigation required for Alternative 2 if 8,145 afy of QCWR is diverted in 2021, is presented in **Table 4-10** and **Chart 4-4**. Buckley and Byerly mitigation volumes are shown in **Table 4-10**, as is the Phase 1 Lake Roosevelt mitigation volume, which does not require payment from the cities. The additional Lake Roosevelt mitigation volume available for purchase is shown with a dashed line in **Chart 4-4**. The results of the projected 2021 Alternative 2 mitigation calculations indicate sufficient Phase 1 mitigation volume is available for January through April, and September through December, but Phase 2 Lake Roosevelt mitigation water is required between May and August. Based on the calculations presented in **Table 4-10**, approximately 383 AF of mitigation volume is required beyond the Buckley, Byerly, and Phase 1 Lake Roosevelt mitigation.

Table 4-10
Projected 2021 Mitigation Volumes – Alternative 2

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (AF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation				Mitigation Difference (Available - Required)[1] (AF)
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Available Mitigation (AF)	
2021 Projections										
January	4.12	2.52	1.60	14	22.41	0.00	22.47	0.00	22.47	0.06
February	3.46	2.11	1.34	15	20.17	0.00	20.30	0.00	20.30	0.13
March	2.04	1.25	0.79	28	22.21	0.00	22.47	0.00	22.47	0.26
April	39.54	16.83	22.71	30	681.33	189.54	18.40	503.72	711.66	30.33
May	46.46	17.29	29.16	31	904.11	249.43	19.02	520.51	788.96	-115.15
June	50.41	18.76	31.65	30	949.40	346.61	18.41	503.72	868.74	-80.66
July	47.11	17.54	29.58	31	916.86	293.83	14.63	520.51	828.97	-87.89
August	46.82	17.43	29.39	31	911.19	277.13	14.49	520.51	812.13	-99.06
September	18.63	6.94	11.70	16	187.14	173.25	14.02	0.00	187.27	0.13
October	3.58	1.52	2.05	16	32.87	10.80	22.22	0.00	33.02	0.15
November	2.07	1.27	0.80	27	21.72	0.00	21.75	0.00	21.75	0.03
December	2.41	1.47	0.94	24	22.45	0.00	22.47	0.00	22.47	0.02
Total					**4,691.87**				**4,340.21**	**-382.76**

(1) The total mitigation difference only includes months requiring mitigation in excess of the mitigation available in Phase 1 (i.e., negative values in the mitigation difference column).

Chart 4-4
Projected 2021 Mitigation Volumes – Alternative 2



Projected 2035 Mitigation

Tables 4-6 and **4-7** identify the projected 2035 QCWR usage as 15,383 afy (annual) and 30.30 cfs (instantaneous). Although the projected 2035 annual QCWR needs exceed the initial 7,227 afy allotment, 15,383 afy was used to calculate the projected mitigation requirements for conservatism, should additional QCWR be issued.

Projected 2035 Mitigation – Alternative 1 (Original)

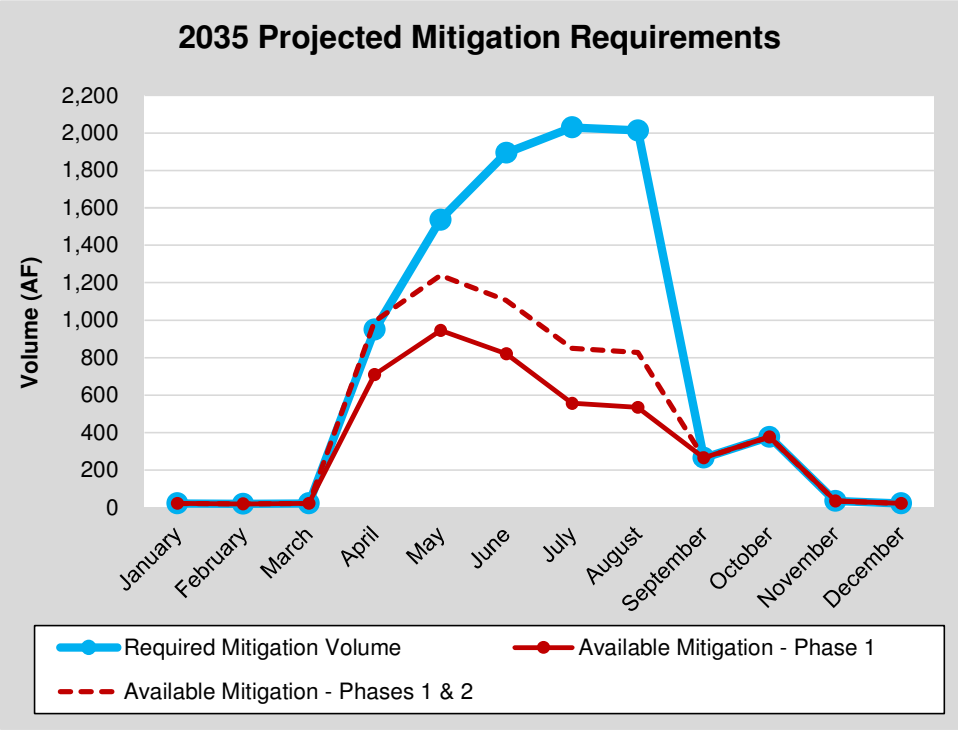
The mitigation volume available within Alternative 1 decreases between the spring and fall months. The mitigation required for Alternative 1, if 15,383 afy of QCWR is diverted in 2035, is presented in **Table 4-11** and **Chart 4-5**. A breakdown of the Phase 1 and Phase 2 Lake Roosevelt mitigation volumes is presented in **Table 4-11**. Similar to the 2021 mitigation calculations described in the previous section, the QCWR diversion volume was calculated for each month to result in nearly-full utilization of the mitigation available each month. Phase 1 mitigation water is sufficient for January through March, and September through December, but Phase 2 Lake Roosevelt mitigation water is required between April and August. The diversion volumes were adjusted to show that the Phase 2 Lake Roosevelt mitigation water is sufficient for April, with exceedances projected for May, June, July, and August. Based on the calculations presented in **Table 4-11**, approximately 4,853 AF of mitigation volume is required beyond the Buckley, Byerly, and Phase 1 Lake Roosevelt mitigation, and approximately 3,450 AF is required in excess of the Buckley, Byerly, and Phases 1 and 2 Lake Roosevelt mitigation.

Table 4-11
Projected 2035 Mitigation Volumes – Alternative 1

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (AF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation					Phases 1 & 2 Mitigation	
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Available Mitigation (AF)	Mitigation Difference (Available - Required)[1] (AF)	Available Mitigation (AF)	Mitigation Difference (Available - Required)[1] (AF)
2035 Projections												
January	4.11	2.51	1.60	14	22.38	0.00	22.47	0.00	22.47	0.09	22.47	0.09
February	3.47	2.12	1.35	15	20.21	0.00	20.30	0.00	20.30	0.09	20.30	0.09
March	2.04	1.24	0.79	28	22.16	0.00	22.47	0.00	22.47	0.31	22.47	0.31
April	55.14	23.47	31.67	30	950.03	187.35	18.40	503.72	709.47	-240.56	992.88	42.85
May	76.94	27.36	49.58	31	1,537.07	406.95	19.02	520.51	946.48	-590.59	1,239.33	-297.74
June	98.43	35.32	63.11	30	1,893.30	299.97	18.40	503.72	822.09	-1,071.21	1,105.50	-787.80
July	102.19	36.72	65.47	31	2,029.52	21.78	14.63	520.51	556.92	-1,472.60	849.79	-1,179.73
August	101.40	36.47	64.93	31	2,012.68	0.00	14.49	520.51	535.00	-1,477.68	827.85	-1,184.83
September	26.41	9.83	16.58	16	265.29	251.46	14.02	0.00	265.48	0.19	265.48	0.19
October	41.09	17.49	23.60	16	377.63	355.61	22.22	0.00	377.83	0.20	377.83	0.20
November	3.33	2.04	1.29	27	34.96	13.46	21.75	0.00	35.21	0.25	35.21	0.25
December	2.39	1.46	0.93	24	22.33	0.00	22.47	0.00	22.47	0.14	22.47	0.14
Total					**9,187.53**				**4,336.19**	**-4,852.63**	**5,781.58**	**-3,450.10**

(1) The total mitigation difference only includes months requiring mitigation in excess of the mitigation available in Phase 1 (i.e., negative values in the mitigation difference column).

Chart 4-5
Projected 2035 Mitigation Volumes – Alternative 1



Projected 2035 Mitigation – Alternative 2 (Amended)

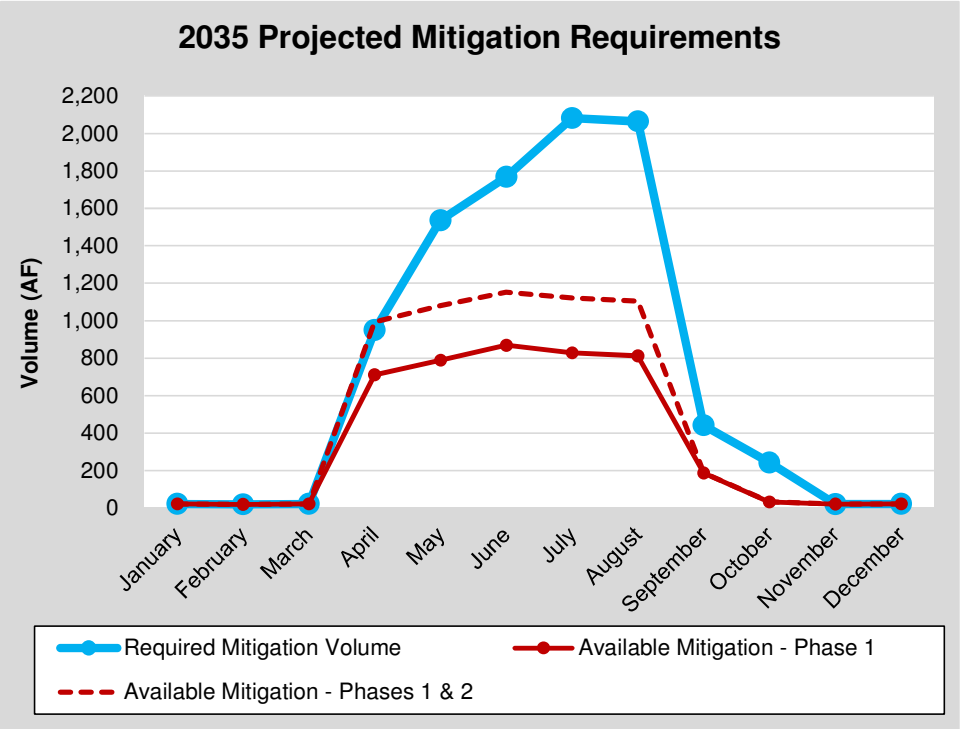
The mitigation volume available within Alternative 2 is approximately constant throughout the spring and summer months, with less mitigation volume available in the fall months compared to Alternative 1. The total mitigation available for Alternative 2 is approximately 4 afy greater than that of Alternative 1. The mitigation required for Alternative 2, if 15,383 afy of QCWR is diverted in 2035, is presented in **Table 4-12** and **Chart 4-6**. Similar to the other mitigation calculations described in previous sections, the QCWR diversion volume was calculated for each month to result in nearly-full utilization of the mitigation available each month. Phase 1 mitigation water is sufficient for January through March, and November and December, but Phase 2 Lake Roosevelt mitigation water is required between April and August. The diversion volumes were adjusted to show that the Phase 2 Lake Roosevelt mitigation water is sufficient for April, with exceedances projected between May and October. Based on the calculations presented in **Table 4-12**, approximately 4,855 AF of mitigation volume is required beyond the Buckley, Byerly, and Phase 1 Lake Roosevelt mitigation, and approximately 3,454 AF is required in excess of the Buckley, Byerly, and Phases 1 and 2 Lake Roosevelt mitigation. The annual Alternative 2 mitigation volume exceedances are approximately equivalent to those presented for mitigation Alternative 1.

Table 4-12
Projected 2035 Mitigation Volumes – Alternative 2

Month	Daily Diverted Volume (AF/day)	Daily Return Volume (AF/day)	Daily Volume Difference (AF/day)	Days to be Mitigated	Monthly Required Mitigation Volume (AF)	Phase 1 Mitigation					Phases 1 & 2 Mitigation	
						Buckley (AF)	Byerly (AF)	Lake Roosevelt (AF)	Available Mitigation (AF)	Mitigation Difference (Available - Required)[1] (AF)	Available Mitigation (AF)	Mitigation Difference (Available - Required)[1] (AF)
2035 Projections												
January	4.11	2.51	1.60	14	22.38	0.00	22.47	0.00	22.47	0.09	22.47	0.09
February	3.47	2.12	1.35	15	20.21	0.00	20.30	0.00	20.30	0.09	20.30	0.09
March	2.04	1.24	0.79	28	22.16	0.00	22.47	0.00	22.47	0.31	22.47	0.31
April	55.14	23.47	31.67	30	950.03	189.54	18.40	503.72	711.66	-238.37	995.07	45.04
May	76.94	27.36	49.58	31	1,537.07	249.43	19.02	520.51	788.96	-748.11	1,081.81	-455.26
June	91.76	32.84	58.92	30	1,767.75	346.61	18.41	503.72	868.74	-899.01	1,152.15	-615.60
July	104.85	37.71	67.14	31	2,081.31	293.83	14.63	520.51	828.97	-1,252.34	1,121.84	-959.47
August	104.06	37.46	66.60	31	2,064.47	277.13	14.49	520.51	812.13	-1,252.34	1,104.98	-959.49
September	44.01	16.38	27.63	16	442.07	173.25	14.02	0.00	187.27	-254.80	187.27	-254.80
October	26.42	11.24	15.17	16	242.75	10.80	22.22	0.00	33.02	-209.73	33.02	-209.73
November	2.06	1.26	0.80	27	21.66	0.00	21.75	0.00	21.75	0.09	21.75	0.09
December	2.39	1.46	0.93	24	22.33	0.00	22.47	0.00	22.47	0.14	22.47	0.14
Total					**9,194.17**				**4,340.21**	**-4,854.69**	**5,785.60**	**-3,454.34**

(1) The total mitigation difference only includes months requiring mitigation in excess of the mitigation available in Phase 1 (i.e., negative values in the mitigation difference column).

Chart 4-6
Projected 2035 Mitigation Volumes – Alternative 2



BIOP COMPLIANCE PLAN

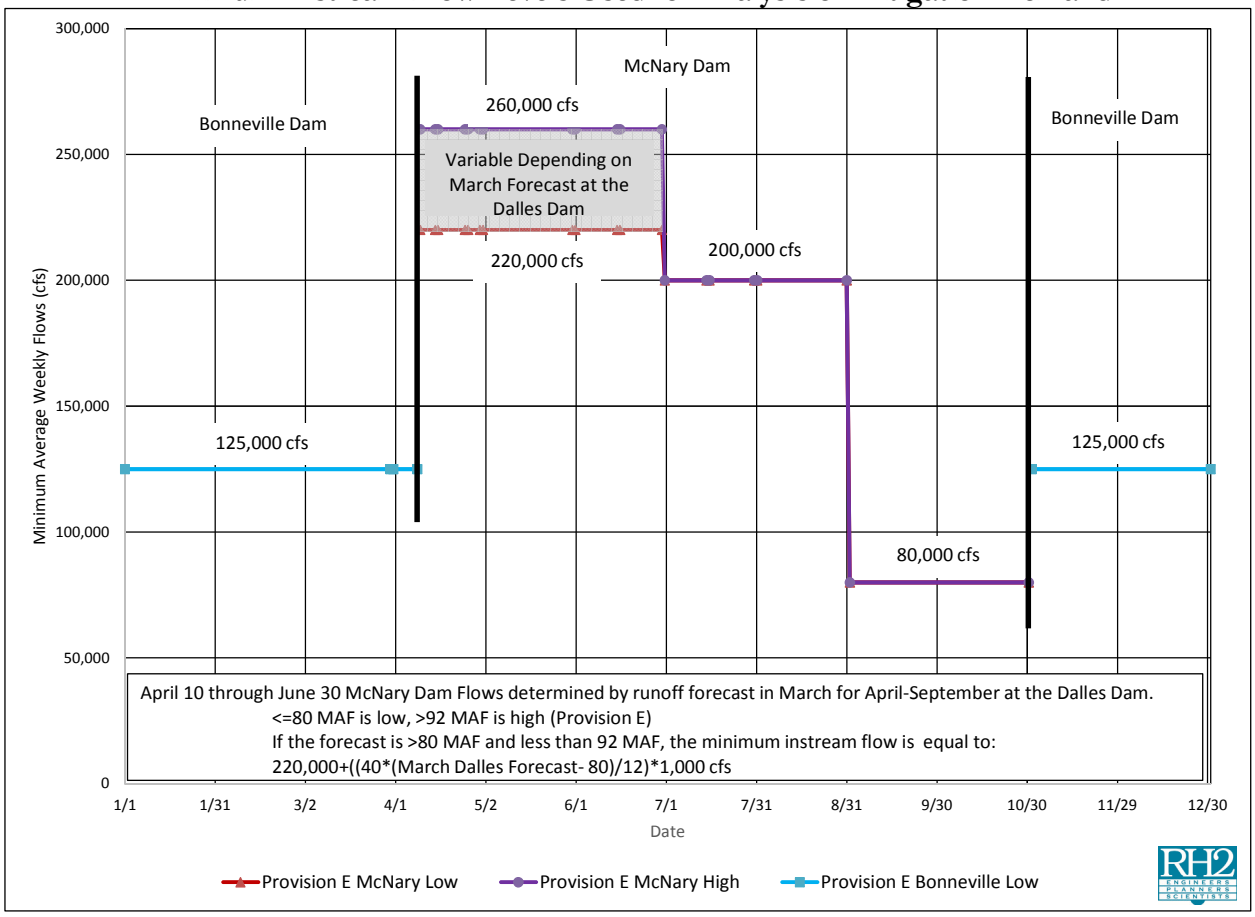
The cities have been making calculations consistent with those provided in the BiOp Compliance Plan, which was Appendix G of the 2008 RWFCP update. There are a few revisions to the BiOp Compliance Plan in this RWFCP update, to allow the plan to better match how the calculations were actually being made, and those are specifically called-out here (**Appendix D**).

First, the older plan stated that "The trigger for this procedure shall be an early March forecast of Columbia River in-stream flow at the Dalles Dam of less than sixty (60) million acre feet." This language is similar to the language contained in WAC 173-563-056, which identifies the trigger for when interruptible water rights issued under the Instream Resources Protection Program for the Main Stem Columbia River in Washington State were to be regulated, based on the actual flow of the river compared to the minimum instream flows. However, the instream flow provision on the QCWR is different from the minimum instream flow provision in Chapter 173-563 WAC. The minimum instream flows specified in the QCWR are in effect every day of the year, regardless of the early March forecast. Therefore, that language has been removed from the BiOp Compliance Plan.

Second, in the QCWR, the minimum instream flows specified for the period of November 1 through April 9 is specified as follows: "Between November 1 and April 9, the minimum flow measured at Bonneville Dam will range from 125,000 to 160,000 cfs, with the specific flow objective to be set by the FCRPS Technical Management Team every two weeks during that period." Ms. Nancy Aldrich, City of Richland, indicated that the Federal Columbia River Power System (FCRPS) Technical Management Team does not actively meet and set specific flow objectives for the period of

November 1 through April 9, as envisioned in the QCWR permit provision. In the absence of variable flow recommendations from this group, the cities have been using a consistent minimum instream flow of 125,000 cfs during this period. The minimum instream flow levels that have been used throughout the year are displayed graphically in **Chart 4-7**.

Chart 4-7
Minimum Instream Flow Levels Used for Analysis of Mitigation Demand



Using the updated BiOp Compliance Plan (**Appendix D**), the cities have demonstrated, in **Table 4-1** and **Chart 4-1**, that the mitigation for Phase 1 has adequately mitigated the cities' consumptive use under the QCWR since 2012. The only years in which the mitigation was insufficient were those years prior to Ecology fulfilling its obligation to provide the full mitigation for the first phase of the allocation.

The BiOp Compliance Plan was also used to project forward and determine if the existing mitigation would be sufficient to mitigate if the actual stream flows were consistent with those observed during 2001, during which the Columbia River experienced the lowest flows in recent years. **Tables 4-8** and **4-10**, and **Charts 4-3** and **4-4** summarize the results for year 2021, and **Tables 4-11** and **4-12**, and **Charts 4-5** and **4-6** summarize the results for year 2035.

REQUEST FOR ADDITIONAL AUTHORIZATION UNDER QCWR

Based on the analysis and justification provided in this report, the cities would like to make the following requests to Ecology:

1. Alteration of the instantaneous rate allowed under Phase 1.

The Phase 1 municipal allocation under the QCWR was 10 cfs and 7,227 afy. This allocation is very close to being equal to the instantaneous rate diverted continuously over the entire year to equal the annual volume. This allocation represents a baseload supply, which does not match the actual use of water by the cities and does not allow the cities to pump at a high enough rate to fully utilize the mitigation secured by Ecology for Phase 1. For the month of May, Ecology secured 946.48 AF of mitigation water under Phase 1. Assuming each city is using its share of the QCWR, the combined measured consumptive use for the cities during that month is 66 percent (**Table 4-9**). That means that for this month, the mitigation water would support municipal diversion of 1,434 AF. In order to be able to divert 1,434 AF for municipal supply during the month of May, the cities will need to divert water under the QCWR at a constant rate of 23.3 cfs for that month.

The cities request that Ecology issue an additional 13.3 cfs under Phase 2, to make the combined municipal water right equal to 23.3 cfs and 7,227 afy to match the mitigation that was obtained by Ecology for the first phase of development.

2. Within the next six years, the City of Pasco is projected to use more municipal water rights than was allocated to all of the cities under Phase 1 of the QCWR.

Pasco has requested a new individual water right from the Lake Roosevelt Incremental Storage Release Program. Based on the facts that water is still available to be allocated from this program, and the city has an identified immediate and future need, it is assumed that this water right will be granted. Granting of this water right, making sure that appropriate instantaneous rate and annual volume are authorized, will allow the cities to continue to equally share and use Phase 1 of the QCWR through the next six-year period.

The cities request that Ecology process the individual water right, split out from application S4-33044, for the City of Pasco.

3. Identification of a future mitigation alternative.

Based on the projected 2021 mitigation requirements, no Phase 2 mitigation is required within mitigation Alternative 1, whereas 383 AF is required within mitigation Alternative 2. Based on the projected 2035 mitigation requirements, 3,450 AF of Phases 1 and 2 mitigation is required for Alternative 1, and 3,454 AF of Phases 1 and 2 mitigation is required for Alternative 2. Although mitigation Alternative 2 provides 4 afy of additional mitigation volume, the monthly Phase 1 mitigation allotments of Alternative 1 are sufficient through 2021.

The cities request that mitigation Alternative 1 (presented as Appendix E of this study and consistent with the 2011 MOA) be utilized for future mitigation.

4. Recalculation of the level of mitigation needed for Phase 1 and future phases.

Based on the BiOp Compliance Plan, approved in the 2008 RWFCP, the cities plan for the future by looking at the days that flows were not met during the 2001 drought year. In that year, target flows

were not met on 293 out of 365 days, or 80 percent of the year. The months where mitigation is only required on some of the days include January (14 days), February (15 days), March (28 days), September (16 days), October (16 days), November (27 days), and December (24 days). This means that to mitigate the consumptive use when target flows are not met, mitigation is only needed for 80 percent of the water diverted if it is diverted equally year round. So, while diverting 7,227 afy for municipal supply, the actual volume of diverted water that will be subject to mitigation could be approximately 5,782 afy, although this number is variable depending on when the water is diverted throughout the year because of monthly return flow variations and days per month requiring mitigation. An average 60 percent of that volume is equal to a total-needed Phase 1 mitigation volume of 3,469 afy. This volume is less than the 4,336.2 afy described in the 2011 MOA, due to the fact that it is not anticipated that mitigation will be needed on more than 80 percent of the days and that the actual calculated average consumptive use is less than 60 percent. If this level of mitigation certainty is approved, that would mean that a total of 2,312.6 afy of Lake Roosevelt mitigation water that has been reserved by Ecology for the cities would be available to the cities to mitigate future phases of the municipal allocation, and the cities would be responsible for covering the cost of the Lake Roosevelt water in Phase 2 and beyond.

If this recalculation of mitigation volume needed is not approved, then the cities will cease to use the 2001 flow data in their forecasts and will be forced to assume that mitigation will be required every day that the QCWR is used in the future. The BiOp Compliance Plan (**Appendix D**) will no longer be necessary.

The cities request that Ecology consider planning to mitigate 80 percent of the time (consistent with the 2001 flow data and BiOp compliance plan) is deemed sufficient, and 2,312.6 afy of Lake Roosevelt mitigation water is considered to be reserved for use by the cities for mitigation of future phases of the QCWR.

5. Phase 2 of the QCWR mitigated by previously reserved Lake Roosevelt mitigation water.

This request is based on the outcome of the above requests.

If Pasco is able to obtain new individual water rights of sufficient rate and volume such that its 2021 demand is satisfied by its existing rights, the new water right, and its portion of Phase 1 of the QCWR, then the cities will only need to request the additional additive instantaneous rate under Phase 2 of the QCWR, as discussed under request 1 above, at this time (Table 4-13).

If Pasco is unable to acquire additional individual water rights, then the cities will need an annual volume allocation under Phase 2 to meet their 2021 demand, as identified in Table 4-14. Ecology's response to request 4, above, will alter the amount of water necessary to mitigate Phase 1. However, since the Lake Roosevelt mitigation water is only utilized in April through August, which require mitigation on every day (per the 2001 instream flow data), the same volume of mitigation water is requested for Phase 2, regardless if either 80 percent or 100 percent mitigation is required. When Phase 2 is issued, the cities consider that the municipal combined instantaneous rate of the two phases (26.4 cfs) can be utilized to divert the combined annual volume of the two phases (8,145 afy).

Table 4-13
Phase 2 QCWR Request for 2021 if Pasco Does Get a New Water Right

Phase	Municipal Supply		Mitigation if 80 percent accepted			Mitigation if 100 percent required		
	Instantaneous Rate	Annual Volume	Byerly and Buckley	Lake Roosevelt	Total	Byerly and Buckley	Lake Roosevelt	Total
	(cfs)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)
1	10.0	7,227	1,767.23	1,701.73	3,468.96	1,767.23	2,568.97	4,336.20
2 (2021)	13.3	0	0.00	0.00	0.00	0.00	0.00	0.00
Total	**23.3**	**7,227**	**1,767.23**	**1,701.73**	**3,468.96**	**1,767.23**	**2,568.97**	**4,336.20**
Remaining mitigation water				**2,312.64**			**1,445.40**	

Assumes that the additional instantaneous rate needed to perfect the Phase 1 annual volume is provided under Phase 2.
Phase 2 (2021) represents the water associated with the forecast demand through the next 6 years, which is through 2021.

Table 4-14
Phase 2 QCWR Request for 2021 if Pasco Does Not Get a New Water Right

Phase	Municipal Supply		Mitigation if 80 percent accepted			Mitigation if 100 percent required		
	Instantaneous Rate	Annual Volume	Byerly and Buckley	Lake Roosevelt	Total	Byerly and Buckley	Lake Roosevelt	Total
	(cfs)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)
1	10.0	7,227	1,767.23	1,701.73	3,468.96	1,767.23	2,568.97	4,336.20
2 (2021)	16.4	918	0.00	605.88	605.88	0.00	605.88	605.88
Total	**26.4**	**8,145**	**1,767.23**	**2,307.61**	**4,074.84**	**1,767.23**	**3,174.85**	**4,942.08**
Remaining mitigation water				**1,706.76**			**839.52**	

Instantaneous rate under Phase 2 sufficient to divert Phase 1 and 2 annual volume, given mitigation available.
Phase 2 (2021) represents the water associated with the forecast demand through the next 6 years, which is through 2021.
Lake Roosevelt mitigation water is used in the summer months when consumptive use is approximately 66 percent.