City of Kennewick

WATER COMPREHENSIVE PLAN

Prepared By

RH2 ENGINEERS PLANNERS SCIENTISTS

AGENCY REVIEW DRAFT

August 2016

VOLUME 1 of 2

City of Kennewick
Water Comprehensive Plan

August 2016

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EXECUTIVE SUMMARY

PURPOSE OF THE PLAN

The City of Kennewick's (City) water system is a major infrastructure, much of which is invisible to the customers that receive its water. The water system requires qualified staff to operate and maintain an ongoing capital improvement program to replace old components to meet the requirements mandated by federal and state laws. The primary purpose of the City's Water Comprehensive Plan (WCP) is to identify and schedule water system improvements that correct existing system deficiencies and ensure a safe and reliable supply of water to current and future customers. This WCP complies with Washington State Department of Health (DOH) regulations under Chapter 246-290 Washington Administrative Code (WAC), which requires water purveyors to update their water system plans every 6 years. In anticipation of proposed changes to the water system planning requirements to extend the planning horizon to 10 years, this WCP was prepared to serve as a 6-year and 10-year document.

CHANGES SINCE THE LAST WCP UPDATE

The City's previous WCP was approved by DOH in 2010. The following changes have occurred since the last update and affect water system planning for the City.

- The DOH *Water System Design Manual* was updated in December 2009. The revisions primarily address water demand requirements and water system physical capacity analysis, both of which affect the City.
- The Benton County (County) *Comprehensive Plan* was updated in 2013. The update projected future growth for the City through 2034.
- Drinking water regulations are continually evolving to ensure that water purveyors are providing a safe and reliable water supply to their customers. Additional water quality monitoring requirements and revisions to existing regulations, such as the Groundwater Rule, Stages 1 and 2 Disinfectants/Disinfection Byproducts Rule, and the revised Coliform Rule have been implemented since the City's last WCP was completed.

SUMMARY OF KEY ELEMENTS

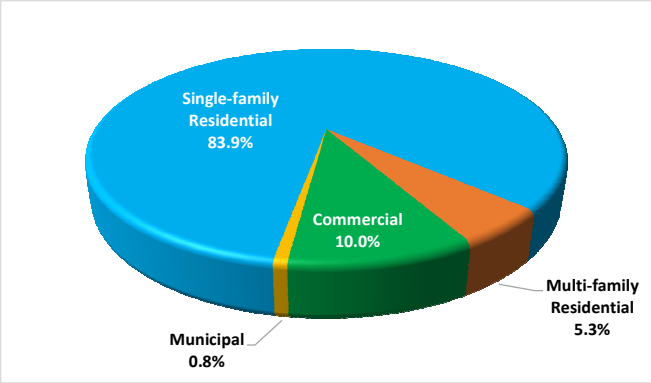
This WCP presents a description of the existing water system and service area, a forecast of future water demands, policies and design criteria for water system operation and improvements, the operations and maintenance program, staffing requirements, a schedule of improvements, and a financial plan to accomplish the improvements. The WCP also includes several ancillary elements that include a water use efficiency plan, a water quality monitoring plan, a wellhead protection plan, a watershed control plan, and a cross-connection control program. A summary of the key issues related to these elements is provided in the following sections.

WATER SERVICE AREA

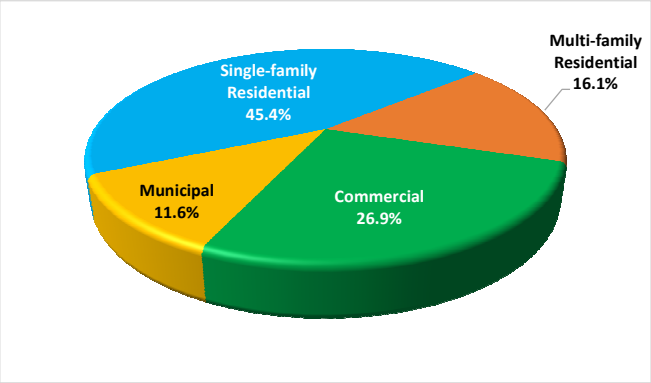
The City provides water service to approximately 80,986 people throughout its water service area boundary, which extends beyond the City's corporate limits. The City is responsible for providing

public water service, utility management, and water system development within this area. The City will provide new water service within the City limits and where there are existing water mains (i.e., the retail water service area). Requests for new water service outside of the City limits but within the Urban Growth Area (UGA), where there are no existing water mains fronting the property, will only be granted after the area is annexed to the City or upon completion of an annexation agreement.

In 2014, the City provided water service to an average of 23,801 connections, which were mainly comprised of single-family connections. Single-family connections represent approximately 84 percent of all accounts; however, the single-family class only consumed 45 percent of all water supplied to the system in 2014.



2014 Water Connections



2014 Water Consumption

EXISTING WATER SYSTEM

The City's water system was initially established in 1949 when the City acquired the Pacific Power and Light Company water system and the Kennewick Irrigation District (KID) water system. In 1949, the water system was supplied by Columbia River water pumped into the water system without filtration, and the Layton Park Wells. Between 1958 and 1960, the City installed five Ranney collector wells on Clover Island with an original combined capacity of 24.5 million gallons per day (MGD). Three of the Ranney wells have been removed from service, and the current capacity of the remaining Ranney wells is approximately 15 MGD. The City's Columbia River Water Treatment Plant (WTP) was constructed in 1980 with an original capacity of 7.5 MGD. The facility's capacity has been expanded to 15 MGD and has the infrastructure to be expanded to 30 MGD in the future. A summary of the City's existing sources and their capacities is shown in **Table ES-1**.

Table ES-1
Supply Facilities Summary

Name	Discharge Pressure Zone	Total Pumping and Treatment Capacity (gpm)	Physical Pumping Capacity (gpm)	Year Installed	Well Depth (feet)	Caisson Diameter (inches)	Pump Type	Pump Motor Size (hp)
Ranney Collector No. 4	Zone 1	1,042	1,042	1959	51.7	20	(2) Vertical Turbine	75 100
Ranney Collector No. 5	Zone 1	6,944	5,000	1960	41.4	20	(4) Vertical Turbine	(4) 350
WTP Intake (Low Lift BPS)	Clearwell	10,417	10,417	1980	---	---	(4) Vertical Turbine	(2) 25 (2) 50

The City's water system has ten booster pump station (BPS) facilities that provide supply throughout the water system. A summary of these pumping facilities is shown in **Table ES-2**.

Table ES-2
Booster Pump Station Facilities Summary

Name	Suction Pressure Zone	Discharge Pressure Zone	Total Pumping Capacity (gpm)	Number of Pumps	Pump Motor Size (horsepower)
Water Treatment Plant BPS	Clearwell	Zone 1	10,417	4	(2) 250, (2) 400
Golf Course BPS	Zone 1	Zone 2	9,900	3	(3) 250
19th and Olympia BPS	Zone 1	Zone 2	10,000	5	(5) 150
47th and Olympia BPS	Zone 2	Zone 3	7,300	3	(1) 75, (2) 150
18th and Kellogg BPS	Zone 2	Zone 3	7,700	3	(1) 75, (2) 150
54th and Olympia BPS	Zone 3	Zone 4	4,400	3	(1) 40, (2) 100
28th and Irving BPS	Zone 3	Zone 4	3,400	3	(1) 40, (2) 100
Thompson Hill BPS	Zone 4	Zone 5	5,300	3	(1) 60, (2) 125
46th and Olson BPS[1]	Zone 4	Zone 5	2,555	3	(1) 15, (1) 40, (1) 100
Zone 6 BPS[2]	Zone 5	Zone 6	2,238	3	(1) 7.5, (2) 75

(1) Also referred to as the Canyon Lakes BPS.

(2) No water service connections are currently located within Zone 6, and therefore the Zone 6 BPS does not currently operate.

The City's water system has 13 storage facility sites that provide direct water storage to 6 pressure zones. A summary of the City's storage facilities is shown in **Table ES-3**.

Table ES-3
Storage Facilities Summary

Name	Pressure Zone	Year Constructed	Material	Capacity (MG)	Diameter (feet)	Base Elevation (feet)	Overflow Elevation (feet)	Overall Height (feet)
WTP Clearwell	Clearwell	1980	Concrete	0.31	---	321	338.5	17.50
19th and Olympia E.	Zone 1	1949	Concrete	2.00	151	517	532	15.00
19th and Olympia W.	Zone 1	1949	Concrete	4.00	213	517	532	15.00
47th and Olympia	Zone 2	1972	Concrete	5.00	170	624	654	30.00
18th and Kellogg	Zone 2	Unknown	Concrete	10.00	250	624	652	28.00
18th and Kellogg	Zone 2	1960	Steel	0.50	54	625	654	29.00
54th and Olympia	Zone 3	1978	Concrete	1.00	95	760	780	20.00
28th and Irving	Zone 3	1978	Concrete	1.00	95	750	780	30.00
Kansas	Zone 3	2006	Concrete	4.00	153	750	780	30.00
Canyon Lakes	Zone 4	1980	Concrete	1.00	58.0 x 58.0 [1]	889	910	21.00
Thompson Hill	Zone 4	2015	Concrete	3.00	143	888	913	25.00
Zone 5 Reservoir	Zone 5	2010	Concrete	1.00	60.0 x 60.0 [1]	1,024	1,045	21.00

(1) Rectangular dimensions

The City's water system contains more than 409 miles of water main ranging in size from 2 inches in the distribution system to 48 inches at the City's supply facilities. As shown in **Table ES-4**, most of the water main (approximately 48 percent) within the service area is 8 inches in diameter.

Table ES-4
Water Main Diameter Inventory

Diameter (inches)	Length (feet)	Percentage of Total
4 or smaller	98,753	4.6%
6	458,864	21.2%
8	1,046,234	48.4%
10	36,169	1.7%
12	224,160	10.4%
14	2,578	0.1%
16	177,946	8.2%
18	16,432	0.8%
20	4,985	0.2%
24	15,801	0.7%
30	6,495	0.3%
32	10	0.0%
36	10,210	0.5%
42	980	0.0%
48	1,618	0.1%
Unknown	59,257	2.7%
Totals	**2,160,492**	**100%**

PAST WATER USAGE

The City has experienced a trend of decreasing per capita water demand since 2007, primarily due to water use efficiency practices, including new buildings with low flow plumbing fixtures, and the repair of water system leaks. Between 2007 and 2014, the City's water service area population increased by more than 19 percent, but the volume of water supplied to the system only increased by approximately 5 percent. **Table ES-5** presents the City's annual net water supply, the average day demand (ADD), water service area population, and average demand per capita from 2007 through 2014.

Table ES-5
Historical Water Supply and System Demand

Year	Net Supply (MG)	Average Day Demand (gpm)	Water Service Area Population	Average Demand Per Capita (gal/day/capita)
2007	3,775.7	7,183.7	67,871	152
2008	3,727.5	7,091.9	68,128	150
2009	3,941.5	7,499.0	70,871	152
2010	3,666.6	6,976.1	72,940	138
2011	3,536.3	6,728.2	76,356	127
2012	3,748.2	7,131.3	77,078	133
2013	3,721.9	7,081.3	78,334	130
2014	3,976.9	7,566.4	80,986	135

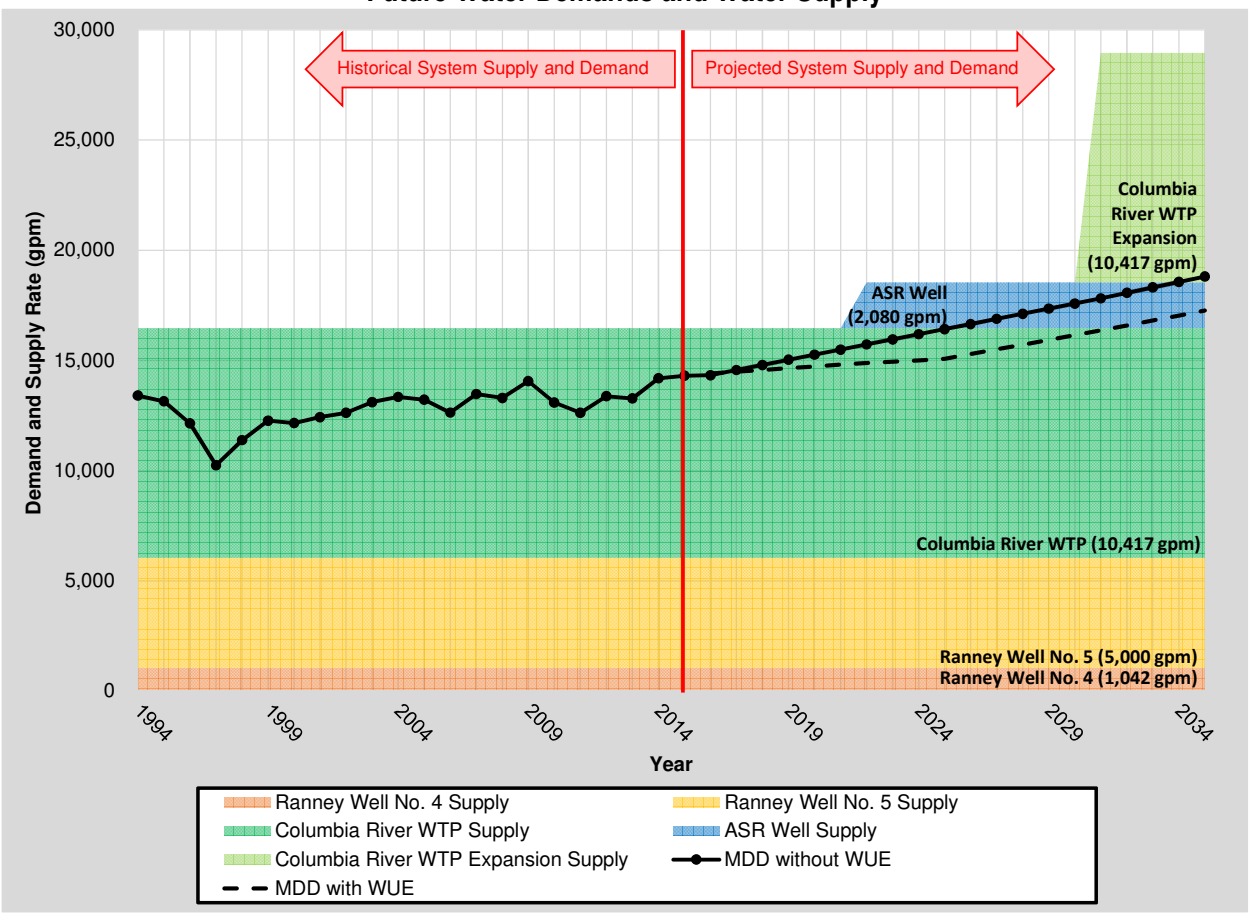
FUTURE WATER DEMANDS AND WATER SUPPLY

Overall water demand within the City's system is estimated to increase by approximately 33 percent by the end of the 20-year planning period. The City's existing active sources are sufficient to meet the projected demands of the system through 2025, but additional source capacity is needed to meet the projected demands beyond 2025.

The City completed construction of an aquifer storage and recovery (ASR) well in 2014. Ongoing testing of the ASR Well and the aquifer storage capacity has been occurring since the well was constructed. If the ASR Well becomes fully developed and is granted source approval by regulatory agencies, a maximum of 2,080 gallons per minute (gpm) may be pumped from the well.

If the maximum ASR Well pumping rate of 2,080 gpm can be achieved, the City is projected to have a slight source capacity deficiency in 2035 based on the projected system maximum day demands (MDD) without reductions from water use efficiency (WUE) efforts, as shown in **Chart ES-1**. The City plans to evaluate an expansion of the Columbia River WTP to meet the projected source capacity requirements.

Chart ES-1
Future Water Demands and Water Supply



WATER SOURCE AND QUALITY

The City's municipal water supply is provided by surface water diverted from the Columbia River, and groundwater pumped from Ranney Wells No. 4 and No. 5. Water from the Columbia River is treated by membrane filtration at the Columbia River WTP. Sodium hypochlorite is injected into the filtered water as the final disinfection process prior to the water entering the clearwell.

Water supplied by the Ranney Wells No. 4 and No. 5 is provided natural filtration by several hundered feet of porous media, and is subjected to ultraviolet light disinfection to treat for *Cryptosporidium* and *Giardia lamblia*. Sodium hypochrlorite is injected into the water prior to it entering a chlorine contact pipeline and the distribution system. The Columbia River WTP and Ranney Wells provide a reliable and high-quality water supply for the City.

In addition to these existing supply facilities, ongoing testing of the ASR Well and the aquifer storage capacity has been occurring since 2014. During testing, the City is analyzing the aquifer's ability to develop a cool water storage zone, establishing baseline and dynamic aquifer parameters, assessing aquifer response, and confirming the compatibility of the City's treated water and groundwater from the ASR Well for long-term drinking water supply.

OPERATIONS AND MAINTENANCE

The City's operations and maintenance organization is staffed by well-qualified, technically trained personnel. City staff regularly participates in safety and training programs to keep abreast of the latest changes in the water industry and to ensure smooth and safe operation of the water system. The current staff of supervisory and maintenance personnel have effectively operated and maintained the water system in the past. The City plans to add staff to properly maintain the system and keep up with system growth as the budget allows.

The City has taken several steps to prepare for emergency situations. The Emergency Response Plan (ERP) was prepared for the City in 2004 and provides information to prepare and assist the City in responding to emergency events. The ERP includes a vulnerability assessment, contingency procedures, and emergency response procedures in accordance with the requirements of the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. Water system improvements completed by the City over the last several years, and proposed improvements identified in this WCP, will reduce the vulnerability of the water system during emergency situations.

WATER SYSTEM EVALUATION

The existing water system was evaluated to determine its ability to meet the policies and design criteria of the City and those mandated by DOH. The results of the evaluation are summarized as follows.

- The City's existing active sources are sufficient to meet the projected demands of the system through 2025, but additional source capacity is needed to meet the projected demands beyond 2025.
- If the maximum ASR Well pumping rate of 2,080 gpm can be achieved, the City is projected to have a slight source capacity deficiency in 2035 based on the projected MDD without reductions from water use efficiency efforts.
- The City's existing booster pump stations have adequate capacity for at least the next 10 years and may be sufficient to meet the projected 2035 demands, depending on the production rate and operational constraints of the ASR Well.
- The City's existing reservoirs have adequate capacity to meet the DOH minimum storage requirements for the next 20 years.
- Several pressure reducing valves are necessary to increase the level of service provided to customers within Zones 1 and 2.
- Several water mains need to be replaced with new water mains to increase fire flows and resolve deficiencies related to undesirable pipe material and aging water main.

PROPOSED WATER SYSTEM IMPROVEMENTS AND FINANCING PLAN

Improvements to the system are primarily necessary to resolve existing system deficiencies, but they will also improve operations, replace older aging infrastructure, and accommodate future water customers. City-funded improvements identified for the first 6 years of the capital improvement program (2016 to 2021) are estimated to cost approximately $12,844,000 (in 2016 dollars), which results in an average expenditure of approximately $2,141,000 per year (in 2016 dollars). Scheduled City-funded improvements in the following 4 years (2022 to 2025) are estimated to cost

approximately $6,327,000 (in 2016 dollars). Scheduled City-funded improvements within the City's 20-year capital improvement program (CIP) (2016 to 2035) are estimated to cost approximately $48,614,000 (in 2016 dollars).

The financial analysis is intended to illustrate the feasibility of funding the operation, maintenance, and capital improvements planned for the water system for the next 6 years. The financial forecast projects that the City is capable of funding the CIP with rate-funded Capital Reserves, Capital Facilities Charges and minimal low interest loans. The revenue needs forecast provides for an approximate 1 percent rate increase each year through 2021.

The City has established rates that are affordable to its customers and has earned a reputation for providing high-quality customer service and outstanding water quality. The City's proven financial strength will ensure that customers will continue to receive the same high-quality level of service they have come to expect.

1 | DESCRIPTION OF WATER SYSTEMS

WATER SYSTEM OWNERSHIP AND MANAGEMENT

The City of Kennewick (City) is a Washington state municipal corporation that owns and operates a Group A community water system within the boundaries of the City. Water system data on file at the Washington State Department of Health (DOH) for the City is shown below in **Table 1-1**.

Table 1-1
Water System Ownership Information

Information Type	Description
System Name	Kennewick, City of
System Type	Group A, Community
DOH System ID Number	38100Q
Primary Operator ID	007563
County	Benton
Address	P.O. Box 6108, Kennewick, WA 99336
Contact	Pat Everham (509.585.4413)

SYSTEM HISTORY AND BACKGROUND

HISTORY

The City of Kennewick Municipal Water System was established in 1949 when the City acquired the Pacific Power and Light Company water system and the Kennewick Irrigation District (KID) water system. The water system in 1949 was supplied by Columbia River water pumped into the water system without filtration, and the Layton Park Wells. Between 1958 and 1960, the City installed five Ranney collector wells on Clover Island with an original combined capacity of 24.5 million gallons per day (MGD). Three of the Ranney wells have been removed from service and the current capacity of the remaining Ranney wells is approximately 15 MGD.

The City's Columbia River Water Treatment Plant (WTP) was constructed in 1980 with an original capacity of 7.5 MGD. The facility capacity has been expanded to 15 MGD, and has the infrastructure to be expanded to 30 MGD in the future.

The City also operates two wells in Columbia Park; the Kiwanis Well is a 25 gallons per minute (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.

TOPOGRAPHY

The topography of the City's water service area varies greatly. The lowest service elevation is approximately 340 feet along the Columbia River, and the highest service elevation is 940 feet in the southern portion of the water service area. This varied terrain has provided a need for six different pressure zones to maintain adequate pressures throughout the system.

INVENTORY OF EXISTING FACILITIES

PRESSURE ZONES

The City's water system consists of five pressure zones served by reservoirs and five small pressure zones served from pressure reducing valves (PRVs). A booster pump station (BPS) has been constructed to provide water supply to a future closed pressure zone (i.e., a pressure zone without a storage facility with the only supply to the pressure zone being pumped), but no water service connections have been installed in this pressure zone. The City's largest zone, both in terms of area and volume of customers, is Zone 2. Zone 1 has the lowest hydraulic grade of the City's pressure zones (531 feet), and is located in the north and northeastern portion of the water system along the Columbia River. Higher pressure zones are located southwest of Zone 1, with the highest pressure zone with water services (Zone 5, 1,045-foot hydraulic grade) located just north of the intersection of State Highway 395 and Interstate 82 (I-82). Development within a future Zone 6 pressure zone 6 is currently underway, but no active water service connections currently exist in Zone 6.

The City's pressure zones and existing system facilities are shown on **Figure 1-1**. The pressure in each pressure zone is regulated by reservoir levels, pressure reducing station settings, pump station settings or a combination of these, as illustrated in the hydraulic profile, **Figure 1-2**.

SUPPLY FACILITIES

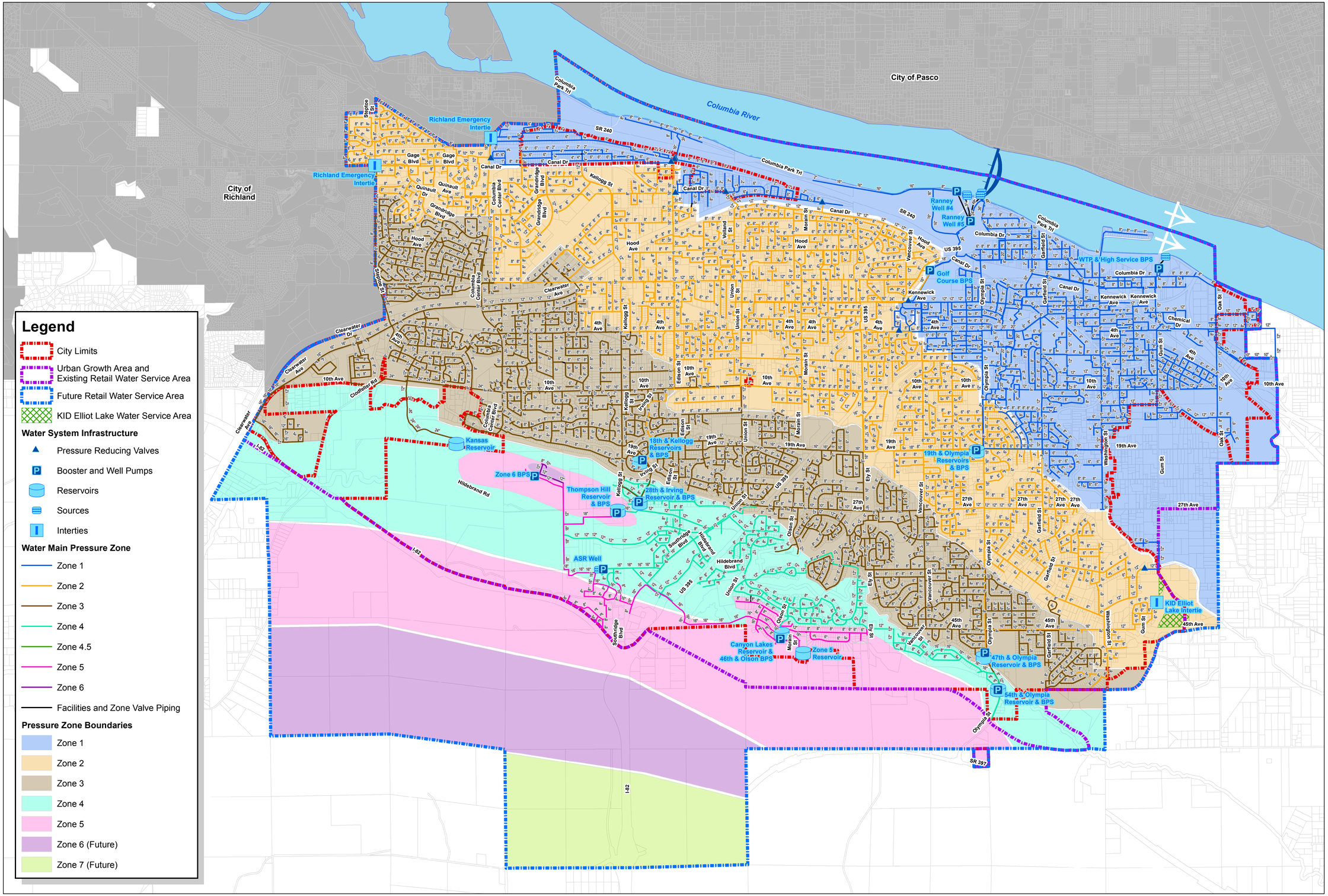
The City's water system is supplied by Ranney Wells No. 4 and No. 5, which have an existing capacity of approximately 10,417 gpm (15 MGD), and a Columbia River surface WTP, which also has an existing capacity of 10,417 gpm (15 MGD). Water from the Ranney Wells and the WTP is pumped directly into Zone 1. The WTP has been constructed with infrastructure to accommodate an expansion to 30 MGD in the future.

A summary of the supply sources and their capacities is shown in **Table 1-2**.

Table 1-2
Supply Facilities Summary

Name	Discharge Pressure Zone	Total Pumping Capacity (gpm)	Total Treatment Capacity (gpm)
Ranney Collector No. 4	Zone 1	833	833
Ranney Collector No. 5	Zone 1	9,583	9,583
WTP Intake	Clearwell	10,417	10,417
Total		**20,833**	**20,833**

In addition to these supply facilities, the City completed construction of an aquifer storage recovery (ASR) well in 2014. The well is located in the southwest portion of the City's existing retail water service area, within Zone 4 of the distribution system, as shown on **Figure 1-1**. The City plans to pump water from the sources shown in **Table 1-2** to recharge the aquifer each winter and spring, and then utilize the ASR well in the summer months to provide additional supply to the water system during peak demand conditions. The ASR well provides the City a source in the southern



Vicinity Map

Figure 1-1
Existing Water System
City of Kennewick
2015 Water Comprehensive Plan

Coordinate System:NAD 1983 StatePlane Washington South FIPS 4602 Feet

By:rwithers

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KENNEWICK WASHINGTON

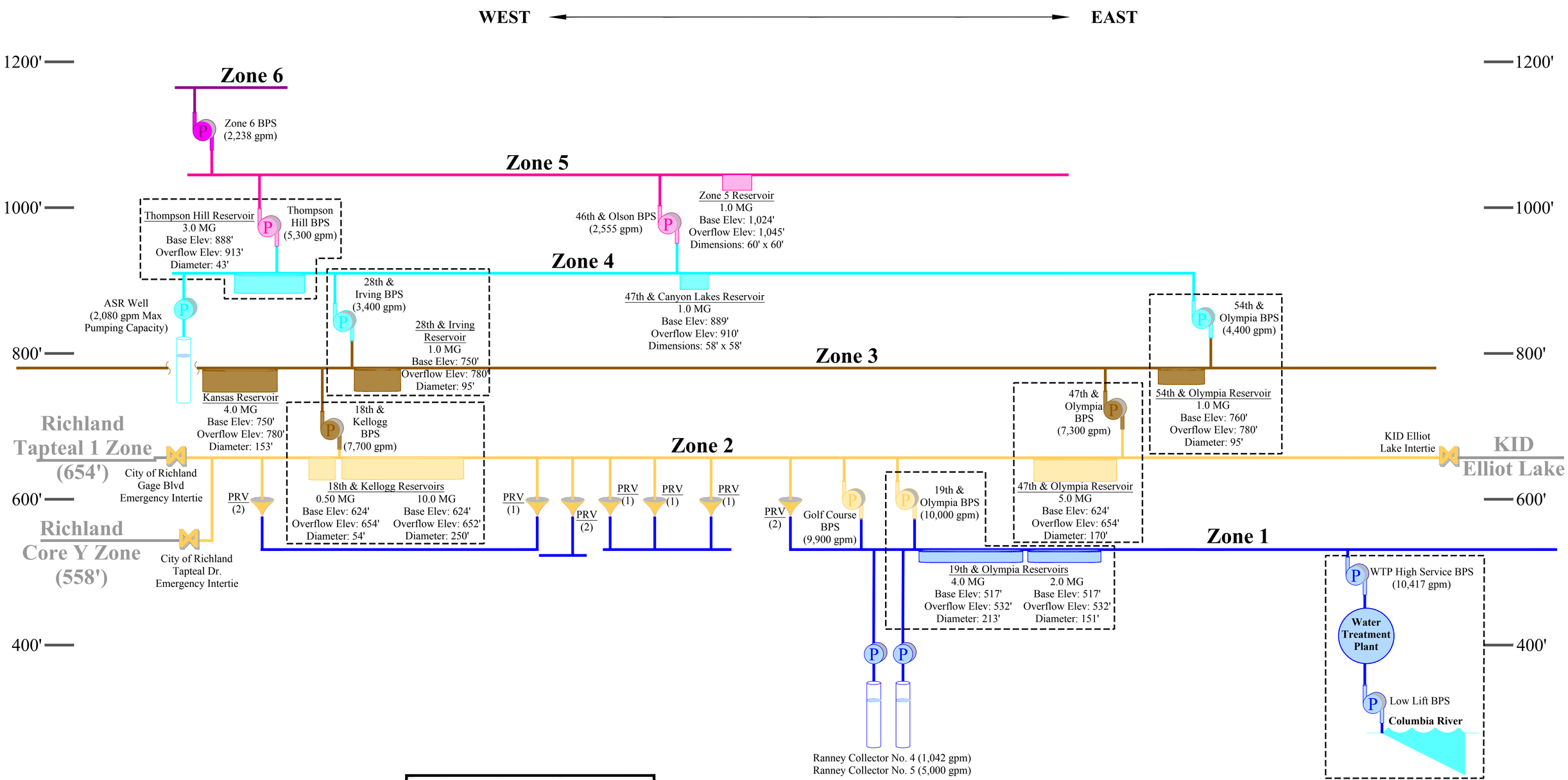
1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 5/2/2016

RH2

NORTH



Legend

Pressure Zones
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6

- Well Pump
- Booster Pump Station
- Pressure Reducing Station
- Facilities at Same Site
- Intertie

Figure 1-2
Existing System Hydraulic Profile

2015 Water Comprehensive Plan

Date: JAN 18, 2016 Filename: \\rh2\dfs\Richland\Data\KENN\715-087\CAD\kenn-hpx.dwg

portion of the water system, which is currently only supplied by the sources shown in **Table 1-2** via a series of BPSs.

Ongoing testing of the ASR well and the aquifer storage capacity has been occurring since 2014. During testing, the City is analyzing the aquifer's ability to develop a cool water storage zone, establishing baseline and dynamic aquifer parameters, assessing aquifer response, and confirming the compatibility of the City's treated water and groundwater from the ASR well for long-term drinking water supply. The City anticipates the aquifer will provide approximately 150 million gallons of underground storage, and that the ASR well will be capable of providing a maximum of 2,080 gpm of supply to the water system, equivalent to the design capacity of the existing well pump. Testing has occurred with the pumped well discharge physically disconnected from the City's distribution system. The City is coordinating with regulatory agencies to obtain source approval for the ASR well based on the testing results.

PUMP STATION FACILITIES

The City's water system has 11 BPS facilities that provide supply throughout the water system. A summary of these pumping facilities is shown in **Table 1-3**.

Table 1-3
Booster Pump Station Facilities Summary

Name	Suction Pressure Zone	Discharge Pressure Zone	Year Constructed	Total Pumping Capacity (gpm)	Number of Pumps	Pump Motor Size (horsepower)
Water Treatment Plant BPS	Clearwell	Zone 1		10,417	4	(2) 250, (2) 400
Golf Course BPS	Zone 1	Zone 2		9,900	3	(3) 250
19th and Olympia BPS	Zone 1	Zone 2		10,000	5	(5) 150
47th and Olympia BPS	Zone 2	Zone 3		7,300	3	(1) 75, (2) 150
45th and Olympia BPS	Zone 3	Zone 4.5		400	2	(2) 20
18th and Kellogg BPS	Zone 2	Zone 3		7,700	3	(1) 75, (2) 150
54th and Olympia BPS	Zone 3	Zone 4		4,400	3	(1) 40, (2) 100
28th and Irving BPS	Zone 3	Zone 4		3,400	3	(1) 40, (2) 100
Thompson Hill BPS	Zone 4	Zone 5	2014	5,300	3	(1) 60, (2) 125
46th and Olson BPS[1]	Zone 4	Zone 5		2,555	3	(1) 15, (1) 40, (1) 100
Zone 6 BPS[2]	Zone 5	Zone 6	2015	2,238	3	(1) 7.5, (2) 75

(1) Also referred to as the Canyon Lakes BPS.

(2) No water service connections are currently located within Zone 6, and therefore the Zone 6 BPS does not currently operate.

STORAGE FACILITIES

The City's water system has 13 storage facility sites that provide direct water storage to six pressure zones. A summary of the City's storage facilities is shown in **Table 1-4**.

Table 1-4
Storage Facilities Summary

Name	Pressure Zone	Year Constructed	Material	Capacity (MG)	Diameter (feet)	Base Elevation (feet)	Overflow Elevation (feet)	Overall Height (feet)
WTP Clearwell	Clearwell		Concrete	0.31		321	338.5	17.50
19th and Olympia E.	Zone 1	1949	Concrete	2.00	151	517	532	15.00
19th and Olympia W.	Zone 1	1949	Concrete	4.00	213	517	532	15.00
47th and Olympia	Zone 2	1972	Concrete	5.00	170	624	654	30.00
18th and Kellogg	Zone 2		Concrete	10.00	250	624	652	28.00
18th and Kellogg	Zone 2	1960	Steel	0.50	54	625	654	29.00
54th and Olympia	Zone 3	1978	Concrete	1.00	95	760	780	20.00
28th and Irving	Zone 3	1978	Concrete	1.00	95	750	780	30.00
Kansas	Zone 3	2006	Concrete	4.00	153	750	780	30.00
47th and Canyon Lakes	Zone 4	1980	Concrete	1.00	58.0 x 58.0 [1]	889	910	21.00
Thompson Hill	Zone 4	2015	Concrete	3.00	143	888	913	25.00
Zone 5 Reservoir	Zone 5	2010	Concrete	1.00	60.0 x 60.0 [1]	1,024	1,045	21.00

(1) Rectangular dimensions

DISTRIBUTION AND TRANSMISSION SYSTEM

The City's water system contains more than 409 miles of water main ranging in size from 2 inches in the distribution system to 48 inches at the City's supply facilities. As shown in **Table 1-5**, most of the water main (approximately 48 percent) within the service area is 8 inches in diameter.

Table 1-5
Water Main Diameter Inventory

Diameter (inches)	Length (feet)	Percentage of Total
4 or smaller	98,753	4.6%
6	458,864	21.2%
8	1,046,234	48.4%
10	36,169	1.7%
12	224,160	10.4%
14	2,578	0.1%
16	177,946	8.2%
18	16,432	0.8%
20	4,985	0.2%
24	15,801	0.7%
30	6,495	0.3%
32	10	0.0%
36	10,210	0.5%
42	980	0.0%
48	1,618	0.1%
Unknown	59,257	2.7%
Totals	**2,160,492**	**100%**

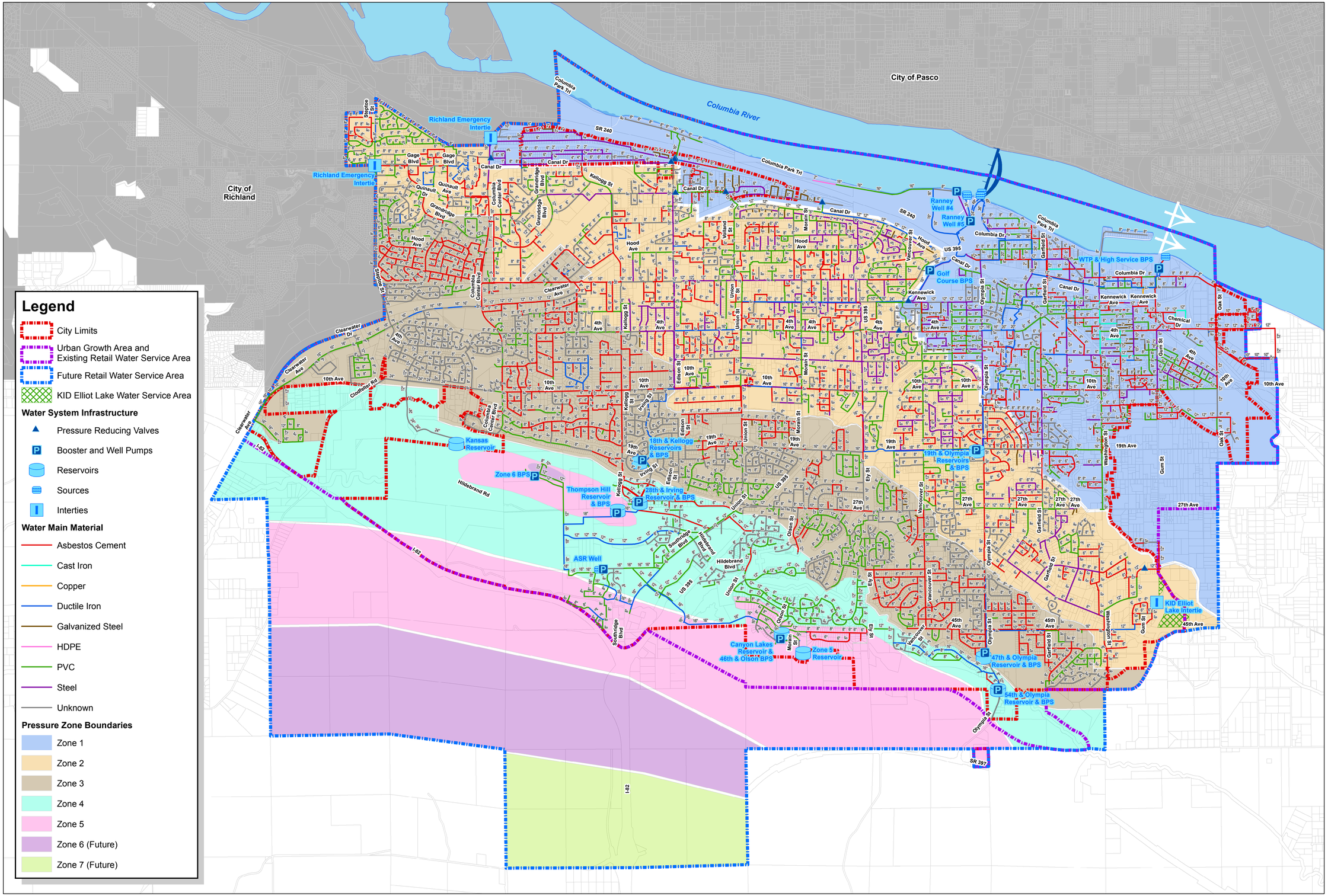
All of the water main in the City's system is constructed of either asbestos cement, cast iron, copper, ductile iron, galvanized steel, high density polyethylene (HDPE), polyvinyl chloride (PVC), and steel, with approximately 30 percent of the system constructed of asbestos cement and 24 percent constructed of PVC. All new water main installations are required to use ductile iron or PVC pipe in accordance with the City's development and construction standards. **Table 1-6** and **Figure 1-3** show the City's existing water main inventory by material.

Table 1-6
Water Main Material Inventory

Water Main Material	Length (feet)	Percentage of Total
Asbestos Cement	646,868	29.9%
Cast Iron	7,183	0.3%
Copper	375	0.0%
Ductile Iron	124,399	5.8%
Galvanized Steel	33,110	1.5%
HDPE	1,045	0.0%
PVC	526,598	24.4%
Steel	256,601	11.9%
Unknown	564,313	26.1%
Totals	**2,160,492**	**100%**

EXISTING RETAIL WATER SERVICE AREA

The City is located in Benton County, Washington, on the right bank of the Columbia River. The City limits encompasses an area of approximately 28.61 square miles, and the City's urban growth area (UGA) encompasses an additional 3.27 square miles outside of the current City limits, for a total area of approximately 31.88 square miles. The existing retail water service area is identical to the UGA, which is shown in **Figure 1-1**, and includes a portion of KID's Elliot Lake water system in the eastern portion of the City limits. The City's water system is located immediately east of the City of Richland's (Richland) water system. Columbia Irrigation District and KID also provide irrigation service throughout much of the City's water system, as shown in **Figure 1-4**. A summary of the current water system data for the City's water system is shown in **Table 1-7**.



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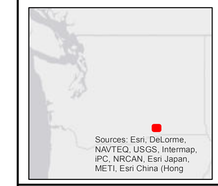

Coordinate System:NAD 1983 StatePlane Washington South FIPS 4602 Feet

By:rwithers

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Figure 1-3
Water Main Material
City of Kennewick
2015 Water Comprehensive Plan

KENNEWICK WASHINGTON

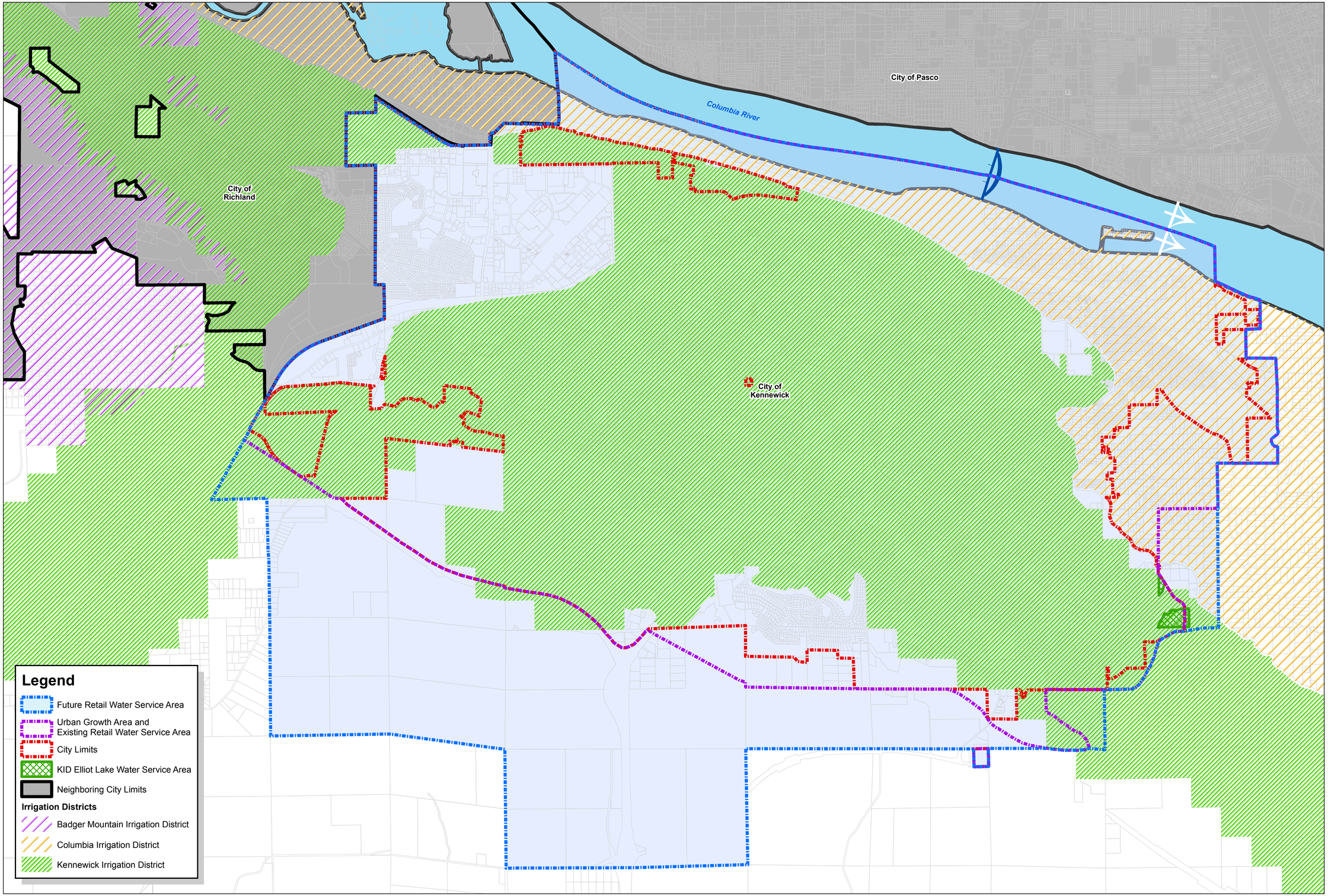
1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 5/2/2016

RH2 ENGINEERING

NORTH



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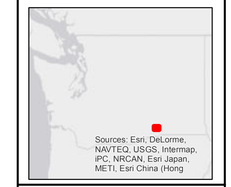

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Figure 1-4
Adjacent Purveyors and Irrigation Districts
City of Kennewick
2015 Water Comprehensive Plan

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 5/2/2016

NORTH

Table 1-7
Kennewick Water System Data

Information Type	Description
Water Service Area Population	80,986
Existing Retail Water Service Area	31.88 square miles
Total Connections	23,801
Total ERU	10,538
Demand per ERU	252 gallons per day per ERU
Demand per Capita	134 gallons per day per capita
Average Annual Supply	4,011 million gallons
MDD/ADD Factor	1.88
PHD/MDD Factor	1.54
Supply Capacity	23.7 million gallons per day
Storage Capacity	32.81 million gallons
Length of Water Piping	409.2 miles

The City's water system has 23,801 connections and serves a population of 80,986. The existing retail water service area comprises approximately 31.88 square miles. Water supply is provided by two Ranney wells and the Columbia River. It is stored in 13 reservoirs with a total capacity of 32,810,000 gallons. Water supply from all sources is chlorinated.

FUTURE RETAIL WATER SERVICE AREA

The City's future retail water service area includes additional area outside of the existing service area, and mostly includes expansion south of Interstate 82, which is the southerly boundary of the City's existing service area. The City's future retail water service area encompasses an area of approximately 40.92 square miles, and is shown in **Figure 1-1**.

Compatibility with Related Plans

To ensure that this WCP is consistent with other related plans, the following planning documents were examined.

- State of Washington Growth Management Act
- *Benton County Comprehensive Land Use Plan*
- *City of Kennewick Comprehensive Plan*
- *Regional Water Supply Feasibility Study*
- *Regional Water Forecast and Conservation Plan*

Growth Management Act

The State of Washington Growth Management Act (GMA), has been most recently updated in 2014. The GMA requires, among other things, consistency between land use and utility plans and

their implementation. The State of Washington GMA of 1990 (and its multiple amendments) defined four goals relevant to this report:

1. Growth should be in urban areas;
2. There should be consistency between land use and utility plans and their implementation;
3. There should be concurrency of growth with public facilities and services; and
4. Critical areas should be designated and protected.

The GMA requires planning consistency from two perspectives. First, it requires consistency of plans among jurisdictions. This means that plans and policies of the City and County must be consistent (RCW 36.70A.100). Second, the GMA requires the implementation of the WCP be consistent with the comprehensive plans (RCW 36.70A.120).

The 2003 Municipal Water Law also requires that water system plans are consistent with local plans and regulations. The signed Consistency Statement Checklist (included in **Appendix Y**) from the City Planning Department documents the determination for this WCP to be consistent with relevant plans and regulations. An ordinance confirming and adopting the WCP from Benton County is also included in **Appendix Y** for the portions of the County that is served by the City.

The GMA also requires that critical areas be designated and protected. Critical areas include aquifer recharge areas, wetlands, streams, and geologically hazardous areas. The State Environmental Policy Act (SEPA) checklist in **Appendix Y** addresses other environmental concerns.

City of Kennewick Comprehensive Plan

The Land Use Element of the city's comprehensive plan is the city's vision of how growth and development should occur over a 20-year horizon. While the Land Use Element goals and policies set forth general standards for locating land uses, the future land use maps indicate geographically where certain types of uses may be appropriate. The future land use map is a blueprint for development of an area, whereas the zoning map and zoning code are the regulatory means for implementing it.

The Land Use Element of the city's comprehensive plan considers the general location of land uses, as well as the appropriate intensity and density of land uses given the current development trends. The utilities, transportation, and capital facilities elements ensure that new development will be adequately serviced without compromising adopted levels of service, similar to the principal of concurrency as defined in the GMA. The City's WCP is reviewed and taken into consideration during the development and subsequent revisions to the comprehensive plan.

Benton County Comprehensive Land Use Plan

The County originally adopted the *Benton County Comprehensive Land Use Plan* on March 12, 2007. Since this time, the plan has been amended several times to incorporate UGA changes, capital facility plan changes, and land use changes. The most recent amendments took effect in March 2013 to include data through 2012. The County's Comprehensive Land Use Plan guides development in rural, unincorporated Benton County and designates land uses in unincorporated UGAs.

Regional Water Supply Feasibility Study

The *Regional Water Supply Feasibility Study* (RWSFS), originally prepared in 2003 and updated in the spring of 2016, provides a detailed analysis of how the Cities of Kennewick, Richland, and West

Richland will obtain, treat, and distribute water south and west of the Columbia River. The RWSFS develops 50-year demand projections for each city, analyzes the hydraulics between the three cities, evaluates the feasibility of a regional treatment facility, and develops a detailed implementation plan for three future supply alternatives.

Regional Water Forecast and Conservation Plan

The *Regional Water Forecast and Conservation Plan* (RWFCP), originally prepared in September 2008 and updated in the spring of 2016, forecasts the long-term needs of the Cities of Kennewick, Pasco, Richland, and West Richland "to serve as a common demand forecast by the four cities when they update their water system plan." The RWFCP recommends a strategy to use the entire Quad City water right of 178 cubic feet per second (cfs) under Application No. S4-30976 between the four cities. The intent of the RWFCP is to supplement the RWSFS and each city's individual water system plan.

SERVICE AREA AGREEMENTS AND POLICIES

KENNEWICK AND RICHLAND WATER SERVICE AREA AGREEMENTS

The City has a water service area agreement with Richland that establishes each city's service area for providing water and sewer service along the shared boundary line between the two cities. The agreement, dated August 31, 1977, rescinds a 1967 agreement between the two cities that was established prior to each cities' corporate boundaries sharing a common boundary. The agreements expired on January 1, 1990, and were not renewed as a result of each cities' corporate boundaries having been expanded to this shared boundary line prior to this date. A copy of the original 1967 agreement and the subsequent 1977 agreement are contained in **Appendix A**.

The City and Richland also have two water service agreements identifying the water and sewer service boundaries and conditions of service near the I-82 Badger Canyon interchange, located at the southwesterly extent of the City's existing service area. The agreements provided for a supply intertie between the City and Richland for the City to provide up to 200 gpm of domestic water supply to a small portion of Richland's water system that was originally unable to be supplied by Richland's water system. The agreements, dated January 27, 1994, and March 2, 1999, are contained in **Appendix A**. Since these agreements were established, Richland has extended domestic water supply to this area, and presently serves this portion of its city limits. The City does not currently provide water service to Richland near the I-82 Badger Canyon interchange, and no intertie currently exists.

KENNEWICK AND KENNEWICK IRRIGATION DISTRICT WATER SERVICE AREA AGREEMENTS

The City also has a regular supply intertie agreement with KID, located approximately 1,000 feet south of the intersection of Gum Street and Kingwood Street in the City's Zone 2 pressure zone. The purpose of this intertie is to provide up to 150 gpm of supply to KID's Elliot Lake potable water system, which is currently owned and operated by KID. The intertie consists of 6-inch-diameter piping and valving that provides regular water supply to KID's Elliot Lake water system, which is comprised of approximately 48 single-family residences. The City is currently evaluating an

acquisition of the Elliot Lake water system. A copy of the City's agreement with KID relating to the Elliot Lake water system is contained in **Appendix B**.

EMERGENCY SUPPLY INTERTIES

The City has two emergency intertie agreements with Richland; one located at the intersection of Gage Boulevard and Steptoe Street; and one located near the intersection of Columbia Center Boulevard and Tapteal Drive, as shown in **Figure 1-1**. The Gage Boulevard and Steptoe Street intertie connects Richland's Tapteal 1 pressure zone (654-foot hydraulic grade) with the City's Zone 2 (657-foot hydraulic grade). The emergency intertie consists of a 16-inch-diameter isolation valve that is normally closed and must be manually opened to flow water to either city during an emergency situation. An emergency situation may occur when one water system loses its main source of supply, or a major transmission main, or during firefighting situations, and is unable to provide a sufficient quantity of water to its customers. The agreed operation of the emergency intertie is contained in an agreement, dated March 5, 1975, a copy of which is included in **Appendix C**.

The Columbia Center Boulevard and Tapteal Drive intertie connects the City's Zone 2 (657-foot hydraulic grade) with Richland's Core Y Pressure Zone (558-foot hydraulic grade). The intertie consists of an isolation valve that is normally closed and must be manually opened to flow water during an emergency situation. Because the hydraulic grade of the City's adjacent pressure zone is 99 feet greater than Richland's at this location, piping was installed at the intertie to facilitate installation of a temporary pump in the event that the City requires emergency supply from Richland. The operation of the emergency intertie is contained in an agreement, dated November 16, 2004, a copy of which is included in **Appendix C**.

CONDITION OF SERVICE

The City has the stability and authority to ensure water service and will continue to provide high-quality water and service. Decisions regarding the water system are made by the City's Public Works Director. The City has sufficient water rights such that water availability is a technical issue, based upon the location of the property and available capacity in the specific pressure zone. The City's water system model can evaluate the supply capacity, while storage needs are tabulated and managed on an equivalent residential units (ERU) basis.

SATELLITE SYSTEM MANAGEMENT AGENCY

A Satellite System Management Agency (SSMA) is defined as a person or entity that is certified by the DOH to own or operate more than one public water system without the necessity for a physical connection between such systems. SSMAs were created to stop the proliferation of small water systems, many of which could not meet federal and state water quality and water system planning regulations. Based on the success of SSMAs, DOH made recommendations to the legislature to include rules for designating entities as qualified SSMAs.

In July 1995, Senate Bill 5448 became law, governing approval of new water systems and setting forth requirements for SSMAs. The goal of the law is to ensure that the people of Washington state will receive safe and reliable water supplies in the future from professionally-managed or properly-operated water systems. SSMAs can provide three different levels of service:

1. Ownership of the satellite system;
2. Operations and management of the satellite system; or
3. Contract services only.

The service can be provided to new systems, existing systems that are no longer viable, or existing systems placed into receivership status by DOH.

The City is responsible for providing water service to all customers in the City's water service area defined in this Water Comprehensive Plan (WCP). Other than KID's Elliot Lake water system, all areas surrounding the City's service area are currently being served by large, stable water systems that are unlikely to be future satellite water systems operated by the City.

In the event that a neighboring water system needs the City's assistance, the City will evaluate providing the necessary satellite management services. Upon agreement between the two systems, the City will pursue the necessary steps to become an approved SSMA. These include:

- Submitting a notice of intent to the DOH;
- Participating in a pre-submittal meeting with the DOH;
- Submitting a SSMA plan to the DOH that meets the plan requirements; and
- Obtaining approval of the plan from the DOH.

DUTY TO SERVE

The City has a duty to service its community with safe, clean water. The four threshold factors for duty to serve are as follows:

1. Capacity: The capacity of the systems to serve the anticipated future needs is addressed as part of the system analysis in **Chapter 3**.
2. Consistency: The *Benton County Land Use Plan* and development regulations for the retail service area allow for the development of residential, industrial, and commercial lands within the City's UGA. The annexation process between the City and Benton County (County) ensures that the retail service area does not exceed the UGA.
3. Water Rights: Water rights self-assessments are included in **Chapter 4** to demonstrate the available supplies are provided within the retail service area.
4. Timely and Reasonable: New buildings and facilities that are within the retail service area will be served. Service policies define how new service will be provided when the City infrastructure requires improvement.

LOCAL GOVERNMENT CONSISTENCY

The City's planning area is part of both the City's corporate boundary and the County. The Local Government Consistency Review Checklists from the City and County are included in **Appendix Y**.

WATER RESOURCE INVENTORY AREA (WRIA) PLANNING

The City's planning area is predominantly part of WRIA 31, Rock-Glad Basin, with a small portion of the western portion of the City's water service area a part of WRIA 40, Lower Yakima Basin. The County, Klickitat County, and the City signed an intergovernmental agreement in May 2003 to begin watershed planning for WRIA 31. A 2008 Watershed Management Plan was completed as part of this planning process, and is included as **Appendix I**.

Summary of Plan Contents

A brief summary of the content of the chapters in this WCP is as follows:

- **Executive Summary**: Provides a brief summary of the key elements of this WCP.
- **Chapter 1 – Description of Water Systems**: Introduces the reader to the City's water system, the objectives of the WCP and the WCP organization. Presents the water service areas, and describes the existing water system.
- **Chapter 2 – Planning and Water Demands**: Identifies current water use, projections, and production and consumption totals.
- **Chapter 3 – System Analysis**: Identifies system design standards, inventory, capacity and water quality analysis, and system deficiencies.
- **Chapter 4 – Water Use Efficiency Program**: Identifies the City's Water Use Efficiency Program and the City's water right self-assessment forms.
- **Chapter 5 – Source Water Protection**: Presents the City's wellhead protection program.
- **Chapter 6 – Operations and Maintenance**: Discusses the City's operations and maintenance program.
- **Chapter 7 – Policies and Design Criteria Program**: Presents the City's design standards.
- **Chapter 8 – Capital Improvement Plan**: Presents the proposed water system improvements, their estimated costs, and implementation schedules.
- **Chapter 9 – Financial Plan**: Summarizes the financial status of the City and presents a program for funding the water system improvements.
- **Chapter 10 – Miscellaneous Documents**: Presents the City's emergency and supply interties with adjoining utilities.
- **Appendices**: Contains additional information and plans that supplement the main chapters of this WCP.

Definition of Terms

The following terms are used throughout this WCP:

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

Cross-connection: A physical arrangement that connects a public water system, directly or indirectly, with anything other than another potable water system and presents the potential for contaminating the public water 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, as well as 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 MGD or 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 as follows:

- **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.
- **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.

Equivalent Residential Units (ERUs): One ERU represents the amount of water used by one single-family residence for a specific water system. The demand of other customer classes can be expressed in terms of ERUs by dividing the demand of each of the other customer classes by the demand represented by one ERU.

Fire Flow: The rate of flow of water required during fire fighting, which is usually expressed in terms of gpm.

Head: A measure of pressure or force exerted by water. Head is measured in feet and can be converted to pounds per square inch (psi) by dividing feet by 2.31.

Head Loss: Pressure reduction resulting from pipeline wall friction, bends, physical restrictions or obstructions.

Hydraulic Elevation: The height of a free water surface above a defined datum; the height above the ground to which water in a pressure pipeline would rise in a vertical open-end pipe.

Maximum Contaminant Level (MCL): The maximum permissible level of contaminant in the water that the purveyor delivers to any public water system user, measured at the locations identified under Washington Administrative Code (WAC) 246-290-300, Table 3.

Potable Water: Water suitable for human consumption.

Pressure Zone: A portion of the water system that operates from sources at a common hydraulic elevation.

Purveyor: An agency, special purpose district, 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 that may consist of supply stations, BPSs, and wells.

Storage: Water that is stored in a reservoir to supplement the supply facilities of a system and provides water supply for emergency conditions. Storage is broken down into the following five components, which are defined and discussed in more detail in **Chapter 3**: 1) operational storage; 2) equalizing storage; 3) standby storage; 4) fire flow storage; and 5) dead storage.

List of Abbreviations

The abbreviations listed below in **Table 1-6** are used throughout this WCP.

Table 1-6
Abbreviations

Abbreviation	Description
ADD	Average Day Demand
AWWA	American Water Works Association
CIP	Capital Improvement Program
City	City of Kennewick
DOH	Department of Health
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
fps	feet per second
gpm	gallons per minute
MDD	Maximum Day Demand
MG	Million Gallons
MGD	Million Gallons per Day
mg/l	milligrams per liter
PDD	Peak Day Demand
PHD	Peak Hour Demand
psi	pounds per square inch
SDWA	Safe Drinking Water Act
WAC	Washington Administrative Code

2 | BASIC PLANNING DATA

EXISTING DATA

EXISTING LAND USE

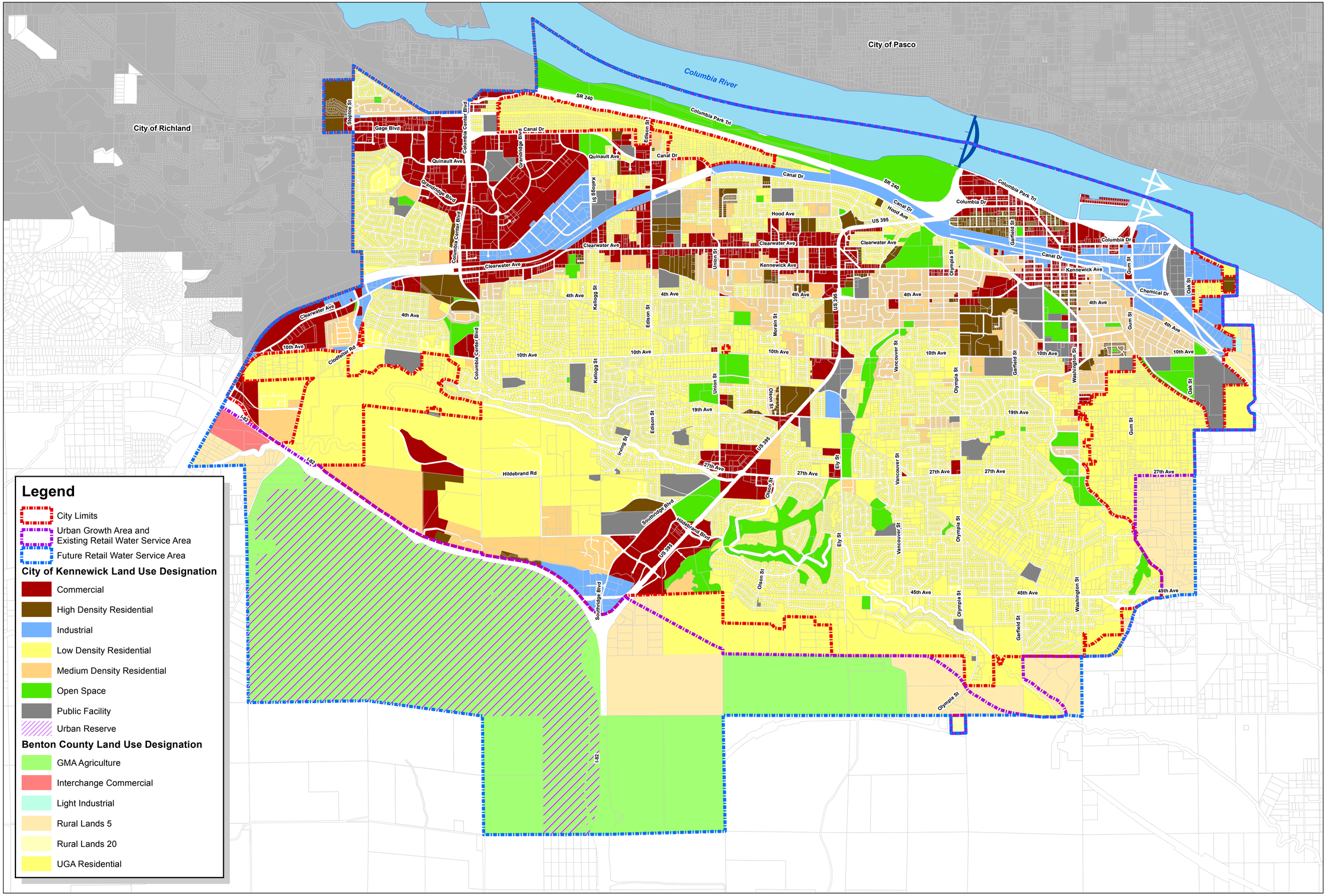
The City limits currently encompass an area of approximately 28.61 square miles, and is shown in **Figure 2-1**. The City's urban growth area (UGA) encompasses an additional 3.27 square miles outside of the current City limits, for a total area of approximately 31.88 square miles. The existing retail water service area is identical to the UGA; however, the future retail water service area is larger, encompassing an additional 9.04 square miles outside of the current UGA, for a total area of approximately 40.92 square miles.

The City's land use designations, as shown in **Figure 2-1**, guide City development. **Figure 2-1** represents the City's future land uses, with the exception of future changes in land use as a result of City-initiated neighborhood plan updates and private citizen requests. Benton County (County) land use designations for areas within the City's future water service area and outside of the City limits are also shown in **Figure 2-1**.

Most of the area within the City limits, UGA, and future retail water service area is designated for low density residential use. Of the 3.44 square miles of commercial area within the future retail water service area, approximately 0.88 square miles (26 percent) are undeveloped or are not fully developed. A summary of the existing land uses within the City's future retail water service area is presented in **Table 2-1**.

Table 2-1
Summary of Land Use Designations

Land Use	Area (square miles)		
	Within City Limits	Within UGA	Within Future Water Service Area
City Land Use			
Commercial	3.44	3.44	3.44
High Density Residential	0.91	0.91	0.91
Industrial	1.24	1.24	1.24
Low Density Residential	11.18	11.18	11.18
Medium Density Residential	2.52	2.52	2.52
Open Space	1.78	1.78	1.78
Public Facility	1.08	1.08	1.08
Right-of-way and Water Bodies	6.47	6.47	6.47
City Land Use Total	**28.61**	**28.61**	**28.61**
County Land Use			
GMA Agriculture	---	---	7.15
Interchange Commercial	---	---	0.09
Light Industrial	---	0.01	0.01
Rural Lands 5	---	0.23	1.94
Rural Lands 20	---	0.02	0.02
UGA Residential	---	3.01	3.09
County Land Use Total	**0.00**	**3.27**	**12.31**
Grand Total	**28.61**	**31.88**	**40.92**



Vicinty Map

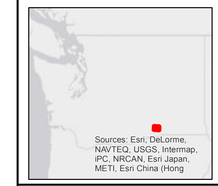


Figure 2-1
Land Use

City of Kennewick
2015 Water Comprehensive Plan

Coordinate System:NAD 1983 StatePlane Washington South FIPS 4602 Feet

By:rwithers

\\rh2\dfs\Richland\Data\KENN\715-087\GIS\maps\LUSE_ex.mxd

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 1/18/2016

NORTH

EXISTING POPULATION

The City primarily consists of residential communities comprised largely of single-family residences. In 2014, the Washington State Office of Financial Management (OFM) estimated that 63 percent of all housing units in the City were single-family residential. According to OFM, the average household size in the City for all single-family residential, multi-family residential, and mobile home residences was 2.60 persons per household in 2014, compared to 2.55 persons per household Countywide.

The County has continued to experience rapid population growth and additional physical developments in recent years. The population of Benton County increased by more than 6 percent from 2010 to 2014. The population of the City increased approximately 5 percent during the same period. The population of the City has steadily increased since 1990. The City's historical population data within the established City limits since 1990 is shown in **Table 2-2**, and has been assembled from OFM records.

Table 2-2
Historical Population Trends

Year	City Limits Population[1]	Water Service Area Population[2]
1990	42,152	---
1995	47,538	56,419
2000	54,751	60,780
2005	62,715	65,744
2008	69,865	68,128
2010	73,917	72,940
2011	74,665	76,356
2012	75,160	77,078
2013	76,410	78,334
2014	77,700	80,986

(1) Census data for 1990, 2000, and 2010. OFM intercesnal estimates for all other years.

(2) 1995 through 2005 data presented in City's 2009 WCP. 2001 through 2014 data calculated based on 2.60 persons per household and City-provided single and multi-family residential unit counts.

The actual number of people served by the City's water system differs from the City limits population, as the water service area includes customers outside of the current City limits. The City's 2010 *Water Comprehensive Plan* (WCP) estimated a water service population of 2,268 outside of the City limits, resulting in a water service area population of 68,128 in 2008 (**Table 2-2**). The average household size of 2.60 persons per household, combined with the average number of housing units receiving water service, was used to calculate the historical water service area population from 2011 through 2014, as shown in **Table 2-3**. The 2010 water service area population was estimated based on the 2008 population presented in the City's 2010 WCP and the calculated 2011 population shown in **Table 2-3**.

Table 2-3
Historical Residential Units Served and Water Service Area Population

Year	Single-family Residential Units	Multi-family Residential Units	Total Units Served	Persons per Household	Water Service Area Population
2011	18,524	10,883	29,407	2.60	76,356
2012	18,688	10,997	29,685	2.60	77,078
2013	18,930	11,238	30,168	2.60	78,334
2014	19,975	11,214	31,189	2.60	80,986

WATER USE CLASSIFICATIONS

The City has divided all water customers into four different classes for billing purposes: single-family residential; multi-family residential; commercial; and municipal. The demand analysis will report on the water use patterns of the four user groups.

EXISTING WATER DEMANDS

WATER CONSUMPTION

Water consumption is the amount of water used by all customers of the system, as measured by the customers' meters. **Table 2-4** shows the historical average number of connections and average annual consumption within the City from 2008 through 2014. As shown in **Chart 2-1**, the single-family residential class represents approximately 84 percent of all connections in 2014, but only 45 percent of total system consumption, as shown in **Chart 2-2**. This is due to lower consumption per connection of single-family residential customers as compared to other customers.

Table 2-4
Average Annual Metered Consumption and Service Connections

Year	Customer Class				Totals
	Single-family Residential	Multi-family Residential[1]	Commercial	Municipal	
Average Number of Connections					
2008	17,592	1,177	1,943	148	20,860
2009	17,873	1,170	1,968	152	21,163
2010	18,206	1,171	2,006	152	21,535
2011	18,524	1,175	2,033	160	21,892
2012	18,688	1,183	2,061	166	22,098
2013	18,930	1,182	2,085	167	22,364
2014	19,975	1,255	2,390	181	23,801
Annual Consumption (gallons)					
2008	1,602,517,593	500,325,762	1,017,123,585	391,903,395	3,511,870,335
2009	1,733,186,967	617,664,885	966,503,042	356,655,279	3,674,010,173
2010	1,587,519,191	604,342,115	918,874,698	371,346,981	3,482,082,984
2011	1,598,243,983	602,450,296	909,764,945	381,922,164	3,492,381,388
2012	1,618,486,216	615,320,496	1,020,532,449	389,739,286	3,644,078,448
2013	1,685,980,524	615,186,595	954,634,480	446,616,520	3,702,418,119
2014	1,731,064,001	616,093,681	1,027,079,382	441,848,449	3,816,085,514
Average Daily Consumption per Connection (gal/day/conn)					
2008	250	1,165	1,434	7,255	461
2009	266	1,446	1,346	6,429	476
2010	239	1,414	1,255	6,693	443
2011	236	1,405	1,226	6,540	437
2012	237	1,425	1,357	6,432	452
2013	244	1,426	1,254	7,327	454
2014	237	1,345	1,177	6,688	439
2008 - 2014 Average	244	1,375	1,293	6,766	452

(1) Each multi-family residential connection serves multiple housing units.

Chart 2-1
2014 Water Connections by Customer Class

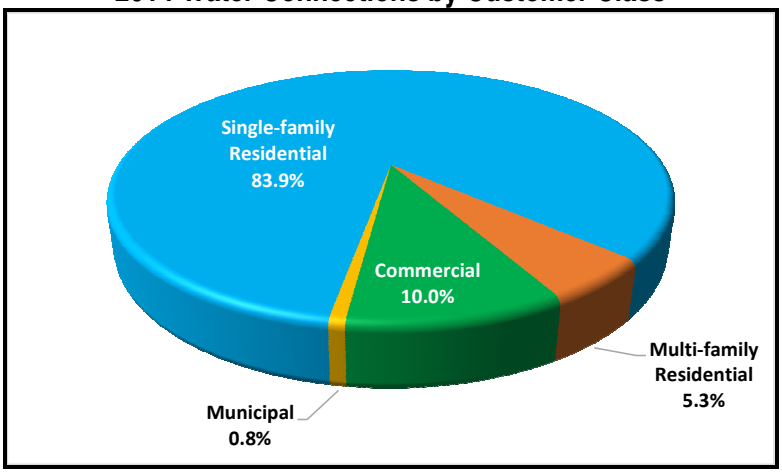
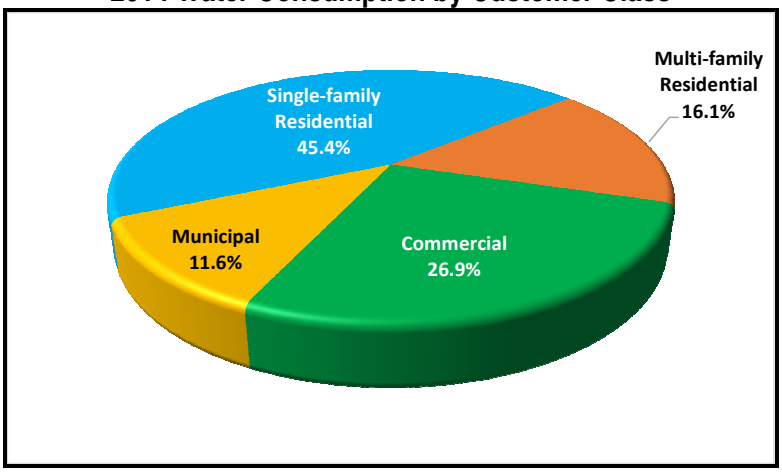


Chart 2-2
2014 Water Consumption by Customer Class



As shown in **Table 2-4**, single-family residential customers consume an average of approximately 244 gallons per day per connection; multi-family customers consume an average of approximately 1,375 gallons per day per connection; commercial customers consume an average of approximately 1,293 gallons per day per connection; and municipal customers consume an average of approximately 6,766 gallons per day per connection. The higher consumption from non-single-family residential customers is expected, since these customers include multi-family residential customers where one connection typically serves several units, commercial customers that include the system's highest individual water users, and municipal connections that include City-owned parks and other areas requiring large water volumes.

Table 2-5 shows the largest water users of the system in 2014 and their total amount of metered consumption for the year. The total water consumption of these 20 individual water meters represented approximately 10 percent of the system's total consumption in 2014. The list of accounts in **Table 2-5** primarily consists of City-owned parks, apartment complexes, and commercial businesses.

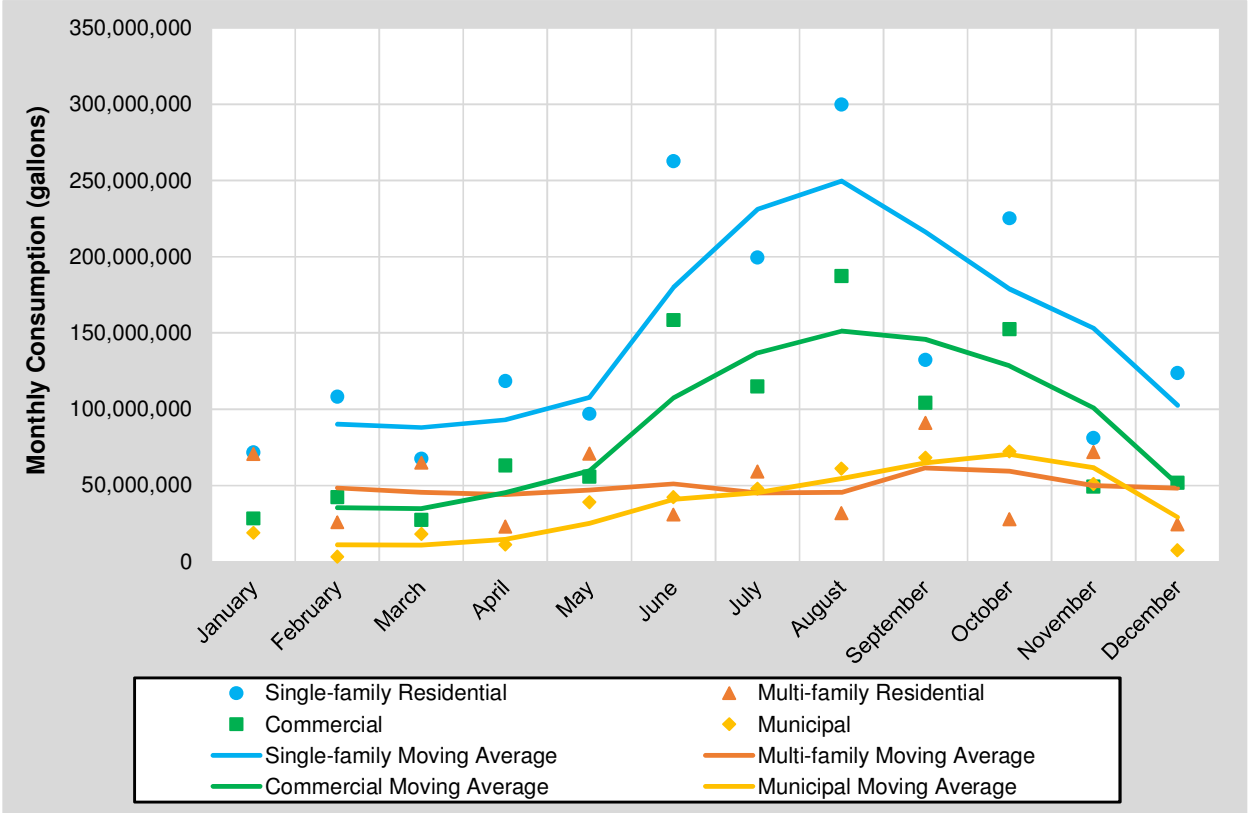
Table 2-5
2014 Largest Water Users

Name	Address	Total Annual Consumption (gallons)
City of Kennewick - Wastewater Treatment Plant	213 N Nutmeg Street	90,536,492
J Lieb Foods	10 E Bruneau Avenue	58,113,012
City of Kennewick - Lawrence Scott Park	6020 W Quinault Avenue	28,808,902
Crestwood Investments	3324 W 19th Avenue	25,716,463
City of Kennewick - Grange Park	1620 S Union Street	23,204,511
City of Kennewick - Wastewater Treatment Plant	416 N Kingwood Street	19,803,876
Benton County Justice Center	7122 W Okanogan Place	18,291,319
City of Kennewick - Southridge Sports Complex[1]	2901 Southridge Boulevard	14,302,716
Wolff Grandridge Apts, LLC	725 N Center Parkway	13,874,083
City of Kennewick - Southridge Sports Complex[2]	2901 Southridge Boulevard	13,509,035
City Of Kennewick - Hansen Park[3]	602 S Columbia Center Boulevard	13,280,132
Baker Produce	223 W Railroad Avenue	12,648,029
City Of Kennewick - Hansen Park[4]	602 S Columbia Center Boulevard	12,576,965
Lakeside Apartments	5100 W Clearwater Avenue	11,909,704
Columbia Mobile Village	4815 W Clearwater Avenue #A	11,068,896
City Of Kennewick - Columbia Center Blvd. Irrigation System	7531 W Okanogan Place	10,839,993
Santiago Sunset Estates	2105 N Steptoe Street #2	10,238,560
Benton County Justice Center	7122 W Okanogan Place	10,130,841
Whispering Winds Home Park	2930 W 7th Ave	9,872,764
City Of Kennewick - Sunset Park	733 N Center Parkway	9,556,339
Top 20 Users Consumption Total		418,282,630
Water System Total Consumption		3,816,085,514
Percentage of Total		11.0%

(1) Account No. 49002966-00.
(2) Account No. 49002965-00.
(3) Account No. 48000525-00
(4) Account No. 48000526-00.

Demand varies throughout the year, typically peaking in the hot summer months. Residential and commercial customers often peak at different times or have different peaking factors because their uses differ. Based on the average of 2013 and 2014 monthly consumption data (2012 monthly data was unavailable), the demand for single-family residential customers in the City's water service area peaks in August, as shown in **Chart 2-3**. However, since the City reads meters every other month, the monthly consumption shown on the chart is not entirely indicative of the specific month when the consumption occurred. The August peak is based on meter readings in August, but the actual peak consumption may have occurred in July. A two-period moving average trendline is shown in **Chart 2-3** for each customer class to approximate the actual monthly consumption based on 2013 and 2014 average consumption data. The 2013 and 2014 average consumption data are also shown in **Chart 2-3** as data points.

Chart 2-3
Historical Monthly Consumption by Customer Class



WATER SUPPLY

Water supply is the total amount of water supplied to the system, as measured by the meters at each supply source. Water supply differs from water consumption in that water supply is the recorded amount of water put into the system, and water consumption is the recorded amount of water taken out of the system. The measured amount of water supply in any system is typically more than the measured amount of water consumption, due to water system leaks and non-metered water uses, which will be described more in the **Distribution System Leakage** section. Additionally, the City completed the construction of an aquifer storage recovery (ASR) well in 2014, which utilizes water from the City's water treatment plant (WTP) and Ranney wells for aquifer recharge. ASR well testing took place in 2014 and 2015, with the City authorized to supply ASR recovery water into the potable water system, which is discharged directly into Zone 4 of the water system. The 2014 and 2015 net supply to the water system is the WTP supply, Ranney well supply, and ASR recovery supply (gross supply) without the volume of water utilized to recharge the ASR well.

Connection and consumption volumes by customer class for 2015 were not available in early 2016 for inclusion with this WCP. However, monthly 2015 supply volumes by source were available, and have been included in this WCP. **Table 2-6** summarizes the total amount of water supplied by the City's sources from 1994 through 2015, the City's annual water service area population, the calculated average day demand (ADD), and the ADD per capita.

Table 2-6
Historical Water System Demand

Year	Annual Supply Volume (MG)[1]								Average Day Demand (gpm)	Water Service Area Population	Average Demand Per Capita (gal/day/capita)
	WTP	Ranney Well No. 4	Ranney Well No. 5	WTP and Ranney Well Supply	ASR Recovery	Gross Supply[2,3]	ASR Recharge	Net Supply[4]			
1994	---	---	---	---	---	3,757.0	---	3,757.0	7,148.0	55,274	186
1995	---	---	---	---	---	3,684.0	---	3,684.0	7,009.1	56,419	179
1996	---	---	---	---	---	3,405.0	---	3,405.0	6,478.3	56,358	166
1997	---	---	---	---	---	2,870.0	---	2,870.0	5,460.4	57,649	136
1998	---	---	---	---	---	3,189.0	---	3,189.0	6,067.4	58,763	149
1999	---	---	---	---	---	3,437.0	---	3,437.0	6,539.2	59,498	158
2000	---	---	---	---	---	3,406.0	---	3,406.0	6,480.2	60,780	154
2001	---	---	---	---	---	3,483.0	---	3,483.0	6,626.7	61,130	156
2002	---	---	---	---	---	3,538.0	---	3,538.0	6,731.4	61,709	157
2003	---	---	---	---	---	3,674.0	---	3,674.0	6,990.1	63,415	159
2004	---	---	---	---	---	3,739.0	---	3,739.0	7,113.8	64,144	160
2005	---	---	---	---	---	3,704.0	---	3,704.0	7,047.2	65,744	154
2006	---	---	---	---	---	3,541.0	---	3,541.0	6,737.1	67,143	144
2007	1,410.4	440.3	1,925.1	3,775.7	---	3,775.7	---	3,775.7	7,183.7	67,871	152
2008	1,909.6	268.6	1,549.3	3,727.5	---	3,727.5	---	3,727.5	7,091.9	68,128	150
2009	2,314.3	151.7	1,475.5	3,941.5	---	3,941.5	---	3,941.5	7,499.0	70,871	152
2010	1,585.9	341.5	1,739.3	3,666.6	---	3,666.6	---	3,666.6	6,976.1	72,940	138
2011	1,203.2	347.7	1,985.4	3,536.3	---	3,536.3	---	3,536.3	6,728.2	76,356	127
2012	1,245.8	442.0	2,060.5	3,748.2	---	3,748.2	---	3,748.2	7,131.3	77,078	133
2013	1,247.7	423.3	2,050.9	3,721.9	---	3,721.9	---	3,721.9	7,081.3	78,334	130
2014 [3]	1,473.9	448.9	2,088.0	4,010.7	72.5	4,083.2	106.3	3,976.9	7,566.4	80,986	135
2015 [3]	1,606.3	415.0	2,005.8	4,027.1	62.7	4,089.8	79.2	4,010.6	7,630.5	82,187	134
Average 2011 to 2015											**132**

(1) Annual supply volume by source not available prior to 2007.
(2) 2007 to 2013: Gross Supply = WTP + Ranney Well No. 4 + Ranney Well No. 5.
(3) In 2014 and 2015: Gross Supply = WTP + Ranney Well No. 4 + Ranney Well No. 5 + ASR Recovery.
(4) Net supply = Gross Supply - ASR Recharge.

The City has experienced a trend of decreasing per capita water demand since the 1990s, as shown in **Table 2-6**, which is most likely the result of water use efficiency practices. The City's 5-year average per capita demand of 132 gallons per day from 2011 through 2015 will be used later in this chapter to forecast average water demands in future years, based on future population projections shown in **Table 2-11**.

Table 2-7 shows the average demand of each of the City's seven existing pressure zones, which include portions of Zone 1 supplied via Zone 2 pressure reducing valves (PRVs), based on 2015 water demand data. The data is shown with and without supply to recharge the City's ASR well, which is located within Zone 4. Most of the water system demand is in Zone 2, as shown in **Table 2-7**. **Figure 1-1** displays the City's existing pressure zones.

Table 2-7
2015 Demands by Pressure Zone

Zone	ADD (gpm)	Percentage of System Demand
Without ASR Recharge		
1 (Direct Service)	1,616	21.2%
1 (via Zone 2 PRVs)	122	1.6%
2	3,127	41.0%
3	2,132	27.9%
4	503	6.6%
4.5	67	0.9%
5	63	0.8%
Total	**7,630**	**100.0%**
With ASR Recharge		
1 (Direct Service)	1,616	20.8%
1 (via Zone 2 PRVs)	122	1.6%
2	3,127	40.2%
3	2,132	27.4%
4	654	8.4%
4.5	67	0.9%
5	63	0.8%
Total	**7,781**	**100.0%**

Chart 2-4 shows the historical amount of water supplied monthly to the City for 2010 through 2015. The peak supply months generally occur in July and August when temperatures are the warmest and irrigation demands are highest. The 2014 and 2015 volumes shown for April through July are higher than in previous years because the City was utilizing water during these months to recharge the aquifer for the ASR well.

Chart 2-4
Historical Monthly Water Supply

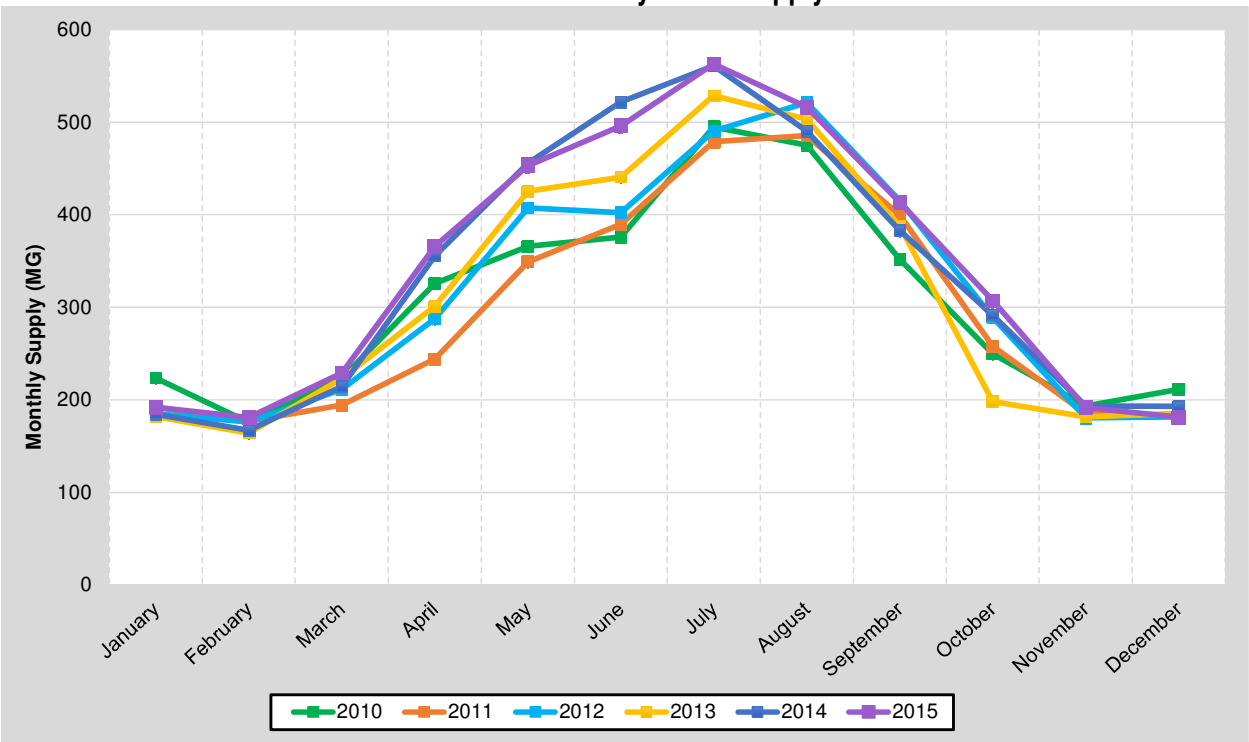
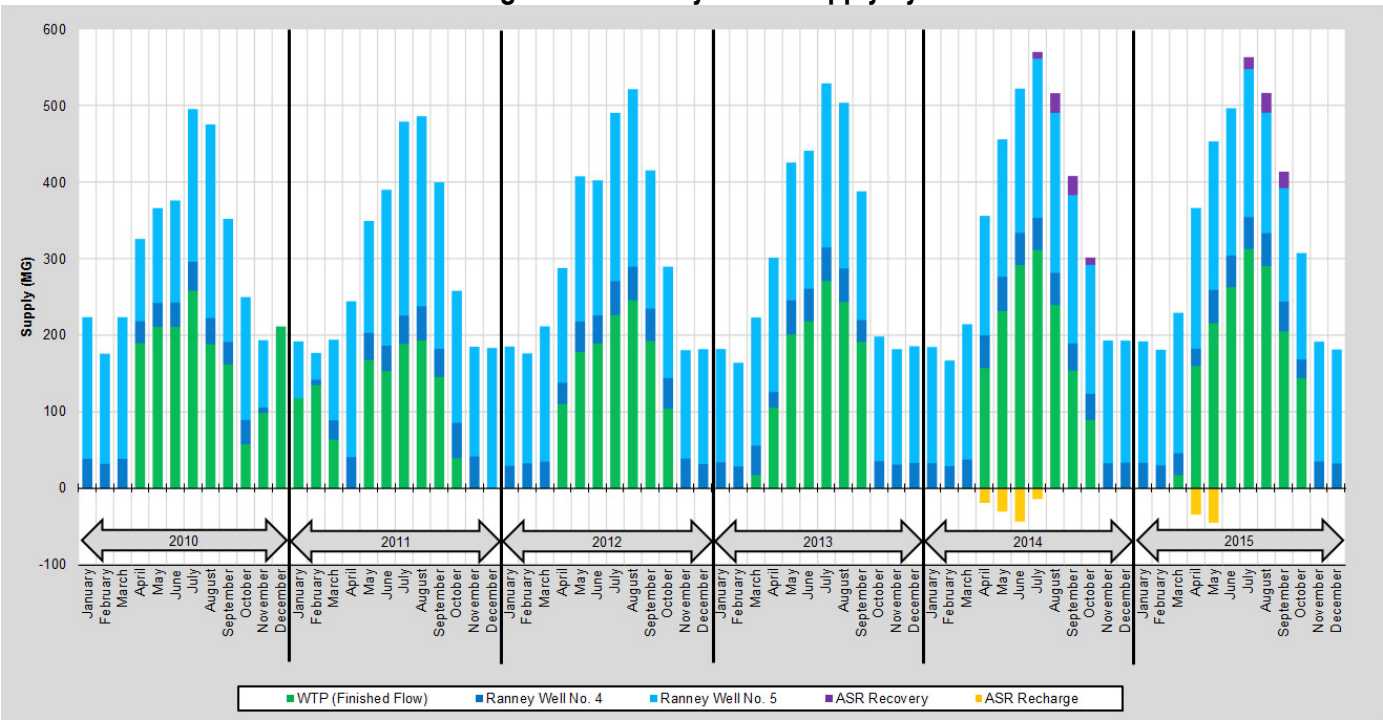


Chart 2-5 identifies the monthly proportion of the City's water supplied by the WTP, Ranney Wells Nos. 4 and 5, and the ASR well from 2010 through 2015. ASR recharge volumes are shown in **Chart 2-5** as a negative value to indicate the volume of water supply not consumed by customers and instead utilized to recharge the aquifer.

Chart 2-5
2010 through 2015 Monthly Water Supply by Source



DISTRIBUTION SYSTEM LEAKAGE

The difference between the amount of water supply and water consumption is the amount of distribution system leakage (DSL). The amount of DSL in a water system is calculated as the difference between the amount of water supply and the amount of authorized water consumption. There are many sources of DSL in a typical water system, including water system leaks, inaccurate supply metering, inaccurate customer metering, well backwash, illegal water system connections or water use, fire hydrant usage, water main flushing, and malfunctioning telemetry and control equipment resulting in reservoir overflows. Several of these types of usages, such as water main flushing and fire hydrant usage, may be considered authorized uses if they are tracked and estimated. Although real losses from the distribution system, such as reservoir overflows or leaking water mains, should be tracked for accounting purposes, these losses must be considered leakage and not included in the authorized consumption calculations. The Water Use Efficiency (WUE) Rule, which became effective in 2007, established a DSL standard of 10 percent or less based on a 3-year rolling average.

The amount of DSL in the City's system gradually decreased from 2008 through 2014, as shown in **Table 2-8**. Although the City's 2013 supply and consumption records were reviewed in detail, some of the data shown are not accurate, which is evident from the negative DSL value presented in the table. Inaccurate customer metering, billing, or data recording is likely the cause of this improbable value. The City 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 wells and the WTP meet the American Water Works Association (AWWA) operating standards. **Table 2-8** reports the total system leakage and the DSL for 2008 through 2014. The rolling 3-year average for DSL has been below 10 percent each year. The City will continue to record the water used for construction, flushing, street cleaning, and fire department uses. The City will also implement the WUE program contained in **Chapter 4**.

Table 2-8
Distribution System Leakage

Description		Year					
	2008	2009	2010	2011	2012	2013	2014
Authorized Consumption (MG)							
Metered Customer Use	3,511.9	3,674.0	3,482.1	3,492.4	3,644.1	3,702.4	3,816.1
General Unmetered Reports	---	27.7	25.0	10.7	---	---	---
Dead End Flushing	---	---	---	---	4.23	6.30	6.61
Routine Maintenance	---	---	---	---	1.52	18.17	24.42
City Fire Department	---	---	---	---	0.26	0.03	0.02
County Fire Department	---	---	---	---	0.03	0.00	0.00
Contractor Hydrant Use	---	---	---	---	2.73	1.07	4.26
ASR Recharge	---	---	---	---	---	---	106.33
Total Authorized Consumption	**3,511.9**	**3,701.7**	**3,507.1**	**3,503.1**	**3,652.8**	**3,728.0**	**3,957.7**
Total Supply (MG)							
Gross Supply (Finished Water)	**3,727.5**	**3,941.5**	**3,666.6**	**3,536.3**	**3,748.2**	**3,721.9**	**4,083.2**
Distribution System Leakage (MG)							
Total DSL Volume	**215.6**	**239.8**	**159.5**	**33.2**	**95.4**	**-6.1**	**125.5**
Total DSL Percentage	5.8%	6.1%	4.4%	0.9%	2.5%	-0.2%	3.1%
Rolling 3-Year Average DSL Percentage	**---**	**---**	**---**	**3.9%**	**2.6%**	**1.1%**	**1.9%**
Adjusted DSL Percentage[1]	5.8%	6.8%	5.0%	1.2%	2.8%	0.5%	4.0%

(1) The adjusted DSL percentage is baesd on the difference between metered consumption and net supply. The calculation does not include the DSL reduction associated with other authorized non-metered consumption.

The annual DSL percentages are applied to the consumption by water use classification as reported in **Table 2-4** to determine the net supply per water use classification. Supply per water use classification for 2008 through 2014 is summarized in **Table 2-9**. The net supply per water use classification is used in the equivalent residential unit calculations.

Table 2-9
Average Annual Supply by Customer Class

Year	DSL[2]	Annual Supply (MG)[1]				
		Single-family Residential	Multi-family Residential	Commercial	Municipal	Total Demand (i.e. Net Supply)
2008	5.8%	1,700.9	531.0	1,079.6	416.0	3,727.5
2009	6.8%	1,859.4	662.6	1,036.9	382.6	3,941.5
2010	5.0%	1,671.7	636.4	967.6	391.0	3,666.6
2011	1.2%	1,618.4	610.0	921.2	386.7	3,536.3
2012	2.8%	1,664.7	632.9	1,049.7	400.9	3,748.2
2013	0.5%	1,694.9	618.4	959.7	449.0	3,721.9
2014	4.0%	1,804.0	642.1	1,070.4	460.5	3,976.9

(1) The adjusted DSL percentage is applied to the metered consumption for each individual water use classification to calculate the demand associated with each individual water use classification.

(2) The adjusted DSL is the difference in metered consumption and supply. The calculation does not include the DSL reduction associated with other authorized non-metered consumption.

EXISTING EQUIVALENT RESIDENTIAL UNITS

The demand of each customer class can be expressed in terms of equivalent residential units (ERUs) for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by a single-family residence. As shown in **Table 2-10**, the demand per ERU is initially calculated for the single-family residential class based on the average annual single-family residential demand, as calculated in **Table 2-9**, and the average number of single-family residential connections. For the single-family residential class, the single-family ERUs equal the single-family number of connections. The number of ERUs represented by the demand of the other customer classes is determined from the total demand of the customer class and the demand per ERU from the single-family residential demand data. Thus, the demand per ERU for each year is the same for all customer classes, as shown in **Table 2-10**.

Table 2-10 presents the computed number of ERUs for each customer class from 2008 through 2014. The average annual demands shown are based on the net supply data that was computed from the consumption of each customer class (**Table 2-4**) and the average percentage of adjusted DSL from each year (**Table 2-8**). A summary of the calculation is presented in **Table 2-10**.

Table 2-10
Equivalent Residential Units (Computed Values)

Year	Average Number of Connections	Average Annual Demand (MG)	Demand per ERU (gallons/day/ERU)	Total ERUs
Single-family Residential (ERU Basis)				
2008	17,592	1,700.9	265	17,592
2009	17,873	1,859.4	285	17,873
2010	18,206	1,671.7	252	18,206
2011	18,524	1,618.4	239	18,524
2012	18,688	1,664.7	244	18,688
2013	18,930	1,694.9	245	18,930
2014	19,975	1,804.0	247	19,975
Average 2011 to 2014			**244**	
Multi-family Residential				
2008	1,177	531.0	265	5,492
2009	1,170	662.6	285	6,369
2010	1,171	636.4	252	6,931
2011	1,175	610.0	239	6,983
2012	1,183	632.9	244	7,105
2013	1,182	618.4	245	6,907
2014	1,255	642.1	247	7,109
Commercial				
2008	1,943	1,079.6	265	11,166
2009	1,968	1,036.9	285	9,967
2010	2,006	967.6	252	10,538
2011	2,033	921.2	239	10,544
2012	2,061	1,049.7	244	11,784
2013	2,085	959.7	245	10,719
2014	2,390	1,070.4	247	11,852
Municipal				
2008	148	416.0	265	4,302
2009	152	382.6	285	3,678
2010	152	391.0	252	4,259
2011	160	386.7	239	4,427
2012	166	400.9	244	4,500
2013	167	449.0	245	5,015
2014	181	460.5	247	5,099
System-wide Totals				
2008	20,860	3,727.5	265	38,552
2009	21,163	3,941.5	285	37,887
2010	21,535	3,666.6	252	39,933
2011	21,892	3,536.3	239	40,477
2012	22,098	3,748.2	244	42,077
2013	22,364	3,721.9	245	41,570
2014	23,801	3,976.9	247	44,034
Average 2011 to 2014			**244**	

The average demand per ERU from 2011 through 2014 was 244 gallons per day. The average demand per ERU does not include data prior to 2011, as the average demand per ERU was approximately 10 percent higher between 2008 and 2010, compared to the more recent data between 2011 and 2014. The City's recent average demand per ERU of 244 gallons per day will be used later in this chapter to forecast ERUs in future years, based on estimated future demands. This demand per ERU value will also be used to determine the capacity (in terms of ERUs) of the City's existing water system in **Chapter 3**.

SERVICE AREA PROJECTIONS

PROJECTED LAND USE, POPULATION, AND WATER DEMAND

Projected Land Use

The City is expected to infill existing undeveloped and underdeveloped land within the City limits with residential and commercial development. The City anticipates a large concentration of growth to occur in the commercial and industrial areas west of N. Kellogg Street and north of W. Clearwater Avenue, and in the predominantly low density residential area in the south and southwest portion of the City limits. The City has also designated approximately 2,900 acres (4.5 square miles) of urban reserve south of Interstate 82 for future industrial growth, shown in **Figure 2-1**. The timeline and extent of the growth will be developer driven, and exact locations of future growth are unknown due to the various options available to developers.

Projected Population

Projected future growth for the City was presented in the 2013 update to the County *Comprehensive Plan* through 2034, and is shown in **Table 2-11**. The projected 2035 (20-year) City limits population projection was calculated assuming growth will occur at an average annual growth rate equal to the 2029 to 2034 projections. The projected 2035 (20-year) water service area population projection was calculated assuming growth will occur at the same 20-year rate projected in the City's 2010 WCP. **Table 2-11** includes the projected future growth within the future water service area boundary, which represents an average growth rate of approximately 1.5 percent per year within the City limits and water service area. The resulting projections for the City's water service area are in accordance with the 2013 update to the County's *Comprehensive Plan*.

Table 2-11
Population Projections

Year	Description	City Limits Population	Water Service Area Population
2014	Base Year	77,700	80,986
2015	Existing	78,290	82,187
2016	+1 Year	78,935	83,540
2017	+2 Years	80,239	84,893
2018	+3 Years	81,544	86,246
2019	+4 Years	82,848	87,599
2020	+5 Years	84,160	88,952
2021	+6 Years	85,472	90,306
2022	+7 Years	86,784	91,659
2023	+8 Years	88,096	93,012
2024	+9 Years	89,408	94,365
2025	+10 Years	90,720	95,718
2035	+20 Years	103,931	109,643

These population projections, along with the historical per capita water use data presented in this chapter, form the basis for determining the future water demands of the City's water system. This analysis and its results are presented in the following sections.

Projected Non-residential Water Needs

The projected future water system in the 6-year, 10-year, and 20-year planning periods is expected to have approximately the same proportion of non-residential connections as the existing ratio, which is approximately 11 percent.

Projected Non-revenue Water

The projected non-revenue water is expected to decrease or have the same proportion as it currently does. See the WUE program contained in **Chapter 4** for additional information.

Average Day Demand

ADD is the total amount of water delivered to the system in a year divided by the number of days in the year. The ADD is determined from the system's historical water use patterns and can be used to project future demand within the system. ADD data is typically used to determine standby storage requirements for water systems. Standby storage is the volume of a reservoir used to provide water supply under emergency conditions when supply facilities are out of service. Water supply records from the City's supply facilities were reviewed to determine the system's ADD, which is based on the net supply to the system, as shown in **Table 2-6**.

Maximum Day Demand

Maximum day demand (MDD) is the maximum amount of water used throughout the system during a 24-hour time period of a given year. MDD typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with Washington Administrative Code (WAC) 246-290-230 – Distribution Systems, the distribution system shall provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during maximum day

demand conditions. Supply facilities (e.g., wells, springs, pump stations, interties) are typically designed to supply water at a rate that is equal to or greater than the system's MDD.

Water supply and reservoir level telemetry records for August 2013 through June 2015 were used to determine the system's MDD, which is calculated to be 14,191 gallons per minute (gpm), based on the demands on July 9, 2014, as shown in **Table 2-12**. Although historical water supply and reservoir level records were not available prior to August 2013, the calculated July 9, 2014 MDD results in a larger MDD/ADD peaking factor than was assumed in the City's 2010 WCP; therefore, this MDD is believed to be a more accurate representation of the City's existing water system demands. This MDD is based on the actual demand of the water system customers, and not water used for ASR recharge. During periods of high demands, the City has the ability to restrict or prevent ASR recharge to ensure adequate water supply is available to the City's water system customers.

Table 2-12
Peak Demands and Peaking Factors

Description	Date	Demand (gpm)
Average Day Demand (ADD)	2014	7,566
Maximum Day Demand (MDD)	Wednesday, July 09, 2014	14,191
Peak Hour Demand (PHD)	Hourly Data Unavailable Assumed PHD/ADD = 2.88 (Same as 2009 WCP)	21,791
Peaking Factors		
MDD/ADD		1.88
PHD/MDD		1.54
PHD/ADD		2.88

Peak Hourly Demand

Peak hour demand (PHD) is the maximum amount of water used throughout the system, excluding fire flow, during a 1-hour time period of a given year. In accordance with WAC 246-290-230, Distribution Systems, new public water systems or additions to existing systems shall be designed to provide domestic water at a minimum pressure of 30 psi during PHD conditions. Equalizing storage requirements are typically based on PHD data.

The PHD, like the MDD, is typically determined from the combined flow of water into the system from all supply sources and reservoirs. Historical hourly water supply and reservoir level telemetry records for the City's supply and storage facilities are only available for a portion of 2013 and 2014. Therefore, the system's PHD could not be computed based on actual system data. Instead, it was estimated by applying the same PHD/ADD ratio as was presented in the City's 2010 WCP. This PHD peaking factor is comparable to the peaking factors for similarly sized water systems within the region. This peaking factor results in an estimated PHD of 21,791 gpm for the peak hour as shown in **Table 2-12**.

Table 2-12 also shows the peaking factors of the water system based on the ADD, MDD, and PHD data presented above. These peaking factors will be used later in this chapter in conjunction with projected ADD to project future MDDs and PHDs of the system.

DEMAND FORECASTING

BASIS FOR PROJECTING DEMANDS

Future demands were calculated from the results of the existing per capita demand computations shown in **Table 2-6** and the projected population data from **Table 2-11**. Future demand projections were computed with and without water savings expected from implementing WUE measures contained in the City's WUE program in **Chapter 4**. The City's 5-year average per capita demand of 132 gallons per day from 2011 through 2015 was used for all demand projections without savings from WUE measures. The per capita demand was reduced to reflect the WUE goals and used as the basis for future water demand projections with implementation of the WUE program. The City's WUE program presents a goal to reduce the water demand per capita by 1 percent each year through the 10-year planning period.

DEMAND FORECASTS AND WUE

Table 2-13 presents the incremental 6-year, 10-year, and 20-year water demand forecasts for the City's water system. The actual demand data from 2014 and 2015 is also shown in the table for comparison purposes. The future ADDs were projected based on population estimates for the given years and the estimated demand per capita values. The future MDDs and PHDs shown were computed from the projected ADDs and the existing system peaking factors shown in **Table 2-12**. The future demand projections are also shown with and without estimated reductions in water use from achieving WUE goals.

The analysis and evaluation of the existing water system with proposed improvements, as presented in **Chapters 3** and **8**, is based on the 20-year projected demand data without WUE reductions. This ensures that the future system will be sized properly to meet all requirements, whether or not additional water use reductions are achieved. However, the City will continue to pursue reductions in water use by implementing the WUE program contained in **Chapter 4** of this WCP.

Table 2-13
Future Water Demand Projections

Description	Base Year 2014	Existing 2015	Projected 2016 +1 yr	2017 +2 yrs	2018 +3 yrs	2019 +4 yrs	2020 +5 yrs	2021 +6 yrs	2022 +7 yrs	2023 +8 yrs	2024 +9 yrs	2025 +10 yrs	2035 +20 yrs
Population Data													
Water Service Area Population	80,986	82,187	83,540	84,893	86,246	87,599	88,952	90,306	91,659	93,012	94,365	95,718	109,643
Increase from Base Year 2014	---	1,201	2,554	3,908	5,261	6,614	7,967	9,320	10,673	12,026	13,379	14,732	28,658
Demand Basis Data (gal/day/capita)													
ADD Per Capita without WUE	135	134	132	132	132	132	132	132	132	132	132	132	132
ADD Per Capita with WUE	---	134	132	131	130	128	127	126	125	123	122	121	121
Average Day Demand (gpm)													
Demand without WUE	7,566	7,630	7,641	7,764	7,888	8,012	8,136	8,259	8,383	8,507	8,631	8,754	10,028
Demand with WUE	---	7,630	7,679	7,725	7,770	7,813	7,854	7,894	7,932	7,968	8,003	8,037	9,206
Maximum Day Demand (gpm)													
Demand without WUE	14,191	14,311	14,330	14,562	14,794	15,026	15,258	15,490	15,723	15,955	16,187	16,419	18,808
Demand with WUE	---	14,311	14,401	14,488	14,572	14,652	14,730	14,804	14,876	14,945	15,010	15,073	17,266
Peak Hour Demand (gpm)													
Demand without WUE	21,791	21,976	22,005	22,362	22,718	23,074	23,431	23,787	24,144	24,500	24,856	25,213	28,881
Demand with WUE	---	21,976	22,114	22,248	22,376	22,500	22,619	22,734	22,844	22,949	23,050	23,147	26,514

Table 2-14 presents the existing and projected number of ERUs of the system. The ERU forecasts are based on the projected water demands from **Table 2-13** and the average demand per ERU that was computed from the actual 2011 through 2014 data (**Table 2-10**).

Table 2-14
Future ERU Projections

Description	Base Year	Existing	Projected										
	2014	2015	2016 +1 yr	2017 +2 yrs	2018 +3 yrs	2019 +4 yrs	2020 +5 yrs	2021 +6 yrs	2022 +7 yrs	2023 +8 yrs	2024 +9 yrs	2025 +10 yrs	2035 +20 yrs
Demand Data (gpm)													
ADD without WUE	7,566	7,630	7,641	7,764	7,888	8,012	8,136	8,259	8,383	8,507	8,631	8,754	10,028
ERU Basis Data (gal/day/ERU)													
Demand per ERU without WUE	247	244	244	244	244	244	244	244	244	244	244	244	244
Equivalent Residential Units (ERUs)													
Total System ERUs	44,034	45,026	45,086	45,816	46,546	47,277	48,007	48,737	49,467	50,198	50,928	51,658	59,174

3 | SYSTEM ANALYSIS

INTRODUCTION

This chapter presents the City of Kennewick's (City) performance standards for infrastructure and an evaluation of the water system facilities' ability to meet current and future water demands based on adopted design standards included in this chapter. This evaluation addresses system facilities, including source of supply, water treatment, storage, transmission, and the distribution system. A summary of system deficiencies is presented together with alternatives to correct the deficiencies.

SYSTEM DESIGN STANDARDS

The City has adopted design and construction standards for all new construction. All City and developer constructed projects are required to be designed and constructed to these standards. Standards related to physical configuration and operational requirements can be found in **Chapter 7**. The City adopts the most current versions of the following agency and organizational standards as minimum requirements.

- Washington State Department of Health (DOH) – *Water System Design Manual*
- Washington Administrative Code (WAC) – Chapter 246-290
- Revised Code of Washington (RCW)
- American Public Works Association (APWA)
- Washington State Department of Transportation (WSDOT) – Standard Specifications for Road, Bridge, and Municipal Construction
- WSDOT – Local Agency General Special Provisions
- American Water Works Association (AWWA)
- International Building Code (IBC)
- International Plumbing Code (IPC)

A copy of the standard specifications and details available to the public are included in **Appendix D**. Current versions of the standard specifications and details are also available on the City's website. The following sections describe the City's performance standards that may not be addressed or exceed those listed in the above standards.

WATER QUALITY

1. The City will pursue steps to meet or exceed water quality laws and standards. The City will take reasonable measures to protect its system and customers.
2. Water quality criteria shall meet, at a minimum, the requirements of WAC 246-290-300, 246-290-310, 246-290-320, 246-290-451, and 246-290-480.
3. Coatings and additives in contact with drinking water shall be compliant with National Sanitation Foundation 61.

4. The quality of the water source shall continuously meet the primary and secondary drinking water standards of the State of Washington and the U.S. Environmental Protection Agency's Safe Drinking Water Act.

AVERAGE AND MAXIMUM DAILY DEMANDS

1. Demand sizing shall comply with WAC 246-290-221.
2. The capacity of the source of supply pumps and transmission mains shall be sufficient to meet maximum day demands (MDD) and replenish storage used during a fire within 72 hours of a fire or other emergency. The supply system should be capable of meeting these criteria with the largest regular supply pump out of service or any other combination of failure that is considered reasonably possible that has an effect on supply sizing, locating, or planning.

PEAK HOUR DEMAND

1. Demand sizing shall comply with WAC 246-290-221.
2. Each pressure zone shall be capable of providing, through supply and storage, the peak hour demand of that pressure zone, without the need for outside or emergency supply.

PUMP STATIONS

1. Pump stations shall include a minimum of two pumps, each sized to meet the MDD requirements. The City shall decide if a spare third bay for installation of an additional pump is required in the future.
2. Pump stations shall be designed to provide ample working space with minimal structural maintenance requirements.
3. Pumps shall be selected to operate within 2 percent of their maximum rated efficiency point at normal system operating conditions.
4. The City shall evaluate and decide if a variable speed drive is required for any new or upgraded pump station.

STORAGE

1. Storage sizing shall comply with WAC 246-290-222 and 246-290-250.
2. Storage must be of sufficient capacity to supplement transmission supply when peak demands are greater than the supply rate and still maintain sufficient storage for a fire or other emergency condition.
3. Under normal conditions, equalizing storage should be replenished within a 24-hour cycle.
4. Standby storage volume must be replenished in 72 hours while continuing to deliver MDD.
5. Nesting of standby and fire flow storage is allowed.
6. Sizing of new reservoirs will consider current fire flow standards for "grandfathered" facilities.

FIRE FLOW

Fire flow demand is the amount of water required during firefighting as defined by applicable codes. Fire flow requirements are nationally established for individual buildings and expressed in terms of

flow rate (gallons per minute (gpm)) and flow duration (hours). Fighting fires imposes the greatest demand on the water system because a high rate of water must be supplied over a period of time, thus requiring each component of the system to be properly sized and configured to operate at its optimal condition while continuing to provide potable water to the community. Adequate storage and supply is ineffective if the transmission or distribution system cannot deliver water at the required rate and pressure necessary to extinguish a fire.

Planning-level fire flow requirements are established by the City's Fire Marshal for the different land use categories to provide a target level of service for planning and sizing future water facilities. The City's planning-level fire flow requirement for each land use category is shown in **Table 3-1**; the water system analyses presented in this chapter are based on an evaluation of the water system providing sufficient fire flow in accordance with these requirements in addition to the system's projected demands. The fire flow requirements shown do not necessarily equate to actual existing or future fire flow requirements at all buildings, as requirements are typically based on actual building size, construction type, and fire suppression systems provided. Improvements to increase the available fire flow to exceed the fire flow requirements shown in **Table 3-1** shall be the responsibility of the developer. **Table 3-1** does not include potential reductions in fire flow if automatic sprinkler systems are installed within buildings. Automatic sprinkler systems generally reduce the fire flow requirement for new buildings, which will likely result in fire flow requirements that are lower than the general planning-level fire flow requirements.

Table 3-1
Planning-level Fire Flow Requirements

Land Use	Planning-level Fire Flow Requirement (gpm)	Duration (hours)
Low Density Residential	1,000	2
Medium Density Residential	1,000	2
Open Space	1,000	2
High Density Residential	3,000	3
Commercial	4,000	4
Public Facilities	4,000	4
Industrial	5,000	4

The City will endeavor to provide these capacities in the appropriate land use area. However, there may be individual buildings or developments that exceed the typical requirements of the local land use. In these cases, the City will require those developments to provide the infrastructure improvements necessary to meet the additional fire flow needs. When such improvements provide benefit to the City as a whole, the City may elect to share the costs of the improvements.

PRESSURE

1. The City shall endeavor to provide a minimum of 30 pounds per square inch (psi) at customer meters during peak hour demand (PHD), not including a fire or emergency.
2. The City shall endeavor to provide a maximum of 120 psi at customer meters during normal demand conditions, not including pressure surges. Individual customers are responsible for providing and maintaining pressure reducing valves at their service when pressure exceeds 80 psi.

PIPELINES

1. The minimum water main size shall be 8-inch diameter. On dead-end lines where no fire flow is provided within the dead-end line and future extension of the water main is reasonably anticipated to take place, 6-inch diameter mains may be approved.
2. The velocity of water in transmission and distribution mains should be less than 7 feet per second (fps) during PHD.
3. The velocity of water in transmission and distribution mains should be less than 10 fps during fire flow events.
4. Where at all practical, distribution mains shall be looped to increase reliability and water quality, and decrease head losses.
5. All 12-inch diameter and larger pipes shall be ductile iron. Pipes smaller than 12-inch diameter shall be ductile iron or polyvinyl chloride (PVC).
6. A minimum of 10 feet of separation shall be maintained between storm, sewer, and water mains unless it can be shown that such separation is unfeasible.
7. Clearance between water mains and both sanitary sewer and irrigation mains shall follow Washington State Department of Ecology (Ecology) and DOH separation standards.
8. All water mains shall be installed with a minimum of 42 inches of cover.

TELEMETRY SYSTEM

1. Pump stations and reservoirs shall each have a remote telemetry unit (RTU) that monitors and displays local sensor and device status data and communicates with the master telemetry unit (MTU).
2. RTUs shall include backup power, surge, and lightning protection, and be easily capable of expansion for additional input and output signals.
3. RTUs shall be programmed by an integrator of the City's choice. Preprogrammed "package" control units are not allowed.

BACK-UP POWER REQUIREMENTS

1. Reliability standards per WAC 246-293-660 shall be followed.
2. Closed zone pump stations shall have permanent backup power installed onsite with an automatic transfer switch.
3. All new pump stations shall include provisions for connecting a portable engine generator to run the facility in the event of a power failure.
4. All RTUs shall include an automatic battery backup.

VALVE AND HYDRANT SPACING

1. Zone valves shall be located at all pressure zone interfaces to allow future pressure zone realignment without the need for additional pipe construction.
2. Isolation valves shall be located wherever necessary to allow individual pipelines to be shut down for repair or installation of new branch mains. In general, three valves shall be provided per cross and two valves per tee.
3. Valves shall be placed at a maximum of 1,000-foot intervals where practical.

4. Combination air/vacuum valves shall be placed at all high points.
5. Hydrant spacing and locations shall be approved by the Fire Department, but in no case shall be more than 500 feet apart in single-family residential areas or more than 300 feet apart in non-single-family residential areas.
6. Hydrants shall be located at street intersections whenever possible.
7. Hydrants shall be dry, barrel type, conforming to AWWA C502.

WATER SYSTEM ANALYSIS

PRESSURE ZONES

The ideal static pressure of water supplied to customers is between 40 and 80 psi. Pressures within a water distribution system are commonly as high as 120 psi, requiring pressure regulators on individual service lines to reduce the pressure to 80 psi or less. It is difficult for the City's water system (and most others) to maintain distribution pressures between 40 and 80 psi, primarily due to the topography of the water service area.

Table 3-2 lists each of the City's five pressure zones, the highest and lowest elevation served in each zone, and the minimum and maximum distribution system pressures within each zone, based on maximum static water conditions (full reservoirs and zero demands). The City is currently providing water at pressures of at least 29 psi throughout the entire water system, as shown in the table. This is below the DOH minimum requirement of 30 psi. The lowest pressures in the distribution system occur in Zone 1 at the intersection of W. 19th Avenue and S. Jean Street, and in Zone 4 along S. Lincoln Street, in the neighborhood south of Ridgeline Drive. The highest pressures in the system occur in a Zone 4 transmission main through the Canyon Lakes Golf Course, and in Zone 5 along S. Sherman Street, just north of the intersection with Hildebrand Boulevard. The services at these locations, as well as services in other pressure zones, have static pressures greater than 80 psi. All water services in these high pressure areas are required to have individual pressure reducing valves, installed and maintained by the customer, to reduce the service pressure to 80 psi or less.

Table 3-2
Minimum and Maximum Distribution System Pressures

Pressure Zone	Highest Elevation Served		Lowest Elevation Served	
	Elevation (feet)	Static Pressure (psi)	Elevation (feet)	Static Pressure (psi)
Zone 1	465	29	342	82
Zone 1 (from Zone 2 PRVs)	486	60	349	119
Zone 2	575	34	403	109
Zone 3	676	45	521	112
Zone 4	846	29	596	137
Zone 5	921	54	691	153

SOURCE ANALYSIS

This section evaluates the City's sources to determine if they have sufficient capacity to provide water supply to the system at a rate that meets the existing and future demands of the system. This section also identifies deficiencies that are unrelated to the capacity of the facilities.

Source Analysis Criteria

Source facilities must be capable of adequately and reliably supplying high-quality water to their respective systems. In addition, the supply facilities must provide a sufficient quantity of water at pressures that meet the requirements of WAC 246-290-230. The evaluation of the combined capacity of the sources in this section is based on the criteria that they provide supply to the system at a rate that is equal to or greater than the MDD of the system.

Source Analysis Results

The City's existing active sources include Ranney Wells No. 4 and No. 5, and the City's Columbia River surface water treatment plant (WTP). The combined capability of these sources to meet both existing, 6-year (2021), and 10-year (2025) demand requirements, based on existing pumping capacities of the individual supply facilities, is presented in **Table 3-3**. In addition to the existing supply facilities, the City completed construction of an aquifer storage and recovery (ASR) well in 2014. Ongoing testing of the ASR Well and the aquifer storage capacity has been occurring since the well was constructed, and if the ASR Well becomes fully developed and is granted source approval by regulatory agencies, a maximum of 2,080 gpm may be pumped from the well. For the purposes of the future system evaluation, it is assumed that the ASR Well will be an active source beyond the 10-year planning period, with the pumping rate of the well shown to meet the projected demands of the system, as shown in **Table 3-3**.

Table 3-3
Water Source Capacity Evaluation

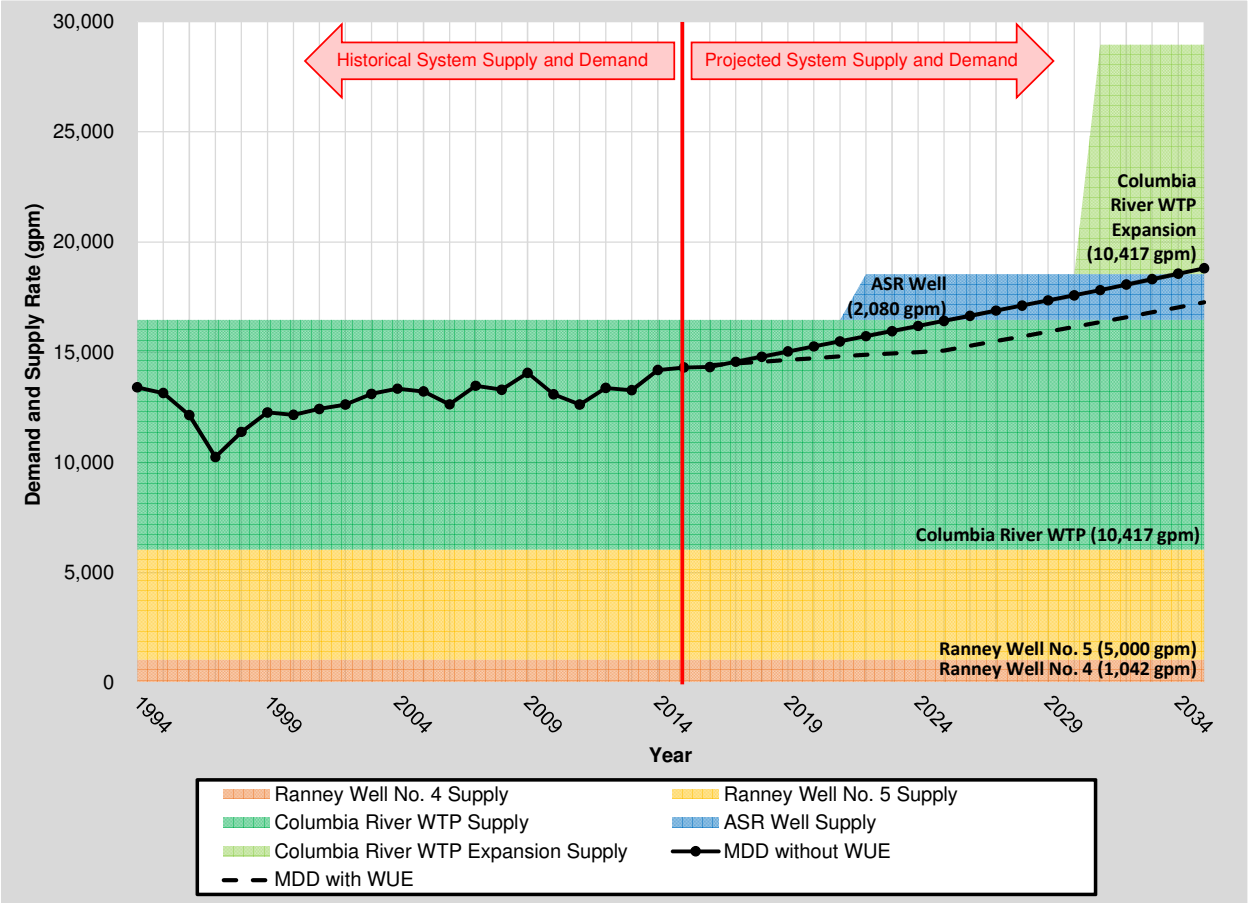
Description	Existing	Future Projections						
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2029 (+14 years)	2031 (+16 years)	2033 (+18 years)	2035 (+20 years)
Required Source Capacity (gpm)								
Maximum Day Demand	**14,311**	**15,490**	**16,419**	**16,883**	**17,347**	**17,821**	**18,308**	**18,808**
Available Source Capacity (gpm)								
Ranney Well No. 4	1,042	1,042	1,042	1,042	1,042	1,042	1,042	1,042
Ranney Well No. 5	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Columbia River WTP	10,417	10,417	10,417	10,417	10,417	10,417	10,417	10,417
ASR Well	---	---	---	425	889	1,363	1,849	2,080
Total Source Capacity	**16,458**	**16,458**	**16,458**	**16,883**	**17,347**	**17,821**	**18,308**	**18,538**
Surplus or Deficient Source Capacity (gpm)								
Surplus or Deficiency	**2,147**	**968**	**39**	**0**	**0**	**0**	**0**	**(269)**

The projected MDD shown in **Table 3-3** are the demand projections without reductions from water use efficiency efforts, as shown in **Table 2-13** of **Chapter 2**. Therefore, if additional reductions in water use are achieved through water use efficiency efforts, the total source capacity required in the future will be less than that shown in the table.

The results of the source capacity evaluation indicate the City has approximately 2,147 gpm of surplus source capacity to meet existing demands. The City's existing active sources are sufficient to meet the projected demands of the system through 2025, but additional source capacity is needed to meet the projected demands beyond 2025. If the maximum ASR Well pumping rate of 2,080 gpm can be achieved, the City is projected to have a slight source capacity deficiency in 2035 based on the projected MDD without reductions from water use efficiency efforts, as shown in **Chart 3-1**.

The City plans to evaluate an expansion of the Columbia River WTP to meet the projected source capacity requirements.

Chart 3-1
Water Source Capacity Evaluation



Source Deficiencies

The City's Ranney Well No. 5 is approved by DOH for a 6,944 gpm (10 million gallons per day (MGD)) capacity, but the maximum sustained pumping rate the City has been able to achieve from the collectors is 5,000 gpm (7.2 MGD).

Emergency power is not available at the WTP, Ranney Well No. 4, or Ranney Well No. 5. The variable frequency drives (VFD) at the WTP's High Service BPS are nearing the end of their useful life. The concrete floor at the Ranney Well No. 4 building is weathered and in need of restoration. Improvements to resolve these deficiencies are included in the City's operations and maintenance budget.

SUPPLY ANALYSIS

This section evaluates the City's existing supply facilities to determine if they have sufficient capacity to provide water supply at a rate that meets the existing and future demands of the one or more zones that they supply. This section also identifies facility deficiencies that are not related to the capacity of the supply facilities.

Supply Analysis Criteria

The evaluation to determine if supply facilities have adequate capacity is based on one of two criteria, as follows: 1) if the pressure zone that the facility provides supply into has water storage, then the amount of supply required is equal to the MDD of the zone; or 2) if the pressure zone that the facility provides supply into does not have water storage, then the amount of supply required is equal to the PHD and the maximum fire flow requirement of the zone. The higher supply requirement of the latter criteria is due to the lack of equalizing and fire flow storage that is typically utilized to provide short-term supply during times of peak system demands. Future supply capacities assume the ASR Well is operational following the 10-year planning period, and that the maximum ASR Well pumping rate of 2,080 gpm can be achieved.

Supply Analysis Results

Zone 1 Facilities

Ranney Wells No. 4 and No. 5, and the Columbia River WTP provide water supply directly to Zone 1. These supply facilities indirectly supply all of the City's customers, via booster pump stations (BPS) or pressure reducing valves (PRVs), and are required to meet the system's existing, projected 6-year (2021), and projected 10-year (2025) MDD. The 20-year supply capacity analysis assumes the ASR Well is operational, and is providing direct supply to Zone 4 and indirect supply to all higher pressure zones (i.e., Zone 5, Zone 6, etc.). The projected 2035 supply requirements of Zone 4 and the higher pressure zones exceeds the capacity of the ASR Well. Therefore, the Zone 1 supply facilities are required to account for supply to Zone 4 and the higher pressure zones at a rate that is equivalent to the difference between the ASR Well supply capacity and the supply requirement of these pressure zones. **Table 3-4** summarizes the existing and future supply requirements of Zone 1. The results of the analyses indicate that the existing and proposed 6- and 10-year configurations are of sufficient capacity to meet the required demands, but that the additional Zone 1 supply will be required to meet the projected 20-year supply requirements. The projected 20-year Zone 1 supply deficiency is equivalent to the projected 20-year source capacity deficiency shown in **Table 3-3**.

Table 3-4
Zone 1 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 1 MDD	3,031	3,156	3,254	3,507
Other Zones MDD	11,280	12,334	13,164	13,220
Total Required Supply	**14,311**	**15,490**	**16,419**	**16,728**
Available Supply (gpm)				
Ranney Well No. 4	1,042	1,042	1,042	1,042
Ranney Well No. 5	5,000	5,000	5,000	5,000
Columbia River WTP	10,417	10,417	10,417	10,417
Total Available Supply	**16,458**	**16,458**	**16,458**	**16,458**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**2,147**	**968**	**39**	**(269)**

Zone 2 Facilities

Water supply to Zone 2 is currently provided by the Golf Course BPS and the 19th and Olympia BPS. These BPSs also indirectly supply isolated portions of Zone 1 via PRVs, and Zones 3, 4, 5, and 6 via other BPSs. The Zone 2 BPSs are required to meet the existing, projected 6-year (2021), and projected 10-year (2025) MDD for Zone 2 and the indirectly supplied pressure zones. The 20-year supply capacity analysis assumes the ASR Well is operational, and is providing direct supply to Zone 4 and indirect supply to all higher pressure zones (i.e., Zone 5, Zone 6, etc.). The projected 2035 supply requirements of Zone 4 and the higher pressure zones exceeds the capacity of the ASR Well. Therefore, the Zone 2 supply facilities are required to account for supply to Zone 4 and the higher pressure zones at a rate that is equivalent to the difference between the ASR Well supply capacity and the supply requirement of these pressure zones. **Table 3-5** summarizes the existing and future supply requirements of Zone 2. The results of the analyses indicate that the existing and proposed configurations are of sufficient capacity to meet both existing and future demands.

Table 3-5
Zone 2 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 2 MDD	5,865	6,402	6,824	7,911
Other Zones MDD	5,415	5,933	6,340	5,309
Total Required Supply	**11,280**	**12,334**	**13,164**	**13,220**
Available Supply (gpm)				
Golf Course BPS	9,900	9,900	9,900	9,900
19th and Olympia BPS	10,000	10,000	10,000	10,000
Total Available Supply	**19,900**	**19,900**	**19,900**	**19,900**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**8,620**	**7,566**	**6,736**	**6,680**

Zone 3 Facilities

Water supply to Zone 3 is currently provided by the 47th and Olympia BPS and the 18th and Kellogg BPS. These BPSs also indirectly supply Zones 4, 5, and 6 via other BPSs. The Zone 3 BPSs are required to meet the existing, projected 6-year (2021), and projected 10-year (2025) MDD for Zone 3 and the indirectly supplied pressure zones. The 20-year supply capacity analysis assumes the ASR Well is operational, and is providing direct supply to Zone 4 and indirect supply to all higher pressure zones (i.e., Zone 5, Zone 6, etc.). The projected 2035 supply requirements of Zone 4 and the higher pressure zones exceeds the capacity of the ASR Well. Therefore, the Zone 3 supply facilities are required to account for supply to Zone 4 and the higher pressure zones at a rate that is equivalent to the difference between the ASR Well supply capacity and the supply requirement of these pressure zones. **Table 3-6** summarizes the existing and future supply requirements of Zone 3. The results of the analyses indicate that the existing and proposed configurations are of sufficient capacity to meet both existing and future demands.

Table 3-6
Zone 3 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 3 MDD	3,999	4,163	4,293	4,627
Other Zones MDD	1,188	1,532	1,802	419
Total Required Supply	**5,186**	**5,695**	**6,095**	**5,045**
Available Supply (gpm)				
47th and Olympia BPS	7,300	7,300	7,300	7,300
18th and Kellogg BPS	7,700	7,700	7,700	7,700
Total Available Supply	**15,000**	**15,000**	**15,000**	**15,000**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**9,814**	**9,305**	**8,905**	**9,955**

Zone 4 Facilities

Water supply to Zone 4 is currently provided by the 54th and Olympia BPS and the 28th and Irving BPS. These BPSs also indirectly supply Zones 5 and 6 via other BPSs. The Zone 4 BPSs are required to meet the existing, projected 6-year (2021), and projected 10-year (2025) MDD for Zone 4 and the indirectly supplied pressure zones. The 20-year supply capacity analysis assumes the ASR Well is operational, and is providing direct supply to Zone 4 and indirect supply to all higher pressure zones (i.e., Zone 5, Zone 6, etc.). The projected 2035 supply requirements of Zone 4 and the higher pressure zones exceed the capacity of the ASR Well. Therefore, the City's other supply facilities are required to account for supply to Zone 4 and the higher pressure zones at a rate that is equivalent to the difference between the ASR Well supply capacity and the supply requirement of these pressure zones. **Table 3-7** summarizes the existing and future supply requirements of Zone 4. Even with the full capacity of existing BPSs not considered for the 20-year analyses, the results of the analyses indicate that the existing and proposed configurations are of sufficient capacity to meet both existing and future demands. The existing BPSs will provide regular supply to Zone 4, specifically in the winter and spring months, but these facilities are presented as backup supply facilities for the 20-year analyses to minimize the projected 20-year supply deficiency in Zone 1.

Table 3-7
Zone 4 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)[1]	2035 (+20 years)[1]
Required Supply (gpm)				
Zone 4 MDD	944	1,105	1,202	1,529
Other Zones MDD	244	426	600	969
Total Required Supply	**1,188**	**1,532**	**1,802**	**2,499**
Available Supply[2] (gpm)				
54th and Olympia BPS	4,400	4,400	4,400	419
28th and Irving BPS	3,400	3,400	3,400	
ASR Well	---	---	---	2,080
Total Available Supply	**7,800**	**7,800**	**7,800**	**2,499**
Surplus or Deficient Supply[1,2] (gpm)				
Surplus or Deficient Amount	**6,612**	**6,268**	**5,998**	**0**

(1) Additional supply to Zone 4 may be required following approval of the ASR Well for water quality purposes relating to the high temperatures of the recovery water. Proposed pressure reducing valves between all of the City's pressure zones will allow the City to move water between zones as needed to facilitate any blending requirements, and will not restrict the City's ability to fully utilize the ASR Well.
(2) The full pumping rates from the 54th and Olympia BPS and the 28th and Irving BPS are available to Zone 4 in the 20-year planning period. A reduced contribution from these pumping facilities is presented in this table for conservatism, and to assign a theoretical operating area for each of the City's sources.

Zone 5 Facilities

Water supply to Zone 5 is currently provided by the 46th and Olson BPS. The Thompson Hill BPS was constructed in 2014, but as of the first quarter of 2016, is not connected to the distribution system. It is anticipated that the Thompson Hill BPS will be connected to the distribution system within 2016 or in 2017. The Zone 5 BPSs will be required to meet the existing and projected MDDs for Zone 5, and the future MDD of any higher pressure zones (i.e., Zone 6, Zone 7, etc.). **Table 3-8** summarizes the existing and future supply requirements of Zone 5. The results of the analyses indicate that the existing and proposed configurations are of sufficient capacity to meet both existing and future demands.

Table 3-8
Zone 5 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 5 MDD	244	376	450	719
Other Zones MDD	0	50	150	250
Total Required Supply	**244**	**426**	**600**	**969**
Available Supply (gpm)				
46th and Olson BPS	2,555	2,555	2,555	2,555
Thompson Hill BPS	---	5,300	5,300	5,300
Total Available Supply	**2,555**	**7,855**	**7,855**	**7,855**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**2,311**	**7,429**	**7,255**	**6,886**

Zone 6 Facilities

The Zone 6 BPS was constructed in 2014, but no water service connections currently exist in Zone 6. It is likely that the City's future water system will include two hydraulically separated Zone 6's, with one located north of the existing Zone 6 BPS, and another located south of the existing City limits and Urban Growth Area (UGA). For conservatism, the Zone 6 supply analysis was performed if all projected Zone 6 and Zone 7 demand was required to be supplied from the existing Zone 6 BPS. The analyses assumed Zone 6 to operate as a closed pressure zone through the 20-year planning period, with a maximum fire flow requirement of 1,000 gpm, which is consistent with the current planning-level fire flow requirement based on the land use in the existing Zone 6 BPS's operating area. **Table 3-9** summarizes the existing and future supply requirements of Zone 6. The results of the analyses indicate that the existing configuration is of sufficient capacity to meet both existing and future demands.

Table 3-9
Zone 6 Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 6 PHD	0	77	154	230
Zone 6 Maximum Fire Flow	1,000	1,000	1,000	1,000
Other Zones PHD	0	0	77	154
Total Required Supply	**1,000**	**1,077**	**1,230**	**1,384**
Available Supply (gpm)				
Zone 6 BPS	2,238	2,238	2,238	2,238
Total Available Supply	**2,238**	**2,238**	**2,238**	**2,238**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**1,238**	**1,161**	**1,008**	**854**

Supply Facility Deficiencies

A summary of the deficiencies at the City's BPS facilities is as follows. Improvements to resolve these deficiencies are identified in the City's operations and maintenance budget.

- Golf Course BPS
  - No emergency power available.
  - Access to the facility is via the golf course cart path.
  - Two VFDs are in need of replacement.
- 19th and Olympia BPS
  - No emergency power available.
  - Lighting is inadequate.
  - Heating, ventilating, and air conditioning system is nearing the end of its useful life.

  - No hoist within the facility to remove pumps or motors.
  - The motors for Pump Nos. 4 and 5 vibrate at higher than desirable levels, with testing indicating a potential imbalance in the pump/motor system and system resonance due to looseness in the system. Minor indications of vane pass frequency imbalances and turbulence were also present in both pumps.
- 18th and Kellogg BPS
  - Heating, ventilating, and air conditioning system is nearing the end of its useful life.
  - The motor for Pump No. 1 vibrates at higher than desirable levels, primarily due to bearing defects and electrical faults. Indications of turbulence and looseness within the pump and motor system were also measured.
- 47th and Olympia BPS
  - Heating, ventilating, and air conditioning system is a ductless, wall mounted unit.
  - Motor soft starters are nearing the end of their useful life.
  - The motor for Pump No. 2 vibrates at higher than desirable levels, primarily due to bearing defects and electrical faults. Indications of turbulence and looseness within the pump and motor system were also measured.
- 54th and Olympia BPS
  - Heating, ventilating, and air conditioning system is nearing the end of its useful life.
- 28th and Irving BPS
  - Heating, ventilating, and air conditioning system is nearing the end of its useful life.
  - Site security is insufficient; no site fencing exists.
- 46th and Olson BPS
  - Heating, ventilating, and air conditioning system is nearing the end of its useful life.
  - Concerning vibration levels have been measured in all three motors, as well as Pump No. 1. Pump No. 1 and the motors for Pump Nos. 1 and 2 vibrate at levels that are likely causing damage to the motors during operation, and the motor for Pump No. 3 vibrates at higher than desirable levels. A potential imbalance and vane pass frequency imbalance have been measured for Pump No. 1. A potential imbalance and bearing defects have been measured for the Pump No. 1 motor. Potential electrical faults, bearing defects, and imbalances have been measured for the motors of Pump Nos. 2 and 3.
- Thompson Hill BPS
  - Compatible with an emergency generator, but an emergency generator has not been purchased.

SYSTEM STORAGE ANALYSIS

This section evaluates the City's existing water storage facilities to determine if they have sufficient capacity to meet the existing and future storage requirements of the system. This section also identifies facility deficiencies that are unrelated to the capacity of the water reservoirs.

Analysis Criteria

Water storage typically includes the following components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage. Each storage component serves a different purpose and will vary from system to system. A definition of each storage component used to evaluate the capacity of the City's reservoirs follows.

Operational Storage – Volume of the reservoir represented by the average amount of drawdown during normal operating conditions, which is essentially storage that will most likely not be available for equalizing, fire flow, or standby storage.

Equalizing Storage – Volume of the reservoir used to supply the water system under peak demand conditions when the system demand exceeds the total rate of supply of the sources. DOH requires that equalizing storage be stored above an elevation that will provide a minimum pressure of 30 psi at all connections throughout the system under PHD conditions. DOH requires the minimum equalizing storage volume to be calculated with Equation 9-1 from the DOH *Water System Design Manual*.

Equation 9-1: $ES = (PHD - Q_S)(150 \text{ minutes})$, but in no case less than zero.

Where:

ES = Equalizing Storage, in gallons.

PHD = Peak Hour Demand, in gpm.

Q_S = Sum of all installed and active sources, except emergency supply, in gpm.

In addition to the equalizing storage requirements calculated from Equation 9-1, the City requires that the equalizing storage volume not be less than 15 percent of the MDD. This calculation determines the equalizing storage volume required for the City's system-wide and individual pressure zone operating areas for all existing and future planning periods.

Standby Storage – Volume of the reservoir used to supply the water system under emergency conditions, when supply facilities are out of service due to equipment failures, power outages, loss of supply, or transmission main breaks, and any other situation that disrupts the supply source. The DOH recommends that standby storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system. Equation 9-3 from the DOH *Water System Design Manual* presents the formula for calculating standby storage.

Equation 9-3: $SB = (2 \text{ days})[(ADD)(N) - t_m (Q_S - Q_L)]$

Where:

SB = Standby Storage, in gallons.

ADD = Average Day Demand per equivalent residential unit (ERU), in gallons per day (gpd) per ERU.

N = Number of ERUs.

Q_S = Sum of all installed and continuously available sources, except emergency supply, in gpm.

Q_L = The capacity of the largest source available to the system, in gpm.

t_m= Time the remaining sources are pumped on the day when the largest source is not available, in minutes. Unless otherwise restricted, this value is 1,440 minutes.

In addition to the standby storage requirements calculated from Equation 9-3, DOH recommends that the minimum standby storage volume be no less than 200 gallons per ERU.

Fire Flow Storage – Volume of the reservoir used to supply water to the system at the maximum rate and duration required to extinguish a fire at a building with the highest fire flow requirement. The magnitude of the fire flow storage is based on the volume of the building being protected, the occupancy hazard, and the construction class. The DOH requires that fire flow storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system under MDD conditions. The fire flow storage requirements shown in the evaluations that follow are based on a 5,000 gpm fire flow rate and 4-hour duration for the system-wide and all individual pressure zone operating areas, except the Zone 4 evaluation which is based on a 4,000 gpm fire flow rate with a 4-hour duration. In addition, the fire flow and standby storage components were not consolidated, as shown in the storage evaluation tables.

Dead Storage – Volume of the reservoir that cannot be used because it is stored at an elevation that does not provide system pressures that meet the minimum pressure requirements established by the DOH without pumping. This unusable storage occupies the lower portion of most ground-level reservoirs. Water that is stored below an elevation that cannot provide a minimum pressure of 20 psi is considered dead storage for the analyses that follow.

Storage Analysis Results

System-wide Storage

The storage analyses are based on an evaluation of the existing storage facilities providing water to the City's distribution system. The maximum combined storage capacity of the City's reservoirs is 32.94 million gallons (MG), as shown in **Table 3-10**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on storing 15 percent of the water system's MDD, which is more conservative than the results of Equation 9-1 from the DOH *Water System Design Manual*. Standby storage is based on providing 200 gallons of storage per ERU, which is more conservative than the results of Equation 9-3 from the DOH *Water System Design Manual*. There is currently minimal dead storage (i.e., non-usable storage) in the water system, all of which is located within Zone 4. The results of the existing storage evaluation, as shown in **Table 3-10**, indicate that the system currently has a storage surplus of approximately 12.02 MG.

Table 3-10
Water Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	33.77	33.77	33.77	33.77
Dead (Non-usable) Storage	0.83	0.83	0.83	0.83
Total Available Storage	**32.94**	**32.94**	**32.94**	**32.94**
Required Storage (MG)				
Operational Storage	7.62	7.62	7.62	7.62
Equalizing Storage	3.09	3.35	3.55	4.06
Standby Storage	9.01	9.75	10.33	11.83
Fire Flow Storage	1.20	1.20	1.20	1.20
Total Required Storage	**20.92**	**21.91**	**22.70**	**24.72**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**12.02**	**11.02**	**10.24**	**8.22**

The system's future storage requirements, also shown in **Table 3-10**, were computed for the 6-, 10-, and 20-year planning periods, based on the corresponding demand projections shown in **Chapter 2**. The City is projected to have a system-wide storage surplus through the 20-year planning period.

Zone 1 Storage

The City's Zone 1 reservoir, the 19th and Olympia Reservoir, has an existing storage capacity of 6.00 MG, as shown in **Table 3-11**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on storing 15 percent of the water system's MDD, which is more conservative than the results of Equation 9-1 from the DOH *Water System Design Manual*. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 from the DOH *Water System Design Manual*. There is currently no dead storage (i.e., non-usable storage) in Zone 1. The results of the storage evaluation, as shown in **Table 3-11**, indicate that the Zone 1 storage facilities have sufficient capacity to meet the existing and future storage requirements through the 20-year planning period.

Table 3-11
Zone 1 Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	6.00	6.00	6.00	6.00
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00
Total Available Storage	**6.00**	**6.00**	**6.00**	**6.00**
Required Storage (MG)				
Operational Storage	1.68	1.68	1.68	1.68
Equalizing Storage	0.65	0.68	0.70	0.76
Standby Storage	1.91	1.99	2.05	2.21
Fire Flow Storage	1.20	1.20	1.20	1.20
Total Required Storage	**5.44**	**5.55**	**5.63**	**5.84**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**0.56**	**0.45**	**0.37**	**0.16**

Zone 2 Storage

The City's Zone 2 reservoirs, the 47th and Olympia Reservoir and the 18th and Kellogg Reservoirs, have a combined existing storage capacity of 15.87 MG, as shown in **Table 3-12**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on storing 15 percent of the water system's MDD, which is more conservative than the results of Equation 9-1 from the DOH *Water System Design Manual*. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 from the DOH *Water System Design Manual*. There is currently no dead storage (i.e., non-usable storage) in Zone 2. The results of the storage evaluation, as shown in **Table 3-12**, indicate that the Zone 2 storage facilities have sufficient capacity to meet the existing and future storage requirements through the 20-year planning period.

Table 3-12
Zone 2 Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	15.87	15.87	15.87	15.87
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00
Total Available Storage	**15.87**	**15.87**	**15.87**	**15.87**
Required Storage (MG)				
Operational Storage	3.47	3.47	3.47	3.47
Equalizing Storage	1.32	1.43	1.53	1.77
Standby Storage	3.83	4.18	4.45	5.14
Fire Flow Storage	1.20	1.20	1.20	1.20
Total Required Storage	**9.82**	**10.28**	**10.64**	**11.58**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**6.05**	**5.59**	**5.23**	**4.29**

Zone 3 Storage

The City's Zone 3 reservoirs, the 54th and Olympia Reservoir, the 28th and Irving Reservoir, and the Kansas Reservoir, have a combined existing storage capacity of 6.78 MG, as shown in **Table 3-13**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on storing 15 percent of the water system's MDD, which is more conservative than the results of Equation 9-1 from the DOH *Water System Design Manual*. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 from the DOH *Water System Design Manual*. There is currently no dead storage (i.e., non-usable storage) in Zone 3. The results of the storage evaluation, as shown in **Table 3-13**, indicate that the Zone 3 storage facilities have sufficient capacity to meet the existing and future storage requirements through the 20-year planning period.

Table 3-13
Zone 3 Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	6.78	6.78	6.78	6.78
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00
Total Available Storage	**6.78**	**6.78**	**6.78**	**6.78**
Required Storage (MG)				
Operational Storage	1.19	1.19	1.19	1.19
Equalizing Storage	0.86	0.90	0.93	1.00
Standby Storage	2.52	2.62	2.70	2.91
Fire Flow Storage	1.20	1.20	1.20	1.20
Total Required Storage	**5.77**	**5.91**	**6.02**	**6.31**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**1.00**	**0.86**	**0.75**	**0.47**

Zone 4 Storage

The City's Zone 4 reservoirs, the Canyon Lakes Reservoir and the Thompson Hill Reservoir, have a combined existing storage capacity of 4.06 MG, as shown in **Table 3-14**. However, the total amount of usable storage is reduced to 3.23 MG as a result of 0.83 MG of dead storage due to the water services that are located at the highest elevations within the water system or near a storage tank. The highest Zone 4 service elevation is 846 feet, located at an existing hydrant on a dead-end water main in Olympia Street, located immediately south of the City's Zone 5 Reservoir.

Table 3-14
Zone 4 Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	4.06	4.06	4.06	4.06
Dead (Non-usable) Storage	0.83	0.83	0.83	0.83
Total Available Storage	**3.23**	**3.23**	**3.23**	**3.23**
Required Storage (MG)				
Operational Storage	1.08	1.08	1.08	1.08
Equalizing Storage	0.20	0.24	0.26	0.33
Standby Storage	0.59	0.70	0.76	0.96
Fire Flow Storage	0.96	0.96	0.96	0.96
Total Required Storage	**2.83**	**2.97**	**3.05**	**3.33**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**0.40**	**0.26**	**0.18**	**(0.10)**

Operational storage in the Zone 4 reservoirs is based on BPS set points provided by the City. Equalizing storage is based on storing 15 percent of the water system's MDD, which is more conservative than the results of Equation 9-1 from the DOH *Water System Design Manual*. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 from the DOH *Water System Design Manual*. The results of the storage evaluation, as shown in **Table 3-14**, indicate that the Zone 4 storage facilities have sufficient capacity to meet the existing and future storage requirements through the 10-year planning period, but not through the 20-year planning period based on the City's storage requirement criteria, which are more stringent than DOH's minimum criteria. The existing storage facilities have sufficient capacity to meet the DOH minimum storage requirements in the 20-year planning period, as the 0.33 MG of equalizing storage presented in **Table 3-14** is not required by DOH. The City will continue to evaluate the applicability of the Zone 4 storage requirements as growth occurs throughout the water system; improvements to resolve the slight 20-year storage deficiency are presented in **Chapter 8**.

Zone 5 Storage

The City's Zone 5 Reservoir has an existing storage capacity of 1.06 MG, as shown in **Table 3-15**. Operational storage in the Zone 5 reservoir is based on BPS set points provided by the City. Equalizing storage is based on Equation 9-1 from the DOH *Water System Design Manual* for the existing storage evaluation; the future equalizing storage is based on storing 15 percent of the water system's MDD once the City's Thompson Hill BPS is connected to the Zone 5 distribution system. Standby storage is based on Equation 9-3 from the DOH *Water System Design Manual* for the existing storage evaluation; the future standby storage is based on a rate of 200 gpd per ERU in the system. There is currently no dead storage (i.e., non-usable storage) in Zone 5. The results of the storage evaluation, as shown in **Table 3-15**, indicate that the Zone 5 storage facilities do not have sufficient capacity to meet typical storage requirements. However, the City has sized the Zone 5 pumping facilities to meet the Zone 5 fire flow requirements, with the pumping facilities having capacity to meet the PHD and maximum fire flow requirements of Zone 5 through the 20-year planning period once the City's Thompson Hill BPS is connected to the Zone 5 distribution system, as shown in **Table 3-16**. Therefore, the 0.96 MG of Zone 4 fire flow storage was assumed to be available to Zone 5 during an emergency event, resulting in a slight storage surplus projected for the City's 20-year planning period, as shown at the bottom of **Table 3-15**. Improvements to evaluate and construct additional Zone 5 storage to improve operational flexibility are presented in **Chapter 8**.

Table 3-15
Zone 5 Storage Capacity Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Available/Usable Storage (MG)				
Maximum Storage Capacity	1.06	1.06	1.06	1.06
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00
Total Available Storage	**1.06**	**1.06**	**1.06**	**1.06**
Required Storage (MG)				
Operational Storage	0.20	0.20	0.20	0.20
Equalizing Storage	0.05	0.08	0.10	0.16
Standby Storage	0.37	0.24	0.28	0.45
Fire Flow Storage	1.20	1.20	1.20	1.20
Total Required Storage	**1.83**	**1.72**	**1.78**	**2.01**
Surplus or Deficient Storage (MG)				
Surplus or Deficient Amount	**(0.77)**	**(0.66)**	**(0.73)**	**(0.95)**
Adjusted Surplus or Deficient Amount (MG)				
Fire Flow Storage From Zone 4	0.96	0.96	0.96	0.96
Adjusted Surplus or Deficient Amount	**0.19**	**0.30**	**0.23**	**0.01**

Table 3-16
Zone 5 PHD and Fire Flow Supply Evaluation

Description	Existing	Future Projections		
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Required Supply (gpm)				
Zone 5 PHD	374	578	691	1,104
Other Zones PHD	0	77	230	384
Zone 5 Maximum Fire Flow	5,000	5,000	5,000	5,000
Total Required Supply	**5,374**	**5,655**	**5,922**	**6,488**
Available Supply (gpm)				
46th and Olson BPS	2,555	2,555	2,555	2,555
Thompson Hill BPS	---	5,300	5,300	5,300
Total Available Supply	**2,555**	**7,855**	**7,855**	**7,855**
Surplus or Deficient Supply (gpm)				
Surplus or Deficient Amount	**(2,819)**	**2,200**	**1,933**	**1,367**

Storage Facility Deficiencies

A summary of the deficiencies at the City's reservoir facilities is as follows. Improvements to resolve these deficiencies are identified in the City's operations and maintenance budget.

- 19th and Olympia Reservoir
  - The reservoir is divided into east and west portions that are hydraulically isolated from each other.
  - The reservoir floor has cracks, and rebar was visible in places during a 2016 reservoir cleaning. The reservoir floor has a history of root intrusion.
- 18th and Kellogg (10 MG) Reservoir
  - Peterson Structural Engineers, Inc., (Peterson) performed a visual condition assessment and structural evaluation of the reservoir in 2014, and found significant defects and vulnerabilities. Improvements to resolve these deficiencies are contained in Peterson's report. A summary of the defects and vulnerabilities noted by Peterson include:
    - Moderate deterioration of the reservoir exterior wall surface;
    - Shrinkage cracking around the reservoir;
    - Areas of efflorescence and stains from roof leakage;
    - Roof slab deflection of as much as 4 inches, particularly at exterior spans;
    - Roof slab cracking;
    - Corrosion of overflow pipe, floor drain, and other internal steel appurtenances;
    - Slab reinforcing was measured to have strength deficiencies at 21 of the 24 tested locations;
    - Post-installed anchors are inadequate to resist the reservoir's seismic loads; and
    - Bearing pad thickness is inadequate.
- 28th and Irving Reservoir
  - Site security is insufficient; no site fencing exists.
- Kansas Reservoir
  - Reservoir mixing is inadequate.
- Canyon Lakes Reservoir
  - Reservoir roof exterior is exhibiting signs of pitting and cracking.
- Zone 5 Reservoir
  - Site access road is gravel and steep, and can be difficult to access in small vehicles.

DISTRIBUTION AND TRANSMISSION SYSTEM ANALYSIS

This section evaluates the City's existing distribution and transmission system (i.e., water mains) to determine if they are sized and looped adequately to provide the necessary flow rates and pressures to meet the existing and future requirements of the system. This section also identifies deficiencies that are unrelated to the capacity of the water mains.

Analysis Criteria

Distribution and transmission water mains must be capable of adequately and reliably conveying water throughout the system at acceptable flow rates and pressures. The criteria used to evaluate the City's distribution and transmission system are the state mandated requirements for Group A water systems contained in WAC 246-290-230, Distribution Systems. The pressure analysis criteria state that the distribution system "…shall be designed with the capacity to deliver the design PHD quantity of water at 30 psi under PHD flow conditions measured at all existing and proposed service water meters." It also states that if fire flow is to be provided, "… the distribution system shall also provide maximum day demand (MDD) plus the required fire flow at a pressure of at least 20 psi at all points throughout the distribution system."

Hydraulic analyses of the existing system were performed under existing PHD conditions to evaluate the current pressure capabilities and identify existing system deficiencies. The existing system was also analyzed under existing MDD conditions to evaluate the current fire flow capabilities and identify additional existing system deficiencies. Additional hydraulic analyses were then performed with the same hydraulic model under future MDD conditions and with proposed improvements to demonstrate that the identified improvements will eliminate the deficiencies and meet the requirements far into the future. The following is a description of the hydraulic model and the operational conditions and facility settings used in the analyses.

Hydraulic Model

Description

A computer-based hydraulic model of the existing water system was created using version 8i (SELECTseries 6) of the WaterGEMS® program, developed by Bentley Systems. All facilities and water mains in the City's water system, including dead-end mains, were modeled. The water mains were entered from the City's Geographical Information System (GIS) water system database and as-built records. The model was updated with additional water system improvement information provided by the City. The junction node elevation data were electronically extracted from Benton County topographic data. A hydraulic model node diagram that provides a graphical representation of the model of the water system is contained in **Appendix E**.

Demand Data

The hydraulic model of the existing system contains 2015 average day demand (ADD) data. Consumption data from 2014 metered billing records were distributed based on the recorded usage for each parcel to the closest representative junction node of the model, which was then uniformly scaled to match the 2015 supply data. The peaking factors calculated in **Chapter 2** were used to analyze the system under PHD and MDD conditions.

The hydraulic model of the proposed system contains 6-year, 10-year, and 20-year demand levels that are projected for the years 2021, 2025, and 2035, respectively. The City's future demand distribution was based on a large concentration of growth occurring within Zone 2's commercial and industrial areas in and around Vista Field, approximately located west of N. Kellogg Street and north of W. Clearwater Avenue. Large concentrations of growth are also anticipated to occur in the predominantly low density residential area in the south and southwest portion of the City limits, broadly referred to as the Southridge area, which is currently within Zones 4 and 5, and within future Zones 6 and 7 located south of the existing City limits but within the City's retail water service area. The future ADD allocations in each pressure zone are shown in **Table 3-17**.

Table 3-17
Future Pressure Zone Demand Allocation

Pressure Zone	ADD (gpm)			
	Existing	2021	2025	2035
Zone 1	1,616	1,683	1,735	1,870
Zone 1 (from Zone 2 PRVs)	122	127	131	141
Zone 2	3,127	3,413	3,639	4,218
Zone 3	2,132	2,220	2,289	2,467
Zone 4	503	589	641	815
Zone 5	130	201	240	383
Zone 6	0	27	53	80
Zone 7	0	0	27	53
Total	**7,630**	**8,259**	**8,754**	**10,028**

Facilities

The hydraulic model of the existing system for the pressure analysis contains active, existing system facilities. For the proposed system analyses in the years 2021, 2025, and 2035, the hydraulic model contained active, existing system facilities and proposed system improvements identified in **Chapter 8** for the 6-year, 10-year, and 20-year planning periods, respectively.

The facility settings for the pressure analyses correspond to a PHD event in the water system. All sources of supply that are currently available to the system, or will be available in the future for the years 2021, 2025, and 2035 analyses, were operating at their normal summertime pumping rates during a peak period. The reservoir levels were modeled to reflect full utilization of operational and equalization storage. All active PRVs were modeled as being in service and at their normal set points, which are shown in **Appendix F**. The operational conditions for the pressure analyses are summarized in **Table 3-18**.

Table 3-18
Hydraulic Analyses Operational Conditions

Description	PHD Pressure Analyses				Fire Flow Analyses			
	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)	2015	2021 (+6 years)	2025 (+10 years)	2035 (+20 years)
Demand	2015 PHD	2021 PHD	2025 PHD	2035 PHD	2015 MDD	2021 MDD	2025 MDD	2035 MDD
Storage Facilities HGL (feet)								
WTP Clearwell	335.0	335.0	335.0	335.0	335.0	335.0	335.0	335.0
19th and Olympia E.	526.2	526.1	526.0	525.9	523.2	523.1	523.0	522.9
19th and Olympia W.	526.2	526.1	526.0	525.9	523.2	523.1	523.0	522.9
47th and Olympia	643.6	643.4	643.2	642.8	641.5	641.2	641.1	640.6
18th and Kellogg	644.2	644.0	643.8	643.4	642.1	641.8	641.7	641.2
18th and Kellogg	644.2	644.0	643.8	643.4	642.1	641.8	641.7	641.2
54th and Olympia	772.3	772.1	772.0	771.7	767.3	767.2	767.1	766.8
28th and Irving	771.4	771.2	771.1	770.8	766.4	766.3	766.2	765.9
Kansas	771.4	771.2	771.1	770.8	766.4	766.3	766.2	765.9
Canyon Lakes	904.6	904.4	904.3	903.9	899.0	898.8	898.6	898.2
Thompson Hill	904.6	904.4	904.3	903.9	899.0	898.8	898.6	898.2
Zone 5 Reservoir	1,040.0	1,039.4	1,039.1	1,037.9	1,024.0	1,024.0	1,024.0	1,024.0
Pumping Facilities Status								
Ranney Wells No. 4	ON	ON	ON	ON	ON	ON	ON	ON
Ranney Wells No. 5	ON	ON	ON	ON	ON	ON	ON	ON
Water Treatment Plant BPS	ON	ON	ON	ON	ON	ON	ON	ON
ASR Well	---	---	ON	ON	---	---	ON	ON
Golf Course BPS	ON	ON	ON	ON	ON	ON	ON	ON
19th and Olympia BPS	ON	ON	ON	ON	ON	ON	ON	ON
47th and Olympia BPS	ON	ON	ON	ON	ON	ON	ON	ON
18th and Kellogg BPS	ON	ON	ON	ON	ON	ON	ON	ON
54th and Olympia BPS	ON	ON	ON	ON	ON	ON	ON	ON
28th and Irving BPS	ON	ON	ON	ON	ON	ON	ON	ON
Thompson Hill BPS	OFF	ON	ON	ON	OFF	ON	ON	ON
46th and Olson BPS	ON	ON	ON	ON	ON	ON	ON	ON
Zone 6 BPS	OFF	ON	ON	ON	OFF	ON	ON	ON
Pressure Reducing Valves Hydraulic Grade Level (HGL) Setpoint (feet)[1]								
Proposed Deschutes and Colorado Zone 3 to 2 PRV (CIP VF1)	---	634	634	634	---	634	634	634
Proposed Columbia Center Blvd and Grandridge Zone 3 to 2 PRV (CIP VF1)	---	615	615	615	---	615	615	615
Proposed Oklahoma Place Zone 3 to 2 PRV (CIP VF1)	---	623	623	623		623	623	623
Proposed Olympia Street Zone 4 PRV (CIP PZ3)	---	---	---	905	---	---	---	905
Proposed Kellogg and 4th Ave Zone 3 to 2 PRV (CIP PRV1)	---	---	630	630	---	---	630	630
Proposed Steptoe and Gage Zone 3 to 2 PRV (CIP PRV1)	---	---	630	630	---	---	630	630
Proposed 27th Ave and Creekstone Zone 4 to Zone 3 PRV (CIP PRV3)	---	---	745	745	---	---	745	745
Proposed Canyon Lakes Drive Zone 4 to Zone 3 PRV (CIP PRV3)	---	---	754	754	---	---	754	754
Proposed 52nd Ave and Olympia Zone 4 to Zone 3 PRV (CIP PRV3)	---	---	744	744	---	---	744	744
Proposed Zone 4 PRV in Southwest of Water System (CIP DF4)	---	---	---	895	---	---	---	895
Proposed Zone 3 PRV in Southwest of Water System (CIP DF5)	---	---	---	760	---	---	---	760
Proposed Olympia Street Zone 6 to Zone 5 PRV (CIP DF8)	---	---	---	1,030	---	---	---	1,030
Intertie Status								
Richland - Gage Blvd	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Richland - Tapteal Drive	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
KID - Elliot Lake	ON	Acquired by City			ON	Acquired by City		

(1) All existing PRVs not specifically shown in this table were operated at the pressure setpoints provided by the City in late 2015. A copy of these PRV setpoints is shown in **Appendix F**.

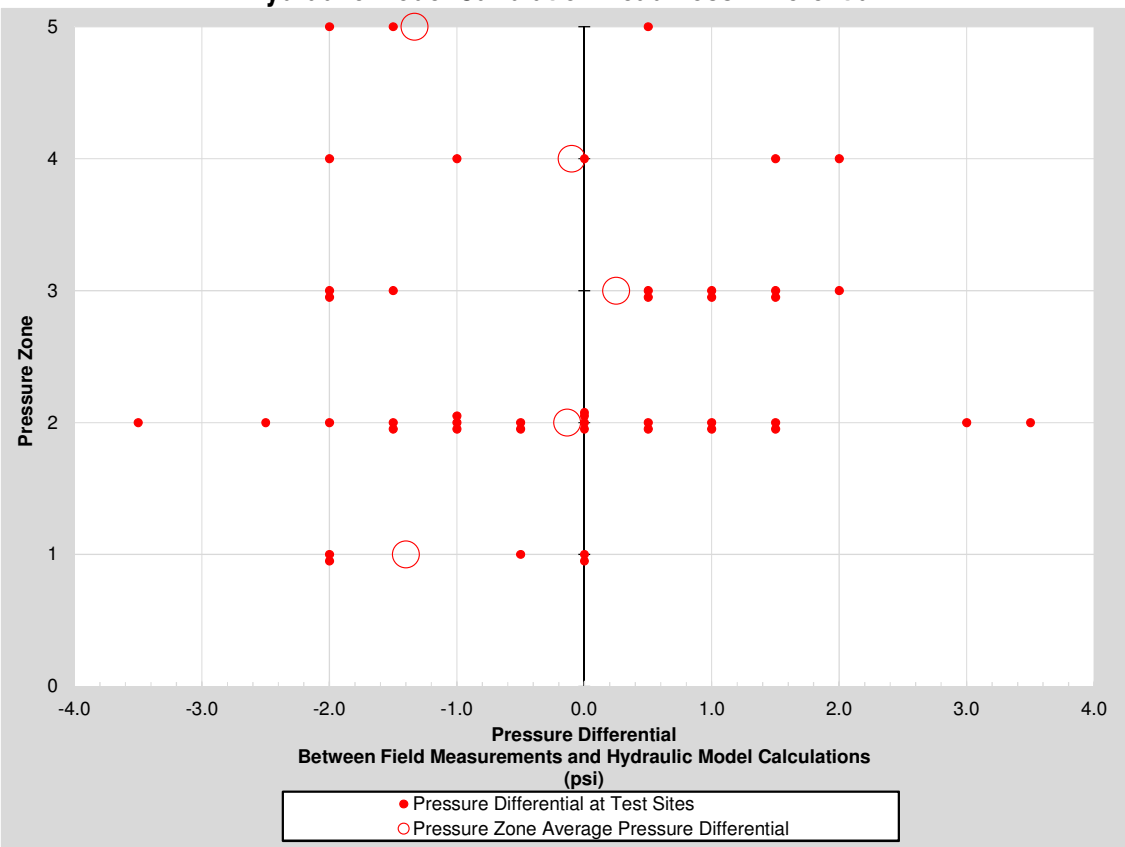
Separate fire flow analyses were performed on the system to size distribution system improvements and calculate fire flow availability. The hydraulic model for the fire flow analyses contained settings that correspond to MDD events. All sources of supply that are currently available to the system during a peak period were operating at their normal pumping rates with the largest pump at each facility offline. Reservoir levels were modeled to reflect full utilization of operational, equalizing, and fire flow storage based on the maximum planning-level fire flow requirement. Each pressure zone was modeled with the largest pump off during the fire flow analyses, consistent with WAC 246-293-660. **Table 3-18** summarizes the operational conditions for the fire flow analyses for the existing and future systems.

Calibration

Hydraulic model calibration is the process of adjusting hydraulic model data so the model closely reflects actual system pressures and flows under similar demand and operating conditions. Initial Darcy-Weisbach roughness coefficients were entered into the model based on computed estimates of the coefficients from available pipe age and material data. For example, assuming that the internal surface of water pipes becomes rougher as it ages, older water mains were assigned higher roughness coefficients than newer water mains. In addition, internal pipe diameters were entered in the model based on nominal pipe diameter and material data.

The City performed hydrant flow tests at 45 locations in late 2015 and early 2016, measuring hydrant flows, and static and residual pressures during the tests for use in calibrating the hydraulic model. Telemetry data for all of the City's water system facilities were provided in 1-minute intervals during the tests, and were used to initialize the settings of the facilities in the hydraulic model. Pressure transducers recording at 2-second intervals were installed in at least two locations in each pressure zone during the flow tests to verify the static and residual pressures at intermediate points in the system (between the water system facilities and the hydrant flow test locations). Hydraulic model calibration of the 45 locations was achieved by adjusting the roughness coefficients of the water mains and elevations of the junction nodes in the model until the model results reflected an acceptable level of accuracy. The hydraulic model's calculated head loss during the flow tests was within plus or minus 3.5 psi of the field-measured head loss at all 45 hydrants that were flow tested, and within 2 psi at 41 of the 45 hydrants. The accuracy of the calibrated hydraulic model exceeds the guidelines identified by the Engineering Computer Application Committee (ECAC) in 1999, which is a recommended standard in the DOH *Water System Design Manual*. **Chart 3-2** shows the pressure differential between the hydraulic model's calculated head loss and the field-measured head loss at all 45 hydrants, with the results shown for each individual pressure zone.

Chart 3-2
Hydraulic Model Calibration Head Loss Differential



Hydraulic Analyses Results

Several hydraulic analyses were performed to determine the capability of the system to meet the pressure and flow requirements identified in **Chapter 7** and contained in WAC 246-290-230. The first set of analysis was performed to determine the pressures throughout the system under existing (i.e., 2015) PHD conditions. Subsequent analyses were performed to determine the pressures throughout the system under future 6-, 10-, and 20-year PHD conditions. The results of these analyses were used to identify locations of low and high pressures. To satisfy the minimum pressure requirements, the pressure at all water service locations must be at least 30 psi during these demand conditions. In addition, the system should not have widespread areas with high pressures, generally considered to be more than 100 psi.

A summary of the pressure deficiencies identified from the results of the analyses is contained in **Table 3-19**. Multiple pressure zones have areas with both low and high pressures during existing PHD conditions. Pressure zone improvements have been proposed for low pressure areas identified in **Table 3-19**. All water mains with pressures greater than 100 psi, as identified from the analyses, were generally located along pressure zone boundaries. Water services in these areas, as with any future services, are required to be equipped with pressure regulators to limit the maximum pressure to 80 psi.

Table 3-19
Pressure Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Node Number	CIP Number	Pressure (psi)			
					Existing System	6-year w/ Improvements	10-year w/ Improvements	20-year w/ Improvements
Low Pressure Areas								
Low Density Residential	Near intersection of W 19th Ave and S Jean St	Zone 1	J-7825	PZ1	26	81	81	81
Low Density Residential	Neighborhood near the intersection of N Nevada Street and W Metaline Ave	Zone 2	J-5833	VF1	21	31	31	34
Commercial	Along and north of W Deschutes Avenue, in N Colorado St and N Young St	Zone 2	J-7670	VF1	22	33	32	33
Low Density Residential	Dead end main south of W 1st Ave, in S Quay St and S Penn St	Zone 2	J-5773	VF1 PRV1	22	30	30	31
Low Density Residential	Near intersection of W 1st Ave and S Kellogg St	Zone 2	J-11719	VF1 PRV1	28	36	36	36
Low Density Residential	Dead end main south of W 4th Ave, in S Harrison St	Zone 2	J-5779	VF1 PRV1	27	32	31	32
Commercial	Near intersection of N Center Pkwy and W Grandridge Blvd	Zone 2	J-10987	VF1	27	38	38	40
High Pressure Areas								
Low Density Residential	W 7th Pl cul-de-sac	Zone 2	J-3328	---	85	102	101	101
Low Density Residential	Near intersection of W 19th Ave and S Garfield St	Zone 2	J-3281	---	105	107	106	106
Low Density Residential	Transmission main through Canyon Lakes Golf Course (no services)	Zone 4	J-5770	---	131	131	135	135
Open Space	Near intersection of Hildebrand Blvd and W Canyon Lakes Dr	Zone 4	J-5182	---	109	109	111	111
Low Density Residential	W 36th Ave within Canyon Lakes development	Zone 4	J-5094	---	103	103	106	106
Low Density Residential	North end of S Green St within Canyon Lakes development	Zone 4	J-3347	---	96	96	101	101
Low Density Residential	Along W 49th St	Zone 4	J-4535	---	93	93	107	106
Low Density Residential	Along W 51st Ave	Zone 4	J-3802	---	88	88	103	102
Low Density Residential	S Sherman St, just north of intersection with Hildebrand Blvd	Zone 5	J-13287	---	134	156	155	154
Commercial	Transmission main under State Highway 395 (no services)	Zone 5	J-265	---	108	120	118	117

Hydraulic analyses were also performed to determine the ability of the existing water system to withstand extreme peak demand conditions. These conditions may occur during a drought if Kennewick Irrigation District's supply availability is limited and the City's water system is used to supply additional irrigation demands. The City's existing sources have capacity to meet demands that are approximately 15 percent greater than the existing MDD, which was assumed to be representative of drought demand conditions for the purposes of these analyses. The results of the analyses, which were performed with existing MDD and PHD peaked by 15 percent, indicate that pressures decrease by up to 5 psi at all locations throughout the system. Results of the drought analyses in existing low pressure areas are presented in **Table 3-20**, and are based on the assumption that the City's reservoirs are drawn down through the operational and equalizing storage components. In Zone 1, there are two junctions with pressures below 30 psi during existing PHD conditions, and these two junctions are the only two junctions below 30 psi with the increased demands. In Zone 2, there are 75 junctions with pressures below 30 psi based on the existing PHD, the majority of which are located along the boundary with Zone 3 in the western portion of the pressure zone. With the PHD increased by 15 percent, 114 junctions in Zone 2 are projected to have pressures below 30 psi. Based on these results, it is recommended that the City complete capital improvement program numbers VF1 and PRV1, as presented in **Chapter 8**, to improve pressures in Zones 1 and 2 during existing peak demands and during increased demand (i.e., drought) conditions.

Table 3-20
Extreme Peak Demand Pressure Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Node Number	Pressure (psi)			
				MDD		PHD	
				Existing	Existing MDD + 15%	PHD	Existing PHD + 15%
Low Density Residential	Near intersection of W 19th Ave and S Jean St	Zone 1	J-7825	27	27	26	26
Low Density Residential	Neighborhood near the intersection of N Nevada Street and W Metaline Ave	Zone 2	J-5833	34	31	21	16
Commercial	Along and north of W Deschutes Avenue, in N Colorado St and N Young St	Zone 2	J-7670	33	31	22	19
Low Density Residential	Dead end main south of W 1st Ave, in S Quay St and S Penn St	Zone 2	J-5773	32	30	22	20
Low Density Residential	Near intersection of W 1st Ave and S Kellogg St	Zone 2	J-11719	37	35	28	26
Low Density Residential	Dead end main south of W 4th Ave, in S Harrison St	Zone 2	J-5779	33	32	27	27
Commercial	Near intersection of N Center Pkwy and W Grandridge Blvd	Zone 2	J-10987	40	37	27	22

Analyses were also performed to determine the capability of the existing water system to provide fire flow under MDD conditions. A separate fire flow analysis was performed for each node in the model to determine the available fire flow at a minimum residual pressure of 20 psi and a maximum velocity of 10 fps in the pipes in the water model. More than 8,400 individual fire flow analyses were performed to comprehensively evaluate the water system. For each node analyzed, the resulting fire flow was compared to its planning-level fire flow requirement, which was assigned according to the land use classifications shown in **Table 3-1**. A summary of the results of the analyses is presented in **Table 3-21**.

Table 3-21
Fire Flow Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Node Number	Available Fire Flow (gpm)				Target Fire Flow (gpm)
				Existing System	6-year w/ Improvements	10-year w/ Improvements	20-year w/ Improvements	
Commercial	Clover Island Inn, east end of Clover Island Dr	Zone 1	J-10689	814	813	812	807	4,000
Industrial	Near intersection of 3rd Ave and Oak St	Zone 1	J-7117	6,000	6,000	6,000	6,000	5,000
High Density Residential	Heatherstone Apartments loop, north of 10th Ave	Zone 1	J-1217	2,549	2,543	2,538	2,520	3,000
Commercial	Near intersection of Kennewick Ave and Olympia St	Zone 1	J-10442	6,000	6,000	6,000	6,000	4,000
Commercial	Safeway, near intersection of Kennewick Ave and Highway 395	Zone 2	J-11520	6,000	6,000	6,000	6,000	4,000
Commercial	Fred Meyer loop, west of Highway 395	Zone 2	J-6320	2,429	4,355	4,337	4,269	4,000
Commercial	Yokes, near intersection of 27th Ave and Olympia Street	Zone 2	J-12136	4,024	4,013	4,009	4,246	4,000
Commercial	Near intersection of Kellogg St and Clearwater Ave	Zone 2	J-600	2,071	5,732	5,672	5,700	4,000
Commercial	Near intersection of Gage Blvd and Steptoe St	Zone 2	J-12797	1,290	2,523	3,173	6,000	4,000
Commercial	Near intersection of Columbia Center Blvd and Quinault Ave	Zone 2	J-1202	1,596	3,851	3,845	6,000	4,000
Low Density Residential	Gum St, at Elliot Lake water system intertie	Zone 2	J-4616	730	1,441	1,441	1,441	1,000
Commercial	Convention Center and Toyota Area	Zone 2	J-12516	1,669	5,843	5,839	5,870	4,000
Commercial	SW corner of Vista Field, in Young St	Zone 2	J-7670	1,190	4,932	4,945	4,989	4,000
Industrial	SE corner of Vista Field, near intersection of Okanogan Ave and Hood Pl	Zone 2	J-8494	2,132	6,000	6,000	5,493	5,000
Commercial	NE corner of Vista Field, in Kellogg St	Zone 2	J-9811	2,056	3,916	3,934	4,114	4,000
Public Facility	NW corner of Vista Field, in Okanogan Pl	Zone 2	J-12623	1,676	2,157	2,144	2,150	4,000
Industrial	SE corner of Vista Field, near intersection of Deschutes Ave and Quay St	Zone 3	J-3383	2,773	2,692	2,662	6,000	5,000
Low Density Residential	Near intersection of 45th Ave and Olympia St	Zone 3	J-12804	3,201	3,194	3,191	3,185	1,000
Commercial	Near intersection of Ely St and 27th Ave	Zone 3	J-8767	3,121	2,922	4,503	4,484	4,000
Commercial	Home Depot loop, north of 27th Ave	Zone 3	J-7083	1,903	1,851	2,080	2,169	4,000
Commercial	La Quinta Inn, Quillan Pl	Zone 3	J-1408	2,170	2,078	2,423	2,420	4,000
Industrial	SE corner of Vista Field, near intersection of Deschutes Ave and Quay St	Zone 3	J-3383	2,773	2,692	2,662	6,000	5,000
Commercial	Near intersection of Columbia Center Blvd and Clearwater Ave	Zone 3	J-2531	6,000	5,804	5,741	5,714	4,000
Commercial	Near intersection of Clearwater Ave, Leslie Rd, Badger Rd, and Ridgeline Dr	Zone 3	J-80	3,083	2,910	2,827	6,000	4,000
High Density Residential	Copper Ridge Apartments loop, south of Hildebrand Blvd	Zone 4	J-5151	2,947	2,941	2,932	2,924	3,000
High Density Residential	Near intersection of Southridge Blvd and Hildebrand Blvd	Zone 4	J-1788	3,999	4,419	6,000	6,000	3,000
Commercial	Near intersection of Southridge Blvd and Ridgeline Dr	Zone 4	J-13275	3,562	3,938	3,781	3,763	4,000
Low Density Residential	Near intersection of Ridgeline Dr and Lincoln St	Zone 4	J-3870	3,130	3,817	5,540	5,762	1,000
Commercial	Trios Southridge Hospital, along Plaza Way	Zone 4	J-4950	3,512	3,689	4,332	4,300	4,000
Commercial	Bob's Burgers and Brew, near intersection of Highway 395 and Hildebrand Blvd	Zone 4	J-1536	2,301	2,299	2,295	2,273	4,000
Commercial	Hapo Credit Untion, near intersection of Highway 395 and Hildebrand Blvd	Zone 4	J-817	1,271	2,808	2,798	2,788	4,000
Low Density Residential	Near intersection of Hildebrand Blvd and Sherman St	Zone 4	J-1796	3,019	3,174	4,943	6,000	1,000
Low Density Residential	Near intersection of Hildebrand Blvd and Sherman St	Zone 5	J-13288	2,613	6,000	6,000	6,000	1,000
Low Density Residential	Near intersection of 46th Ave and Olson St	Zone 5	J-7823	1,719	1,767	1,763	1,759	1,000
Commercial	Near intersection of Southridge Blvd and 41st Ave	Zone 5	J-13285	3,008	6,000	6,000	6,000	4,000

Public facility land uses typically have the largest variation in fire flow requirements, as the land use includes high fire flow properties such as schools or community centers, as well as low fire flow properties such as parks and athletic fields. The fire flow analysis results for all nodes located within or adjacent to each of the City's public facility land uses are presented in **Table 3-22**. Many of the public facilities are represented by multiple nodes in the hydraulic model, and the lesser of the average and median fire flow availabilities for each property is shown in **Table 3-22**. It is recommended the City confirm the actual fire flow requirement at each public facility with the City's Fire Marshal, and identify locations with fire flow deficiencies. Hydraulic analyses can identify the improvements necessary to meet the actual fire flow requirement at these facilities.

Table 3-22
Public Facility Land Use Fire Flow Analysis Summary

Location	Existing Pressure Zone	Available Fire Flow (gpm)			
		Existing System	6-year w/ Improvements	10-year w/ Improvements	20-year w/ Improvements
City Government Office	Zone 1	3,496	3,488	3,479	4,761
Civic Center Park and Police Department	Zone 1	3,144	3,129	3,122	5,221
Eastgate Elementary	Zone 1	5,430	5,408	5,386	5,660
Eastgate Park	Zone 1	5,726	5,703	5,680	6,000
Fairgrounds	Zone 1	1,891	1,889	1,889	3,330
Kennewick High School	Zone 1	2,031	2,026	2,026	4,864
Kennewick High School Parking Lot	Zone 1	2,397	2,388	2,388	6,000
Kennewick High School Track	Zone 1	3,773	3,765	3,764	5,884
Kennewick School District Offices	Zone 1	1,865	1,864	1,863	6,000
Park Middle School	Zone 1	2,277	2,284	2,286	3,841
Trios Women's and Children's Hospital	Zone 1	2,509	2,504	2,502	2,891
Vista Elementary	Zone 1	65	1,294	1,308	1,312
Benton County Jail, Court, and Assessor Office	Zone 2	1,626	2,540	2,533	2,573
Benton County Justice Center	Zone 2	2,301	3,740	3,740	3,736
Benton County Road Department	Zone 2	5,608	5,212	4,730	4,879
Benton PUD	Zone 2	3,223	3,222	3,222	3,212
Canyon View Elementary	Zone 2	3,472	3,469	3,469	5,103
Cascade Elementary School	Zone 2	1,440	1,427	1,438	1,440
Edison Elementary	Zone 2	2,206	2,159	2,158	2,141
Hawthorne Elementary	Zone 2	1,983	1,982	1,982	2,621
Kamiakin High School	Zone 2	2,870	3,355	3,346	3,346
Tri Tech Campus	Zone 2	2,099	2,629	2,627	2,623
Westgate Elementary	Zone 2	2,598	2,726	2,722	2,720
Cascade Elementary School	Zone 3	1,508	1,492	1,508	1,510
Desert Hills Middle School	Zone 3	3,185	3,180	3,185	3,177
Horse Heaven Hills Middle School	Zone 3	3,377	3,239	3,839	3,911
Lincoln Elementary School	Zone 3	1,567	1,566	1,565	1,565
Ridge View Elementary	Zone 3	2,790	2,794	2,798	2,782
Southgate Elementary	Zone 3	2,794	2,748	2,792	2,794
Sunset View Elementary	Zone 3	2,669	2,649	2,534	2,998
Southridge High School	Zone 4	3,024	3,338	4,312	4,311

Once the existing system deficiencies were identified, proposed water main improvements were included in the model, and pressure and fire flow analyses were performed throughout the system to demonstrate that the improvements will eliminate the deficiencies and meet the flow and pressure requirements. Pressure analyses were performed under the projected 2021, 2025, and 2035 PHD conditions and the results are provided in **Table 3-19**. Fire flow analyses were modeled under the projected 2021, 2025, and 2035 MDD conditions to ensure that the proposed improvements are sized sufficiently to meet future needs. Improvements were not evaluated for existing dead-end water main unless a future water main extension is anticipated as part of future growth. Improvements also were not evaluated for existing looped water main on private property, which

typically occurs around commercial, industrial, and school buildings. It was assumed that these loops have been properly sized to meet the actual fire flow requirements of the buildings, which better represent the actual fire flow requirements than the planning-level requirements presented in **Table 3-1**. The fire flow availability of select commercial and industrial customers with on-site water main loops are presented in **Table 3-21** and the fire flow availability of all public facilities, including schools, are presented in **Table 3-22**.

The proposed 2021 improvements were selected to resolve existing pressure deficiencies in the water system, as shown in **Table 3-19**, and increase the fire flow availability in the western portion of Zone 2. The 2025 improvements were selected to resolve high priority water main replacement projects, as presented in **Chapter 8**. The 2035 improvements were selected to resolve all non-public facility or private property looped fire flow deficiencies, as shown in **Table 3-21**. The results of the analyses indicate that some of the fire flow deficiencies are resolved with the proposed improvements by 2035. A description of these improvements and figures showing their locations are presented in **Chapter 8**.

Additional analyses were performed to determine the improvements necessary to increase the fire flow availability throughout Vista Field to meet the existing 4,000 gpm commercial and 5,000 gpm industrial planning-level fire flow requirements. The analyses were performed with the system's 2015 MDD, and without any additional improvements taking place in the water system. The proposed Vista Field improvements have been separated into three phases, and are described in detail in **Chapter 8**. The resulting fire flow availability in each corner of Vista Field is presented in **Table 3-23** for each phase of proposed improvements. The average fire flow availability throughout Vista Field increases by approximately 1,000 gpm with the completion of each improvement phase. As development plans become available for Vista Field, it is recommended that the City identify the actual fire flow requirements of the development, and confirm that the proposed Vista Field water system improvements provide adequate flows and pressures to the development.

Table 3-23
Vista Field Phased Improvement Fire Flow Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Node Number	Available Fire Flow (gpm)				Target Fire Flow (gpm)
				Existing System	Phase 1 Improvements	Phase 2 Improvements	Phase 3 Improvements	
Commercial	SW corner of Vista Field, in Young St	Zone 2	J-7670	1,190	1,843	4,983	5,078	4,000
Industrial	SE corner of Vista Field, near intersection of Okanogan Ave and Hood Pl	Zone 2	J-8494	2,132	2,844	2,818	6,000	5,000
Commercial	NE corner of Vista Field, in Kellogg St	Zone 2	J-9811	2,056	3,560	3,666	3,983	4,000
Public Facility	NW corner of Vista Field, in Okanogan Pl	Zone 2	J-12623	1,676	2,138	2,160	2,164	4,000

Distribution and Transmission System Deficiencies

This section presents a summary of the distribution and transmission system deficiencies that were identified from the results of the hydraulic analyses of the existing water system and also includes deficiencies unrelated to the capacity of the mains. These low pressure deficiencies will be eliminated upon completion of the proposed improvements that are presented in **Chapter 8**. Services in the high pressure areas are equipped with individual pressure reducing valves, and all future service connections in these areas will be required to install individual pressure reducing valves.

Pressure Deficiencies

Areas of low and high pressures are shown in **Table 3-19**. Areas of low pressure during extreme peak conditions, such as droughts, are shown in **Table 3-20**.

Fire Flow Deficiencies

Areas of low fire flow availabilities are shown in **Tables 3-21** and **3-22**.

Other Deficiencies

Some areas of the system have water mains that are more than 50 years old, which is approaching the average life expectancy of water mains installed at that time. Much of the older water main, is either asbestos cement (AC) or steel, which comprise approximately 30 percent and 12 percent, respectively, of the water main in the City's system. These water mains may be in need of replacement. Most of the AC and steel water main is located in the older areas of the City.

The City is planning to replace deficient water mains in the future, as shown in the schedule of planned improvements in **Chapter 8**.

PHYSICAL SYSTEM CAPACITY

This section evaluates the capacity of the City's water system components (e.g., supply, storage, and transmission) to determine the maximum number of ERUs it can serve. Once determined, system capacity becomes useful in determining how much capacity is available in the water system to support new customers that apply for water service. The system capacity information, together with the projected growth of the system expressed in ERUs, as presented in **Table 2-14** of **Chapter 2**, also provides the City with a schedule of when additional system capacity is needed.

ANALYSIS CRITERIA

The capacity of the City's system was determined from the limiting capacity of the supply, storage, and transmission facilities (i.e., the facility with the least capacity). The average annual based source capacity analysis considered the physical capacity of the City's supply facilities, which was then compared to the system's ADD per ERU, which includes distribution system leakage (DSL).

The maximum day based source capacity analysis also considered the physical capacity of the City's supply facilities, but compared the capacity to the system's MDD per ERU, which includes DSL.

The storage capacity analysis was based on the storage capacity for equalizing and standby storage and the computed storage requirement per ERU. Operational and fire flow storage capacity were excluded from the storage analysis because these components are not directly determined by water demand or ERUs. For the analyses, a reserve amount equivalent to the existing operational and fire flow storage requirements was deducted from the total available storage capacity to determine the storage capacity available for equalizing and standby storage since distribution system pressure limits do not restrict equalizing and standby storage. The storage capacity available for equalizing and standby storage was divided by the existing number of ERUs presented in **Chapter 2** to determine the storage requirement per ERU. The ERU-based demand data was derived from the ADD of the system and peaking factors from **Chapter 2**.

The transmission capacity analysis was based on the total capacity of the transmission system with a maximum pipeline velocity of 5 fps for the PHD analysis and 10 fps for the MDD plus fire flow

analysis. The transmission system includes two 8-inch-diameter water mains and one 42-inch-diameter water main extending from the WTP, and the 16- and 48-inch-diameter water mains extending from Ranney Wells No. 4 and 5. The transmission capacity analysis considered the limiting supply requirement between the system's PHD and the MDD plus the maximum fire flow requirement for the system. In both the existing and future analyses, PHD is the limiting supply requirement that was used to compare with the system's transmission capacity.

CAPACITY ANALYSIS RESULTS

A summary of the results of the existing system capacity analysis is shown in **Table 3-24**. The results of the existing system capacity analysis indicate that the limiting capacity of the system is the source capacity based on the MDD, which can support up to a maximum of approximately 51,782 ERUs. The existing water system has a surplus of approximately 6,757 ERUs. All other water system components have a higher capacity to support existing water system customers.

Table 3-24
Existing System Capacity Evaluation

Demands Per ERU Basis	
Average Day Demand Per ERU (gal/day)[1]	244
Maximum Day Demand Per ERU (gal/day)[1]	458
Peak Hour Demand Per ERU (gal/day)[1]	703
Water Rights Capacity - Annual Average Based	
Water Rights Capacity - Annual Average Based (gal/day)	16,075,370
Average Day Demand Per ERU (gal/day)	244
Water Rights Annual Average Based Source Capacity (ERUs)	**65,873**
Water Rights Capacity - Instantaneous Based	
Water Rights Capacity - Instantaneous Based (gal/day)	66,199,680
Maximum Day Demand Per ERU (gal/day)	458
Maximum Day Based Source Capacity (ERUs)	**144,641**
Source Capacity - Maximum Day Based	
Source Treatment Capacity - Maximum Day Based (gal/day)	23,700,000
Maximum Day Demand Per ERU (gal/day)	458
Maximum Day Based Source Treatment Capacity (ERUs)	**51,782**
Storage Capacity	
Maximum Equalizing & Standby Storage Capacity (gal)	24,117,093
Equalizing & Standby Storage Requirement per ERU (gal)	269
Maximum Storage Capacity (ERUs)	**89,771**
Transmission Capacity - PHD Based (5 fps)	
Transmission Capacity (gal/day)	78,468,600
Peak Hour Demand per ERU (gal/day)	703
Maximum Transmission Capacity (ERUs)	**111,648**
Transmission Capacity - MDD + Fire Flow Based (10 fps)	
Transmission Capacity (gal/day)	156,937,400
MDD + Maximum Fire Flow Requirement (gpm)	19,311
Maximum Day Demand per ERU (gal/day)	458
Maximum Transmission Capacity (ERUs)	**282,137**
Maximum System Capacity	
Based on Limiting Facility - Source Capacity (Max Day Based)	**51,782**
Unused Available System Capacity	
Maximum System Capacity (ERUs)	51,782
Existing (2015) ERUs	45,026
Unused Available System Capacity (ERUs)	**6,757**

(1) Includes DSL.

The results of the 6-year projected system capacity analysis, shown in **Table 3-25**, indicate that the system capacity will remain constant at approximately 51,782 ERUs based on the limiting component of the source capacity. The system is projected to have a surplus system capacity of 3,045 ERUs in 2021, and 124 ERUs in 2025. If the ASR Well is fully permitted and operational prior to 2025, the results of the 10-year projected system capacity analysis will indicate an approximate 10-year surplus capacity of approximately 6,600 ERUs.

Table 3-25
6- and 10-year Projected System Capacity Evaluation

Description	2021 (+6 Years)	2025 (+10 Years)
Demands Per ERU Basis		
Average Day Demand Per ERU (gal/day)[1]	244	244
Maximum Day Demand Per ERU (gal/day)[1]	458	458
Peak Hour Demand Per ERU (gal/day)[1]	703	703
Water Rights Capacity - Annual Average Based		
Water Rights Capacity - Annual Average Based (gal/day)	16,075,370	16,075,370
Average Day Demand Per ERU (gal/day)	244	244
Water Rights Annual Average Based Source Capacity (ERUs)	**65,873**	**65,873**
Water Rights Capacity - Instantaneous Based		
Water Rights Capacity - Instantaneous Based (gal/day)	66,199,680	66,199,680
Maximum Day Demand Per ERU (gal/day)	458	458
Maximum Day Based Source Capacity (ERUs)	**144,641**	**144,641**
Source Capacity - Maximum Day Based		
Source Treatment Capacity - Maximum Day Based (gal/day)	23,700,000	23,700,000
Maximum Day Demand Per ERU (gal/day)	458	458
Maximum Day Based Source Treatment Capacity (ERUs)	**51,782**	**51,782**
Storage Capacity		
Maximum Equalizing & Standby Storage Capacity (gal)	24,117,093	24,117,093
Equalizing & Standby Storage Requirement per ERU (gal)	269	269
Maximum Storage Capacity (ERUs)	**89,771**	**89,771**
Transmission Capacity - PHD Based (5 fps)		
Transmission Capacity (gal/day)	78,468,600	78,468,600
Peak Hour Demand per ERU (gal/day)	703	703
Maximum Transmission Capacity (ERUs)	**111,648**	**111,648**
Transmission Capacity - MDD + Fire Flow Based (10 fps)		
Transmission Capacity (gal/day)	156,937,400	156,937,400
MDD + Maximum Fire Flow Requirement (gpm)	19,311	19,311
Maximum Day Demand per ERU (gal/day)	458	458
Maximum Transmission Capacity (ERUs)	**282,137**	**282,137**
Maximum System Capacity		
Based on Limiting Facility - Source Capacity (Max Day Based)	**51,782**	**51,782**
Unused Available System Capacity		
Maximum System Capacity (ERUs)	51,782	51,782
Projected ERUs	48,737	51,658
Unused Available System Capacity (ERUs)	**3,045**	**124**

(1) Includes DSL.

WATER QUALITY ANALYSIS

DRINKING WATER REGULATIONS

Overview

The quality of drinking water in the United States is regulated by the U.S. Environmental Protection Agency (EPA). Under provisions of the Safe Drinking Water Act (SDWA), the EPA is allowed to delegate primary enforcement responsibility for water quality control to each state. In the State of Washington, the DOH is the agency responsible for implementing and enforcing drinking water regulations. For the State of Washington to maintain primacy (delegated authority to implement requirements) under the SDWA, the state must adopt drinking water regulations that are at least as stringent as the federal regulations. In meeting these requirements, the state, in cooperation with the DOH, has published drinking water regulations that are contained in Chapter 246-290 WAC.

Existing Regulations

The Federal SDWA was enacted in 1974 as a result of public concern about water quality. The SDWA sets standards for the quality of drinking water and requires water treatment if these standards are not met. The SDWA also sets water testing schedules and methods that water systems must follow. In 1986, the SDWA was amended as a result of additional public concern and frequent contamination of groundwater from industrial solvents and pesticides. The 1986 Amendments require water systems to monitor and treat for a continuously increasing number of water contaminants identified in the new federal regulations. The EPA regulated approximately 20 contaminants between 1974 and 1986. The 1986 Amendments identified 83 contaminants that the EPA was required to regulate by 1989. Implementation of the new regulations has been marginally successful due to the complexity of the regulations and the associated high costs. To rectify the slow implementation of the new regulations, the SDWA was amended again and re-authorized in August of 1996.

In response to the 1986 SDWA Amendments, the EPA established six rules, known as the Phase I Rule, Phase II and IIb Rules, Phase V Rule, Surface Water Treatment Rule (SWTR), Total Coliform Rule, and Lead and Copper Rule. The EPA regulates most chemical contaminants through the Phase I, II, IIb, and V Rules. The City's active sources are affected by many of these rules.

The EPA set two limits for each contaminant that is regulated under the rules. The first limit is a health goal, referred to as the Maximum Contaminant Level Goal (MCLG). The MCLG is zero for many contaminants, especially known cancer-causing agents (carcinogens). The second limit is a legal limit, referred to as the Maximum Contaminant Level (MCL). The MCLs are equal to or higher than the MCLGs; however, most MCLs and MCLGs are the same, except for contaminants that are regulated as carcinogens. The health goals (MCLGs) for carcinogens are typically zero, because they cause cancer and it is assumed that any amount of exposure may pose some risk of cancer. A summary of each rule follows.

To fully understand the discussion that follows, a brief definition of several key terms is provided below.

- Organic Chemicals – Animal or plant produced substances containing carbon and other elements such as hydrogen and oxygen.

- Synthetic Organic Chemicals (SOCs) – Man-made organic substances including herbicides, pesticides, and various industrial chemicals and solvents.
- Volatile Organic Compounds (VOCs) – Chemicals, as liquids, that evaporate easily into the air.
- Inorganic Chemicals (IOCs) – Chemicals of mineral origin that are naturally occurring elements. These include metals such as lead and cadmium.

Phase I Rule

The Phase I Rule, which was the EPA's first response to the 1986 Amendments, was published in the Federal Register on July 8, 1987, and became effective on January 9, 1989. This rule provided limits for eight VOCs that may be present in drinking water. VOCs are used by industries in the manufacture of rubber, pesticides, deodorants, solvents, plastics, and other chemicals. VOCs are found in everyday items such as gasoline, paints, thinners, lighter fluid, mothballs, and glue, and are typically encountered at dry cleaners, automotive service stations, and elsewhere in industrial processes. The City currently complies with all contaminant monitoring requirements under this rule.

Phase II and IIb Rules

The Phase II and IIb Rules were published in the Federal Register on January 30, 1991 and July 1, 1991, and became effective on July 30, 1992 and January 1, 1993, respectively. These rules updated and created limits for 38 contaminants (organics and inorganics), of which 27 were newly regulated. Some of the contaminants are frequently applied agricultural chemicals (nitrate), while others are more obscure industrial chemicals. The City currently complies with all contaminant monitoring requirements under this rule.

Phase V Rule

The Phase V Rule was published in the Federal Register on July 17, 1992, and became effective on January 17, 1994. This rule set standards for 23 additional contaminants, of which 18 are organic chemicals (mostly pesticides and herbicides), and 5 are IOCs (such as cyanide). The City currently complies with all contaminant monitoring requirements under this rule.

Surface Water Treatment Rule

The SWTR was published in the Federal Register on June 29, 1989, and became effective on December 31, 1990. Surface water sources, such as rivers, lakes, and reservoirs (which are open to the atmosphere and subject to surface runoff), and groundwater under the influence of surface water (GWI) sources are governed by this rule. The SWTR seeks to prevent waterborne diseases caused by the microbes *Cryptosporidium, Legionella,* and *Giardia lamblia*, which are present in most surface waters. The rule requires disinfection of all surface water sources and GWI sources. All surface water sources and GWI sources must also be filtered, unless a filtration waiver is granted. A filtration waiver may be granted to systems with pristine sources that continuously meet stringent source water quality and protection requirements. The City currently filters and chlorinates the Columbia River source and provides UV disinfection and chlorination at the Ranney Wells No. 4 and No. 5 sources, and therefore complies with the requirements of this rule.

Interim Enhanced Surface Water Treatment Rule

The EPA proposed the Interim Enhanced Surface Water Treatment Rule (IESWTR) on July 29, 1994. The final rule was published in the Federal Register on December 16, 1998, and became effective on February 16, 1999, concurrent with the Stage 1 Disinfectants/Disinfection Byproducts Rule. The rule primarily applies to public water systems that serve 10,000 or more people and use surface water or GWI sources. The rule also requires primacy agencies (i.e., DOH in Washington State) to conduct sanitary surveys of all surface water and GWI systems, regardless of size. The rule is the first to directly regulate the protozoan *Cryptosporidium* and has set the MCLG for *Cryptosporidium* at zero. Water systems affected by this rule needed to comply with it by December 16, 2001. The City currently filters and chlorinates the Columbia River source and provides UV disinfection and chlorination at the Ranney Wells No. 4 and No. 5 sources, and therefore complies with the requirements of this rule.

Long Term 1 Enhanced Surface Water Treatment Rule

This is the follow-up rule to the IESWTR and became effective in December of 1998. The final Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) was published on January 14, 2002, and became effective February 13, 2002. The rule addresses water systems using surface water or GWI sources serving fewer than 10,000 people. The rule extends protections against *Cryptosporidium* for smaller water systems. The City currently filters and chlorinates the Columbia River source and disinfects the Ranney Wells No. 4 and No. 5 sources, and therefore complies with the requirements of this rule.

Revised Total Coliform Rule

The Total Coliform Rule was published in the Federal Register on June 29, 1989, and became effective on December 31, 1990. The rule set both health goals (MCLGs) and legal limits (MCLs) for total coliform levels in drinking water, and the type and frequency of testing that is required for water systems. The rule requires more monitoring than prior requirements, especially for small systems. In addition, every public water system is required to develop a coliform monitoring plan, subject to approval by DOH.

On February 13, 2013, the EPA published revisions to the rule in the Federal Register, which sets an MCL for *Escherichia Coli (E. Coli)*, and specifies the frequency and timing of coliform testing based on population served, public water system type, and source water type. Water systems that are vulnerable to microbial contamination must conduct an assessment of their system and fix any sanitary defects.

Coliform is a group of bacteria, some of which live in the digestive tract of humans and many animals, and are excreted in large numbers with feces. Coliform can be found in sewage, soils, surface waters, and vegetation. The presence of any coliform in drinking water indicates a potential health risk and potential waterborne disease outbreak, which may include gastroenteric infections, dysentery, hepatitis, typhoid fever, cholera, and other infectious diseases. *E. Coli* is a member of the coliform group that is almost exclusively of fecal origin, and their presence can lead to increased health risks.

The rule established the health goals for total coliform and *E. Coli* at zero. To comply with the legal limit, systems may not find coliform in more than 5 percent of the samples taken each month. Based on the 2015 water service area population of 82,187, the City must take 80 samples per month (WAC 246-290-300). If five samples are found to contain coliform, the City would have exceeded the legal limit, triggering the follow-up sampling requirements. A copy of the City's Water Quality

Monitoring Plan, including the coliform monitoring program, is contained in **Appendix H** of this Water Comprehensive Plan (WCP).

Lead and Copper Rule

The Lead and Copper Rule was published in the Federal Register on June 7, 1991, and became effective on December 7, 1992. On January 12, 2000, the EPA published some minor revisions to the rule in the Federal Register, which primarily improved the rule's implementation. On June 29, 2004, additional minor revisions and clarification of several requirements of the Lead and Copper Rule were published by the EPA. The rule identifies "action levels" for both lead and copper. An action level is different than a MCL in that a MCL is a legal limit for a contaminant, and an action level is a trigger for additional prevention or removal steps. The action level for lead is greater than 0.015 milligrams per Liter (mg/L). The action level for copper is greater than 1.3 mg/L. If the 90th percentile concentration of either lead or copper from the group of samples exceeds these action levels, a corrosion control study must be undertaken to evaluate strategies and make recommendations for reducing the lead or copper concentration below the action levels. The rule requires systems that exceed the lead level to educate the affected public about reducing its lead intake. Systems that continue to exceed the lead action level after implementing corrosion control and source water treatment may be required to replace piping in the system that contains the source of lead. Corrosion control is typically accomplished by increasing the pH of the water to make it less corrosive, which reduces its ability to breakdown water pipes and absorb lead or copper.

Lead is a common metal found throughout the environment in lead-based paint, air, soil, household dust, food, certain types of pottery, porcelain, pewter, brass, and water. Lead can pose a significant risk to health if too much of it enters the body. Lead builds up in the body over many years and can cause damage to the brain, red blood cells, and kidneys. The greatest risk is to young children and pregnant women. Lead can slow down normal mental and physical development of growing bodies.

Copper is a common, natural, and useful metal found in our environment. It is also a trace element needed in most human diets. The primary impact of elevated copper levels in water systems is stained plumbing fixtures. At certain levels (well above the action levels), copper may cause nausea, vomiting, and diarrhea. It can also lead to serious health problems in people with Wilson's disease. Long-term exposure to elevated levels of copper in drinking water could also increase the risk of liver and kidney damage. The City currently complies with all contaminant monitoring requirements under this rule.

Radionuclides Rule

The EPA established interim drinking water regulations for radionuclides in 1976 under the SDWA. MCLs were established for alpha, beta, and photon emitters, and radium 226/228. Radionuclides are elements that undergo a process of natural decay and emit radiation in the form of alpha or beta particles and gamma photons. The radiation can cause various kinds of cancers, depending on the type of radionuclide exposure from drinking water. The regulations address both man-made and naturally occurring radionuclides in drinking water.

The 1986 SDWA Amendments finalized the regulations for radionuclides by eliminating the term "interim." The Amendments also directed the EPA to promulgate (publish as law) health-based MCLGs, as well as MCLs. The EPA failed to meet the statutory schedules for promulgating the radionuclide regulations, which resulted in a lawsuit. In 1991, the EPA proposed revisions to the regulations, but a final regulation based on the proposal was never published. The 1996 SDWA Amendments directed the EPA to revise a portion of the earlier proposed revisions, adopt a

schedule, and review and revise the regulations every 6 years, as appropriate, to maintain or improve public health protection. Subsequent to the 1996 Amendments, a 1996 court order required the EPA to either finalize the 1991 proposal for radionuclides or ratify the existing standards by November 2000.

The final rule was published in the Federal Register on December 7, 2000, and became effective on December 8, 2003. The rule established an MCLG of zero for the four regulated contaminates and MCLs of 5 picocuries per liter (pCi/L) for combined radium-226 and radium-228, 15 pCi/L for gross alpha (excluding radon and uranium), 4 millirems per year (mrem/year) for beta particle and photon radioactivity, and 30 micrograms per liter (ug/L) for uranium. The City currently complies with all contaminant monitoring requirements under this rule.

Watershed Control Program

The Washington State mandate for watershed protection and the required elements of a watershed control program are contained in WAC 246-290-135, Source Protection, which became effective in July of 1994. In Washington State, DOH is the lead agency for the development and administration of the State's Watershed Control Program.

A watershed control program is a proactive and ongoing effort of a water purveyor to exercise surveillance over the conditions and activities within the watershed affecting source water quality to protect the health of its customers, as outlined in WAC 246-290-668, Watershed Control. All federally defined Group A public water systems that use surface water or groundwater as their source are required to develop and implement a watershed control program. All required elements of a watershed control program must be documented and included in the purveyor's Water Comprehensive Plan (applicable to the City) or Small Water System Management Program (not applicable to the City) at least every 6 years. A copy of the 2008 Water Resource Inventory Area (WRIA) 31 Watershed Management Plan is contained in **Appendix I**.

Wellhead Protection Program

Section 1428 of the 1986 SDWA Amendments mandates that each state develop a wellhead protection program. The Washington State mandate for wellhead protection and the required elements of a wellhead protection program are contained in WAC 246-290-135, Source Protection, which became effective in July of 1994. In Washington State, the DOH is the lead agency for the development and administration of the State's wellhead protection program.

A wellhead protection program is a proactive and ongoing effort of a water purveyor to protect the health of its customers by preventing contamination of the groundwater that it supplies as drinking water. All federally defined Group A public water systems that use groundwater as their source are required to develop and implement a wellhead protection program. All required elements of a local wellhead protection program must be documented and included in the Water Comprehensive Plan. A copy of the City's Wellhead Protection Plan is contained in **Appendix J** of this WCP.

Consumer Confidence Report

The final rule for the Consumer Confidence Report (CCR) was published in the Federal Register on August 19, 1998, and became effective on September 18, 1998. Minor revisions were posted in the Federal Register on May 4, 2000. The CCR is the centerpiece of the right-to-know provisions of the 1996 SDWA Amendments. All community water systems like the City were required to issue the first report to customers by October 19, 1999. The annual report must be updated and re-issued to all customers by July 1st of each year thereafter.

The CCR is a report on the quality of water that was delivered to the system during the previous calendar year. The reports must contain certain specific elements but may also contain other information that the purveyor deems appropriate for public education. Some, but not all, of the information that is required in the reports includes the source and type of the drinking water, type of treatment, contaminants that have been detected in the water, potential health effects of the contaminants, identification of the likely source of contamination, violations of monitoring and reporting, and variances or exemptions to the drinking water regulations. A copy of the City's most recent CCR is contained in **Appendix K**.

Stage 1 Disinfectants/Disinfection Byproducts Rule

Disinfection byproducts (DBPs) are formed when free chlorine reacts with organic substances, most of which occur naturally. These organic substances (called precursors) are a complex and variable mixture of compounds. The DBPs themselves may pose health risks. Trihalomethanes (THM) are a category of DBP that had been regulated previous to this rule. However, systems with groundwater sources that serve a population of less than 10,000 were not previously required to monitor for THM.

The EPA proposed the Stage 1 Disinfectants/Disinfection Byproducts Rule (D/DBPR) on July 29, 1994. The final rule was published in the Federal Register on December 16, 1998, and became effective on February 16, 1999. The rule applies to the City and most other water systems, including systems serving fewer than 10,000 people that add a chemical disinfectant to the drinking water during any part of the treatment process. The rule reduced the MCL for total THM, which are a composite measure of four individual THM, from the previous interim level of 0.10 mg/L to 0.08 mg/L. The rule established MCLs and requires monitoring of three additional categories of DBPs (0.06 mg/L for five haloacetic acids (HAA5), 0.01 mg/L for bromate, and 1.0 mg/L for chlorite). The rule established maximum residual disinfectant levels for chlorine (4.0 mg/L), chloramines (4.0 mg/L), and chlorine dioxide (0.8 mg/L). The rule also requires systems using surface water or groundwater directly influenced by surface water to implement enhanced coagulation or softening to remove DBP precursors, unless alternative criteria are met. Compliance with this rule must have been satisfied by December 16, 2001 for large surface water systems (those serving over 10,000 people, i.e., the City), and by December 16, 2003 for smaller surface water systems and all groundwater systems. The City currently complies with all contaminant monitoring requirements under this rule.

Stage 2 Disinfectants/Disinfection Byproducts Rule

This rule is the second part of the D/DBPR, of which Stage 1 D/DBPR became effective in February 1999. The Stage 2 D/DBPR was published in the Federal Register on January 4, 2006, and became effective on March 6, 2006. The EPA implemented this rule simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule.

Similar to the Stage 1 D/DBPR, this rule applies to most water systems that add a disinfectant to the drinking water other than ultraviolet light or those systems that deliver such water. The Stage 2 D/DBPR changes the calculation procedure requirement of the MCLs for two groups of disinfection byproducts, total THM (TTHM) and HAA5. The rule requires each sampling location to determine compliance with MCLs based on their individual annual average DBP levels (termed the Locational Running Annual Average), rather than utilizing a system-wide annual average. The rule also proposes new MCLGs for chloroform (0.07 mg/L), trichloroacetic acid (0.02 mg/L), and monochloroacetic acid (0.03 mg/L).

Additionally, the rule requires systems to document peak DBP levels and prepare an Initial Distribution System Evaluation (IDSE) to identify Stage 2 D/DBPR compliance monitoring sites. IDSEs require each water system to prepare a separate IDSE plan and report, with the exception of those systems who obtain a 40/30 Certification or a Very Small System Waiver. In order to qualify for the 40/30 Certification, all samples collected during Stage 1 monitoring must have TTHM and HAA5 levels less than or equal to 0.040 mg/L and 0.030 mg/L, respectively. The first stage of the IDSE schedule required systems serving 100,000 or more people to submit IDSE plans by October 1, 2006. Systems serving 50,000 to 99,999 people, such as the City, had to submit IDSE plans by April 1, 2007. The City currently complies with all contaminant monitoring requirements under this rule and has completed its IDSE plan, which is included in **Appendix L**.

Long Term 2 Enhanced Surface Water Treatment Rule

Following the publishing of the IESWTR, the EPA introduced the LT1ESWTR to supplement the preceding regulations. The second part of the regulations of the LT1ESWTR, which became effective in February 2002, are mandated in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The final rule was published in the Federal Register on January 5, 2006, and became effective on March 6, 2006. The final rule was implemented simultaneously with the Stage 2 D/DBPR described in the previous section. This rule applies to all systems that use surface water or GWI sources.

This rule establishes treatment technique requirements for filtered systems based on their risk level for contamination, calculated from the system's average *Cryptosporidium* concentration. Requirements include up to 2.5-log *Cryptosporidium* treatment, in addition to existing requirements under the IESWTR and LT1ESWTR. Filtered systems that demonstrate low levels of risk will not be required to provide additional treatment. Unfiltered systems under this rule must achieve at least a 2-log inactivation of *Cryptosporidium* if the mean level in the source water remains below 0.01 oocysts/L. If an unfiltered system's mean level of *Cryptosporidium* exceeds 0.01 oocysts/L, the LT2ESWTR requires the system to provide a minimum 3-log inactivation of *Cryptosporidium*. All unfiltered systems are also required to utilize a minimum of two disinfectants in their treatment process.

The LT2ESWTR also addresses systems with unfinished water storage facilities. Under this rule, systems must either cover their storage facilities or achieve inactivation and/or removal of 4-log virus, 3-log *Giardia lamblia* and 2-log *Cryptosporidium* on a state-approved schedule. Lastly, the rule extends the requirement of the disinfection profiles mandated under the LT1ESWTR to the proposed Stage 2 D/DBPR. The City currently filters and chlorinates the Columbia River source and provides UV disinfection and chlorination at the Ranney Wells No. 4 and No. 5 sources, and therefore complies with the requirements of this rule.

Unregulated Contaminant Monitoring Regulation

The EPA established the Unregulated Contaminant Monitoring Regulation (UCMR) to generate data on contaminants that are being considered for inclusion in new drinking water standards. The information collected by select public water systems will ensure that future regulations established by the EPA are based on sound science. The rule was first published in the Federal Register on September 17, 1999, and was subsequently amended on March 2, 2000, and January 11, 2001. The UCMR became effective on January 1, 2001.

Three separate lists of unregulated contaminants are maintained under the UCMR: List 1; List 2; and List 3. Contaminants are organized on the tiered lists based on the availability of standard testing procedures and the known occurrence of each contaminant, with List 1 containing contaminants

that have established standard testing procedures and some, but insufficient, information on their occurrence in drinking water. Monitoring for contaminants on the three lists is limited to a maximum of 30 contaminants within a 5-year monitoring cycle, and the EPA is required to publish new contaminant monitoring lists every 5 years. As new lists are published, contaminants will be moved up the lists if adequate information is found to support additional monitoring. All public water systems serving more than 10,000 people and a randomly selected group of smaller water systems are required to monitor for contaminants. The City currently monitors for unregulated contaminants.

Arsenic

The EPA established interim drinking water regulations for arsenic in 1976 under the SDWA. Arsenic is highly toxic, affects the skin and nervous system, and may cause cancer. The 1996 SDWA Amendments require the EPA to conduct research to assess health risks associated with exposure to low levels of arsenic. The EPA issued a proposed regulation on June 22, 2000, and allowed a 90-day public review period. The final rule, which was published in the Federal Register on January 22, 2001, was to become effective on March 23, 2001, except for certain amendments to several sections of the rule. However, on May 22, 2001, the EPA announced that it was delaying the effective date for the rule until February 22, 2002, to allow time to reassess the rule and afford the public a full opportunity to provide further input. On October 31, 2001, the EPA implemented the final rule.

The rule sets the MCLG of arsenic at zero and reduces the MCL from the current standard of 0.05 mg/L to 0.01 mg/L. Arsenic's monitoring requirements are consistent with the existing requirements for other inorganic contaminants. The City has complied with these monitoring requirements since the regulations were implemented.

Filter Backwash Recycling Rule

The 1996 SDWA amendments required the EPA to promulgate a regulation governing the recycling of filter backwash water within public water systems' treatment processes. Public water systems using surface water or groundwater under the direct influence of surface water that utilize filtration processes and recycling must comply with this rule. The rule aims to reduce risks associated with recycling contaminants removed during filtration. The EPA issued a proposed regulation on June 22, 2000, and allowed a 90-day public review period. The final rule was published in the Federal Register on June 8, 2001, and became effective on August 7, 2001.

The rule requires filter backwash water be returned to a location that allows complete treatment. In addition, filtration systems must provide detailed information regarding the treatment and recycling process to the state. The regulation requires water systems to have complied with the rule starting December 8, 2003, if filter backwash water was recycled. The Columbia River Water Treatment Facility does not recycle backwash water; therefore, this rule does not apply.

Groundwater Rule

The EPA promulgated the Groundwater Rule (GWR) to reduce the risk of exposure to fecal contamination that may be present in public water systems that use groundwater sources. The GWR also specifies when corrective action (which may include disinfection) is required to protect consumers who receive water from groundwater systems from bacteria and viruses. The GWR applies to public water systems that use groundwater and to any system that mixes surface and ground waters if the groundwater is added directly to the distribution system and provided to

consumers without treatment equivalent to surface water treatment. The final rule was published in the Federal Register on November 8, 2006, and became effective on January 8, 2007.

The rule targets risks through an approach that relies on the four following major components.

1. Periodic sanitary surveys of groundwater systems that require the evaluation of eight critical elements and the identification of significant deficiencies (such as a well located near a leaking septic system). States must complete the initial survey for most community water systems by December 31, 2012, and for community water systems with outstanding performance and all non-community water systems by December 31, 2014. DOH conducted its most recent sanitary survey of the City's water system on June 11, 2014, under the state's existing sanitary survey program.
2. Source water monitoring to test for the presence of *E. coli*, enterococci, or coliphage in the sample. There are two monitoring provisions.
    - Triggered monitoring for systems that do not already provide treatment that achieves at least 99.99 percent (4-log) inactivation or removal of viruses and that have a total coliform positive routine sample under the Total Coliform Rule sampling in the distribution system.
    - Assessment monitoring is a complement to triggered monitoring. A state has the option to require systems to conduct source water assessment monitoring at any time to help identify high risk systems.
3. Corrective actions required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options: correct all significant deficiencies; eliminate the source of contamination; provide an alternate source of water; or provide treatment that reliably achieves 99.99 percent inactivation or removal of viruses.
4. Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves at least 99.99 percent inactivation or removal of viruses.

The compliance date for requirements of this rule other than the sanitary survey was December 1, 2009. The City's last sanitary survey was completed in June 2014, and no significant deficiencies were observed during the survey, which is included in **Appendix G**. The City currently complies with all other requirements of the rule.

Future Regulations

Drinking water regulations are continuously changing in an effort to provide higher quality and safer drinking water. Modifications to the existing rules described above and implementation of new rules are planned for the near future. A summary of upcoming drinking water regulations that will most likely affect the City is presented below.

Radon

In July of 1991, the EPA proposed a regulation for radon, as well as three other radionuclides. The 1996 SDWA amendments required the EPA to withdraw the 1991 proposal due to several concerns that were raised during the comment period. A new proposed regulation was published in the Federal Register on November 2, 1999. Comments on the proposed rule were due to the EPA by February 4, 2000. Final federal requirements for addressing radon were delayed until 2008 but have not yet been published. The rule proposes a 300 pCi/L MCL for community water systems that use groundwater or an alternative, less stringent MCL of 4,000 pCi/L for water systems where their state

implements an EPA-approved program to reduce radon risks in household indoor air and tap water. It is not currently known when or what a radon regulation may require as adopted by the EPA or what will be the implementation schedule for the rule. Because the final radon rule requirements are uncertain, the impact of this rule on the City is unknown at this time.

Unregulated Contaminant Monitoring Regulation Revisions

In accordance with the original Unregulated Contaminant Monitoring Regulation (UCMR), the EPA is proposing an updated contaminant monitoring list for the next 5-year monitoring cycle, in addition to other minor revisions to the UCMR. The proposed rule was published August 22, 2005, in the Federal Register, and the comment period for the proposed revisions closed on October 21, 2005. The proposed revisions include a list of 26 chemicals that were monitored during the 2007 through 2011 monitoring cycle, and approves several new testing methods to conduct the monitoring. For this upcoming cycle, all systems serving more than 100,000 people and a larger representative sample of smaller water systems than mandated under the original rule will be required to monitor for contaminants. The rule also requires additional water system data to be reported with the monitoring results, establishes a procedure for determining minimum reporting levels, and proposes several revisions to the implementation of the monitoring program.

4 | WATER RESOURCE ANALYSIS AND WATER USE EFFICIENCY

INTRODUCTION

The City of Kennewick (City) acknowledges that water is a valuable and necessary natural resource that must be used wisely. The Water Use Efficiency (WUE) program provides an approach to increase WUE within the City's water system.

BACKGROUND

THE WATER USE EFFICIENCY RULE

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 (MWL), passed by the Washington State Legislature in September 2003. The MWL requires the state to implement the WUE Rule. The intent of the rule is to help reduce the demand that growing communities, agriculture, and industry have placed on the 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 requirements of the WUE Rule are set forth in Washington Administrative Code (WAC) Chapter 246-290, Part 8.

WATER USE EFFICIENCY REQUIREMENTS

The *Water Use Efficiency Guidebook,* published by DOH in January 2011, identifies the water use reporting, forecasting, and efficiency program requirements for public water systems. A WUE program meeting these requirements is a necessary element of a water system plan as required by the DOH and is necessary to obtain water right permits from the Washington State Department of Ecology (Ecology). The *Water Use Efficiency Guidebook* defines the necessary components of a WUE program as four fundamental elements.

1. Planning requirements, which include collecting data, forecasting demand, evaluating WUE measures, calculating distribution system leakage, and implementing a WUE program to meet goals.
2. A distribution system leakage (DSL) standard of 10 percent or less based on a 3-year rolling average.
3. Goal setting and annual performance reporting on progress towards meeting WUE goals.

WATER USE EFFICIENCY PROGRAM

REGIONAL WATER USE EFFICIENCY EFFORTS

Throughout the past 10 years, beginning with the *2005 Interim Regional Water Forecast and Conservation Plan* (RWFCP), the Cities of Kennewick, Pasco, Richland, and West Richland (quad cities) 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 WUE programs since 2007 that comply with the DOH WUE Rule.

The original combined WUE goals and objectives of the quad cities, developed in the 2005 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 2016 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 water comprehensive plan update.
- Focus the conservation program on using water efficiently.

CITY OF KENNEWICK WATER USE EFFICIENCY PROGRAM

The City's current WUE program elements are summarized in this section.

Planning Requirements and WUE Program Activities

The City's water use data, demand forecasts, and other planning requirements are contained in **Chapter 2** of this Water Comprehensive Plan (WCP). The City is committed to continue collecting water use data beyond that presented in **Chapter 2** for evaluation of its WUE program and water use patterns, and for forecasting demands for future facilities. Consistent with WAC 246-290-810, the WUE program effectiveness will continue to be evaluated within each WCP update.

Recent WUE program activities have involved participation in regional efforts and City-led activities that are presented in the **Selected Measures** section of this chapter.

Water Use Efficiency Goals and the Public Process

Per WAC 246-290-830, WUE goals must be set through a public process and shall be evaluated and reestablished a minimum of every 6 years. The goals and objectives of the City's previous WUE program, which extends to the approval of this WCP, are as follows.

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

Results indicate the City is meeting the current WUE goals and objectives as the annual average demand per capita was 132 gpd in 2015. Water consumption per capita has decreased by 12 percent between 2008 (baseline for the City's 2010 WCP) and 2015.

Based on the success the City has had in achieving its DSL goals and objectives, new goals have been proposed to maintain low DSL levels. The proposed WUE goals for the 2016 to 2025 water system planning cycle are as follows.

- Reduce the water demand per capita by 1 percent each year through the 10-year planning period, resulting in an average demand per capita of 119 gpd or lower in 2025.
- Increase awareness among all water users of the value and importance of conserving water, and of the methods available to achieve reductions in water use.

In compliance with the new WUE Rule, a public hearing was held on Month, Day, Year [public hearing to be held during DOH review process. Date in this sentence to be updated once hearing is scheduled], at a City Council meeting to present and discuss the new goals. Background on the City's proposed WUE program, water supply characteristics, water demand forecasts, and other elements were made available 2 weeks prior to the public forum date. The City Council affirmed the new goals on Month, Day, Year.

Water Use Efficiency Program Evaluation and Performance Reporting

The City will continue to evaluate overall demand, per capita water use, and the amount of DSL on an annual basis (coinciding with the production of the Consumer Confidence Report (CCR)). The City will also evaluate the performance of its WUE program and implemented measures at this time by analyzing demand data and determining the long-term trend towards reducing water usage and meeting WUE goals. If the WUE program monitoring shows that progress towards meeting the WUE goals is not being accomplished, more rigorous WUE program implementation or additional WUE program items will be considered, along with a cost-effective evaluation of measures.

The City will continue to provide annual WUE performance reports to its consumers in the CCR, and detail the results of water use monitoring and progress towards achieving the system's WUE goals. A copy of the City's 2015 CCR is included in **Appendix K**. The City will comply with DOH Annual WUE Performance report requirements, due to DOH by July 1st of each year.

EVALUATION AND SELECTION OF WATER USE EFFICIENCY MEASURES

The 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 either must be evaluated or implemented.

The City served 23,801 water service connections in 2014, which is the base year of the City's WCP. Based on the number of connections, at least nine WUE measures must be evaluated or implemented. Measures that are mandatory cannot be credited towards the system's WUE measures. Since the City implements or plans on implementing all of the evaluated measures presented here, a cost-effective evaluation is not required.

Mandatory Measures

Source Meters

The volume of water produced by the 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 of the City's sources. The City 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. Any new sources installed in the future will be equipped with a source meter.

All interties that the City's water system shares with adjacent water systems are also metered. This includes seasonal and emergency interties.

City of Richland – Gage Boulevard	Emergency only, Two-way
City of Richland – Tapteal Drive	Emergency only, Two-way
Kennewick Irrigation District	
Elliot Lake Potable System	Supply, One-way, One location

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 the distribution system. All future connections that are installed or activated will be equipped with a service meter.

Meter Calibration

The City must calibrate and maintain meters based on generally accepted industry standards and manufacturer information. The City has tested all large (2 inches and larger) meters on an annual basis over the last 5 years. As of 2014, 87 large meters were installed in the City'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.

The City repairs or replaces small (less than 2 inches) meters if they are discovered to be defective or not properly measuring water use. The City periodically replaces old meters with meters compatible with an automatic read system.

Water Loss Control Action Plan

To control leakage, systems that do not meet the DSL standard must implement a Water Loss Control Action Plan (WLCAP). The City's rolling 3-year average DSL was 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 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. Additional customer education and outreach measures are identified in the **Selected Measures** section.

Measures That Must Be Evaluated

Rate Structure

Evaluation of rate structures to increase water demand efficiency is required (WAC 246-290-100(4)(j)(iv)), but actual implementation of a conservation rate structure counts as a WUE measure (WAC 246-290-810(4)(d)). The 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, counting as a WUE measure. The base rate for residential water for customers within the City limits (as of January 1, 2015) was $20.54 in a 2-month billing cycle. Commercial customers within the City limits are billed varying base rates based on service meter size, ranging from $39.71 for ¾-inch meters to $469.03 for 6-inch meters. All customers are billed an additional $1.167 per 100 cubic feet of consumption in the 2-month billing cycle. Commercial customers also receiving sewer service are billed an additional charge for every 100 cubic feet of water consumed in each 2-month billing cycle. The current rate structure is shown in **Table 4-1**.

Table 4-1
Rate Structure

Service Type	Customer Location	
	Inside City Limits	Outside City Limits
Base Fee		
Residential	$20.54	$45.19
Commercial 3/4-inch	$39.71	$87.36
Commercial 1-inch	$59.39	$130.66
Commercial 1 1/2-inch	$105.62	$232.36
Commercial 2-inch	$138.76	$305.27
Commercial 3-inch	$211.39	$465.06
Commercial 4-inch	$310.46	$683.01
Commercial 6-inch	$469.03	$1,031.87
Consumption per 100 Cubic Feet		
All Services	$1.167	$2.567

In 2016, the City is retaining the services of a financial consultant to perform a rate study on all customer classes.

Reclamation Opportunities

Reclaimed water is treated effluent from a wastewater treatment system that is suitable for a direct beneficial use or a controlled use that would not otherwise occur. The use of reclaimed water is regulated under Chapter 90.46 of the Revised Code of Washington (RCW). Water systems with 1,000 or more connections must evaluate reclamation opportunities (WAC 246-290-100(4)(f)(vii)), but actual use of reclaimed water counts as a WUE measure (WAC 246-290-810(4)(d)) or multiple WUE measures if the reclaimed water is used for multiple purposes.

The City 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 the City's water service area.

Potential reclaimed water users could be the parks and/or school systems. Irrigating the parks and schools with reclaimed water would require significant financial and social backing. No parks or schools are located near the City's wastewater plant. A large amount of additional infrastructure is needed to get the water to the parks or schools, including crossing State Route 397. This would also mandate modifications to the plant to produce Class A water. Public acceptance of the use of reclaimed water in City parks and schools is uncertain.

Based on Ecology's Water Reclamation and Reuse Standards, the only currently feasible use for the City's wastewater treatment plant effluent is flushing of sanitary sewers. The City will continue to evaluate the feasibility of using reclaimed water for sanitary sewer flushing.

Selected Measures

The City has chosen to implement six different WUE measures, many of which are existing measures. For the purposes of water system planning in this document, the City's water billing classes have been combined into four different groups: single-family residential; multi-family residential; commercial/industrial; and municipal/institutional/other. If a single WUE measure is implemented for different customer classes, it counts as multiple WUE measures. Multiplying the nine different WUE measures across the customer classes in which they will be implemented, the City will implement a total of 21 WUE measures, as shown in **Table 4-2**. This exceeds the requirement of nine WUE measures based on the number of service connections.

Plumbing Retrofit Program

The 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.

Displays at Fairs and Events

The City currently participates in WUE education by providing information on the City website 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 the quad cities.

Water Use Audits

The City currently has an audit program for large commercial and industrial users.

School Outreach

Schools within the 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.

Water Bill Showing Consumption History

The City currently shows consumption history charts and information on water bills for all customer classes.

Table 4-2
WUE Measures

WUE Measure	Implementation Status			
Mandatory WUE Measures				
Source Meters Installed	✓			
Service Meters Installed	✓			
Meter Calibration Compliance	✓			
Water Loss Control Action Plan	Not Applicable			
Customer Education	✓			
WUE Measures That Must Be Evaluated				
Rate Structure	✓			
Reclamation Opportunities	✓			
Selected WUE Measures				
Measure Description	**SF**	**MF**	**CI**	**MEO**
Plumbing Retrofit Program	✓	✓	✓	✓
Displays at Fairs and Events	✓	✓	✓	✓
Water Use Audits			✓	
Rate Structure	✓	✓	✓	✓
School Outreach	✓	✓	✓	✓
Water Bill Showing Consumption History	✓	✓	✓	✓
Total Selected WUE Measures	**21**			

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

Water Use Efficiency Program Schedule and Budget

The WUE measures described above and selected for implementation by the City are summarized in **Table 4-3** with their corresponding schedule and budget. The successful implementation of this WUE program is expected to achieve the goal of an annual 1-percent reduction in water use per capita through 2025.

Table 4-3
WUE Program Schedule and Budget

WUE Measure	Schedule	Budget
Mandatory WUE Measures		
Source Meters Installed	Ongoing	O&M Funded
Service Meters Installed	Ongoing	O&M Funded
Meter Calibration Compliance	Ongoing	O&M Funded
Water Loss Control Action Plan	Not Applicable	Not Applicable
Customer Education	Ongoing	$2,000/year
WUE Measures That Must Be Evaluated		
Rate Structure	Ongoing	Not Applicable
Reclamation Opportunities	Ongoing	Not Applicable
Selected WUE Measures		
Plumbing Retrofit Program	Ongoing	$2,000/year
Displays at Fairs and Events	Ongoing	Regional Program
Water Use Audits	Ongoing	$2,000/year
Rate Structure	Ongoing	Not Applicable
School Outreach	Ongoing	Regional Program
Water Bill Showing Consumption History	Ongoing	Not Applicable

O&M = operations and maintenance

DISTRIBUTION SYSTEM LEAKAGE

DSL in the City's water system is described and presented in **Chapter 2.** DSL for the last 3 years is as follows, with a current 3-year rolling average of 1.9 percent.

- 2012 DSL: 2.5 percent.
- 2013 DSL: -0.2 percent.
- 2014 DSL: 3.1 percent.

WATER RIGHTS SELF-ASSESSMENT

OVERVIEW

A water right is a legal authorization to use a specified amount of public water for specific beneficial purposes. The water right amount is expressed in terms of instantaneous diversion rate and annual withdrawal volume. Unless water use started before the applicable water code was enacted (1917 for surface water and 1945 for groundwater) and is documented by a water right claim or adjudicated certificate, Washington State law requires users of public water to receive approval from Ecology prior to actual water use. This approval is granted in the form of a water right permit or certificate. However, a state-issued water right is not required for certain uses of groundwater that are exempt from the permitting process, including the use of 5,000 gpd or less for domestic and industrial purposes, unlimited use for stock watering, and irrigation of ½ acre or less of lawn or non-commercial garden.

The process for obtaining a water right involves submitting a water right application that is reviewed by Ecology. If the request is approved, a water right is issued to allow for water use to commence. A water right permit provides permission to construct the necessary wells or diversions, pumps, and pipes to start using water. The water right permit remains in effect until the permit holder determines that their project is complete and they have used as much water as they will under the water right. At that time, the permit holder files a proof of appropriation form, which attests to the rate and volume of water used under the water right. A water right certificate is issued by Ecology following a proof of examination and determination that the amount of water put to beneficial use is consistent with the amount and conditions indicated on the water right permit.

A water right permit can only be issued by Ecology if the proposed use meets the following requirements.

- Water will be put to beneficial use.
- There will be no impairment to existing or senior rights.
- Water is physically and legally available for appropriation.
- Issuance of the requested water right will not be detrimental to the public interest.

During preparation of the report of examination, Ecology considers existing basin management plans, stream closures, minimum instream flows, hydraulic continuity (surface water interconnected to groundwater), utilization of existing water sources, water conservation, and availability of alternative water supplies, among other things. The water right decision process is increasingly becoming more complex and time consuming, due to the many competing interests for water, environmental issues, and regulatory requirements.

MUNICIPAL WATER LAW

The 2003 MWL (Second Engrossed Second Substitute House Bill 1338; Chapter 5, Laws of 2003; 58th Legislature; 2003 1st Special Session; Municipal Water Supply – Efficiency Requirements) clarified many outstanding questions related to water rights used to supply many water systems. The MWL clarified the definition of what use constitutes a municipal water right and who is a municipal water supplier. The MWL allowed changes to the water right place of use to occur via the approval

of the service area by DOH, as opposed to the previous method of the water right change application process with Ecology. The MWL states that the inchoate (unused) portion of a municipal water supply water right is in good standing if the original water right certificate was issued based on the administrative policy of requiring the pumps and pipes to be in place, but not requiring there to be actual beneficial use. This law was the subject of a lawsuit that questioned the constitutionality of portions of the law; however, on October 28, 2010, the Washington State Supreme Court unanimously ruled that all parts of the MWL are constitutional.

Ecology reissued Water Resources Program Policy 2030 in May 2012 that addressed the implementation of the MWL. This policy document was used to assist with determining if the City's water rights qualify as being for municipal water supply purposes.

Using the definitions provided by the MWL, it has been determined that all water rights held by the City are for municipal water supply purposes, as defined under RCW 90.03.015(4), since the water rights are used to serve 15 or more residential connections or are for governmental or governmental proprietary purposes. Since the water rights are for municipal water supply purposes, that makes the City a municipal water supplier as defined under RCW 90.03.015(3).

EXISTING POTABLE WATER RIGHTS

For its potable municipal supply system, the City currently utilizes one surface water certificate, four groundwater certificates, and one surface water permit. A summary of the City's water right information is presented below and in **Table 4-4**. Copies of the City's certificates and permits are included in **Appendix M**.

Table 4-4
Existing Potable Water Rights

Water Right	Document	Use	Source	Instantaneous Rate (gpm)			Annual Volume (afy)		
				Additive	Non-additive	Total	Additive	Non-additive	Total
GWC 93-D	Certificate	Municipal	WTP; Ranney Collector No. 5	400	0	400	70	0	70
GWC 94-D	Certificate	Municipal	WTP; Ranney Collector No. 5	1,000	0	1,000	450	0	450
GWC 1805-A	Certificate	Municipal	Ranney Collector Nos. 1, 2, and 3	4,950	0	4,950	4,800	0	4,800
GWC 3897-A	Certificate	Municipal	Ranney Collector Nos. 4 and 5	13,500	0	13,500	5,600	0	5,600
S4-25479C	Certificate	Municipal	WTP	25,000	0	25,000	5,280	10,400	15,680
S4-30976P[1] (Phase 1)	Permit	Municipal	WTP; Ranney Collector Nos. 4 and 5; Columbia Park Wells	1,122	0	1,122	1,806.75	0	1,806.75
			Water Right Total	**45,972**			**18,006.75**		

Notes:
(1) S4-30976P is jointly held by the Cities of Kennewick, Richland, Pasco, and West Richland. The first phase of 10 cfs (4,488 gpm) and 7,227 afy was the portion authorized to be utilized by the cities for municipal supply until additional mitigation can be secured to access future phases of the water right. The entire water right, of which one quarter is owned by the City, is equal to 178 cfs and 96,619 afy.

WTP = Water Treatment Plant
gpm = gallons per minute
cfs = cubic feet per second
afy = acre-feet per year

Ground Water Certificate 93-D

Pacific Power & Light Company filed Declaration 131 on February 27, 1946, to get pre-code groundwater use recognized. The information contained within this declaration was certificated by the Washington State Department of Conservation and Development (predecessor to Ecology). Ground Water Certificate (GWC) 93-D was issued to Pacific Power & Light Company, recognizing the use of water for municipal and domestic use within the Town of Kennewick, Benton County, Washington from a well located in Lot 2, Block 5 of Layton's Addition, with a priority date of November 4, 1944. The recognized rates were 400 gallons per minute (gpm) and 70 acre-feet per year (afy).

On July 9, 2012, the Benton County Water Conservancy Board (BCWCB) received an application for change from the City of Kennewick on GWC 93-D, which was assigned tracking number BENT-12-03 by the BCWCB and CG4-GWC093-D by Ecology. The change application requested to change the point of withdrawal to the aquifer storage and recovery (ASR) well. On October 1, 2012, the BCWCB approved the change as requested. On December 20, 2012, Ecology issued an order reversing the BCWCB decision and denying the change application. The reason for the denial included that the original point of withdrawal appeared to be completed in the Saddle Mountain Aquifer, while the ASR well is completed in the deeper Wanapum Formation, which in this area was considered to be a different body of public groundwater. Insufficient information was included to allow Ecology to make a tentative determination on the extent and validity of the water right; the impairment analysis was incomplete, which would not allow Ecology to come to a conclusion, and there were other technical deficiencies. The denial was appealed. The appeal was assigned Pollution Control Hearings Board (PCHB) Case No. 13-009. A settlement agreement was reached between the parties; in response, Ecology issued an order on October 3, 2013, that modified the original BCWCB decision and superseded the prior Ecology denial.

The current attributes of this certificate are that it is held by the City of Kennewick, with a priority date of November 4, 1944, for municipal and domestic use, year round, at rates of 400 gpm and 70 afy (22,809,570 gallons per year), with points of withdrawal/diversion that include the original Layton's Addition Well No. 1 in Section 6, Township 8 North, Range 30 East W.M. (no longer in use), the surface water treatment plant in Section 31, Township 9 North, Range 30 East W.M., and Ranney Well No. 5 located in Government Lots 1 and 2, Section 35, Township 9 North, Range 29 East W.M.

Ground Water Certificate 94-D

Pacific Power & Light Company filed declaration 132 on February 27, 1946, to get pre-code groundwater use recognized. The information contained within this declaration was certificated by the Washington State Department of Conservation and Development. GWC 94-D was issued to Pacific Power & Light Company recognizing the use of water for municipal supply within the Town of Kennewick, Benton County, Washington from a well located in Lot 6, Block 5 of Layton's Addition, with a priority date of March 19, 1945. The recognized rates were 1,000 gpm and 450 afy.

On July 9, 2012, the BCWCB received an application for change from the City of Kennewick on GWC 94-D, which was assigned tracking number BENT-12-04 by the BCWCB and CG4-GWC094-D by Ecology. The change application requested to change the point of withdrawal to the ASR well. On October 1, 2012, the BCWCB approved the change as requested. On December 20, 2012, Ecology issued an order reversing the BCWCB decision and denying the change application. The reason for the denial included that the original point of withdrawal

appeared to be completed in the Saddle Mountain Aquifer, while the ASR well is completed in the deeper Wanapum Formation, which was considered to be a different body of public groundwater. Insufficient information was included to allow Ecology to make a tentative determination on the extent and validity of the water right; the impairment analysis was incomplete, which would not allow Ecology to come to a conclusion, and there were other technical deficiencies. The denial was appealed. The appeal was assigned PCHB Case No. 13-010. A settlement agreement was reached between the parties; in response, Ecology issued an order on October 3, 2013, that modified the original BCWCB decision and superseded the prior Ecology denial.

The current attributes of this certificate are that it is held by the City of Kennewick, with a priority date of November 4, 1944, for municipal and domestic use, year round, at rates of 1,000 gpm and 450 afy (146,632,950 gallons per year), with points of withdrawal/diversion that include the original Layton's Addition Well No. 2 in Section 6, Township 8 North, Range 30 East W.M. (no longer in use), the surface water treatment plant in Section 31, Township 9 North, Range 30 East W.M., and Ranney Well No. 5 located in Government Lots 1 and 2, Section 35, Township 9 North, Range 29 East W.M.

Ground Water Certificate 1805-A

This groundwater certificate has been held by the City from application through certification.

The current attributes of this certificate are that it is held by the City of Kennewick, with a priority date of February 23, 1950, for municipal water supply, year round, at rate of 4,950 gpm and 4,800 afy (1,564,084,800 gallons per year), with four wells and an infiltration trench located in Government Lot 2, Section 31, Township 9 North, Range 30 East W.M.

The City facilities that correlate with the point of withdrawal location include Ranney Well Nos. 1, 2, and 3.

Ground Water Certificate 3897-A

This groundwater certificate has been held by the City from application through certification.

The current attributes of this certificate are that it is held by the City of Kennewick, with a priority date of February 27, 1957, for municipal water supply, year round, at rate of 13,500 gpm and 5,600 afy (1,824,765,600 gallons per year), with two horizontal collectors (Ranney Wells) located in Government Lot 1, Section 35, Township 9 North, Range 29 East W.M.

The City facilities that correlate with the point of withdrawal location include Ranney Well Nos. 4 and 5.

Surface Water Certificate S4-25479C

This surface water certificate has been held by the City from application through certification.

The current attributes of this certificate are that it is held by the City of Kennewick, with a priority date of April 10, 1977, for municipal water supply, year round, at rate of 55.7 cubic feet per second (25,000 gpm) and 15,680 afy (5,109,343,680 gallons per year), from the Columbia River in the SE ¼ Section 31, Township 9 North, Range 30 East W.M., which is consistent with the location of the City's surface water treatment plant.

The certificate contains a provision that states:

> A total of 10,400 acre-feet per year has been granted under previous certificate; therefore, 5,280 acre-feet per year of the total allowed under this certificate will be a primary right; 10,400 acre-feet per year will be a supplemental supply and may be used in conjunction with, or as an alternate supply, to the existing rights so long as the total annual quantity from all sources does not exceed 15,680 acre-feet per year.

The volume identified as being granted under previous certificates, 10,400 afy, is the sum of the annual volumes allocated under GWC 1805-A and GWC 3897-A held by the City, which allow for withdrawal from Ranney Collector Nos. 1, 2, 3, 4, and 5. Based on our interpretation of the use of supplemental supply in this provision, combined with the guidance provided in Ecology Water Resources Program Policy 1040, it has been determined that this water right is partially additive and partially alternate to GWC 1085-A and GWC 3897-A. The rates that are additive, under this water right, include the entire instantaneous rate of 55.7 cubic feet per second (cfs) and 5,280 afy (1,720,493,280 gallons per year) of the annual volume granted. So, under this water right the City has the option to divert the entire 15,680 afy from the Columbia River, which would not allow any water to be withdrawn from the Ranney Collectors under GWC 1805-A and GWC 3897-A, or it can elect to divert 5,280 afy from the Columbia River at the surface water treatment plant, which would allow the full water rights under GWC 1805-A and GWC 3897-A to be withdrawn from the Ranney Collectors, or it can opt for any ratio between those two end points.

The additive annual volume of 5,280 afy is considered to be a portion of the volume of water reserved by the adoption of the John Day/McNary Basin Plan, Chapter 173-531 WAC, which is now Chapter 173-531A WAC.

The City facilities that correlate with the point of diversion location include the City water treatment plant, which diverts water directly from the Columbia River.

Surface Water Permit S4-30976P

The Cities of Kennewick, Richland, Pasco, and West Richland jointly applied for and were granted a surface water right. This new water right was assigned tracking number S4-30976. The permit has a priority date of September 23, 1991, and was issued for 178 cfs and 96,619 afy for municipal supply. The City diverts its portion of the permit from the Kennewick Filter Plant, Ranney Wells, and Army Corps of Engineers (COE) – Columbia Park facilities.

This permit was issued on September 15, 2003, and is commonly referred to as the Quad Cities Permit. This permit was the first municipal water right issued from the Columbia River after a long moratorium. The permit has extensive provisions and mitigation requirements, which included the creation of the Regional Water Forecast and Conservation Plan by the quad cities (**Appendix N**).

In order to mitigate low-flow conditions on the Columbia River, Ecology required that the consumptive use under the permit be mitigated when actual river discharge dropped below identified levels. Ecology also specified that the cities' access to water under the permit would be contingent upon there being sufficient mitigation available. For this reason, the permit is designed to be issued in phases, up to the maximum rates of 178 cfs and 96,619 afy. The first phase was issued for 10 cfs and 7,227 afy and assigned a priority date of June 24, 1980, pursuant to WAC 173-531A-050(3). For the first phase, the City's portion was 2.5 cfs and 1,806.75 afy (588,731,294 gallons per year). See the 2014 RWFCP for more details on this permit.

Potable Supply System Conclusions

Since these water rights are all for municipal water supply purposes, the place of use for the water rights are automatically the service area described in this WCP.

The water right certificates and permits for the potable distribution system are included in **Appendix M**. Water Right Self-Assessment Forms for existing, 6-year, 10-year, and 20-year forecasted use are included in **Appendix O**. The basis for the demand projections and analyses in other chapters of this WCP utilize actual 2015 supply data. The Water Right Self-Assessment Forms were prepared in early 2016 prior to inclusion of year-end 2015 data, and are based on projected 2015 supply and demand data. The actual 2015 ADD was calculated to be less than the previously projected ADD used as the basis for the existing and future Water Right Self-Assessment Forms. Since the demand projections and the analyses in other chapters utilize actual 2015 data, the consumption data presented in the existing and future Water Right Self-Assessment Forms is more conservative than what would be calculated based on actual 2015 demands.

NEW WATER RIGHT APPLICATIONS

The City owns, either in whole or in part, portions of three water right applications that are pending before Ecology. One application requests a new surface water right; the other two applications (one groundwater and one reservoir) are associated with the City's ASR project at the Southridge site.

S4-33044(B)A

The City, in conjunction with the Cities of Richland, Pasco, and West Richland, applied for a new joint water right from the Columbia River that was assigned tracking number S4-33044. The water right application has a priority date of November 28, 2011, and requested 165 cfs and 86,983 afy for municipal supply. The City requested to divert its portion from the Kennewick Filter Plant, Ranney Wells, and Army COE – Columbia Park. The instantaneous rate and annual volume requested are equal to the amount of municipal water remaining under S4-30976P beyond the rates that the cities were promised would be mitigated by Ecology in the 2011 Memorandum of Agreement (MOA). The water right was filed to take advantage of the water that was made available for municipal and industrial use through Ecology's Office of Columbia River, Lake Roosevelt Incremental Storage Release Program. Under this program, any entity receiving a water right is required to pay Ecology $35 per acre-foot per year for the life of the water right to offset the costs of developing the supply.

On October 16, 2015, the four cities requested that Ecology administratively split the application such that the City of Pasco was assigned 6.9 cfs and 5,000 afy under the (A) portion of the application, and the four cities were left with 158.1 cfs and 81,983 afy under the (B) portion of the application. This split was necessary since the City of Pasco needs to proceed with having the application processed in order to acquire additional water rights to meet demand beyond its existing water rights.

Ecology has not yet made a final determination on either the (A) or (B) portions of this application.

R4-35237A

The City applied for this reservoir application to store water in the subsurface under an ASR project at the Southridge site. The application was filed based on item 5a in the "Kennewick Underground Artificial (Aquifer) Storage and Recovery (ASR) Project Development Memorandum of

Understanding" (MOU) that was signed between the City and Ecology in January 2008 (**Appendix P**).

The application has a priority date of May 15, 2009, and requests to recharge at a rate of up to 900 gpm to store up to 714 acre-feet (232,657,614 gallons) in the Columbia River Basalt Aquifer System from a well or wells located in SE ¼ Section 17, Township 8 North, Range 29 East W.M. Recharge was proposed to occur between the period of October 15th to June 15th, with extraction occurring during the summer months for municipal supply.

On October 8, 2009, a preliminary permit was issued to the City to drill a test well to assess the feasibility of ASR under this application. This preliminary permit was in effect through September 30, 2010.

On March 14, 2011, a preliminary permit was issued to the City to drill a test well and conduct aquifer testing to assess the feasibility of ASR under this application. This preliminary permit was in effect through March 1, 2013.

On February 10, 2014, a preliminary permit was issued to the City to conduct recharge and recovery testing as part of the completion of construction of infrastructure related to ASR under this reservoir application. This preliminary permit was in effect through January 1, 2015. The target reservoir was identified as the Priest Rapids Member of the Wanapum Basalt Formation within the Columbia River Basalt Aquifer System.

On March 14, 2014, a preliminary permit was issued to the City to conduct recharge and recovery testing as part of the pilot testing for ASR under the reservoir application. This preliminary permit covered activities through January 1, 2015.

On July 1, 2014, a temporary authorization for the beneficial use of water for municipal supply under reservoir application no. R4-35237 was issued to the City. This temporary permit covered operation of the ASR project from July 1, 2014 through October 15, 2015. This temporary permit placed stipulations on the source of the water being injected, when water could be injected and retrieved, the rates at which water could be injected and retrieved, what monitoring needed to be performed during the testing, and what information had to be reported to Ecology.

On April 3, 2015, a temporary authorization for the beneficial use of water for municipal supply under reservoir application no. R4-35237 was issued to the City. This temporary permit covered operation of the ASR project from April 3, 2015 through January 1, 2016. This temporary permit placed stipulations on the source of the water being injected, when water could be injected and retrieved, the rates at which water could be injected and retrieved, the duration of storage between recharge and recovery, what monitoring needed to be performed during the testing, and what information had to be reported to Ecology.

Under the preliminary and temporary permits, the City has installed an ASR well (ASR-1) and an observation well. Pumping tests have been performed on the ASR well to obtain information about the aquifer properties, including the transmissivity of the aquifer and the storage coefficient. Treated water from the City's system has been used to recharge the aquifer and has been recovered using the ASR well. Starting in 2015, the water that is recovered from the ASR well is now able to be utilized for meeting demand within the water system.

In 2015, the City recharged approximately 243 acre-feet of water from the ASR well and withdrew 192 acre-feet after a storage period. The difference between the water added and withdrawn was 51 acre-feet. Unfortunately, for the City, the 51 acre-feet is counted against its existing water rights,

but could not be used. If the recovery percentage is too low, it will reduce the usefulness of the ASR project as a source of supply, as the non-recoverable water will become a new demand on the water system.

According to the 2008 MOU, the City may need to donate a perfected portion of S4-25479C to the Trust Water Right Program to be managed by Ecology consistent with the Columbia River Program, once the ASR project is fully permitted. Donation of this portion of an existing water right to trust will reduce the ability of the City to divert that water directly from the Columbia River. It is currently unknown how large the donation will need to be. In the MOU, Ecology indicated that it planned on using its portion of that trust water right to satisfy the mitigation requirements under the first phase of the Quad Cities Permit (S4-30976). Since the first phase has already been fully mitigated by Ecology, the City is unsure what Ecology would do with this trust water right now.

Ecology has not yet made a final determination on this reservoir (ASR) application.

G4-35338A

The City applied for this groundwater right from the same well that is to be used as part of a new ASR project at the Southridge site. The application was filed based on item 5c in the "Kennewick Underground Artificial (Aquifer) Storage and Recovery (ASR) Project Development Memorandum of Understanding" that was signed between the City and Ecology in January 2008 (**Appendix P**).

The application has a priority date of June 1, 2010, and requests 2,500 gpm from a well located in the NE ¼ SE ¼ Section 17, Township 8 North, Range 29 East W.M. The name of this well is ASR-1. This application is intended to balance the City's pre-ASR and post-ASR water right portfolio in the event that the ASR project is approved, which will require the City to place a portion of its existing perfected surface water rights into the Trust Water Rights Program. The annual volume that could be granted will match the volume placed into the Trust Water Rights Program.

Ecology has not yet made a final determination on this groundwater application.

NON-POTABLE WATER RIGHTS HELD BY THE CITY

The City holds and utilizes one water right that is not connected to its potable system.

G4-29926C

This water right has a priority date of February 9, 1989 and was originally applied for and issued to Cascade Columbia Foods, Ltd. The source of water is a basalt well located within the place of use. It was issued for the purpose of industrial vegetable washing with disposal to a spray field with an area of approximately 2 acres. In 2005, the place of use was obtained by the City and is now occupied by the City of Kennewick Frost Municipal Building. The water right certificate was issued to the City on July 13, 2011, for irrigation of 1.6 acres, during the period of April 1st through December 31st, at rates of 100 gpm and 7.2 afy (2,346,127 gallons per year).

Since this irrigation system is separate from the regional municipal system, the water right and irrigation use will not be considered farther in this WCP.

POTABLE WATER SUPPLY EVALUATION

An evaluation of the City's existing water rights was performed to determine the sufficiency of the water rights to meet both existing and future water demands. **Table 4-5** compares the combined maximum instantaneous water right amounts of the sources with the peak day demand of the system, and the combined maximum annual water right amounts of the sources with the average day demand of the system. As shown in the table, the City has sufficient water rights (both instantaneous and annual amounts) to meet the demands of its existing customers.

Table 4-5
Existing Potable Water Rights Evaluation

Description	Instantaneous Rights / Maximum Day Demand	Annual Rights / Average Day Demand	
	(gpm)	(acre-feet)	(gpm)
Total Water Rights	45,972	18,007	11,163
Existing (2015) Water Demand	14,311	12,308	7,630
Surplus (or Deficient) Rights	**31,661**	**5,699**	**3,533**

Table 4-6 summarizes the results of the future water rights evaluation, which compares the water rights of the existing sources with the system's future 6-year, 10-year, and 20-year demand projections. The analysis considered future demand projections with and without water use reductions from the City's planned WUE efforts, as shown in the table. The results of the future water rights evaluation indicate the City has sufficient water rights to meet the demands through the year 2035.

Table 4-6
Future Potable Water Rights Evaluation

Description	Instantaneous Rights / Maximum Day Demand (gpm)	Annual Rights / Average Day Demand (acre-feet)	Annual Rights / Average Day Demand (gpm)
Year 2021 (+6 years) Without Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	15,490	13,323	8,259
Surplus (or Deficient) Rights	**30,482**	**4,684**	**2,904**
Year 2025 (+10 years) Without Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	16,419	14,121	8,754
Surplus (or Deficient) Rights	**29,553**	**3,886**	**2,409**
Year 2035 (+20 years) Without Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	18,808	16,175	10,028
Surplus (or Deficient) Rights	**27,164**	**1,831**	**1,135**
Year 2021 (+6 years) With Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	14,804	12,732	7,894
Surplus (or Deficient) Rights	**31,168**	**5,274**	**3,270**
Year 2025 (+10 years) With Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	15,073	12,964	8,037
Surplus (or Deficient) Rights	**30,899**	**5,043**	**3,126**
Year 2035 (+20 years) With Conservation			
Total Water Rights	45,972	18,007	11,163
Projected Water Demand	17,266	14,850	9,206
Surplus (or Deficient) Rights	**28,706**	**3,157**	**1,957**

WATER RIGHT RECOMMENDATIONS

Although the City has sufficient water rights to supply the water system through 2035 and beyond, some administrative paperwork and facility improvements are necessary to fully utilize the City's existing water rights.

A water right change application should be prepared to change the points of withdrawal to GWC 1805-A since Ranney Well Nos. 1, 2, and 3 are no longer used. It is recommended that the City change the points of withdrawal to Ranney Well Nos. 4 and 5. This water right change should not be controversial and will remedy the 2015 issue of exceeding the annual volume from these two Ranney Wells. Even though the annual volume granted under GWC 1805-A can be diverted from the Columbia River at the City's treatment plant under S4-25479C, the instantaneous rate authorized under GWC 1805-A cannot be utilized to meet demand unless the point of withdrawal is changed to include a new source.

On certificate S4-25479C, a request should be made to Ecology to strike the metes and bounds description of the diversion provided under the "Approximate Location of Diversion-Withdrawal" in the water right file since it is not located in the correct quarter section referenced and does not match the actual location of the point of diversion. This language appears to be left over from the originally conceived diversion location, which was changed long ago by Ecology through a water right change process.

Continue pilot testing of the Southridge ASR facility. Discuss the 2008 MOU trust water right donation implications of fully permitting this project with Ecology.

Work jointly with the Cities of Richland, Pasco, and West Richland to identify opportunities for obtaining water rights that can be used as mitigation under permit G4-30976P.

WATER SUPPLY RELIABILITY ANALYSIS

SOURCE OF SUPPLY ANALYSIS

The City's existing active sources include Ranney Well Nos. 4 and 5, and the City's Columbia River surface water treatment plant, which have adequate capacity to meet the existing, 6-year (2021), and 10-year (2025) demand requirements of the water system. Additional source capacity is needed to meet the projected demands beyond 2025. The City is currently performing ongoing testing of an ASR well, which would provide the water system sufficient source capacity beyond the 10-year (2025) planning period. The City is planning to evaluate an expansion of the Columbia River water treatment plant to meet the projected 20-year (2035) source capacity requirements.

5 | SOURCE WATER PROTECTION

INTRODUCTION

The two basic objectives of a water system are to provide a sufficient quantity of water to meet customer usage demands and to provide high-quality water. **Chapter 3** discusses the City of Kennewick's (City) ability to supply a sufficient quantity of water and identifies future source requirements. This chapter discusses the City's ability to protect the existing sources from contamination, and to continue providing high-quality water to its customers.

All purveyors of water systems using surface water or groundwater under the direct influence of surface water (GWI) sources are required to develop and implement a watershed control program. In addition, all federally defined Group A public water systems that use groundwater as their source are required to develop and implement a wellhead protection (WHP) program. The City's Columbia River water treatment plant (WTP) is subject to the watershed control program requirements. The City's Ranney Wells and aquifer storage recovery (ASR) well, which is currently putting water to beneficial use as part of the testing phase to determine the well's feasibility, are subject to the WHP program requirements. The City's Water Facilities Inventory (WFI) report presents the City's active potable water sources, and is presented in **Appendix Q**.

WATERSHED CONTROL PROGRAM

Purveyors of water systems using surface water or GWI sources are required to develop and implement a watershed control program. The City's water supply is provided surface water from the Columbia River. To protect water supplies and prevent source water contamination, the Washington State Department of Health (DOH) requires purveyors of surface water or GWI sources to prepare a watershed control program as a component of the Water Comprehensive Plan (WCP). A copy of the 2008 *Water Resource Inventory Area (WRIA) 31 Watershed Management Plan* is contained in **Appendix I**, which serves as the watershed control program for the City. The watershed control program contains the following elements, as required by Washington Administrative Code (WAC) 246-290-135. A brief summary of the information presented in the City's watershed control program is presented in the subsequent sections.

- A description of the watershed that includes its location, hydrology, land ownership, and identification of activities that may have a negative impact on source water quality.
- An inventory of all potential sources of surface water contamination, including the locations of owners/operators located within the watershed that have a significant potential to contaminate the source water quality.
- Watershed control measures that include documentation of ownership and relative written agreements, as well as monitoring activities and water quality.
- System operation, source vulnerability, and emergency provisions.
- Documentation of water quality trends.

DESCRIPTION OF THE WATERSHED

The City is located in Benton County, Washington, near the confluence of the Columbia, Snake, and Yakima Rivers. The City's watershed is the Rock-Glade Watershed, identified as WRIA 31, which includes portions of Benton, Klickitat, and Yakima counties. WRIA 31 encompasses approximately 1,594 square miles, and is approximately bound by the City on the east, the John Day Dam on the west, the Horse Heaven Hills on the north, and the Columbia River at the Washington and Oregon border to the south. The Columbia River is the primary water supply for WRIA 31. Although the City is within WRIA 31 and can play a role in protecting the watershed, the Columbia River incorporates a very large watershed upstream of the City's sources and WRIA 31, and could be contaminated by numerous sources over which the City has no control or jurisdiction.

POTENTIAL SOURCES OF SURFACE WATER CONTAMINATION

An essential element of a watershed control program is an inventory of all potential sources of contamination throughout delineated WHP and watershed control areas. The purpose of the inventory is to identify past, present, and proposed activities that may pose a threat to the sources of water supply.

The Washington State Department of Ecology (Ecology) maintains a facility/site database online that lists facilities and sites that could pollute the air or water, including:

- State clean-up sites;
- Federal superfund sites;
- Hazardous waste generators;
- Solid waste facilities;
- Underground storage tanks; and
- Enforcement.

A list of each potential source of contamination within WRIA 31 is contained in **Appendix I**, as is a figure presenting the location of each potential contamination source within the City's water service area.

SOURCE VULNERABILITY

The City is highly dependent on the Columbia River for its water supply, which makes it vulnerable to water quality contamination. The City's current use of its ASR Well eases its reliance on the Columbia River and reduces the possibility that a water contamination event in the Columbia River will impact the City's ability to supply its water system. Additional information regarding the City's source vulnerability is presented in Section 6.2 of **Appendix I**.

EMERGENCY PROVISIONS

In the event of a surface water contamination event that renders water unsuitable for potable use, the City will implement the following emergency response.

1. Shut down the WTP, and obtain water quality samples.

2. Notify DOH of the surface water contamination.
3. Notify all customers of the problem and instruct them to boil all water to be used for consumption and cooking, if boiling is effective for the type of contamination.
4. Close the appropriate distribution and transmission main valves to isolate the area of contamination within the distribution system.
5. Isolate booster pump station and reservoir facilities, as needed, to prevent the spread of contamination within the distribution system.
6. Analyze water quality of water within reservoirs and dispose of properly, if contaminated.
7. Disinfect reservoirs, water treatment plant and water mains, as necessary, to remove any contaminated residuals, if disinfection is effective for the contamination type.
8. Adjust control of system facilities, as necessary, to provide supply from the Ranney Wells, ASR Well, or the interties with the City of Richland provided that these sources have not been contaminated.
9. Flush and disinfect the water treatment plant as needed to remove contaminant from source water.
10. Monitor water quality at the water treatment plant and investigate cause of contamination.
11. Implement water use reduction measures, as necessary, to ensure an adequate supply of water.

WELLHEAD PROTECTION PROGRAM

The quality of drinking water in the United States is regulated by the Environmental Protection Agency (EPA). Under provisions of the Safe Drinking Water Act (SDWA), the EPA is allowed to delegate primary enforcement responsibility for water quality control to each state. In the State of Washington, the DOH is the agency responsible for implementing and enforcing the drinking water regulations. For the state to maintain primacy (delegated authority to implement requirements) under the SDWA, it must adopt drinking water regulations that are at least as stringent as the federal regulations. To meet these requirements, the state has published drinking water regulations that are contained in Chapter 246-290 WAC.

Section 1428 of the 1986 SDWA Amendments mandates that each state develops a WHP program. The Washington State mandate for WHP and the required elements of a WHP program are contained in WAC 246-290-135 – Source Protection, which became effective in July of 1994. In Washington State, the DOH is the lead agency for the development and administration of the state's WHP program.

The purpose of the WHP program is to provide an organized approach to effectively protect drinking water supplies from contamination. The program seeks to identify and manage potential contaminant sources near public water supply wells to prevent future contamination. An effective WHP program safeguards the health of residents, employees, visitors, and all other water users, and avoids negative financial impacts associated with contamination. To ensure a safe, quality water supply and avoid additional costs, it is necessary to protect groundwater at its source. The WHP program is a straightforward and cost-effective method to accomplish this goal.

The City's WHP for the Ranney Wells was prepared in January 2007 by Golder Associates. The ASR Well was prepared in October 2013 by Golder Associates. The WHP for both the Ranney Wells and the ASR Well are contained in **Appendix J**. The WHPs contain the following required elements.

- Documentation and notification to all owners/operators of known and potential sources of contamination within the wellhead protection area (WHPA).
- Notification to regulatory agencies and local governments of the defined boundaries of the WHPAs and the findings of the contaminant source inventory (completed as part of this WCP).
- Coordination with local emergency spill responders (i.e., police, fire, and health departments) regarding WHPA boundaries, source susceptibility, and contingency plans.
- Management strategy for the sanitary control area of the well.
- Public education and outreach presenting wellhead safety and the direct impact employees and residents with the WHPA can have on the quality of groundwater.
- Emergency and spill response plan to be implemented in the event of a hazardous spill event within the WHPA.

6 | OPERATIONS AND MAINTENANCE

WATER SYSTEM MANAGEMENT AND PERSONNEL

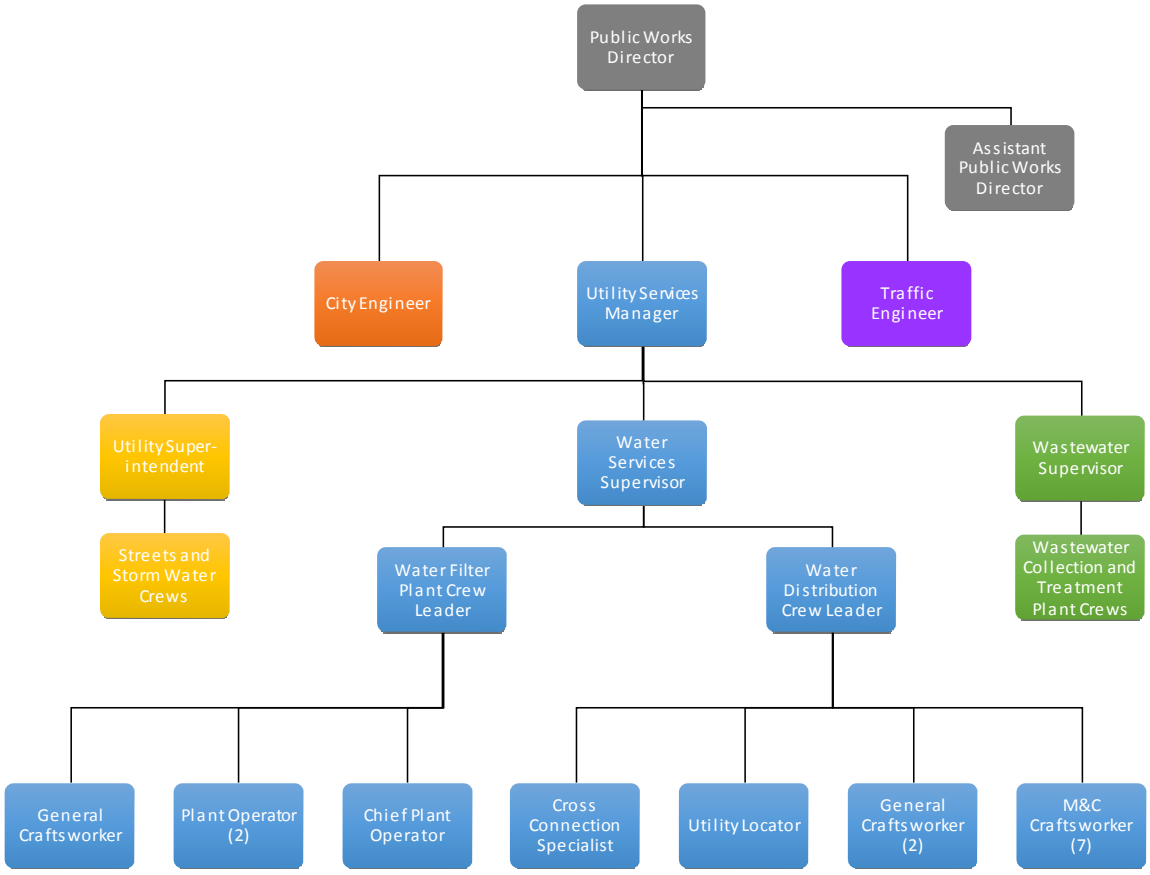
GENERAL POLICIES

The City of Kennewick's (City) general policies are established by a seven-member City Council in coordination with the Mayor. Policy priorities include the protection of public health and welfare, regulatory compliance, and sound fiscal management of the City. In addition, the City Council and Mayor hire a City Administrator to oversee various departments and functions. **Chapter 1** presents more detailed information on the water system ownership and management.

STRUCTURE

The City consists of several departments, including the Public Works Department. The Mayor and City Administrator have appointed Mr. Cary Roe, P.E., to direct the City's Public Works Department. The City's Public Works Department organizational structure, with an emphasis on the water system personnel, is shown in **Chart 6-1**.

Chart 6-1
City Water System Organizational Structure



OPERATOR CERTIFICATION

Under Washington Administrative Code (WAC) 256-292-040, the City's distribution system and water treatment plant are both currently classified as Group 4, requiring the City to have at least one Water Distribution Manager (WDM) and one Water Treatment Plant Operator (WTPO) classified at a level equal to or higher than the water system's classification. The WDM and WTPO can be the same person. The operator in charge during an operating shift shall have a minimum classification of one level lower than the classification of the distribution system or treatment plant's highest class.

The City's water system is also required to have a Cross-connection Control Specialist (CCS) responsible for the cross-connection control program, and a certified backflow assembly tester (BAT) for inspecting, testing, and monitoring backflow prevention assemblies. **Table 6-1** shows the current certifications of the City's water system operations and maintenance staff. The City supports the scheduling and training necessary to ensure that all applicable operations and maintenance staff meet professional growth requirements.

Table 6-1
Water Personnel and Certificates

Personnel	Water System Certifications		
	WTPO	WDM	Other
Charlie Arntz		3	CCS
Bob Bepple	2		CCST
Wade Bonds		2	
Trevor Brain		1	
Paul Briggs	4	4	CCS
Darrell Buck		1	
Dean Bugher	3		
Tyrel Davis		1	
Chris Espinosa		2	
Pat Everham	4	4	CCS
Bobby Flores		3	
Brian Garza		2	
Dustin Gerlach		3	
Bryson Hamby		2	
Dave Hansen	1	4	
Bill Hansford		1	
Mike Hanson	4	4	CCS
Rick Harding	4	3	CCS
Keith Howell		3	
Louis Kitchens	3		
Ed Melville		3	BAT, CCS
Greg Mendoza		1	
Layne Soggie		3	

CCST = Certified Control Systems Technician

NORMAL OPERATIONS

ROUTINE OPERATIONS

Routine operations involve analysis, formulation, and implementation of procedures to ensure that the facilities are functioning efficiently and meeting pressure requirements and other demands of the system. The City has written procedures for major activities. The procedures outline customer notification, locates, and tasks to perform the various functions of the division.

PREVENTIVE MAINTENANCE

Preventive maintenance is based on regular and frequent visits to the various facilities with scheduled routine inspections and tasks performed as part of the maintenance program. Information is recorded, and any necessary work is noted and scheduled accordingly. Materials required for maintenance are handled by the City's Purchasing Department or put out to bid, depending on the material. Maintenance schedules that meet or exceed manufacturers' recommendations have been established for all critical components in the water system. The City's maintenance procedures are exceptional, with repairs being made promptly, ensuring customers receive high-quality water service with limited interruptions. The preventive maintenance procedures, as well as the normal and emergency operations of the utility, are described in the later in this chapter.

STAFFING

The hours of labor and supervisory activity required to effectively execute the ongoing maintenance and operations schedules form the basis for determining adequate staffing levels. The amount of time annually available for each staff member for operations and preventive maintenance of the water system is shown in **Table 6-2**.

Table 6-2
Time Available Per Person Per Year

Description	Annual Hours
Beginning Hours Available	**2,080**
Less average vacation of 3 weeks per year	-120
Less average sick leave of 2 weeks per year	-80
Less holidays of 10 days per year	-80
Less average training of 40 hours per year	-40
Less average small tasks other than above of 1 hour per day	-220
Net Available Hours Per Year Per Person	**1,540**

The current staff includes management and supervisory personnel with partial time allocated to the water system, and water treatment plant operators and maintenance workers engaged in operating and maintaining the water system. There are currently 18 full-time staff assigned to the water system, as shown in **Chart 6-1**. The Public Works Director, Assistant Public Works Director, City Engineer, and Utility Services Manager are involved in other activities and can only partially devote time to the water system.

The City's water system operations and maintenance includes the City's water treatment plant, both Ranney wells, the aquifier storage and recovery (ASR) Well, 13 reservoirs, 11 booster pumps stations, 12 pressure reducing valve (PRV) stations, 2 interties, and a telemetry system. In addition, maintenance is performed on the distribution system, including pipelines, valves, hydrants, meters, and service connections. The estimated hours of work required to achieve optimum operation and maintenance of the water system is shown in **Table 6-3**. The table identifies the staffing time for maintenance tasks, operational tasks, capital improvements, and construction of water system facilities. The upper section of the table identifies the staffing time requirements for recommended preventive maintenance tasks, and the lower section identifies the staffing time requirements for recommended operations tasks. The estimates of time required for each component are based on a composite of similarly sized utilities in the region that are considered to have a responsible preventive and corrective water system maintenance program.

To achieve the level of operations and maintenance shown in **Table 6-3**, approximately 20.9 full-time personnel are required for the water system alone. The City's current available water system staff is slightly inadequate meet these requirements. At the current staffing level, which includes approximately 19 full-time personnel (as shown in **Chart 6-1**) and one part-time seasonal employee, the City is capable of adequately operating the water system and complying with the minimum Washington State Department of Health (DOH) requirements, although some preventative maintenance tasks are not able to be completed at the recommended frequency. The City should plan to add additional staff as necessary to improve preventative maintenance within the system, and as additional preventive maintenance tasks are required, such as the unidirectional flushing program anticipated to be implemented in 2017.

Table 6-3
Current Staff Required

Description	Total Units In System	Frequency (Times/Year)	Time/Unit (Hours)	Time/Year (Hours)
Preventive Maintenance				
Hydrants	4,100	0.25	0.5	513
Isolation Valves, Hydrant Valves	11,083	0.25	0.25	693
Air and Vacuum Release Valves	7	1	0.5	4
Blowoff Assemblies	209	1	0.25	52
Meters	23,801	0.1	2	4,760
Flushing Water Mains	41 miles	1	32	1,309
Booster Pump Station	11	1	24	264
Pressure Reducing Stations	12	1	8	96
Interties	2	1	8	16
Reservoirs	13	1	20	260
Telemetry and Control System	1	1	40	40
Preventive Maintenance Total				**8,006**
Operations				
Monitor System	10	260	0.3	780
Ranney Well Facilities	1	1	1,540	1,540
Water Treatment Plant	1	1	3,080	3,080
ASR Well	1	1	770	770
False Alarm Response	2	12	2	48
Meter Reading	23,801	6	0.05	7,140
Groundskeeping	26	12	8	2,496
Inventory	1	1	40	40
Meter Repair/Replace	238	1	2	480
Main Breaks	19	4	8	608
System Failures	2	4	8	64
Hydrant Repairs	41	1	4	164
Service Connections	490	1	8	3,921
Main Connections	10	1	24	240
Routine Dist. System Coliform Sampling	80	12	0.5	480
Routine Source Coliform Sampling	12	12	0.5	72
Misc. Water Quality Sampling	20	12	0.5	120
Administration	1	260	8	2,080
Operations Total				**24,124**
Total Staff Required				
Total Hours Required				32,130
Total Full-time Staff Required (based on 1,540 hours per person per year)				**20.9**

NOTE: Individual hours many not sum to totals due to rounding.

CONTINUITY OF SERVICE

As a municipality, the City has the structure, stability, authority, and responsibility to ensure that water service will be continuous. For example, City Council, Mayor, Public Works Director, or other staff changes would not have a pronounced effect on the City's customers or quality of service.

ROUTINE WATER QUALITY SAMPLING

The DOH has adopted federal regulations that specify minimum monitoring requirements for water systems. The sampling requirements depend on the population served, source type, and treatment provided. The specific requirements are contained in WAC 246-290-300. The City currently performs water quality monitoring at its sources and in the distribution system as required by the DOH Drinking Water Regulations. Based on population, the City is required to test at least 80 routine coliform samples each month. A further discussion of the water quality monitoring program is contained in **Chapter 3** and **Appendix H**.

CROSS-CONNECTION CONTROL

The City has adopted a Cross-connection Control Program to comply with WAC 246-290-490 pertaining to contamination of potable water due to cross-connections. The Cross-connection Control Program is included in **Appendix R**. Backflow prevention devices are required at service connections where a potential for contamination exists, as outlined in the Kennewick Municipal Code 15.41 and Kennewick Administrative Code 12-12. The staff members with CCS and BAT certifications are shown in **Table 6-1**.

RECORDKEEPING AND REPORTING

DOH has enacted regulations for recordkeeping and reporting procedures for operations and water quality testing that may be found in WAC 246-290-480.

Recordkeeping

Records must be kept for chlorine residual and other information as specified by DOH. DOH requires retention of critical records dealing with facilities and water quality issues as summarized below.

- Bacteriological analysis results: 5 years.
- Chemical analysis results: for as long as the system is in operation.
- Daily source meter readings: 10 years.
- Water treatment plant records: 10 years.
- Public notices and certifications to DOH: 3 years after issuance.
- Other records of operation and analyses as may be required by DOH: 3 years.
- Documentation of actions to correct violations of primary drinking water standards: 3 years after last corrective action.
- Records of sanitary surveys: 10 years.
- Project reports, construction documents and drawings, inspection reports, and approvals: life of the facility.

- Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWT) initial and second round source water monitoring: 3 years after bin classification.
- Applicable LT2ESWT treatment monitoring associated with microbial toolbox options: 3 years.

Reporting

The City's 24-hour notice procedures are consistent with DOH and U.S. Environmental Protection Agency (EPA) guidelines, and are described in the City's Emergency Response Plan. Mr. Pat Everham, Utilities Superintendent, is the person identified to speak on the City's behalf as these situations dictate.

The City must report the following to DOH.

- Within 48 hours: A failure to comply with the primary standards or treatment technique requirements specified in Chapter 246-290 WAC.
- Within 48 hours: A failure to comply with the monitoring requirements specified in Chapter 246-290 WAC.
- Within 48 hours: A violation of a primary maximum contaminant level (MCL).
- Within 1 business day: A backflow incident per WAC 246-290-490(8)f.
- As soon as possible, but no later than 24 hours after the violation is known: National Primary Drinking Water Regulation (NPDWR) violations and situations with significant potential to have serious adverse effects on human health as a result of short-term exposure that require Tier 1 public notices per title 40 of the Code of Federal Regulations (CFR) 141.202.

The City must submit to DOH all applicable reports required by Chapter 246-290 WAC. Monthly reports are due by the tenth day of the following month, unless otherwise specified. Daily and annual source meter recordings must be made available to DOH upon request. Records regarding the status of monitoring waivers must be submitted during each monitoring cycle. Waiver information is updated annually by DOH, and the utility is provided with a testing schedule.

A water facilities inventory (WFI) and report form must be submitted to DOH within 30 days of any change in name, category, ownership, or responsibility for management of the water system.

The City must notify DOH of the presence of:

- Coliform in a sample within 10 days of notification by the testing laboratory; and
- Fecal coliform or *E. coli* in a sample by the end of the business day in which the City is notified by the testing laboratory.

When a coliform MCL violation is determined, the City must:

- Notify DOH within 24 hours of determining acute coliform MCL violations;
- Notify DOH before the end of the next business day when a non-acute coliform MCL violation is determined; and
- Notify water customers in accordance with WAC 246-290-71001 through 71007 and the EPA's Public Notification Rule.

If volatile organic compound (VOC) monitoring is required, a copy of the results of the monitoring and any public notice must be sent to DOH within 30 days of receipt of the test results.

Other Reports

Several reports are required for other Washington State agencies, including the Department of Revenue, Department of Labor and Industries, Department of Social and Health Services, Department of Ecology, and the Employment Security Department. All of these reports must be completed according to the agency's instructions.

Customer Complaint Program

The City shall maintain a list of complaints and identify what was done to respond to any complaints where public health was at risk.

SAFETY PROCEDURES AND EQUIPMENT

Safety is the concern and responsibility of all water system staff. To maintain the highest level of safety, the City has taken steps toward educating its staff and providing resources to ensure a safe working environment. The City strives to improve its safety program on an on-going basis. The AWWA publishes a manual entitled, *Safety Practices for Water Utilities* (M3), which describes safety programs and provides guidelines for safe work practices and techniques for a variety of water utility work situations. This manual is available to all City personnel.

Safety training classes in first aid, CPR, traffic safety and flagging, air testing, confined space entry, and equipment calibration are required of all water system staff. In addition, safety talks are conducted weekly for all water system staff. The following identifies procedures to be followed for operations and maintenance (O&M) tasks that involve the most common potential work place hazards in the water system.

The City's Public Works Department follows all appropriate Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) regulations in its day to day operations and complies with the following state requirements.

- WAC 296-809-500 to 800: Entry into confined spaces.
- WAC 296-155-650 to 66411 Part N: Shoring of open ditches.
- WAC 296-155-429: Lockout-tagout for work on energized or de-energized equipment or circuits.
- Chapter 296-155 WAC Part C1: Fall restraint for access to the top of the City's water reservoirs.
- *Manual on Uniform Traffic Control Devices*: Traffic control for work in the public right-of-way.
- All requirements and training necessary to maintain state certifications.

Operation of heavy equipment is a potential work place hazard. The water system operators shall follow all appropriate OSHA regulations.

Use of Chlorine or Chlorine Products

Standard Procedure – Handle with care, provide adequate ventilation, wear safety glasses, rubber gloves, and a self-contained breathing apparatus (SCBA), and follow the material safety data sheets (MSDS) and facility standard operating procedures.

Use of Water Treatment Chemicals

Standard Procedure – Follow MSDS and facility standard operating procedures.

Working in Confined Spaces

Standard Procedure – Follow state requirements for confined space entry.

Working around Heavy Equipment

Standard Procedure – Obtain proper training and follow all safety procedures. Use noise protection equipment.

Working in Traffic Areas

Standard Procedure – Wear proper clothing and provide adequate signage and flagging for work area. Certified flaggers are to be used when traffic management requires flagging around a work site.

Working on or around Water Reservoirs

Standard Procedure – Follow proper safety harness procedures for working on tall structures. Entry into a reservoir is considered entry into a confined space work area. Follow regulations and procedures for confined space entry.

Working in or around Pump Stations

Standard Procedure – Obtain proper training and follow all safety procedures for working on pumps and electrical equipment. Use noise protection equipment. Use lockout-tagout safety procedure.

Working on Asbestos Cement Water Main

Standard Procedure – Obtain proper training and follow all safety procedures for working with asbestos materials.

Working on Pressurized Water Main

Standard Procedure – Obtain proper training and follow all safety procedures for working with pressurized water mains.

The following list includes safety and first aid equipment available to water system staff to carry out safety procedures for O&M tasks.

- First aid kits in each vehicle, workshop, and lab
- Safety boots
- Safety eye glasses and goggles
- Ear plugs
- Reflective vests and pants

- Fall harnesses
- Fire extinguishers
- Chemical aprons
- Gloves
- Hard hats
- Respirators
- Eye wash stations in each facility
- Air-fed breathing apparatus equipment for non-hazardous work environments
- Trench shoring equipment
- Air tester for confined spaces
- Traffic safety equipment
- Confined space blower
- Construction radios and cell phones

WATER QUALITY SAMPLING PROCEDURES AND PROGRAM

The City performs water quality monitoring at its sources and in the distribution system as required by DOH Drinking Water Regulations shown in Chapter 246-290 WAC. Further discussion of the City's water quality monitoring is provided in **Chapter 3** of this Water Comprehensive Plan and in the City's Water Quality Monitoring Plan, which is included in **Appendix H**.

Monitoring is required at each of the City's three well sources for inorganic chemicals (IOC), physical substances, organic chemicals, and radionuclides. New unregulated contaminant monitoring must also be performed by the City as required by the Unregulated Contaminant Monitoring Regulation, second cycle.

DOH provides the City with a list detailing the chemical sampling required each year. **Chapter 3** includes a listing of source water quality tests and sampling frequencies. The City will always request that a copy of the drinking water analytical results be sent to DOH.

The following tests are to be conducted by the City's water system operators.

1. **Coliform Bacteria:** The sample must be taken directly from various points in the distribution system. The **Coliform Monitoring Plan** section of this chapter describes the City's sampling procedures.
2. **Inorganic Chemicals:** The sample must be taken at the source tap to monitor source water.
3. **Nitrates:** The samples must be taken at the source tap to monitor source water.
4. **Volatile Organic Chemicals (VOCs):** The sample is to be taken at the source tap to monitor source water.
5. **Synthetic Organic Chemicals (SOCs):** The sample is to be taken at the well house tap to monitor source water.
6. **Radionuclides:** The sample is to be taken at the well house tap to monitor source water.
7. **Lead and Copper:** Samples must be taken directly from residential taps.

8. **Residual Chlorine:** Residual free chlorine samples are taken directly from various points in the distribution system.

DISINFECTANT RESIDUAL CONCENTRATION MONITORING

The distribution system has continually monitoring chlorine analyzers located at nine reservoirs and Booster Pump Stations (BPSs) to measure the free chlorine concentration at each facility. The chlorine analyzers communicate wirelessly with the City's supervisory control and data acquisition (SCADA) system and are monitored daily by the Water Treatment Plant Operators. All chlorine analyzers are calibrated monthly.

Six chlorine-boosting injection stations are located throughout the system at reservoir and BPS facilities. The chlorine booster stations also communicate wirelessly with the City's SCADA system to ensure adequate chlorine residuals are maintained.

In addition to the automatic measurements performed by the chlorine analyzers, City staff take physical chlorine measurements from all reservoirs on a weekly basis. The samples are taken from the top and bottom of the reservoirs. Samples are recorded on a monthly data sheet.

Chlorine residuals are monitored with every coliform bacteria test that is taken throughout the City's water system. Eighty routine coliform samples are collected each month. The average of the monthly chlorine residuals is reported each month to DOH.

DISINFECTION BYPRODUCTS MONITORING

Quarterly monitoring was performed for total trihalomethanes (TTHMs) and haloacetic acids (HAA5) through 2012 as part of the Stage 1 Disinfectants/Disinfection Byproducts Rule (Stage 1 D/DBPR) requirements. The City currently performs standard monitoring at eight sample locations to meet Stage 2 Disinfectants/Disinfection Byproducts Rule (Stage 2 D/DBPR) requirements.

Lead and Copper Monitoring

Currently, 30 or more samples are taken every 3 years as required by the City for lead and copper. Samples are taken at customer taps from June through September. The City most recently performed lead and copper monitoring in 2011, and will be required to sample for lead and copper again by September 2016. The 2011 sampling identified lead and copper levels below the action levels.

Asbestos Monitoring

DOH has granted the City's Water Department a 9-year waiver for asbestos monitoring, with the next sample required prior to June 2018. Therefore, until required, no asbestos monitoring takes place within the water system.

COLIFORM MONITORING

The City's coliform monitoring procedures are included in this Water Comprehensive Plan (WCP) as part of **Appendix H**, as is a copy of Kennewick Administrative Code (KAC) 12-56-050, which

identifies the responsibilities and procedures associated with coliform monitoring. A copy of the City's water quality monitoring schedule, effective June 2016, is also presented in **Appendix H**.

Coliform sampling protocol involves collecting at least 80 routine coliform samples each month in the distribution system at specified locations. If a sample tested by the laboratory is unsatisfactory (positive, coliforms present), the lab will contact the City and the City will collect repeat samples at specified locations per the **Violation Procedures** section that follows. At various frequencies, coliform samples are also taken at the City's water sources, at house taps in response to customer complaints, at locations of new construction or system repairs, and at the reservoirs. Chlorine grab samples are also taken with all coliform samples. All routine coliform bacterial samples from 2010 to June 2016 have been satisfactory.

VIOLATION PROCEDURES

MCLs and WCP are stated in WAC 246-290-310. If an MCL or MRDL is exceeded, the City will take follow-up action in accordance with WAC 246-290-320. In general, when a primary standard violation occurs, the City will do the following:

1. Provide notification to the DOH in accordance with WAC 246-290-480;
2. Provide notification to consumers in accordance with 40 CFR 141.201 through 141.208 and Part 7, Subpart A, of WAC 246-290-300;
3. Determine the cause of the contamination; and
4. Take action as directed by the DOH.

When a secondary standard violation occurs, the City will notify DOH and take action as directed. Additional follow-up action specific to coliform monitoring includes repeat sample monitoring, identification of the cause of the coliform presence, and correction. MCLs for disinfection byproducts and MRDLs for disinfectant residuals are primary standards.

There are no MCLs established for lead and copper. If the 90th percentile results of either lead or copper exceed the corresponding action level, the City will need to follow additional requirements as required by the Lead and Copper Rule and the DOH. Additional requirements include increased monitoring and treatment.

EMERGENCY PROGRAM, SERVICE RELIABILITY REQUIREMENTS, AND WATER SHORTAGE PLAN PER WAC 246-290-420

CAPABILITIES

The City is equipped to accommodate short-term system failures and abnormalities. The general water system emergency response capabilities are as follows.

Multiple Supply Capability

The City could lose the operation of the ASR Well or either Ranney Well without adversely impacting its ability to meet the normal demands of its customers. Loss of operation of the City's water treatment plant (WTP) in the non-winter months could adversely impact the City's ability to

meet the normal demands of its customers, depending on the nature of the facility failure and the time that the facility is offline. The City has two emergency intertie agreements with the City of Richland that can be utilized during an emergency situation: one located at the intersection of Gage Boulevard and Steptoe Street; and one located near the intersection of Columbia Center Boulevard and Tapteal Drive. Additional information regarding the emergency interties is presented in **Chapter 1**.

Reservoirs

The maximum combined storage capacity of the City's reservoirs is 32.94 million gallons (MG), with the storage located at nine sites throughout the water system. The duplication of reservoirs in Zones 2, 3, and 4 provides sufficient redundancy to prevent service disruption when one of the reservoirs is out of service for cleaning, painting, repairs, or any other reason. Zones 1 and 5 have redundant pumping facilities and can meet the maximum day demands and fire flow requirements of the zones in the event that the 19th and Olympia (Zone 1) or Zone 5 reservoirs are offline.

Distribution System

The City has attempted to loop water mains wherever possible to improve water circulation (i.e., water quality) and minimize impacts to the system in the event that a portion of the distribution system must be taken out of service for maintenance or repairs. Additionally, zone valves between pressure zones can be fully or partially opened on an as-needed basis in the event of an emergency.

Emergency Equipment

The City is equipped with the necessary tools to deal with common emergencies. If a more serious emergency should develop, the City will hire a local contractor to make repairs to alleviate the emergency condition.

Emergency Telephone

The Water Department has an established emergency procedure for the public to contact Water Department personnel. The City's emergency call roster, radio contact roster, personnel list, and employee experience table are updated quarterly, and are distributed to a contracted answering service, emergency dispatch (911), Benton County Emergency Services, Franklin County Emergency Services, Kennewick Police, Kennewick Fire, and each individual Public Works Department.

On-call Personnel

The on-call person is required to respond to a call within 60 minutes, but can often respond to a call within 30 minutes. A list of emergency telephone numbers is provided to each on-call employee. New employees are not placed on-call until they are familiar with the water system and maintenance procedures and are properly certified by the State of Washington.

Contacts

The City maintains a list of adjacent utility contacts for routine and emergency use, shown in **Table 6-4**.

Table 6-4
Utility and Agency Contacts

Agency	Contact	Phone	Address
Utility Contacts			
City of Richland	Water Utility	(509) 942-7670	2700 Duportail Street Bldg. 100 Richland, WA 99352
	After Hour and Weekend Emergencies	(509) 545-2763	
Kennewick Irrigation District	Main Office	(509) 586-9111	2015 S Ely Street Kennewick, WA 99337
Columbia Irrigation District	Main Office	(509) 586-6118	10 E Kennewick Avenue Kennewick, WA 99336
Agency Contacts			
Washington State Department of Health	Jeff Johnson	(800) 833-6388	16201 E Indiana Avenue Suite 1500 Spokane Valley, WA 99216

Material Readiness

Some critical repair parts, tools, and equipment are kept on-hand and in fully operational condition. As repair parts are used, they are re-ordered. Inventories are kept current and are adequate for most common emergencies that can reasonably be anticipated. The City has ready access to an inventory of repair parts, including parts required for repair of each type and size of pipe within the service area.

EMERGENCY RESPONSE PLAN

In 2004, an *Emergency Response Plan* (ERP) was prepared for the City by CH2M Hill, Inc., to assist in preparing for emergency events related to the City's water supply and distribution system. The ERP includes a vulnerability assessment, contingency procedures, and emergency response procedures. The ERP should be updated in accordance with the requirements of the Bio-Terrorism Act of 2002 amendments to the Safe Drinking Water Act.

The updated ERP should contain a vulnerability assessment of the City's water system facilities, a contingency operation plan for responding to emergency events, a list of water personnel responsible for making decisions in emergency situations, and other elements. The ERP contains confidential and/or sensitive information and is exempt from the Public Disclosure Act. However, it will be available to City staff and can be reviewed by regulatory agencies on a need to know basis.

PUBLIC NOTIFICATION

The Federal Safe Drinking Water Act (SDWA), WAC 246-290-71001 through 71007, and the EPA's Public Notification Rule require purveyors to notify their customers if any of the following conditions occur.

- Violations of NPDWR.
- Failure to comply with a primary MCL described under WAC 246-290-310.

- Failure to comply with a surface water treatment technique.
- Failure to comply with monitoring requirements under Chapter 246-290 WAC.
- Operation under a variance or exemption.
- Failure to comply with the requirements of any schedule that has been set under a variance or exemption.
- Failure to comply with testing procedures as prescribed by drinking water regulations.
- Occurrence of a water-borne disease outbreak or other water-borne emergency.
- Exceedance of the secondary maximum contaminant level (SMCL) for fluoride.
- Availability of unregulated contaminant monitoring data.
- Issuance of a departmental order.
- Failure to comply with a departmental order.
- Issuance of a category red operating permit by DOH.

Public notice requirements for each type of violation or situation are organized into three tiers per 40 CFR 141.201 through 208 and are based on the seriousness of the violation and the potential for adverse health effects. Tier 1 public notices are required for NPDWR violations and situations with significant potential to have serious adverse effects on human health as a result of short-term exposure. Public notices in this tier must be provided as soon as possible (no later than 24 hours after the violation is known). The DOH must also be notified within this timeframe, and it may require repeat or additional notices.

Tier 2 public notices are required for all other NPDWR violations and situations not covered in Tier 1 with the potential to have serious adverse effects on human health. Public notices under Tier 2 requirements, with the exception of turbidity violations, must be provided as soon as possible, but no later than 30 days after the violation is known. Turbidity violations must be reported to DOH as soon as possible, but no later than 24 hours after the violation is known, to determine whether a Tier 1 public notice will be necessary. Repeat notices must be issued for as long as the violation persists.

All other NPDWR violations and situations not included in Tier 1 and Tier 2 are grouped within Tier 3. Tier 3 public notices must be provided within 1 year of the City learning of the violation or beginning operations under a variance or exemption. The notice must be repeated annually for as long as the violation, variance, exemption, or other situation persists.

PREVENTIVE MAINTENANCE

Maintenance schedules that meet or exceed manufacturers' recommendations have been established for all critical components in the City's water system. The following schedule is used as a minimum for preventive maintenance. A copy of the City's maintenance form is included in **Appendix S**.

WATER TREATMENT PLANT

Daily	Log and record run hours, motor starts, chemicals used, chemicals added, chlorine solution generated, fuse indicators, backwash volumes, volume delivered, and current supply rate; visually inspect pumps; check pump packing; check pump oil levels; check all equipment for proper function and operation; check security.
Monthly	Exercise the emergency eyewash and emergency shower.
Monthly	Perform filter maintenance cleaning.
Annually	Check all valves and screens; check control valve settings; re-grease pumps; change pump oil.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; calibrate equipment; maintain and repair indoor and outdoor facilities.

WELLS

Daily	Log and record volume delivered and current supply rate; perform visual and audio inspection; check packing; check security; check for excessive heat and vibration of pump motors.
Annually	Check all valves and screens; check control valve settings; re-grease.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; calibrate equipment; replace o-rings and diaphragms in equipment.

STORAGE FACILITIES

Daily	Monitor water levels and chlorine residuals. Check security.
Annually	Perform leak test. Inspect the following for proper operation: aesthetics; check valves; doors/hatches; drains; ladders; paint; riser pipe; roof/cover; screens; turnover; and vents.
5-year Intervals	Clean and inspect reservoir interiors.

DISTRIBUTION SYSTEM

As Required	Leak survey.
As Required	Flushing.

BOOSTER PUMP STATIONS

Weekly	Operate pumps; observe and record current draw (three phases); check packing; log and record volume delivered and pump motor hours; check motor oil level; measure and record discharge pressure; check motor noise, temperature, and vibration; check security.
Weekly	Inspect the following to confirm proper operation: efficiency; leaks; lubrication; noise; odor; operation; and pressure.

INTERTIES

Annually	Review intertie procedures with adjacent utility.

ENGINE GENERATOR SETS

Weekly	Operate to achieve normal operating temperatures; observe output.
As needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on amount of use).
As needed	Perform tune-up; replace parts as necessary.

PRESSURE REDUCING STATIONS

Monthly	Check vault for adequate drainage, clean drain if necessary. Check grout at pipe penetrations for leaks; check ladders, lid, and hatch for proper operation and condition; check piping and valves for leaks.
Annually	Inspect for noise, leaks, open/close speed, pressure settings, and operation.

ISOLATION VALVES

4-year Intervals	Inspect the following for proper operation: valve box; valve box lid; packing; nut; stem; and operation.

HYDRANTS

4-year Intervals	Inspect the following for proper operation: cables; caps; drain; gaskets; guard posts; nozzle; operating nut; operation; paint; static pressure; reflectors; tag; valve box; valve box lid; water quality; and tracing wire.

METERS

10-year Intervals	Time and measure volume of meter-delivered flow; dismantle, clean, and inspect all parts; replace worn or defective parts; retest meter for accuracy. Frequency varies based on meter size. Customer meters shall be replaced when reading problems are encountered.

AIR AND VACUUM RELEASE VALVE ASSEMBLIES

Bi-annually	Inspect the following for proper operation: valve; plumbing; valve box; valve box lid; standpipe; and tracing wire.

BLOWOFF ASSEMBLIES

Bi-annually	Inspect the following for proper operation: valve; valve box; valve box lid; blowoff box; blowoff box lid; standpipe; plug; and tracing wire.

STRUCTURES

Annually	Inspect the following for proper operation: aesthetics; bulkhead; doors/hatches; paint; roof; gutters; vents; and plumbing.

BACKFLOW PREVENTION DEVICES

Annually	Inspect and record status.

TELEMETRY AND CONTROL SYSTEM

Weekly	Visually inspect cabinets and panels for damage, dust, and debris.
Annually	Inspect the following for proper operation: wiring; register accuracy; box; panel; battery; radio; labels; and locks.

TOOLS AND EQUIPMENT

Rolling Stock	
Daily	Check all fluid levels and brakes.
As scheduled	Replace fluids and filters in accordance with manufacturer's recommendations.
Tools	
As needed	Clean after each use; lubricate and maintain as necessary.

7 | DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS

INTRODUCTION

The City of Kennewick (City) Water Utility operates and plans water service according to the design criteria, laws, and policies that originate from the seven sources listed in **Table 7-1**, shown in descending order of authority from the broadest to the narrowest.

Table 7-1
Regulatory Agencies

Agency	Design Criteria/Laws/Policies
U.S. Department of Health and Human Services	Federal Regulations
U.S. Environmental Protection Agency	Federal Regulations
Washington State Department of Health	State Regulations
Washington State Department of Ecology	State Regulations
Benton County Commission	County Regulations
Kennewick City Council	Administrative Policies
American Water Works Association	Design Criteria

These design criteria, laws, and policies guide the City's operation and maintenance of the water system on a daily basis, and it's planning for growth and improvements. The overall objective is to ensure that the City can provide high-quality water service at a minimum cost to its users. The design criteria also set standards that the City must meet to ensure that the water supply is adequate to meet existing and future water demands. The system's ability to meet these demands is detailed in **Chapter 3**, and the recommended improvements are identified in **Chapter 8**.

The highest three governmental entities – U.S. Government, Washington State, and the Benton County Commission – establish policies and laws in statutes, regulations, or ordinances. The Kennewick City Council and Mayor adopt policies that cannot be less stringent or in conflict with those established by governments above them. The City's policies take the form of ordinances, memoranda, and operational procedures, many of which are summarized in this chapter.

The following policies associated with the following categories are presented in this chapter.

- Supply
- Customer Service
- Facilities
- Finance
- Organization

SUPPLY POLICIES AND STANDARDS

QUALITY PROTECTION

- The City will pursue steps to meet or exceed all water quality laws and standards.
- The City will take all reasonable measures to protect its system and customers.

CROSS-CONNECTION CONTROL

- The City has the responsibility to protect its water system from contamination due to cross-connections.
- The City has a cross-connection control program for eliminating cross-connection contamination, as authorized by Kennewick Municipal Code 15.41 and Kennewick Administrative Code 12-12. A copy of the City's Cross-connection Control Program is contained in **Appendix R**.
- The City has backflow assembly tester (BAT) staff that is certified for backflow prevention and testing.
- The City will comply with the backflow prevention assembly installation and testing requirements as indicated in Washington Administrative Code (WAC) 246-290-490, and as published in the manual entitled, *Cross Connection Control Manual Accepted Procedure and Practice*, Pacific Northwest Section, American Water Works Association (AWWA).
- A copy of the City's cross-connection program summary report, submitted annually to the Washington State Department of Health (DOH), is contained in **Appendix W**.

QUANTITY

- The City will plan for at least 20 years into the future so that future water resource limitations can be handled efficiently.
- The City will ensure that the capacity of its systems, including pump stations, reservoirs, and transmission mains, is sufficient to meet the maximum day demand (MDD) of the water system.

CONSERVATION

- The City will promote efficient and responsible use of water and will conserve water during a shortage.
- The City has a Water Use Efficiency Program that is contained in **Chapter 4**.

REGIONAL PARTICIPATION

- The City participates in regional water forecasting and conservation planning with the Cities of Pasco, Richland, and West Richland. These cities, including Kennewick, share the Quad City Water Right and update the Regional Water Forecast and Conservation Plan every 6 years as required by the Washington State Department of Ecology.

CUSTOMER SERVICE POLICIES

DUTY TO SERVE

The City has a duty to provide service to all new connections within the retail service area when the circumstances meet four threshold factors:

- The City has sufficient capacity to serve water in a safe and reliable manner;
- The service request is consistent with local plans and development regulations;
- The City has sufficient water rights to provide service; and
- The City can provide service in a timely and reasonable manner.

The following section, **Water Service and Connection**, provides additional detail regarding the City's duty to serve policies.

WATER SERVICE AND CONNECTION

- The City will strive to provide potable water service to all people within the designated water service area, provided all policies related to service can be met.
- All proposed developments within the designated water service area will connect directly to the City's water system, unless deemed unfeasible by the City at the time of the request.
- Water system extensions required to provide water service to proposed developments will be approved by the Department of Public Works. Extensions must conform to the City's adopted design criteria, construction standards, and specifications, as shown in the City's Water System Standard Specifications and Drawings contained in **Appendix D**. All costs of the extension will be borne by the developer.
- Requests for new water service will be processed by the City's Finance Department and approved by the Public Works Director, in accordance with Kennewick Municipal Code 14.09.030. The City may require the applicant to provide construction plans signed and stamped by a professional engineer, licensed in Washington State. After the request for new water service and any required construction plans are received by the City, the location of the proposed service will be reviewed to ensure it is within the City's retail water service area. The location will also be evaluated to determine fire flow availability, meter size, and improvements necessary for adequate water pressure, fire flow, looping, or extensions. The adequacy of water system capacity to serve the applicant's property will also be evaluated at this time. New water service applications will be reviewed within 30 days of receipt of application and associated fees.
- The City will determine whether adequate water system capacity is available to serve the applicant's property, based on available capacity from supply, storage, and transmission. This will be accomplished through the ongoing tracking of equivalent residential units served by the City in comparison to the maximum number of equivalent residential units that can be served by the system, as computed in **Chapter 3** of this Water Comprehensive Plan (WCP).

- Water availability certifications will expire at the time that the associated building permit expires or in the event that the water service is not made ready by the applicant for connection to the City within 120 days of the approval of the application.
- Delays resulting from non-technical conditions that affect the City's ability to provide new water service will be the responsibility of the applicant. These conditions include, but are not limited to, environmental assessments, local ordinances, and annexation procedures.
- Water service to areas outside of the City's retail water service area boundary will be coordinated with adjacent water purveyors and the DOH, and evaluated on a case-by-case basis by the City Council. Water service to these areas shall be in compliance with the adopted land use plan, zoning, and development regulations for the area.

ANNEXATIONS

- Areas annexed without existing municipal supply will be served by the City.
- Areas annexed with existing municipal supply must meet the City's water standards.
- The City will follow State guidelines in the assumption of facilities in annexation areas.
- Service to areas outside of the City limits without annexation will be coordinated with adjacent water purveyors and evaluated on a case-by-case basis by the City Council.

TEMPORARY SERVICES

- Compliance with standards may be deferred for temporary water service.

EMERGENCY SERVICE

- Compliance with standards may be deferred for emergency water service, as reviewed and approved on a case-by-case basis by the Public Works Director.
- Policy criteria may be waived for emergency service.

PLANNING BOUNDARIES

- For planning purposes, the City will use water service boundaries established by agreement.
- The City will follow State of Washington guidelines in assuming portions of adjacent water systems as a result of annexation.

FINANCIAL POLICIES

The policies that guide the development of the Financial Plan in **Chapter 9** are contained in **Appendix #** of this WCP.

CONSTRUCTION STANDARDS

The City's construction standards are summarized in the section that follows and described in the Water System Standard Specifications and Drawings shown in **Appendix D**.

WSDOT STANDARD SPECIFICATIONS

The Washington State Department of Transportation (WSDOT) *Standard Specifications for Road, Bridge, and Municipal Construction* will supplement the City's construction standards.

PROJECT APPROVAL

Prior to construction of all water system projects and improvements, it is necessary to receive DOH approval of construction documents in accordance with WAC 246-290-120, except for those projects exempted under WAC 246-290-125. The City would like to retain eligibility for the submittal exception process for all distribution system related improvements, as well as transmission main, storage tank, and booster pump station improvements identified in this WCP. Pending DOH concurrence, the City would continue to be exempt from having to submit project reports and construction documents pending the approval of the standard construction details contained in **Appendix D** of this WCP. Current versions of the standard specifications and details are also available on the City's website.

PROJECT COMPLETION

Once construction of a water system project has been completed, a Construction Completion Report Form is required to be submitted to DOH within 60 days of completion and before use of any water system facility. For distribution system related improvements, the forms will not be submitted to the DOH, but will be kept on file and made available to the DOH upon request. The form shall be provided per WAC 246-290-040.

Additional criteria are contained in the City's Water System Standard Specifications and Drawings, a copy of which is included in **Appendix D** of this WCP.

8 | IMPROVEMENT PROGRAM

INTRODUCTION

This chapter presents proposed improvements to the City of Kennewick's (City) water system that are necessary to resolve existing system deficiencies and accommodate the projected growth of water customers. The water system improvements were identified following the water system analyses presented in **Chapter 3**. The water system improvements were sized to meet both the existing and future demand conditions of the system.

A Capital Improvement Program (CIP) number has been assigned to each improvement. Numbers were assigned to the improvements starting at the northeast end of the system and, in general, incrementally increase to the southwest. The proposed 6-year planning period improvements are shown in **Figure 8-1**, and the proposed 20-year planning period improvements are shown in **Figure 8-2**. The improvements are organized and presented in this chapter according to the following categories:

- Water System Improvements since the 2010 Water Comprehensive Plan (WCP);
- Water Main Improvements;
- Pressure Zone Improvements;
- Vista Field Emergency Supply Improvements;
- Pressure Reducing Valve (PRV) Improvements;
- Miscellaneous Improvements; and
- Developer-funded Improvements.

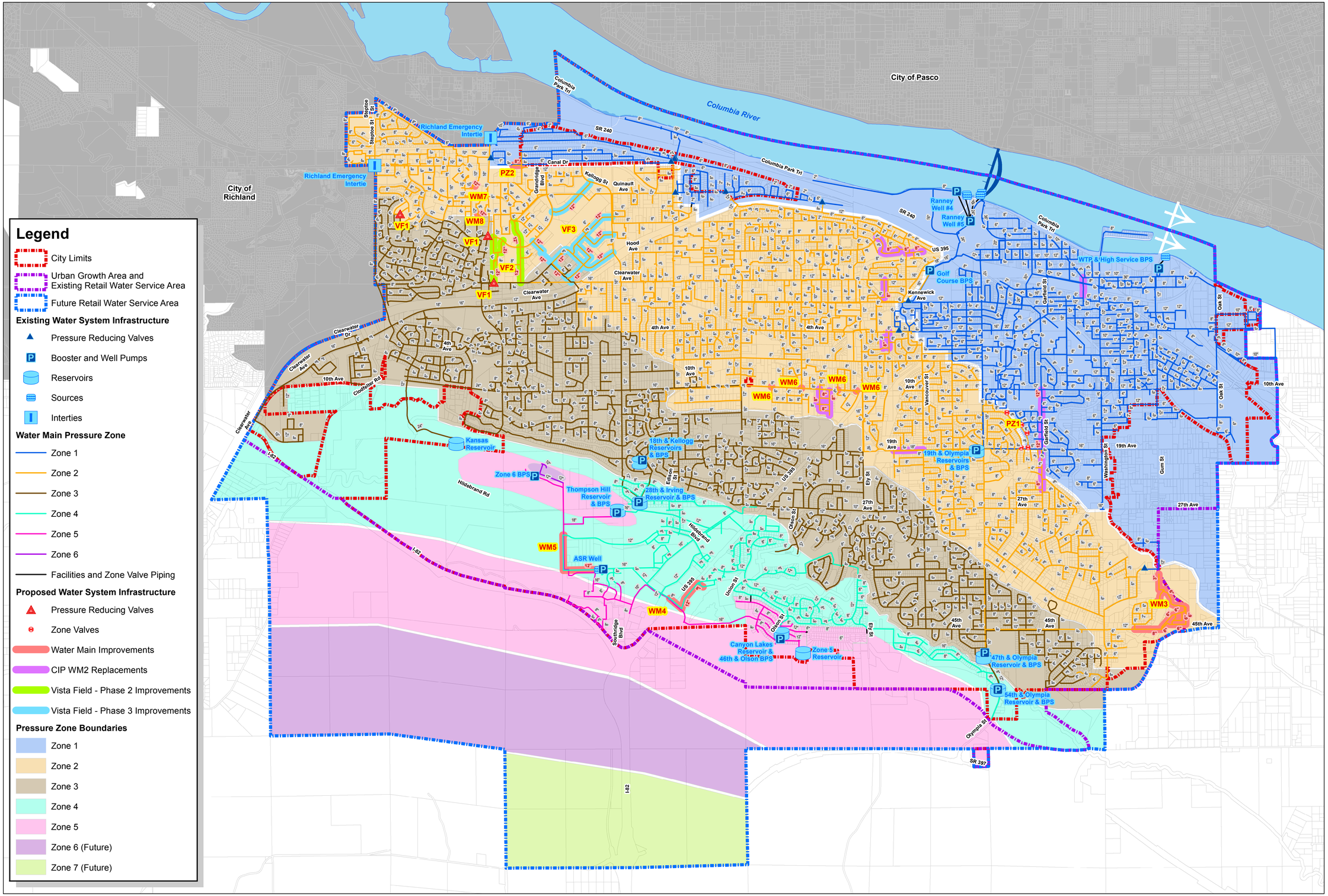
The remainder of this chapter presents a brief description of each group of improvements, the criteria for prioritizing, the basis for the cost estimates, and the schedule for implementation.

DESCRIPTION OF IMPROVEMENTS

This section provides a general description of each group of improvements and an overview of the deficiencies they will resolve. Most of the improvements are necessary to resolve existing system deficiencies. However, improvements have also been identified for some undeveloped areas to illustrate the major facilities that will be required when future development occurs in those areas. The costs associated with these improvements shall be borne by the developers, rather than the existing water customers. The locations of improvements in the undeveloped areas that are most likely to develop within the 20-year planning horizon are shown schematically in **Figure 8-2**. The CIP numbers for the developer-funded improvements have a "DF" prefix (example: DF1). The DF projects will most likely be altered to fit the layout of the future developments as necessary.

WATER SYSTEM IMPROVEMENTS SINCE THE LAST WCP

The water system has undergone changes since 2010, when the City last updated its WCP. **Table 8-1** lists the CIP projects that have been completed since the City's 2010 WCP. These projects have primarily consisted of large diameter transmission main, reservoirs, and booster pump stations (BPS) to support growth in the southern portion of the City's water service area. The City has also installed



Vicinity Map

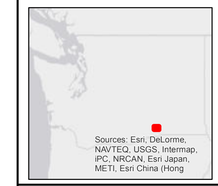


Figure 8-1
Proposed 6-Year (2021) Water System Improvements
City of Kennewick
2015 Water Comprehensive Plan

Coordinate System:NAD 1983 StatePlane Washington South FIPS 4602 Feet

By:rwithers

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KENNEWICK WASHINGTON

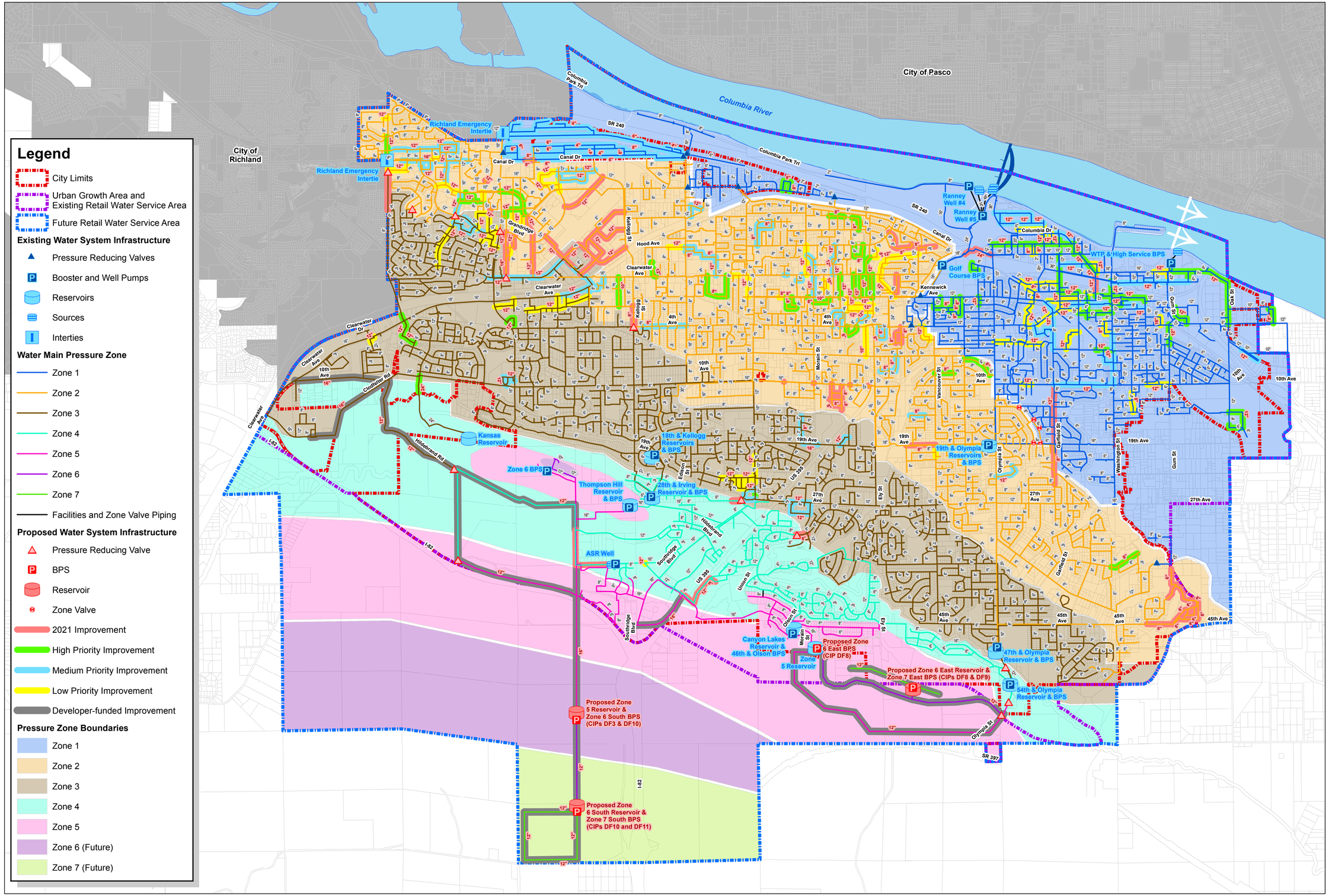
1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 8/10/2016

RH2 ENGINEERING

NORTH



Vicinity Map

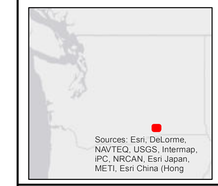


Figure 8-2
Proposed 20-Year (2035) Water System Improvements
City of Kennewick
2015 Water Comprehensive Plan

Coordinate System:NAD 1983 StatePlane Washington South FIPS 4602 Feet

By:rwithers

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KENNEWICK WASHINGTON

1 inch = 2,000 feet

0 1,000 2,000 4,000 Feet

Plot Date: 8/10/2016

RH2 ENGINEERING

NORTH

an aquifer storage recovery (ASR) well and has been performing operational and regulatory well testing since 2014.

Table 8-1
Improvements Completed Since 2010

Project Description	Size or Capacity	Length (feet)	Year
ASR Well	2,080 gpm	---	2014
Thompson Hill BPS	5,300 gpm	---	2015
Thompson Hill Reservoir	3.0 MG	---	2015
Zone 3 Railroad Crossing in Steptoe Street	8"	4,800	2013
Zone 4 Transmission Main	8", 12", 16"	10,600	2012-2014
Zone 5 Transmission Main	8", 12", 16", 18"	26,200	2011-2014
Zone 5 Reservoir	1.0 MG	---	2010
Zone 6 BPS	2,238 gpm	---	2014
Zone 6 Transmission Main	8", 12"	2,400	2014

WATER MAIN IMPROVEMENTS

The following water main improvements were identified from the results of the distribution and transmission system analyses discussed in **Chapter 3**. The water main improvements involve replacing existing distribution water main and constructing new water main to improve fire flow availability. The City has an annual water main replacement program and several high-priority water main replacement projects are grouped under Annual Fire Flow Deficiency Water Main Replacement Program projects (CIP WM1). The individual water main improvement projects within this group are numbered 1 through 154, as shown in **Figure 8-2**. Other significant water main improvement projects have been described individually and labeled as CIP WM2 through CIP WM8, also shown in **Figures 8-1** and **8-2**.

Future Water Main Extensions and Replacements

All new water main extensions and replacements shall be installed in accordance with the City's Standard Specifications and Drawings, which are contained in **Appendix D**. All new water main shall be cement-mortar lined ductile iron pipe. Polyvinyl chloride (PVC)-C900 may be approved by the City for mains 10-inches in diameter and smaller. All new water main shall be sized by a hydraulic analysis to ensure that all pressure, flow, and velocity requirements, as stated in **Chapter 7**, are met. In general, new water mains that will carry fire flow in residential areas shall be a minimum of 8 inches in diameter and looped for single-family transmission purposes. New water mains in commercial, high density (multi-family) residential, industrial, and school areas shall be a minimum of 12 inches in diameter and looped.

CIP WM1: Fire Flow Deficiency Water Main Replacement Program

Deficiency: The water main improvements shown in **Figure 8-2** are required to resolve existing system fire flow deficiencies caused primarily by undersized water mains. Many areas also contain non-standard water main materials.

Improvement: Replace existing water main with new ductile iron or PVC-C900 water main in accordance with the City's construction standards. The individual water main improvements grouped under this project are numbered 1, 2, 3, etc., as shown in **Figure 8-2**. The selection of

specific projects will be accomplished biennially during the City's budget development process and will be guided by the prioritization presented in the **Prioritizing Improvements** section in this chapter. This method for selecting projects provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area. An allowance of $750,000 per year ($1,500,000 per biennium) has been established for the replacement of undersized water mains during the initial 10-year planning period.

CIP WM2: Asbestos Cement, Galvanized, or Steel Water Main Replacement Program

Deficiency: Water mains constructed of non-standard water main materials (e.g., asbestos cement (AC), galvanized, or steel) are nearing the end of their useful life and have had a higher frequency of breaks or maintenance needs in the past 10 years.

Improvement: Replace existing water main constructed of non-standard materials that are adequately sized and therefore not included in CIP WM1. The selection of specific projects will be accomplished biennially during the City's budget development process. The highest priority AC, galvanized, and steel water main replacement projects, identified by the City's water system maintenance staff, are shown in **Table 8-2**.

Table 8-2
High Priority Non-standard Material Water Main Replacement Projects

CIP No.	Length (LF)	Diameter	Material	Location Description		
				In	From	To
MAT1	559	8"	Steel	W Grand Ronde Ave	N Yelm St	W Hood Ave
MAT2	787	8"	Steel	Parking Lot	~ W Kennewick Ave	W Clearwater Ave
MAT3	3,439	8"	AC, Steel	S Irby St	W 10th Ave	W 13th Ave
			AC, Steel	S Johnson St	W 10th Ave	W 13th Ave
MAT4	1,717	8"	Steel	W Grand Ronde Ave	W Grand Ronde Pl	N Conway Pl
			Steel	N Conway Pl	W Grand Ronde Ave	N Ely Pl
MAT5	786	12"	Steel	N Benton St	W Canal Dr	W Columbia Dr
MAT6	1,406	8"	Steel	S Buntin St	W 4th Ave	W 6th Ave
			Steel	W 6th Ave	S Buntin St	S Conway St
			Steel	S Conway St	W 6th Ave	S Buntin St
MAT7	1,313	8"	Steel	W 19th Ave	S Buntin St	S Vancouver St
MAT8	2,652	8", 12"	Steel	S Garfield St	W 10th Ave	W 19th Ave
MAT9	1,815	8"	AC	S Garfield St	W 19th Ave	W 24th Ave

Replacement of the high-priority, non-standard material water main is proposed to be accomplished within the 6-year planning period. Replacement of these mains with ductile iron or PVC-C900 main of the same capacity, or a minimum of 8-inch water main for existing smaller diameter water main, is estimated to cost $2,074,000. An allowance of $350,000 per year ($700,000 per biennium) has been established for the replacement of the high-priority, non-standard material water main to complete these replacements within the 6-year planning period.

Following replacement of the high-priority, non-standard material water main, approximately 104 miles of AC main, 5 miles of galvanized main, and 42 miles of steel main will remain in the City's water system. An allowance of $350,000 per year is proposed to continue through the 20-year planning period for replacement of non-standard material water main. This allowance will result in approximately 7 miles of water main replacement between the 7- and 20-year planning period, depending on the water main size and location of the specific projects identified biennially during the City's budget development process.

CIP WM3: Kennewick Irrigation District Elliot Lake Water System Acquisition

Deficiency: Kennewick Irrigation District (KID) currently owns and operates the Elliot Lake potable water system, located approximately 1,000 feet south of the intersection of Gum Street and Kingwood Street in the City's Zone 2 pressure zone. The City currently provides water service to the water system, which consists of approximately 48 single-family residences, through an existing intertie. KID desires to transfer ownership and operation responsibilities of the Elliot Lake water system to the City. Portions of the existing Elliot Lake distribution system are undersized, not looped, and do not meet the City's distribution system standards.

Improvement: Replace approximately 4,300 linear feet (LF) of existing 4-inch and smaller water main with 6-inch water main in the existing Elliot Lake water system. Install approximately 1,300 LF of 8-inch water main in the E. 45th Avenue extension to provide looped service to the existing Elliot Lake customers. This water main will be located within wetland areas immediately south of Elliot Lake, and may require special construction procedures and permitting requirements. Costs associated with these improvements will be paid by KID prior to the City's acquisition of the water system. Therefore, identification of the planning-level improvements necessary to upgrade the distribution system in this area are included in this WCP, but the costs of these improvements, which are estimated to be approximately $964,000 (in 2016 dollars) based on the unit costs presented in the **Estimating Costs of Improvements** section of this chapter, are not included in the proposed implementation schedule for future budgeting.

CIP WM4: Ridgeline Drive Highway 395 Crossing Water Main

Deficiency: A single 12-inch AC water main provides the only hydraulic connection to the Zone 4 distribution system on the west and east sides of Highway 395, limiting fire flow availability to existing Zone 4 customers.

Improvement: Install approximately 2,400 LF of 12-inch water main in S. Zintel Way and Ridgeline Drive, approximately between Christensen Road on the west side of Highway 395 and the existing commercial development near the intersection of S. Zintel Way and W. Hildebrand Drive on the east side of Highway 395. A Washington State Department of Transportation project is currently planned at the intersection of Ridgeline Drive and Highway 395, and it is recommended that these improvements be installed during this roadway improvement project.

CIP WM5: W. Hildebrand Avenue and Ridgeline Drive Dead-end Water Main Looping

Deficiency: Two existing dead-end mains are located in Zone 4 in W. Hildebrand Avenue and Ridgeline Drive, creating water quality deficiencies and restricting fire flow availabilities in the vicinity.

Improvement: Install approximately 1,600 LF of 12-inch water main in S. Sherman Street between W. Hildebrand Avenue and Ridgeline Drive, and approximately 1,850 LF of 12-inch water main in Ridgeline Drive between the ASR Well site and S. Sherman Street.

CIP WM6: W. 10th Avenue Parallel Main Connections

Deficiency: Parallel 8- and 12-inch water main are located in W. 10th Avenue that are not hydraulically connected between Highway 395 and S. Union Street, restricting fire flow availabilities in the vicinity.

Improvement: Provide connections between the existing parallel main at four locations, each requiring approximately 20 LF of 12-inch water main in W. 10th Avenue. The locations are as follows.

- Intersection of W. 10th Avenue and approximately S. Green Street.
- Intersection of W. 10th Avenue and S. Huntington Place.
- Intersection of W. 10th Avenue and S. Moran Street.
- Intersection of W. 10th Avenue and S. Reed Street.

CIP WM7: Columbia Center Mall Loop

Deficiency: Two existing 10-inch-diameter AC dead end main are located on the southeast side of the Columbia Center Mall, restricting fire flow availabilities in the vicinity.

Improvement: Install approximately 130 LF of 12-inch water main in the Columbia Center Mall parking lot to loop the existing water main.

CIP WM8: Red Lion Hotel Loop

Deficiency: Two existing 8-inch-diameter AC dead-end mains are located on the southwest side of the Red Lion Hotel, restricting fire flow availabilities in the vicinity.

Improvement: Install approximately 40 LF of 12-inch water main in the Red Lion Hotel parking lot to loop the existing water main.

CIP WM9: Entiat Avenue to Canal Drive Water Main

Deficiency: A 12-inch-diameter steel main has failed beneath the canal and railroad easements northeast of Canal Drive, near the Tri-City Country Club, leaving a 16-inch-diameter ductile iron main as the primary conveyance route between the City's existing sources and the Golf Course BPS.

Improvement: Abandon the existing 16-inch-diameter ductile iron main and install approximately 1,000 LF of 24-inch water main beneath the canal and railroad easements, between Palouse Street and Canal Drive. Alignment alternatives will be evaluated during the predesign phase of the improvement to minimize the number of canal and railroad crossings. This project has been previously identified by the City, and has been funded within the current biennium.

CIP WM10: 20th Avenue Zone 3 Connection

Deficiency: No water main currently exists in W. 20th Avenue between S. Buchanan Street and S. Arthur Street.

Improvement: Install approximately 550 LF of 8-inch water main in W. 20th Avenue to connect the existing Zone 3 water main and significantly improve fire flow availability in the vicinity.

CIP WM11: Tri-City Heights Water Main Replacement

Deficiency: Water main in the Tri-City Heights area, which is located outside the City limits but is served by the City's water system, is undersized, is constructed of non-standard materials, and is primarily located within easements with difficult access for the City's operations and maintenance staff.

Improvement: Install approximately 36,400 LF of new water main in the Tri-City Heights area that meets the City's current design standards. The majority of the new water main shall be 8-inch-diameter ductile iron water main. All new water main and customer water meters shall be located within public rights-of-way. The City tentatively plans to construct these improvements to coincide with a future possible annexation of the area. The schedule for this annexation, if it were to occur, is unknown.

PRESSURE ZONE IMPROVEMENTS

The following pressure zone improvements are proposed in areas of the City's water service that do not meet the City's pressure standards and will improve low pressure problem areas throughout the water system. A brief description of the existing deficiency and proposed improvement for each project are provided below.

CIP PZ1: Conversion of Zone 1 to Zone 2 near W. Park Hills Drive

Deficiency: As shown in **Table 3-18** of **Chapter 3**, existing customers in the higher elevations of Zone 1 near W. Park Hills Drive have low pressure. These pressures are below the Washington State Department of Health (DOH) minimum requirement of 30 pounds per square inch (psi).

Improvement: Convert the existing Zone 1 customers on S. Jean Street, S. Ione Street, and W. 14th Avenue to Zone 2 to resolve the low pressures in this area. Open an existing in-line zone valve located approximately at 1130 W. 14th Avenue. Install and close an 8-inch-diameter valve in W. Park Hills Drive between S. Ione Street and S. Ione Place.

Close the following existing in-line valves, creating a hydraulic boundary between Zones 1 and 2. If a valve does not exist in these locations, install a closed valve at these locations.

- 1016 W. 14th Avenue.
- Eastside of intersection of S. Ione Street and W. 17th Avenue.
- Northside of intersection of S. Jean Street and W. 19th Avenue.
- Northside of intersection of S. Ione Street and W. 19th Avenue.

CIP PZ2: Conversion of Zone 1 to Zone 2 near Vista Elementary

Deficiency: As shown in **Table 3-20** of **Chapter 3**, minimal fire flow is available at Vista Elementary.

Improvement: Confirm the actual fire flow requirements of the building and the location(s) at which the fire flow is required. For the purposes of this analysis, approximately 390 LF of 8-inch-diameter dead-end water main is proposed to be installed in W. Umatilla Avenue, connecting to existing 8-inch-diameter Zone 2 water main in N. Young Street. This improvement increases the fire flow availability at Vista Elementary to 1,294 gallons per minute (gpm) based on analyses performed for the 6-year planning-period. This represents an increase of 1,229 gpm compared to the 65 gpm available based on the existing system configuration.

CIP PZ3: Conversion of Zone 4 to Zone 5 in S. Olympia Street

Deficiency: As shown in **Table 3-14** of **Chapter 3**, dead storage currently exists in Zone 4, and the zone is projected to have a slight storage deficiency in the 20-year planning period.

Improvement: Following completion of CIP DF6, convert approximately 600 LF of existing dead-end Zone 4 water main in S. Olympia Street to Zone 5. This improvement will reduce the highest Zone 4 service elevation from 846 feet to 808 feet, eliminating Zone 4 dead storage and the projected storage deficiency in the 20-year planning period. An 8-inch PRV is proposed as part of this improvement to have a set point of 905 feet HGL (43 psi) to provide emergency supply to Zone 4. It is recommended that this project take place at the same time as, or immediately following completion of, CIP DF6.

VISTA FIELD EMERGENCY SUPPLY IMPROVEMENTS

Vista Field is located in the western portion of Zone 2, and primarily consists of commercial and industrial land uses. The City anticipates significant growth will occur at Vista Field within the 6-year planning period. Transmission capacity to Vista Field is currently limited to three existing transmission mains that cross the Central Washington Railroad. Three improvement phases have been identified to increase the fire flow availability throughout Vista Field to meet the 4,000 gpm commercial, and 5,000 gpm industrial planning-level fire flow requirements.

CIP VF1: Vista Field – Phase 1 Improvements

Improvement: Install pressure reducing valve (PRV) stations at three locations between Zones 3 and 2 to provide additional supply to the western portion of Zone 2 during emergency conditions. These PRVs will also maintain pressures above 20 psi throughout Zone 2 during emergency conditions. The recommended location, size, and set points for the proposed PRV stations are as follows.

- Intersection of W. Deschutes Avenue and N. Colorado Street
  - Size: 12-inch PRV
  - Set point hydraulic grade line (HGL): 634 feet (approximately 35 psi)
- Intersection of N. Columbia Center Boulevard and W. Grandridge Boulevard
  - Size: 12-inch PRV
  - Set point HGL: 615 feet (approximately 37 psi)
- Near N. Oklahoma Place cul-de-sac
  - Size: 8-inch PRV
  - Set point HGL: 623 feet (approximately 35 psi)

CIP VF2: Vista Field – Phase 2 Improvements

Improvement: Replace approximately 6,400 LF of existing 8-inch-diameter water main with 12- and 16-inch-diameter water main. A summary of the proposed improvements are shown in **Table 8-3**.

Table 8-3
Vista Field – Phase 2 Improvements

CIP No.	Length (LF)	Existing Diameter	Proposed Diameter	Location Description		
				In	From	To
VF2A	1,236	8"	12"	N Young St	W Grandridge Blvd	W Okanogan Pl
VF2B	1,580	8"	12"	N Young St	W Deschutes Ave	W Grandridge Blvd
VF2C	2,035	8"	12", 16"	N Colorado St	W Deschutes Ave	W Grandridge Blvd
VF2D	1,522	8"	12"	Hood Pl and Parking Lots	N Colorado St	W Grandridge Blvd

CIP VF3: Vista Field – Phase 3 Improvements

Improvement: Replace approximately 14,000 LF of existing 8-inch-diameter water main with 12-inch-diameter water main. Install approximately 800 LF of 12-inch-diameter water main to loop the water main between the east and west sides of Vista Field. A summary of the proposed improvements are shown in **Table 8-4**.

Table 8-4
Vista Field – Phase 3 Improvements

CIP No.	Length (LF)	Existing Diameter	Proposed Diameter	Location Description		
				In	From	To
VF3A	2,173	8"	12"	Vista Field Loop	W Deschutes Ave	W Grandridge Blvd
VF3B	1,204	8"	12"	N Quay St	Railroad	W Deschutes Ave
VF3C	3,495	8"	12"	W Deschutes Ave	N Kellogg St	N Quay St
VF3D	1,319	8"	12"	W Hood Pl	W Okanogan Ave	N Quay St
VF3E	2,595	8"	12"	W Okanogan Ave	N Kellogg St	W Deschutes Ave
VF3F	2,249	8"	12"	W Rio Grande Ave	N Kellogg	W Grandridge Blvd
VF3G	1,553	8"	12"	W John Day Ave	N Kellogg St	W Okanogan Ave
VF3H	953	8"	12"	N Quay St	N Quay St	W Deschutes Ave

PRESSURE REDUCING VALVE STATION IMPROVEMENTS

The following PRV station improvements were identified to resolve existing system deficiencies.

CIP PRV1: S. Kellogg Street and W. 4th Avenue PRV Station (Zone 3 to Zone 2 PRV)

Deficiency: Some of the highest Zone 2 elevations exist in neighborhoods south of W. 4th Avenue and experience pressures at or near 20 psi during Zone 2 fire flow conditions.

Improvement: Install a PRV station at the intersection of S. Kellogg Street and W. 4th Avenue to maintain pressures above 20 psi at the Zone 2 high elevations during fire flow conditions. An 8-inch PRV is proposed to have a set point of 630 feet HGL (30 psi).

As part of this improvement, approximately 925 LF of existing 6-inch-diameter steel water main is recommended to be replaced with 8-inch water main in S. Kellogg Street, between W. 4th Avenue and W. 1st Avenue, to adequately convey flow through the proposed PRV into the Zone 2 distribution system.

CIP PRV2: N. Steptoe Street and Gage Boulevard PRV Station (Zone 3 to Zone 2 PRV)

Deficiency: As growth occurs in Zone 2, additional transmission capacity to the western portion of the pressure zone is needed to meet the domestic and fire flow demands of the pressure zone.

Improvement: Install a PRV station at the intersection of N. Steptoe Street and Gage Boulevard. A 12-inch PRV is proposed to have a set point of 630 feet HGL (50 psi).

Approximately 1,725 LF of 12-inch-diameter water main is required to connect the existing Zone 3 water main in N. Steptoe Street to the proposed PRV.

CIP PRV3: Low Zone 3 Services Residual Pressure Improvements (Zone 4 to Zone 3 PRVs)

Deficiency: The high elevations of Zone 3 located in the commercial area near the intersection of Southridge Boulevard, W. 27th Avenue, and S. Union Street experience pressures at or near 20 psi during Zone 3 fire flow conditions.

Improvement: Install PRV stations at two locations between Zones 4 and 3 to provide pressures in excess of 20 psi throughout Zone 3 during emergency conditions. The recommended location, size, and set points for the proposed PRV stations are as follows. Water main extensions are required to connect the existing Zone 4 water main to the proposed PRV locations. The length and recommended size of the water main improvements are also included below.

- Intersection of W. 27th Avenue and Creekstone Drive
  - Size: 12-inch PRV
  - Set point HGL: 745 feet (approximately 31 psi)
  - Water main: Approximately 530 LF of 12-inch diameter
- In W. Canyon Lakes Drive
  - Size: 8-inch PRV
  - Set point HGL: 754 feet (approximately 31 psi)
  - Water main: Approximately 475 LF of 8-inch diameter

CIP PRV4: Low Zone 3 Hydrant Residual Pressure Improvements (Zone 4 to Zone 3 PRV)

Deficiency: Existing hydrants located at the high elevations of Zone 3 in S. Olympia Street on the transmission main connecting the 54th and Olympia Reservoir to the Zone 3 distribution system experience pressures at or near 20 psi during Zone 3 fire flow conditions.

Improvement: Install a PRV station at the intersection of W. 52nd Avenue and S. Olympia Street. An 8-inch PRV is proposed to have a set point of 744 feet HGL (25 psi). Due to the proximity of Zone 3 and Zone 4 water main at this location, minimal water main improvements are anticipated as part of this improvement project.

FACILITY IMPROVEMENTS

The following water system improvement was identified to resolve future system deficiencies due to projected growth, as presented in **Chapter 3**.

CIP F1: Water Treatment Plant Expansion

Deficiency: The City does not currently have sufficient source capacity to meet the projected demands of the 20-year planning period.

Improvement: The City's existing water treatment plant (WTP) has a maximum capacity of 15 million gallons per day (MGD), but has been designed to be expanded to a maximum capacity of 30 MGD. Although the City's projected 20-year source capacity deficiency is less than 1 MGD with the ASR Well operating at 2,080 gpm (3 MGD), the *2016 Regional Water Supply Feasibility Study* identified an 8 MGD deficiency in the 50-year planning period. Therefore, the WTP is proposed to be expanded to 23 MGD for the purposes of these analyses. The proposed 8 MGD expansion is assumed to utilize membrane filtration to match the treatment method at the existing WTP.

The following improvements are anticipated to increase the treatment capacity to 23 MGD, with some improvements sized to meet a future WTP capacity of 30 MGD, where applicable.

- Installation of a new 15 MGD screen in the Columbia River.
- Increase the intake siphon piping capacity to 30 MGD.
- Replace two existing 3,000 gpm (25 HP) low lift pumps and motors with two 5,300 gpm (40 HP) pumps and motors.
- Construct three additional pretreatment trains in parallel with the two existing pretreatment trains.
- Construct additional membrane basins and membrane equipment with a capacity of 10 MGD (existing basins have 20 MGD capacity, but the City has only purchased 15 MGD of membrane capacity).
- Purchase and install 8 MGD of membrane capacity.
- Construct a 15 MGD clearwell adjacent to the existing clearwell. Modify existing piping to allow existing and proposed clearwells to operate in series.
- Replace two existing 3,000 gpm (250 HP) high service pumps and motors with two 5,300 gpm (400 HP) pumps and motors.
- Increase the capacity of the filter waste washwater system to meet a future WTP capacity of 30 MGD.

Electrical and control improvements, and improvements to other ancillary equipment will also be required. For the purposes of these analyses, it is assumed that the existing WTP operations building and site access, both of which were modified during a previous WTP expansion, are sufficient to accommodate a treatment capacity increase to 30 MGD. It is recommended that the City confirm the necessary improvements during the predesign phase of this project. Permitting costs have been estimated as part of this improvement, but are highly variable due to the number of regulatory agencies that are anticipated to be involved with this project. The permitting, construction, and indirect costs presented for this project are for planning purposes only, and are recommended to be confirmed during the predesign phase of this project.

CIP F2: 18th and Kellogg (10 MG) Reservoir Improvements

Deficiency: Peterson Structural Engineers, Inc., (Peterson) performed a visual condition assessment and structural evaluation of the reservoir in 2014, and found significant defects and vulnerabilities. A summary of the defects and vulnerabilities is presented in **Chapter 3**, which include shrinkage cracking, roof slab deflection and cracking, concrete slab reinforcing strength deficiencies, and inadequate bearing pad thickness.

Improvement: Peterson's evaluation recommended improvements to either remediate or replace the reservoir. The remediation recommendation includes replacement of the roof slab, columns,

slab footings, and the reservoir wall base connection, and includes replacement or repair of the reservoir's internal piping and appurtenances. The replacement recommendation includes construction of a new 10.0 MG prestressed concrete reservoir with a membrane floor slab.

Peterson estimated the planning-level cost for the remediation and replacement recommendations to be $4,740,000 and $6,250,000, respectively. The City is currently evaluating the improvements to proceed with for the 18th and Kellogg reservoir, but will fund the improvements from the operations and maintenance budget. Due to the applicability of this improvement to the WCP, it has been included here for reference.

MISCELLANEOUS IMPROVEMENTS

The following miscellaneous improvements are planning efforts and program elements that are required to comply with various Washington State water regulations.

CIP M1: Water Comprehensive Plan Update

Deficiency: The Washington Administrative Code (WAC) 246-290-100 requires that the City's WSP be updated every 6 years and submitted to the DOH for approval. It is anticipated that WCP updates will only be required every 10 years in the future.

Improvement: Update the WCP every 10 years or as required by DOH.

CIP M2: Annual Customer Meter Replacement Program

Deficiency: Individual service meters need to be replaced when they reach the end of their service life or are determined to be malfunctioning.

Improvement: Replace approximately 500 customer meters each year as the meters reach the end of their service life. This is an ongoing program to ensure accurate measuring of water usage in the system.

CIP M3: Water Use Efficiency Program

Deficiency: Several Water Use Efficiency (WUE) measures must be carried out on an ongoing basis to comply with WUE requirements, including customer education, meter calibration, and replacement.

Improvement: The City will continue to perform ongoing WUE measures, as outlined in the Water Use Efficiency Program included in **Chapter 4**.

CIP M4: Redundant Pumps and Motors

Deficiency: As the City's water system grows, it will become increasingly reliant upon the pumping equipment at each pumping facility. Many of the pumps and motors in the City's water system are custom-sized for the current application, and have multiple-week lead times in the event that the equipment fails beyond repair and the City is in need of a new pump or motor.

Improvement: The City will endeavor to purchase a redundant pump and motor sufficiently sized to replace the most critical pump in each pressure zone, which is typically the pump with the greatest pumping capacity. The City is funding the purchase of the redundant pumping equipment from the operations and maintenance budget, but due to the applicability of this improvement to the WCP, it has been included here for reference.

CIP M5: Emergency Portable Generators

Deficiency: Of the City's existing pumping facilities, only the City's 46th and Olson BPS (Canyon Lakes BPS) and the Zone 6 BPS have permanent emergency generators. The City's water department has a limited number of portable emergency generators, none of which have sufficient capacity to power any of the City's existing pumping facilities at their full pumping rate.

Improvement: The City will endeavor to purchase multiple emergency portable generators to allow source facilities and BPSs to pump a sufficient volume of water to each pressure zone in the event of a prolonged power outage. The minimum pumping requirements through the 20-year planning period for each pressure zone are presented in **Chapter 3** of this WCP. The City will evaluate the generator sizing requirements based on these pumping requirements, and will make a policy decision regarding the number of emergency portable generators needed to meet various emergency scenarios. The City is funding the purchase of the emergency portable generators from the operations and maintenance budget, but due to the applicability of this improvement to the WCP, it has been included here for reference.

CIP M6: Pump and Motor Condition Assessment

Deficiency: The wire-to-water efficiency, energy signature, and vibration characteristics of the pumps and motors in each of the City's pumping facilities was evaluated in October 2015. It is recommended that the condition of each pump and motor be retested and reevaluated every 3 to 5 years, using the data collected in October 2015 as a baseline to evaluate pump and motor degradation over the service life of the equipment.

Improvement: Assess the condition of each pump and motor in 2019 or 2020. Funding for the testing and evaluation will be provided from the City's operations and maintenance budget, but due to the applicability of this improvement to the WCP, it has been included here for reference.

DEVELOPER-FUNDED IMPROVEMENTS

The following water system facility improvement primarily consist of costs borne by developers, rather than the existing water customers, unless over-sizing the improvements provides benefit to the existing customers. Improvements have been identified for the areas mostly likely to develop within the City's water service area within the 20-year planning horizon. The improvements listed illustrate the major facilities that will be required to properly serve those areas. The locations of the facilities are shown schematically in **Figure 8-2**.

CIP DF1: Future Development Benefit to Existing Customers

Deficiency: Future improvements constructed for new developments may provide benefit to existing water customers. Examples of benefits include improved water quality, redundancy, and fire flow availability.

Improvement: As water system improvements are designed and constructed for new developments, determine the benefit to existing water customers, if any. An allowance of $1,130,000 per year has been estimated to be attributed to providing benefit to existing customers for each year within the 10-year planning period. The resulting 10-year total cost is equivalent to 5 percent of the total estimated cost of the developer-funded improvements presented in this chapter.

CIP DF2: Southwest Zone 5 Water Main

Deficiency: Development that occurs in the currently vacant land in the southwest portion of the City's water service area will require 12- and 16-inch water main to be extended from the existing Zone 5 transmission system at the intersection of S. Sherman Street and Ridgeline Drive.

Improvement: Upon further development of the adjacent properties, install 12- and 16-inch water main from the intersection of S. Sherman Street and Ridgeline Drive to the existing canal approximately 1,400 feet south (12-inch-diameter water main), and from this point, west approximately 5,500 feet (16-inch-diameter water main). A PRV station is proposed at this location to provide supply to future Zone 4 water customers, and is described in CIP DF4.

CIP DF3: Proposed Zone 5 Reservoir and Water Main

Deficiency: Development that occurs in the currently vacant land in the southwest portion of the City's water service area served by the proposed water main described in CIP DF2, will require a future Zone 5 Reservoir to provide storage for the proposed development.

Improvement: Upon further development of the adjacent properties and completion of CIP DF2, install approximately 5,300 LF of 16-inch water main to connect the future development to a proposed Zone 5 Reservoir. The reservoir will have capacity to satisfy the DOH storage component requirements for the operating area, which is estimated to have a 0.97 million gallon (MG) deficiency in the 20-year planning period, as shown in **Table 3-15** of **Chapter 3**. With consideration to additional demands between the 20-year planning period and buildout, a 1.5 MG reservoir has been proposed for the purposes of this analysis. The actual reservoir capacity and configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served.

CIP DF4: Zone 4 Water Main and PRV Station

Deficiency: Development that occurs in the currently vacant land in the southwest portion of the City's water service area that is located at elevations too low to be served by the proposed Zone 5 water main described in CIP DF2, will require 12-inch water main to be extended from the existing Zone 4 transmission system in S. Sherman Street and the westernmost water main of the proposed CIP DF2 Zone 5 water main.

Improvement: Upon further development of the adjacent properties, install approximately 11,000 LF of 12-inch water main in S. Sherman Street, Bob Olson Parkway, and currently vacant land. A 12-inch PRV is proposed to have a set point of 895 feet HGL to reduce the pressure from the Zone 5 water main (CIP DF2).

CIP DF5: Zone 3 Water Main and PRV

Deficiency: Development that occurs in the currently vacant land in the southwest portion of the City's water service area that is located at elevations too low to be served by the proposed Zone 4 water main described in CIP DF4, will require 12-inch water main to be extended from the proposed Zone 4 transmission system located south of the City's existing Zone 3 Kansas Reservoir.

Improvement: Upon further development of the adjacent properties, install approximately 6,000 LF of 12-inch water main in Bob Olson Parkway. A 12-inch-diameter PRV is proposed in W. Hildebrand Road to provide supply to future Zone 3 water customers from the proposed Zone 4 water main described in CIP DF4. A 12-inch PRV is proposed to have a set point of 760 feet HGL to reduce the pressure from the Zone 4 water main (CIP DF4).

CIP DF6: Zone 3 Clodfelter Road and W. 10th Avenue Water Main

Deficiency: Development that occurs adjacent to S. Clodfelter Road and adjacent to W. 10th Avenue between W. Clearwater Avenue and S. Clodfelter Road will require 16-inch water main to be extended from the existing Zone 3 transmission system at the roundabout at the intersection of W. 10th Avenue, S. Clodfelter Road, and Bob Olson Parkway.

Improvement: Upon further development of the adjacent properties, install approximately 8,700 LF of 16-inch water main in S. Clodfelter Road and W. 10th Avenue. This proposed water main will eliminate an existing dead-end water main and provide looped supply to existing Zone 3 customers located near the intersection of W. Clearwater Avenue and Ridgeline Drive, improving water quality and fire flow availability in this portion of the distribution system.

CIP DF7: Southeast Zone 5 Water Main

Deficiency: Development that occurs in the currently vacant land in the southeast portion of the City's water service area will require 12-inch water main to be extended from the existing Zone 5 transmission system.

Improvement: Upon further development of the adjacent properties, install approximately 13,000 LF of 12-inch water main from the existing Zone 5 Reservoir site to approximately S. Olympia Street, and connect to the proposed PRV described in CIP DF8. This proposed PRV will provide looped emergency supply to the proposed Zone 5 water main. The layout of the water main will be determined in the future by the location of roadways for the new development.

CIP DF8: Zone 6 East Booster Pump Station, Reservoir, PRV, and Water Main

Deficiency: Development that occurs in the currently vacant land in the southeast portion of the City's water service area will not be adequately served by the proposed Zone 5 water main extension (CIP DF7).

Improvement: Install a new pump station at the existing Zone 5 Reservoir site to provide domestic and fire flow supply for the proposed development, and a new Zone 6 East Reservoir to provide storage for the proposed development. Install water main as needed to adequately provide supply to the proposed development, which is assumed to be approximately 10,600 LF of 12-inch diameter for the purposes of this analysis. The layout of the water main will be determined in the future by the location of roadways for the new development. A 12-inch PRV is proposed to be located at the eastern extent of the proposed water main, approximately in S. Olympia Street, to eliminate a long dead-end main within the Zone 6 piping and provide looped emergency supply to the proposed Zone 5 water main improvements described in CIP DF7.

The pump station will have a maximum capacity to satisfy the largest fire flow requirement and peak water demand of the operating area, estimated at approximately 1,300 gpm, which includes Zone 6 and a future Zone 7 described in CIP DF9. The recommended pump arrangement is two smaller pumps for providing domestic service and one larger pump to provide fire flow and peak demand supply. The actual pump capacities and final configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. The proposed BPS shall be equipped with a permanent emergency power supply.

The reservoir will have a capacity to satisfy DOH storage component requirements for the operating area, estimated to be 0.64 MG in the 20-year planning period. With consideration to additional demands between the 20-year planning period and buildout, a 0.75 MG reservoir has been proposed for the purposes of this analysis. The actual reservoir capacity and configuration will be determined

during the preliminary design phase of the project when more information is available about the area to be served.

CIP DF9: Zone 7 East Booster Pump Station and Water Main

Deficiency: Development that occurs in the highest elevations of the currently vacant land in the southeast portion of the City's water service area will not be adequately served by the proposed Zone 6 water main extension (CIP DF8).

Improvement: Install a new pump station to provide domestic and fire flow supply for the proposed development. Install water main as needed to adequately provide supply to the proposed development, which is assumed to be approximately 4,200 LF of 12-inch diameter for the purposes of this analyses. The layout of the water main will be determined in the future by the location of roadways for the new development.

The pump station will have a maximum capacity to satisfy the largest fire flow requirement and peak water demand of the zone, estimated at approximately 1,200 gpm. The recommended pump arrangement is two smaller pumps for providing domestic service and one larger pump to provide fire flow and peak demand supply. The actual pump capacities and final configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. The proposed BPS shall be equipped with a permanent emergency power supply.

CIP DF10: Zone 6 South Booster Pump Station, Reservoir, and Water Main

Deficiency: Development that occurs in the currently-vacant land in the southwest portion of the City's water service area will not be adequately served by the proposed Zone 5 Reservoir and water main extension (CIP DF3).

Improvement: Install a new pump station at the proposed Zone 5 Reservoir site to provide domestic and fire flow supply for the proposed development, and a new Zone 6 South Reservoir to provide storage for the proposed development. Install water main as needed to adequately provide supply to the proposed development, which is assumed to be approximately 4,500 LF of 12-inch diameter for the purposes of this analysis. The layout of the water main will be determined in the future by the location of roadways for the new development.

The pump station will have a maximum capacity to satisfy the largest fire flow requirement and peak water demand of the operating area, estimated at approximately 1,200 gpm, which includes Zone 6 and a future Zone 7 described in CIP DF11. The recommended pump arrangement is two smaller pumps for providing domestic service and one larger pump to provide fire flow and peak demand supply. The actual pump capacities and final configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. The proposed BPS shall be equipped with a permanent emergency power supply.

The reservoir will have a capacity to satisfy DOH storage component requirements for the operating area, estimated to be 0.64 MG in the 20-year planning period. With consideration to additional demands between the 20-year planning period and buildout, a 0.75 MG reservoir has been proposed for the purposes of this analysis. The actual reservoir capacity and configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served.

CIP DF11: Zone 7 South Booster Pump Station and Water Main

Deficiency: Development that occurs in the highest elevations of the currently vacant land in the southwest portion of the City's water service area will not be adequately served by the proposed Zone 6 water main extension (CIP DF10).

Improvement: Install a new pump station to provide domestic and fire flow supply for the proposed development. Install water main as needed to adequately provide supply to the proposed development, which is assumed to be approximately 9,200 LF of 12-inch diameter for the purposes of this analyses. The layout of the water main will be determined in the future by the location of roadways for the new development.

The pump station will have a maximum capacity to satisfy the largest fire flow requirement and peak water demand of the zone, estimated at approximately 1,200 gpm. The recommended pump arrangement is two smaller pumps for providing domestic service and one larger pump to provide fire flow and peak demand supply. The actual pump capacities and final configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. The proposed BPS shall be equipped with a permanent emergency power supply.

CIP DF12: Christenson Road Water Main

Deficiency: Development that occurs in the currently vacant land adjacent to Christenson Road, between Southridge Boulevard and Ridgeline Drive will require 16-inch water main to be extended from the existing Zone 5 transmission system.

Improvement: Upon further development of the adjacent properties, install approximately 2,600 LF of 16-inch water main in Christenson Road, between the existing Zone 5 transmission main in Southridge Boulevard and Ridgeline Drive.

ESTIMATING COSTS OF IMPROVEMENTS

Project costs for the proposed improvements are presented in second quarter 2016 dollars and include the estimated construction cost of the improvement and indirect costs estimated at 35 percent of the construction cost for engineering preliminary design, final design, and construction management, permitting, legal, and administrative services. The project cost estimates include a 20-percent contingency and sales tax of 8.6 percent, and are shown for each water main diameter in **Table 8-5**. Construction cost estimates for water main projects were determined from the water main unit costs (i.e., cost per linear foot) shown in **Table 8-5** and the proposed diameter and approximate length of each improvement.

Table 8-5
Water Main Unit Costs

Water Main Diameter (inches)	Project Cost Per Foot Length (2016 $/LF)
6	$162
8	$167
10	$171
12	$173
16	$183
20	$194
24	$202

The unit costs for each water main size are based on estimates of all construction related improvements, such as materials and labor for the water main installation; water services; fire hydrants; fittings; valves; connections to the existing system; trench restoration; asphalt surface restoration; and other work for a complete installation. Additional costs were added to some water main improvements to cover anticipated increased costs related to the project location and degree of difficulty.

PRIORITIZING IMPROVEMENTS

The water system improvements were prioritized from established criteria to identify projects with the most deficiencies and greatest need for improvement. A description of the criteria and method for prioritizing each category of improvements is provided in the following section.

WATER MAIN IMPROVEMENTS

Table 8-6 lists criteria that were established for prioritizing the water main improvements. The criteria are based on the underlying deficiencies of the existing water main that will be replaced by the proposed improvements. The criteria are arranged in five different categories with a weight factor assigned to each category. The Existing Water Main Maintenance/Breaks and the Existing Water Main Fire Flow Capability categories were given the most weight.

Table 8-6
Water Main Improvements Priority Ranking Criteria

Points	Category	Weight Factor	Weighted Points
	Existing Water Main Maintenance/Breaks		
5	High Maintenance Requirements/High Frequency of Recent Breaks	3	15
3	Annual Maintenance/Recent History of Breaks	3	9
0	No Maintenance and No History of Problems	3	0
	Existing Water Main Fire Flow Capability		
5	Derated Fire Flow is 59% or less of Required Fire Flow	3	15
4	Derated Fire Flow is 60-69% of Required Fire Flow	3	12
3	Derated Fire Flow is 70-79% of Required Fire Flow	3	9
2	Derated Fire Flow is 80-89% of Required Fire Flow	3	6
1	Derated Fire Flow is 90-99% of Required Fire Flow	3	3
0	Derated Fire Flow is 100% of Required Fire Flow	3	0
	Existing Water Main Material		
5	Galvanized or Steel	2	10
4	Asbestos Cement	2	8
3	Copper or Unknown	2	6
2	HDPE	2	4
1	Cast Iron	2	2
0	Ductile Iron or PVC	2	0
	Existing Water Main Year of Installation		
5	Before 1950	2	10
4	1950-1959	2	8
3	1960-1969	2	6
2	1970-1979	2	4
1	1980-1989	2	2
0	After 1989	2	0
	Existing Water Main Benefit Area[1]		
5	Large Benefit Area (greater than 500 gpm)	1	5
4	Large Area Served (250 to 500 gpm)	1	4
3	Medium to Large Area Service (100 to 250 gpm)	1	3
2	Medium Area Served (50 to 100 gpm)	1	2
1	Small to Medium Area Served (25 to 50 gpm)	1	1
0	Small or Localized Area Served (less than 25 gpm)	1	0

(1) Flows based on existing maximum day demands.

The Existing Water Main Maintenance/Breaks category ranks the water main improvements based on the number of reported leaks, breaks, or maintenance required by the City since 2012. The Existing Water Main Fire Flow Capability category ranks the water main improvements based on the ability of the existing water mains to provide the required fire flow, as determined from the results of the hydraulic analyses addressed in **Chapter 3**. The Existing Water Main Material category ranks the water main improvements based on the material of the existing water main. The Existing Water Main Year of Installation category ranks the water main improvements based on the age of

the existing water main. The Existing Water Main Benefit Area category ranks the water main improvements based on the size of the area that will benefit from the water main replacement.

The water main priority ranking criteria was applied to the water main replacement projects, which are listed as CIP 1 through CIP 154. The water main replacement projects are presented in **Table 8-7** with their priority ranking, and are also shown in **Figure 8-2**.

Table 8-7
CIP WM1: Fire Flow Deficiency Water Main Replacement Program Inventory

CIP No.	Water Main Properties			Location Description			Estimated Cost	Priority
	Length (LF)	Prop. Diam.	Existing Material	In	From	To		
1	662	8"	AC, DI	S Verbena St	E 3rd Ave	E 1st Ave	$111,000	H
2	1,772	12"	AC, DI	Easement	E 7th Ave	E 7th Ave	$229,000	M
3	2,048	12"	AC, Steel	Fairgrounds Loop	Fairgrounds	Fairgrounds	$355,000	H
4	2,982	12"	AC	N & S Oak St	E 3rd Ave	N Oak St	$517,000	H
				Industrial	N Oak St	E Columbia Dr		
5	2,152	12"	AC, Steel	E Columbia Dr	Railroad	N Gum St	$373,000	H
				N Juniper St	E Bruneau Ave	E Columbia Dr		
6	1,147	12"	AC	Industrial	E Chemical Drive	Driveway	$199,000	H
7	3,443	12"	PVC	E Bruneau Ave	N Washington St	N Juniper St	$597,000	M
8	898	12"	Steel	S Gum St	E 5th Ave	E 3rd Ave	$156,000	H
9	975	12"	AC, Steel	E 10th Ave	S Date St	S Gum St	$169,000	L
10	476	12"	PVC	N Gum St	E Bruneau Ave	E Columbia Dr	$83,000	L
11	631	12"	AC, PVC	E Columbia Dr	N Elm St	N Gum St	$110,000	L
12	365	16"	PVC	Driveway	E 3rd Ave	E 2nd Ave	$67,000	L
13	1,296	12"	AC, Steel	N Date St	E Kennewick Ave	Driveway	$225,000	H
				Industrial	N Date St	N Alder St		
14	1,724	12"	AC, DI, PVC	E 1st Ave	S Date St	Easement	$299,000	M
				Driveway	Easement	S Alder Street		
				Easement	Driveway	E Kennewick Ave		
				E Kennewick Ave	Easement	S Beech St		
				Easement	E 1st Ave	Driveway		
15	Removed During WCP Review Process							
16	1,336	8"	AC	E 36th Ave	S Auburn St	E 35th Pl	$224,000	H
17	889	8"	AC	S Beech St	E 14th Ave	E 11th Ave	$149,000	L
18	1,118	12"	AC	Comm. Driveway	S Washington St	S Alder St	$194,000	H
				S Alder St	Commercial Driveway	N Alder St		
				Comm. Driveway	S Alder St	S Washington St		
19	3,271	12"	AC, CI, Steel	S Washington St	W 4th Ave	W 10th Ave	$567,000	M
				W 7th Ave	S Washington St	S Auburn St		
				S Auburn St	W 7th Ave	W 6th Ave		
20	2,653	12"	AC, Steel	W 10th Ave	S Garfield St	S Washington St	$460,000	M
21	1,038	12"	CI, PVC, Steel	S Washington St	E Kennewick Ave	W Railroad Ave	$180,000	H
22	2,373	12"	PVC	Driveway	S Fruitland St	S Washington St	$411,000	M
23	724	12"	Steel	W 6th Ave	S Auburn St	S Washington St	$126,000	H
24	2,054	8", 12"	AC, DI	Easement	W 4th Ave	S Ione St	$351,000	L
				W 4th Ave	S Washington St	S Auburn St		
				S Auburn St	W 4th Ave	W 2nd Ave		
25	1,488	12"	AC, Galv	Comm. Driveway	S Dayton St	S Washington St	$258,000	H

Table 8-7 (Continued)
CIP WM1: Fire Flow Deficiency Water Main Replacement Program Inventory

CIP No.	Water Main Properties			Location Description			Estimated Cost	Priority
	Length (LF)	Prop. Diam.	Existing Material	In	From	To		
26	718	12"	AC	Comm. Driveway	S Benton St	S Washington St	$125,000	H
27	788	12"	AC	W Deschutes Ave	N Benton St	W Columbia Dr	$137,000	L
28	1,162	12"	Steel	W Columbia Dr	N Benton St	W Entiat Ave	$202,000	H
29	419	12"	PVC	Comm. Driveway	S Cascade St	S Benton St	$73,000	L
30	1,128	12"	AC, CI, Galv, Steel	S/N Cascade St	W 2nd Ave	W Canal Drive	$196,000	H
31	349	12"	AC	Comm. Driveway	N Dayton St	N Cascade St	$61,000	H
32	1,259	12"	AC, CI	W Deschutes Ave	W Columbia Dr	N Fruitland St	$218,000	M
33	1,041	12"	AC	W Albany Ave	N Fruitland St	S Dayton St	$181,000	H
				N Dayton St	W Albany Ave	Driveway		
34	823	12"	PVC	Driveway	N Fruitland St	N Dayton St	$143,000	L
35	1,811	12"	AC, DI, PVC	W 10th Ave	Driveway	Driveway	$314,000	L
36	450	12"	AC	N Everett St	W Entiat Ave	W Grand Ronde Ave	$78,000	H
37	656	12"	AC	W Grand Ronde Ave	N Fruitland St	N Everett St	$114,000	H
38	796	12"	DI	W Columbia Dr	N Fruitland St	W Grand Ronde Ave	$138,000	M
39	2,586	12"	PVC	W 4th Ave	S Kent St	S Garfield St	$448,000	L
				W Vineyard Dr	S Garfield St	W 1st Ave		
				W 1st Ave	S Fruitland St	S Dayton St		
40	1,496	12"	PVC	W Kennewick Ave	W Carmichael Dr	S Dayton St	$260,000	L
41	767	12"	AC, PVC	S Fruitland St	W 1st Ave	W Albany Ave	$133,000	L
42	1,668	12"	AC	N Fruitland St	W Albany Ave	W Entiat Ave	$289,000	H
43	949	12"	AC	N Fruitland St	W Entiat Ave	W Columbia Dr	$165,000	H
44	2,972	12"	PVC	W Grand Ronde Ave	N Olympia St	N Fruitland St	$515,000	H
45	657	12"	AC	W Columbia Dr	N Hartford St	N Fruitland St	$114,000	M
46	1,768	12"	AC, PVC	W Canal Dr	W Bruneau Pl	N Fruitland St	$307,000	L
47	2,195	12"	AC, PVC	S Garfield St	W 6th Ave	W Kennewick Ave	$381,000	M
48	1,325	8"	Unknown	Easement	W 4th Ave	S Garfield St	$222,000	M
49	1,386	8", 12"	AC, PVC	N Garfield St	W Grand Ronde Ave	W Columbia Dr	$235,000	L
				N Jean St	W Entiat Ave	W Grand Ronde Ave		
				Driveway	W Entiat Ave	W Grand Ronde Ave		
50	924	12"	AC, PVC	N Hartford St	W Grand Ronde Ave	W Klamath Ave	$160,000	L
51	2,409	12"	AC, PVC, Steel	Easement	W Metaline Ave	W Klamath Ave	$418,000	M
				W Klamath Ave	Easement	N Hartford St		
52	2,116	12"	AC	W 5th Ave	S Olympia St	S Ione St	$367,000	L
53	1,417	12"	PVC, Steel	N Kent Pl	W Klamath Ave	W John Day Ave	$246,000	L
				W John Day Ave	N Kent Pl	N Hartford St		
54	713	8"	Steel	W Albany Ave	W Kennewick Ave	N Jean St	$120,000	L
55	2,083	12"	PVC	W Metaline Ave	US Highway 395	N Jean St	$361,000	M
				N Jean St	W Metaline Ave	W Klamath Ave		
56	1,203	12"	AC	Easement	S Olympia St	W 22nd Ave	$209,000	M
57	1,440	8"	Steel	W 7th Pl	S Rainer St	W 9th Ave	$242,000	H
58	357	12"	Steel	S Quincy St	W 1st Ave	W Kennewick Ave	$62,000	H
59	608	8"	Steel	N Quincy Pl	W Canal Dr	W Clearwater Ave	$102,000	H
				W Clearwater Ave	N Quincy Pl	N Quincy St		
60	970	8"	Steel	Easement	W 3rd Ave	W Kennewick Ave	$163,000	H
61	1,329	8"	Galv	Easement	S Vancouver St	S Sharron St	$223,000	H
				Easement	W 2nd Ave	W Kennewick Ave		
62	156	8"	Steel	Easement	Private property	W 2nd Ave	$27,000	H
63	838	8"	Steel	W 9th Ave	S Vancouver St	S Sharron St	$141,000	H
64	592	8"	Steel	W 1st Ave	S Vancouver St	S Underwood St	$100,000	H
				S Underwood St	W 1st Ave	W Kennewick Ave		
65	526	12"	PVC	S Vancouver St	W 21st Ct	W 19th Ave	$92,000	L
66	953	12"	PVC, Steel	Easement	W 5th Ave	W 4th Ave	$166,000	L
67	2,368	12"	AC, PVC	N Dennis St	W Clearwater Ave	W Deschutes Ave	$411,000	L
				W Entiat Ave	W Deschutes Ave	N Dennis Pl		
				N Dennis Pl	W Entiat Ave	W Falls Ave		
				W Falls Ave	N Dennis Pl	N Yelm St		
68	655	8"	Steel	W 15th Ave	Driveway	S Yelm St	$110,000	M
69	1,359	8"	Steel	Easement	S 9th Ave	S Conway St	$228,000	M
				S Conway St	Easement	W 8th Ave		
				Easement	W 8th Ave	W 7th Ave		
70	1,275	12"	PVC	Vista Way	W Kennewick Ave	N Dennis St	$221,000	L
				N Dennis St	Vista Way	W Clearwater Ave		

Table 8-7 (Continued)
CIP WM1: Fire Flow Deficiency Water Main Replacement Program Inventory

CIP No.	Water Main Properties			Location Description			Estimated Cost	Priority
	Length (LF)	Prop. Diam.	Existing Material	In	From	To		
71	1,249	8"	Galv, Steel	S Dennis Pl	W 4th Pl	W 5th Ave	$210,000	M
				W 5th Ave	S Dennis Pl	S Dennis St		
				S Dennis St	W 5th Ave	W 4th Pl		
72	484	8"	AC	W Grand Ronde Ave	N Fisher St	N Ely St	$82,000	L
				N Ely St	W Grand Ronde Ave	W Hood Ave		
73	5,116	12"	AC, Steel	N Huntington St	W Kennewick Ave	W Clearwater Ave	$886,000	H
				Comm. Driveway	W Kennewick Ave	W Clearwater Ave		
				Parking Lot	W Kennewick Ave	W Clearwater Ave		
				N Ely St	W Kennewick Ave	W Clearwater Ave		
74	2,701	12"	AC	S Huntington St	W Kennewick Ave	W 2nd Ave	$468,000	L
				W 2nd Ave	S Huntington St	S Green St		
				W 2nd Ave	S Green St	S Ely St		
				Comm. Driveway	S Huntington St	S Ely St		
75	710	12"	AC	W 2nd Ave	W Green St	Commercial Driveway	$123,000	M
76	1,323	10"	AC	Driveway	W 7th Ave	W 4th Ave	$227,000	L
77	826	12"	Steel	Easement	W Clearwater Ave	W Grand Ronde Ave	$144,000	H
78	1,404	8"	Steel	N Green Pl	W Hood Ave	W Grand Ronde Ave	$236,000	H
				W Grand Ronde Ave	N Green Pl	N Fisher Pl		
				N Fisher Pl	W Grand Ronde Ave	W Hood Ave		
79	1,447	8"	Galv, Steel	W Metaline Pl	N Keller St	N Irby St	$243,000	H
				W Metaline Pl	N Huntington St	N Green St		
				N Green St	W Metaline Pl	W John Day Ave		
80	999	8"	Steel	S Huntington Pl	W 4th Ave	S Green Pl	$168,000	H
				S Green Pl	S Huntington Pl	W 4th Ave		
81	627	12"	AC	Easement	W 19th Ave	W 18th Ave	$109,000	M
				W 18th Ave	Easement	S Huntington Pl		
82	1,983	10"	AC	S Johnson St	W 4th Ave	End of S Johnson St	$340,000	M
				W 3rd Pl	S Johnson St	S Keller St		
				Apartment Complex	S Johnson St	S Irby St		
				S Irby St	Apartment Complex	W 4th Ave		
83	1,536	12"	AC	N Johnson St	W Clearwater Ave	Commercial Driveway	$266,000	M
				Loop, Parking Lot	N Johnson St	N Johnson St		
				N Johnson St	Commercial Driveway	W Hood Ave		
84	879	10"	Steel	Easement	S Morain St	W Kennewick Ave	$151,000	H
85	593	10"	AC	Comm. Loop	W Kennewick Ave	W Clearwater Ave	$102,000	L
86	635	16"	AC	W 19th Ave	S Olson St	Nocturne Ln	$116,000	M
87	1,050	12"	AC	N Morain St	W Clearwater Ave	N Neel St	$182,000	M
88	984	12"	PVC	N Morain St	W Kennewick Ave	W Clearwater Ave	$171,000	M
89	302	8"	Steel	W Kennewick Ave	N Neel St	N Morain St	$51,000	H
90	831	12"	Unknown	S Olson St	W 28th Ave	W 27th Ave	$144,000	M
91	1,851	12"	PVC	S Quillan St	W 27th Ave	W 28th Ave	$321,000	M
				W 28th Ave	S Quillan St	S Olson St		
92	1,082	12"	Unknown	W 27th Ave	Driveway	S Olson St	$188,000	M
93	1,312	12"	AC	N Neel St	W Clearwater Ave	W Hood Ave	$228,000	L
94	1,239	8"	AC, Galv	S Olson St	W 19th Ave	W 15th Ave	$208,000	M
95	480	12"	AC	Parking Lot	N Perry St	W Clearwater Ave	$84,000	M
96	1,651	8"	Steel	S Reed St	W Kennewick Ave	W 2nd Ave	$277,000	H
				W 2nd Ave	S Reed St	S Quillan St		
97	564	8"	Steel	W Kennewick Ave	N Sheppard Pl	S Quillan St	$95,000	L
98	1,152	8"	Galv	N Perry Loop	W Payette Ave	W Payette Ave	$193,000	H
99	125	12"	PVC	W Clearwater Ave	N Quillan St	Driveway	$22,000	M
100	2,521	8"	AC	N Tweedt St	W Hood Ave	N Sheppard St	$423,000	M
				W Klamath Ave	N Sheppard St	N Sheppard St		
				N Sheppard St	W Klamath Ave	W John Day Pl		
				W John Day Pl	N Sheppard St	N Tweedt St		
101	240	12"	Unknown	S Union St	Creekstone Dr	W 26th Ave	$42,000	H
102	Removed During WCP Review Process							
103	967	12"	Unknown	S Union St	W 21st Ave	W 19th Ave	$168,000	L
				S Union St	W 26th Ave	Driveway		
104	1,514	12"	PVC	W 24th Ave	W 24th Pl	S Union St	$263,000	L
105	1,364	12"	Unknown	Creekstone Dr	S Union St	W 26th Ave	$237,000	M
				S Williams Pl	Creekstone Dr	Union St		

Table 8-7 (Continued)
CIP WM1: Fire Flow Deficiency Water Main Replacement Program Inventory

CIP No.	Water Main Properties			Location Description			Estimated Cost	Priority
	Length (LF)	Prop. Diam.	Existing Material	In	From	To		
106	904	12"	AC	N Volland St	W Kennewick Ave	W Clearwater Ave	$157,000	L
107	1,814	12"	PVC	Storage Facility Loop	W 24th Ave	W 24th Ave	$315,000	L
				Storage facility	W 24th Ave	Back of facility		
108	543	12"	PVC	W Clearwater Ave	N Zinser St	N Williams St	$95,000	L
109	2,609	8"	AC	Easement	W Clearwater Ave	C St	$437,000	H
				D St	C St	N Zinser St		
				N Zinser St	D St	W Clearwater Ave		
110	828	12"	AC	N Arthur St	W Clearwater Ave	Driveway	$144,000	M
111	2,181	8"	AC	Loop	N Edison St	N Edison St	$366,000	M
				Easement	N Edison St	N Arthur St		
112	970	12"	Unknown	W Okanogan St	N Edison St	N Cleveland St	$168,000	M
				Easement	W Metaline Ave	W Okanogan St		
113	1,929	8"	Steel	W 4th Ave	W Jefferson St	S Edison St	$323,000	M
114	763	12"	PVC	W Hood Ave	North Grant St	N Edison St	$133,000	L
115	850	12"	Unknown	Parking Lot	W Clearwater Ave	N Irving St	$148,000	H
116	Removed During WCP Review Process							
117	1,311	10"	AC	N McKinley St	W 1st Ave	W Clearwater Ave	$225,000	H
118	1,295	12"	AC	Comm.	W Quay St	W Clearwater Ave	$225,000	M
119	3,501	12"	AC, PVC	Parking Lot	W Grandridge Blvd	N Kellogg St	$607,000	M
				Comm. Loop	W Grandridge Blvd	W Grandridge Blvd		
120	1,520	12"	AC	W Clearwater Ave	N Taft St	N Quay St	$264,000	M
121	1,053	12"	AC	W Kennewick Ave	S Taft St	N Quay St	$183,000	L
122	5,536	12"	AC, DI	W Deschutes Ave	Driveway	N Columbia Center Blvd	$959,000	M
123	44	12"	PVC	Ridgeline Dr	W 36th Ave	12" Water Main	$8,000	L
124	2,281	12"	AC, PVC	W 1st Ave	S Young St	S Taft St	$395,000	L
				N & S Taft St	W 1st Ave	W Clearwater Ave		
125	893	12"	PVC	Traffic Roundabout	W Grandridge Blvd	W Grandridge Blvd	$155,000	L
				W Grandridge Blvd	W Okanogan Pl	W Canal Dr		
126	541	12"	AC	N & S Van Buren St	W 1st Ave	W Clearwater Ave	$94,000	L
127	2,090	12"	PVC	Comm. Loop	W Grandridge Blvd	W Grandridge Blvd	$362,000	L
128	1,944	12"	AC	W Quinault Ave	N Columbia Center Blvd	N Young St	$337,000	H
129	1,936	12"	PVC	Comm. Loop	W Okanogan Pl	W Quinault Ave	$336,000	L
130	1,052	12"	AC	N Colorado St	Driveway	W Okanogan Pl	$183,000	H
				W Okanogan Pl	N Colorado St	W Quinault Ave		
131	1,044	12"	PVC	Loop around Bldg.	S Columbia Center Blvd	S Columbia Center Blvd	$181,000	H
132	1,531	12"	PVC	Comm. Bldg. Loop	W 10th Ave	S Columbia Center Blvd	$266,000	M
133	1,133	12"	AC	W Kennewick Ave	S Columbia Center Blvd	S Colorado St	$197,000	L
				N Colorado St	W Kennewick Ave	W Clearwater Ave		
134	1,522	12"	PVC	Hood Pl & Parking Lots	N Colorado St	W Grandridge Blvd	$264,000	L
135	1,625	12"	AC, PVC	Comm.	N Columbia Center Blvd	W Grandridge Blvd	$282,000	L
136	2,435	12"	PVC	Comm. Bldg. Loop	W Grandridge Blvd	W Grandridge Blvd	$422,000	L
137	389	12"	AC, PVC	Driveway	W Quinault Ave	Driveway	$68,000	L
138	2,029	12"	Unknown	Comm. Driveway	N Center Pkwy	Commercial Driveway	$352,000	H
				Comm. Parking Lot	Private Driveway	W Quinault Ave		
139	1,380	12"	Unknown	Comm. Parking Lot	N Center Pkwy	W Grandridge Blvd	$239,000	M
140	2,974	16"	AC, DI, PVC	W Gage Blvd	N Pittsburgh St	Mall Parking Lot	$544,000	M
141	1,038	12"	AC	N Center Pkwy	W Grandridge Blvd	W Quinault Ave	$180,000	M
142	1,134	12"	PVC	W Quinault Ave	W Grandridge Blvd	N Center Pkwy	$197,000	L
143	2,187	12"	AC	Loop	N Louisiana St	N Louisiana St	$379,000	M
144	2,456	12"	AC	N Center Pkwy	W Grandridge Blvd	W Deschutes Ave	$426,000	L
145	1,089	12"	PVC	N Louisiana St	W Quinault Ave	W Gage Blvd	$189,000	M
146	619	12"	PVC	Easement	W Gage Blvd	Commercial Driveway	$108,000	L
147	2,372	12"	AC, PVC	W Victoria Ave	N Steptoe St	N Pittsburgh St	$411,000	M
				Easement	N Pittsburgh St	N Louisiana St		
148	1,226	12"	AC	Loop, Comm. Bldg.	W Gage Blvd	W Gage Blvd	$213,000	M
149	1,671	12", 16"	PVC	Steptoe St	Bridge	W Clearwater Ave	$293,000	H
				S Clodfelter St	W Clearwater Ave	W 4th Ave		
				W 4th Ave	S Clodfelter St	S Oklahoma St		
150	1,666	12"	PVC	Steptoe St	Gage Blvd	W Tucannon Ave	$289,000	L
				W Tucannon Ave	Steptoe St	N Pittsburgh St		
				N Pittsburgh St	W Tucannon Ave	W Gage Blvd		
151	1,063	12", 16"	PVC	N Steptoe St	Gage Blvd	W Arrowhead Ave	$191,000	H
152	324	12"	PVC	Lincoln Dr	Katherine St	N Steptoe St	$57,000	L
				W Arrowhead Ave	N Texas St	N Steptoe St		
153	434	12"	PVC	S Utah St	W Clearwater Ave	Driveway	$76,000	L
				W Clearwater Ave	S Utah St	Driveway		
154	734	24"	Unknown	Kansas Res. Driveway	W 10th Ave	24" Water Main		H

OTHER IMPROVEMENTS

The additional water main, PRV, and facility improvements were prioritized based on existing deficiencies, safety concerns, maintenance requirements, and capacity requirements. The miscellaneous improvements were prioritized based on regulatory requirements and assessment of the water system needs. The priority order of these improvements is reflected in the schedule of improvements that is presented in **Table 8-8**.

SCHEDULE OF IMPROVEMENTS

The results of prioritizing the improvements were used to establish an implementation schedule that can be used by the City for preparing its 10-year CIP and biennial water utility budget. The implementation schedule for the proposed improvements is shown in **Table 8-8**. An allowance of $750,000 per year ($1,500,000 per biennium) has been allocated for the water main replacement program (CIP WM1), and an allowance of $350,000 per year ($700,000 per biennium) has been allocated for the non-standard water main material replacement program (CIP WM2). The City will identify and schedule the replacement of water mains to be funded by the water main replacement program during the biennial budget process. This provides the City with the flexibility to coordinate these projects with road or other projects within the same area. Because of the amount of water main in the City's water system, not all deficient mains can be replaced within the 20-year planning horizon of this WCP. As shown in **Table 8-8**, many water main replacement projects have been scheduled for years beyond 2035 and will be completed as time and budget allows.

FUTURE PROJECT COST ADJUSTMENTS

All cost estimates shown in the tables are presented in 2016 second quarter dollars. These cost estimates will need to be adjusted to account for the effects of inflation and changing construction market conditions to determine future costs at the actual time of project implementation. Future costs can be estimated using the Engineering News Record (ENR) Construction Cost Index for the Seattle area or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.

Table 8-8
Proposed Implementation Schedule

CIP No.	Description	Estimated Cost (2016 $)	20-Year Schedule of Improvements: Planned Year of Project and Estimated Cost in 2016 $												Improvement Cost Breakdown		
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2035	2036+	Repair and Replacement	Improvement	Expansion
	Water Main Improvements																
WM1	Fire Flow Deficiency Water Main Replacement Program	$35,128,000	$750K	$750K	$750K	$750K	$750K	$750K	$750K	$750K	$750K	$750K	$7,500K	$20,128K	85%		15%
WM2	Asbestos Cement, Galvanized, or Steel Water Main Replacement Progra	$7,000,000	$350K	$350K	$350K	$350K	$350K	$350K	$350K	$350K	$350K	$350K	$3,500K	$0K	97%		3%
WM3	KID Elliot Lake Water System Acquisition	$964,000	Not Funded by City														
WM4	Ridgeline Drive Highway 395 Crossing Water Main	$416,000				$416K										100%	
WM5	W. Hildebrand Avenue and Ridgeline Drive Dead End Water Main Loopin	$598,000			$598K											100%	
WM6	W. 10th Avenue Parallel Main Connections	$30,000				$30K										100%	
WM7	Columbia Center Mall Loop	$30,000					$30K									100%	
WM8	Red Lion Hotel Loop	$10,000					$10K									100%	
WM9	Entiat Avenue to Canal Drive Water Main	Previously Funded															
WM10	20th Avenue Zone 3 Connection	$100,000						$100K								100%	
WM11	Tri-City Heights Water Main Replacement	$6,100,000									$3,050K	$3,050K			100%		
	Pressure Zone Improvements																
PZ1	Conversion of Zone 1 to Zone 2 near W. Park Hills Drive	$20,000		$20K											100%		
PZ2	Conversion of Zone 1 to Zone 2 near Vista Elementary	$66,000		$66K											100%		
PZ3	Conversion of Zone 4 to Zone 5 in S. Olympia Street	$93,000											$93K		100%		
	Vista Field Emergency Supply Improvements																
VF1	Vista Field - Phase 1 Improvements	$298,000		$298K											33%		67%
VF2	Vista Field - Phase 2 Improvements	$1,117,000			$1,117K										33%		67%
VF3	Vista Field - Phase 3 Improvements	$2,557,000				$2,557K									33%		67%
	Pressure Reducing Station Improvements																
PRV1	S. Kellogg Street and W. 4th Avenue PRV Station	$248,000							$248K						95%		5%
PRV2	N. Steptoe Street and Gage Boulevard PRV Station	$401,000								$401K					50%		50%
PRV3	Low Zone 3 Services Residual Pressure Improvements	$367,000									$367K				95%		5%
PRV4	Low Zone 3 Hydrant Residual Pressure Improvements	$93,000										$93K			95%		5%
	Facility Improvements																
F1	Water Treatment Plant Expansion	$17,640,000											$17,640K				100%
F2	18th and Kellogg (10 MG) Reservoir Improvements	O&M Funded															
	Miscellaneous Improvements																
M1	Water Comprehensive Plan Update	$300,000										$150K	$150K		100%		
M2	Annual Customer Meter Replacement Program	$1,000,000	$50K	$50K	$50K	$50K	$50K	$50K	$50K	$50K	$50K	$50K	$500K		100%		
M3	Water Use Efficiency Program	$120,000	$6K	$6K	$6K	$6K	$6K	$6K	$6K	$6K	$6K	$6K	$60K		100%		
M4	Redundant Pumps and Motors	O&M Funded															
M5	Emergency Portable Generators	O&M Funded															
M6	Pump and Motor Condition Assessment	O&M Funded															
	Developer Funded Improvements																
DF1	Future Development Benefit to Existing Customers	$1,130,000	$113K	$113K	$113K	$113K	$113K	$113K	$113K	$113K	$113K	$113K				100%	
DF2	Southwest Zone 5 Water Main	$1,209,000	Timing of Project Based on Timing of Future Developments														95%
DF3	Proposed Zone 5 Reservoir and Water Main	$3,969,000	Timing of Project Based on Timing of Future Developments														95%
DF4	Zone 4 Water Main and PRV Station	$2,007,000	Timing of Project Based on Timing of Future Developments														95%
DF5	Zone 3 Water Main and PRV Station	$1,142,000	Timing of Project Based on Timing of Future Developments														95%
DF6	Zone 3 Clodfelter Road and W. 10th Avenue Water Main	$1,590,000	Timing of Project Based on Timing of Future Developments														95%
DF7	Southeast Zone 5 Water Main	$2,251,000	Timing of Project Based on Timing of Future Developments														95%
DF8	Zone 6 East BPS, Reservoir, PRV, and Water Main	$3,918,000	Timing of Project Based on Timing of Future Developments														95%
DF9	Zone 7 East BPS and Water Main	$1,171,000	Timing of Project Based on Timing of Future Developments														95%
DF10	Zone 6 South BPS, Reservoir, and Water Main	$2,723,000	Timing of Project Based on Timing of Future Developments														95%
DF11	Zone 7 South BPS and Water Main	$2,037,000	Timing of Project Based on Timing of Future Developments														95%
DF12	Christensen Road Water Main	$475,000	Timing of Project Based on Timing of Future Developments														95%
Total Estimated Cost of Repair and Replacement Projects		**$29,423,497**	**$1,032K**	**$1,218K**	**$1,405K**	**$1,885K**	**$1,032K**	**$1,032K**	**$1,268K**	**$1,233K**	**$4,431K**	**$4,321K**	**$10,567K**		**$29,423K**	**---**	**---**
Total Estimated Cost of Improvement Projects		**$2,314,000**	**$113K**	**$113K**	**$711K**	**$559K**	**$153K**	**$213K**	**$113K**	**$113K**	**$113K**	**$113K**	**$0K**		**---**	**$2,314K**	**---**
Total Estimated Cost of Expansion Projects		**$22,996,503**	**$124K**	**$322K**	**$868K**	**$1,828K**	**$124K**	**$124K**	**$136K**	**$324K**	**$142K**	**$128K**	**$18,876K**		**---**	**---**	**$22,997K**
Total Estimated Costs of Developer Funded Projects		**$21,362,000**													**---**	**---**	**---**
Improvement Projects Beyond 20-year Planning Period		**$20,128,000**												**$20,128K**	**$17,110K**	**---**	**$3,018K**

9 | FINANCIAL PROGRAM

INTRODUCTION

The purpose of the financial plan is to provide reasonable assurance that the City of Kennewick (City) has and will have the financial ability to maintain and operate the utility on an ongoing basis, and has the capacity to obtain sufficient funds to construct the water system improvements as identified in **Chapter 8**.

The financial plan can only provide this qualified assurance if it considers the total system costs of providing water service, including operating and capital. To meet these objectives, the financial plan includes the following elements.

- Past Financial Performance
    - Comparative Statement of Revenues, Expenses, and Changes in Fund Equity 2009 through 2016
    - Comparative Balance Sheets 2009 through 2016
    - Schedule of Long-term Debt
- Funding Sources
- Capital Financing Plan
    - Capital Improvement Plan (CIP) Financing Plan 2016 through 2022
- Projected Financial Performance
    - Revenue Requirement Summary 2016 through 2022
- Rate Structure and Conservation Objectives

PAST FINANCIAL PERFORMANCE

The City's primary function is to provide potable water and fire flow services to City customers at the lowest reasonable price, ensuring reliability of source, storage, and distribution.

The historical financial statements presented in **Tables 9-1 and 9-2** clearly show the financial viability and strength of the City to continue providing a high level of service. The water system is part of a combined water and sewer fund, so the financial statements reflect the combined utility results.

COMPARATIVE FINANCIAL STATEMENTS

Table 9-1
Comparative Statement of Revenues, Expenses, and Changes in Fund Equity (2009 through 2016)

Income and Expense - O&M	Biennium			
	2009/2010	2011/2012	2013/2014	2015/2016 [1]
Operating Revenues				
Rate Revenue	$15,807,760	$16,431,921	$17,827,332	$18,976,122
Income from Other Sources	$699,048	$822,677	$1,101,529	$1,209,100
Total Income	**$16,506,808**	**$17,254,598**	**$18,928,861**	**$20,185,222**
Operating Expenses				
General & Administrative Expenses (55% Water)	$3,539,113	$3,323,581	$3,446,466	$3,713,225
Well Maintenance	$109,177	$99,141	$159,139	$87,701
Filtration Plant Maintenance	$185,174	$447,494	$502,795	$694,282
Water Distribution Maintenance	$2,279,600	$1,504,748	$2,574,559	$3,654,623
BPS and Reservoir Maintenance	$200,599	$235,598	$297,566	$258,813
General Plant Maintenance	$28,337	$12,712	$58,295	$30,000
Well Operations	$351,875	$450,683	$518,785	$508,701
Filtration Plant Operations	$1,362,272	$1,509,107	$1,353,247	$1,761,484
Water Distribution Operations[2]	$693	$819	$0	$0
BPS and Reservoir Operations[3]	$411,609	$462,738	$0	$0
Other Services and Charges	$199,722	$182,442	$182,313	$499,502
Intergovernmental Services/Taxes	$1,844,518	$2,108,733	$2,498,919	$2,603,510
Total O&M Expenses	**$10,512,689**	**$10,337,796**	**$11,592,084**	**$13,811,841**
Net O&M Income				
Net O&M Income	**$5,994,119**	**$6,916,802**	**$7,336,777**	**$6,373,381**

(1) Adjusted 2015/2016 budget.
(2) In 2013, these expenses were moved to water distribution maintenance.
(3) In 2013, these expenses were split between water distribution maintenance and filtration maintenance.

Table 9-2
Comparative Balance Sheet (2009 through 2016)

Income and Expense - Capital Improvements	Biennium			
	2009/2010	2011/2012	2013/2014	2015/2016 [1]
Capital Revenues				
Beginning Cash Reserve Balance	**$7,357,099**	**$5,365,902**	**$3,672,778**	**$2,462,398**
Net O&M Income	$5,994,119	$6,916,802	$7,336,777	$6,373,381
Outside Funding Sources	$2,531,885	$1,180,755	$5,810,195	$694,747
Total Capital Income	**$8,526,004**	**$8,097,557**	**$13,146,972**	**$7,068,128**
Capital Expenses				
Capital Outlays	$6,853,361	$5,681,375	$11,079,708	$5,302,241
Debt Service	$3,551,673	$3,544,504	$3,450,314	$3,879,787
Total Capital Expenses	**$10,405,034**	**$9,225,879**	**$14,530,022**	**$9,182,028**
Change in Capital				
Change in Working Capital	($1,879,030)	($1,128,322)	($1,383,050)	($2,113,900)
Interfund Loan Activity	$162,866	($724,803)	$44,343	$261,499
Intergovernmental Payments	($275,033)	$160,000	$128,326	$769,382
Ending Cash Reserves Balance	**$5,365,902**	**$3,672,778**	**$2,462,398**	**$1,379,379**

(1) Adjusted 2015/2016 budget.

EXISTING LONG-TERM DEBT

The water utility currently has seven outstanding debt obligations that are either Public Works Trust Fund (PWTF) or Drinking Water State Revolving Fund (DWSRF) loans. The water utility is responsible for 55 percent of the 2001 Comprehensive Water and Sewer Improvement loan, and 100 percent of the PWTF and DWSRF loans discussed in this chapter. **Table 9-3** shows the schedule of annual debt service payments through the full term of each debt obligation, except for the Zone 4 Reservoir and Booster Pump Station (BPS) debt, which is scheduled to be paid through year 2032.

Table 9-3
Schedule of Long-term Debt

Due	Principal	Interest	Payment
2009	$1,562,236.05	$178,721.09	$1,740,957.14
2010	$1,619,831.00	$190,886.21	$1,810,717.21
2011	$1,619,831.07	$176,746.26	$1,796,577.32
2012	$1,586,136.24	$161,791.44	$1,747,927.67
2013	$1,586,136.24	$147,173.59	$1,733,309.83
2014	$1,584,448.99	$132,555.72	$1,717,004.71
2015	$1,820,560.11	$133,326.64	$1,953,886.75
2016	$1,820,560.10	$123,423.18	$1,943,983.28
2017	$1,451,890.63	$107,641.63	$1,559,532.26
2018	$1,451,890.62	$95,546.78	$1,547,437.40
2019	$1,451,890.63	$83,451.92	$1,535,342.55
2020	$1,451,890.62	$71,357.07	$1,523,247.69
2021	$1,451,890.62	$59,262.21	$1,511,152.83
2022	$1,364,234.37	$47,167.38	$1,411,401.75
2023	$1,364,234.38	$35,510.79	$1,399,745.17
2024	$1,137,567.70	$23,854.22	$1,161,421.92
2025	$924,936.13	$14,464.33	$939,400.46
2026	$236,111.11	$8,263.88	$244,374.99

FUNDING SOURCES

The City may fund the water capital improvement program from a variety of sources. In general, these sources can be summarized as: 1) government grant and loan programs; 2) publicly issued debt (tax exempt or taxable); 3) cash resources; and 4) capital facilities charges. Each source is described below.

GOVERNMENT GRANT AND LOAN PROGRAMS

Historically, federal and state grant programs were available to local utilities for capital funding assistance. However, these assistance programs have been mostly eliminated, substantially reduced in scope and amount, or replaced by loan programs. Remaining grant programs are generally underfunded and extremely competitive. Nonetheless, the benefit of the very low-interest loans makes the effort of applying worthwhile. State programs identified as potential funding sources for the utility improvements set forth in this Water Comprehensive Plan (WCP) are as follows.

Public Works Trust Fund – The PWTF is a commonly used, low-cost revolving loan fund established by the 1985 State Legislature to provide financial assistance to local governments for public works projects. Eligible projects must improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance.

PWTF loans are available at low interest rates. The useful life of the project determines the loan term, up to a maximum of 20 years for non-distressed communities. The applicant must be a local government, such as a city, county, or special purpose utility district, and have an approved long-term plan for financing its public works needs. Local governments must compete for PWTF dollars since more funds are requested each year than are available. The Public Works Board evaluates each application and transmits a prioritized list of projects to the legislature. The legislature then indicates its approval by passing an appropriation from the Public Works Assistance Account to cover the cost of the approved loans. Once the Governor has signed the appropriations bill into law, the local governments receiving the loans are offered a formal loan agreement with the appropriate interest rate and term, as determined by the Public Works Board. Normally, these loan agreements are executed but the proceeds are drawn down as expenditures are made and then reported to the state.

Community Economic Revitalization Board – Managed by the Department of Commerce, this program provides grants and loans to fund public facilities that support specific private-sector business growth and expansion. Eligible projects include water, sewer, and other public improvements.

Department of Ecology – The Department of Ecology's Water Quality Financial Assistance Program sponsors three grant and loan programs: 1) the Centennial Clean Water Fund; 2) the Federal 319 program; and 3) the State Revolving Fund Loan program. While some of these funding sources go to wastewater programs, projects such as the development and implementation of groundwater, and wellhead protection programs, are also included.

Department of Health – The U.S. Congress has authorized a limited amount of money for the DWSRF loan specifically for programs to improve water quality. The Washington State Department of Health Office of Drinking Water, the Department of Commerce's Public Works Board, and the

Contract Administration Unit (CAU) jointly administer the DWSRF loan program. Priority is given to projects that address severe public health threats and compliance issues.

Of these programs, the PWTF is the most attractive loan program for the City. However, given the level of competition for these funds, the PWTF should not be relied on as a source of funding for all qualified projects in a conservative rate-making forecast. It is recommended that the City pursue PWTF loans as needed.

PUBLICLY ISSUED DEBT

Revenue Bonds – Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility, and the debt obligation does not extend to the City's other revenue sources. With this limited commitment, revenue bonds typically require security conditions related to the maintenance of dedicated reserves (i.e., a bond reserve) and financial performance (e.g., added bond debt service coverage). The City agrees to satisfy these requirements by ordinance as a condition of the bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic. In the case of the City, strong historical financial performance bodes well for this form of financing. For the most part, tax-exempt bonds may be issued by a governmental agency for its capital projects, with the exception of funding needs that serve private sector or non-governmental interests, such as mutual water companies and homeowners associations (which are classified as 501(c) corporations). Generally speaking, if more than 10 percent of a capital project provides direct benefit and service to the private sector (e.g., a business or mutual water company receiving wholesale water), the associated revenue bonds will likely be taxable. It is important that each agency perform due diligence in this regard when there is a question of private versus public benefit.

CASH RESOURCES

The City has combined water and sewer reserves that include a Working Capital Reserve, an Operating Capital Reserve, and a Capital Contingency Reserve. The rate revenue needs analysis for water must consider reserves available to the water utility, based upon a financial goal of maintaining a minimum balance of 1% of water system assets. As of the end of 2014, water system assets were $121,000,000 resulting in a minimum capital reserve goal of $1,210,000. Allocation of the reserve balances, as of year-end 2013, was made to water and sewer separately based on rate revenue for the Working Capital and Operating Capital reserves, and CIP spending for the Capital Contingency Reserves. **Table 9-4** shows a summary of the projected balances through 2022.

Table 9-4
Projected Capital Reserve Balances

Year	Beginning Balance	Net Rate Revenue	Ending Balance
2016	$1,269,536	$109,843	$1,379,379
2017	$1,379,379	$229,307	$1,608,686
2018	$1,608,686	($9,846)	$1,598,840
2019	$1,598,840	($330,460)	$1,268,380
2020	$1,268,380	$293,400	$1,561,779
2021	$1,561,779	$116,616	$1,678,395
2022	$1,678,395	$370,136	$2,048,531

CAPITAL FACILITIES CHARGES

Capital Facilities Charges (CFCs) are legal sources of funding provided through development and growth in customers, typically used by utilities to support capital needs. CFCs are a form of connection charges as authorized in the Revised Code of Washington (RCW) 35.92.025. CFCs are imposed on new customers as a condition of service, in addition to any other costs incurred to connect the customer, such as meter installation charges. Typically, the basis for the CFC is the total original capital cost the utility will or has incurred to provide the water system. The underlying premise of the CFC is that growth (i.e., future customers) will pay upfront for growth-related costs that would not have been necessary absent the increase in customer base.

The purpose of the CFC is two-fold: 1) to provide funding sources for capital financing; and 2) to recover an equitable level of investment in the system from new customers. In the absence of such a charge, growth-related costs would be borne, in large part, by existing customers. In addition, the current customers' net investment in the utility would be diluted by the addition of new customers absent a CFC. This dilution, if allowed, would in effect be a subsidy to new connections.

A brief description of the components that can be included in the CFC is provided below.

- Existing Cost Basis – Legal interpretations of state statutes have provided guidelines for CFCs. CFCs should reflect the actual original cost of the utility system and can include interest on that cost at the rate of interest applicable at the time of construction for up to a 10-year period, not to exceed 100 percent of the construction costs. This cost is net of donated facilities and non-utility cash payments, whether from grants or developers, or through Local Improvement District assessments. Although not required by state law, outstanding debt principal (net of existing cash balances) is then subtracted from this cost basis to avoid double charging, in recognition that debt service is repaid through rates.
- Future Cost Basis – Legal interpretations also suggest that future facilities needed to serve growth, as well as regulatory system improvements, can be included in the connection charge. The future cost basis can include utility capital projects planned for construction and identified in an approved comprehensive system planning document. Projects directly funded by developers, grants, or special property assessments are not included in the calculation. Replacement projects are most often excluded from the calculation unless needed to increase the size of the system. The original cost of replacement project is already included in the existing cost basis. Further, replacement costs are typically recovered through user rates.

- Customer Base/System Capacity – The sum of the existing cost basis and future cost basis is then divided by the total customer base to determine the maximum allowable connection charge. The customer base represents the equivalent residential units (ERUs) that can be supported by the planned system capacity.

The City's current CFC is $1,900 for a 1-inch meter within the City limits based upon a combination of service charge, frontage charge (maximum 100 front feet), and area charge (maximum 20,000 square feet). **Table 9-5** summarizes the CFC analysis and results. Kennewick Municipal Code 14.13.010 determines how customer base is calculated for CFC purposes.

Table 9-5
Capital Facility Charges

Meter Size	Service Charge	Frontage Charge	Area Charge
Inside City Limits			
3/4"	$600.00	$9.00	$0.015
1"	$700.00	$9.00	$0.015
1-1/2"	$1,600.00	$9.00	$0.015
2"	$1,900.00	$9.00	$0.015
3"	$6,200.00	$9.00	$0.015
4"	$7,300.00	$9.00	$0.015
6"	$9,000.00	$9.00	$0.015
Outside City Limits			
3/4"	$800.00	$9.00	$0.015
1"	$900.00	$9.00	$0.015
1-1/2"	$1,800.00	$9.00	$0.015
2"	$2,100.00	$9.00	$0.015
3"	$6,400.00	$9.00	$0.015
4"	$7,500.00	$9.00	$0.015
6"	$9,200.00	$9.00	$0.015

CAPITAL FINANCING PLAN

The water utility will look to receive financing for a total of $3,750,000 from one of the funding sources mentioned above in 2018 and 2019 to fund the 7-year projected capital spending total of $16 million. Existing capital reserves (funded in part by system replacement contributions from rates), annual interest earnings, and CFC collections during the 7-year period are anticipated to fund the remaining projected costs. **Table 9-6** shows the annual funding sources for the 7-year forecast period.

Table 9-6
Capital Improvement Program Financing Plan (2016 through 2022)

Capital Improvement Program	2016	2017	2018	2019	2020	2021	2022
Replacement Projects	$1,032,370	$1,266,411	$1,519,327	$2,120,035	$1,207,727	$1,256,036	$1,542,679
Upgrade/Expansion Projects	236,630	452,709	1,708,168	2,685,384	323,618	409,562	302,983
Total Capital Projects[1]	**$1,269,000**	**$1,719,120**	**$3,227,494**	**$4,805,419**	**$1,531,345**	**$1,665,598**	**$1,845,662**
Capital Financing Plan	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Funding Sources							
Rate Funded System Reinvestment	$1,269,000	$1,719,120	$1,977,494	$2,305,419	$1,531,345	$1,665,598	$1,845,662
New Debt	-	-	1,250,000	2,500,000	-	-	-
Total Funding Sources	**$1,269,000**	**$1,719,120**	**$3,227,494**	**$4,805,419**	**$1,531,345**	**$1,665,598**	**$1,845,662**

PROJECTED FINANCIAL PERFORMANCE

BASIS FOR REVENUE REQUIREMENTS

The revenue requirement analysis determines the amount of rate revenue needed in a given year to meet that year's expected financial obligations.

The cash flow test identifies cash requirements for the utility in the year addressed. These requirements can include cash operating and maintenance expenses, debt service, directly funded capital outlays, capital transfers, and any projected additions to reserves. The total cash needs were then compared to projected utility revenues. Any projected shortfalls were identified and the level of rate increase necessary to make up the shortfall was estimated.

The City's internal coverage policy is currently 1.50 times all utility debt, meaning that revenues must be sufficient to meet operating expenses plus a factor, set at a minimum of 1.50 times annual debt service on all utility debt (revenue bonds and PWTF loans). The coverage factor adds some protection for bondholders against the risk of poor financial performance in any given fiscal year. The excess cash flow derived from the added coverage can be used for capital costs.

A number of forecast assumptions are used in the analysis.

- Non-rate revenue is calculated to increase with growth in future years, which is projected to be about 1 percent per year.
- Operation and maintenance (O&M) expenses are escalated at 5 percent for general cost inflation plus additional future staff and expenses. An additional 2 FTE are anticipated in

2017 with an additional 1.5 FTE needed per year to meet both additional population increases and catching up on deferred maintenance.

- Capital expenses are escalated at 4 percent per year.
- In addition to O&M costs, the revenue requirements include capital costs for debt service, directly rate-funded capital projects, and rate-funded system reinvestment transfers to CIP funds.
- The City's fund interest earnings rate is assumed to be 0.5 percent.
- The forecast assumes a PWTF Fund loan interest rate of 0.5 percent with a 20-year term.

Table 9-7 summarizes the projected financial performance and rate requirements for 2016 through 2022.

Table 9-7
Revenue Requirements Summary (2016 through 2022)

Revenue Requirements Summary	2016	2017	2018	2019	2020	2021	2022
				Revenues			
Rate Revenues Under Existing Rates	$9,624,197	$9,949,588	$10,209,089	$10,491,047	$10,759,467	$11,004,525	$11,648,245
Non-rate Revenues	$604,550	$610,596	$616,701	$622,868	$629,097	$635,388	$641,742
Total Revenues	**$10,228,747**	**$10,560,184**	**$10,825,791**	**$11,113,915**	**$11,388,564**	**$11,639,913**	**$12,289,987**
				Expenses			
Expenses	$6,905,921	$7,251,217	$7,613,777	$7,994,466	$8,394,190	$8,813,899	$9,254,594
Existing Debt Service	$1,943,983	$1,559,532	$1,547,437	$1,535,343	$1,523,248	$1,511,153	$1,411,402
New Debt Service	$0	$0	$0	$74,132	$223,611	$225,694	$224,653
Rate-funded System Reinvestment	$1,267,000	$1,717,040	$1,975,331	$2,303,169	$1,529,005	$1,663,165	$1,843,229
Total Expenses	**$10,116,904**	**$10,527,789**	**$11,136,546**	**$11,907,110**	**$11,670,053**	**$12,213,911**	**$12,733,878**
Net Revenue from Rate Increases	$0	$198,992	$303,073	$464,984	$577,229	$693,046	$816,459
Net Annual Surplus (Deficiency)	**$111,843**	**$231,387**	**($7,683)**	**($328,210)**	**$295,739**	**$119,049**	**$372,569**
Annual Rate Adjustment	0.00%	2.00%	1.00%	1.50%	1.00%	1.00%	1.00%
Cumulative Rate Adjustment	0.00%	2.00%	3.02%	4.57%	5.61%	6.67%	7.73%

RATE STRUCTURE AND CONSERVATION OBJECTIVES

EXISTING RETAIL RATES

The City's existing (2015) water rates for single-family residential customers are comprised of a fixed monthly and total water consumption charge, both of which vary based on the customer's location (inside or outside of the City limits). Residential customers within the City have a base rate of $20.54 for the bi-monthly billing period. The fixed bi-monthly charge for single-family residential customers inside the City limits is $20.54, and $45.19 outside of the City limits. Residential and commercial customers within the City are both billed for all water usage at $1.167 per 100 cubic feet and all outside City users are billed at $2.567 per 100 cubic feet. The flat-rate structure is intended to provide a pricing incentive for conservation because the more you use the more you pay. Flat-rate

structures are also fair because they don't penalize high commercial users for their required water supplies.

AFFORDABILITY

An affordability test was conducted based upon a standard threshold of 1.5 percent of the annual median family income. The median household income values for 2005 to 2014 are from the Washington State Office of Financial Management (OFM). The OFM states that the median household income for the Kennewick-Pasco-Richland metro area for 2014 was projected to be $58,020. A 2-percent annual increase in the median household income was projected for 2015 through 2022. Based upon these affordability criteria, the City is well within the threshold for the forecast years of 2017 through 2022. The rates for years 2014 through 2019 are projected rates based upon the need to fund the capital improvements as shown in **Table 8-8** of **Chapter 8**. **Table 9-8** shows the average annual monthly bill based on past and projected rate increases and the maximum annual average monthly bill. With the rate increases projected in **Table 9-8**, the average monthly bill for a single-family residence will be no more than 73.6 percent of the maximum affordable monthly bill for drinking water.

Table 9-8
Affordability of Residential Rates

Year	Maximum Affordable Monthly Bill	Average Monthly Bill (Single-family Residential)	Effective Rate Increase
2022	$84.97	$58.97	1.00%
2021	$83.31	$58.38	1.00%
2020	$81.67	$57.81	1.00%
2019	$80.07	$57.23	1.00%
2018	$78.50	$56.67	1.00%
2017	$76.96	$56.11	1.00%
2016	$75.46	$55.55	0.00%
2015	$73.98	$55.55	---

CONCLUSION

The City continues to maintain the water utility in a healthy financial position and is taking steps with this WCP to ensure future stability of the water utility's financial status. Additionally, the City plans to conduct an in-depth rate study in 2016 that will more carefully evaluate both rates and CFCs required for financial stability.