CERTIFICATE OF ENGINEER

I hereby certify that this Water System Plan for the City of Kelso was prepared under the supervision and direction of the undersigned, whose seals as licensed professional engineers of the State of Washington are affixed below.

Signed: xx/xx/2023

_____

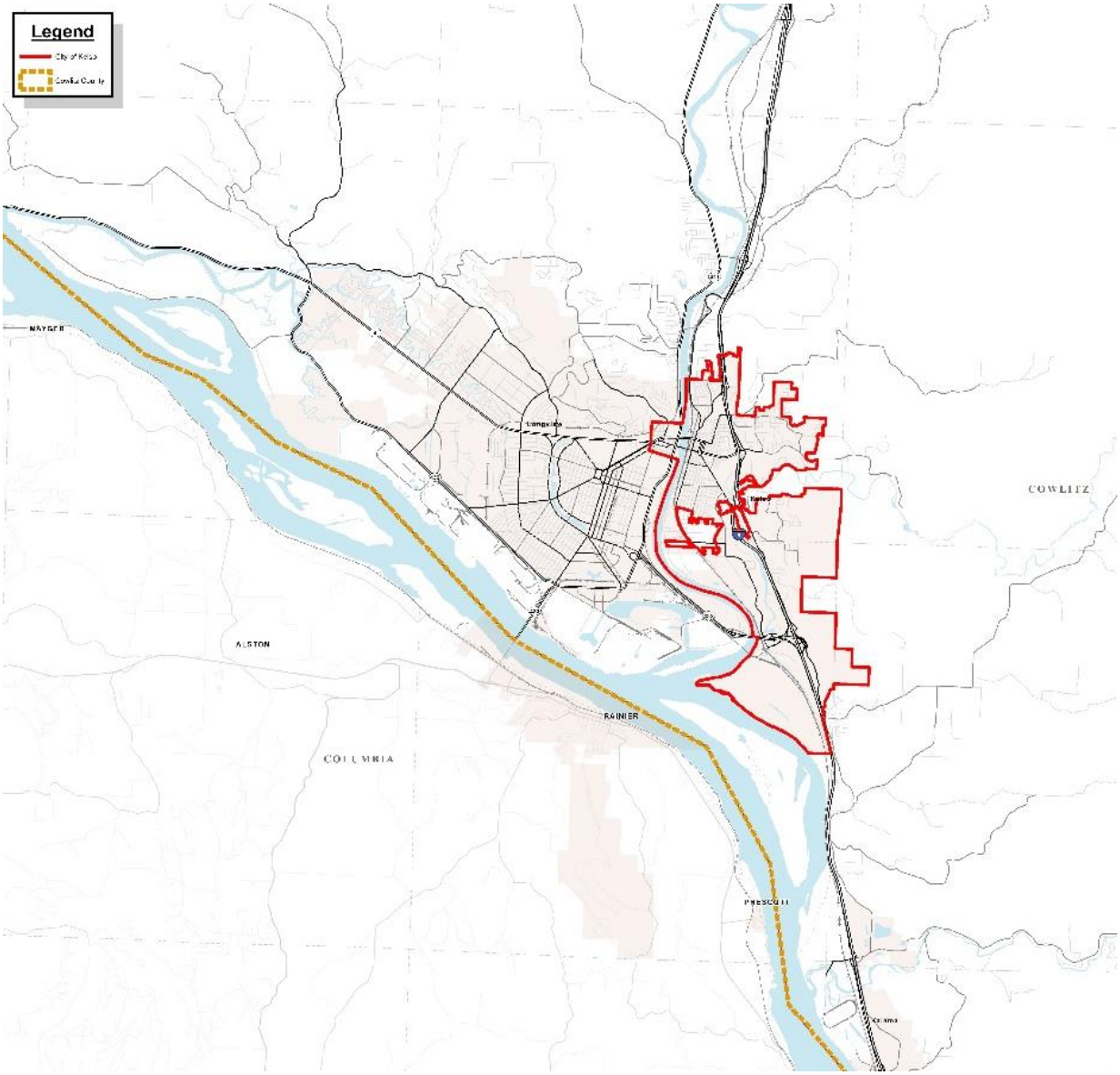
Geoffrey G. Dillard, P.E.

1 | INTRODUCTION

LOCATION

The City of Kelso (City) is located just north of the Washington-Oregon border, just upstream of the confluence of the Cowlitz and Columbia Rivers. The City was established in 1847, and was developed as a logging community before it was finally incorporated in 1889. **Figure 1.1, Vicinity Map (Cowlitz County)** illustrates the location of the City within Cowlitz County.

Figure 1.1
Vicinity Map



WATER SYSTEM OWNERSHIP

The City owns and operates a public water system. Water system data on file at the Washington State Department of Health (DOH) for the City's system is shown in **Table 1.1, Water System Ownership Information**.

Table 1.1
Water System Ownership Information

Information Type	Description
System Type	Group A - Community - Public Water System
System Name	City of Kelso
County	Cowlitz
DOH System ID Number	38000L
Address	PO Box 819 Kelso, WA 98626
Contact	Randy Johnson
Contact Phone Number	(360) 423-5730

OVERVIEW OF EXISTING SYSTEM

A summary of water system data for the City's system and the number of customers served in 2020 is shown in **Table 1.2, Water System Summary**.

Table 1.2
Water System Summary

Description	Data (2020)
Total City Population	12,340 people
Estimated Population Served by City	11,735 people
Estimated Population Served by Davis Terrace	605 people
Total Connections	4,688 accounts
Total Customers (w/o DSL)	12,450 ERU
Total Customers (w/ DSL)	15,275 ERU
Largest Customer (Foster Farms)	5,377 ERU
Average Day Demand per Customer	150 gpd/ERU

gpd = gallons per day
ERU = equivalent residential unit

A summary of the important characteristics of the City's existing water system facilities in 2020 is shown in **Table 1.3, Water System Description** and **Table 1.4, Water System Data.**

Table 1.3
Water System Description

Description	Facilities
Number of Pressure Zones	12
Wholesale Intertie Capacity	1,000 gpm
Source Capacity	2,300 gpm
Treatment Capacity	2,800 gpm
Total Water Rights	9,835 gpm
Number of Pressure Reducing Stations	10
Total Length of Water Main	410,893 LF (78 miles)
Number of Pump Stations	7
Number of Reservoirs [1]	10
Total Storage	7.8 MG

[1]Does not include Highland Park attenuation tank.

gpm = gallons per minute
LF = linear feet
MG = million gallons

Table 1.4
Water System Data

Description	Data (2020)
Population (2020)	12,340
Water Service Area	8.8 sq. miles
Total Connections (Accounts)	4,688
Total Customers	12,450
Demand per ERU (2020)	142 gpd/ERU
Demand per ERU used in WSP (5-year max)	150 gpd/ERU
Annual Supply	796 MG
Average Day Demand	1,231 gpm
Distribution System Leakage	19%
Maximum Day Demand/Average Day Demand Factor	1.69
Peak Hour Demand/Maximum Day Demand Factor	1.63
Ranney Collector Well (Production Capacity)	2,300 gpm
Number of Wholesale Interties (Production Capacity)[2]	1,000 gpm
Total Water Rights (Qi)	9,835 gpm
Total Water Rights (Qa)	6,728 afy
Number of System Reservoirs (Total Capacity)	10 (7.8 MG)
Number of Pressure Zones	12
Number of Pressure Reducing Stations	10
Total Length of Water Main	410,893 LF (78 miles)

The location of the City is shown in **Figure 1.1, Vicinity Map.**

AUTHORIZATION AND PURPOSE

In September 2018, the City authorized RH2 Engineering, Inc., to prepare a *Water System Plan* (WSP) update as required by state law under Washington Administrative Code (WAC) 246-290-100. It is the City's intent to update its WSP and submit it to DOH every 10 years. The previous plan was updated in March 2013. The purpose of this updated WSP is as follows:

- To evaluate the existing water demand data and project future water demands.
- To analyze the existing water system to determine if it meets minimum requirements mandated by DOH and the City's own policies and design criteria.
- To identify water system improvements to resolve existing system deficiencies and accommodate future needs of the system for at least 20 years into the future.
- To prepare a schedule of improvements that meets the goals of the City's financial program.

- To evaluate past water quality and identify water quality improvements, as necessary.
- To document the City's operations and maintenance program.
- To evaluate conservation, emergency response, cross-connection control, wellhead and watershed protection, and water quality monitoring plans.
- To comply with all other 2021 WSP requirements of DOH.

ORGANIZATION OF PLAN

A summary of the content of the chapters in the WSP is as follows:

- The **Executive Summary** provides a brief summary of the key elements of this WSP.
- **Chapter 1** introduces the reader to the City's water system, the objectives of the WSP, and the WSP organization.
- **Chapter 2** presents the water service area, describes the existing water system, and identifies the adjacent water purveyors.
- **Chapter 3** presents related plans, land use, and population characteristics.
- **Chapter 4** identifies existing water demands and projected future demands.
- **Chapter 5** presents the City's operational policies and design criteria.
- **Chapter 6** discusses the City's water sources and water quality.
- **Chapter 7** discusses the water system analyses and existing system deficiencies.
- **Chapter 8** discusses the City's operations and maintenance program.
- **Chapter 9** presents the proposed water system improvements, their estimated costs, and implementation schedule.
- **Chapter 10** summarizes the financial status of the water utility.
- The **Appendices** contain additional information and plans that supplement the main chapters of the WSP.

ACRONYMS AND ABBREVIATIONS

AC	asbestos cement
ADD	Average Day Demand
afy	acre feet per year
AWWA	American Water Works Association
BPS	Booster Pump Station
CIP	Capital Improvement Program
City	City of Kelso

cfs	cubic feet per second
County	Cowlitz County
CT	Contact Time
CWSSA	Critical Water Supply Service Area
DOH	Washington State Department of Health
DI	ductile iron
DSL	Distribution System Leakage
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential Unit
fps	feet per second
GMA	Growth Management Act
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HGL	Hydraulic Grade Line
hp	Horsepower
MCL	Maximum Contaminant Level
MDD	Maximum Day Demand
MG	million gallons
mg/L	milligrams per liter
MGD	Million Gallons per Day
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
psi	pounds per square inch
RCW	Revised Code of Washington
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SSPL	Second Supply Pipe Line (City of Tacoma)
TDH	Total Dynamic Head
UGA	Urban Growth Area

WAC	Washington Administrative Code
WSFFA	Water Supply and Facilities Funding Agreement
WSA	Water Service Area
WSP	Water System Plan

DEFINITION OF TERMS

Annual Demand: The total water system demand for one calendar year.

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. ADD is typically expressed as gallons per day per equivalent residential unit (gpd/ERU).

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.

Contaminant: A substance present in drinking water that may adversely affect the health of the consumer or the aesthetic qualities of the water.

Critical Water Supply Service Area (CWSSA): A geographical area that is characterized by a proliferation of small, inadequate water systems, or by water supply problems that threaten the present or future water quality or reliability of service in a manner that efficient and orderly development may best be achieved through coordinated planning by the water utilities in the area.

Cross-Connection: Any physical connection, actual or potential, between a water system and any source of a non-potable substance that presents the potential for contaminating the public water system.

Dead Storage: The volume of stored water not available to all consumers at the minimum design pressure.

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

Demand Forecast: An estimate of future water system water supply needs assuming historically normal weather conditions and calculated using numerous parameters, including population, historic water use, local land use plans, water rates and their impacts on consumption, employment, projected water use efficiency savings from implementation of a water use efficiency program, and other appropriate factors.

Disinfection: The use of chlorine or other agent or process for killing or inactivating microbiological organisms, including pathogenic and indicator organisms.

Distribution System Leakage (DSL): The amount of water supply lost to leakage.

Equalizing Storage: The volume of storage needed to supplement supply to consumers when the peak hourly demand exceeds the total source pumping capacity.

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 firefighting, which is usually expressed in terms of gpm.

Fire Suppression Storage: The volume of stored water available during fire suppression activities to satisfy minimum pressure requirements.

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: Reduction in pressure resulting from pipeline wall friction, bends, physical restrictions, or obstructions.

Hydraulic Analysis: The study of a water system's distribution main and storage network to determine present or future adequacy for provision of service to consumers within the established design parameters for the system under peak flow conditions, including fire flow. The analysis is used to establish any need for improvements to existing systems or to substantiate adequacy of design for distribution system components such as piping, elevated storage, booster stations, or similar facilities used to pump and convey water to consumers.

Hydraulic Elevation: The height of a free water surface above a defined datum; the height above the ground to which water in a pressurized 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 WAC 246-290-300, Table 3.

Maximum Day Demand (MDD): The maximum amount of water delivered to the system during a 24-hour time period of a given year.

Operational Storage: The volume of distribution storage associated with source or booster pump normal cycling times under normal operating conditions. Operational storage is additive to the equalizing and standby storage components, and to fire flow storage if this storage component exists for any given tank.

Peak Hour Demand (PHD): The maximum amount of water delivered to the system, excluding fire flow, during a one-hour time period of a given year. A system's peak hour demand usually occurs during the same day as the maximum day demand.

Potable: Water suitable for human consumption.

Pressure Zone: A portion of the water system that operates from sources at a common hydraulic elevation. For example, 748 Pressure Zone refers to a pressure zone that has water tanks with an overflow elevation of 748 feet.

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

Reclaimed Water: Effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for beneficial use or a controlled use that would not otherwise occur; it is no longer considered wastewater.

Standby Storage: The volume of stored water available for use during a loss of source capacity, power, or similar short-term emergency.

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

Storage: Water that is "stored" in a reservoir to supplement the supply facilities of a system and provide water supply for emergency conditions. Storage is broken down into the following five components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage.

Water Right: A permit, claim, or other authorization, on record with or accepted by the Washington State Department of Ecology, authorizing the beneficial use of water in accordance with all applicable State laws.

2 | WATER SYSTEM DESCRIPTION

WATER SYSTEM MANAGEMENT

The City of Kelso's (City) water system is operated and maintained by the City, a municipal corporation that is governed by a Mayor-Council form of government. The water system is operated and maintained by the City's Public Works Department. The Washington State Department of Health (DOH) water system identification number is 38000L. A copy of the Water Facilities Inventory (WFI) Form is included in **Appendix A – Water Facilities Inventory (WFI) Form**. DOH has oversight on the review and approval of the City's system and *Water System Plan* (WSP).

SYSTEM BACKGROUND

HISTORY OF WATER SYSTEM DEVELOPMENT AND GROWTH

The City was founded in the mid-1800s and has been providing water to its customers since the 1920s. Water service to the Longview-Kelso Urban Area is supplied by three major purveyors: the City of Kelso, the City of Longview (Longview), and the Beacon Hill Water and Sewer District (BHWSD). The City has a 2019 estimated population of 12,220. The City's water service area covers approximately 5,632 acres, or 8.8 square miles, within the city limits and unincorporated Cowlitz County (County) areas. Two private water associations also operate in the urban area, the Carrolls Water Association and the Davis Terrace Water Association (DTWA). The Carrolls Water Association is located to the Southeast of the City of Kelso and owns multiple groundwater wells. The DTWA receives its water from the City's distribution system.

Growth and System Planning Efforts

The City, along with Longview and the Cowlitz County Public Utility District No. 1 (PUD), developed the *Longview-Kelso Urban Area Comprehensive Water System Plan* (CWSP). In 2012, each purveyor was encouraged by DOH to develop their own water system plan. The primary purpose of this WSP update is to assist the City in developing a long-term planning strategy and its ability to handle future demands and requirements for water quality, storage, source, transmission, and distribution for a 20-year planning horizon. In order to continually provide reliable water service to its customers, this WSP makes recommendations for water system improvements necessary to accommodate future demands.

ADJACENT PURVEYORS

There are two major purveyors adjacent to the City's water service area (WSA): Longview and Beacon Hill Water and Sewer District (BHWSD). Adjacent purveyors and the County have been afforded the opportunity to comment on this WSP. Comments received from adjacent purveyors have been included in **Appendix B – Adjacent Purveyors and Agency Review Comments**.

INVENTORY OF EXISTING FACILITIES

This section provides a detailed description of the existing water system and the current operation of the facilities. The analysis of the existing water system is presented in **Chapter 7 – Water System Analysis**.

SYSTEM OVERVIEW

The City's water system is served by the Ranney Collector Well, located in the western portion of the City along the eastern bank of the Cowlitz River. Water from the Ranney Collector Well is then pumped to the Kelso Water Treatment Plant and delivered to the 188 Pressure Zone.

The City has 10 reservoirs that serve its water system. The City's distribution system currently operates with 12 pressure zones: the highest-pressure zone has a hydraulic grade line of approximately 544 feet, and the lowest pressure zone has a hydraulic grade line of approximately 188 feet. Portions of the City's system operate with high pressures (i.e., over 100 pounds per square inch [psi]); and individual pressure reducing valves (PRVs) are required on all high-pressure service connections throughout the WSA. **Figure 2.1, Existing Water System** illustrates the existing configuration of the City's water system.

SOURCES OF SUPPLY

Ranney Collector Well

Currently, the City's primary source of water is the City's Ranney Collector located in the western portion of the City's WSA. Typical flow capacities for the Ranney Collector Well, with water rights for comparison purposes, are listed in **Table 2.1, Capacity**. Over the last several years, late summer flows from the Ranney Collector Well have been decreasing.

Table 2.1
Capacity

Water Right Capacity	Treatment Capacity	Recent Ranney Collector Well Capacity (2020)	Longview Intertie Capacity	MDD (2020)
(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
9,835	2,800	2,300	1,000	2,367

gpm = gallons per minute

Water Rights

The City currently holds five water rights, including two surface water certificates, one groundwater certificate, one surface water permit, and one groundwater permit on file with the Washington State Department of Ecology (Ecology).

These water rights meet the definition of being for municipal water supply purposes, provided under Revised Code of Washington (RCW) 90.03.015. These water rights are summarized in **Table 2.2, Water Rights.**

Table 2.2
Water Rights

Water Right Number	Record/Document Number	Priority Date	Source Type	Instantaneous Rate (Qi) (gpm)		Annual Volume (Qa) (afy)	
				Additive	Non-additive	Additive	Non-additive
SWC 2195	S2-*01536CWRIS	11/2/1925	Cowlitz River	1,347	0	2,172	0
S2-01119C	S2-01119CWRIS	2/20/1968	Cowlitz River	4,488	0	208	2,172
G2-24762C	G2-24762CWRIS	12/28/1977	Ranney Well	2,500	0	420	2,380
S2-29856P	S2-29856	6/3/1999	Ranney Well	0	8,335	2,800	0
G2-29813P	G2-29813	11/20/1998	Three Wells	1,500	0	1,128	1,272
Total		--	--	**9,835**	--	**6,728**	--

Notes:

gpm = gallons per minute. afy = acre-feet per year

SWC 2195 authorizes 3.0 cubic feet per second (cfs), which is equal to 1,347 gallons per minute, as shown in this table.

SWC 2195 does not specify the annual volume. The value assigned here is based on 24/7 diversion.

S2-01119C authorizes 10.0 cfs, which is equal to 4,488 gpm.

S2-29856P authorizes SWC 2195, S2-01119C, G2-24762C, and S2-29856P to divert up to 18.57 cfs, which is equal to 8,335 gpm.

Interties

Water system interties are physical connections between two adjacent water systems. Interties are normally separated by a closed isolation valve or a control valve. Emergency supply interties provide water from one system to another during emergency situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main, and is unable to provide a sufficient quantity of water to its customers. Normal supply interties provide water from one system to another during non-emergency situations and are typically supplying water at all times.

The City currently has four interties with adjacent water systems. Two interties connect the City with BHWSD to provide continuous water service to the District's service areas. One two-way intertie connects the Longview and the City water systems. The fourth is with DTWA to provide continuous wholesale water to DTWA. The intertie descriptions are outlined in **Table 2.3, Intertie Water Supply and Water Wheeling Agreements**.

Table 2.3
Intertie Water Supply and Water Wheeling Agreements

Agreement	Date of Agreement	Approximate Supply Capacity (gpm)
City of Longview Emergency Two-Way Intertie	March 1977	1,000
Beacon Hill Water and Sewer District; Cowlitz Gardens	Decmber 2010	No recorded capacity
Beacon Hill Water and Sewer District; Williams-Finney	Decmber 2010	No recorded capacity
Davis Terrace Water Association	August 1991	No recorded capacity

PUMPING FACILITIES

The City currently operates and maintains seven active pump stations. An overview of the City's pump stations is provided in **Table 2.4, City of Kelso Pump Stations**.

Table 2.4
City of Kelso Pump Stations

Pumping Station Name and Location	Pumps From	Pumps To	Serves	Control	Horsepower and Approximate Capacity
Minor Road, 200 Minor Road (Minor Road Reservoir)	Main Pressure Zone 188	Williams-Finney Reservoir (El 322)	Zone 322	Supervisory Control and Data Acquisition (SCADA) Ethernet Radio.	Two Pumps No. 1 50 HP 800 gpm No. 2 50 HP 800 gpm
Carroll Road (a) 517 Carroll Road	Main Pressure Zone 188	Carroll Road Reservoir (El 517)	Zone 517 Zone 311	SCADA Ethernet Radio.	Two Pumps No. 1 25 HP 130 gpm No. 2 25 HP 130 gpm
18th Ave. 18th Ave., next to Butler Acres Grade School	Williams-Finney Pressure Zone 322	Behshel Heights Reservoir (El 443)	Zone 443 Zone 320 Zone 264	SCADA Ethernet Radio.	Two Pumps No. 1 50 HP 600 gpm No. 2 50 HP 600 gpm
Rocky Point Rocky Point Reservoir	Main Pressure Zone 188 ft.	Rocky Point Pressure Zone 301	Zone 301	Pressure switch at the station. Pumps run in series.	Two Pumps No. 1 5 HP 75 gpm No. 2 5 HP 75 gpm
Behshel Heights 1418 Behshel Heights Road	Behshel Heights Pressure Zone (El. 443 ft.)	Mt. Brynion Estates Pressure Zone	Zone 522	Pressure switch at station. Pumps run continuously in parallel. Backed up by a standby generator.	Three Pumps No. 1 5 HP 100 gpm No. 2 15 HP 400 gpm No. 3 40 HP 1,120 gpm
Lower Haussler Pump House Kelso Drive	Kelso Main Pressure Zone 188	Highland Park Pump Station (El 410)	Zone 410 Zone 297	Pressure switch and SCADA controlled on Ethernet Radio. Pumps operate as lead / standby.	Two Pumps No. 1 15 HP 150 gpm No. 2 15 HP 150 gpm
Highland Park Highland Park Drive	Pressure Zone 410 (Equalization Tank)(b)	Tybren Heights Reservoir (El 544)	Zone 410 Zone 544	Reservoir Level SCADA Radio telemetry controlled using equalizing tank with float controls adjacent pump station. Pumps operate with one lead and two standbys.	Three Pumps No. 1 15 HP 175 gpm No. 2 15 HP 175 gpm No. 3 15 HP 175 gpm

Minor Road Pump Station

The Minor Road Pump Station has a maximum capacity of approximately 800 gallons per minute (gpm). The two pumps were designed to operate at 800 gpm each. A 12-inch-diameter water main runs from the Minor Road Pump Station to the 322 Pressure Zone.

Carroll Road Pump Station

The Carroll Road Pump Station has a maximum capacity of approximately 130 gpm. The two pumps were designed to operate at 130 gpm each. An 8-inch-diameter water main runs from the Carroll Road Pump Station to the 311 and 517 Pressure Zones.

18th Avenue Pump Station

The 18th Avenue Pump Station has a maximum capacity of approximately 600 gpm. The two pumps were designed to operate at 600 gpm each. An 8-inch-diameter water main runs from the 18th Avenue Pump Station to the 443, 320, and 264 Pressure Zones.

Rocky Point Pump Station

The Rocky Point Pump Station has a maximum capacity of approximately 75 gpm. The two pumps run in series. A 6-inch-diameter water main runs from the Rocky Point Pump Station to the 301 Pressure Zone.

Behshel Heights Pump Station

The Behshel Heights Pump Station has three pumps that run continuously in parallel. The three pumps were designed to operate at 1,120, 400, and 100 gpm respectively. An 8-inch-diameter water main runs from the Behshel Heights Pump Station to the 522 Pressure Zone.

Lower Haussler Pump Station

The Lower Haussler Pump Station has a maximum capacity of approximately 150 gpm. The two pumps were designed to operate at 150 gpm each. An 8-inch-diameter water main runs from the Lower Haussler Pump Station to the 297 and 410 Pressure Zones.

Highland Park Pump Station

The Highland Park Pump Station has a maximum capacity of approximately 175 gpm. The three pumps were designed to operate at 175 gpm each. An 8-inch-diameter water main runs from the Highland Park Pump Station to the 410 and 544 Pressure Zones.

STORAGE

The City currently is served by 10 reservoirs. An overview of the City's storage facilities and reservoirs is provided in **Table 2.5, City of Kelso Reservoirs**.

Table 2.5
City of Kelso Reservoirs

No.	Reservoir Name	Volume (MG)	Overflow Elevation (feet)	Material	Year Built
1	Minor Road	2.00	188	Prestressed Concrete	2018
2	Williams-Finney	0.50	322	Welded Steel	1965
3	Behshel Heights No. 1	0.25	443	Welded Steel	1957
4	Behshel Heights No. 2	0.50	443	Bolted Steel	1988
5	Carrolls Road	0.50	517	Welded Steel	1978
6	Rocky Point	0.50	188	Welded Steel	1978
7	Paxton Road No. 1	0.50	188	Welded Steel	1973
8	Paxton Road No. 2	2.00	188	Prestressed Concrete	2012
9	Tybren Heights No. 1	0.20	544	Bolted Steel	2000
10	Tybren Heights No. 2	0.20	544	Bolted Steel	2000
Total		7.15	--	--	--

Minor Road Reservoir

The 2.00 Million Gallon (MG) Minor Road Reservoir is located on City owned parcels approximately 450 feet northeasterly from the intersection of North Minor Road and Mt. Brynion Street. This reservoir was constructed in 2018, and has an overflow elevation of approximately 188 feet.

Minor Road Reservoir

Williams-Finney Reservoir

The 0.50 MG Williams-Finney Reservoir is located on a City owned parcel approximately 1,100 feet southeasterly from the intersection Mt. Brynion Street and Williams Finney Road. This reservoir was constructed in 1965, and has an overflow elevation of approximately 322 feet.

Williams-Finney Reservoir

Behshel Heights Reservoir No. 1

The 0.25 MG Behshel Heights Reservoir No. 1 is located on a City owned parcel approximately 650 feet southeasterly from the intersection of Behshel Heights and Tara Street. This reservoir was constructed in 1957, and has an overflow elevation of approximately 443 feet.

Behshel Heights Reservoir No. 1

Behshel Heights Reservoir No. 2

The 0.50 MG Behshel Heights Reservoir No. 2 is located on a City owned parcel approximately 650 feet southeasterly from the intersection of Behshel Heights and Tara Street. This reservoir was constructed in 1988, and has an overflow elevation of approximately 443 feet.

Behshel Heights Reservoir No. 2

Carrolls Road Reservoir

The 0.50 MG Carrolls Road Reservoir is located on a City owned parcel approximately 250 feet northeasterly from the intersection of Carrolls Road and Tybren Heights Road. This reservoir was constructed in 1978, and has an overflow elevation of approximately 517 feet.

Carrolls Road Reservoir

Rocky Point Reservoir

The 0.50 MG Rocky Point Reservoir is located on a City owned parcel approximately north of the end of Rocky Point Road just west of Interstate 5 (I-5). This reservoir was constructed in 1978, and has an overflow elevation of approximately 188 feet.

Rocky Point Reservoir

Paxton Road Reservoir No. 1

The 0.50 MG Paxton Road Reservoir No. 1 is located on a City owned parcel approximately 650 feet northeasterly from the intersection of S Kelso Drive and Paxton Road. This reservoir was constructed in 1973, and has an overflow elevation of approximately 188 feet.

Paxton Road Reservoir No. 1

Paxton Road Reservoir No. 2

The 2.00 MG Paxton Road Reservoir No. 2 is located on a City owned parcel approximately 650 feet northeasterly from the intersection of S Kelso Drive and Paxton Road. This reservoir was constructed in 2012, and has an overflow elevation of approximately 188 feet.

Paxton Road Reservoir No. 2

Tybren Heights Reservoir No. 1

The 0.20 MG Tybren Heights Reservoir No. 1 is located on a City owned parcel at the end of Tybren Heights Road. This reservoir was constructed in 2000, and has an overflow elevation of approximately 544 feet.

Tybren Heights Reservoir No. 1

Tybren Heights Reservoir No. 2

The 0.20 MG Tybren Heights Reservoir No. 2 is located on a City owned parcel at the end of Tybren Heights Road. This reservoir was constructed in 2000, and has an overflow elevation of approximately 544 feet.

Tybren Heights Reservoir No. 2

Highland Park Tank (Non-Distribution Storage)

The 0.02 MG Highland Park Tank is located a on City owned parcel along Highland Park Drive 500 feet before it turns into W Highland Park Drive. This reservoir was constructed in 1998, and has an overflow elevation of approximately 544 feet.

Highland Park Reservoir

PRESSURE ZONES

The City's water system consists of 12 pressure zones. An existing system hydraulic profile is shown on **Figure 2.2, Existing Hydraulic Profile**. This figure shows the vertical relationship of the pressure zones and demonstrates how the water moves throughout the system. Additionally, **Figure 2.3, Existing Pressure Zones** shows the various pressure zones located within the City. Currently the City's system has five open pressure zones and seven closed pressure zones. An open pressure zone is served by a storage reservoir open to atmospheric pressure whereas a closed pressure zone is not open to atmospheric pressure. These pressure zones have been created through the use of PRVs and closed valves in the system.

PRESSURE REDUCING STATIONS

PRVs are installed between pressure zones to allow water from a higher-level pressure zone to flow into the lower level pressure zone at reduced pressures. The PRVs hydraulically vary the flow rates to maintain a constant and preset pressure in the downstream or lower level pressure zone. This results in a safe range of pressures in the lower zone. The City has ten pressure reducing stations that serve five pressure zones throughout the system to help moderate pressures in the distribution system.

Table 2.6, Pressure Reducing Valves summarizes the location and upstream and downstream pressure zones of the City's existing PRVs.

Table 2.6
Pressure Reducing Stations

Pressure Reducing Station Location	Elevation (feet)	Size (inches)	Upstream Pressure Setting (psi)	Downstream Pressure Setting (psi)	Upper Pressure Zone (HGL)	Lower Pressure Zone (HGL)
Carroll Road	149	2	155	48.0	517	311
	149	6	152	48.0	517	311
Sunrise Street & Sunburst Ct.	102	2	150	94.0	443	320
	102	6	148	94.0	443	320
18th Avenue & Harris Street	166	6	Off	Off	443	--
19th Avenue & Allen Street	29	6	Off	Off	322	--
Barr Drive & Allen Street	32	4	Off	Off	322	--
North Crescent Drive (Behshel Heights)	98	2	150	36.0	443	264
	98	6	146	36.0	443	264
Apple Lane & Haussler Road (Tybren Heights)	240	2	80	34.0	410	297
	240	4	80	34.0	410	297
West Vista Way	335	2	108	47.0	544	410
	335	4	102	47.0	544	410
Highland Park	335	2	108	0.0	544	297
	335	4	108	0.0	544	297
Corduroy	25	4	Off	Off	443	--

TRANSMISSION AND DISTRIBUTION

Pipes

The existing transmission and distribution system is shown in **Figure 2.1, Existing Water System**. The water system consists of approximately 411,000 linear feet of pipe. The existing transmission and distribution system consist of pipes ranging in size from 2 inches to 16 inches in diameter. The pipes are manufactured from various materials, including asbestos cement (AC), ductile iron (DI), cast iron (CI), galvanized iron (GI), copper, steel, and polyvinyl chloride (PVC). **Table 2.7, Pipe Inventory** shows a summary of the various pipe sizes and materials.

Table 2.7
Pipe Inventory

Diameter (inches)	Length (feet)	Percent of Total
3 or less	23,622	5.7%
4	37,152	9.0%
6	110,110	26.8%
8	137,108	33.4%
10	29,681	7.2%
12	50,465	12.3%
14	4,084	1.0%
16	17,823	4.3%
18	849	0.2%
Total	410,893	**100%**
Material	**Length (feet)**	**Percent of Total**
Asbestos Cement	62,017	15.1%
Cast Iron	101,807	24.8%
Ductile Iron	220,018	53.5%
Galvanized Iron	8,143	2.0%
PVC	18,298	4.5%
Steel	609	0.1%
Total	410,893	100%

The size and material of the existing water mains are an important element when evaluating the City's water system. **Figure 2.4, Existing Pipe Sizes** shows the various pipe sizes of the City's water system. **Figure 2.5, Existing Pipe Materials** shows the various pipe materials of the City's water system.

Meters

There are 4,688 metered service connections within the City's WSA at the time of this plan. Approximately 77 percent, or 3,599, of the connections are for single-family residences. The remaining meters are for public buildings and facilities, multi-family residences, irrigation, and industrial and commercial businesses. Not all of the City's facilities have meters, the City will continue to install meters throughout their system as the need arises.

TELEMETRY AND CONTROL SYSTEM

A telemetry and supervisory control system collects information and can efficiently control a water system by automatically optimizing facility operations. The telemetry and control system is capable of providing alarm notifications in the event of equipment failure, reservoir overflow, or other emergency situations. The City currently tracks reservoir levels via SCADA.

TREATMENT FACILITIES

The City owns and operates a Ranney Collector Well along the Cowlitz River. A Ranney Collector Well consists of a concrete caisson with laterals extending from the base that intercept groundwater. The City's Ranney Collector Well, originally installed in 1979, delivers raw water to the Kelso Water Treatment Plant (WTP). The water supply is considered by DOH to be groundwater under the influence of surface water. The City owns and operates a Group 3 WTP (Kelso WTP), which is located along 1st Ave South, adjacent to the Cowlitz River. The water treatment system is designed to remove manganese, iron, particulate matter, and arsenic. The iron/manganese treatment facility was originally constructed in 1984. The plant was updated in 2002 to comply with surface water treatment requirements established by DOH. The treatment plant filters are capable of producing up to 4.8 million gallons per day (MGD); however, the Ranney Collector Well was designed to produce between 3.5 and 4.08 MGD. The treatment process consists of coagulation, pressure filtration, iron, arsenic and manganese removal, chlorination, fluoridation, and pH adjustment for corrosion protection. The water is then pumped to the distribution system from the treatment plant. A description of elements of the facility are as follows:

- **Ranney Collector Well** – The estimated capacity is between 3.5 and 4.08 MGD depending on how recently the iron bacteria have been removed from the screens and laterals.
- **Vertical pressure filters** – Seven Tri-media filters, originally rated at 3 gpm per sf (3.6 MGD), were re-rated by DOH to be 4.0 gpm/square foot (4.8 MGD) provided that the current WTP optimization status is maintained.
- **Filter booster pumps** – Each pressure filter has a dedicated 7.5 horsepower (HP) booster pump. The booster pump primary operating point is 320 gpm with an upper end of 360 gpm; however, the pumps can produce up to 400 gpm during periods of high demand. When operated at 360 gpm or above, booster pumps are operating beyond the recommended amperage. To improve plant reliability, the booster pump motors should be upsized to a minimum of 10 HP.
- **Filter Backwash** – The backwash process consists of a modulated butterfly valve which operates based on the backwash surge tank level. The backwash flows to directly to sewer.
- **Finished (treated) water delivery** – Two pumps and clear well, both pumps can operate simultaneously. One pump operation produces approximately 2,400 gpm; and two pump operation produces approximately 3,600 gpm.
- **Chemical feed systems** – Chemical feed systems for chlorination, fluoridation, coagulation, and finished water pH adjustment.

WATER SERVICE AREA

The boundaries of the City's water service area (WSA) are depicted in **Figure 2.6, Water Service Area**.

Retail Service Area

The Municipal Water Supply – Efficiency Requirements Act, Chapter 5, Laws of 2003 (Municipal Water Law) amended the Washington State Board of Health Code (Chapter 43.20 RCW) to require that municipal water suppliers provide water service to all new retail customers within a retail service area under certain conditions. A retail service area is the area within which water is or will be sold directly to the ultimate consumers.

According to the Municipal Water Law, a municipal water supplier has a duty to serve new water service within the identified retail service area if the utility:

- Its service can be available in a timely and reasonable manner;
- The municipal supplier has sufficient water rights to provide service;
- Has sufficient capacity to serve the water in a safe and reliable manner as determined by DOH; and
- Is consistent with the requirements of any comprehensive plans or development regulations adopted under Chapter 36.70A RCW or any other applicable adopted comprehensive plans, land use plans, or development regulations adopted by the city or town, with the utility service extension ordinances of the city or town.

PHYSICAL ENVIRONMENT

Planning for the future water system requires a basic understanding of the physical environment of the WSA. A working knowledge is useful in identifying any constraints that may affect the development of the water system. Physical characteristics that influence planning and design include topography, geology, soils, surface water, groundwater, and climate. Descriptions of these characteristics, as well as a summary of environmentally sensitive areas in the City, are as follows.

Topography

The City is located within a topographic basin that is surrounded by bedrock uplands. The topography within the basin is predominantly flat with a shallow regional slope towards the Columbia River. The City's service area topography varies from steep slopes to generally flat terrain, sloping south and west towards the Cowlitz and Columbia Rivers. The Columbia and Cowlitz Rivers border the City's service area to the south and west, respectively. The northern and eastern portions of the City's service area consist of hilly uplands. The change in elevation between the City's lower and upper pressure zones is approximately 300 feet.

Geology and Soils

The City is located at the northern extent of the Portland Basin physiographic province. The Portland Basin is a structural depression that is part of the larger north-to-south trending Puget-Willamette Lowland, a tectonic forearc trough between the Coast Range forearc high to the west and Cascade Range volcanic arc to the east. The basin has been shaped by an active tectonic margin, basin fill from surrounding uplands and volcanic activity, catastrophic glacial flood events, and modern river drainages.

The City is located immediately north of the confluence of Cowlitz River and the Columbia River and includes the lower Coweeman River and surrounding uplands. Portions of the City are located within the river valleys on recent alluvium and older alluvial (Pleistocene-aged) terrace deposits. The remainder of the City is located on eastern uplands composed of Tertiary-aged volcanic and sedimentary bedrock.

Recent alluvium, east of Cowlitz River and along Coweeman River, consists of unconsolidated sand, gravel, and silt and peat deposits. Forming terraces along the edges of recent alluvium are Pleistocene-age valley fill deposits consisting of fine sand and silt. Within the City, these terraces are located at the eastern edge of the Cowlitz River Valley, along Interstate 5 (I-5) in the northern portion of the City and along the north and south edges of Coweeman River Valley.

The upland areas in the northeast and southeast portions of the City are situated on volcanic and sedimentary bedrock of the Troutdale Formation, Cowlitz Formation, and Goble Formation. The Troutdale Formation, widespread in upland portions of the City, consists of poorly consolidated sedimentary units deposited by an ancestral Columbia River. The Cowlitz Formations consists of sedimentary and volcanic units and the Goble Formation is primarily volcanic units.

Significant land sliding has occurred that is associated with deeply weathered or poorly consolidated sediments of the Troutdale and Cowlitz formations in the City (Wegmann, 2006). Landslide mapping by the Washington State Department of Natural Resources (WDNR) identifies several large active and inactive deep-seated landslides in the northeast and southeast portion of the City along the upland margins. Smaller areas of active and inactive landslides and potentially unstable sediments are identified in the northeast upland areas of the City.

WDNR geologic mapping identifies faulting originating in bedrock that is mapped roughly along the I-5 corridor trending north to south within the City. Fault activity and offset is unknown according to WDNR.

The tectonic setting of the City results in significant seismic activity. During an earthquake, unconsolidated sediments are susceptible to liquefaction when saturated. The WDNR identifies the following liquefaction susceptibility of surficial deposits in the City vicinity: recent alluvium deposits are identified as having a moderate to high liquefaction susceptibility; older alluvium (Pleistocene terraces) has a very low to low liquefaction susceptibility; and the poorly consolidated Troutdale Formation has a very low liquefaction susceptibility. Bedrock of the Cowlitz and Goble Formations is not susceptible to liquefaction.

The WDNR identifies the following Seismic Site Classes for the geologic units in the City vicinity, based on the National Earthquake Hazards Reduction Program (NEHRP): Class D to E for recent alluvium, Class C for older alluvium (Pleistocene terraces), Class C to D for younger bedrock (Troutdale Formation), and Class B for older bedrock (Cowlitz and Goble Formations).

Surface Water

The City's WSA lies within the Cowlitz River drainage basin (Water Resource Inventory Area [WRIA] 26). A number of rivers, wetlands, and creeks lie within the WSA.

The lower Coweeman and Cowlitz Rivers are located in the southern and western part of the City limits. The lower Coweeman River discharges to the Cowlitz River just upstream of the mouth of the Cowlitz at the Columbia River.

Ostrander Creek discharges to the Cowlitz River just north of the City. Regulating land use within the basin is critical in order to promote open space and protect the drainage basin from future degradation.

The Cowlitz River originates just south of Mount Rainer, approximately 75 miles northeast of the City. Mainstream flows are regulated approximately 30 miles upstream of the City by a flood control structure owned by Tacoma Public Utilities known as the Mayfield Dam.

Climate

The City experiences a semi-maritime climate since it is located approximately 50 miles inland from the Pacific Ocean. Seasons are somewhat mild with cool wet winters, occasional snowfall, and warm summers. Cloudy skies and fog are common due to the proximity of the Pacific Ocean. According to the Western Regional Climate Center, the City receives an average of 42.87 inches of precipitation per year, an average high of 60.7 degrees Fahrenheit and average low of 40.2 degrees Fahrenheit.

Environmentally Sensitive Areas

The Kelso Municipal Code (KMC), Chapter 17.26 establishes regulations for development in environmentally sensitive areas, also known as critical areas. These regulations were developed to protect sensitive areas within the City which include wetlands, geologically hazardous areas, fish and wildlife habitat conservation areas, frequently flooded areas, and critical aquifer recharge areas. Data on the location and extent of documented sensitive areas within the City can be obtained from the City, Cowlitz County, and/or state and federal agency databases.

KMC establishes regulated buffers that protect the land directly surrounding sensitive areas. The width of the regulated buffer depends on the type and quality of the sensitive area. Direct impacts to sensitive areas or their associated buffer are either prohibited by KMC or require documentation, minimization actions, and compensatory mitigation subject to approval by the City or County. If a project is proposed within proximity to a known or potential sensitive area, the presence or absence of sensitive areas shall be confirmed by a qualified professional per KMC. Any project involving new development or significant alteration of an area should assess potential impacts to sensitive areas and/or their buffers and correspond with the City's planning department regarding required permits and documentation. The existing

environmental conditions, potential project impacts, and regulatory requirements shall be assessed before or concurrently with design of each individual project.

Moreover, certain projects may require compliance with the State Environmental Policy Act (SEPA) wherein project impacts to various elements of the environment will be evaluated.

LAND USE AND ZONING

Land use and zoning play an important role in determining growth patterns, and therefore, future water requirements. Future land use, variations in use, and changing population densities, as determined by applicable zoning ordinances, can significantly impact the City's ability to provide adequate water service. Land use and zoning are discussed in more detail in **Chapter 3 – Land Use and Population**.

SERVICE AREA AGREEMENTS

The City has a service area agreement that was developed with the City, Longview, and BHSWD. BHSWD assumed responsibility for agreements formerly signed by the PUD as ownership transfer took place in 2011. Additionally, the City has a Water Service Agreement with DTWA. The location of adjacent water purveyors is shown in **Figure 2.7, Adjacent Water Systems**. A copy of the following agreements has been included in **Appendix C – Water Service Area Agreements.**

- Water Services Area Agreement – March 1977: The City, Longview, and the PUD entered into an agreement to provide water to the urban area, to plan orderly system improvements to meet growth, and to provide a basis for decision-making on how to serve new customers without costly duplication of facilities. The following emergency agreements are in place in the event that normal water service is interrupted by an unforeseen event:
    - Water Utilities' Mutual Assistance Plan – 1971: This is a plan among the Cities of Kelso, Longview, Castle Rock, and Woodland; and the BHWSD, Carrolls Water Association, and Cloverdale Water Users' Association. The plan includes the exchange of assistance, emergency aid, equipment charges, labor charges, and equipment damage or loss between the water utilities.
- Water Service Agreement (Davis Terrace) – August 1991: Provides water service from the City to Davis Terrace granted acceptable assessment with upgrades of the Davis Terrace's existing system to meet the City's standards.
- Water Wheeling Agreements: The three purveyors established long-term wheeling agreements that allow the utilities to use each other's facilities to move water from the treatment facility to the service area point of delivery; without duplication of facilities. Water wheeling agreements include:
    - Agreement, Kelso and Beacon Hill Water & Sewer District – December 28, 2010: Provides for wheeling service by the City for the BHWSD to deliver water to the Cowlitz Gardens and Williams-Finney areas.

3 | LAND USE AND POPULATION

RELATED PLANNING DOCUMENTS

The following related planning documents were examined in the preparation of the City of Kelso's (City) *Water System Plan* (WSP) to ensure consistency with the land use policies of all involved agencies. Comments received from these agencies have been included in **Appendix B – Adjacent Purveyors and Agency Review Comments.** Comments and correspondence with Washington State Department of Health (DOH), including review checklists, are included in **Appendix D – DOH Checklists and Correspondence**.

CITY OF KELSO PLANNING DOCUMENTS

City of Kelso Water System Plan

The City's *2012 Water System Plan Update* (Kennedy/Jenks Consultants), approved by DOH in 2012, presented system improvements and projects necessary to update and enhance the existing water system facilities.

City of Kelso Comprehensive Plan

The City's *Comprehensive Plan* document includes chapters regarding the City's urban area, population and employment characteristics, and land use. The City's *Comprehensive Plan* was adopted in 2015 and revised in 2017.

REGIONAL PLANS AND DOCUMENTS

Cowlitz County Comprehensive Plan

The *Cowlitz County Comprehensive Plan* was adopted in 1976 and last updated in 2017. This document includes the City within the urban area of Cowlitz County (County) for purposes of planning, land use, and facility needs. The City's WSP has been developed consistent with the *Cowlitz County Comprehensive Plan*.

Cowlitz County Code

The Cowlitz County Code contains details in Chapter 15.14 regarding Water and Sewer Comprehensive Plans. A listing of the code sections is available through Cowlitz County and is available online. The City's WSP has been developed in conformance with these codes.

Water Resource Inventory Area (WRIA) 26 Plans

In 2014, Cowlitz County adopted the Grays-Elochoman and Cowlitz River Watershed *WRIA 26 Water Supply and Stream Flow Review Findings and Recommendations* which addresses topics such as fish resources, stream flows, future water supply needs, and watershed planning. These plans address interim and long-term conservation plans for salmon habitat in the Grays-Elochoman and Cowlitz watersheds. The City's WSP does not propose any improvements that are known to be in conflict with these planning documents.

LAND USE AND ZONING

Land use and zoning play an important role in determining growth patterns, and therefore, future water requirements. Future land use, variations in use, and changing population densities, as determined by applicable zoning ordinances, can significantly impact the City's ability to provide adequate water service.

Figure 3.1, City Land Use Designation is the proposed land use for the City as included in the City's *Comprehensive Plan*. This figure shows designated land use within incorporated Kelso that are within the City's Water Service Area (WSA). Current land uses are primarily residential uses, with some industrial and commercial areas.

Figure 3.2, County Land Use Designation includes the designated land uses for the area of Cowlitz County within the City's WSA. **Figure 3.2, County Land Use Designation** includes the zoning designations as defined by the County.

PROJECTED POPULATION AND LAND USE

Population projections for the 20-year planning horizon were estimated for the City's WSA based on a moderate annual growth rate of 1.00 percent. The growth rate data used for this study is based on the *Cowlitz County Comprehensive Plan* population projections and the US Census Bureau. The *Cowlitz County Comprehensive Plan* was last adopted in 2017.

Projected land uses are based on the City's Land Use Map as shown in the City's *Comprehensive Plan* and has been included previously in this WSP as **Figure 3.1, City Land Use Designation**. Population and equivalent residential unit (ERU) projections are included in **Table 3.1, Growth Projections.**

Table 3.1
Growth Projections

Year	City Population	Estimated Population Served By WSA	ERUs[1,2]
2020	12,340	17,683	15,275
2021	12,463	17,860	15,374
2022	12,588	18,039	15,474
2023	12,714	18,219	15,575
2024	12,841	18,401	15,677
2025	12,969	18,585	15,780
2026	13,099	18,771	15,884
2027	13,230	18,959	15,989
2028	13,362	19,148	16,095
2029	13,496	19,340	16,202
2030	13,631	19,533	16,311
2031	13,767	19,729	16,420
2032	13,905	19,926	16,530
2033	14,044	20,125	16,642
2034	14,185	20,326	16,755
2035	14,326	20,530	16,868
2036	14,470	20,735	16,983
2037	14,614	20,942	17,099
2038	14,760	21,152	17,217
2039	14,908	21,363	17,335
2040	15,057	21,577	17,455

[1]Includes Distribution System Leakage.

[2]Assumes constant water usage by Foster Farms.

4 | WATER DEMANDS

INTRODUCTION

A detailed analysis of system demands is crucial to a water purveyor's planning efforts. A demand analysis first identifies current supplies and demands to determine if the existing system can effectively provide an adequate quantity of water to its customers under the most crucial conditions, in accordance with federal and state laws. A future demand analysis identifies projected supplies and demands to determine how much water will be needed to satisfy future water system growth while continuing to meet federal and state laws.

Water system demands determine the size of storage reservoirs, supply facilities, water mains, and treatment facilities. Several different types of demands were analyzed and are addressed in this chapter, including average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), fire flow demand, future demands, and a conservation demand reduction forecast.

The magnitude of water demands is typically based on three main factors: 1) population; 2) weather; and 3) water use classification. Population and weather have the two largest impacts on water system demands. Population growth tends to increase the annual demand, whereas high temperatures tend to increase the demand over a short period of time. Population does not solely determine demand, because different populations use varying amounts of water. Actual water use varies based on the number of users in each type of customer class, land use density, and irrigation practices. Water use efficiency efforts also will impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

WATER USE CLASSIFICATIONS

For planning purposes, in the City of Kelso's (City) *Water System Plan* (WSP), the water customers have been combined into five different groups: 1) single-family residential; 2) multi-family residential; 3) commercial (which includes City and County government uses, schools, churches); 4) industrial (southern portion of water system), and; 5) wholesale customers (Cowlitz Gardens, Williams-Finney and Davis Terrace).

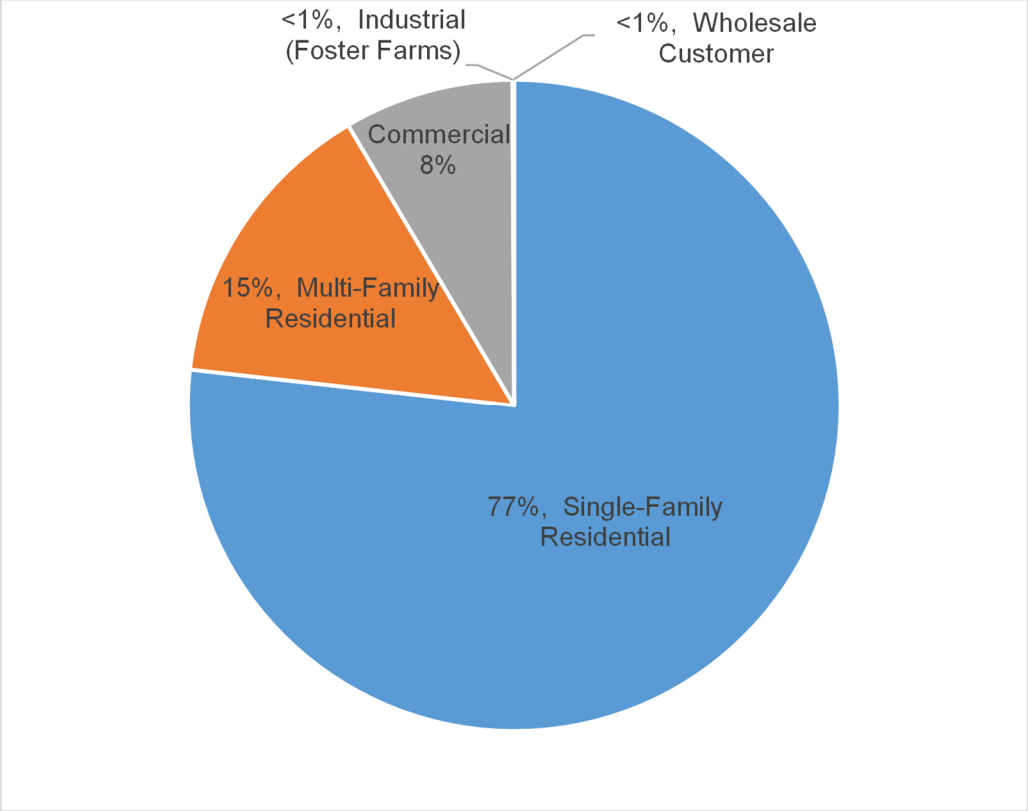
As shown in **Table 4.1, 2020 Service Connections by Customer Class** the City currently has 4,688 active service connections**.**

Table 4.1
2020 Service Connections by Customer Class

Customer Class	Accounts	
	(Meters)	(Percent)
Single-Family Residential	3,599	77%
Multi-Family Residential	690	15%
Commercial	394	8%
Industrial (Foster Farms)	1	<1%
Wholesale Customer	3	<1%
Total (2020)	**4,688**	**100%**

Approximately 77 percent of these connections are for single-family residences as shown in **Chart 4.1, 2020 Service Connections by Customer Class**.

Chart 4.1
2020 Service Connections by Customer Class



EXISTING WATER CONSUMPTION

Water consumption is the amount of water used by all customers of the system, as measured by the customer's meters. The City's water consumption was broken down into billed and authorized consumption. Authorized consumption is the volume of metered and unmetered water that is consumed by authorized users. Examples of authorized uses that are not billed

include but are not limited to firefighting and training, water main flushing, street cleaning, and backwash water. Whereas billed consumption is metered consumption documented by the City's accounting department. Historical billed and authorized consumption for the City is shown in **Table 4.2, Historical Consumption**.

Table 4.2
Historical Consumption

Year	Billed Metered Consumption		Total Authorized Consumption	
	(CF/Year)	(MG/Year)	(CF/Year)	(MG/Year)
2015	94,148,445	704	96,916,355	725
2016	90,593,052	678	93,011,039	696
2017	87,394,561	654	89,805,283	672
2018	89,711,753	671	92,431,663	691
2019	89,845,747	672	92,452,833	692
2020	83,891,188	628	86,708,358	649

CF = cubic feet

MG = million gallons

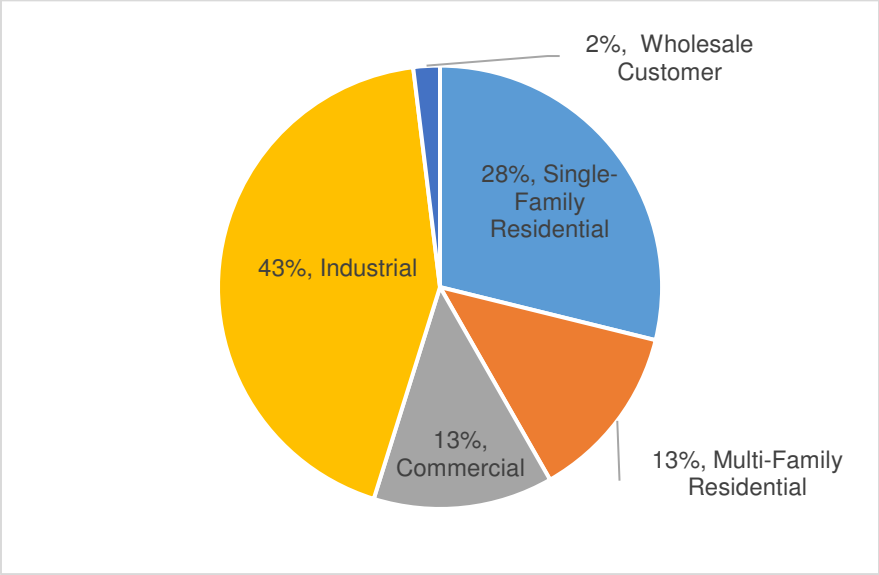
Meter data for the City is collected monthly and bimonthly. Recent consumption records based on customer billing records are included in **Table 4.3, Historical Billed Consumption by Customer Class**.

Table 4.3
Historical Billed Consumption by Customer Class

Customer Class	Total Billed Metered Consumption (MG)					
	2015	2016	2017	2018	2019	2020
Single-Family Residential	182.6	181.4	182.5	195.1	184.2	181.0
Multi-Family Residential	94.9	88.4	88.7	84.4	88.5	81.0
Commercial	105.7	90.7	83.0	81.7	89.7	82.1
Industrial (Foster Farms)	308.9	304.1	284.0	296.6	296.4	271.3
Wholesale Customer	12.1	13.0	15.4	13.2	13.3	12.2
Total	**704**	**678**	**654**	**671**	**672**	**628**

Chart 4.2, 2020 Billed Consumption by Customer Class indicates that roughly 43 percent of the consumption has been by the industrial customer class. Including single-family and multi-family customers, approximately 41 percent of the City's consumption could be classified as residential use.

Chart 4.2
2020 Billed Consumption by Customer Class



EXISTING WATER DEMANDS

Equivalent Residential Units

For demand forecasting and planning purposes, the water used by each customer class can be expressed in terms of equivalent residential units (ERUs). One ERU is equivalent to the amount of water used by a one typical single-family residence. An ERU is calculated by dividing the total volume of water consumed in the single-family customer class by the total number of typical single-family residential connections. Typical single-family connections do not include mobile home parks, apartments, or duplexes/triplexes. The volume of water used by other customer classes can then be divided by this number to determine the ERUs utilized by the other customer classes.

The ERU is meant to capture how much water a single-family household uses in a year. In planning for how many customers a water system has enough capacity to serve, it is helpful to know how many additional homes, or large new commercial businesses, are being proposed. Converting all customers, both residential and non-residential, to a common demand factor helps planners understand the relative usage of various types of accounts. For example, understanding how much water a food processing plant might use, compared to how many households could be served by that same amount of water, is useful information.

The results of this analysis are shown in **Table 4.4, Historical Authorized Consumption by Customer Class**, **Table 4.5, Historical Single-Family Residential Authorized Consumption and Historical Demand Per Customer**, and **Table 4.6, Historical Authorized Consumption per Typical Single-Family Account and Historical ERUs Served**. It is important to note that the consumption and the number of accounts shown in this table differ from previous tables in this

WSP since the numbers in this table only represent the consumption of a typical, or fully occupied, household.

Table 4.4
Historical Authorized Consumption by Customer Class

Customer Class	Total Authorized Consumption (MG)					
	2015	2016	2017	2018	2019	2020
Single-Family Residential	188.0	186.2	187.6	201.1	189.5	187.0
Multi-Family Residential	97.7	90.8	91.1	87.0	91.1	83.7
Commercial	108.9	93.1	85.3	84.1	92.3	84.8
Industrial (Foster Farms)	318.0	312.2	291.9	305.6	305.0	280.4
Wholesale Customer	12.4	13.4	15.8	13.6	13.7	12.6
Total	**725**	**696**	**672**	**691**	**692**	**649**

Table 4.5
Historical Single-Family Residential Authorized Consumption and Historical Demand Per Customer

Year	Total Single Family Residential Authorized Consumption (gal/Year)	Number of Single Family Residential Connections	Demand Per Customer (gpd/ERU)
2015	187,964,490	3,574	144
2016	186,238,382	3,588	142
2017	187,569,983	3,661	140
2018	201,054,233	3,668	150
2019	189,501,028	3,657	142
2020	187,041,111	3,599	142
5-Year Average			143
5-Year Max			150

Table 4.6
Historical Authorized Consumption per Typical Single-Family Account and Historical ERUs Served

Year	Total Authorized Consumption (MG/Year)	Demand Per Customer (gpd/ERU)	Typical Customer[1] (Accounts)
2015	725	144	13,784
2016	696	142	13,404
2017	672	140	13,111
2018	691	150	12,614
2019	692	142	13,321
2020	649	142	12,449

[1] Represents the number of potential single-family home accounts based on average yearly authorized consumption.

The estimated demand per capita is shown in **Table 4.7, Historical Demand Per Customer and Per Capita**.

Table 4.7
Historical Demand Per Customer and Per Capita

Year	Demand Per Customer (gpd/ERU)	Demand Per Capita[1] (gpd/Capita)
2015	144	58
2016	142	57
2017	140	56
2018	150	60
2019	142	57
2020	142	57
5-Year Average		57

[1] Assumes an average of 2.5 people per household, derived from household information provided in the City's *Comprehensive Plan*.

Table 4.5, Historical Consumption per Typical Single-Family Customer and per Capita shows that over the last 5 years, single-family residential customers used an average of approximately 143 gallons per day (gpd) per connection. The highest demand factor of 150 gpd/ERU was in 2018. **Table 4.7, Historical Demand Per Customer and Per Capita**, also shows that the amount of water used per person, or per capita, is approximately 57 gpd/Capita. This number assumes that approximately 2.5 people live in a single-family home.

Historical consumption and the number of customers by classification were used to calculate a demand factor per customer. These demand factors are used to convert the number of service meters within a customer class to ERUs, and are included in **Table 4.8, Demand Factors by Customer Class and Total ERUs**. The total number of ERUs for 2020 represents the total

number of customers the City has committed to serve; therefore, it includes all accounts. The numbers also are based on the ERU factor of 142 gpd/ERU, which represents the demand from the 2020 as shown in **Table 4.5, Single-Family Residential Authorized Consumption and Historical Demand Per Customer**.

Table 4.8
Demand Factors by Customer Class and Total ERUs

Customer Class	Total Customers Served (ERU)	Metered Connections or Units	Factor	Basis
Single-Family Residential	3,599	3,599 meters	1.0	Equal to the total customers connected to the system regardless if the homes are occupied yet or not.
Multi-Family Residential	1,605	690 meters	2.3	Total number of multi-family connections times a ERU/MF factor.
Commercial	1,627	394 meters	4.1	Total number of commercial connections times the conversion factor based on annual consumption divided by 142 gpd/ERU.
Industrial (Foster Farms)	5,377	1 meters	5,377	Total number of industrial connections times the conversion factor based on annual consumption divided by 142 gpd/ERU.
Wholesale Customer	242	3 meters	81	Total number of Davis Terrace Area connections times the conversion factor based on annual consumption divided by 142 gpd/ERU.
DSL	2,825	147 MG/Year	142 gpd/ERU	Total annual consumption divided by 142 gpd/ERU.
Total Customers w/o DSL	**12,450**	--		
Total Customers (2020)	**15,275**	--		

Largest Water Users

The 20 largest water users of the system, and their total amount of metered consumption for 2020 are shown in **Table 4.9, 2020 Largest Water Users**. The total water consumption of these 20 water accounts represented approximately 53 percent of the system's total metered consumption in 2020. The list of customer accounts in **Table 4.9, 2020 Largest Water Users** consists of water users from all customer classes. A large amount of water is consumed by Foster Farms, an industrial customer that accounts for approximately 44 percent of the City's water consumption.

Table 4.9
2020 Largest Water Users

Rank	Account	Account	Customer Class	Total Annual Consumption (gallons/year)	Percent of City-Wide Consumption
1	1700 S 13th Ave, Foster Farms	1700 S 13th Ave	Industrial	284,380,542	43.8%
2	2500 Allen	2500 Allen	Multi family	11,798,952	1.8%
3	Davis Terrace Area	Davis Terrace Area	Wholesale Customer	7,669,244	1.2%
4	510 S Kelso Dr	510 S Kelso Dr	Commercial	5,249,464	0.8%
5	Cowlitz Gardens Area	Cowlitz Gardens Area	Wholesale Customer	3,755,708	0.6%
6	2404 Allen	2404 Allen	Multi family	3,748,228	0.6%
7	250 S Kelso Dr	250 S Kelso Dr	Commercial	3,307,656	0.5%
8	2700 Allen	2700 Allen	Multi family	3,267,264	0.5%
9	Williams Finney Area	Williams Finney Area	Wholesale Customer	2,712,248	0.4%
10	1505 Allen	1505 Allen	Commercial	2,635,204	0.4%
11	507 Colorado	507 Colorado	Multi family	2,266,440	0.3%
12	501 Three Rivers Mall Dr	501 Three Rivers Mall Dr	Commercial	2,261,204	0.3%
13	2623 Abbotsford Loop	2623 Abbotsford Loop	Multi family	2,214,828	0.3%
14	505 Allen	505 Allen	Commercial	1,994,916	0.3%
15	1403 S 11th Ave	1403 S 11th Ave	Commercial	1,751,816	0.3%
16	505 N Pacific Ave	505 N Pacific Ave	Commercial	1,607,452	0.2%
17	917 Cedar	917 Cedar	Commercial	1,525,920	0.2%
18	207 Three Rivers Mall Dr Irrig	207 Three Rivers Mall Dr Irrig	Commercial	1,520,684	0.2%
19	351 Three Rivers Mall Dr Irr	351 Three Rivers Mall Dr Irr	Commercial	1,491,512	0.2%
20	1021 Allen	1021 Allen	Commercial	1,473,560	0.2%
Total				**346,632,842**	**53%**
City-Wide Consumption				648,578,516	100%

Water Supply

Water supply, or production, is the total amount of water supplied to the system, as measured by the meters at each supply source (i.e., 100 percent of the water that the City withdrawals from the Cowlitz River). Water supply is different than water consumption in that water supply is essentially the recorded amount of water used by the whole system, and water consumption is the total amount of water used by customers as recorded by individual meter data. The measured amount of water supply of any system is typically larger than the measured amount of water consumption due to non-metered water use and water loss (e.g., firefighting, water main breaks, distribution system leakage, etc.).

The City's water system has one source of supply – the Ranney Collector Well and one emergency source of supply – the City of Longview Emergency Intertie. The supply meter is monitored and read by City personnel. Historical production records have been included in **Table 4.10, Historical Production**.

Table 4.10
Historical Production

Year	Treatment Plant - Annual Production (gallons/year) [1]	Longview Intertie - Annual Production (gallons/year)	Total Annual Production (gallons/year) [1]	Total Annual Production (MG/year) [1]	Total Annual Production (CF/Year)
2013	765,636,403	-	765,636,403	766	102,350,966
2014	774,060,785	-	774,060,785	774	103,477,145
2015	820,720,748	-	820,720,748	821	109,714,691
2016	800,488,150	-	800,488,150	800	107,009,979
2017	762,653,773	-	762,653,773	763	101,952,246
2018	763,705,398	-	763,705,398	764	102,092,828
2019 [2]	782,647,000	1,547,612	784,194,612	784	104,831,844
2020 [2]	768,928,011	26,994,572	795,922,583	796	106,399,650

[1] Inlcudes treatment and backwash water.

[2] Includes production from the Longview Emergency Intertie.

Distribution System Leakage

An important factor in analyzing water system demands is knowing how much water is knowingly consumed by City customers (e.g., metered residential and non-residential accounts, operation and maintenance (O&M) uses, firefighting, water main flushing, etc.) and how much is consumed or lost unintentionally (e.g., theft, meter inaccuracies, and leaks). Water use efficiency programs developed under Washington Administrative Code (WAC) 246-290-810 require purveyors to track and report to DOH how much water is lost to system leakage. Total production (TP) can be divided into two categories: Authorized Consumption (AC) and Distribution System Leakage (DSL). WAC 246-290-820 defines DSL as the difference between total water produced and authorized consumption (DSL = TP - AC). Prior to water use efficiency programs, water was classified as accounted-for and unaccounted-for water. These terms are no longer used. AC includes metered consumption by all City customers, as tracked by the City's Finance Department, including metered consumption by the City's O&M staff for City uses and unmetered and known but estimated uses, such as firefighting, backwash water, and water main breaks. In a typical water system, there are several sources of water loss, or DSL, including water system leaks, inaccurate meters, and illegal water system connections or water use.

The Water Use Efficiency Rule, which became effective January 2007, sets a standard for DSL of less than 10 percent averaged over the last 3-year period. WAC 246-290-820(1)(b)(i) requires purveyors to implement a stricter water use efficiency program until their DSL 3-year average is less than 10 percent. To meet this standard, the City will continue to implement the measures discussed in the Water Use Efficiency Program. These measures include water main replacements, leak detection programs, system-wide service meter replacements, source meter calibration, and increased monitoring of water used for construction and firefighting.

The water produced by the City was classified into two categories: revenue and non-revenue water. The water classified as revenue water includes billed metered consumption and billed

unmetered consumption. Revenue water is water consumed by customers and contractors. The water classified as non-revenue water includes unbilled metered, unbilled unmetered, unauthorized consumption, meter inaccuracies and data errors, and leaks from water mains and storage facilities. Non-revenue water is water consumed by flushing, filter backwash, firefighting, and leaking infrastructure.

Chart 4.3, Revenue and Non-Revenue Water Distribution shows the different classifications of all water produced. This chart divides all water into revenue generating water and non-revenue generating water and shows the different components that make up DSL water. For instance, production water needed for facility operations and backwash water are considered authorized consumption, but do not directly generate revenue. The chart also describes how the various categories, or classifications, are specific to the City's system.

Chart 4.3
Revenue and Non-Revenue Water Distribution

<table>
<tr><td rowspan="8">Total Water Produced (TP) (water supplied from all sources)</td><td rowspan="8">Own Sources: Ranney Collector Well</td><td rowspan="4">Exported Water: BHWSD</td><td rowspan="4">Authorized Consumption (AC) to customers, other purveyors, contractors, fire departments, and the City</td><td rowspan="2">Billed Consumption to customers, other purveyors, and contractors.</td><td>Billed Water Exported</td><td rowspan="2">Revenue Water (money collected)</td></tr>
<tr><td>Billed Metered Consumption (customers and contractors)</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Consumption to the City and fire departments</td><td>Unbilled Metered Consumption City uses (i.e., flushing, backwash, production/operation water and street washing)</td><td rowspan="6">Non-Revenue Water (lost revenue)</td></tr>
<tr><td>Unbilled Unmetered Consumption (Fire fighting, street cleaning, maintenace of water system, etc.)</td></tr>
<tr><td rowspan="4">Water Supplied to the City of Kelso water system: Longview Intertie</td><td rowspan="4">Distribution System Leakage (DSL) or Unintentional losses</td><td rowspan="2">Apparent Losses and theft</td><td>Unauthorized Consumption (water theft)</td></tr>
<tr><td>Meter Inaccuracies & Data Errors (source & customer meters; accounting)</td></tr>
<tr><td rowspan="3">Real Losses or actual water loss through leaks</td><td>Leaks from Transmission and Mains (leaks from distribution system mains)</td></tr>
<tr><td>Leaks from Service Lines (leaks from service lines on City side of meter)</td></tr>
<tr><td>Leaks & Overflows from Storage Facilities</td></tr>
</table>

Since 2015, the amount of DSL has ranged between a high of 18.5 percent and a low of 9.5 percent, as shown in **Table 4.11, Authorized Consumption and Distribution System Leakage**. The average amount of DSL over the last 3 years is 13 percent, which is higher than the preferred range of 5 to 10 percent; therefore, it is higher than the compliance standard of less than 10 percent. The City is actively investigating the mechanisms that contribute to DSL and will continue to improve its recordkeeping for all known water uses.

Table 4.11
Authorized Consumption and Distribution System Leakage

Year	Annual Production (AP)	Annual Billed Consumption	Non-Billed Authorized Consumption	Total Authorized Consumption (AC)	Distribution System Leakage (DSL)			DSL 3-Year Average
	(MG/Year)	(MG/Year)	(MG/Year)	(MG/Year)	(MG/Year)	(ERU)	%	%
2015	821	704	21.5	725	95.7	1,807	11.7%	14%
2016	800	678	18.5	696	104	2,011	13.0%	13%
2017	763	654	19.0	672	90.7	1,755	11.9%	12%
2018	764	671	19.8	691	72.9	1,329	9.5%	11%
2019	784	672	19.5	692	92.6	1,797	11.8%	11%
2020	796	628	21.1	649	147	2,825	18.5%	13%
3-Year Average								**13%**

Historical Customers Served

Determining the total number of customers served in any given year is based on both consumption and production data. Calculating the number of billed customers served is based on annual consumption per customer class and the amount of water used for non-billed purposes (i.e., municipal uses such as water main flushing and treatment system backwash) and lost to DSL. This analysis is represented in **Table 4.12, Total ERUs**.

Table 4.12
Total ERUs

Customer Classification	2015	2016	2017	2018	2019	2020
Residential	3,574	3,588	3,661	3,668	3,676	3,599
Multi-family	1,857	1,749	1,778	1,587	1,767	1,605
Commercial	2,070	1,794	1,666	1,535	1,790	1,627
Industrial (Foster Farms)	6,047	6,015	5,697	5,576	5,917	5,377
Wholesale Customer	236	258	309	248	266	242
System Leakage (DSL)	1,807	2,011	1,755	1,329	1,797	2,825
TOTAL Customers (ERU) [1]	**15,591**	**15,415**	**14,866**	**13,943**	**15,213**	**15,275**
ERU Demand Factor (gpd/ERU)	144	142	140	150	142	142
Total Production (MG/Year)	**821**	**800**	**763**	**764**	**784**	**796**

[1] The accounted for but unbilled water is distributed equally across metered accounts.

DEMAND ANALYSIS

Demand Elements

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. ADD is determined from the system's historical water use data and can be used to project future demands. 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 production records from the City's wells, springs, and wholesale sources were reviewed to determine the system's ADD.

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 is typically determined from the combined flow of water into the system from all supply sources and water reservoirs on the peak day. MDD typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with 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 MDD conditions. Supply facilities (i.e., wells, springs, pump stations, and interties) are typically designed to supply water at a rate that is equal to or greater than the system's MDD.

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. PHD, like MDD, is typically determined from the combined flow of water into the system from all supply sources and water reservoirs. 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.

Maximum Month Demand

Maximum month demand is the maximum amount of water used over a 1-month period. It is expressed in terms of gallons per day, which is an average of the total demand in gallons over one month divided by the number of days in the month. This demand can be used to see how different summers compare from year to year, and how peak MDD is compared to average summer usage.

Demand Factor per Customer

An average demand per customer, or ERU, of 150 gpd per ERU is utilized in calculating projected water needs for all future growth in this WSP. This value is derived from the largest demand per customer factor calculated from the last 5 years and occurred in 2018.

Fire Flow Demand

Fire flow demand is the amount of water required during firefighting as defined by applicable codes. Fire flow requirements are 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 short period of time, requiring each component of the system to be properly sized and configured to operate at its optimal condition. Adequate storage and supply are useless if the transmission or distribution system cannot deliver water at the required rate and pressure necessary to extinguish a fire.

These minimum, or general, fire flow requirements were established for the different land use categories to provide a target level of service for planning and sizing future water facilities in areas that are not fully developed. The general fire flow requirement for each land use category is shown in **Table 4.13, General Fire Flow Requirements**. The water system analyses presented in **Chapter 7 – Water System Analysis** are based on an evaluation of the water system providing sufficient fire flow in accordance with these general fire flow requirements and the fire flow requirements of existing buildings. At a minimum, the City's general requirements are used, except for areas where the other land use agency's requirements are more stringent. The general requirements do not necessarily equate to actual existing or future fire flow needs for a specific site. The values shown in **Table 4.14, General Fire Flow Requirements** are the minimums set by code.

Table 4.13
General Fire Flow Requirements

Land Use Category	Jurisdiction	Fire Flow Requirement (gpm) [1]	Flow Duration (hours)
Residential/Single-Family	County	500	0.5
	City	1,000	2
Residential/Multi-family	County	1,500	3
	City	1,500	2
Commercial	County	1,500	2
	City	1,500	3
Schools	City	1,500	3
Industrial	City	4,000	5

[1] The estimated fire flow is based on typical construction type and size for each building class. For additional information regarding required fire flow refer to the International Fire Code (IFC) and/or applicable jurisdictions code.

Peaking Factors

Detailed telemetry data does not exist for the City, so typical peaking factors were utilized from other sources. The City provided data included maximum month's average day demand (MMADD). The MDD was calculated using the DOH recommended MDD to MMADD ratio of 1.35 for systems serving 1,000 to 100,000 people. PHD was calculated based on formulas presented in DOH's *Water System Design Manual* (Equation 3-1). The available historical demand data for the City is shown in **Table 4.14, Historical Demand and Demand per ERU**.

Table 4.14
Historical Demand and Demand per ERU

Demand Type	2015	2016	2017	2018	2019	2020	Maximum
Average Day Demand (ADD, gpd/ERU)	144	142	140	150	141	143	150
Maximum Month Average Day Demand (MMADD, gpd/ERU) [1]	181	171	167	--	--	--	181
Maximum Month Average Day Demand/ Average Day Demand (MMADD/ADD)	1.25	1.21	1.19	--	--	--	1.25
Maximum Day Demand/Maximum Month Average Day Demand (MDD/MMADD)[2]	1.35	1.35	1.35	1.35	1.35	1.35	1.35
Maximum Day Demand/ Average Day Demand (MDD/ADD)	1.69	1.63	1.61	--	--	--	1.69
Maximum Day Demand (MDD, gpd/ERU)	244	231	226	--	--	--	244

[1]Monthly data was provided by the City for 2015 to 2017.
[2]A MDD to MMADD ratio of 1.35 is recommended for systems serving 1,000 to 100,000 people.
[3]Assumes that Foster Farms does not peak through out the year.

The values shown in **Table 4.15, Demand Factors and Peaking Factors** are the peaking factors for the City's water system based on the ADD, MDD, and PHD data presented earlier in this chapter. The MDD/ADD demand ratio of 1.69 is within the typical range of 1.2 to 2.5 for most systems. The estimated PHD/MDD ratio of 1.68 is within the typical range of 1.3 to 2.0 for most systems. These peaking factors will be used later in this chapter, in conjunction with projected ADD, to forecast future MDDs and PHDs of the system.

Table 4.15
Demand Factors and Peaking Factors

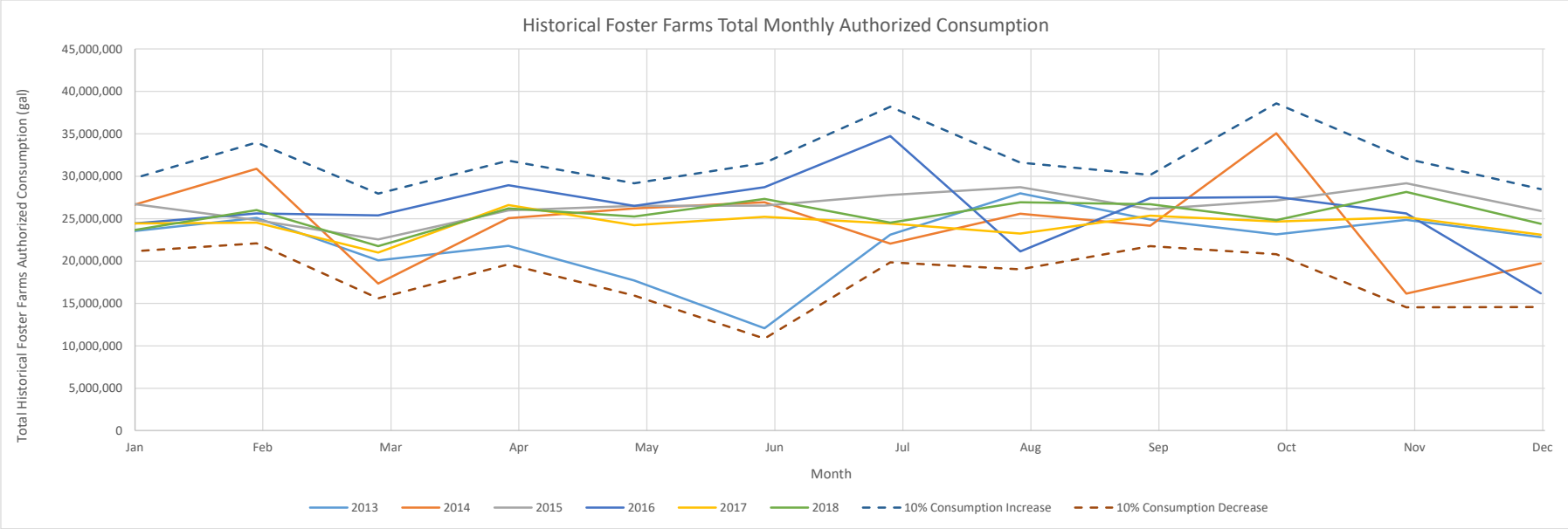
Demand Type	Demand Factors	
	(gpm/ERU)	(gpd/ERU)
Average Day Demand (ADD)	0.104	150
Maximum Day Demand (MDD)	0.176	254
Peak Hour Demand (PHD)	0.296	NA
Peaking Factors		
Maximum Day Demand/Average Day Demand (MDD/ADD)		1.69
Peak Hour Demand/Maximum Day Demand (PHD/MDD)[1]		1.68
Peak Hour Demand/Average Day Demand (PHD/ADD)		2.84

[1]Based on DOH Equation 3-1

DEMAND PROJECTIONS

The City's largest water user, Foster Farms, demands a consistent volume of water throughout the year and does not exhibit demand fluctuations as a result of seasonal variations that are commonly observed water consumption patterns. **Chart 4.4, Historical Foster Farms Total Monthly Authorized Consumption** illustrates the historical total monthly consumption and a representative increase and decrease of the maximum and minimum average monthly consumption for Foster Farms.

Chart 4.4
Historical Foster Farms Total Monthly Authorized Consumption



Demand projections for the next 20 years are presented in the tables below. Due to the nature of Foster Farm's operations and the large volume of water they consume they were analyzed separate from the rest of the system. The first, **Table 4.16, Projected Non Foster Farms Water Demands** summarizes the projected water demands for future years and includes growth in the City's Water Service Area, excluding Foster Farms which was assumed to have no growth associated with its water demand.

Table 4.16
Projected Non Foster Farms Water Demands

Year	Customers (ERUs)	ADD (MGD)	MDD[1] (MGD)	PHD[2] (gallons/hour)	PHD/MDD
2020	9,898	1.48	2.51	171,123	1.63
2021	9,997	1.50	2.54	172,799	1.63
2022	10,097	1.51	2.57	174,493	1.63
2023	10,198	1.53	2.59	176,203	1.63
2024	10,300	1.55	2.62	177,930	1.63
2025	10,403	1.56	2.64	179,675	1.63
2026	10,507	1.58	2.67	181,437	1.63
2027	10,612	1.59	2.70	183,217	1.63
2028	10,718	1.61	2.72	185,014	1.63
2029	10,826	1.62	2.75	186,830	1.63
2030	10,934	1.64	2.78	188,664	1.63
2031	11,043	1.66	2.81	190,516	1.63
2032	11,154	1.67	2.83	192,386	1.63
2033	11,265	1.69	2.86	194,275	1.63
2034	11,378	1.71	2.89	196,184	1.63
2035	11,492	1.72	2.92	198,111	1.63
2036	11,607	1.74	2.95	200,057	1.63
2037	11,723	1.76	2.98	202,023	1.63
2038	11,840	1.78	3.01	204,009	1.63
2039	11,958	1.79	3.04	206,014	1.63
2040	12,078	1.81	3.07	208,040	1.63

[1]MDD is calculated using DOH's MDD to MMADD ratio of 1.35 for systems serving 1,000 to 100,000 people.

[2]PHD is calculated using DOH's Water Sytem Design Manual Equation 3-1 which varies with system size.

The values shown in **Table 4.17, Projected Foster Farms Water Demands**, summarize the projected demands for Foster Farms. The demand projections associated with Foster Farms assume that the average demand for the facility is constant. The projections also assume that Foster Farms operates five days a week for 16 hours a day.

Table 4.17
Projected Foster Farms Water Demands

Year	Customers (ERUs)	ADD (MGD)	MDD[1] (MGD)	PHD[2] (gallons/hour)	PHD/MDD
2020	5,377	0.81	0.97	64,961	1.61
2021	5,377	0.81	0.97	64,961	1.61
2022	5,377	0.81	0.97	64,961	1.61
2023	5,377	0.81	0.97	64,961	1.61
2024	5,377	0.81	0.97	64,961	1.61
2025	5,377	0.81	0.97	64,961	1.61
2026	5,377	0.81	0.97	64,961	1.61
2027	5,377	0.81	0.97	64,961	1.61
2028	5,377	0.81	0.97	64,961	1.61
2029	5,377	0.81	0.97	64,961	1.61
2030	5,377	0.81	0.97	64,961	1.61
2031	5,377	0.81	0.97	64,961	1.61
2032	5,377	0.81	0.97	64,961	1.61
2033	5,377	0.81	0.97	64,961	1.61
2034	5,377	0.81	0.97	64,961	1.61
2035	5,377	0.81	0.97	64,961	1.61
2036	5,377	0.81	0.97	64,961	1.61
2037	5,377	0.81	0.97	64,961	1.61
2038	5,377	0.81	0.97	64,961	1.61
2039	5,377	0.81	0.97	64,961	1.61
2040	5,377	0.81	0.97	64,961	1.61

[1]MDD is assumed to reflect Foster Farms only operating 5 days per week.

[2]PHD assumes that Foster Farms operates 16 hours per day.

The values shown in **Table 4.18, Projected System Wide Water Demands**, summarize the projected demands for the City's entire water system.

Table 4.18
Projected System Wide Water Demands

Year	Customers (ERUs)	ADD (MGD)	MDD[1] (MGD)	PHD[2] (gallons/hour)	PHD/MDD
2020	15,275	2.29	3.48	236,083	1.63
2021	15,374	2.31	3.51	237,760	1.63
2022	15,474	2.32	3.53	239,453	1.63
2023	15,575	2.34	3.56	241,164	1.63
2024	15,677	2.35	3.58	242,891	1.63
2025	15,780	2.37	3.61	244,636	1.63
2026	15,884	2.38	3.64	246,398	1.63
2027	15,989	2.40	3.66	248,178	1.63
2028	16,095	2.41	3.69	249,975	1.63
2029	16,202	2.43	3.72	251,791	1.63
2030	16,311	2.45	3.75	253,624	1.63
2031	16,420	2.46	3.77	255,476	1.63
2032	16,530	2.48	3.80	257,347	1.62
2033	16,642	2.50	3.83	259,236	1.62
2034	16,755	2.51	3.86	261,144	1.62
2035	16,868	2.53	3.89	263,071	1.62
2036	16,983	2.55	3.92	265,018	1.62
2037	17,099	2.56	3.95	266,984	1.62
2038	17,217	2.58	3.98	268,970	1.62
2039	17,335	2.60	4.01	270,975	1.62
2040	17,455	2.62	4.04	273,001	1.62

[1]MDD is calculated using DOH's MDD to MMADD ratio of 1.35 for systems serving 1,000 to 100,000 people.

[2]PHD is calculated using DOH's Water Sytem Design Manual Equation 3-1 which varies with system size.

5 | POLICIES AND DESIGN CRITERIA

INTRODUCTION

The service area policies for the City of Kelso's (City) water system have been developed to guide the development and financing of the infrastructure required to provide water service throughout its water service area (WSA).

The City plans and provides water service for the residents and businesses it serves both inside and outside of city limits, consistent with laws, policies and design criteria emanating from multiple sources. **Table 5.1, Regulatory Agencies** summarizes the primary entities that govern the City's water system planning and operation.

Table 5.1

Regulatory Agencies

Agency	Design Criteria/Laws/Policies
U.S. Department of Health & 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
Kelso City Council	City Regulations
American Water Works Association	Design Criteria

The guidance and direction from other regulatory sources circumscribe the City's approach to its water system and help assure City water customers are provided adequate, safe, and reliable water service. The regulatory guidance from these various sources also help ensure that future customers and the growth that is planned for the City's water service area are supplied in a similar manner. The City's ability to meet planned and forecast demands is detailed in **Chapter 7**. Recommended improvements to the City's water system are identified in **Chapter 9**.

Within the framework established by federal and state requirements, the City adopts regulations and policies. The City's water system and service policies take the form of ordinances, memoranda, and operation procedures, many of which are summarized in this Chapter.

Policies listed below that are italicized are set by federal or state law or by City code, all others are Public Works guidelines.

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

- Supply
- Customer Service
- Facilities
- Finance

- Organization

It is important to understand that if standards are set too low, customers will not be satisfied, and if standards are set too high, the cost of installing and operating facilities at this level will be unacceptable.

SUPPLY POLICIES

QUALITY PROTECTION

- The City will pursue aquifer protection by developing a Wellhead Protection Program and Watershed Control Program (Washington Administrative Code [WAC] 246-290-135).
- The quality goal of the City is to maintain water quality at a level that equals or is better than water quality in its natural state and that meets or exceeds all water quality laws and standards (WAC 246-290-250 and WAC 246-290-300).
- 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 a responsibility to protect the public water system from contamination due to cross-connections. Cross-connections that can be eliminated will be eliminated.
- The City has staff that is certified for backflow prevention and inspection.
- *The City will comply with the backflow prevention assembly installation and testing requirements as indicated in 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).*

QUANTITY

- *The City will meet or exceed all laws and regulations regarding supply and storage quantities (WAC 246-290-200).*
- The City will observe water rights seniority.
- The City will pursue the acquisition of water rights or wholesale water to meet or exceed water demand at saturation development conditions.
- The City will pursue maximum supply rates as designated by relevant water rights without impacting the regional environment.
- The City is actively pursuing saturation planning for supply sources so that future water resource limitations can be handled effectively, and the impacts of limitations can be minimized.

- The City will manage water resources to assure a continued, long-term, high quality supply for homes, commerce, industry, and recreation.
- The City will ensure that the capacity of the system, including wells, pump stations and transmission mains, is sufficient to meet the peak day demand of the system.

FIRE FLOW

Design fire flow demands were used in the hydraulic analysis of the distribution systems and to determine fire storage requirements.

REGIONAL PARTICIPATION

- *The City will update the Water System Plan and submit for approval from the State as required per WAC 246-290-100.*
- The City will participate in regional supply management and planning activities to protect the environment, reduce cost of service, and improve reliability, water quality and quantity.

  Participation in these activities includes attending meetings, providing information for studies, and performing water quality monitoring tasks, as needed.
- The City will supply all customers within the water service area, unless a special agreement with an adjacent purveyor exists, due to topography or other limiting factors.

CUSTOMER SERVICE POLICIES

WATER SERVICE AND CONNECTION

The following policies are in compliance with policies set forth by City Council as outlined in the *Comprehensive Plan* and Kelso Municipal Code (KMC).

- The City will strive to provide potable water service to the people within the City's water service area, provided all policies related to service can be met.
- All proposed developments within the City's water service area shall 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 shall be approved by the City and must conform to the City's adopted design criteria, construction standards and specifications, as may be shown in the developer extension program for the City. All costs of the extension shall be borne by the developer or applicant.
- Water service can be extended within the water service area if the project is in compliance with the City's utility regulations and policies, and adopted land use plan,

zoning, and development regulations.

- All applications for permits for the use of water shall be made to the building department. Such application shall be made by the owner of the property to which the water may be required, and must agree to conform to the rules and regulations thereof that may be established from time to time as conditions for the use of water.
- For water service applications outside of the City Limits but within the water service area, the applicant will follow the steps for a standard meter connection, including completion of an Outside City Agreement form and obtaining a water service agreement from the City.
- Water system capacity will be evaluated at the time of water service application. The City will use the capacity analysis contained in **Chapter 7** to evaluate source of supply, storage, and water rights capacity available to the applicant.
- Delays resulting from non-technical conditions that affect the City's ability to provide new water service are the responsibility of the applicant. These conditions include, but are not limited to, environmental assessments and local regulations.

POLICIES AND REQUIREMENTS FOR OUTSIDE PARTIES

Policies and requirements for outside parties, such as developers, are outlined in **Appendix E – Unified Development Code**. Various sections of these standards cover the requirements of a development project that will include City water system components.

The City's water standards cover the general design requirements for additions to the City's water system. Developer extension agreements cover the administrative and contractual requirements of outside parties constructing water projects to be included in the City's water system. These documents generally address the necessary applications, provisions for special circumstances, design standards, developer charges, and performance bonding for outside parties.

It is recommended that the City implement a documentation program for the availability of its water supply. This program should include up to date tracking of water system capacity and current water usage throughout the system. This data can then be weighed against those requests for future water service to project system capacity in support of development. This also can be used to assist in assessment of future capital facilities needs for the City's water system.

ANNEXATIONS

- Provision of service will be provided per the adopted extraterritorial utility policy. The City will follow State guidelines in the assumption of facilities in annexation areas.
- Areas annexed will be served by the City at the customer's expense unless accepted by City Council and must meet the City water standards.

EMERGENCY SERVICE

- Compliance with standards may be temporarily deferred for emergency water service.
- Policy criteria may be waived for emergency service.

PLANNING BOUNDARIES

- New developments will be required to pay for system extensions. Provisions for late-comer agreements will be allowed as outlined in the KMC.
- For planning purposes, the City will use the designated service area boundary established by existing interlocal agreements.
- The City will follow State of Washington guidelines in assuming portions of adjacent water systems as a result of annexation.

FACILITY POLICIES

This section describes the planning criteria and policies used to establish an acceptable hydraulic behavior level and a standard of quality for the water system. Additional criteria are contained in the City's Design Standards, a copy of which is included in **Appendix F – Municipal Standards**.

MINIMUM STANDARDS

All proposed developments within the City's service area shall conform to the City's adopted design criteria, construction standards and specifications.

PRESSURE

A minimum pressure of 30 pounds per square inch (psi) at customer meters shall be provided during normal peak hourly demand conditions, not including fire flow or other emergency demand conditions (WAC 246-290-230 (4)).

During fire flow and other emergency demand conditions, the minimum pressure at customer meters and in the remainder of the system shall not be less than 20 psi (WAC 246-290-420-230 (5)).

The City will endeavor to maintain a minimum pressure of 40 pounds per square inch (psi) at customer meters during normal demand conditions, excluding a fire or emergency.

The City will endeavor to maintain a maximum pressure of 90 psi in the water mains during normal demand conditions, excluding pressure surges. Individual residences are responsible for reducing pressures over 100 psi.

The City will endeavor to maintain a minimum pressure of 30 psi at customer meters during all demand conditions, excluding a fire or emergency.

During fire conditions, the minimum pressure at customer meters and throughout the remainder of the system will be 20 psi.

During a failure of any part of the system, the maximum pressure will not exceed 150 psi.

VELOCITIES

- During normal demand conditions, the velocity of water in a water main should be less than 5 feet per second (fps).
- During the Peak Hour Demand (PHD) the velocity of the water in a water main shall not exceed 8 fps.
- During emergency conditions such as a fire, and for design purposes, the velocity of water in a water main may exceed 5 fps, but may not exceed 8 fps.

TRANSMISSION AND DISTRIBUTION

- Unless deemed impractical, transmission and distribution mains will be looped to increase reliability and fire flow capacity and to decrease head losses.
- All mains will comply with the generally recognized design criteria from the AWWA and Department of Health guidelines that follow.
    1. All new construction will be in accordance with the City's Design Standards, of which a copy is included in **Appendix F – Municipal Standards** of this Plan.
    2. Distribution system design assumes that adequately-sized service lines will be used. Service lines will be the same size as the meter or larger.
    3. The minimum diameter of distribution mains will be 8 inches. Water mains not required to carry fire flow, as determined by the City, may be a smaller diameter. All water mains will be ductile iron pipe. The City may consider other piping materials for specialized applications on a case-by-case basis.
    4. All new distribution mains will be sized by a hydraulic analysis.
    5. All new mains providing fire flow will be sized to provide the required fire flow at a minimum residual pressure of 20 psi during peak day demand conditions, while maintaining a maximum pipeline velocity of 8 feet per second. In general, new water mains that will carry fire flow in residential areas shall be a minimum of 8 inches in diameter . Looping of water main extensions is required when serving more than 20 equivalent residential units (ERUs). New water mains in commercial, industrial, and school areas shall be a minimum of 12 inches in diameter and looped.

6. Valve installations will satisfy the following criteria.
    a. All valves larger than 10 inches shall be butterfly valves. All valves 8 inches and smaller shall be resilient seat gate valves.
    b. Zone valves will be located at all pressure zone boundaries to allow future pressure zone realignment without the need for additional pipe construction.
    c. Isolation valves will typically be installed in the lines to allow individual pipelines to be shut down for repair or installing services. Unless it is impractical to do so, the minimum distance between isolation valves will not exceed 1,000 feet. A minimum of four valves will be provided per cross, and a minimum of three valves per tee. The City may increase or decrease the number of and distance between valves for new construction based on system configuration.
    d. Air/vacuum release valves will be placed at all high points, or "crowns," in all pipelines.
    e. Blowoff assemblies shall be located at main dead ends where there is not a fire hydrant.
    f. Individual check valves will be installed on customer service lines where conditions warrant.
7. Fire hydrant installations will satisfy the following criteria.
    a. Fire hydrants serving detached single-family dwellings or duplex dwellings on individual lots will be located not more than 500 feet on center, such that all single-family lots are within 300 feet from a fire hydrant, as measured along the path of vehicular access.
    b. Fire hydrants serving any use other than detached single-family dwellings or duplex dwellings on individual lots will be located not more than 250 feet on center, and will be located so that at least one hydrant is located within 150 feet of all structures, but not closer than 50 feet, unless approved by the fire marshal. Hydrants located in dead-end areas or cul-de-sacs shall service an area of no more than 120,000 square feet.
    c. A minimum of one fire hydrant shall be installed per intersection.
    d. The fire marshal will review all proposed fire hydrant installations to ensure the correct number and spacing of fire hydrants for each project.
8. A sampling station shall be required every fifty (50) ERUs or as determined by the City Engineer. The location for said sampling stations will be determined by the City Engineer.

FACILITIES

- All existing and future facilities will be modified/constructed to comply with the following minimum standards:
    1. All structures will be non-combustible, where practical.
    2. All buildings will have adequate heating, cooling, ventilation, insulation, lighting, and work spaces necessary for on-site operation and repair.
    3. Sites will be fenced to reduce vandalism and City liability.
    4. Each facility will be equipped with a flow meter and all necessary instrumentation to assist personnel in operating and troubleshooting the facility.
    5. Emergency power capability will be provided where practical.
- Pumps will be operated automatically, with flexibility in pump start/stop settings.
- Facilities will be operated with the provision for at least two methods of control to minimize system vulnerability.
- Manual override of pumps will be provided for and located at the Operations and Maintenance office using the City's Supervisory Control and Data Acquisition system.
- Facilities will be monitored with alarms for the following conditions.
    1. Pump started automatically or manually.
    2. Power phase failure.
    3. Power outage/generator running.
    4. Communication failure.
    5. Water in structure.
    6. Low suction pressure.
    7. High and low discharge pressure.
    8. Intrusion.
    9. Smoke detector.
    10. Heat detector.
- Facilities will have the following indicators.
    1. Local flow indication and totalizing.
    2. Flow indication and totalizing at the Operations and Maintenance office.
    3. Recording of combined supply flow to the system.

PRESSURE REDUCING STATIONS

- All pressure reducing valves will be placed in vaults that are large enough to provide

ample workspace for field inspection and valve repair.

- Vaults will drain to daylight, or will be equipped with sump pumps to prevent vault flooding.
- Pressure relief valves may be provided on the low-pressure side of the pressure reducing valves to prevent the system from overpressurizing in case of a pressure reducing valve failure.

CONTROL

- The City's control system must be capable of efficiently operating the water system's components in accordance with this Plan, and in response to reservoir levels, system pressures and abnormal system conditions.

MAINTENANCE

- Facility and equipment breakdown is given highest maintenance priority. Emergency repairs will be made even if overtime labor is involved.
- Equipment will be scheduled for replacement when it becomes obsolete, and as funding is available.
- Worn parts will be repaired, replaced, or rebuilt before they represent a high failure probability.
- Spare parts will be stocked for all equipment items whose failure will impact the ability to meet other policy standards.
- Equipment that is out-of-service will be returned to service as soon as possible.
- A preventive maintenance schedule will be established for all facilities, equipment, and processes.
- Tools will be obtained and maintained to repair all items whose failure will impact the ability to meet other policy standards.
- Dry, heated shop space will be available for maintenance personnel to maintain facilities.
- All maintenance personnel will be trained to efficiently perform their job descriptions.
- Maintenance will be performed by the water maintenance staff or other approved sources and supervised by the Senior Water Quality Specialist.
- Written records and reports showing operation and maintenance history will be maintained on each facility and item of equipment.

JOINT-USE

- All joint-use facilities (with other public water systems) must comply with City policy and design standards.

- All joint-use facilities will be maintained by the Water Department.
- Joint-use facilities will be pursued only in those areas that improve reliability or reduce operating costs.

FINANCIAL POLICIES

GENERAL

- The City will set rates that comply with State regulations.
- Rates and additional charges established for the City should be:
    1. Cost-based rates that recover current, historical, and future costs associated with the City's water system and services;
    2. Equitable charges to recover costs from customers, commensurate with the benefits they receive;
    3. Adequate and stable source of funds to cover the current and future cash needs of the City.
- The existing customers of the City will pay the direct and indirect costs of operating and maintaining the facilities through water rates. In addition, the water rates will include debt service incurred to finance the capital assets of the City.
- New customers seeking to connect to the water system will be required to pay connection fees and charges for an equitable share of the historical cost of the system and for the system's capital improvement program (CIP). Connection charge revenues will be used to fund the CIP in conjunction with rate revenue.
- New and existing customers will be charged for extra services through separate ancillary charges based on the costs to provide the services. Ancillary charges can increase equitability, as well as increase operating efficiency by discouraging unnecessary demand for services. The charges should be reviewed regularly and updated annually based on increases in the Consumer Price Index. Revenue from ancillary charges will be used to finance annual operations and maintenance.
- The City will maintain information systems that provide sufficient financial and statistical information to ensure conformance with rate-setting policies and objectives.
- User charges must be sufficient to provide cash for the expenses of operating and maintaining the system. To ensure the fiscal and physical integrity of the utility, each year an amount should also be set aside and retained for capital expenditures, which will cover some portion of the depreciation of the physical plant. The amount may be transferred from the Operations and Maintenance Fund to the Construction Fund for general purposes or for specific purposes.
- A non-restricted contingency reserve amount will be maintained to cover unanticipated emergencies and fluctuations in cash flow.

- Water rates will be based on either the Base-Extra Capacity Method or the Commodity-Demand Method. Both methods strive to equitably charge customers with different service requirements based on the cost of providing the water service. Service requirements relate to the total volume of water used, peak rates of use and other factors.
- Fees and charges are calculated based on the service location. Rates will be the same for all customers within the city limits. Rates will be established separately for customers located outside of the city limits.

CONNECTION CHARGES

Owners of properties that have not been assessed, charged, or have not borne an equitable share of the cost of the water system will pay one or more of the following connection charges prior to connection to a water main.

1. *Latecomers Fees:* Latecomers fees are negotiated with developers and property owners; they provide for the reimbursement of a pro rata portion of the original cost of water system extensions and facilities.
2. *Connection Charge:* The connection charge will be assessed against any property that has not participated in the development of the water system. Meter charges, or hookup fees, are additional in order to recover the cost of meter and service line installation.
3. *Developer Extension Charges:* These charges are for the administration, review, and inspection of a developer extension project.

ORGANIZATIONAL POLICIES

STAFFING

- Personnel certification will meet or exceed State standards.
- The City will promote staff training.

Relationship with Other Departments

- The Finance Department is responsible for customer billing, payment collection, project cost accounting and fund activity reporting.
- The Personnel Department is responsible for employee records, union labor negotiations and salary schedules.
- The Fire Department uses water utility facilities for fire protection and the fire marshal establishes fire flow requirements.
- The Fire Department is responsible for emergency responses to hazardous events at water system facilities.
- The Fire Department is responsible for hydrant fire flow testing.

- Fire hydrant testing is performed jointly by the Fire Department and the City's Water Department.
- The Police Department is responsible for enforcing violations of City water ordinances.

6 | WATER SOURCE AND QUALITY

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 7** discusses the City of Kelso's (City) ability to supply a sufficient quantity of water and identifies future source requirements. This chapter discusses the City's existing water sources, its water rights, water quality regulations, and water quality monitoring results.

EXISTING WATER SOURCES AND TREATMENT

WATER SOURCES

The City obtains its municipal water supply from its Ranney Collector Well, located on the bank of the Cowlitz River. Additional information on the City's source is presented in **Chapter 2**.

WATER TREATMENT

The City's Ranney Collector Well, originally installed in 1979, delivers raw water from the Cowlitz River to the Kelso Water Treatment Plant (WTP). The water supply is considered by the Washington State Department of Health (DOH) to be groundwater under the direct influence of surface water (GWI). The City owns and operates a Group 3 WTP (Kelso WTP), which is located adjacent to the Cowlitz River. The water treatment system is designed to remove manganese, iron, particulate matter, and arsenic. The iron/manganese treatment facility was originally constructed in 1984. The plant was updated in 2002 to comply with surface water treatment requirements established by DOH. The treatment plant filters are capable of producing up to 4.8 million gallons per day (MGD); however, the Ranney Collector Well can only produce between 3.5 and 4.08 MGD. Raw water is pumped from a Ranney Collector Well on the bank of the Cowlitz River to the WTP. The treatment process consists of coagulation, pressure filtration, iron, arsenic and manganese removal, chlorination, fluoridation, and pH adjustment for corrosion protection. The water is then pumped to the distribution system from the treatment plant.

WATER RIGHTS AND INTERTIES

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 withdrawal rate and annual withdrawal volume. Washington State law requires users of public water to receive approval from the Washington State Department of Ecology (Ecology) prior to actual use of the water. This approval is granted in the form of a water right permit, which is

developed into a certificate. However, a water right is not required for certain purposes (typically individual residences) that use 5,000 gallons per day (gpd) or less of groundwater from a well.

The process of 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 its 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.

EXISTING WATER RIGHTS

The City currently holds five water rights consisting of two surface water certificates (SWC), one groundwater certificate (GWC), one surface water permit, and one groundwater permit. The two surface water certificates were for diversion directly from the Cowlitz River, while the groundwater certificate and surface water permit are for withdrawal from a Ranney Collector Well located adjacent to the Cowlitz River. The groundwater permit is for withdrawal from a wellfield located near the confluence of the Cowlitz River with the Columbia River. The City's water rights total 9,835 gallons per minute (gpm) and 6,728 acre-feet per year (afy).

The City no longer diverts water directly from the Cowlitz River, but instead pumps water from the Ranney Collector Well. The groundwater wellfield permitted near the confluence of the Cowlitz River and Columbia River is undeveloped and is not currently used as a source of supply.

The Ranney Collector Well is located on the left bank of the Cowlitz River in the SE ¼ SE ¼ of Section 27, Township 8 North, Range 2 West W.M. near the Kelso Train Station. A summary of

the water right information is presented below and in **Table 6.1, Existing Water Rights**. Select documents from each water right file are contained in **Appendix G – Water Right Documents**.

Table 6.1

Existing Water Rights

Water Right	Priority Date	Document	Source Name	Instantaneous Rate (Qi) (gpm)		Annual Volume (Qa) (afy)	
				Additive	Non-additive	Additive	Non-additive
SWC 2195	11/2/1925	Certificate	Cowlitz River	1,347	-	2,172	-
S2-01119C	2/20/1968	Certificate	Cowlitz River	4,488	-	208	2,172
G2-24762C	12/28/1977	Certificate	Ranney Well	2,500	-	420	2,380
S2-29856P	6/3/1999	Permit	Ranney Well	-	8,335	2,800	-
G2-29813P	11/20/1998	Permit	Three Wells	1,500	-	1,128	1,272
			Total	**9,835**	**gpm**	**6,728**	**afy**

Notes:

SWC 2195 authorizes 3.0 cubic feet per second (cfs), which is equal to 1,347 gallons per minute, as shown in this table.

SWC 2195 does not specify the annual volume. The value assigned here is based on 24/7 diversion.

S2-01119C authorizes 10.0 cfs, which is equal to 4,488 gpm.

S2-29856P authorizes SWC 2195, S2-01119C, G2-24762C, and S2-29856P to divert up to 18.57 cfs, which is equal to 8,335 gpm.

The purpose of use of each water right held by the City is municipal water supply purposes based on the definition provided in the Revised Code of Washington (RCW) 90.03.015. The place of use for each water right held by the City is the service area as defined in the most recent approved water system plan.

The City's water rights are all for sources located in Water Resource Inventory Area (WRIA) 26 – Cowlitz. Each water right is discussed in more detail below.

Surface Water Certificate 2195

The water right certificate was issued on April 13, 1945, with a priority date of November 2, 1925. This water right certificate was granted to the City for the maximum diversion of 3.0 cubic feet per second (cfs) from the Cowlitz River. No annual volume was specified under this water right. In this *Water System Plan* (WSP), it has been assumed that the annual volume is equal to continuous diversion of the instantaneous rate of 3.0 cfs, which is equal to 2,172 afy. The place of use on the water right certificate is defined as the "City of Kelso." No changes to this water right have been made since it was originally issued.

Surface Water Certificate S2-01119C

The water right certificate was issued on March 1, 1982, with a priority date of February 20, 1968. This water right certificate was granted to the City for the maximum diversion of 10.0 cfs and 2,380 afy (interpreted as 208 afy additive and 2,172 afy non-additive) from the Cowlitz River. The place of use on the water right certificate is defined as the "Area Served by the City of Kelso." The water right contains a provision that states, "The total amount of water to be diverted under this certificate and Surface Water Certificate No. 2195 shall not exceed 2,380 acre-feet per year." SWC 2195 and S2-01119C are for diversion from the same point of diversion. No changes to this water right have been made since it was originally issued.

Groundwater Certificate G2-24762C

The water right certificate was issued on July 31, 1980, with a priority date of December 28, 1977. This water right certificate was granted for the maximum use of 2,500 gpm and 2,800 afy (interpreted as 420 afy additive and 2,380 afy non-additive to the annual volume authorized under the older SWC 2195 and S2-01119C) from the Ranney Collector Well for municipal supply. The place of use on the water right certificate is defined as the "Area Served by the City of Kelso." The water right contains a provision that states, "The total amount of water diverted under this permit and Surface Water Certificate No. 2195 shall and Surface Water Permit 16812 [which became S2-01119C] shall be limited to 2,800 acre-feet per year." No changes to this water right have been made since it was originally issued.

Surface Water Permit S2-29856P

The amended water right permit was issued on November 20, 2019, with a priority date of June 3, 1999. This water right permit was granted for the maximum use of 18.57 cfs (non-additive) and 2,800 afy from the Ranney Collector Well for municipal supply. The place of use on the water right permit is defined as the service area described in the most recent water system plan. The water right contains a provision that states, "The total amount of water diverted under certificates and or permits S2195, S2-01119C, G2-24762C, and S2-29856 shall be limited to 18.57 cfs and 5,600 acre-feet per year." When originally issued, this water right contained a due date for putting the water to full beneficial use of December 1, 2005. Multiple extensions have been requested and approved by Ecology. The City filed an extension request on this permit in January 2025, requesting that the full beneficial use date be extended until December 1, 2029. No changes to this water right, except for administratively correcting the location of the Ranney Collector Well, have been made since it was originally issued.

Groundwater Permit G2-29813P

The water right permit was issued on December 11, 2001, with a priority date of November 20, 1998. This water right permit was granted for the maximum withdrawal of 1,500 gpm and 2,400 afy (1,128 afy additive and 1,272 afy non-additive) from three wells for municipal supply. The place of use on the water right permit is defined as the "Area served by the City of Kelso." The water right contains a provision that states, "The total amount of water diverted under certificates and or permits S2195, S2-01119C, G2-24762C, S2-29856, G2-29813, and G2-29185 [since cancelled] shall be limited to 6,728 acre-feet per year." When issued, this permit contained a due date for completion of construction (December 1, 2003) and for putting the water to full beneficial use (December 1, 2005). Multiple extensions have been requested and approved by Ecology, such that the current due date for completion of construction has been extended to December 1, 2028. No changes to this water right have been made since it was originally issued.

EXISTING INTERTIES

The City currently has an intertie with the City of Longview (Longview). This intertie allows water to move between the two Cities' water systems. The maximum rate that can be obtained by the City through the intertie is 1,000 gpm.

PENDING WATER RIGHT APPLICATIONS

The City currently has neither any pending new water right applications, nor any water right change applications.

WATER SUPPLY EVALUATION

An evaluation of the City's existing water rights compared to the installed capacity indicates that the current limiting factor for the City's supply is the actual installed capacity. Comparison of the City's water rights with actual installed capacity is contained in **Table 6.2, Water Right and Installed Capacity Evaluation**.

Table 6-2

Water Right and Installed Capacity Evaluation

Source	Water Right Capacity (gpm)	Installed Capacity (gpm)	Difference (gpm)
Ranney Collector Well	8,335	2,300	6,035
Three Wells	1,500	0	1,500
Total	**9,835**	**2,300**	**7,535**

WATER SUPPLY PLANNING

EXISTING WATER SUPPLY

The City's water system is currently supplied by water from the City's Ranney Collector Well and the intertie with Longview.

LONG-TERM WATER SUPPLY PLANNING

The City has enough water rights to meet its existing and forecast demand. However, the installed physical capacity of the infrastructure operating under these water rights is much less (approximately one-third) than the water right limits and has been declining over time. In order to meet demand, the City will need to increase its physical capacity through rehabilitation of existing infrastructure (Ranney Collector Well), construction of additional wells and possibly treatment capacity, or through securing additional supply through an expanded intertie with Longview.

FEASIBILITY OF OBTAINING NEW WATER RIGHTS

The City does not need additional water rights. It needs is to increase its utilization of the water rights it already holds.

FEASIBILITY OF TRANSFERRING EXISTING WATER RIGHTS

If the City decides to add additional points of withdrawal (groundwater wells) or points of diversion (Cowlitz River) to its water rights, it should consider locations farther downstream from existing points of diversion/withdrawal to minimize the potential for causing new impacts farther upstream in the Cowlitz River, which would likely not be authorized.

Water right change applications are easier to approve for municipal water suppliers when the water right is already at certificate stage, or when the permit is a groundwater right. Changing the attributes of a surface water permit, such as the City's current permit S2-29856P for the Ranney Collector Well, has additional hurdles that can be difficult to overcome and could lead to a reduction in that water right.

DRINKING WATER REGULATIONS

OVERVIEW

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, DOH is the agency responsible for implementing and enforcing the 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 EPA, has published drinking water regulations that are contained in Chapter 246-290 of the Washington State Administrative Code (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, EPA established six rules, known as the Phase I Rule, the Phase II and IIb Rules, the Phase V Rule, the Surface Water Treatment Rule (SWTR), the Total Coliform Rule, and the Lead and Copper Rule. The EPA regulates most chemical contaminants through the Phase I, II, IIb, and V Rules. The City's recently decommissioned surface water source was affected by these rules.

The EPA set two limits for each contaminant 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 Chemicals (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, 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 updates and creates limits for 38 contaminants (organics and inorganics). 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 these rules.

Phase V Rule

The Phase V Rule sets 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

Surface water sources, such as rivers, lakes, and reservoirs (which are open to the atmosphere and subject to surface runoff), and groundwater sources that are under the direct influence of

surface water (referred to as GWI sources), are governed by the SWTR. 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 and GWI sources. All surface water and GWI sources also must 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's Ranney Collector Well source is considered to be GWI, and is therefore subject to this rule. The City currently complies with the filtration and disinfection requirements of this rule.

Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) became effective 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 City's Sanitary Survey is included in **Appendix H – Sanitary Survey**. The rule is the first to directly regulate the protozoan *Cryptosporidium* and has set the MCLG for *Cryptosporidium* at zero. The City's Ranney Collector Well source is considered to be GWI, and is therefore subject to this rule. The City currently complies with all requirements of this rule.

Long Term 1 Enhanced Surface Water Treatment Rule

The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) 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 serves greater than 10,000 people, and is therefore not affected by this rule.

Revised Total Coliform Rule

The Revised Total Coliform Rule sets an MCL for *Escherichia Coli (E. coli)* and specifies the frequency and testing of coliform testing based on population served, public water system type, and source water type. When total coliform is detected, it is a treatment technique trigger. The water system must conduct an assessment of their water system facilities and operations and fix any sanitary defects. For confirmed *E. coli* incidents, known as an *E. coli* MCL violation, the water system must perform a Level 2 assessment and provide public notice within 24 hours. If a positive sample is collected on a consecutive systems, the City will also need to collect source samples.

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 which is almost exclusively of fecal origin, and their presence can lead to increased health risks.

The City's *Water Quality Monitoring Plan*, including the *Coliform Monitoring Plan* and *E. coli Response Plan*, is contained in **Appendix I – Water Quality Monitoring Plan**.

Lead and Copper Rule

The Lead and Copper Rule identifies action levels for both lead and copper. An action level is different than an MCL. An 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 lead sources. Corrosion control typically is accomplished by increasing the pH of the water to make it less corrosive, which reduces its ability to break down water pipes and absorb lead or copper.

The EPA is in the process of implementing a lead trigger level of 10 micrograms per liter (µg/L) which would require additional monitoring and treatment requirements.

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 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 also could increase the risk of liver and kidney damage. The City's current water quality monitoring schedule dictates that 30 samples be taken every 3 years. The City currently complies with all contaminant monitoring and treatment 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, photon emitters, radium-226 and radium-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 Amendments to the SDWA finalized the regulations for radionuclides by eliminating the term "interim." The amendments also directed the EPA to promulgate 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 promulgated. The 1996

amendments to the SDWA 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 µg/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 Comprehensive Water System Plan (applicable to the City) or Small Water System Management Program (not applicable to the City) at least every 6 years. The City no longer operates the treatment of its water supply, and is therefore not affected by this rule. The City's *Wellhead Protection Program* is contained in **Appendix J – Watershed Control Program**.

Consumer Confidence Report

The *Consumer Confidence Report* (CCR) is the centerpiece of the right-to-know provisions of the 1996 Amendments to the SDWA. The annual report must be updated and re-issued to all customers by July 1st of each year.

The CCR is a report on the quality of water that was delivered to the water users 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 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. The City's latest CCR is contained in **Appendix K – Consumer Confidence Report**.

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 DBPs 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 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 trihalomethanes (TTHMs), which are a composite measure of four individual trihalomethanes, 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 (MRDLs) 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. The current water quality monitoring schedule dictates that the City collect at a reduced frequency of two TTHM and two HAA5 samples on a quarterly basis. The City currently complies with all contaminant monitoring requirements under 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.

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 on 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 some unregulated contaminants.

Arsenic

Arsenic is highly toxic, affects the skin and nervous system, and may cause cancer. The Arsenic Rule sets the MCLG of arsenic at zero and reduces the MCL from the previous standard of 0.05 mg/L to 0.01 mg/L. Arsenic's monitoring requirements will be consistent with the existing requirements for other inorganic contaminants. The City complies with this rule since its source has levels of arsenic that are below the MCL.

Filter Backwash Recycling Rule

Public water systems using surface water or groundwater under the direct influence of surface water that utilize filtration processes and recycling must comply with the Filter Backwash Recycling Rule. The rule aims to reduce risks associated with recycling contaminants removed during filtration.

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 City discharges filter backwash to sewer so this rule does not apply.

Stage 2 Disinfectants/Disinfection Byproducts Rule

The EPA implemented Stage 2 Disinfectants/Disinfection Byproducts Rule (Stage 2 D/DBPR) 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, 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) report 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 current water quality monitoring schedule dictates that the City collect four TTHM and HAA5 samples on a quarterly basis. The City currently complies with all contaminant monitoring requirements under this rule and has qualified for 40/30 Certification and does not require an IDSE plan.

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 are mandated in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). 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 also are 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 filters and chlorinates its water supply and complies with all inactivation requirements of this rule.

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 groundwaters if the groundwater is added directly to the distribution system and provided to consumers without treatment equivalent to surface water treatment.

The rule targets risk 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). DOH conducted its most recent sanitary survey of the City's water system on October 16, 2018, 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 Revised 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 City's last sanitary survey was completed in October 2018. The City addressed or is currently addressing minor deficiencies identified in this sanitary survey and complies with all other requirements of the rule.

Per- and Polyfluoroalkyl Substances

In 2016, the EPA established a combined health advisory level for two per- and polyfluoroalkyl substances (PFAS) at 70 parts per trillion (ppt). DOH proposed a regulation for PFAS in 2017, and state action levels (SALs) for these substances are now in effect as of August 2024. The SALs are 10 ppt for perfluorooctanoic acid (PFOA), 15 ppt for perfluorooctanesulfonic acid (PFOS), 9 ppt for perfluorononanoic acid (PFNA), 65 ppt for perfluorohexanesulphonic acid (PFHxS), and 345 ppt for perfluorobutanesulfonic acid (PFBS). All water systems in Washington State are required to sample their sources for PFAS by December 2025. Water systems that find PFAS in their supply are required to complete additional monitoring, and systems that exceed a SAL are required to notify all customers. The primary source of PFAS contamination was the historical use of PFAS based firefighting foam used by the US military, local fire departments, and airports.

In April 2024, the EPA finalized MCLs for PFOS and PFOA each at 4 ppt; PFHxS, PFNA, and hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX) at 10 ppt each; and mixtures containing two or more of PFBS, PFHxS, PFNA, and GenX through a combined Hazard Index (HI). The HI normalizes each of the four compound levels to a Health-Based Water Concentration of 2,000 ppt for PFBS and 10 ppt for PFNA, PFHxS, and GenX . The sum of normalized values must be less than 1. Compliance with MCLs will be determined based on a running annual average. PFAS MCLs will supersede DOH SALs when they take effect in 2029. All community and non-transient non community public water systems must test for PFAS under the final rule. The City collected water samples in June 2023 and analyzed them for PFAS compounds.

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 rule's

implementation schedule. 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 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 December 20, 2016 in the Federal Register. The revisions include a list of 30 chemicals that will be monitored during the 2018 through 2020 monitoring cycle. For this cycle, all community water systems and non-transient non-community water systems serving more than 10,000 people will be required to monitor for contaminants. A large surface water and GWI source will be monitored for 10 cyanotoxins and 20 additional contaminants (two metals, eight pesticides plus one pesticide manufacturing byproduct, three brominated haloacetic acid disinfection byproducts groups, three alcohols, and three semivolatile organic chemicals). All large ground water systems will monitor for the 20 additional contaminants. Small water systems serving 10,000 or fewer people will be selected at random to monitor for cyanotoxins or the 20 additional contaminants.

SOURCE WATER QUALITY

This section presents the current water quality standards and the results of the City's recent source water quality monitoring efforts. A discussion of the water quality requirements and monitoring results for the City's distribution system is presented in the section that follows.

DRINKING WATER STANDARDS

Drinking water quality is regulated at the Federal level by the EPA and at the State level by DOH. Drinking water standards have been established to maintain high quality drinking water by limiting the levels of specific contaminants (i.e., regulated contaminants) that can adversely affect public health and are known or likely to occur in public water systems. Non-regulated contaminants do not have established water quality standards and are generally monitored at the discretion of the water purveyor and in the interest of customers.

The regulated contaminants are grouped into two categories of standards: primary and secondary. Primary standards are drinking water standards for contaminants that could affect health. Water purveyors are required by law to monitor and comply with these standards and notify the public if water quality does not meet any one of the standards. Secondary standards are drinking water standards for contaminants that have aesthetic effects, such as unpleasant taste, odor, or color (staining). The national secondary standards are unenforceable federal guidelines or goals where federal law does not require water systems to comply with them. However, states may adopt their own enforceable regulations governing these contaminants. The State of Washington has adopted regulations that require compliance with some of the secondary standards. Water purveyors are not required to notify the public if water quality does not meet secondary standards.

SOURCE MONITORING REQUIREMENTS AND WAIVERS

The City is required to perform water quality monitoring at each of its active sources for inorganic chemical and physical substances, organic chemicals, and radionuclides. The monitoring requirements that the City must comply with are specified in WAC 246-290-300. A description of the source water quality monitoring requirements and procedures for each group of substances is contained in the City's *Water Quality Monitoring Plan*, which is included as **Appendix G – Water Right Documents**.

SOURCE MONITORING RESULTS

The City's source maintains a high level of water quality and has met or exceeded all drinking water standards within the last 6 years, with the exception of 1 discrete detection of coliform in August of 2016. Repeat coliform samples were not positive; therefore, these samples can be disregarded as outliers.

The Ranney Collector Well source (Source S02) has waivers for IOCs valid through December 2028; VOCs, Manganese, herbicides, pesticides, and soil fumigants through 2022; and radionuclides valid through December 2025. The source is sampled annually for nitrates.

The results of inorganic chemical (including nitrate) and VOC monitoring for the City's sources indicate that all primary and secondary standards were met.

DISTRIBUTION SYSTEM WATER QUALITY

Monitoring Requirements and Results

The City is required to perform water quality monitoring within the distribution system for coliform bacteria, disinfectant (chlorine) residual concentration, DBP, lead and copper, and asbestos in accordance with Chapter 246-290 WAC. A description of the distribution system water quality monitoring requirements and procedures are contained in the City's *Water Quality Monitoring Plan* that is included in **Appendix I – Water Quality Monitoring Plan**.

The City has been in compliance with all monitoring requirements for the past several years. A summary of the results of distribution system water quality monitoring within the City's system is presented below.

Coliform Monitoring

The City is required to collect a minimum of 15 coliform samples per month from different locations throughout the system, based on a population served of 15,097 in 2020. The results of coliform testing from the past 6 years were all satisfactory, except a positive sample in August 2016. Follow-up repeat samples were negative; therefore, the positive sample was likely due to error.

Disinfectant Residual Concentration Monitoring

Disinfection requirements applicable to the City's Cowlitz River source are contained in WAC 246-290-662 for filtered systems, which states that a minimum 0.2 mg/L disinfectant

residual concentration shall be maintained at the point the water enters the system, and that the disinfectant residual concentration in the distribution system is detectable in at least 95 percent of the samples taken each calendar month. In an effort to comply with these requirements, the City has established a chlorination target to maintain a positive disinfectant residual in the distribution system. The water samples collected by the City for coliform analysis also are tested for residual disinfectant concentration. As of April 1, 2009, the City has been collecting two samples daily in a north pressure zone and have been rotating zones weekly. The City also has been collecting two samples daily from the 218 Pressure Zone. The disinfection residual has fluctuated; however, they have all measured positive. The City targets a free chlorine residual between 1.2 to 1.4 mg/L downstream of the plant at the entry point to distribution. The residual for the entire distribution system ranged between 0.45 to 1.51 mg/L in 2019. Therefore, the City is in compliance with these regulations.

Lead and Copper Monitoring

The Lead and Copper Rule identifies the action level for lead as being greater than 0.015 mg/L, and the action level for copper as being greater than 1.3 mg/L. When it was in operation, the City's WTP adjusted pH to reduce lead and copper levels. Although the City no longer operates its own treatment plant, it will still be required to monitor lead and copper concentrations. Every 3 years, the City must collect and report a minimum of 30 samples. All previous samples indicate the City is in compliance with these regulations. In August 2020, 30 samples were collected, with the 90th percentile concentration of both lead or copper falling below their respective action levels.

Asbestos

Asbestos monitoring is required if the sources are vulnerable to asbestos contamination or if the distribution system contains more than 10 percent of asbestos cement (AC) pipe. Although none of the City's sources are susceptible to asbestos contamination, AC pipe comprises approximately 15 percent of the City's distribution system. Therefore, the City must monitor for asbestos in the distribution system. The current MCL for asbestos is 7 million fibers per liter (MFL) and greater than 10 microns in length. Monitoring must be accomplished during the first 3-year compliance period of each 9-year compliance cycle. The water sample must be taken at a tap that is served by an asbestos cement pipe under conditions where asbestos contamination is most likely to occur. The City's most recent sample in 2013 detected asbestos at 1.4 MFL, which is under its MCL of 7 MFL. Currently, the City is under a 9-year waiver that began in 2020. The next sample is scheduled for May 2022.

Disinfectants/Disinfection Byproducts Monitoring

TTHM and HAA5 are disinfection byproducts that are formed when free chlorine reacts with organic substances (i.e., precursors), most of which occur naturally. Formation of TTHM and HAA5 is dependent on such factors as amount and type of chlorine used, water temperature, concentration of precursors, pH, and chlorine contact time. TTHM and HAA5 have been found to cause cancer in laboratory animals and are suspected to be human carcinogens.

The City was granted a reduced sampling requirement and only collects two TTHM and two HAA5 samples on a quarterly basis. All recent samples show concentrations below both

substances' MCLs. Therefore, the City is in compliance with this regulation. The City's *Stage 2 D/DBP Monitoring Plan* is provided in **Appendix I – Water Quality Monitoring Plan**. The City was granted 40/30 Certification based on historical water quality data, and was therefore not required to perform an IDSE.

7 | WATER SYSTEM ANALYSIS

INTRODUCTION

This chapter presents the analysis of the City of Kelso's (City) existing water system. Individual water system components were analyzed to determine their ability to meet policies and design criteria under existing and future water demand conditions. The policies and design criteria are presented in **Chapter 5 – Policies and Design Criteria**, and the water demands are presented in **Chapter 4 – Water Demands**. A description of the water system facilities and current operation is presented in **Chapter 2 – Water System Description**. The last section of this chapter presents the existing and projected system capacity analyses that were performed to determine the maximum number of equivalent residential units (ERUs) that can be served by the City's water system. These analyses are based on regulatory requirements for water system design and for maintaining an acceptable level of service. The City's primary goal is to have all its facilities in compliance with federal and state requirements; the secondary goal is to have all its facilities provide the ideal level of service as defined by the City's policies and design criteria.

DISTRIBUTION SYSTEM HYDRAULIC CAPACITY ANALYSIS

The City's transmission and distribution system consists of approximately 411,000 linear feet of pipe providing water to 12 pressure zones within the City. Specifics regarding pipe sizes and materials, as well as the pressure zones, have been documented previously in **Chapter 2 – Water System Description**. Portions of the system are generally considered to need replacement, as over 15 percent of the pipes are constructed of asbestos cement (AC) materials and there are areas where water mains are undersized and unable to provide sufficient flow to meet minimum fire flow requirements. It is recommended that these pipes be removed and replaced with more appropriately sized ductile iron pipes and appurtenances. These projects have been included in the recommended projects listed in **Chapter 9 – Improvement Program**.

HYDRAULIC MODEL AND CALIBRATION

Description

A computer-based hydraulic model of the existing water system was created using version 10.2 of the WaterGEMS® program developed by Bentley Systems, Inc. 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 water system mapping database, as-built records, and information obtained through discussions with City staff.

Demand Data

The hydraulic model of the existing system contains 2020 ADD data. System-wide demands were allocated in the model as part of the *Water System Plan* (WSP) preparation and were scaled to match the system's demands as necessary. The peaking factors calculated in **Chapter 4 – Water Demands,** were used to analyze the system under MDD and PHD conditions.

The hydraulic model of the proposed system contains 10-year and 20-year demand levels that are projected for the years 2030, and 2040, respectively. The future demand allocations in each pressure zone are presented later is this chapter.

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 2030 and 2040, the hydraulic model contained active, existing system facilities and proposed system improvements identified in **Chapter 9 – Water System Improvements**.

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, 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 pressure reducing valves (PRVs) were modeled as being in service and at their normal setpoints. The operational conditions for the pressure analyses are summarized in **Table 7.1, Hydraulic Model Calibration Results.**

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 Washington Administrative Code (WAC) 246-293-660. **Table 7.1, Hydraulic Model Calibration Results,** summarizes the operational conditions for the fire flow analyses for the existing and future systems.

Table 7.1
Hydraulic Model Calibration Results

Junction Number	Field											Model		Absolute Difference	
	Hydrant Location	Date	Start Time	End Time	Run Time (min)	Static Pressure (psi)	Residual Pressure (psi)	Port Size (inch)	Pitot (psi)	Flow (gpm)	Tot. Flow (gallons)	Static Pressure (psi)	Residual Pressure (psi)	Static Pressure (psi)	Residual Pressure (psi)
T-1	Maple & North Pacific	August 2017	9:19:00 AM	9:23:00 AM	4	60	55	5	30	3,797	15,188	61.7	48.8	-1.7	6.2
T-2	Bowmant & Barnes	August 2017	9:55:00 AM	10:01:00 AM	6	73	62	4.5	20	2,877	17,262	71.3	53.4	1.7	8.6
T-3	3rd & NW 8th	August 2017	10:45:00 AM	10:48:00 AM	3	73	44	4.5	10	2,370	7,110	70.7	36.6	2.3	7.4
T-4	3rd & Alder	August 2017	12:50:00 PM	12:53:00 PM	3	73	65	4.5	20	2,718	8,154	70.6	62.2	2.4	2.8
T-5 [1]	Vine & 9th	August 2017	1:17:00 PM	1:23:00 PM	6	75	40	4.5	10	2,106	12,636	74.7	53.1	0.3	-13.1
T-6	Mill & 3rd	August 2017	2:38:00 PM	2:43:00 PM	5	72	65	5	20	3,488	17,440	72	62.7	0	2.3
T-7	Kelso High School	August 2017	8:33:00 AM	8:36:00 AM	3	70	55	4.5	20	2,663	7,989	66	53.1	4	1.9
T-8	Coweeman Park Dr	August 2017	9:11:00 AM	9:18:00 AM	7	72	38	4.5	10	2,370	16,590	71.4	37.8	0.6	0.2
T-9	Kelso Dr	August 2017	11:07:00 AM	11:11:00 AM	4	53	45	4.5	30	3,395	13,580	53.4	43.9	-0.4	1.1

[1] The cast iron piping in this area has been found to contain significant buildup.

psi = pounds per square inch

gpm = gallons per minute

Model Calibration

PEAK HOUR DEMANDS

According to Washington State Department of Health DOH requirements, a water system must maintain a minimum pressure of 30 psi in the distribution system under PHD conditions. In all modeling scenarios, all pressures throughout the distribution system exceeded the minimum system pressure of 30 psi. Additionally, DOH requires a maximum velocity of 8 feet per second (fps), not including fire flow. In all modeling scenarios, all pipe velocities throughout the distribution system are less than 8 fps.

FIRE FLOW ANALYSIS

A detailed fire flow analysis was completed for the City's water system. The analysis was conducted in conformance with DOH requirements that state a water system must provide adequate fire flow under maximum day demand conditions, while maintaining a minimum system pressure of 20 psi. **Table 4.11, Fire Flow Requirements** provides the minimum fire flow requirements used by the City. They have been developed based on the land use classifications that are included in the City's *Comprehensive Plan*. These are the minimum fire flows to be considered in the design of system improvements. Actual fire flow requirements for proposed new structures will be as determined by the City's Fire Marshal.

DISTRIBUTION AND TRANSMISSION SYSTEM DEFICIENCIES

A summary of the primary system deficiencies is outlined as follows. **Chapter 9 – Water System Improvements** provides specifics on proposed improvement projects.

In its existing condition, the water system will be able to serve the projected growth that the City is anticipating. There are existing deficiencies to the system, such as the inability to meet fire flow requirements. These deficiencies can be eliminated through the upsizing of water mains or looping of the water system. Other deficiencies to the distribution system include water mains constructed of AC.

Selection and Justification of Proposed Improvements

Projects were selected for inclusion in the program based on the following criteria.

1. **Growth Related Projects (New Development) –**The proposed Capital Improvement Program includes growth-related projects to serve these proposed new developments.
2. **Growth Related Projects (Existing System) –** These are proposed projects to upsize and improve portions of the existing system that will not be able to adequately serve the system with the anticipated growth.
3. **System Improvements –** These projects are included to address existing system deficiencies such as inabilities to meet minimum fire flow requirements. These projects include upsized lines and system looping improvements.

4. **Small Line Replacements –** Projects have been included to replace all water main that is 4 inches and smaller.
5. **AC Line Replacements –** Projects have been included to remove all asbestos cement water main and replace them with ductile iron.

SOURCE ANALYSIS

The City has two sources of supply for its municipal water system – the Ranney Collector Well and an intertie with the City of Longview (Longview). Details regarding the capacity and allowable withdrawal rates have been included in **Chapter 2 – Water System Description**.

WATER SUPPLY EVALUATION

An evaluation of the City's existing water supply was performed to determine the sufficiency of the combined supply under the City's municipal water right and agreement with Longview to meet both existing and future water demands. **Table 7.2, Existing Water Supply Evaluation**, compares the combined maximum reliable water supply from the sources with the MDD of the system, and the combined maximum physical limitation on the volume of the sources with the ADD of the system. As shown in **Table 7.2, Existing Water Supply Evaluation**, the City has sufficient water rights and agreements to meet existing demand.

Table 7.2
Existing Water Supply Evaluation

Source	Supply (Pumping Capacity vs. MDD)		Annual Volume (Maximum Physical Volume vs. ADD)	
	(gpm)	(gpd)	(afy)	(MG/Year)
Ranney Collector Well	2,300	3,312,000	3,710	1,209
Three Wells	0	0	0	0
City of Longview - Intertie	1,000	1,440,000	1,613	526
Total Supply Available	**3,300**	**4,752,000**	**5,323**	**1,734**
Reliable Supply Available	**2,750**	**3,960,000**	**4,436**	**1,445**
Required Demand (2020)	2,417	3,480,783	2,443	796
Surplus or (Deficit)	333	479,217	1,993	649

gpd = gallons per day
afy = acre feet per year
MG/year = million gallons per year

Table 7.3, Future Water Supply Evaluation, summarizes the results of the future water supply evaluation, which compares the combined installed capacity under the City's municipal water right and agreement with Longview with the system's 10-year and 20-year demand projections. The analyses considered future demand projections without water use reductions from the City's planned water use efficiency efforts. The results of the future water supply evaluation indicate that the City has sufficient water supply to meet the demands through the year 2030, but does not have sufficient water supply to meet the demands through the year 2040. The

anticipated shortfall is in the combined instantaneous capacity, which is reflected in the supply not being able to meet the MDD.

Table 7.3
Future Water Supply Evaluation

Source	Supply (Pumping Capacity vs. MDD)		Annual Volume (Maximum Physical Volume vs. ADD)	
	(gpm)	(gpd)	(afy)	(MG/Year)
Ranney Collector Well	2,300	3,312,000	3,710	1,209
Three Wells	0	0	0	0
City of Longview - Intertie	1,000	1,440,000	1,613	526
Total Supply Available	**3,300**	**4,752,000**	**5,323**	**1,734**
Reliable Supply Available	**2,750**	**3,960,000**	**4,436**	**1,445**
Required Demand (2030)	2,600	3,743,425	2,740	893
Surplus or (Deficit)	150	216,575	1,695	552
Required Demand (2040)	2,801	4,033,546	2,932	955
Surplus or (Deficit)	-51	-73,546	1,503	490

SUPPLY VULNERABILITY

Source Vulnerability

The intertie with the City of Longview was completed in 1977 and is expected to remain in service for at least the 20-year planning period covered by this WSP. The City has sufficient capacity from the Ranney Collector Well and the Longview Intertie to accommodate current water demands, as well as projected water demands for the 10-year and 20-year periods. The existing transmission mains have sections that are undersized and constructed of AC, so these sections will need to be upgraded.

Detailed information regarding the City's water rights has been presented in **Chapter 2 – Water System Description.** In addition, **Chapter 4 – Water Demands** includes calculations of projected water needs over the planning period. The City has sufficient water rights and reliable water supply to service the projected growth that the City is anticipated to experience over the next 20 years.

Collection Vulnerability

Potential problems with the source collection areas are primarily associated with the risks of aging infrastructure and contamination or damage to the Ranney Collector Well by human and/or animal vandalism. The Ranney Collector Well is considered to be Groundwater Under the Influence of Surface Water (GWI) since the facility is located on the Cowlitz River, and thus is vulnerable to rapid shifts in water characteristics and/or quality.

Transmission Vulnerability

The Ranney Collector Well is located in the western portion of the City's distribution system. Water is pumped from the Ranney Collector Well to the City's Water Treatment Plant which supplies water directly to the 188 Pressure Zone.

TREATMENT CAPACITY ANALYSIS

CORROSION CONTROL

DISINFECTION

STORAGE CAPACITY ANALYSIS

The City currently has ten reservoirs for distribution system storage. Details regarding these reservoirs have been provided in **Chapter 2 – Water System Description**. The City will evaluate whether to recoat aging reservoirs or rebuild them at a better hydraulic grade line (HGL) location based on future growth in the area.

It is anticipated that potentially no additional reservoirs will be required during the 20-year planning period. The need for this additional storage capacity will be to serve projected growth, help maintain constant flows from the intertie, and create open, as opposed to closed, pressure zones in proposed higher pressure zones in the City.

ANALYSIS CRITERIA

The existing and proposed storage facilities have been analyzed to ensure that there is sufficient capacity to meet the existing and future storage requirements of the system. Storage needs have been analyzed based on the projected distribution of ERUs throughout the system. **Table 7.4, ERU Distribution by Pressure Zone** includes the assumed distribution of ERUs throughout the pressure zones as included in the computerized hydraulic model of the City's water system.

Table 7.4
ERU Distribution by Pressure Zone

Pressure Zone	2020	2030	2040
	Existing	10-Year	20-Year
	(ERU)	(ERU)	(ERU)
188 (Main Zone)	14,065	14,894	15,810
301 (Rocky Point)	10	11	12
322 (Williams-Finney)	664	703	746
443 (Behshel Height)	171	181	192
522 (Mt. Brynion Estates)	79	84	89
264 (Sunrise Street/Stardust Street)	24	25	26
320	51	54	58
410 (Highland Park)	12	13	14
544 (Tybren Heights)	101	106	113
517 (Carrolls Road)	9	9	10
311 (Lower Carrols Road)	50	53	57
297	38	41	43
Total	15,275	16,175	17,170

Basic physical data for existing storage reservoirs has been included in **Table 7.5, Storage Facility Data**.

Table 7.5
Storage Facility Data

Reservoir Data	Minor Road	Williams-Finney	Behshel Heights No. 1	Behshel Heights No. 2	Carrolls Road	Rocky Point	Paxton Road No. 1	Paxton Road No. 2	Tybren Heights No. 1	Tybren Heights No. 2
	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)	(Existing)
Main Pressure Zone(s) Served	188	322	443	443	517	188	188	188	544	544
Base Elevation (Feet)	168	290	413	413	472	158	164	164	525	525
Diameter (Feet)	133	60	42	59	48	60	60	120	42	42
Height (Feet)	20	32	30	30	45	30	24	24	19	19
Overflow Elevation (Feet) or HGL	188	322	443	443	517	188	188	188	544	544
Volume per Height (gallon per vertical foot)	103,926	21,151	10,364	20,452	13,536	21,151	21,151	84,603	10,364	10,364
Total Volume (MG) (7.8 MG)	2.07	0.67	0.31	0.61	0.60	0.63	0.50	2.03	0.19	0.19
Highest Service Elevation (MSL)	110	210	320	320	445	110	110	110	433	433
Bottom of Standby Storage[1] (MSL)	156	256	366	366	491	156	156	156	479	479
Total Usable Volume (MG) (7.55 MG)	**2.07**	**0.67**	**0.31**	**0.61**	**0.35**	**0.63**	**0.50**	**2.03**	**0.19**	**0.19**
Percent Usable to Total Volume	100%	100%	100%	100%	58%	100%	100%	100%	100%	100%
[1] Calculated as the water surface elevation at which highest service elevation can be served with 20 psi.										
[2] The Highland Park tank serves as a pressure tank for the highland park pump station and does not provide usable storage for the system.										

MG = million gallons
MSL = mean sea level

Storage capacity has been analyzed for the following components: 1) operational storage; 2) equalizing storage; 3) standby storage; 4) fire suppression storage; and 5) dead storage.

Operational Storage

Operational storage is the volume of the reservoirs used to supply the water system under normal conditions when the Ranney Collector Well and/or the Longview Intertie are not delivering water to the system. This volume is associated with the elevation difference required for the pump level sensors which is an operational distance of 3 feet for each of the reservoirs.

Equalizing Storage

Equalizing storage is the volume of water used to supply the system at a minimum pressure of 30 psi at all service connections under peak demand conditions and when the system demand exceeds the total rate of supply by the Ranney Collector Well and/or the Longview Intertie. The formula used for reservoirs with electronic level controls is:

ES = (PHD – Qs) * (150 min), but in no case less than zero

where, ES = Equalizing storage (gallons)

PHD = Peak Hourly Demand (gpm)

Qs = Sum of all active source of supply capacities, except emergency sources of supply (gpm).

Standby Storage

Standby storage is the volume of water used to supply the water system under emergency conditions when supply facilities are out of service due to equipment failures, loss of supply, transmission main breaks, power outages, and any other situation that disrupts the supply source. Per DOH requirements, standby storage should never be less than 200 gallons per ERU.

For this WSP storage analysis, standby storage requirements were calculated with the 200 gallons per ERU equation.

Fire Suppression Storage

Fire suppression storage is the volume of storage used to supply water to the system at the maximum rate and duration required to extinguish a building with the highest fire flow requirement. Maximum fire flow requirements served by each of the reservoirs are outlined in **Table 7.6, Maximum Fire Flows by Reservoir**.

FSS = (FF) x (t)

Where, FSS = Fire Suppression Storage

FF = Required Fire Flow rate (gpm)

t = Duration of time when Fire Flow rate is required (minutes).

Table 7.6
Maximum Fire Flows by Reservoir

Reservoir	Maximum Fire Flow Rate (gpm)	Duration (minutes)
Minor Road	4,000	300
Williams-Finney	1,500	180
Behshel Heights Nos. 1 & 2	1,500	120
Carrolls Road	1,500	180
Rocky Point	4,000	300
Paxton Road Nos. 1 & 2	4,000	300
Tybren Heights Nos. 1 & 2	1,000	120
Highland Park	1,500	180

Dead Storage

Dead storage is the volume of water in 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 DOH without pumping.

STORAGE REQUIREMENTS

An analysis of the required storage components indicates that there is sufficient storage capacity within the system for existing conditions as summarized in **Table 7.7, Existing Storage Evaluation**. Future storage evaluations looked on the reliable supply and storage available to each pressure zone. The results for the 10-year planning period of 2030 are summarized in **Table 7.8, Future Storage Evaluation (2030)**; and for the 20-year planning period of 2040 are summarized in **Table 7.9 Future Storage Evaluation (2040)**.

Table 7.7
Existing Storage Evaluation

Storage Component	Total System[1] (gallons)	188 Pressure Zone (gallons)	322 Pressure Zone (gallons)	443 Pressure Zone (gallons)	544 Pressure Zone (gallons)	517 Pressure Zone (gallons)
Operational Storage	951,400	692,600	63,500	92,500	62,200	40,600
Equalizing Storage	333,100	307,000	14,500	7,100	3,300	400
Standby Storage [2]	3,055,065	2,815,106	132,789	65,066	30,243	11,862
Fire Suppression Storage	1,200,000	1,200,000	270,000	180,000	120,000	270,000
Total Storage Required	**5,539,565**	**5,014,706**	**480,789**	**344,666**	**215,743**	**322,862**
Total Storage Available [2]	7,549,300	5,230,000	670,000	920,000	380,000	349,300
Surplus or (Deficit)	2,009,735	215,294	189,211	575,334	164,257	26,438

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones since fire flow suppression is not cumulative per pressure zone.

[2]Total Includes subzones and closed pressure zones with no storage facility.

Table 7.8
Future Storage Evaluation (2030)

Storage Component	Total System[1] (gallons)	188 Pressure Zone (gallons)	322 Pressure Zone (gallons)	443 Pressure Zone (gallons)	544 Pressure Zone (gallons)	517 Pressure Zone (gallons)
Operational Storage	951,400	692,600	63,500	92,500	62,200	40,600
Equalizing Storage	333,100	325,100	15,300	7,500	3,500	400
Standby Storage	3,055,065	2,981,028	140,616	68,901	32,025	12,561
Fire Suppression Storage	2,040,000	1,200,000	270,000	180,000	120,000	270,000
Total Storage Required	**6,379,565**	**5,198,728**	**489,416**	**348,901**	**217,725**	**323,561**
Total Storage Available [2]	7,549,300	5,230,000	670,000	920,000	380,000	349,300
Surplus or (Deficit)	1,169,735	31,272	180,584	571,099	162,275	25,739

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones since fire flow suppression is not cumulative per pressure zone.

[2] Total includes subzones and closed pressure zones with no storage facility.

Table 7.9
Future Storage Evaluation (2040)

Storage Component	Total System[1] (gallons)	188 Pressure Zone (gallons) [2]	322 Pressure Zone (gallons)	443 Pressure Zone (gallons)	544 Pressure Zone (gallons)	517 Pressure Zone (gallons) [4]
Operational Storage	951,400	692,600	63,500	92,500	62,200	40,600
Equalizing Storage	333,100	345,100	16,300	8,000	3,700	400
Standby Storage	3,055,065	3,164,310	149,261	73,138	33,994	13,333
Fire Suppression Storage	1,200,000	1,200,000	270,000	180,000	120,000	270,000
Total Storage Required	**5,539,565**	**5,402,010**	**499,061**	**353,638**	**219,894**	**324,333**
Total Storage Available [3]	7,549,300	5,230,000	670,000	920,000	380,000	349,300
Surplus or (Deficit)	2,009,735	-172,010	170,939	566,362	160,106	24,967

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones since fire flow suppression is not cumulative per pressure zone.

[2] The storage deficit shown is due to the required standby storage needed to accommodate growth. Actual need for additional storage should be reassesed in the 10- to 20-year horizon.

[3] Total includes subzones and closed pressure zones with no storage facility.

[4] The lack of storage redundancy can be augmented by connecting the 544 and 517 Pressure Zones.

OVERALL SYSTEM CAPACITY ANALYSIS

This section summarizes the various components of the water system that could limit the capacity of the City to serve future customers (e.g., supply, storage, and water rights) to determine the maximum number of ERUs it can serve. System capacity is useful in determining how much capacity is available in the water system to support new customers that apply for water service through the building permit process. The system capacity information, together with the projected growth of the system expressed in ERUs, as shown in **Chapter 4 – *Water Demands***, 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 reliable supply, water rights, and storage. The supply capacity analysis was based on the limiting capacity of the supply facilities and the system's MDD per ERU. The annual water rights capacity evaluation was based on the existing annual water rights, as summarized in **Chapter 6 – Water Source and Quality**, and the system's ADD per ERU. The instantaneous water rights capacity evaluation was based on the existing instantaneous water rights, as summarized in **Chapter 6 – Water Source and Quality**, and the system's MDD per ERU. The storage capacity analysis was based on the total capacity of the storage facilities and the computed storage requirement per ERU. The storage requirement per ERU was determined from the existing storage requirements presented previously in this chapter and the existing number of ERUs presented in **Chapter 4 – Water Demands**.

SYSTEM CAPACITY

A summary of the results of the existing system capacity analysis is shown in **Table 7.10, System Capacity**. The results of the 2020 system capacity analysis indicate that the system can support up to a maximum of approximately 17,156 ERUs. The limiting component is supply. Per demand forecast as shown in **Table 4-18 Projected System Wide Water Demands**, it is anticipated that by the year 2038 the system will exceed its current supply capacity.

Table 7.10
System Capacity

Demands per ERU Basis			
Average Day Demand per ERU (gpd/ERU)	150		
Maximum Day Demand per ERU (gpd/ERU)	254		
Peak Hour Demand per ERU (gpm/ERU)	0.287		
YEAR	**2020**	**2030**	**2040**
Supply			
Source Capacities (gpd)	3,960,000	3,960,000	3,960,000
Maximum Day Demand (gpd)	3,482,103	3,745,218	4,035,861
Maximum Supply Capacity (ERU)	17,156	17,156	17,156
Storage Capacity			
Maximum Storage Capacity (gal)	7,549,300	7,549,300	7,549,300
Storage Requirement per ERU (gal)1	357	350	343
Maximum Storage Capacity (ERU)	21,152	21,589	22,030
Annual Water Rights Capacity			
Annual Water Right Capacity (gpd)	6,005,962	6,005,962	6,005,962
Average Day Demand per ERU (gpd)	150	150	150
Maximum Annual Water Right Capacity (ERU)	40,040	40,040	40,040
Instantaneous Water Rights Capacity			
Instantaneous Water Right Capacity (gpd)	14,162,400	14,162,400	14,162,400
Maximum Day Demand per ERU (gpd)	254	254	254
Maximum Instantaneous Capacity (ERU)	55,741	55,741	55,741
Maximum System Capacity			
Based on Limiting Facility (ERU)	17,156	17,156	17,156
Available System Capacity			
Maximum System Capacity (ERU)	17,156	17,156	17,156
Customers (ERU)	15,275	16,311	17,455
Surplus or (Deficit) Capacity (ERU)	1,881	845	-299
Note: [1]Assumes no nesting of standby storage and fire suppression storage.			

Appendix **L – Hydraulic Analysis** includes a hydraulic analysis for the **existing,** 10- and 20-year planning horizons. **Table 7.11** summarizes the results of fire flow analyses simulated during MDD with the existing water system shown in **Figure 2.1, Existing Water System**. The improvements shown in **Chapter 9** primarily address redundancy, resiliency and replacing old infrastructure past its useful life. Additional analyses and improvements should be completed to address fire flow deficiencies.

Table 7.11
Hydraulic Modeling Results – Fire Flow Analysis

Fire Flow Requirements	2020			
	Total Nodes Modeled	Total Nodes Satisfying Fire Flow		Failing Nodes Average Deficiency
	(Quantity)	(Quantity)	(%)	(%)
Residential/Single Family	469	319	68%	64%
Residential/Multifamily	35	23	66%	30%
Commercial	81	63	78%	62%
Industrial (Foster Farms)	1	1	100%	--
Total	**586**	**406**	**69%**	**52%**

8 | OPERATION AND MAINTENANCE

WATER SYSTEM MANAGEMENT AND PERSONNEL

The City of Kelso's (City) Public Works Department operates the City's water system and is led by a Superintendent who is assisted as needed by maintenance staff. The Public Works Superintendent is charged with the day-to-day operational responsibilities of the water utility. Those responsibilities include preventive maintenance, field installation and repair judgments, water quality monitoring, and management of the City's cross-connection control program.

On issues requiring more formal notification or responses to the public or press, the Public Works Superintendent serves as a technical advisor to the City administration in formulating the appropriate responses/notifications to the public/press.

Utility billing for the system is accomplished through the field meter reading managed by Meter Readers, LLC, a third-party utility billing company.

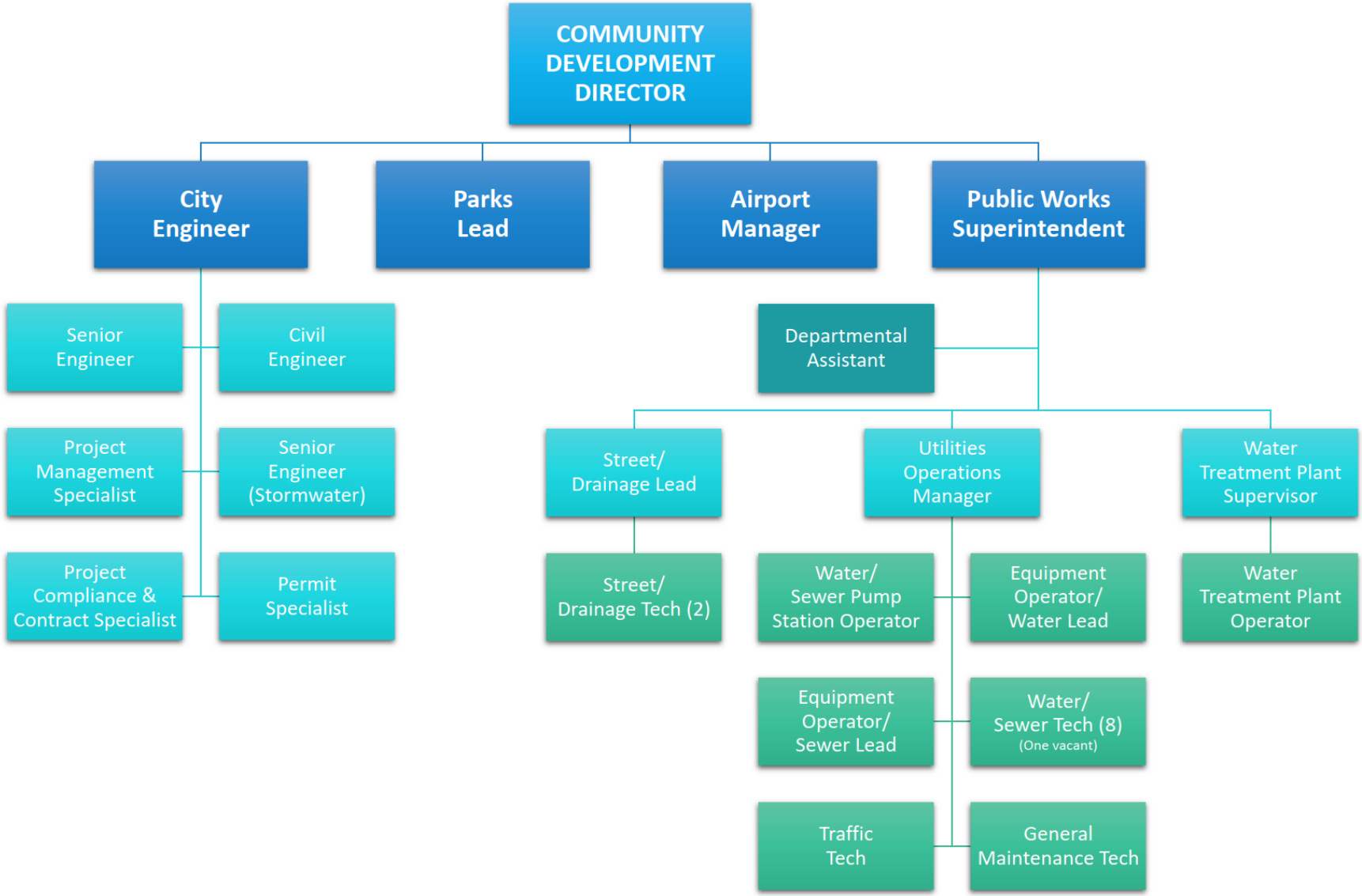
STAFFING

The preventive maintenance procedures, as well as the normal and emergency operations of the utility, are described in the previous table. The hours of labor and supervisory activity required to effectively carry out the work of these on-going maintenance and operations schedules form the basis for determining adequate staffing levels.

The current staff includes management personnel, supervisory personnel, maintenance workers and office personnel engaged in operating and maintaining the water system. **Chart 8.1, City Organization Chart** shows the organization and departmental hierarchy for the operation of the City's water system.

Chart 8.1

City Organization Chart



OPERATOR CERTIFICATION

The City has a responsibility to comply with regulations established by the Washington State Department of Health (DOH) Washington Administrative Code (WAC) Chapter 246-292. This requires the City to employ the services of a Water Distribution Manager (WDM) who is in responsible charge of the daily operational activities of the system. This position is required to maintain their currency in the field by obtaining not less than three continuing education units (CEUs) within a specified three-year time frame. Common sources of that training include seminars put on by the American Water Works Association (AWWA) or Washington Education and Training Resources Center (WETRC). Current water system certificate holders for the City are listed below.

Operator Name	Operator Number	Position Number	Certification Level Required
M. Randy Johnson	010952	1	Water Distribution Manager 3
Nathaniel Bell	012794	2	Water Treatment Plant Operator 2
Lamont Salte	003507	3	Water Treatment Plant Operator 3
Jason Cook	011064	4	Water Treatment Plant Operator 2
Jason Gorans	012807		
Nathaniel Bell	012794		
Chad Smith	012404		
Devin Mackin	011613		
Edward Pardue	006377		
Geary Martin	012836		
Vacant			

SYSTEM OPERATION AND CONTROL

SYSTEM COMPONENTS

The City's existing storage facilities, pump stations, piping materials, and pressure reducing stations are included in **Figure 2.1 – Existing Water System.** The details regarding the Water Treatment Plant (WTP) system and components are documented in the Kelso WTP and Water System Operations Program. The following treatment, distribution and alarm indicators operate as follows:

Treatment System: The Ranney collector and treatment system currently operate 24 hours per day. Plant operation and flow varies daily to meet system demands and maintain desired distribution system reservoir levels. The plant shuts down automatically if it operates outside set water quality parameters or if the clearwell trips the high-level sensor.

Distribution System: The high-lift distribution pumps deliver the finished water from the clearwell to the distribution system into the 188 Pressure Zone. The high-lift distribution pumps are operated based on the clearwell level only. The levels of all the reservoirs in the distribution system are monitored by the supervisory control and data acquisition (SCADA) system;

however, they don't play a role in the control of the high-lift pumps. Reservoirs in higher pressure zones have pressure switches to control the supply to booster pump stations.

Alarm Indicators: Remote alarm indicators allow continuous monitoring and early detection of problems in the water supply system. The master alarm indicator panels are located at the City's WTP, where they receive information from the City's reservoirs, booster pump stations, and all major WTP equipment. Alarms include pump failure, reservoir high or low water, power failure, line failure, turbidity level, and low well water.

ROUTINE SYSTEM OPERATION AND PREVENTATIVE MAINTENANCE

Routine maintenance activities help to preserve the value of the water system and to ensure that the utility can continue to operate in an efficient manner. In a water system, maintenance is essential to ensure that the system can fulfill the safety and health requirements of the customers. Operators manage the WTP seven days per week, a list of daily routine system operation is as follows:

- Inspect water supply and WTP for obvious leaks, broken parts, or other abnormality.
- Examine charts showing reservoir levels and high head pumping frequency.
- Check filter differential pressure (indicating degree of filter capacity).
- Check the chlorine and fluoride scales for chemical usage.
- Verify the operation of filters.
- Conduct plant testing and perform laboratory work.
- Inspect reservoirs twice per week.
- Inspect booster pump stations twice a week, provided that reservoir level indicators are positive during the period.

The City conforms to all recommended maintenance tasks as published by equipment suppliers as a minimum standard for maintenance activities. Regular operational tasks for City staff are outlined in **Table 8.1, Routine Operations and Preventative Maintenance**. Sample forms to be used in documenting and recording maintenance activities have been provided in **Appendix M – Operations and Maintenance Forms**.

Table 8.1

Routine Operations and Preventative Maintenance

System Component	Maintenance	Frequency
Pumps	Lubricate, inspect mechanical seals	Regularly
	Measure total suction and discharge heads	Annually
	Monitor temperature	Monthly
	Inspect pump bearings	Quarterly
Electric Motors	Lubricate; inspect motors;	Regularly
	Inspect grease quantity, oil level in oil-lubricated bearings	As required
	Check for excessive vibration and repair as necessary	Regularly
	Measure motor amp readings	Semi-annually
	Run thermal imaging scan	As required (every 4 to 5 years)
Ranney Collector	Visit Site	Weekly
	Chlorinate and backflush laterals	Monthly
	Well draw-down test	Three times per year
Filters	Inspect	Two times per year, or more as required
Water Mains	Flush	Recommended Annually
	Leak Detection and repair	As required (every 4 to 5 years)
Reservoirs	Inspect exterior components of the reservoirs. Inspect for vandalism. Record levels.	Daily
	Inspect screens, vents, and hatch seals. Repair or replace screens and seals as needed.	Monthly
	Operate reservoir drain and run reservoir to overflow. Inspect tank interior. Clean and/or repaint interior and exterior as needed.	Annually
	Clean and Inspect	As required
Pumping Facilities	Inspect pump stations.	Bi-weekly
	Inspect condition of pump motors and lubricate as necessary. Replace pump oil. Inspect pump station buildings and piping. Repaint and repair as needed.	Annually
Pressure Reducing Valves (PRVs)	Inspect for proper operation.	Quarterly, or additionally as system pressures require
Distribution System Valves	Inspect valves for proper operation.	Semi-Annually
Fire Hydrants	Inspect hydrants, exercise valves, and conduct flow testing.	Annually (by Public Works)
Valves	Exercise	Annually
Blowoff Assemblies	Flush lines to remove stagnant water and debris.	Bi-Annually
Air Valve	Inspect	Annually
Meters	Test and calibrate source meter	Every Five Years
	Replace worn or defective meters (10% every year)	Annually
Telemetry & Control Systems	Backup program and data.	Daily
	Visually inspect cabinets and panels for damage, dust, and debris. Test alarm indicator units. Clean and flush all pressure sensitive devices.	Semi-Annually

STAFFING

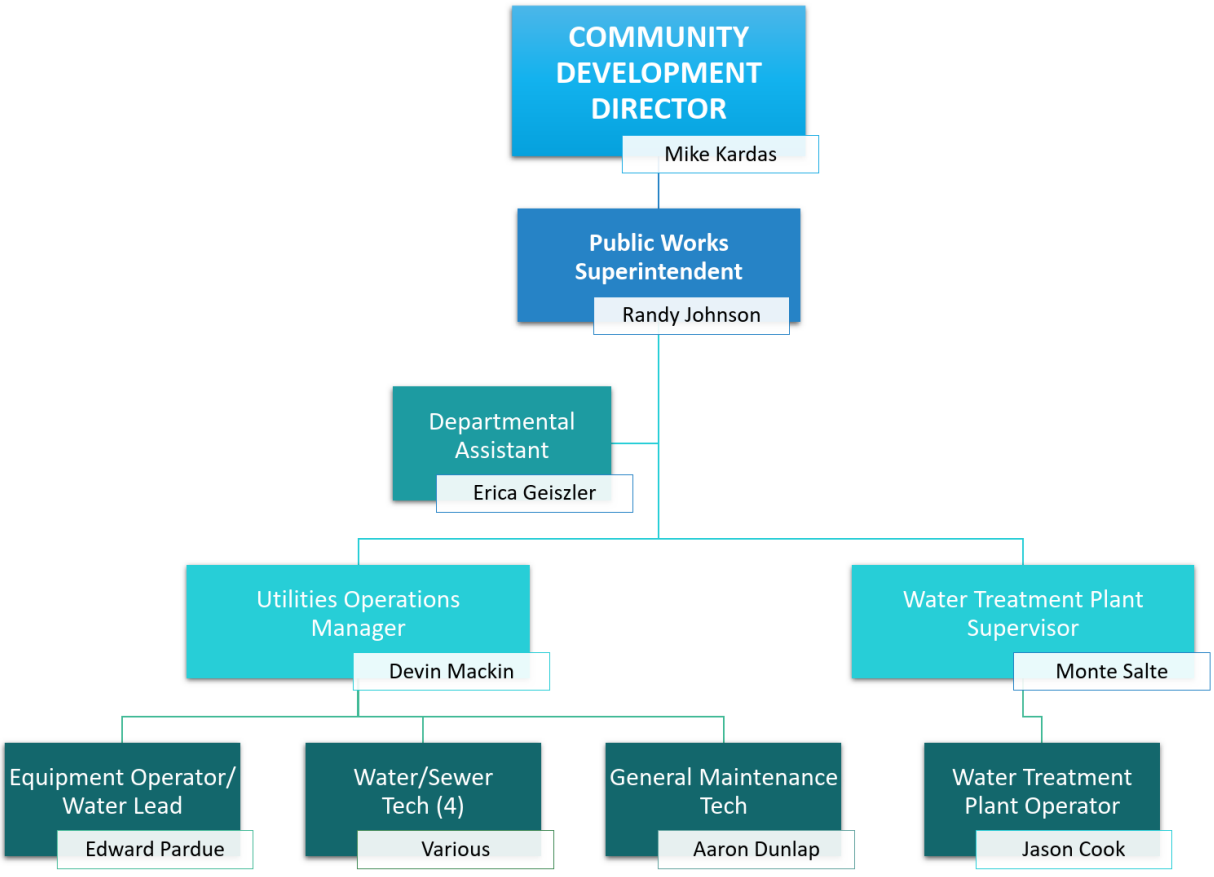
The preventive maintenance procedures, as well as the normal and emergency operations of the utility, are described in the previous table. The hours of labor and supervisory activity required to effectively carry out the work of these on-going maintenance and operations schedules form the basis for determining adequate staffing levels.

CURRENT STAFF

The current staff includes management personnel, supervisory personnel, maintenance workers and office personnel engaged in operating and maintaining the water system. There are currently four maintenance crew, two Water Treatment Plant operators, one utility manager, and one administrative personnel in the operations and maintenance organization that support the City's water system as shown in **Chart 8.2, Water System Personnel**.

Chart 8.2

Water System Personnel



STAFFING REQUIREMENTS

The estimated hours of work required in order to achieve optimum operation and maintenance of the water system (excluding time required for clerical tasks) is shown in **Table 8-2 – Staffing Requirements**. The upper section of the table identifies the staffing time requirements for preventive maintenance tasks and the lower section identifies the staffing time requirements for operations tasks.

To achieve the level of operations and maintenance shown in **Table 8-2 – Staffing Requirements**, approximately nine full-time personnel are required for the water system alone. At the current staffing level, the City is capable of adequately operating the water system and complying with the minimum requirements of DOH. However, the preventive maintenance tasks listed in **Table 8-2 – Staffing Requirements** have not been accomplished at the desired frequency shown in the table due to the staff shortage. The City's Sewer and Water Departments currently share eight full time technicians, one general maintenance technician, and the lead and equipment operators, and it is assumed that the employee hours are distributed evenly (approximately 50 percent) for each department. Therefore, because the City only has 5.5 full-time Water Department staff positions filled, and nine full-time personnel are required, the City needs 3.5 additional full-time employees for operation of the water system. As the system continues to age or expand, the need for additional staff will continue to grow.

Table 8.2

Staffing Requirements

Description	Total Units in System	Frequency (times per year)	Time/Unit (hours)	Time/Year (hours)
Preventive Maintenance				
Hydrants	1,000	1	0.5	500
Isolation Valves, Hydrant Valves	2,500	1	0.25	625
Air and Vacuum Release Valves	50	1	0.5	25
Blow-off Assemblies	50	1	0.25	13
Connections	4,763	0.1	2	953
Leak Survey of Water Mains	78 miles	0.1	4	31
Flushing Water Mains	78 miles	0.2	20	311
Booster Pump Stations	7	52	1	364
Pressure Reducing Stations	10	52	2	1,040
Interties	1	30	2	60
Ranney Collector Well	1	52	1	52
Reservoirs	11	52	1	572
Telemetry and Control System	1	1	40	40
Operations				
Booster Pump Stations Repairs	7	1	8	56
Filtration Plant Operation	2	260	8	4,160
False Alarm Response	1	12	2	24
Meter Reading	0	0	0	0
Groundskeeping	10	12	4	480
Inventory	1	1	40	40
Meter Repair and Replacement	238	1	4	953
Main Breaks	1	4	16	64
System Failures	1	4	8	32
Hydrant Repairs	20	1	8	160
Service Connections	1	10	8	80
Main Connections	1	5	16	80
Water Quality Sampling	38	12	1	456
Administration	1	260	8	2,080
Total Requirements				
Total Hours Required				**13,251**
Total Full-Time Staff Required (based on 1,540 hours per year, per person)				**8.6**
Time Available Per Year, Per Person				
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 Total Available Hours Per Year, Per Person				**1,540**

EQUIPMENT, SUPPLIES, AND CHEMICAL LISTING

The City utilizes the supplies included in **Table 8.3, Operation and Maintenance Equipment** to perform routine operation and maintenance of the water system.

Table 8.3
Operation and Maintenance Equipment

Equipment
Water main, ductile iron, 4-, 6-, 8-, 10-, 12-, and 16-inch
Pipe fillings and couplings, 4-, 6-, 8-, 10-, 12-, and 16-inch
Tapping tees, 4-, 6-, 8-, 10-, 12-, and 16-inch
Repair clamps, all sizes
Service pipe, copper, 3/4-, 1-, 1-1/2-, and 2-inch
Service meters, 3/4-, 1-, 1-1/2-, and 2-inch
Miscellaneous fittings and valves
Spare parts
Fire hydrants and valves
Tapping tool
Van with welder, parts bins, and power take-off

Additionally, **Table 8.4, Chemical Supplies** lists chemicals that are maintained on hand in order to operate the system.

Table 8.4
Chemical and Miscellaneous Supplies

Chemical	Amount (gallons)
Aluminum sulfate	4,200-gallon loads (ordered as needed)
Sodium fluoride	50-pound sacks (ordered as needed)
Sodium hypochlorite	4,800-gallon loads
Sodium hydroxide	4,800-gallon loads
Pump seals	--
Filter media	--
Oil and grease	--
Strip charts	--
Laboratory supplies	--

COMPREHENSIVE MONITORING PLAN

The City conducts regular water quality testing to ensure that a safe product is being distributed to its customers in conformance with DOH regulations. A copy of the City's *Coliform Monitoring*

Plan has been included in **Appendix I – Water Quality Monitoring Plan**. Further details regarding water quality monitoring requirements have been included in **Chapter 6 – Water Source and Quality**.

EMERGENCY RESPONSE PROGRAM

Utility emergency planning can be defined as the activities that prepare a utility to respond to an emergency situation. Emergencies can be small or large with respect to their effects on utility operations and service.

Many utilities cope with smaller scale or routine emergency situations frequently, perhaps weekly or daily. Larger scale, or "disaster emergency," situations occur far less frequently, but many aspects or effects of a disaster manifest themselves in the same way as the routine emergencies. In many respects, a disaster can be thought of as the simultaneous occurrence of many smaller scale emergencies. If a utility is well prepared to handle the routine emergencies, then they will be better prepared to handle the more serious ones as well.

PRIORITY SERVICES LIST

In certain instances, particularly during an emergency, it is not possible to provide advanced notice of a water shut down. However, there are certain water customers that must be notified in the event of a disruption of service. Critical among these in the City are kidney dialysis patients. A current list of customers with dialysis machines requiring an uninterrupted supply of water must be maintained. The list must be updated regularly by the City. Customers on the priority list are notified prior to emergency shut down of water service.

AFTER HOURS EMERGENCY CALLOUT

The Call-Up List, in the appropriate call order, for the City in case of an emergency is shown in Table 7-4. Every employee has a copy of the City's emergency call-up list. Additional communication numbers and information can be found in the City's *Water System Emergency Response Plan* (2004). An emergency call list has been provided in **Table 8.5, Emergency Call List**.

Table 8.5
Emergency Call List

City Key Personnel	Position
Randy Johnson	Public Works Superintendent
Mike Kardas	Director of Public Works
Lamont Salte	Water Treatment Plant Supervisor
Jason Cook	Water Treatment Operator
Devin Mackin	Utility Operations Manager
Chad Smith	Sewer Distribution Lead
Ed Pardue	Water Distribution Lead

In the event of a major disaster:

a. All staff should report to City Hall upon learning of the disaster.

b. During the ensuing survey of the system's facilities for damage, use of the radio should be kept to a minimum and limited to the transmitting of important information.

c. Upon a request to clear the air, all operators should standby for emergency instructions.

d. All contact with the media should be through the Mayor only. This is critical as it will minimize the amount of misinformation that typically accompanies such events.

e. It is important to stick to the task at hand until the damage to the system has been evaluated and City staff have declared that the water system emergency status has been terminated. The damage to the water system must be evaluated to prevent, where possible, loss of life, bodily injury, property damage, and contamination as a result of the damage to water system facilities. All City and King County forces will be overburdened at such times, but it is not the role of the City personnel to assist Police, Fire, or other personnel unless directed to do so or until released from the emergency work associated with the water system facilities.

EMERGENCY RESPONSE PLAN

In addition to the City's *Emergency Response Plan*, emergency responses for the Ranney Collector Well, reservoirs, and distribution system have been identified for the following emergencies: power failure; severe earthquake; severe snowstorm; and contamination of water supply. The City last updated its *Emergency Response Plan* in 2004, and while response procedures may not have changed, updates to communication protocols may need to be updated.

Power Failure

Various types of weather can cause loss of power (i.e., wind, lightning, freezing rain, and freezing snowstorm). Power is provided by Cowlitz County Public Utility District. **Table 8.6, Power Failure Emergency Response**, summarizes action recommendations for a power failure event. It is important to note that neither the treatment plant of Ranney collector have back up power. A portable generator set can be transported of the Ranney Collector Well during power outages.

Table 8.6
Power Failure Emergency Response

System Component	Action
Pumps: Electric pump will shut off and system will automatically switch to backup power	Verify backup power is working.
Reservoirs: Water level may fall if system demand exceeds supply	Check reservoir level and notify customers to curtail water use if reservoir level continues to drop – increase pumping.
Distribution System: Pressure will drop if reservoir level drops	Continuously monitor reservoir level, implement water restrictions if needed.

Severe Earthquake

Although severe earthquakes are rare, the City may be vulnerable if facilities are damaged. The City should obtain the ability to procure trucked-in water. **Table 8.7, Severe Earthquake Emergency Response**, summarizes action recommendations for a severe earthquake event. The City has installed seismic actuated valves at two of their newest reservoirs: Paxton and Minor Road. The seismic actuated valve will automatically isolate these two facilities during an earthquake event.

Table 8.7
Severe Earthquake Emergency Response

System Component	Action
Pumps: Structural damage may have occurred and/or mechanical damage to pumps or piping may have occurred	Check pumps and mechanical piping.
Reservoirs: Reservoir may be leaking or structurally damaged	Check reservoir for structural damage and drain if necessary.
	Check reservoir for cracks and leaks and seal or drain as required.
	Bypass reservoir and run system from pumps only.
Distribution System: Distribution and transmission mains may be broken	Isolate broken sections and repair.

Severe Snowstorm

In a severe snowstorm, heavy snowfall will bring motor vehicle traffic to a standstill, employees will not be able to reach the problem area, and power outages may occur. Water supply should not be interrupted. **Table 8.8, Severe Snowstorm Emergency Response**, summarizes action recommendations for a severe snowstorm event.

Table 8.8
Severe Snowstorm Emergency Response

System Component	Action
Pumps	No immediate effect – snow may prevent access. Clear snow from access roads.
Reservoirs	No immediate effect – snow may prevent access. Clear snow from access roads.
Distribution System	Transportation for City crew to monitor system and to make repairs will be limited. City crews will plow important streets – contact State Highway Department to expedite plowing to any problem area under their jurisdiction. Have chains or other snow gear in readiness for maintenance equipment. Valve location maps should be made available for maintenance personnel and should be kept current. Clear snow from fire hydrants.

Contamination of Water Supply

Contamination of the water supply might occur due to main breaks or pollution from an isolated source. Redundant source capacity and the ability to isolate the reservoirs helps to reduce the City's vulnerability; however, due to the topography of the water service (WSA) and the distribution network, it may be very difficult to maintain a desired level of service if a booster station or a reservoir in the upper pressure zones need to be isolated. Other than the 188 Pressure Zone, the distribution network is not redundant. **Table 8.9, Contamination of Water Supply Emergency Response**, summarizes action recommendations for a contamination of the water supply event.

Table 8.9
Contamination of Water Supply Emergency Response

System Component	Action
Reservoirs: Chlorinate	Isolate contaminated reservoir from system and decide method of disinfection.
	Inspect vent screens, hatches, and piping to try and identify the source of contamination.
	If reservoir water is considered unsuitable for consumption due to stagnation, etc., consider draining, cleaning, and disinfecting reservoir.
	If water surface needs skimming, consider overflow reservoir and then disinfect contents.
	Disinfect reservoir with chlorine as required by AWWA standards – take bacteriological samples and return reservoir to service when results are satisfactory.
Distribution System: Isolate source of contamination	Close valves as required to isolate source of contamination. Repair and/or otherwise remove source of pollution.
	Flush previously contaminated section and test until free of contamination prior to resumption of use.

SAFETY PROCEDURES

Safety is the highest concern and responsibility of all water operations and maintenance staff. First aid kits are available at all Public Works buildings and in each maintenance vehicle. **Table**

8.10, Safety Procedures identifies safety procedures to be followed for operations and maintenance tasks that are associated with the City's water system.

Table 8.10
Safety Procedures

Hazardous Condition	Safety Procedure
Use of Chlorine and Chlorine Products	Handle with care, provide adequate ventilation, and wear safety glasses and rubber gloves. Detailed handling procedures are found in the respective Material Safety Data Sheets (MSDS).
Use of Sodium Hydroxide	Handle with care, provide adequate ventilation, wear safety goggles, apron, and rubber gloves. Keep container tightly closed, store in a dry, corrosion-proof area. Never return contaminated material to its original container. Immediately contact the chemical supplier / manufacturer for handling instructions if drums of caustic appear to be swollen. Detailed handling procedures are found in the respective MSDS.
Working in Confined Spaces	Follow State requirements for confined space entry.
Working around Heavy Equipment	Obtain proper training and follow all safety procedures. Use noise protection equipment.
Working in Traffic Areas	Wear proper clothing and provide adequate signage and flagging for work area. Refer to the Manual of Uniform Traffic Control Devices (MUTCD) for current requirements.
Working on or Around Water Reservoirs	Follow proper safety harness procedures for working on tall structures.
Working in or around Pump Stations	Obtain proper training and follow all safety procedures for working on pumps and electrical equipment. Use noise protection equipment.
Working on Asbestos Cement (AC) Water Main	Obtain proper training and follow all safety procedures for working with asbestos materials.

CROSS-CONNECTION CONTROL PROGRAM

The City has developed a Cross-Connection Control policy to prevent contamination of the City's water supply. A copy of the City's Cross Connection Control Program has been included in **Appendix N – Cross Connection Control Program**.

CUSTOMER CONCERN PROCESS

The City refers to customer complaints as "Customer Concerns." When a concerned customer contacts the Public Works Department, a Citizen Concern Form is completed at the time of the call. The City then has 10 days to correct the concern if it is within the City's responsibilities and notify the concerned customer as to the resolution. All Citizen Concern Forms are forwarded daily to the Public Works Department Assistant for central filing. When the concern is settled, an updated final copy of the form is added to the files. All Citizen Concern Forms are kept on file for a minimum of 3 years. An example of the Citizen Concern Form is included in the appendices.

RECORDKEEPING AND REPORTING

Records and reports maintained by the City are shown below in **Table 8.11, Kelso – Recordkeeping Procedures.**

Table 8.11

Kelso – Recordkeeping Procedures

Record	Comments	Minimum Years Maintained
WTP Report	Submitted monthly to DOH Maintained at WTP	3
SWTR Disinfection Report	Submitted monthly to DOH Maintained at DOH	Life of facility
Water Supply and High Head Pump Pumping Hours	Maintained at WTP	3
Quantity of Chemicals Used	Maintained at WTP	3
Fluoridation Report	Submitted monthly to DOH Maintained at WTP	3
Reservoir levels, pumping, and plant flow telemetry strip charts	Maintained at WTP	3
Water Facilities Inventory Report	Submitted annually to DOH Maintained at WTP	3
Disinfection Byproducts Monitoring Report	Submitted Monthly to DOH Maintained at WTP	10
Supplemental Reporting – Individual Filter Turbidity for	Submitted Monthly to DOH Maintained at WTP	5
Customer Concerns	Maintained at Public Works (City Hall)	3
Cross Connection Control Annual Summary Report	Submitted Annually to DOH Maintained at WTP	3
Consumer Confidence Report	Submitted Annually to DOH Maintained at WTP	3
Annual Water Use Efficiency Report	Submitted Annually to DOH Maintained at WTP	3
Sanitary Survey	Maintained at WTP	10

9 | WATER SYSTEM IMPROVEMENTS

Tee and Valve Cluster

INTRODUCTION

This chapter presents proposed improvements to the City of Kelso's (City) water system that are necessary to resolve existing system deficiencies. It also gives overview of major projects that may be necessary to accommodate the City's projected growth of water customers.

Water system improvements were identified from an evaluation of the results of the water system analyses presented in **Chapter 7 – Water System Analysis**. Where applicable, 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 in this *Water System Plan*. The locations of major water system improvements are shown in **Figure 9.1, Proposed Water System Improvements**. The improvements also are illustrated in the hydraulic profile of the future water system, which is shown in **Figure 9.2, Proposed Hydraulic Profile**. The improvements are organized and presented in this chapter according to the following categories.

- Water Main Improvements
- Supply Improvements
- Storage Improvements
- Facility Improvements
- System-Wide Improvements

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

IDENTIFYING AND PRIORITIZING IMPROVEMENTS

This chapter presents the proposed projects and schedule for the City's 10-year CIP in accordance with the requirements of Washington Administrative Code (WAC) 246-290-100.

The projects were selected to address existing deficiencies and expected growth within the water system customer base. In identifying projects, the plan looked at the supply system, storage requirements, and transmission and distribution needs. The projects were evaluated considering health standards, land use, supply requirements, system reliability, capital investment requirements, consistency with regional plans, and environmental impacts, among others.

Projects were selected for inclusion in the program based on the following criteria:

1. **Growth-Related Projects (Existing System) –** These are proposed projects to upsize and improve portions of the existing system that will not be able to adequately serve the system with the anticipated growth.
2. **System Improvements –** These projects are included to address existing system deficiencies, such as inabilities to meet minimum fire flow requirements. These projects include upsized lines and system looping improvements.
3. **Small Line Replacements –** These projects have been included to replace all water mains that are 4 inches and smaller.
4. **Asbestos Cement Line Replacements –** These projects have been included to remove all asbestos cement (AC) water mains and replace them with ductile iron materials.

FUNDING SOURCES

Three major funding sources have been identified for funding the proposed improvement projects: 1) system development charges; 2) commodity rates; and 3) grants.

System development charges have been identified as a funding source for projects that are to be funded outright by developments as extensions to the system. Commodity rates and grants have been identified as a funding source for projects that address existing system deficiencies.

Additional discussion regarding the funding of improvements is included in **Appendix Q – Financial Analysis**.

PROPOSED IMPROVEMENTS

This section provides general descriptions of the 10-year capital improvement projects and an overview of the deficiencies they will resolve. Several of the improvements are necessary to resolve existing system deficiencies. However, several improvements have been identified to illustrate the major facilities that will be required as development occurs. Additional developer-funded projects include localized, on-site water main improvements that are not

associated with overall water distribution, but are necessary when the property served by the water main is redeveloped or expanded. The costs associated with these improvements shall be borne by the developers, rather than the existing water customers.

CIP No. W01 – Annual Replacement Program

This project provides for the replacement of small diameter (2-inch and 4-inch), undersized, deteriorating, and AC piping. In the previous WSPs CIP, this project was numbered as A1 and W59.

CIP No. W02 – Transmission Main: Kelso Drive

This project completes the design for the replacement of the existing 4-inch and 6-inch AC water main with 12-inch and 16-inch transmission main along North Pacific Avenue from Redpath Street to Barnes Street.

CIP No. W03 – Transmission Main: Minor Road

The 16-inch supply line to the Minor Road Reservoir along Minor Road Drive failed due to soil corrosion. A condition assessment indicated that the pipeline needed to be replaced due to corrosive soil conditions. This project will replace pipeline between the skate park and the Mt. Brynion Street bridge.

CIP No. W04 – Hazel Street Over Crossing

Installs approximately 2,000 linear feet of new water main along Hazel Street across the existing railroad right-of-way. This will provide water service to the area west of South Pacific Avenue, that currently does not have water service provided by the City.

CIP No. W05 – Mill Street Wellfield

Install a test well on the City owned property at Mill Street and River Road to determine its suitability as an additional water source. In the previous WSPs CIP, this project was numbered as W7.

CIP No. W06 – Mill Street Raw Water Main

This project includes water main installation to deliver raw water from new Mill Street Wells to the existing Water Treatment Plant (WTP). The new water main will improve the system's water supply resiliency.

CIP No. W07 – New Source Blending

The project is dependent upon results for Mill Street Wellfield investigations (W5). As part of this project a water blending evaluation will be completed to determine the most cost effective, long-term combination of water supply to optimize the City's treatment capacity.

CIP No. W08 – WTP Improvements

This project includes an evaluation of various components in WTP potentially including pumps, drivers, control systems, filters. The improvements will increase system resilience and improve operational efficiency.

CIP No. W11 – Cedar Street Transmission Main

Replace 8-inch, 10-inch, and 12-inch pipe with 16-inch pipe on Cedar Street from South Pacific Avenue to Grade Street.

CIP No. W12 – Grade Street Transmission Main

This project replaces the existing 6-inch AC water main and 8-inch DI water main with 12-inch DI water main from 13th Avenue to the Haussler Pump Station. Phase III involves improving the storage transmission.

CIP No. W13 – Ranney Collector Rehab

The aging piping and appurtenances that supply the Ranney Collector are in need of rehabilitation to maintain existing system operations. This project includes an evaluation of the piping for the existing Ranney Collector. It is expected that the improvements will include installing a liner in the existing raw water main from Ranney Collector to the WTP.

CIP No. W14 – Haussler Booster Station Rehab

This project includes rehabilitation of a key booster station that serves the 297, 410 and 544 Pressure Zones. The existing pumps at the Haussler Pump Station should be replaced and a backup generator installed. Sizing will be developed at the time of the project.

CIP No. W15 – Rocky Point Booster Station Rehab

The existing station is aging and is in need of pipe and pump replacement. Sizing will be developed at the time of the project.

CIP No. W16 – Old Behshel Tank Rehab

The City's Sanitary Survey identified the need for the Behshel Heights southern tank to be rehabilitated to improve the reliability of the storage facility. The improvements include screening vents, protecting overflow piping with valving and installing an air gap.

CIP No. W17 – Highlander Estates Main Replacement

There have been water main breaks in recent years due to highly corrosive pipe bedding which has caused pipe failure in multiple locations throughout the development. This project includes a full replacement of the water main and appurtenances that serve the development.

CIP No. W18 – Control and Telemetry Upgrades

Perform analysis to provide wireless telemetry and supervisory control and data acquisition (SCADA) system for existing reservoirs and booster pump stations. Currently, the City has the capability to identify components status, but is not able to control components remotely. Additionally, most booster pumping and reservoir facilities are not metered.

CIP No. W19 – West Vista Water Main

Replace the service line replacement along the West Vista area.

CIP No. W20 – Source and Supply Implementation

This project will evaluate the most efficient implementation of integrating the City's new source of supply. The project is dependent upon results for Alternative Source of the Mill Street source of supply.

CIP No. W21 – Water System Plan

This project includes completion of this *Water System Plan*.

CIP No. W22 – West Kelso Connection

The transmission main to West Kelso failed in 2017. The existing transmission main currently crosses the railroad tracks and is not accessible for repair. The City will work with the railroad company to install a new casing and stablish a new connection on the north side of the Westside Road Bridge.

CIP No. W23 – Cowlitz Gardens Crossing

Replace the 6-inch water main that serves the Cowlitz Gardens area.

CIP No. W24 – Flow Meters for All Pump Stations

Install flow meters at all water pump stations (seven stations). Currently, none of these facilities has metering capabilities with the exception of Minor Road Booster Pump Station (BPS).

CIP No. W25 – Davis Terrace Meter Replacement

This project will replace the wholesale meter at the Davis Terrace site.

CIP No. W26 – Emergency Power Provisions

Provide either an emergency power receptacle for portable generators or permanent generators for all booster pump stations. Currently, none of these facilities has emergency power capabilities. In the previous WSPs CIP, this project was numbered as P03.

CIP No. W27 – Haussler Road Water Main Replacement

Replace existing 4-inch AC with 1,900 LF of new 8-inch pipe. Replace fire hydrants and upgrade existing service laterals and meters to current City standards. Complete in conjunction with road replacement. In the previous WSPs CIP, this project was numbered as W57.

The undersized and aging piping that will be repaired or replaced as part of the City's annual program is included in **Figure 9.3, Annual Replacement Program**. The proposed improvements are presented in **Table 9.1, Proposed 10-year CIP**.

Table 9.1, Proposed CIP

CIP No.	Description	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2035-2045
Annual Programs													
W1	Annual Replacement Program	$ 300,000	$ 300,000	$ 100,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 3,000,000
	Subtotal Annual Programs Cost	**$ 300,000**	**$ 300,000**	**$ 100,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 300,000**	**$ 3,000,000**
Water Main, Supply, System, and Facility Improvements													
W2	Tranmission Main: Kelso Drive	$ 1,050,000	$ 3,350,000										
W3	Transmission Main: N 7th to Donation		$ 400,000	$ 1,600,000									
W4	Hazel Street Over Crossing	$ 1,000,000											
W5	Mill Street Wellfield	$ 1,000,000	$ 1,500,000	$ 1,000,000									
W6	Mill St Wellfield Raw Water Main			$ 700,000	$ 700,000								
W7	New Source Blending				$ 200,000	$ 250,000							
W8	WTP Improvements					$ 250,000	$ 1,250,000						
W11	Transmission Main: Cedar				$ 400,000	$ 1,700,000							
W12	Transmission Main: Grade					$ 350,000	$ 1,525,000						
W13	Ranney Collector Raw Main Rehab.				$ 100,000	$ 375,000							
W14	Haussler Booster Station Rehab	$ 150,000	$ 1,500,000										
W15	Rocky Point Booster Station Rehab				$ 500,000								
W16	Old Behshel Tank Rehab				$ 600,000								
W17	Highlander Estates Main Replacement			$ 350,000									
W18	Control and Telemetry Upgrades		$ 100,000	$ 150,000	$ 650,000								
W19	West Vista Water Main Replacement	$ 500,000											
W20	Source and Supply Implementation	$ 250,000	$ 250,000										
W21	Water System Plan	$ 75,000											
W22	West Kelso Connection	$ 850,000											
W23	Cowlitz Gardens Crossing								$ 1,000,000				
W24	Flow Meters for All Pump Stations									$ 100,000			
W25	Davis Terrace Meter Replacement									$ 125,000			
W26	Emergency Power Provisions												$ 300,000
W27	Haussler Road Water Main Replacement												$ 665,000
YEARLY TOTALS [1]		**$ 5,175,000**	**$ 7,400,000**	**$ 3,900,000**	**$ 3,450,000**	**$ 3,225,000**	**$ 3,075,000**	**$ 300,000**	**$ 1,300,000**	**$ 525,000**	**$ 300,000**	**$ 300,000**	**$ 3,965,000**

[1] The estimated cost was provided by the City.

Planning, prioritizing, scheduling, and funding capital improvements for the next 10 years after the 10-year CIP projects have been completed is more speculative, and many adjustments and additions to the 20-year CIP are to be expected.

ESTIMATING COSTS OF IMPROVEMENTS

Project costs for the proposed improvements were estimated based on costs of similar, recently constructed water projects in the City and around southwestern Washington area and are presented in 2021 dollars. The cost estimates include the estimated construction cost of the improvement and indirect costs related to construction cost for engineering preliminary design, final design, and construction management and contract administration services, permitting, legal, and administrative services.

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 necessary 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.

All cost estimates shown in the tables are presented in year 2021 dollars. Therefore, it is recommended that future costs be adjusted to account for the effects of inflation and changing construction market conditions at the actual time of project implementation. Future costs can be estimated using the Engineering News Record (ENR) Construction Cost Index for the area, or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.