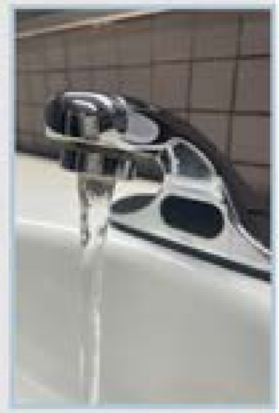


CITY OF SPOKANE

WATER SYSTEM PLAN 2023

INTEGRATED CAPITAL MANAGEMENT
808 W. SPOKANE FALLS BLVD.
SPOKANE, WA 99201-3343
509.625.6700

September 27, 2023

ATTN: BRENDA SMITS
EASTERN DRINKING WATER OPERATIONS
RIVER VIEW CORPORATE CENTER
16201 E INDIANA AVE STE 1500
SPOKANE VALLEY WA 99216

RE: City of Spokane Revised Water System Plan Submittal

Enclosed is the revised Water System Plan for the City of Spokane. We have addressed the comments from the Washington State Department of Health (DOH) and made minor format and grammar corrections.

Documents provided include Form 331-149, DOH Comment Response Form with the City's responses, the City of Spokane's Water System Plan, and Appendices.

Please contact me or Loren Searl, Water Department Director, if you have any questions with the materials. When we receive notification from DOH, we will proceed to have official approval from the City Council of the City of Spokane.

Sincerely,

Marcia Davis
Integrated Capital Management
Director

cc: Loren Searl, Water Department

Drinking Water

Project Approval Application (PAA) Form

331-149 F • Revised 1/10/2022

Please complete all appropriate sections of this application form and include it with your project.

WATER SYSTEM Information

Water System Name: City of Spokane	PWS ID #: 83100 K
Submittal Description: Water System Plan Update	County: Spokane
Classification: A-Communinty	# of Service Connections: 10,000 or more

OWNER Information

Name: City of Spokane Water Department		Owner ID #: Enter text	
E-mail address: lsearl@spokanecity.org		Phone: 509.625.7800	
Mailing address: 914 E. Foothils Dr	City: Spokane	State:	Zip:

PROJECT CONTACT Information

Name/Position: Marcia Davis, Director		ICM Dept	
E-mail address: mdavis@spokanecity.org		Phone: 509.625.6398	
Mailing address: 808 W. Spokane Falls	City: Spokane	State: WA	Zip: 99201

CONSULTING/DESIGN ENGINEER Information

Name/Firm: N/A		N/A	
E-mail address: N/A		Phone: N/A	
Mailing address: n/a	City: n/a	State: WA	Zip: Zip

SMA Information

Name/SMA: Enter text		SMA #: Enter text	
E-mail address: Enter text		Phone: Enter text	
Mailing address: Enter text	City: Enter text	State: WA	Zip: Zip

BILLING Information*

Name: Rebecca Graybeal			
E-mail address: rgraybeal@spokanecity.org		Phone: 509.625.6093	
Mailing address: 808 W. Spokane Falls Blvd	City: Spokane	State: WA	Zip: 99201

GENERAL Submittal Information

☐ Check here if you need a Box.com folder set up for transferring your project to us electronically. (You will receive an invite by email after we have received the PAA form.)

Do you have projects currently under review by us? ☐ Yes ☒ No

☐ This is a new water system (if so, include a completed Water Facilities Inventory Report Form with your project).

☐ DWSRF Loan
Application # Enter Number
Loan # Enter Number

☐ Enforcement
Docket # Enter Number
Type Enter Text

☒ Water System Plan (complete Planning Information)

☐ Small Water System Management Program (complete Planning Information)

☐ Engineering (complete Engineering Information)

☐ Group B (complete Engineering Information)

☐ Satellite Management Agency Plan (complete SMA Information)

☐ Alternate Technology (complete Engineering Information)

ENGINEERING Information

Project Report Type: Choose Project Report	Special Report or Plans: Choose Special Report or Plans
Predesign Study: Choose Predesign Study	Existing System Approval: Choose Existing System Approval
Construction Documents: Choose Construction Documents	Waiver: Choose Waiver
Other: Choose Other	

PLANNING Information

How many connections does system currently have?	86,882
If system is private-for-profit, is it regulated by UTC?	☐ Yes ☒ No
Is system expanding?	☒ Yes ☐ No
Expanding service area?	☐ Yes ☒ No
Increasing number of approved connections?	☒ Yes ☐ No
If the number of connections is expected to increase, how many *new* connections are proposed in the next ten (10) years?	15,000
Is your system pursuing additional water rights from Department of Ecology in the next 20 Years?	☐ Yes ☒ No
Is a new intertie proposed?	☐ Yes ☒ No
Is the system located in a Critical Water Supply Service Area (is there a Coordinated Water System Plan)?	☒ Yes ☐ No
If yes, have you sent a copy of the plan to the county or responsible agency for the CWSP?	☐ Yes ☒ No
Are you requesting distribution main project report and construction document submittal exception?	☒ Yes ☐ No
If so, does the WSP contain standard construction specifications for distribution mains?	☒ Yes ☐ No

The water system/purveyor is responsible for sending a copy of the plan to:

Adjacent utilities for review or a letter notifying them that a copy is available for their review and where it is located.	☒ Yes ☐ No
All local governments within the service area.	☒ Yes ☐ No
County and city planning departments, one or both if applicable, adjacent water systems, etc..	☒ Yes ☐ No
List who have you sent the WSP to for review other than ODW?	Enter Text
Are you proposing a change in the place of use of your water right?	☐ Yes ☒ No
If "yes," the purveyor must send a copy of the WSP or SWSMP to all local governments within the service area (county and city planning departments) for a local consistency determination. Has this been completed?	☐ Yes ☐ No
What are the years of the requested plan approval period (for example 2022 to 2032)?	2023 to 2032
Does your plan follow your preplan checklist?	☒ Yes ☐ No

SMA Information

☐ Ownership only ☐ Management and Operations only ☐ Ownership, Management & Operations

Where can we find the *SMA Notice of Intent* 331-590, in your plan: Enter Text

Please submit all documents electronically. We request one paper copy of planning documents be submitted to the address for your regional office below.

☒ Eastern Regional Office	☐ Northwest Regional Office	☐ Southwest Regional Office
Department of Health	Department of Health	Department of Health
eroadmin@doh.wa.gov	dw.nwro.wsprojects@doh.wa.gov	swro.admin@doh.wa.gov
Phone: 509-329-2100	Phone: 253-395-6750	Phone: 360-236-3030

To request this document in another format, call 1-800-525-0127. Deaf or hard of hearing customers, please call 711 (Washington Relay) or email civil.rights@doh.wa.gov.

City of Spokane
Water System Plan

September 2023

Certificate of Engineer

The material and data contained in this report were prepared under the direction and supervision of the undersigned whose seal as a professional engineer, licensed to practice in the State of Washington, is affixed below.

09/27/2023

Marcia F. Davis, P.E.
Director, Integrated Capital Management

Table of Contents

Chapter 1 - Description Of Water System

Table of Contents

Chapter 1 – Description of Water System

Introduction

The City of Spokane's (City) Water Department is a municipal water purveyor that provides approximately 180 million gallons of clean, safe drinking water daily to a water service area population of approximately 250,000 people in Spokane County, Washington. The City's water system is the third largest water system in the state of Washington based on the number of connections. The City of Spokane's water system has a long history of operation, which includes meeting current demands, stewardship of water resources, and strategic future thinking. This chapter generally describes the City's water system and the factors that affect the City's planning and operations.

1.1 Ownership and Management

The City of Spokane is a municipal water purveyor and operates a Class A public water system through the City Water & Hydroelectric Department. ''As required by State law, the City operates the water system under the Washington State Public Water System Identification No. 83100K. The City provides potable water to customers within the City's designated service area, which includes all the area within city boundaries as well as several adjacent outlying areas. The City's water service area is defined in Figure 1.5.

Type of Ownership

The Water System is wholly owned and operated by the City of Spokane, Washington. The Water & Hydroelectric Department operates as an "Enterprise Fund," a separate fund account from the General Fund of the City. The City's water and wastewater operations are organized in a single, unified revenue fund. These funds were merged to make bonds more attractive and to devote available capital funding to the most pressing issues within these operations. Ratepayers primarily fund this account through monthly water utility fees based on usage.

Management Structure

The City of Spokane is operated under the laws of the State of Washington as a municipal corporation. The City's form of government is an elected Strong Mayor system. The City has a seven-member elected City Council, including the Council President, who all serve in a legislative capacity. The Director of Public Works Division, as well as the Department Directors of Water, Integrated Capital Management, and Engineering, are all appointed by the Mayor and confirmed by City Council. The Water & Hydroelectric Services (Water Department) Directors, Integrated Capital Management, and Engineering Services report to the Public Works Division Director. The Water Department Director oversees the water system's day-to-day operations and maintenance. The Director of Integrated Capital Management provides capital modeling, programming, and funding strategies as a service to the Water Department to ensure the timely identification of capital needs and implementation of future capital facilities. The Director of Engineering Services manages the design and construction of capital projects for the Water Department.

The Director of Public Works Division has general oversight over the departments (Water, Integrated Capital Management, and Engineering). The Director must approve annual budgets necessary for operation, maintenance, and capital projects. The Mayor, through the City Administrator, also approves and submits these budgets/projects to the City Council for final adoption. The Mayor sets policy as recommended by City staff for approval by City Council. A simplified representation of the City Water Department's organizational structure is provided in Figure 1.1 for reference. More detailed organizational charts related to system operations, as well as the Water Facility Inventory containing contact information for system owners, operators, and emergency contacts, are included in Appendix 1.1.

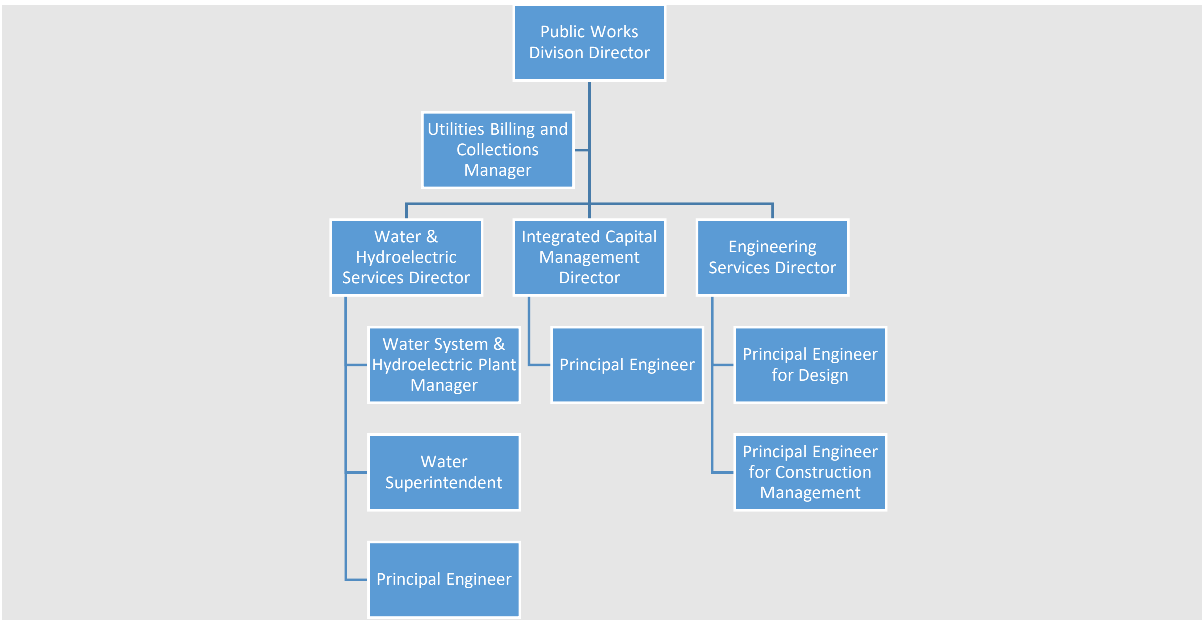


Figure 1.1 City Water Department Organizational Structure

The primary management roles within the Water Department include:

Water & Hydroelectric Services Director

The Water Director supervises the operation of the City's water distribution system, municipal water, and hydroelectric facilities. Several key responsibilities include:

- Ensure the City system operates in compliance with existing public drinking water regulations and rules (Drinking Water Regulation and Compliance | Washington State Department of Health); monitor activities by federal, state, and local governmental entities to anticipate future needs and requirements;
- Ensure safe operations by meeting all safety rules and requirements (i.e., OSHA, WISHA, and FERC); and
- Provide recommendations on capacity planning, rate setting, programming, and development studies.

Water System and Hydroelectric Plant Manager

The Manager provides direction to internal and external agencies regarding water production and hydroelectric plant operations and maintenance activities involving the power generation plant, water supply and treatment systems, pumping system, water storage reservoirs, and associated infrastructure, in addition to the Supervisory Control and Data Acquisition (SCADA) system. Day-today responsibilities include ensuring the hydroelectric facility and the pumping and storage system are managed safely and follow established risk management procedures.

Water Superintendent

The Superintendent is responsible for administrative and supervisory work in the daily operations of the water system, which includes planning and directing in-house construction projects, system maintenance and repair, and metering activities related to the City's water system. The Superintendent also provides on-call work in the event of an emergency, disaster, or snow removal event.

Principal Engineer for Water Department

The Principal Engineer is responsible for engineering activities, including design of in-house projects or changes to existing water facilities; reviewing changes in capital projects; review and coordination of private projects; and engineering support for the operations, maintenance, and construction.

The primary management roles within the Integrated Capital Management Department include:

Integrated Capital Management Director

The Integrated Capital Management Director supervises the capital planning and programming of the City's water system in close coordination with operations via the Water Director. Several key responsibilities include:

- Ensure the City accurately models and analyzes the water system and identifies the needed capital for future capacity is available and appropriately sited;
- Ensure water capacity improvement projects are scoped, scheduled, and budgeted to address future capital needs; and
- Provide input on capacity studies, rate setting, and programming.

Principal Engineer for Integrated Capital Management

The Principal Engineer coordinates the six-year capital program for water, the development of design charters for water facilities, annual budgeting, and cash flow for the ten-year planning period. Supervises the ongoing computer model update, twenty-year capital facility planning, and resulting capital facilities.

The primary management roles within the Engineering Services Department include:

Engineering Services Director

The Engineering Services Director supervises the design and construction management of the City water system facilities in close coordination with operations via the Water Director. Several key responsibilities involve ensuring the City completes the design and manages construction projects within the identified schedule and budget.

Principal Engineer for Design

The Principal Engineer coordinates the design of capital projects for the Water Department. Supervises design teams to ensure deadlines and funding requirements are met.

Principal Engineer for Construction Management

The Principal Engineer coordinates the construction management of capital projects for the Water Department. Supervises field staff to ensure projects are constructed in accordance with the plans and to meet project deadlines and budgets.

1.2 System History and Background

The Spokane Valley/Rathdrum Prairie Aquifer is the sole source of potable water for the City's water system. The City's water system has seven well stations with 14 wells and 27 well pumps, 25 booster pump stations with 72 booster pumps, 23 pressure zones with 34 reservoirs, and over 1,100 miles of water pipe. A visual overview of the City's water system is also provided in Figure 1.2 below.

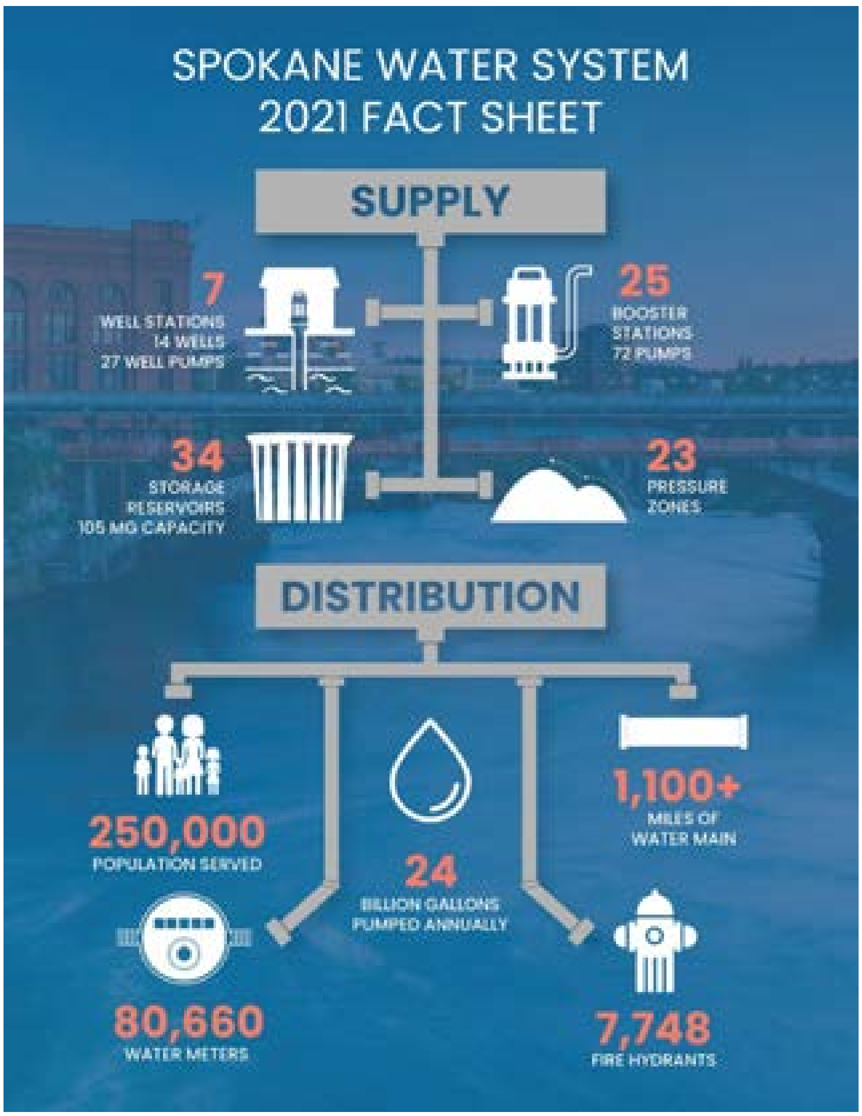


Figure 1.2 Spokane Water System Overview

The City of Spokane has been operating its water system since 1883. Below is a brief history of the City's water system. Figure 1.3 is a visual timeline of the water system.

1883

The City purchased a private water system that was serving the downtown area. The original system comprised a water-driven pump installed in the Echo Flour Mill on Havermale Island to serve Spokane River water to a few customers in the new city. Some of the cast iron water mains constructed for this system continue to be used today.

1884

The pumping plant was relocated and a second pump was added to serve the expanding city.

1896

Upriver pumping facility began operation. The Upriver facility was located approximately five miles upstream of the City and constructed to address a growing population and deteriorating water quality in the Spokane River near the City. Pumps delivering water from the new facility to the City's customers were mechanically powered by water routed from a reservoir, created by a timber crib dam upstream of the facility. Groundwater encountered during construction was a nuisance and was overlooked as a potential supply source at the time.

1905

Continued population growth and pollution in the Spokane River drove a search for an alternative source of high-quality potable water. Groundwater discovered during construction of the Upriver facility was evaluated and considered as a potential new supply source for development.

1907

The first well was constructed at the Upriver facility to withdraw water from the newly discovered groundwater source, ending the City's use of the Spokane River as a municipal source of supply. The groundwater source was later named the Spokane Valley–Rathdrum Prairie (SVRP) aquifer.

1910-1925

Additional groundwater wells completed in the SVRP aquifer were constructed at the Upriver facility/Well Electric Well Station. This well station consists of two 48-foot diameter caisson wells with four pumps (two vertical line shaft turbines and two centrifugal) ranging in size between 900- and 1,000-horsepower.

1920

Caisson production wells at the City's Hoffman Well Station were constructed as water supply sources for the Great Northern Railway before transferring ownership to the City.

1936

The timber crib dam upstream of the Upriver facility was replaced with a taller concrete dam. Water in the reservoir behind the new dam was diverted to a new hydroelectric powerhouse, which powered electric motors that drove pumps installed in the groundwater wells.

1937

Ray Street Well Station constructed. This well station houses two 24-foot-diameter caisson wells and three 900-horsepower pumps, with two pumps in one well and a single pump in the second well.

1938

Hoffman Well Station acquired by the City from Great Northern Railway. This well station houses two 16-foot diameter caisson wells. Under full operating conditions, each well is equipped with a 600-horsepower vertical line shaft turbine pump. One of the wells has been out of service since 1993.

1949

Parkwater Well Station constructed. This well station houses eight pumps in four 18-foot diameter wells. The pumps are vertical line shaft turbines ranging in size between 600- and 1,000- horsepower.

1950

Grace Well Station constructed. This well station houses one 18-foot diameter caisson well with two 900-horsepower pumps.

1956

Nevada Well Station constructed. This well station houses a single caisson well equipped with two 400-horsepower submersible pumps and two 800-horsepower vertical line shaft turbine pumps.

1959

Central Well Station constructed. This well station has two 7-foot diameter caisson wells with two 450-horsepower submersible pumps in each well.

1967

The City's Water Department began serving water to customers outside city limits.

1981-1984

Major improvements at the Upriver facility increased the hydroelectric generating capacity of the three existing generators from 1.3 to 2.0 megawatts each and added a second powerhouse with two additional 5.58 megawatt generators. The hydroelectric power generation allows the City's Water Department to sell power during times of low electrical demand from the City's water pumps. Revenue from power sales offset the cost of pumping water to help keep customers' water rates low and affordable.

1995

The Water Department replaced the City's last uncovered reservoir with two covered concrete tank reservoirs, protecting the water system from potential contaminants.

2018

Havana Wellfield wells drilled and constructed. The wellfield consists of six 24-inch diameter vertical wells completed in the SVRP aquifer. Each well is capable of producing 3,750 gallons per minute. Final design and construction of the well station is currently in progress (as of fall 2021).

2021

The City continues to use the SVRP aquifer as its sole source of potable water. Once the Havana Wellfield Station is complete, the City's water system will have eight well stations with 20 wells and 33 well pumps, 25 booster pump stations with 72 booster pumps, 23 pressure zones with 34 reservoirs, and more than 1,100 miles of water pipes.

Figure 1.3 History Timeline

The long-range planning of the City's water system and infrastructure is discussed in more detail in Chapter 8 of this Water System Plan and provides an overview of the City's capital improvement program.

Geography

The Spokane Valley/Rathdrum Prairie Aquifer system results from massive, ancient flooding events over the northern Idaho, Spokane, and eastern Washington region. These floods, often referred to as the Missoula Floods, are thought to have repeatedly scoured the region as many as forty times, ultimately leaving highly permeable flood deposits and forming an aquifer beneath the Rathdrum Prairie of northern Idaho and the Spokane Valley of Spokane County.

The Spokane River originates as the outflow of Lake Coeur d'Alene and travels from east to west, flowing through the center of the City of Spokane. On the western edge of downtown Spokane, the river turns north, forming the western city boundaries in some places. Latah (Hangman) Creek enters the City boundaries from the south and travels in a northerly direction to intersect the Spokane River at the elbow, where the Spokane River turns to the north. A map of the subsurface and surface water bodies described is depicted below in Figure 1.4.

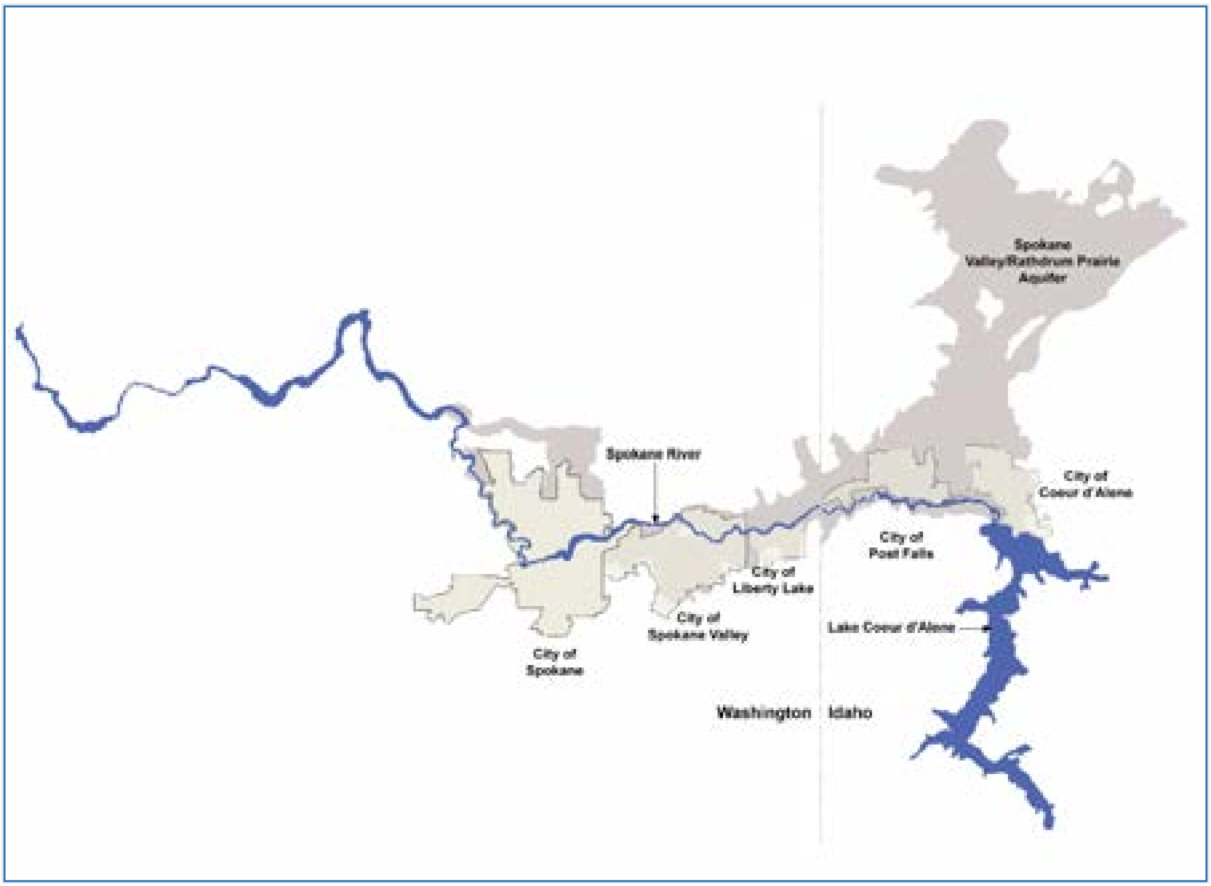


Figure 1.4 Map of the subsurface and surface water bodies

Within the City's water service area, the south side of the City (South Hill) rises from the Spokane River to Moran Prairie and the western slopes of Browne Mountain. Elevations range from the valley floor of 1,870 feet above sea level to about 3,000 feet. To the west, elevations vary from a low of 1,735 feet in the Hangman (Latah) Creek-Vinegar Flats area to 2,580 feet on the West Plains. The City's north side (generally north of the Spokane River) experiences elevations ranging from 1,683 feet to 2,145 feet. Also located on the north side is a plateau known as the Five Mile Prairie, a prominent geographical feature. Elevations of the prairie feature range from 2,145 feet at its base to 2,400 feet on the plateau.

The wide variety of geographical features and the substantial elevation changes in and around the City create the need to maintain many water system pressure zones.

Ordinances/Bylaws

The Water Department is subject to Ordinances, Rules, and Regulations adopted by the Spokane City Council. Title 13 of the Spokane Municipal Code (SMC) governs the operation of the water system. The SMC is publicly available on the City of Spokane's website: Spokane Municipal Code - Title 13: Public Utilities and Services (spokanecity.org).

1.3 Related Plans

This section describes related planning documents developed by the City or other planning entities in the region, all of which impact the City's water system planning. The purpose of reviewing related plans is to understand any inconsistencies, conflicts, and commonalities between plans that have been implemented and are guiding community decisions across the region. An overview of each related plan is provided in the following sections.

1.3.1 Comprehensive Plans

The City's Comprehensive Plan guides land use and zoning designations within the water system service area. Land use and zoning assumptions are integral to the development of the Water System Plan as the plans inform the development of future conditions, including expected water demands.

The City's Comprehensive Plan complies with the provisions of the Washington State Growth Management Act and provides a link to the Spokane County Comprehensive Plan and the Countywide Planning Policies by which the Water Department provides water service outside the City of Spokane boundaries.

1.3.2 Spokane County Coordinated Water System Plan

The Spokane County Coordinated Water System Plan defines the water service boundaries for the current and future service areas of the water purveyors who provide water service to customers throughout Spokane County. Spokane County adopted the coordinated plan in July 1999, and Spokane County is currently revising the plan. The Coordinated Water System Plan was developed collaboratively between the regional water purveyors, and the City of Spokane was a key member in the development. The Coordinated Water System Plan is further discussed in Section 1.7.

1.3.3 Stormwater Plans

The City of Spokane has a stormwater management plan that addresses stormwater quantity and quality within the City's boundaries. The plan is required pursuant to the Eastern Washington Phase II Municipal Stormwater Permit as issued by the Washington State Department of Ecology. The current stormwater management plan is updated on an annual basis by the City's Wastewater Department and was last updated in 2021. The stormwater management plan relates to Water System Plan planning and seeks to reduce the non-point source pollution from stormwater runoff which can impact the benefits of water bodies, including the Spokane River, Latah (Hangman) Creek, and Spokane Valley/Rathdrum Prairie Aquifer.

1.3.4 Wastewater Plans

The Wastewater Department of the City of Spokane manages the public sewer system, which operates within and outside the City's boundaries and inside the Urban Growth Area. The City owns and operates a publicly owned wastewater treatment facility known as the Riverside Park Water Reclamation Facility, which manages and treats wastewater prior to discharge into the Spokane River. The City recently upgraded the facility by installing tertiary treatment for additional treatment of wastewater. The City's Combined Sewer Overflow abatement and elimination plan has been completed to satisfy regulations. In 2014, the City adopted an integrated Clean Water Plan designed to improve water quality while balancing affordability to ratepayers. One goal of this plan was to integrate and coordinate water main replacements with other construction projects throughout the City's service areas.

A portion of the City's water system is located outside of City boundaries and within Spokane County. The ongoing goal of the County's sewer program has been the prevention and elimination of septic tanks located over the Spokane Valley/Rathdrum Prairie Aquifer, Spokane's sole source of potable water. Spokane County adopted its Comprehensive Wastewater Management Plan in April 2015 to meet the overall goal of protecting the Spokane/Rathdrum Aquifer while satisfying regulations. The Sanitary Sewer Code for Spokane County was updated in 2019. County sewage is conveyed to the Spokane County Regional Water Reclamation Facility, which provides 8 million gallons per day of treatment capacity. County capital improvement plans include increasing the treatment capacity in expandable 4 million gallons per day increments, up to a maximum capacity of 24 million gallons per day to treat the required demand growth expected in Spokane Valley. The remainder of County sewage is conveyed through the County and City's sewer systems and ultimately to Riverside Park Water Reclamation Facility. The County capital improvement plans include upsizing the capacity to convey sewage to Riverside Park Water Reclamation Facility and investing in the Facility upgrades required to treat County sewer flow. Additional information can be found in the County's 2022-2027 Sewer Six-Year Capital Improvement Program and the County's 2014 Comprehensive Wastewater Management Plan.

1.3.5 On-Site Sewage Disposal Regulations

On-site sewage disposal regulations are defined in SMC 13.03.0304. The code limits septic tanks installation to areas where sewer service is unavailable. Septic tanks are permitted and approved by the Spokane Regional Health District. Customers are referred to the City's Wastewater Management Department for sewer connection availability. In general, both the City and County try to avoid and discourage the use of septic tanks within the sewer service areas.

1.3.6 Wellhead Protection Plan

The City maintains a Wellhead Protection Plan. The City's Wellhead Protection Plan Phase 1 Technical Report was completed in February, 1998. The Phase 2 Implementation Report was completed in June, 2000. These plans and resulting programs are outlined in more detail in Chapter 5.

1.3.7 Adjacent Water Purveyors

There are twelve water purveyors adjacent to the City's water service area. The boundaries of the adjoining water purveyors are shown on the Spokane County Coordinated Water System Plan, depicted in Section 1.7. The following is a brief discussion of the adjoining water purveyors.

Carnhope Irrigation District #7

Carnhope Irrigation District #7 is located east of the City of Spokane along Interstate 90. Their latest Water System Plan was approved in 2008, and a 2022 update has been submitted to the Washington State Department of Health, and approval is pending. This system has no interties with the City and does not plan any future installations. Although this district has no reservoir, it does have an intertie with Spokane County Water District #3. Emergency water supplies will be obtained from Spokane County Water District #3 (Water Service Area #1) and serve as Carnhope's backup system.

City of Airway Heights

The City of Airway Heights is located west of the City of Spokane and submitted its Comprehensive Water System Plan in 2021. Airway Heights has two interties with the City of Spokane: one for permanent water supply that the City has been providing supplemental water since 1988 and the other for emergency water supply connected in 2018. The City is currently supplying all the water demands for Airway Heights due to groundwater contamination discovered in 2017, which has resulted in the inability to use their wells. Airway Heights is working on a long-term solution which will likely include continued water supply from the City of Spokane.

City of Medical Lake

The City of Medical Lake is located west of the City of Spokane and submitted its Water System Plan in 2019. Medical Lake has one intertie with the City of Spokane for supplemental and emergency purposes. Medical Lake also has two interties with Consolidated Support Services for permanent use.

East Spokane Water District #1

East Spokane Water District #1 is located east of the City of Spokane and submitted its Water System Plan in 2018. This water district does not have an intertie with the City of Spokane, but it does have four interties with other adjacent districts. East Spokane Water District #1 has one emergency intertie with Spokane County Water District #3 (WSA #1) and one permanent intertie to supplement their water rights by purchasing water from Modern Electric Water Company via Spokane County Water District #3.

Fairchild Air Force Base

Fairchild Air Force Base is located west of the City of Spokane, between the City of Airway Heights to the north and the Medical Lake to the south. Fairchild Air Force Base submitted its Water System Plan in 2017 and has one intertie with the City of Spokane. The City constructed a 36-inch pipeline to Fairchild Air Force Base's property fence for a future connection; however, it has not constructed a connection yet.

Four Lakes Water District #10

Four Lakes Water District is located at the southwest area of the City of Spokane's future retail service area. Four Lakes submitted its Water System Plan in 2019. Four Lakes Water District currently has no direct interties with the City of Spokane. Spokane has an intertie with the City of Medical Lakes, who has an intertie with Four Lakes Water District #10. In addition, Four Lakes Water District is supplying water to a customer located within the City's long term service area.

Kaiser North Water District and Kaiser South Water District

The Kaiser Aluminum manufacturing facilities were located north of the City of Spokane; Kaiser owned and operated the two water districts. The facilities have since closed, and the two water districts are defunct. Kaiser North Water District was absorbed into Whitworth Water System. Kaiser South Water District has not been taken by any of the adjacent water districts.

North Spokane Irrigation District #8

North Spokane Irrigation District shares south and west boundaries with the City of Spokane and submitted a Water System Plan in 2015. North Spokane Irrigation District has one intertie connection with the City of Spokane at Francis and Freya for emergency use. The district's water supply is vulnerable due to petroleum tank farms, gasoline transportation pipelines, and a former railroad tie manufacturing site located near their two wells.

Orchard Avenue Irrigation District #6

Orchard Avenue is located east of the City of Spokane and submitted its Water System Plan in 2015. Orchard Avenue has no interties with the City of Spokane.

Pasadena Park Irrigation District #17

Pasadena Park is located east of the City of Spokane and submitted its Water System Plan for approval in 2021. Pasadena Park has no interties with other systems.

Spokane County Water District #3

Spokane County Water District #3 is divided into five Water Service Areas and has four interties with the City. Water Service Area #1 borders the City of Spokane service area on the south and on the east, where there are two interties that supply fire flow and supplemental service from the City. WSA#1 has not constructed storage but is using its intertie with the City instead. Water Service Area #3 is surrounded by the City of Spokane service area on the north and has one intertie with the City for emergency use. In the future, Spokane County Water District #3 may consider turning ownership over to the City. Water Service Area #8, located just south of the Manito Golf Course, is entirely within the City's service area and is supplied solely from the City's intertie. Spokane County Water District #3 anticipates turning this system over to the City; however, it is likely the City will be able to take over maintenance and operation until the replacement of the existing distribution system is completed. Spokane County Water District #3's other Water Service Areas do not border the City's service area. Spokane County Water District #3 submitted an update to their Water System Plan in 2016, followed by three amendments in 2019, 2021, and 2021, respectively.

Vel View Irrigation District #13

The Vel View Irrigation District is located north of the City of Spokane's future retail water service area and submitted its Water System Plan in 2002. Vel View has one intertie with the City of Spokane installed for emergency use in 2004. The City has been supplying all the water for Vel View since 2014.

Vel View has approached the City to take over its distribution system; however, the City requires existing systems to meet the current code requirements. Vel View is actively pursuing funding to replace the existing system and for consolidation to the City of Spokane.

Whitworth Water District #2

Whitworth Water District #2 is located north of the City of Spokane and completed its latest Water System Plan in 2018 and submitted an amendment in 2021. Whitworth Water District has two interties with the City of Spokane for emergency use. Whitworth Water District #2 recognized a fire flow deficiency in Zone 2 many years ago and constructed an intertie with the City. This intertie resolves any fire flows that strain their system through connection to a 10 psi drop Pressure Relief Valve to supply up to 2,500 gpm.

Several small water districts are adjacent or within the City's future retail service, but there are currently no interties:

- Mullan Hill Terrace Mobile Home Park
- Valley of Horses Water District #12
- Marshall Community Water Association
- Hidden Hills Estates
- Mount St. Michaels Water District
- Balmer Gardens
- Ridgeview
- White Bluff
- Stevens County PUD #1
- Riverdale

1.4 Service Area, Maps, and Land Use

The City of Spokane's current Water Retail Service Area represents the area where the City recognizes its duty to serve water. The Retail Service Area is approximately 80 square miles in size. Future growth will occur within the boundary of the City's Future Service Area, which represents the City's buildout water service area as bounded by the neighboring water purveyors' service areas and is approximately 158 square miles in size. The existing Water Retail Service Area and Future Service Area are shown in Figures 1.5 and Figure 1.6. The relationship of the Future Water Service Area within Spokane County and the City boundaries is shown in Figure 1.5. Land use and zoning within the service area for both City and County are shown in Figures 1.7 and 1.8, respectively.

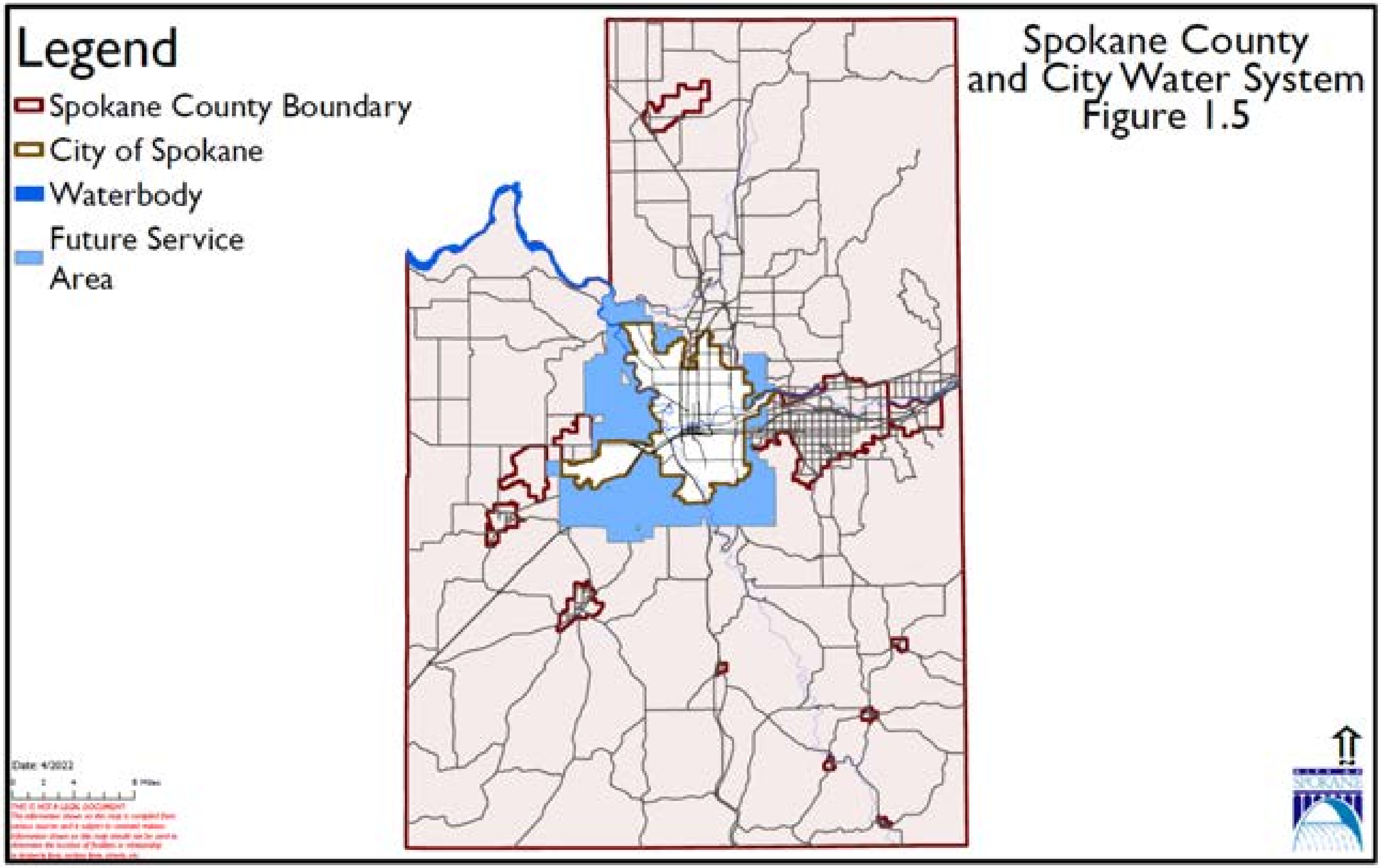


Figure 1.5 Existing Retail Service Area

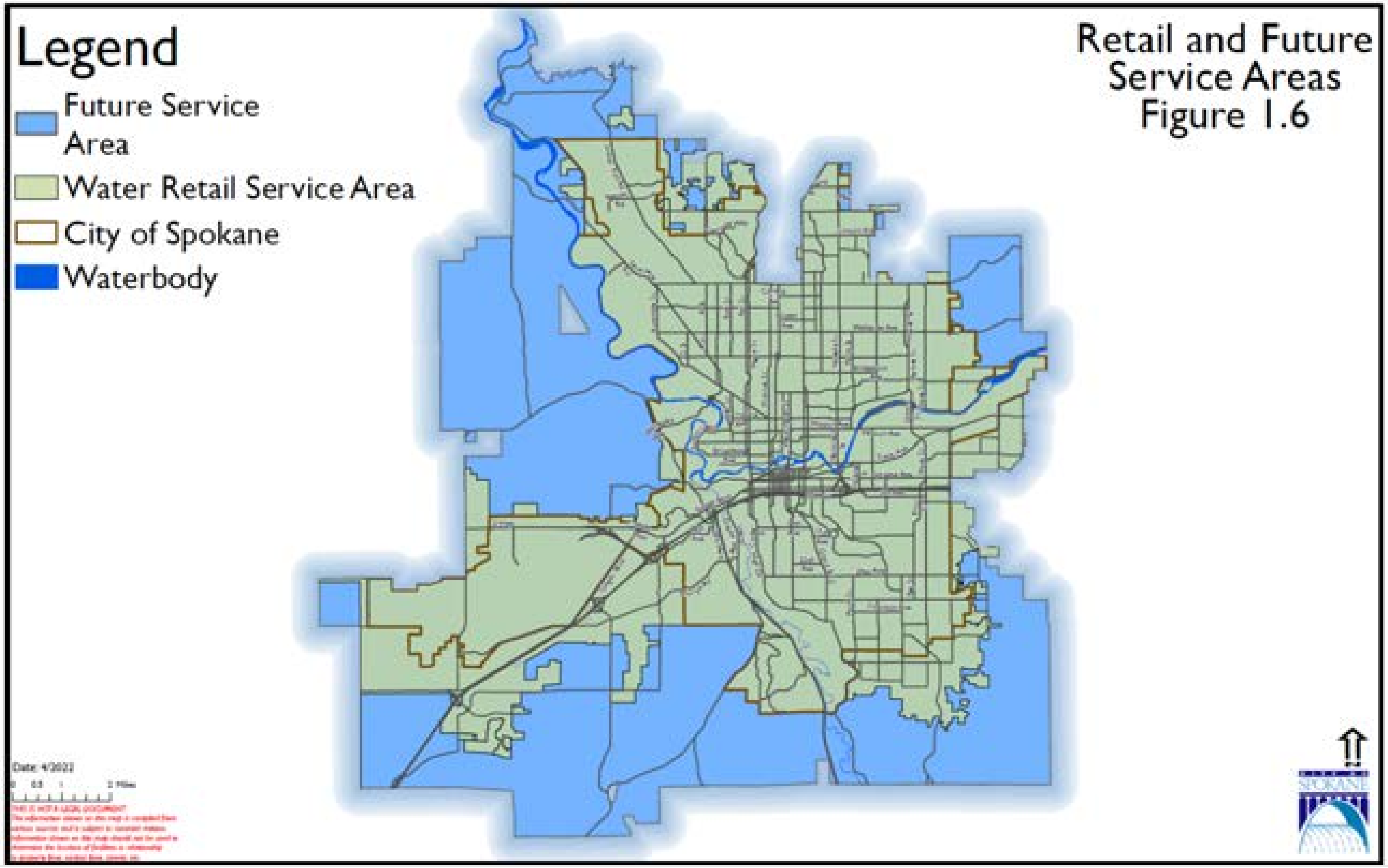


Figure 1.6 Future Service Area

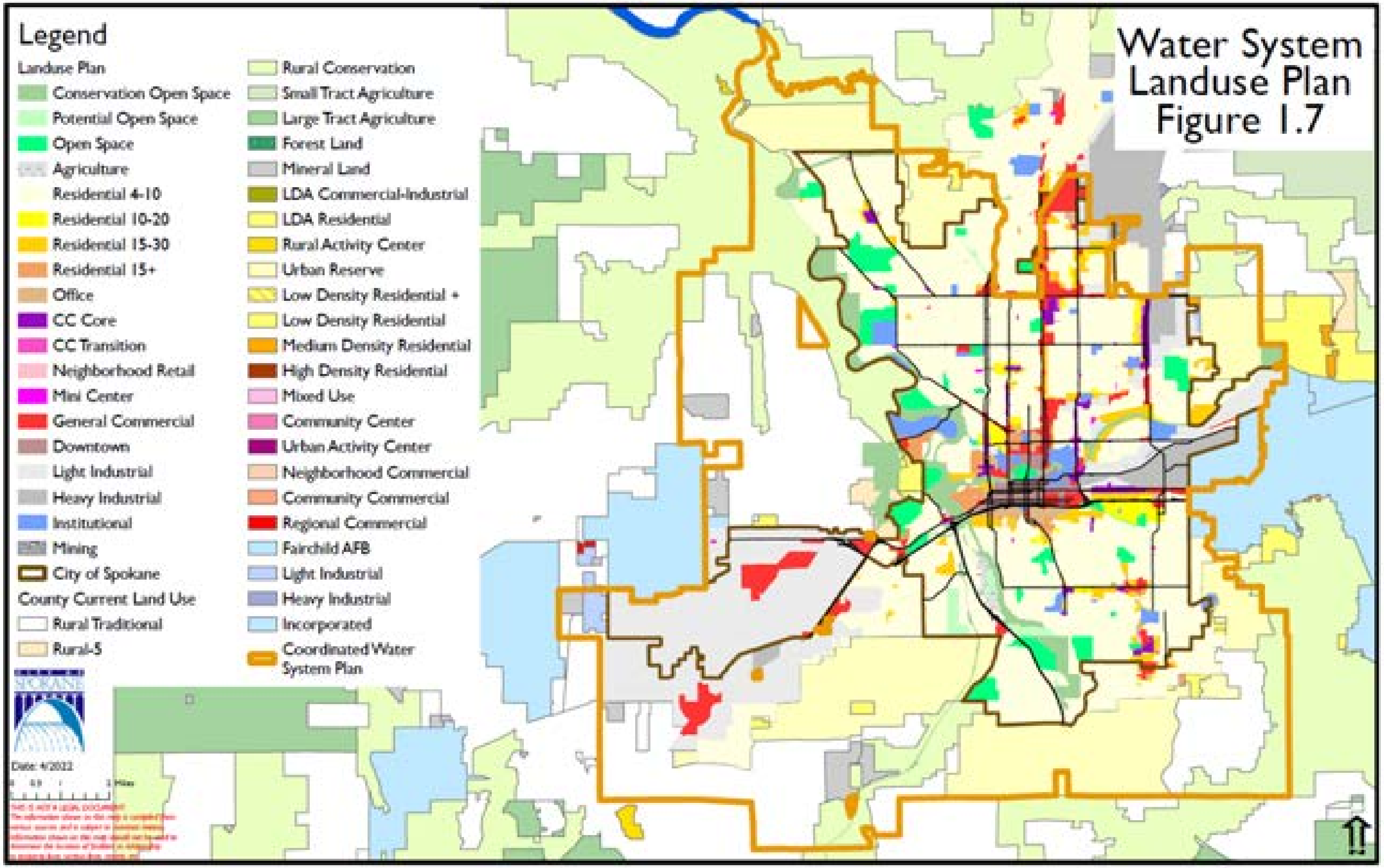


Figure 1.7 City Land Use and Zoning

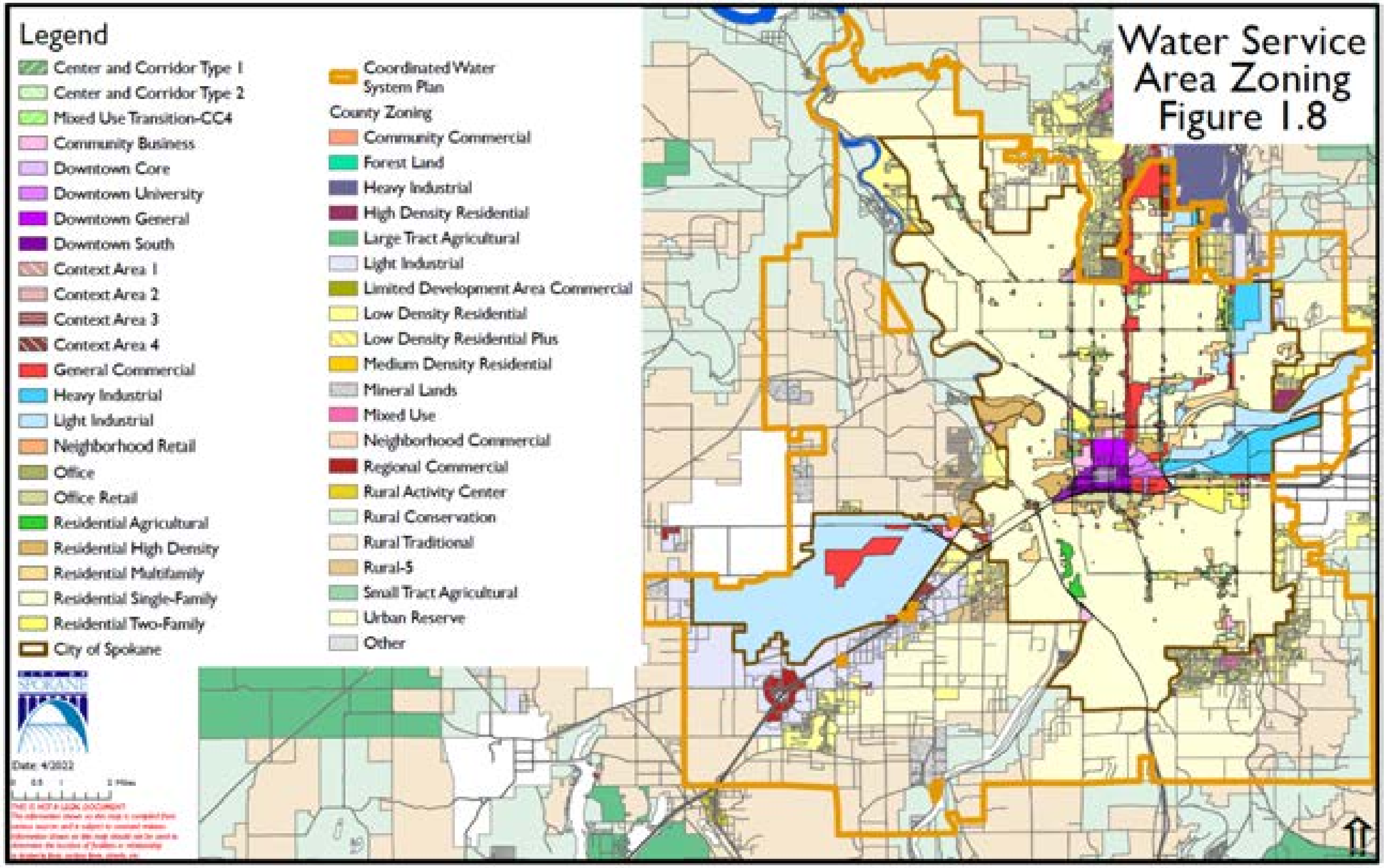


Figure 1.8 County Land Use and Zoning

1.5 System Policies

This section provides an overview of the adopted policies that affect water system planning and operations. Specific subjects are detailed in this section; this is not an exhaustive review of all policies which impact the City's water system. Rather, it is list of policies, codes, and requirements that affect planning efforts.

Service Area Agreements between Neighboring Water Systems

The present Coordinated Water System Plan governs the water purveyors in the Spokane region, and details of the Coordinated Water System Plan are contained in Section 1.3.2 and Section 1.7.2.

New Water Service Policies

New water services are managed by the City's Development Services Center. Information concerning the permitting process, applications for land use and development, code references, and engineering standards, policies, and plans are located on the City's website at Business & Development Resources - City of Spokane, Washington (spokanecity.org).

Annexation

When property owners outside City boundaries request connection to City water, owners must obtain any necessary permits from the County, contact the City, and execute an annexation covenant similar to the exhibit in Appendix 1.2.

Consolidation

City of Spokane policy requires any new or additional infrastructure to comply with the City's design and engineering standards for water systems before being accepted.

Conditions of Service

Conditions of service are specific requirements that facilitate the implementation of the City's Water Department service area policies. Conditions of service requirements are provided to each project proponent at the time of request for a permit or predevelopment information and include requirements for design, construction, and inspection.

The City has established procedures to address water service requests to a property from the initial development of land to the purchase of an established residence. It can be found in the City's municipal code, ordinances, policies, and design standards.

Satellite Systems

The City of Spokane Water Department does not currently manage any satellite water systems and has no plans to become a Satellite Management Agency per Washington Administrative Code 246-295. However, the City will evaluate future opportunities on a case-by-case basis.

The City prefers direct connections to its piping system for service within the retail service area. The City will consider on a case-by-case basis a satellite system to be operated by others on an interim basis until an appropriate time when the system can be connected directly to the City's water system. The Water Director will make the final decision for such an arrangement subject to Mayor and City Council approval.

Wholesaling Water and Wheeling Water

The City has intertie agreements for wholesaling and wheeling of water. These agreements are outlined in detail in Section 2.5.1.

Rates for Customers

Service Rates are set in accordance with the City's ratemaking policies and processes. Rates are based on a review of the costs and expenses associated with water service, maintenance, and operations of the water system and service to customers. The City charges for connection into the City's system and capital connections. These charges generally include General Facility Charges, latecomer agreements, and special connection charges. The City does provide for surcharges pursuant to the RCW 35.92.010 for those customers located outside the City's boundaries. Differences between service inside or outside a corporate boundary or urban growth area can be found in SMC 13.04.2002 through 13.04.2030.

Formation of Local Improvement Districts

Property owners within the City boundaries that wish to form a Local Improvement District to build a water system extension can do so by contacting the City's Planning and Developer Services. This department will provide technical assistance to the property owner with all the necessary procedures. The procedures for a property owner wishing to establish a Local Improvement District outside the City are similar. The owner will have to prepare a "Request for Local Improvement District Covenant" as shown in Appendix 1.3. The City's Hearing Examiner reviews all Local Improvement District proposals and issues a final decision.

Water Rates to Other Purveyors

The City has separate rates for water sold to other purveyors through intertie agreements. These rates are located in SMC 13.04.2014 and 13.045.040.

Cross-Connection Program

The Cross-Connection Program is addressed in Chapter 6.

Consent Agreements for Inspection, Maintenance, and Repair Activities that may Disrupt Water Service

Consent agreements to disrupt water service are not required for inspection, maintenance, and repair activities. The department makes every effort to coordinate disruptions and meet the needs of the customers. Spokane Municipal Code 4.02.180 provides that notice shall be given prior to termination of water service due to nonpayment of water service charges.

1.6 Duty to Serve Statement

The City of Spokane Water Department as a municipal water supplier has a duty to provide water service to all new connections within its retail water service area. Service within the retail water service area will be provided when the service connection request meets all four elements stated in Revised Code of Washington (RCW) 43.20.260:

> **1. Capacity:** The water system has sufficient capacity to serve water to the new service requested in a safe and reliable manner. Capacity is and will be sufficient to meet all flow

requirements and will not impede or reduce existing services below all required flow requirements.

2. Consistency: All new service requests shall be consistent with the requirements of any comprehensive plan or development regulations adopted under RCW 36.70A or any other applicable comprehensive plan, land use plan, or development regulation adopted by the City or County for the property location and consistent with the City's utility service extension ordinances.

3. Water Rights: Available water rights must be sufficient to provide for all new service requested.

4. Timely and Reasonable: Prior to connection, the water system shall have the necessary infrastructure in place to accommodate the new service or must-have in the capital improvement plan the necessary infrastructure improvements to provide for new services in a timely and reasonable manner. A developer may elect to construct infrastructure improvements at their cost, but all such infrastructure improvements shall meet all applicable rules and regulations and shall be consistent with all development regulations.

If these elements for a new water service request within the City's retail service area are met and per the details presented in Sections 1.6, 1.7, and 1.8 of this chapter, water service shall be available by the City of Spokane Water Department and will comply with the "duty to serve" requirement of RCW 43.20.260. The City has enacted an administrative policy addressing water service terms and conditions under Admin 5200-16-03, as attached in Appendix 1.4.

1.7 Local Government Consistency

The City coordinates with the water jurisdictions and local government. This section describes these activities.

1.7.1 Local Planning Consistency Determination

Requests for water service must comply with local planning policies and comprehensive plans. A Consistency checklist was provided to the local jurisdictions within the City's water service area. The City of Spokane Comprehensive Plan addresses the necessary links with Spokane County's Comprehensive Plan and the Countywide Planning Policies. Spokane County Planning, Spokane County Utilities, City of Spokane Planning, and City of Spokane Valley were contacted to verify no conflicts with their local planning documents. A Consistency Checklist was also provided to the City of Airway Heights as a wholesale customer. Consistency checklists are provided in Appendix 1.5.

1.7.2 Coordinated Water System Plan Agreement

The City of Spokane is a member of the Water Utility Coordinating Committee. The City has a service area within the confines of the critical water supply area and is part of the 1999 Spokane County Coordinated Water System Plan. Although a significant portion of the Coordinated Water System Plan identifies service area boundaries, Section 3 of the Coordinated Water System Plan establishes the mechanism for service area agreements between all local water purveyors within the critical water supply area. Exhibits and amendments to Section 3 of the Coordinated Water System Plan are provided in Appendix 1.6. Exhibit 3-4 is the Water Utility Service Area Agreement and includes one amendment to the agreement, "Amendment No. 1."

Section 3-1 of the Coordinated Water System Plan outlines common service area transfer requirements. The water service area boundaries for each purveyor, typically following streets, are identified in Section 3-2 and Exhibit 3-1 of the Coordinated Water System Plan. These boundaries are also shown in Figure 1.9 of this plan. Exhibit 3-4 of the Coordinated Water System Plan, "Service Area Boundary Amendment Procedure," is in Appendix 1.6, details the procedure to make boundary adjustments. Amendments to the defined service area boundaries can occur if both utilities agree to the change. The Coordinated Water System Plan has a form to make such a change, as contained in Appendix 1.6. Service Area terms of agreement are identified in the Coordinated Water System Plan in Exhibit 3-6, Certificate of Completion Service Area Adjustment, herein Appendix 1.6. Documents for the Spokane County Coordinated Water System Plan are maintained on the Spokane County website and may be found at https://www.spokanecounty.org/1287/Coordinated-Water-System-Plan.

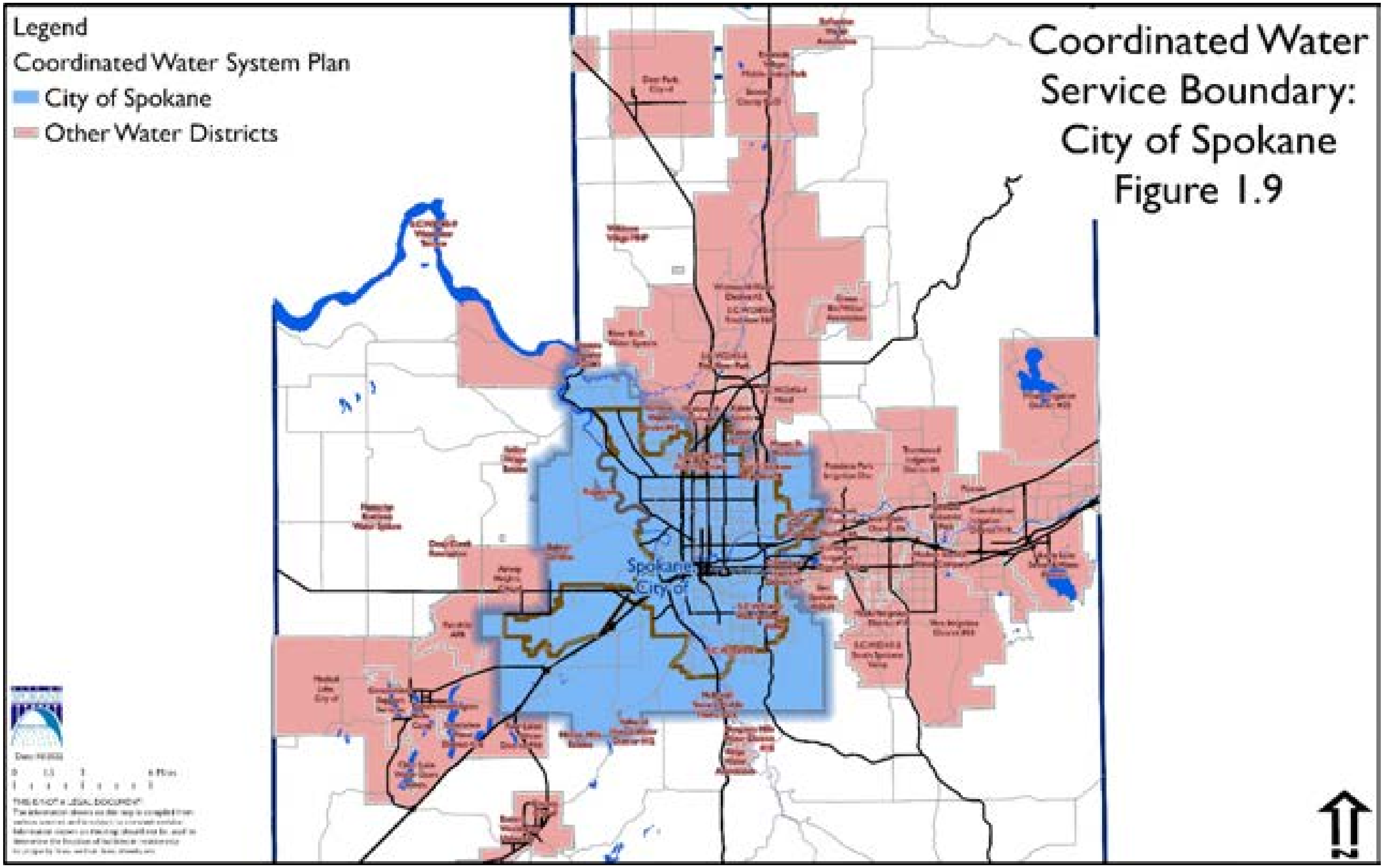


Figure 1.9 Water Service Area Boundaries

1.8 Watershed Plan Consistency

Watershed planning in Washington State is conducted under the framework of the Watershed Management Act (ESHB 2514) passed by the Washington State Legislature in 1998. The Act enables local community, interest groups, and government organizations to collaboratively identify and solve water-related issues in 62 Water Resource Inventory Areas of the state.

The goal is to assess the water resources within each watershed and make recommendations to ensure the state's water resources are used wisely by:

- Protecting existing water rights
- Protecting in-stream flows for fish
- Forecasting the future water resource needs
- Ensuring future water availability

The City of Spokane and the City Water Department, as the largest metropolitan area and the largest publicly owned water utility in each watershed, are often the initiating agency and have been involved in four watershed planning processes. A brief discussion on the status of each plan is presented as follows:

Water Resource Inventory Area 54 – The Lower Spokane River Watershed

The water Resource Inventory Area 54 Watershed involves the Spokane River and all the tributaries that flow into the Lower Spokane River, downstream of the confluence with the Hangman (Latah) Creek (Water Resource Inventory Area 56) to its confluence with the Columbia River.

The Water Resource Inventory Area 54-Lower Spokane Watershed Detailed Implementation Plan was adopted in December 2010. This plan provides the framework for implementation of watershed planning strategies presented in the 2009 Water Resource Inventory Area 54 Watershed Plan. Implementation of the Watershed Detailed Implementation Plan represents moving into Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW). The Water Resource Inventory Area 54-Lower Spokane Watershed Detailed Implementation Plan, December 2010, and the Water Resource Inventory Area 54-Lower Spokane Watershed Plan, August 2009 are available on the Spokane County website at http://www.spokanecounty.org/WQMP/project54/.

Water Resource Inventory Area 56 – Latah (Hangman) Creek Watershed

The Water Resource Inventory Area 56 Watershed spans two states and four counties before it outflows into the Spokane River about a mile west of the Spokane Falls in downtown Spokane. Water Resource Inventory Area 56 includes the portion of this watershed within Washington State. The Spokane County Conservation District initiated the watershed planning process in Latah (Hangman) Creek. In 1999, the Spokane County Conservation District received funds from the Washington State Department of Ecology to constitute a planning unit and develop a scope of work for the planning process. Additional funding was received for a watershed assessment and the development of a watershed management plan.

The Water Resource Inventory Area 56 Latah (Hangman) Creek Detailed Implementation Plan, dated February 19, 2008, is intended to be used for the coordination and implementation of the 68 recommendations of the Water Resource Inventory Area 56 Latah (Hangman) Creek Watershed

Management Plan. The final Water Resource Inventory Area 56 Latah (Hangman) Creek Watershed Management Plan was completed in September 2005, completing Phases 1-3; the Detailed Implementation Plan represents Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW).

The Water Resource Inventory Area 56 Latah (Hangman) Creek Watershed Management Plan, dated May 19, 2005, is available on the Spokane County Conservation District (SCCD) website at: http://www.sccd.org/pdfs/WR_DL/HC%20Final%20Draft%20Report%2005-19-05.pdf.

The Detailed Implementation Plan may be found at:
http://www.sccd.org/pdfs/WR_DL/WRIA%2056%20DIP%20FINAL.pdf.

In-stream flow, water quality, and water storage are the primary issues being addressed in this watershed. The goal is to protect the watersheds in stream resources and associated habitat balanced with the economic interests within the watershed.

Water Resource Inventory Area 55 – Little Spokane River Watershed & Water Resource Inventory Area 57 - Middle Spokane River Watershed

Water Resource Inventory Area 55 Little Spokane River Watershed spans three counties before it outflows into the Spokane River approximately three miles downstream of the Nine-Mile Falls Dam.

Water Resource Inventory Area 57 Watershed is comprised of the Spokane River drainage basin that begins at the state line of Washington and Idaho and ends at the confluence of Latah (Hangman) Creek.

In 1998 the watershed planning effort was initiated when funding was provided by Washington State Department of Ecology. A planning group of local agencies, and various interest groups were formed to plan for future water use in the Middle Spokane and Little Spokane watersheds.

The Water Resource Inventory Area 55/57 Watershed Plan was approved by the planning group on July 6, 2005. The Watershed Plan was then presented to the initiating agencies for approval. After some minor adjustments, the Water Resource Inventory Area 55/57 Watershed Plan was adopted by the County Commissioners of Pend Oreille, Spokane, and Steven Counties on January 31, 2006.

The Detailed Implementation Plan for Water Resource Inventory Area 55/57 was approved February 20, 2008, for the coordination of the implementation of the 107 recommendations outlined in the Water Resource Inventory Area 55/57 Management Plan. These recommendations address issues central to water resource management. Implementation of the Watershed Detailed Implementation plan represents moving into Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW). Recommendations fall into the following categories:

- In-stream flow needs
- Water conservation, reclamation, and reuse
- Domestic exempt wells
- Water rights and claims
- Strategies for base flow augmentation
- Strategies for groundwater recharge augmentation
- Approaches to plan implementation

1.9 State Environmental Policy Act (SEPA)

A SEPA checklist was completed for this Water Service Plan and a Determination of Nonsignificance was issued and a copy is in Appendix 1.7. The CIty received one comment letter from the Spokane Tribe of Indians. This letter is also in Appendix 1.7.

Chapter 2 – Basic Planning Data

Table of Contents

Chapter 2 – Basic Planning Data

Introduction

This chapter provides the basic planning data needed to support the City's Water System Plan (WSP) development. Understanding the gap between existing and future planning conditions is a key outcome of the Water System Plan and a foundational component of developing an effective capital improvement plan. This chapter includes an overview of the current population and existing water demand information, including service connections, Equivalent Residential Units (ERUs), water production and usage data, distribution system loss, water supply characteristics, and reliability evaluation results. Also included are water system growth forecasts and future water demands for the 20-year planning horizon.

2.1 Current Population, Service Connections, and Equivalent Residential Units

The population, service connections, and Equivalent Residential Units for 2020 are examined in this section. The City chose to evaluate water usage by pressure zone because demand per Equivalent Residential Unit varies widely and will impact the resulting capital projects needed in the future.

2.1.1 Current Population

In 2020, the United States government completed a census for the entire country. Spokane's water system currently provides water service within the water Retail Service Area (RSA), including all of the City of Spokane and areas within Spokane County. Using the 2020 census data, parcel information, and meter location data from Geographic Information System (GIS), the total estimated population for the City's Retail Service Area in 2020 is 244,817. Most of the population of 228,989 people is within the City limits. The remaining 15,828 people are outside the City limits but within the City's Retail Service Area.

2.1.2 Current Service Connections

The City has eight customer classes for tracking water usage, as summarized in Table 2.1 using 2020 meter counts. The majority of meters are for single-family residences and comprise approximately 86% of the service connections. The commercial/industrial class is the next highest number of meters, with 9% of the total. The remaining six categories represent 5% of the total number of meters.

Table 2.1 Number of Meters by Customer Class

Customer Class	Meter Count
Commercial/Industrial	7,275
Fire Hydrant	133
Government	813
Miscellaneous	3
Multi Family	2,846

Parks Department	293
Resale	19
Single-Family	68,329
Total	**79,711**

2.1.3 Current Equivalent Residential Units

Equivalent Residential Unit, or ERU, is the basis for measurement for determining water system capacity and requirements for capital facility planning. In Washington State, an Equivalent Residential Unit is defined as *a system-specific unit of measure used to express the amount of water consumed by a typical full-time single-family residence* (WAC 246-290-010). Equivalent Residential Unit flowrates have been calculated for Average Day Demand (ADD), Maximum Day Demand (MDD), and winter demands for each pressure zone using meter records from 2018, 2019, and 2020. The calculation methodology and results are in Appendix 2.1, 2021 Equivalent Residential Unit Calculation Technical Memo. The summary of the number of Equivalent Residential Units and flowrates are shown in Table 2.2 and Figure 2.1.

Table 2.2 Equivalent Residential Unit Flowrates by Pressure Zone

Pressure Zone	ERU (Count)	DSL ERU (Count)	Total ERU (Count)	ERU_{ADD} (gpd/unit)	ERU_{MDD} (gpd/unit)	ERU_{Winter} (gpd/unit)
Hatch Road	198	n/a	198	951	4,460	161
Southview	43	1	44	657	3,001	166
Woodridge	64	4	68	733	2,895	135
Glennaire	522	8	530	571	2,709	139
Shawnee	156	10	166	603	2,277	148
Eagle Ridge	459	3	462	501	2,157	132
Indian Hills	56	n/a	56	524	2,150	147
Five Mile	2,047	54	2,101	594	2,138	141
Woodland Heights	243	82	325	463	1,976	124
Kempe	885	28	913	529	1,970	123
Midbank	573	12	585	514	1,911	128
Cedar Hills	221	6	227	443	1,906	116
Highland	862	67	929	442	1,883	126
Eagle Ridge 2	915	25	940	455	1,821	120
Northwest Terrace	1,497	n/a	1,497	487	1,739	120
Top	11,811	1,181	12,992	509	1,718	127
SIA	5,840	31	5,871	419	1,661	132
West Plains	4,665	167	4,832	415	1,547	130
High	9,563	604	10,167	368	1,203	130
North Hill	39,531	2,104	41,635	347	1,032	120
Intermediate	8,757	1,073	9,830	303	838	107
Low	47,166	8,990	56,156	303	734	106

Equivalent Residential Unit flowrates vary from larger to smaller pressure zones for both average day and winter by approximately 50%, while the Maximum Day Demand increases by over 300%. In general, pressure zones with greater number of Equivalent Residential Units have lower flowrates. Low Pressure Zone is the City's largest pressure zone in both number of Equivalent Residential Units and geographic size; it also has the lowest flowrates for average, summer, and winter demands.

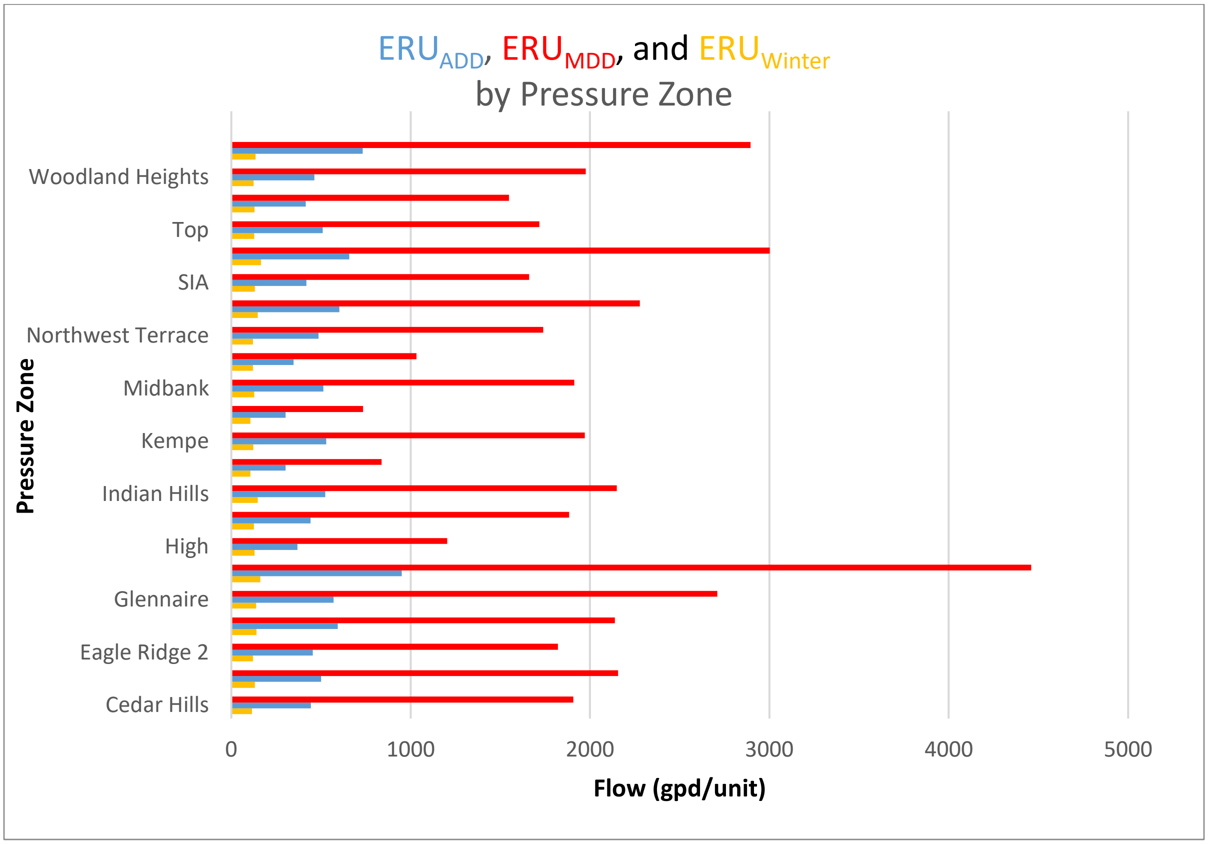


Figure 2.1 Comparison of Equivalent Residential Unit (ERU), Values for Average Day Demands (ADD), Maximum Day Demands (MDD), and Winter Use by Pressure Zone

2.2 Water Production and Usage

The production and usage data have been analyzed for 2018 through 2020. Production varies by season, with summer production making up approximately 30% of the total. Water usage is tracked via meters to eight customer classes. Interties with the City used between 3 and 4% of the total. Peaking factors have been calculated for each pressure zone based on meter usage. The 2020 data used in the analysis was collected during the COVID-19 lockdown. The annual water usage was within the range of normal usage, but the location and time of use was different than past usage. In the next 20 years, more at-home works may change the diurnal usage; however, the future demands calculated in this Water System Plan used peaking factors calculated from past usage.

2.2.1 Production

The City's seven wells supply water to the City's entire water system. Parkwater and Well Electric wells produce water year-round, while the other five wells are generally used to meet summer peak demands and during maintenance activities, such as pump replacements. Before 2020, production volume was calculated based on pump run-times and nameplate flowrates. The City installed well production meters in 2020 to measure system production more precisely through its Supervisory Control and Data Acquisition (SCADA) system. The maximum-day volume supplied to the City's water system was 149,701,000 gallons on July 9, 2021.

The monthly and annual production for each of the City's seven wells for 2018, 2019, and 2020 are shown in Table 2.3 and Figure 2.2. Overall production decreased from 2018 to 2020, but summer water usage has increased. Despite population growth of approximately 10,000 over that time frame, the system-wide production has decreased by over 2,000 acre-feet (Ac-ft.). This decrease is likely due to cooler temperatures in 2019 and 2020 and improved metering by the City. Summer production increased from 3.6 to 4.3 times the winter production. This increase is due to outdoor water use.

Table 2.3 Monthly Production Volumes

2018 Monthly Production Volumes, Ac-ft								
Month-Year	**Well Electric**	**Nevada**	**Park-water**	**Ray**	**Hoffman**	**Grace**	**Central**	**Total System**
January	1,365	11	1,928	6	24	0	3	3,337
February	338	1	2,076	2	0	178	408	3,004
March	1,436	11	1,838	3	0	0	114	3,402
April	338	5	2,541	44	0	184	695	3,806
May	0	865	3,575	615	274	831	1,209	7,370
June	2,688	200	3,535	724	135	783	956	9,020
July	3,622	1,004	3,661	1,557	240	1,607	1,138	12,830
August	2,035	2,845	2,273	1,362	535	1,271	1,078	11,400
September	957	1,409	2,706	717	260	1,063	1,144	8,255
October	804	0	2,453	18	0	63	915	4,253
November	1,104	4	1,909	2	0	0	114	3,133
December	1,060	0	2,056	0	0	101	0	3,216
2018 TOTAL:	**15,748**	**6,357**	**30,550**	**5,049**	**1,469**	**6,080**	**7,775**	**73,027**
2019 Monthly Production Volumes, Ac-ft								
January	1,149	0	2,182	7	0	0	0	3,338
February	1,147	0	1,969	0	0	0	0	3,116
March	1,511	0	2,185	0	2	2	0	3,699
April	280	4	2,687	0	8	717	0	3,696
May	2,164	99	3,285	414	382	291	887	7,521
June	3,531	24	3,470	714	235	670	1,124	9,767
July	1,946	2,433	2,485	1,223	503	1,048	1,108	10,748
August	429	3,286	2,476	1,649	634	1,335	1,103	10,911
September	994	1,878	2,551	592	211	208	1,075	7,510
October	1,217	3	2,327	2	0	4	141	3,695
November	1,190	0	1,867	0	0	0	0	3,057
December	1,183	0	2,220	1	0	0	20	3,423
2019 TOTAL:	**16,741**	**7,727**	**29,703**	**4,602**	**1,975**	**4,276**	**5,457**	**70,480**
2020 Monthly Production Volumes, Ac-ft								
January	1,077	1	2,255	3	0	1	6	3,344
February	1,322	0	1,834	3	0	0	0	3,159
March	1,575	0	1,866	2	0	0	41	3,484
April	1,299	0	2,373	236	0	94	278	4,279
May	161	111	3,705	701	0	828	971	6,476
June	1,485	184	3,346	863	101	325	843	7,147
July	2,675	511	3,437	1,750	351	999	1,091	10,814
August	2,363	1,960	3,566	1,401	576	1,231	1,086	12,185
September	1,913	1,016	3,627	648	550	367	790	8,912
October	1,185	2	2,842	25	3	20	423	4,501
November	787	0	2,362	0	0	0	26	3,175
December	1,108	44	2,194	0	2	0	2	3,349
2020 TOTAL:	**16,949**	**3,830**	**33,406**	**5,633**	**1,582**	**3,866**	**5,558**	**70,824**

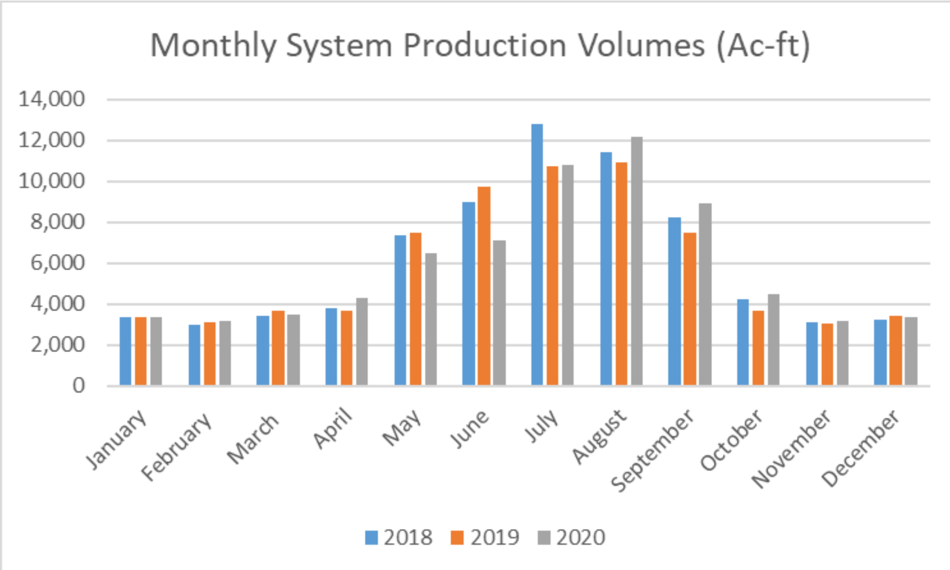


Figure 2.2 Total Monthly Water System Production

2.2.2 Annual usage by customer class

The City has eight customer classes for tracking water usage. These customer classes are summarized in Table 2.4 below with 2020 usage values. The 2020 average annual water metered usage demands were geolocated in the current City's water model.

Table 2.4 Annual Water Usage by Customer Class for 2018, 2019, and 2020

Customer Class	Annual Usage 2018 (Gallons)	Annual Usage 2019 (Gallons)	Annual Usage 2020 (Gallons)
Commercial/Industrial	4,092,684,992	3,994,738,880	3,714,170,812
Fire Hydrant	0	0	28,958,820
Government	893,082,080	835,759,848	764,070,780
Miscellaneous	103,972	225,148	309,672
Multi Family	2,671,333,148	2,632,273,336	2,657,065,796
Parks Department	708,160,772	650,101,012	546,140,980
Resale	651,724,172	656,176,268	730,441,448
Single-Family	9,531,719,120	8,833,397,540	9,403,218,704
Total	**18,548,808,256**	**17,602,672,032**	**17,844,377,012**

2.2.3 Annual Usage of Water Supplied to Other Water Systems

As shown in Table 2.5, the City supplies water to other water systems adjacent to the City. These water interties are shown in Table 2.5 for 2018, 2019, and 2020. In 2018, the City of Airway Heights constructed a second intertie connection in the Craig Road and McFarlane Road intersection area to supply their water demand because of contamination found in their wells. In 2020, the City of Medical Lake constructed an intertie in the intersection of Craig Road and Medical Lake Highway and began using water in 2021.

Table 2.5 Annual Intertie Usage in Gallons

Annual Gallons	2018	2019	2020
City of Airway Heights	598,378,000	605,031,000	661,131,000
City of Medical Lake	n/a	n/a	n/a
Fairchild Air force Base	1,167,000	972,000	3,000,000
North Spokane District No. 8	0	0	0
Spokane County Water 3	45,922,000	46,574,000	61,181,000
Vel View Water District #13	5,839,000	3,599,000	5,131,000
Whitworth Water Irrigation District 2	45,000	0	0
Total	**651,351,00052,973,000**	**656,176,000**	**730,443,000**
Percentage of overall City Usage	3.5%	3.7%	4.1%

2.2.4 Description of Seasonal Variations by Customer Class

Variations in system demand occur continually throughout the day and year. These variations must be identified to design the necessary water system improvements required to meet existing and future water system demands, as well as rules and regulations.

November through May has the lowest average monthly use, and June through October is the peak water demand period. This peak usage typically occurs in July and August due to outdoor water use and cooling demands. Since Spokane is located in an arid climate, water demand in the summer months is highly dependent on weather patterns. A cool and wet spring and summer, as compared to a hot and dry summer, will have more impact on water usage than any other factor.

Diurnal System Demand/Peak Hour Demand

Water demand variations occur throughout the day, every day of the year. These daily demand variations are best represented graphically on a “diurnal demand curve” that shows the relationship between time of day and water demand. The hourly peak water demand in the City’s water system varies in each pressure zone.

Summer and winter diurnal curves were developed for each pressure zone group in the system using Supervisory Control and Data Acquisition (SCADA) production data for the selected calibration periods and confirmed during model calibration. Zones were grouped by supply source, and hourly usage then were calculated individually using a mass balance between the zone supply from Supervisory Control and Data Acquisition and the Average Day Demand (ADD) allocated in the model. The hourly totals were then converted to hourly peaking factors. The hourly peaking factors were then applied to the base Average Day Demand in the model for each hour timestep for 24 hours.

Peaking Factors

Peaking factors (demand ratios) show the relationship between the various demand conditions. The peaking factors developed for the existing demands were used to project future demand conditions. An important peaking factor is the relationship between the Average Day Demand and the Maximum Day Demand. The Average Day Demand to Maximum Day Demand multiplier varies over the entire system based on the type of use and/or customer class in each pressure zone. In order to accurately represent the Average Day Demand to Maximum Day Demand multiplier, values were calculated for each pressure zone. The values range from 2.42 to 4.74 and are reported in Table 2.6.

Table 2.6 Peaking Factors by Pressure Zone

Pressure Zone	ADD-MDD Multiplier
Cedar Hills	4.31
Eagle Ridge	4.31
Eagle Ridge 2	4.00
Five Mile	3.60
Glennaire	4.74
Hatch Road	4.69
High	3.27
Highland	4.26
Indian Hills	4.10
Intermediate	2.76
Kempe	3.72
Low	2.42
Midbank	3.71
North Hill	2.98
Northwest Terrace	3.57
Shawnee	3.78
SIA	3.97
Southview	4.57
Top	3.37
West Plains	3.73
Woodland Heights	4.27
Woodridge	3.95

2.3 Distribution System Loss

Distribution System Loss (DSL) is water lost from the distribution system and includes both apparent and real losses. Apparent losses may include theft, meter inaccuracies (at the source and/or service connections), and data collection errors. Real losses are physical losses from the distribution system and may include reservoir overflows, leaky valves and fittings, pipe leakage, and water main breaks. Neither apparent nor real losses are authorized uses of water; therefore, they are considered Distribution System Loss even if they are not actual “leaks.” Distribution System Loss can be expressed in terms of volume (gallons) or in terms of percentage of production lost.

Distribution System Loss was calculated both system-wide and by pressure zone by determining the difference between pumped volume and consumption records. The information available via the source meter data and Consumption Summary Reports from 2018, 2019, and 2020 was used to calculate the Distribution System Loss; each year was considered separately as well as averaged over the entire period. The average system-wide Distribution System Loss for 2018 through 2020 is 16% of overall production volume or approximately 3,455,522,000 gallons. A more detailed discussion on Distribution System Loss, including a breakdown of pressure zone Distribution System Loss, is included in Chapter 4.

The Distribution System Loss was applied to the City's water model. The difference between water pumping and billing was calculated for each pressure zone group and distributed evenly across each pressure zone's demand nodes. This established the total average base demand loading for the calibration effort, which could be increased or decreased by an overall factor depending on Supervisory Control and Data Acquisition production values during the calibration data collection period. The Distribution System Loss is estimated both to account for water loss in Equivalent Residential Units calculations accurately and to estimate future water supply requirements.

2.4 Water Supply Characteristics

The Spokane Valley/Rathdrum Prairie (SVRP) Aquifer is the sole source of water supply for the City of Spokane's water system. This aquifer extends nearly 370 square miles and reaches from Lake Pend Oreille, Idaho, to the Little Spokane River in Washington. The Spokane Valley/Rathdrum Prairie Aquifer was formed during repeated inundations of water from the breach of glacial dams impounding historic Glacial Lake Missoula that created thick layers of coarse-grained material of cobbles, rock, and sand. This coarse-grained material gives the Spokane Valley/Rathdrum Prairie Aquifer high hydraulic conductivity and allows for high sustained pumping rates. The Spokane Valley/Rathdrum Prairie Aquifer was designated a sole source aquifer by the United States Environmental Protection Agency (EPA) in 1978. The Spokane Valley/Rathdrum Prairie Aquifer is the sole source of drinking water for over 600,000 people in Idaho and Washington. There is no viable alternate drinking water supply.

The Spokane River is hydraulically connected to the Spokane Valley/Rathdrum Prairie Aquifer. There are both gaining and losing reaches of the river. Water transfers from the river to the aquifer or from the aquifer to the river. The City of Spokane is one of many water purveyors in Washington and Idaho that use the water supply from the Spokane Valley/Rathdrum Prairie Aquifer. The United States Geological Service (USGS) has completed several studies of the Spokane Valley/Rathdrum Prairie Aquifer through 2007. The Spokane Aquifer Joint Board (SAJB) initiated a study to examine the influences on groundwater pumping in 2017. The City completed studies concerning well production in 2014 and 2017. (See References for a complete list and links to these studies.)

The City continues to engage in planning studies concerning the aquifer. A technical memorandum was completed in 2022 assessing the potential impact of climate on the future water demand. A copy is in Appendix 2.2. The City has initiated a study on the potential effect of climate changes on the aquifer levels at the City's existing well stations.

Washington State Department of Ecology (WSDOE) set a minimum instream flow for the Spokane River in 2015 (codified in Chapter 173-557 WAC), measured by the United States Geological Service gage at Spokane 12422500. The summertime flow minimum is 850 cubic feet per second (CFS). All the City's water rights are senior to the Spokane River instream flow rule. The instream flow is a water right. Junior water rights to the instream flow will need to be curtailed during those time periods when the river flow drops below the minimum flow set in the rule. A copy of the final rule is in Appendix 2.3.

2.5 Water Supply Reliability Evaluation

For over 115 years, water supply from the Spokane Valley/Rathdrum Prairie Aquifer has been dependable, consistent, and reliable. Studies completed by the United States Geological Service show the Spokane Valley/Rathdrum Aquifer is recharged annually (see Chapter 2 references). Water purveyors throughout the Spokane Valley/Rathdrum Aquifer have monitored water levels for over 100 years, and there appear to be no indications of long-term reductions. The City recently evaluated three of its wells and found no apparent indications to expect reduced production in the near future.

Recently the population growth in the region has been unprecedented, and the long-term future demands on this resource will need to be reviewed. Even though water conservation is being strongly marketed, the regional growth has increased water demands. The impacts of climate change on this water resource are not yet known at this time; however, climate modeling suggests there will be warmer winters and hotter summers. Annual precipitation is expected to slightly increase but storms may be less frequent and more intense, resulting in less snowpack and more frequent runoff events. The impacts of climate change have not yet been documented or studied to determine potential changes which could impact the aquifer recharge. The City is currently studying the potential ways climate change may impact well productions.

Other concerns that may impact reliability of the water supply are the Spokane River flows and potential future contamination. There is a need to maintain river flows to meet aquatic habitat requirements. Ecology's minimum instream flowrate, codified in chapter 173-557 WAC, provides for summer and winter flow minimums. The other concern is contamination which could come from septic tanks, petroleum storage, pipeline spills, or commercial/industrial activities conducted over the aquifer. The City's Wellhead Protection Program, described in Chapter 5, addresses possible contamination of the aquifer near the City's wells.

2.5.1 Interties - Annual Usage for Water Supplied to Other Systems

Interties provide connection to the City's water system for the purpose of supplying water to another water purveyor's system. The City has supplemental and emergency water supply intertie agreements with other water purveyors. Depending on the agreement, the intertie may be used for permanent water supply; to supplement limited supply capacity of a purveyor; to provide water to an area that has limited storage capacity; to provide water to meet peak or fire demand; and/or to provide for emergency service, such as an equipment failure. All interties with the City anticipate and provide for flow going only to the adjoining purveyor.

Seven of the adjoining purveyors have interties with the City of Spokane Water System. Interties to these purveyors supply both emergency and non-emergency conditions. All interties are metered, and the purveyor is billed for the water used per rates established in Spokane Municipal Code Outside City Rate to Other Purveyors 13.04.2014. A list of the interties, the location, and the type is shown in Table 2.7. Copies of intertie agreements are found in Appendix 2.4.

The City does not anticipate additional intertie agreements in the next 20 years but recognizes the water quality and declining aquifer concerns in the West Plains. The City is collaborating with the water purveyors in the West Plains to determine a pathway forward to supply essential water needs to this area. For planning purposes, this Water System Plan has evaluated the impact of supplying additional water to the West Plains. Any changes to intertie agreements requires approval by Spokane City Council.

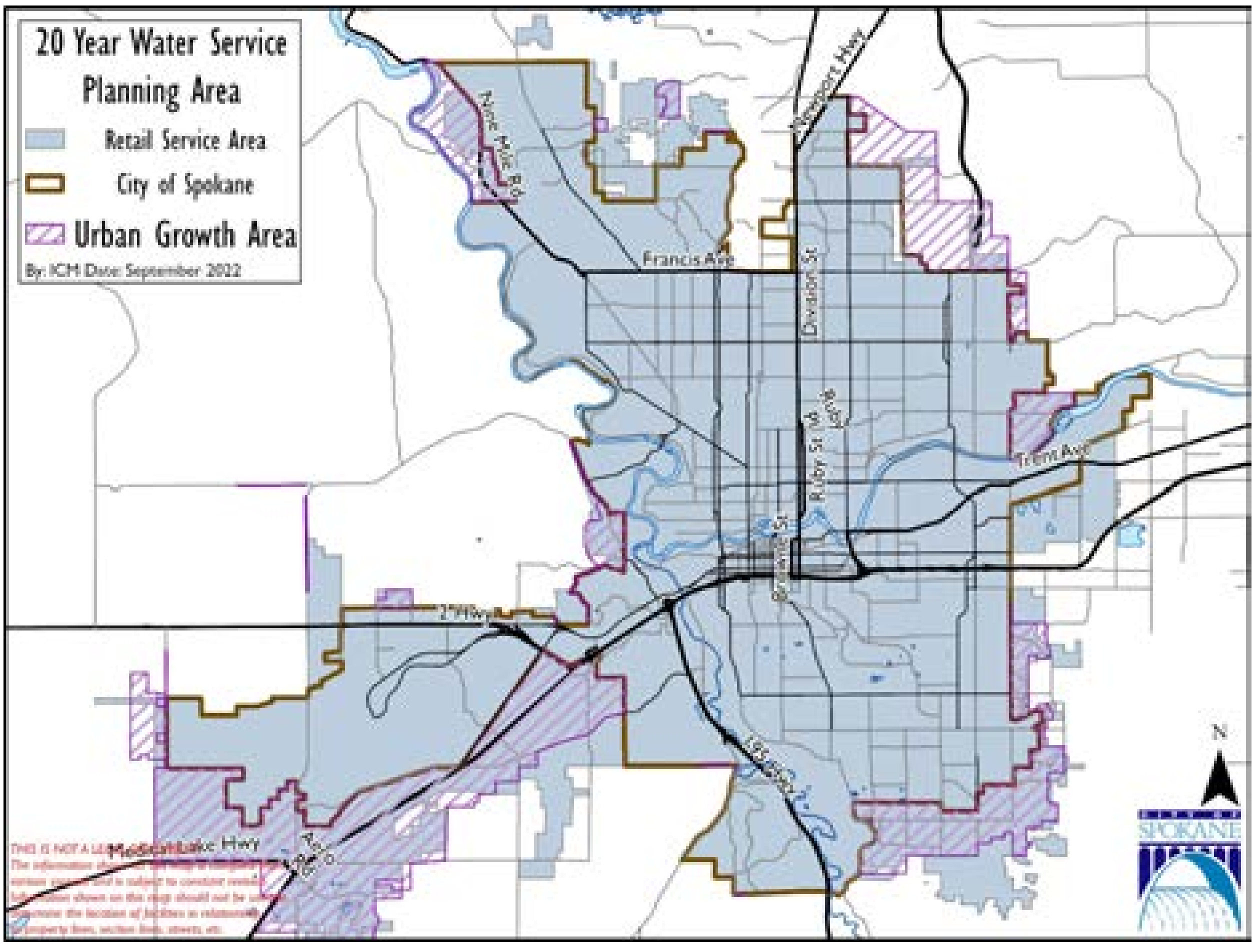
Table 2.7 City of Spokane Interties

Water District	Supplied from Pressure Zone	Intended Use & Control	Agreement Flowrates	Agreement Date/Filed Date	Agreement Duration	Installation Date	Intertie Size	Location
City of Airway Heights	2 Interties	--	--	--	--		2 Interties	
1	SIA	Non-emergency (manual)	Not to exceed 1,500 gpm	4/12/2018	5+ Renewal	7/15/1986	12-inch	10800 West U.S. Hwy 2 and Hayford Road
2	West Plains	Emergency (automatic)	Not to exceed 1,400 gpm	4/12/2018	2026	2018	12-inch	Craig Road and McFarlane Road
City of Medical Lake	West Plains	Non-emergency & emergency (automatic)	Not to exceed 200 gpm or 105 MG per year (Short-Term Emergency Use: Max: 800 gpm or 70 MG per year)	8/24/2018	20 Years	10/13/2020	36-inch	Craig Road and Medical Lake Highway 902
Fairchild Air Force Base	SIA	Emergency (manual)	2,500 gpm	1/22/2001	None. City may renegotiate when water use changes per agreement (Sec. 4-D).	3/13/2002	10-inch	Spotted Road and Airport Drive
North Spokane Irrigation District No. 8	North Hill	Emergency (manual)	1,500 gpm @ 55psi residual pressure 3,280 gpm @20 psi residual pressure	6/11/2014	20 Years	5/7/2008	8-inch	Francis Avenue and Freya Street
Spokane County Water District No. 3	5 interties	--	--	--	--	--	5 Interties	--
A	Low	Emergency (manual)	none	12/4/2000	None	11/16/1960	12-inch	Sprague Avenue and Havana Street
B	High	Non-emergency (automatic)	none	12/4/2000	None	2/1/1978	6-inch	Carnahan Road and Glenrose Road
C	Low	Non-emergency (automatic)	none	12/4/2000	None	10/28/1974	8-inch	Mission Avenue and Thierman Road
D	North Hill	Emergency (manual)	none	12/4/2000	None	3/6/1987	8-inch	Francis Avenue and Wall Street
E	Top	Non-emergency (automatic)	none	12/4/2000	None	6/2/1960	8-inch	54th Avenue and Perry Road off of
Vel View Water District No. 13	Kempe	Emergency (automatic)	1,500 gpm maximum	3/13/2003	None	9/9/2004	4-inch	Prescott Road and West Velview Drive
Whitworth Water District No. 2	2 Interties	--	--	--	--	--	2 Interties	--
	North Hill	Emergency (manual)	none	12/4/2000	None	10/16/1968	6-inch	6300 North Monroe Street
	North Hill	Emergency (automatic)	none	12/4/2000	None	8/6/1990	12-inch	Hawthorne Road and Nevada Street

2.6 Water System Growth Forecasts

To calculate future water use, growth within the water system has been estimated. Growth is based on demographic categories assigned to each pressure zone to forecast future water demand more accurately. Future growth has been calculated as the increase in the number of households, employees, or students as appropriate based on the land use type. The water service for the 20-year growth includes the current Retail Service Area (RSA) plus areas within the Urban Growth Area (UGA), as shown in Figure 2.3.

Figure 2.3 20-year Water Service Area



2.6.1 Future Growth

Future growth analysis and baseline water demand forecast are discussed in detail in the Technical Memorandum Spokane Future Flows – Baseline Water Demand Forecast contained in Appendix 2.5. The City of Spokane hired HDR Inc. to estimate future 20-year flow projections within the City's Retail Service Area boundary and Urban Growth Area boundaries in 2022. The analysis utilized the Spokane Regional Transportation Council (SRTC) 2019 Land Use Update Summary, where estimates of single-family and multifamily households and the number of employees in various commercial sectors were generated in Traffic Analysis Zones (TAZs), and associated demands were applied to forecast water demand by 2042. The 2019 update to Spokane Regional Transportation Council Land Use data was the resource referenced to understand growth in demand within each pressure zone. Other projection data reference resources that were used to verify growth projections were the Office of Financial Management, 2020 Census, City of Spokane 2015 Land Quantity analysis, 2021 Spokane Housing Action Plan, and 2021 Spokane Regional Transportation Council US 195/I90 Transportation Study. For additional information, refer to the Spokane Future Flows – Baseline Water Demand Forecast memo (HDR-2022) located in Appendix 2.5.

The Traffic Analysis Zones data is used for other City infrastructure planning and was chosen to be consistent with other infrastructure projects. These zones are constructed by census block information and had the most granular growth data available for allocation to pressure zones. Each Traffic Analysis Zones contain categories based on land use types that measure growth generally by the number of people served in the future. This information was used to generate the future number of Equivalent Residential Units. Table 2.8 lists the data categories and the type of measurement and describes the usages.

Table 2.8 Traffic Analysis Zones Data Categories

Code	Type	Measure	Description
LU1	Population	Housing units	Single-family, duplex, triplex, manufactured, or mobile home
LU2	Population	Housing units	Four or more residential units on a single parcel
LU3	Other	Rooms/campsites	Hotel, motel, or campsite
LU4	Employment	Employees	Agriculture, forestry, mining, industrial, manufacturing, wholesale
LU5	Employment	Employees	Retail trade (non-CBD)
LU6	Employment	Employees	Services and offices
LU7	Employment	Employees	Finance, insurance, and real estate services (FIRES)
LU8	Employment	Employees	Medical
LU9	Employment	Employees	Retail trade (CBD)
LU10	Other	Students	College and university commuter students
LU11	Employment	Employees	Education employees (K–12)
LU12	Employment	Employees	Education employees (college and university)

Using Geographic Information System (GIS) spatial data for Traffic Analysis Zones, the current retail service area plus Urban Growth Area, and the water system pressure zones, Traffic Analysis Zones that intersect the Retail Service Areas were isolated, and the pressure zones intersected were determined. The estimated growth for Traffic Analysis Zones fully within a single pressure zone was allocated entirely to that pressure zone. A method was developed to proportionally allocate populations from Traffic Analysis Zones which intersected multiple pressure zones. The number of Equivalent Residential Units were determined for each pressure zone based on the growth of each demographic category. Originally, the estimated growth was calculated for 23 years of growth due to the Traffic Analysis Zones data available. Table 2.9 displays the estimated growth for each pressure zone by demographic category for 20 years of growth. Approximately 20,000 to 25,000 additional Equivalent Residential Units are projected to be added to the City's Water System, and about 50% of this growth in water demand is expected to be residential.

Table 2.9 Growth for Each Pressure Zone by Demographic Category

Pressure Zone	LU1: Single Family Households	LU2: Multifamily Households	LU3: Hotel and Motel Rooms/Campsites	LU4: Ag./Forestry/Mining /Industry/Manufact	LU5: Retail Trade (non-CBD)	LU6: Services and Offices	LU7: FIRES	LU8: Medical	LU9: Retail Trade (CBD)	LU10: College and Commuter Students	LU11:Education (K-12)	LU12: Education (College and University)
Cedar Hills	196	0	0	0	5	0	1	2	0	0	10	0
Eagle Ridge	304	0	0	0	9	0	1	2	0	0	16	0
Eagle Ridge 2	402	0	0	0	11	1	2	3	0	0	21	0
Five Mile	743	31	0	0	40	39	5	37	0	0	17	0
Glennaire	6	1	0	0	0	2	0	1	0	0	3	0
Hatch Road	23	0	0	0	0	0	0	0	0	0	0	0
High	437	100	0	1	52	77	30	492	0	3	196	3
Highland	262	757	99	6	45	19	0	0	0	0	0	0
Indian Hills	3	0	0	0	5	7	1	10	0	0	0	0
Intermediate	234	199	163	1	89	98	10	2,236	0	0	77	2
Kempe	191	0	0	0	12	4	0	1	0	0	37	0
Low	1,592	2,517	399	830	839	2,728	138	3,791	61	3,950	617	1,178
Midbank	0	0	0	0	21	19	2	7	0	0	0	0
North Hill	2,136	922	125	184	1,100	2,197	723	2,307	0	115	434	8
Northwest Terrace	459	335	0	0	0	86	0	0	0	0	0	0
Shawnee	15	0	0	0	7	10	2	15	0	0	0	0
SIA	711	1,600	243	4,285	2,039	922	89	572	0	86	42	0
Southview	0	0	0	0	0	0	0	0	0	0	0	0
Top	760	748	0	5	1,035	197	30	717	0	5	134	1
West Plains	1,070	281	36	1,494	1,073	34	0	0	0	0	2	0
Woodland Heights	3	23	31	2	35	6	0	12	0	0	0	0
Woodridge	6	0	0	0	1	0	0	0	0	0	8	0
TOTAL	**9,553**	**7,514**	**1,096**	**6,808**	**6,418**	**6,446**	**1,034**	**10,205**	**61**	**4,159**	**1,614**	**1,192**

The future service connections were estimated based on the existing number of meters and meter type to average water usage for the type of meter, as shown in Table 2.10. The estimated growth in the number of meters over 20-years for the entire water system is 13,485, or a 17% increase.

Table 2.10 Future Meter Count per Customer Class

Customer Class	2020 Meter Count	20-Year Growth Meter Count
Single-Family	68,329	78,854
Multi Family	2,846	3,352
Commercial/Industrial	7,275	9,729
Government	813	813
Parks Department	293	293
Resale	19	19
Misc.	136	136
Total	**79,711**	**93,196**

The future number of Equivalent Residential Units was calculated per pressure zone by referencing the 2020 Equivalent Residential Units count and the calculated Equivalent Residential Unit-Average Day Demand multiplier as documented in the Equivalent Residential Units memo attached in Appendix 2.1. The Equivalent Residential Units-Average Day Demand multipliers for each pressure zone were divided by the 20-year growth in Average Day Demand. The resulting number of Equivalent Residential Units for each pressure zone is shown in Table 2.11. The resultant system-wide growth in the number of Equivalent Residential Units is approximately 19% or slightly less than 1% per year. This reflects a similar population growth rate projected for Spokane County by the Office of Financial Management.

Table 2.11 20-year Projected Number of Equivalent Residential Units per Pressure Zone

Pressure Zone	Number of ERU (includes DSL)
Cedar Hills	475
Eagle Ridge	1,001
Eagle Ridge 2	1,665
Five Mile	3,095
Glennaire	530
Hatch Road	230
High	10,955
Highland	1,653
Indian Hills	56
Intermediate	11,874
Kempe	1,178
Low	62,948
Midbank	604
North Hill	46,540
Northwest	2,257
Shawnee	182
SIA	11,127
Southview	44
Top	14,955
West Plains	7,602
Woodland	347
Woodridge	82
Uncategorized	828
TOTAL	**180,228**

2.7 Future Water Demand

The Water Rights Self-Assessment Form has been completed for the 20-year planning horizon. The estimated water demand is forecasted for each pressure zone from the projected growth and the resulting number of Equivalent Residential Units. The Equivalent Residual Units are based on the existing value.

2.7.1 Demand Forecast

The raw demographic growth forecasts described above were converted to water demands using water use factors described in the Baseline Demands Analysis TM (HDR Inc., March 1, 2022) contained in Appendix 2.5. The baseline demands are developed from current water use and do not include savings from water use efficiency.

The 20-year future demands are shown in Table 2.12. Water demand forecast was developed at the pressure zone scale based on growth. Each pressure zone has a unique Equivalent Residential Units value (see Section 2.1.3). Water demand growth was forecasted by applying the pressure zone-specific Equivalent Residential Units factors to the estimated Equivalent Residential Units growth in that same pressure zone. Water use factors were developed for demographic categories other than single-family to determine Equivalent Residential Units and associated water demands. The Average Day Demand/Maximum Day Demand Multiplier for each pressure zone described in Section 2.2.4 was used to calculate the future Maximum Day Demand values.

The future water demands include an estimate of unmetered water use based on a system-wide analysis of current losses, which was then applied to each pressure zone and extrapolated into the future (see Appendix 2.7). The future water losses were estimated to be 1.98 mgd for both Average Day Demand and Maximum Day Demand, or about 15% of Average Day Demand (detailed in Table 4, Appendix 2.7). This value was calculated based on Average Day Demand and is used for both Average Day Demand and Maximum Day Demand unmetered water use because it is assumed leakage, maintenance uses, undocumented connections, and meter inaccuracies do not typically vary by time of day or season.

Table 2.12 20-year Future Demand Projections for Average Day Demand (ADD) and Maximum Day Demand (MDD)

	20-Year Demand		
Pressure Zone	**ADD (mgd)**	**MDD (mgd)**	
Cedar Hills	0.16	0.67	Note
Eagle Ridge	0.52	2.25	Note
Eagle Ridge 2	0.83	3.31	Note
Five Mile	1.83	6.60	Note
Glennaire	0.31	1.46	Note
Hatch Road	0.16	0.75	Note
High	3.78	12.35	Note
Highland	0.52	2.20	Note
Indian Hills	0.03	0.13	Note
Intermediate	3.47	9.57	Note
Kempe	0.65	2.41	Note
Low	18.92	45.79	Note
Midbank	0.32	1.18	Note
North Hill	15.94	47.51	Note
Northwest Terrace	1.05	3.76	Note
Shawnee	0.11	0.41	Note
SIA	4.08	16.18	Note
Southview	0.03	0.13	Note
Top	7.51	25.32	Note
West Plains	3.08	11.49	Note
Woodland Heights	0.15	0.65	Note
Woodridge	0.06	0.22	Note
TOTAL	**63.51**	**194.34**	

Notes:

1. Pressure zone boundaries were not accurately shown for undeveloped areas when intersecting with TAZ boundaries.
2. A portion of the growth shown in Cedar Ridge is actually at a higher elevation and will be served from Eagle Ridge 2 Pressure Zone. The 0.11 mgd demand was subtracted from Cedar Hills and added to Eagle Ridge 2 Pressure Zone.
3. Development has occurred since the meter records data was analyzed. For these pressure zones, the growth estimated by HDR in Table 4 of Appendix 2.7 was added to the current demand from the ERU Memo.
4. The demand is from Table 4 of Appendix 2.7 as calculated.
5. Values include DSL in both current and future flows.

The 20-year Peak Hour Demand (PHD) was calculated based on the Washington State Department of Health Water System Design Manual (WSDM) Equation 3-1 by referencing the 20-year projected Equivalent Residential Unit counts and applying the appropriate factors based on the future number of Equivalent Residential Unit to the Equivalent Residential Unit and values. There were several zones that created extreme peak-hour demand multipliers: Glennaire, Hatch Road, Indian Hills, Midbank, Shawnee, Southview, and Woodland Heights, with multipliers that ranged from 5 to 34 for Peak Hour Demand/Maximum Day Demand. These values were manually replaced with the original existing Peak Hour Demand/Maximum Day Demand multipliers created from the existing 2018-2021 pumping data to reference a more reasonable value. Table 2.13 shows the multipliers and the resultant 20-year Peak Hour Demand.

Table 2.13 20-year Future Peak Hour Demand Projections

20-Year in Peak Hour Demand		
Pressure Zone	**Selected PHD/MDD Multiplier**	**20-year PHD (mgd)**
Cedar Hills	2.39	1.60
Eagle Ridge	2.10	4.73
Eagle Ridge 2	1.85	6.13
Five Mile	1.71	11.29
Glennaire	2.04	2.97
Hatch Road	2.41	1.81
High	1.62	20.01
Highland	1.85	4.07
Indian Hills	3.14	0.41
Intermediate	1.63	15.60
Kempe	1.86	4.48
Low	1.60	73.26
Midbank	2.01	2.37
North Hill	1.61	76.49
Northwest Terrace	1.76	6.62
Shawnee	2.51	1.03
SIA	1.64	26.54
Southview	3.17	0.41
Top	1.62	41.02
West Plains	1.65	18.95
Woodland Heights	2.28	1.49
Woodridge	3.01	0.66
TOTAL		**321.93**

2.7.2 Water Rights Self-Assessment

The Water Rights Self-Assessment Form for the 20-year projected water demand has been completed and is contained in Appendix 2.6. The City of Spokane has adequate water rights for the projected demands. The self-assessment form does not include any additional supply to the West Plains area, but the City has sufficient water rights if water supply is needed in the next 20 years. The Department of Ecology reviewed the Water Rights Self-Assessment and did not identify any issues of concern. A copy of the Department of Ecology's review letter is in Appendix 2.8.

References

Spokane Valley/Rathdrum Prairie (usgs.gov)

Specific publications by the USGS are referenced below.

Hydrogeologic Framework and Groundwater Budget of the Spokane Valley/Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho; 2007; SIR; 2007-5041; Kahle, Sue C.; Bartolino, James R.

Groundwater Flow Model for the Spokane Valley/Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho; 2007; SIR; 2007-5044; Hsieh, Paul A.; Barber, Michael E.; Contor, Bryce A.; Hossain, Md. Akram; Johnson, Gary S.; Jones, Joseph L.; Wylie, Allan H.

Assessment of Areal Recharge to the Spokane Valley/Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho; 2007; SIR; 2007-5038; Bartolino, James R.

Compilation of geologic, hydrologic, and groundwater flow modeling information for the Spokane Valley/Rathdrum Prairie aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho; 2005; SIR; 2005-5227; Kahle, Sue C.; Caldwell, Rodney R.; Bartolino, James R

Well Station Evaluation Study summary book: https://static.spokanecity.org/documents/publicworks/water/well-station-evaluation-booklet-2021-04-30.pdf.

Chapter 3 – System Analysis and Asset Management

Table of Contents

Chapter 3 – System Analysis and Asset Management

Introduction

It is essential to understand the existing condition and capacity of the City of Spokane's water system to operate the water utility successfully now and in the future. This chapter provides an overview of the existing water system facilities, including current asset management practices, and a discussion on existing water quality, minimum design standards, and system capacity needs identified as part of a capacity analysis. Each of these components helps identify existing system deficiencies, which are summarized at the end of the chapter. The deficiencies identified herein will delineate the projects identified in Chapter 8 – Capital Improvement Program.

3.1 Asset Management – Asset Inventory and Analysis

This section provides an overview of the assets owned and operated by the City of Spokane's water utility. This section will discuss the existing asset inventory, condition data, and system criticality data, as well as provide an overview of the plan to refine and expand the City's existing asset management program to address system deficiencies and support future needs.

3.1.1 Asset Inventory

The City's water system includes source well stations, reservoirs, booster stations, and more than 1,100 miles of water lines. The system includes:

- 23 pressure zones;
- 7 well stations with one additional well station under construction;
- 33 reservoirs with two additional reservoirs in design or construction;
- 21 booster stations;
- 27 pressure-reducing valve stations;
- 160+ miles of transmission pipe (greater than 12 inches in diameter);
- 860+ miles of distribution pipe (4 to 12 inches in diameter); and
- 13 interties with seven different local water purveyors.

A visual summary of the City's water system facilities is shown in Figure 3.1.

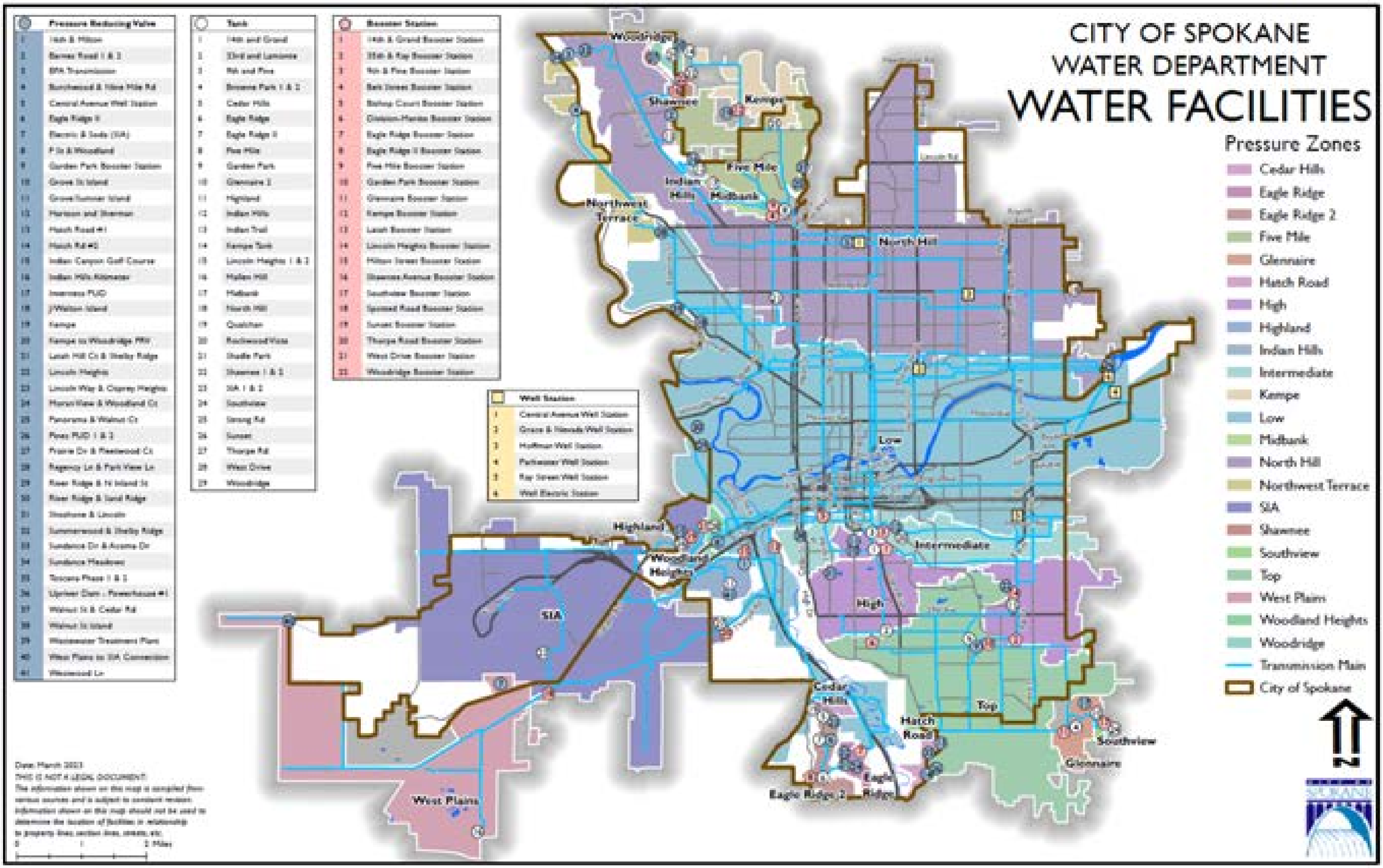


Figure 3.1 Water System Facilities

The City of Spokane water system has 23 pressure zones based on elevation and geography. This chapter divides the pressure zones into three groups based on the well station supplying the pressure zone. The intent is to simplify the information and make the overall asset and capacity analysis more understandable. Figure 3.2 shows the distribution in supply from these three pressure zones. The Low Pressure Zone wells supply most of the water service area. The Northwest Pressure Zone is supplied from the Low and North Hill Pressure Zones and represents approximately 1.5% of the system supply.

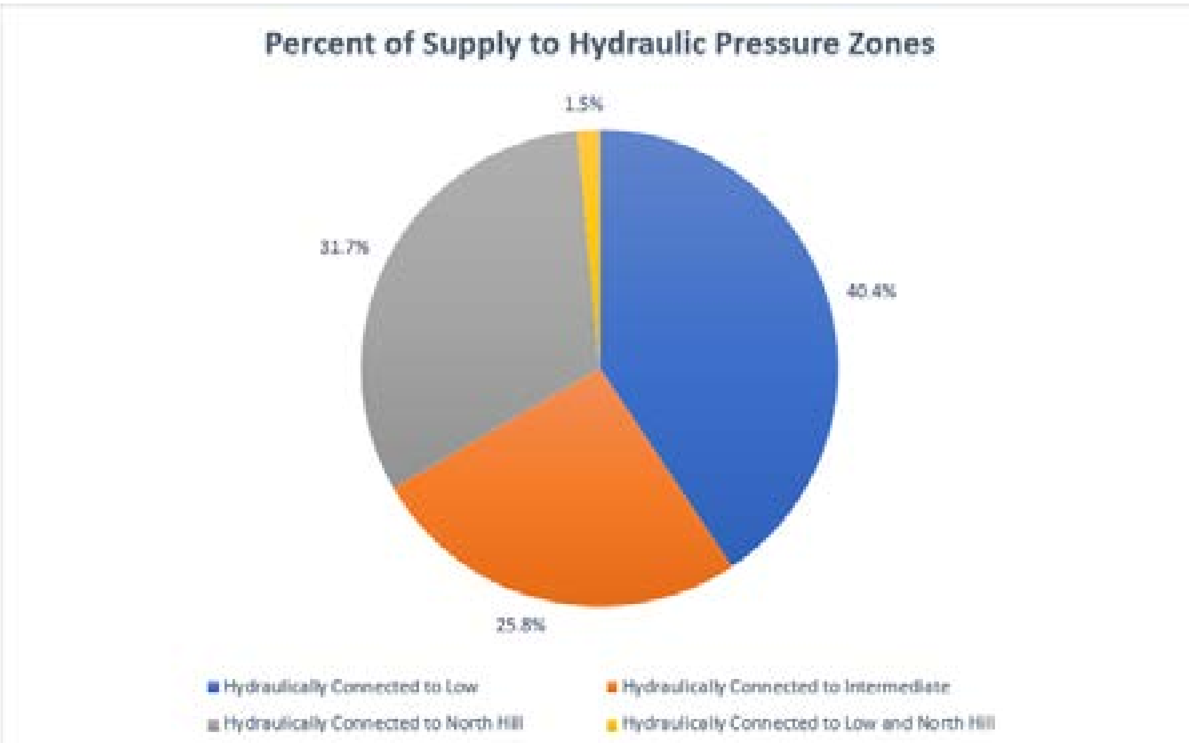


Figure 3.2 Water Supply Distribution by Pressure Zone

A summary of supply to each pressure zone is provided in Tables 3.1 and 3.2. Additional information includes the % of total supply water each zone delivers as well as where the zone draws water from and supplies water to.

Table 3.1 Supply Summary for Pressure Zone Supplied by Low & Intermediate Pressure Zones

Pressure Zone	% of Total Water Supply	Pumps From	Supplies To	Storage
Pressure Zones Connected to Low-Pressure Zone				
Low	29.0%	Well Electric Well Station Parkwater Well Station Nevada Well Station	Intermediate Woodland Heights Northwest Terrace Highland Cedar Hills SIA Eagle Ridge	9th & Pine Qualchan Rockwood Shadle Thorpe West Drive
SIA	5.0%	Low	West Plains	SIA 1 SIA 2
West Plains	3.9%	SIA	none	Mallen Hill
Cedar Hills	0.2%	Low	none	Cedar Hills
Eagle Ridge	0.5%	Low	Eagle Ridge 2	Eagle Ridge
Eagle Ridge 2	0.8%	Eagle Ridge	none	Eagle Ridge 2
Woodland Heights	0.2%	Low	Highland	Sunset
Highland	0.8%	Low	none	Highland
Pressure Zones Connected to Intermediate Pressure Zone				
Intermediate	5.4%	Well Electric Well Station Parkwater Well Station Ray Street Well Station Low	High	14th & Grand Lincoln Heights West Lincoln Heights East
High	7.1%	Intermediate	Top	Lamonte Garden Park
Top	12.2%	High	Glennaire Hatch	Browne Park 1 Browne Park 2
Glennaire	0.6%	Top	Southview	Glennaire 2
Southview	0.1%	Glennaire	none	Southview
Hatch	0.4%	Top	none	none

Table 3.2 Supply Summary for Pressure Zone Supplied by North Hill Pressure Zones

Pressure Zones Connected North Hill Pressure Zone				
North Hill	27.8%	Central Well Station Grace Well Station Hoffman Well Station Well Electric Well Station	Midbank Five Mile Northwest Terrace Shawnee	Indian Trail Five Mile North Hill
Indian Hills	0.1%	Five Mile	none	Indian Hills
Five Mile	2.5%	North Hill	Kempe Indian Hills	Strong
Kempe	1.0%	Five Mile	none	Kempe
Shawnee	0.2%	North Hill	Woodridge	Shawnee 1 Shawnee 2
Woodridge	0.1%	Shawnee	none	Woodridge
Northwest Terrace is supplied from both Low Pressure and North Hill and is shown in both pressure zones				
Northwest Terrace	1.5%	Low Pressure	none	none
		North Hill	none	none

Asset Inventory Information

The inventory information for the water system assets is primarily contained within the City of Spokane's Geographic Information System (GIS). The geodatabase is regularly updated after maintenance operations are completed and when new capital facilities are operational. The data available for each asset varies slightly based on asset type. An example of the data available for a distribution water main is provided in Figure 3.1. The City's Geographic Information System (GIS) data is publicly available and can be accessed at the City's website: Map Spokane (arcgis.com), City of Spokane (arcgis.com).

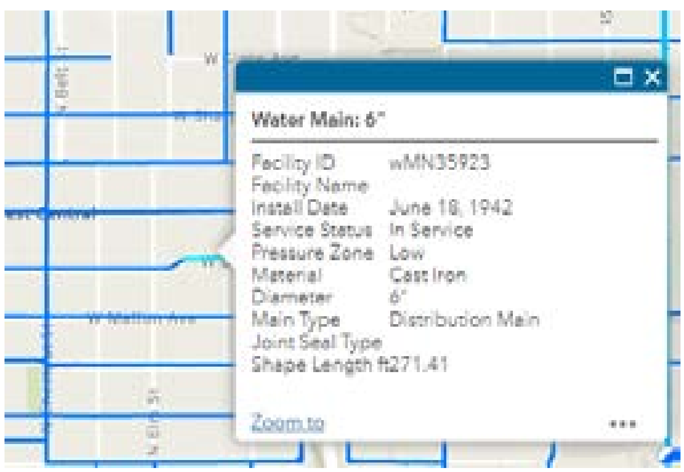


Figure 3.3 Example of Asset Data Available for 6" Water Main in City of Spokane GIS Information

Maintenance activities are tracked in CityWorks, the Water Department's GIS-centric maintenance management system, which links directly to the asset data within GIS. CityWorks is the City's best resource for finding a record of maintenance activities that have been performed. The Water Department also uses information from Supervisory Control and Data Acquisition to determine the performance of water facilities. The City is working on developing a more robust and comprehensive asset management program in the next several years and expects to expand the existing asset register to include available condition and criticality information.

3.1.2 Asset Condition & Criticality

The available condition and criticality data for the water system's source wells, booster stations, storage reservoirs, and transmission and distribution conveyance mains are described in the subsequent sections.

Source Descriptions and Condition

The City's water system pumps water from the Spokane Valley/Rathdrum Prairie Aquifer through seven well stations at distinct points within the water system to supply the three main pressure zones—Low, Intermediate, and North Hill. Water is then boosted from these three main pressure zones to provide water to the remainder of the water system. Construction of an eighth well station is currently underway and is anticipated to be completed by 2024.

Different pump types are used at the well stations, including horizontal centrifugal, vertical line shaft turbine, and submersible pumps. Some well stations have multiple wells and multiple pumps. No well station has less than two well pumps.

Well station condition is assessed on a five-year cycle as part of the overall station condition assessment program that includes all well and booster stations. This booster station condition assessment program was initiated in 2015; the first cycle was completed in 2017; the second was initiated in 2020 and is ongoing. The results from the first inspection cycle are provided in Appendix 3.1. Each well station was rated for the consequence of failure, maintenance, pump performance, safety, and electrical. The scoring criteria range from 0.0 for an excellent condition to 1.0 for complete failure. Based on the 2015 inspection cycle results, an additional study of the Hoffman, Ray Street, and Well Electric well stations was initiated to investigate the most cost-effective ways to maintain or increase the supply resiliency of each of these three well stations. Options include possible modification of existing facilities and/or construction of additional groundwater pumping infrastructure at one or more of these three well stations. This in-depth study of the three well stations, the "Well Station Evaluation," was completed in 2020 and is available on the City's website at well-station-evaluation-booklet-2021-04-30.pdf (spokanecity.org)

Disinfection of the water occurs at each well head with the injection of gaseous chlorine at a rate of one ton of chlorine per 1.2 billion gallons of water. Due to the high quality of water in the aquifer, no other water treatment is needed or is being used at this time.

A brief description of each well station is presented in Table 3.3 below. A more detailed discussion of the existing condition and criticality of each well station is provided in subsequent sections. The well station piping from the well head to the connection to the transmission system is described for each well station. The analysis of the transmission mains is discussed in Section 3.4.4.

Table 3.3 Well Stations

DOH Source No.	Source Name	Source Category	Use	Well Depth (feet)	Allowable Pumping Capacity (per Water Rights) (gpm)	Existing Pumping Capacity (i.e., nameplate capacity) (gpm)	Avg. % of Annual Production *	Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
S01	Nevada Street	Well	Year-round	122	25,000	31,000	8%	0.198	0.250	0.050
S02	Well Electric	Well	Year-round	50	54,750	39,300	23%	0.201	0.875	0.176
S03	Parkwater	Well	Year-round	126	63,000	63,000	44%	0.417	0.875	0.365
S04	Ray Street	Well	Year-round	75	24,850	21,550	7%	0.222	0.313	0.069
S05	Hoffman Avenue	Well	Seasonal	235	11,600	10,920	2%	0.317	0.250	0.079
S06	Grace Avenue	Well	Seasonal	124	31,000	19,000	7%	0.082	0.250	0.020
S08	Central Avenue	Well	Year-round	272	30,900	11,900	9%	--**	0.188	--**

**average annual production from 2018-2020*

*** Central Well Station construction was completed in 2018 and consequently was not evaluated as part of the 2015 condition assessment cycle*

Nevada Well Station (Department of Health Source #S01)

Nevada Well Station is located at the intersection of Nevada Street and North Foothills Drive at the Water Department yards. This well station is the sole water supply to the Low-Pressure Zone, providing water from four pumps. Two of the pumps are 400 horsepower submersible pumps, which were installed in 1958, and the other two are 800 horsepower vertical turbine pumps, which were installed in 2003 (these replaced two older and less efficient pumps). Failure at this station would have a serious impact on the entire water system, as the Low-Pressure Zone is the largest sub-service area in the City. The City has planned some redundancy to mitigate the risk; the Nevada Well Station is one of three well stations serving the Low Pressure Zone. Risks due to natural disasters are minimal at the Nevada Well Station site because the location is not susceptible to natural risks from flooding or hillside erosion.

The maximum instantaneous withdrawal rate allowed for this per the water right of this well station is 25,000 gallons per minute. The actual pumping capacity is 31,000 gallons per minute, which equates to the total capacity of the pumps. The total yield of the well exceeds the allocated water rights. The actual potential yield of the well station is unknown to the City. Historically, there have been no significant variations in source capacity or water table levels at or near this site.

The 2015 cycle condition assessment concluded the well station needs some upgrades, including pump and other equipment replacements, in the next six years. The Six-Year Capital Water Program includes a study to determine the detailed scope of work and Nevada Well Station Rehabilitation. The rehabilitation may include the replacement of pumps, motors, motor control centers, power, instrumentation, and piping. The study will consider the well station's long-range (50+ years) ability to supply the Low Pressure Zone.

Nevada Well Station pumps into four 16-inch cast iron pipes (installed in 1949). These cast iron pipes connect into a north-south transmission main (installed in 1957) that varies in diameter (30 inches to the south and 36 inches to the north). The pipe configuration at the well is shown below in Figure 3.4. Modeling indicates adequate capacity in this area of the system, as verified by the model discussed in Section 3.4.3. The well station piping shows no signs of deterioration, however it will be assessed as part of the study.

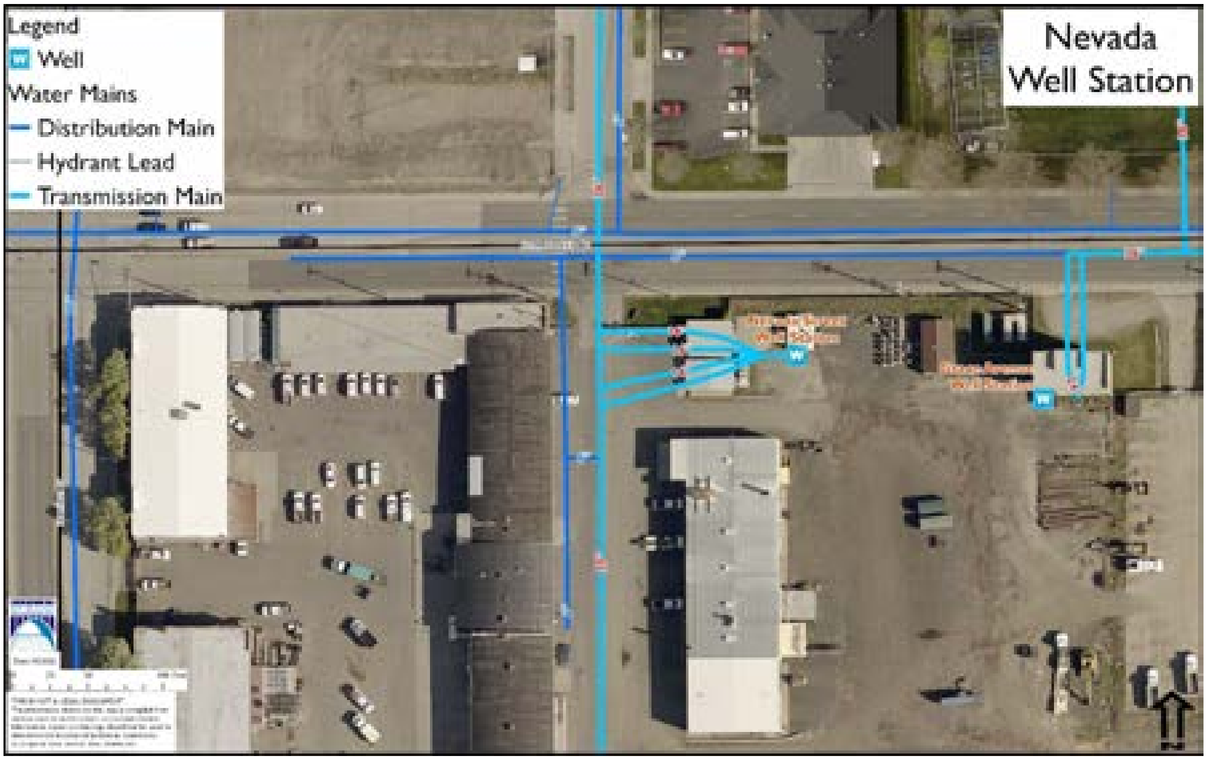


Figure 3.4 Nevada Well Station Transmission Mains

Well Electric Well Station (Department of Health Source #S02)

Well Electric Well Station is the oldest well station in the water system and is located adjacent to the Spokane River within the Upriver Complex. The well station supplies the three main pressure zones of the City's system: Low Pressure Zone, Intermediate Pressure Zone, and North Hill Pressure Zone. Well Electric is one of the system's larger well stations and operates year-round, making it essential to the operations of the City's water system. It consists of two large 48-foot diameter wells that are adjacent to each other in a north-south orientation. The City identifies the north well as Well Number 4 and the south well as Well Number 5. Well Number 4 contains a single 900 horsepower horizontal centrifugal pump that provides water to the North Hill Pressure Zone and was replaced in 2022.

Well Number 5 supplies water to three pumps:

- Pump Number 1: 900 horsepower vertical turbine pump installed in 1996; pumps water to the Intermediate Pressure Zone and was rebuilt in 2022.
- Pump Number 2: 900 horsepower horizontal centrifugal installed in 1926; pumps water to the North Hill Pressure Zone. The pump was last rebuilt in 1996 and is currently in service with no scheduled replacement date.
- Pump Number 3: 1,000 horsepower vertical turbine pump installed in 2015; pumps water to the Low Pressure Zone.

The maximum total instantaneous withdrawal rate for the well station is 39,300 gallons per minute, which is the total nameplate capacity of the pumps. The total capacity of the wells exceeds the pumping capacity, but the actual potential yield of the well station is unknown to the City. The water right allows 54,750 gallons per minute. Historically, there have been no significant variations in source capacity or water table levels at or near this site.

Major studies conducted on the Well Electric Station include:

Groundwater Influence Study (1998-2001): This study investigated whether there are any surface water impacts from the Spokane River on the groundwater at the Well Electric site. After extensive water quality monitoring, the study found there is no surface water influence during normal operation; however, there is operational impact on the well station due to flooding when the river flow exceeds 15,000 cubic feet per second. As such, the City elects to stop pumping when these conditions are met (usually a handful of times during the spring for a week or two at a time). The proximity of Well Electric's wells to the Spokane River has been identified as a system vulnerability in the water system's Risk and Resiliency Analysis in Appendix 3.3.

Performance and Reliability Assessment (GSI Water Solutions, Inc., et al. 2018-2019): Study to assess the options for increasing the performance and reliability of the groundwater production capacity from the facility and to evaluate the potential for expanding groundwater development of the site for greater operational/production redundancy. The goals of this study were to provide solutions to:

- Improve performance and reliability through structural and/or operational changes that will limit or reduce the impact that lower seasonal water levels in the Spokane Valley/Rathdrum Prairie Aquifer have on production capacity; and
- Avoid creating a nearby direct connection with surface water from the Spokane River to increase the well station's current seasonal reliability by allowing year-round groundwater.

Several alternatives were developed. The City selected the alternative of constructing a new well field within a deep sand unit that was discovered.

The City is currently evaluating the Well Electric site for the feasibility of developing a new well field in the deep sand unit. The study is expected to conclude in 2024, and the project design will follow. The City plans to construct two new well station buildings adjacent to the existing transmission piping.

The well station piping shows no signs of deterioration. Most transmission mains from the Well Electric Well Station have been replaced in the past 35 years with ductile iron pipe, the exception being the 48-inch steel pipe installed in 1929 to serve the Low Pressure Zone. This pipe was assessed in 2022 and is currently awaiting the results for potential replacement of discrete segments identified by the condition assessment. Table 3.4 provides the details of these transmission mains. Figure 3.5 shows how the mains connect to the transmission system for the three pressure zones.

Table 3.4 Well Electric Transmission Mains

Pressure Zone Served	Pipe Size (inches)	Pipe Material	Year Installed	Location
Low	36	Ductile Iron	1987	Northwest under the Spokane River
Low	36	Ductile Iron	1987	Southwest toward Waterworks Street connects to 1929 48-inch Steel pipe
Low	30	Ductile Iron	1999	Southwest toward Waterworks Street connects to 1999 42-inch ductile iron pipe
North Hill	30	Ductile Iron	2009	Northwest under the Spokane River
Intermediate	30	Ductile Iron	1999	Southwest toward Waterworks Street connects to 1999 36-inch ductile iron pipe

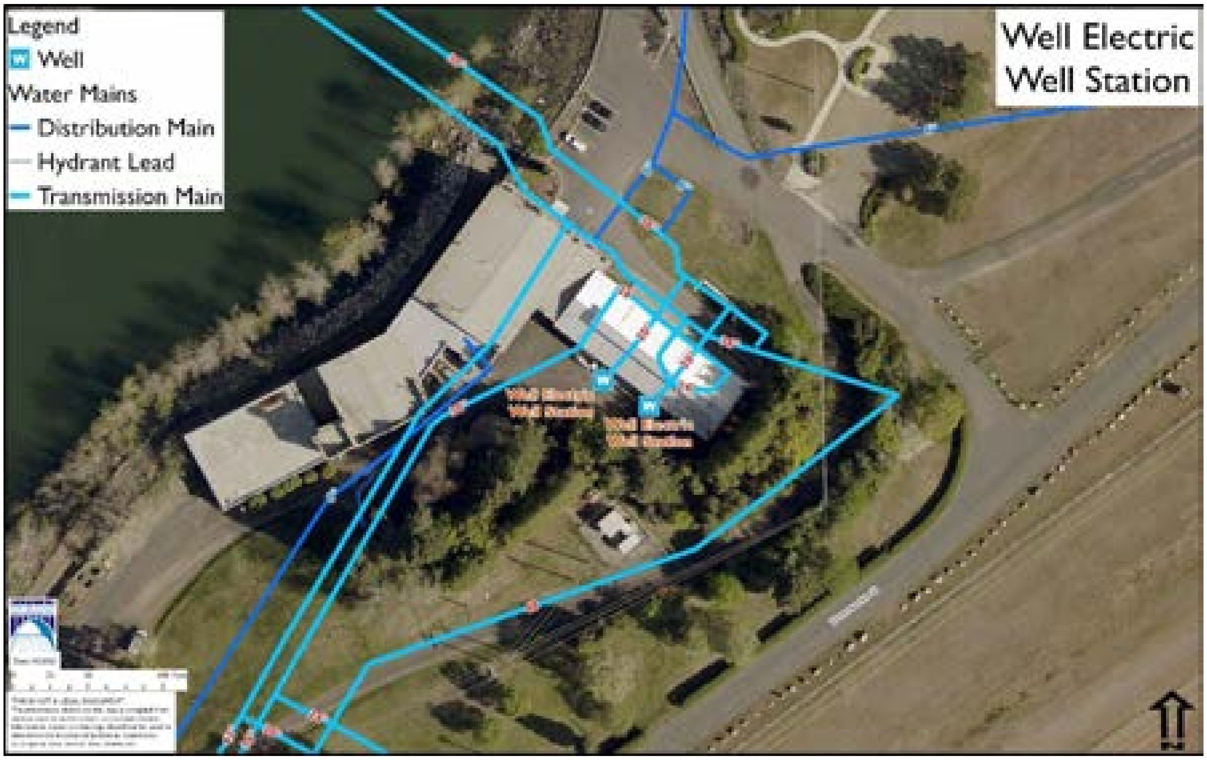


Figure 3.5 Well Electric Well Station Transmission Mains

Parkwater Well Station (Department of Health Source #S03)

The Parkwater Well Station is one half mile south and east of the Well Electric Well Station. Completed in 1949, the Parkwater Well Station houses eight pumps in four 18-foot diameter hand-dug wells. The wells are adjacent to each other in an east-west orientation. The City identifies the east well as Well Number 1 and continues the numbering scheme westward, with the most western well identified as Well Number 4. The well station supplies the Low Pressure Zone and Intermediate Pressure Zone. The Parkwater Well operates year-round and is essential to the operation of the City's water system.

The Parkwater Well Station has eight pumps total, with two pumps in each well. All the station's pumps are vertical lineshaft turbine pumps. Two pumps supply the Intermediate Pressure Zone and six pumps supply the Low Pressure Zone.

The 2015 well station condition assessment cycle concluded Parkwater's pumps and motors will need to be replaced in the next six years. Pump and header replacement is scheduled in the Six-Year Capital Water Program. The replacement schedule for all pumps at the Parkwater station is outlined in Table 3.5.

Table 3.5 Parkwater Well Station Pumps

Pump Position	Horsepower	Pressure Zone Supplied	Year Installed	Scheduled Replacement
1	900	Low	1949	2025
2	1000	Low	2001	2031
3	600	Intermediate	1949	2025
4	600	Intermediate	2020	2050
5	600	Intermediate	1949	2023
6	600	Intermediate	2021	2051
7	600	Intermediate	1949	2023
8	600	Intermediate	2021	2051

The maximum total instantaneous withdrawal rate of the Parkwater Well Station is 63,000 gallons per minute, which is the total nameplate capacity of the pumps and also the maximum allowed per the water right. The total yield of the wells exceeds the pumping capacity, but the actual potential yield of the well station is unknown to the City.

Historically, there have been no significant variations in source capacity or water table levels at or near this site. The Risk and Resiliency Assessment did not identify any natural hazard risks for the Parkwater Well Station.

The Parkwater Well Station pumps into the Low and Intermediate Pressure Zones. The well station piping shows no signs of deterioration. Table 3.6 provides the details of these transmission mains. Figure 3.6 shows how the water mains connect to the water transmission system for the Low and Intermediate Pressure Zones.

Table 3.6 Parkwater Well Station Transmission Mains

Pressure Zone Served	Pipe Size (inches)	Pipe Material	Year Installed	Location
Low	18	Steel	1973	Southeast
Low	42	Steel	1949	Northwest toward Waterworks Street
Low	30	Steel	1949	Northwest toward Waterworks Street
Intermediate	24	Steel	1949	Northwest toward Waterworks Street

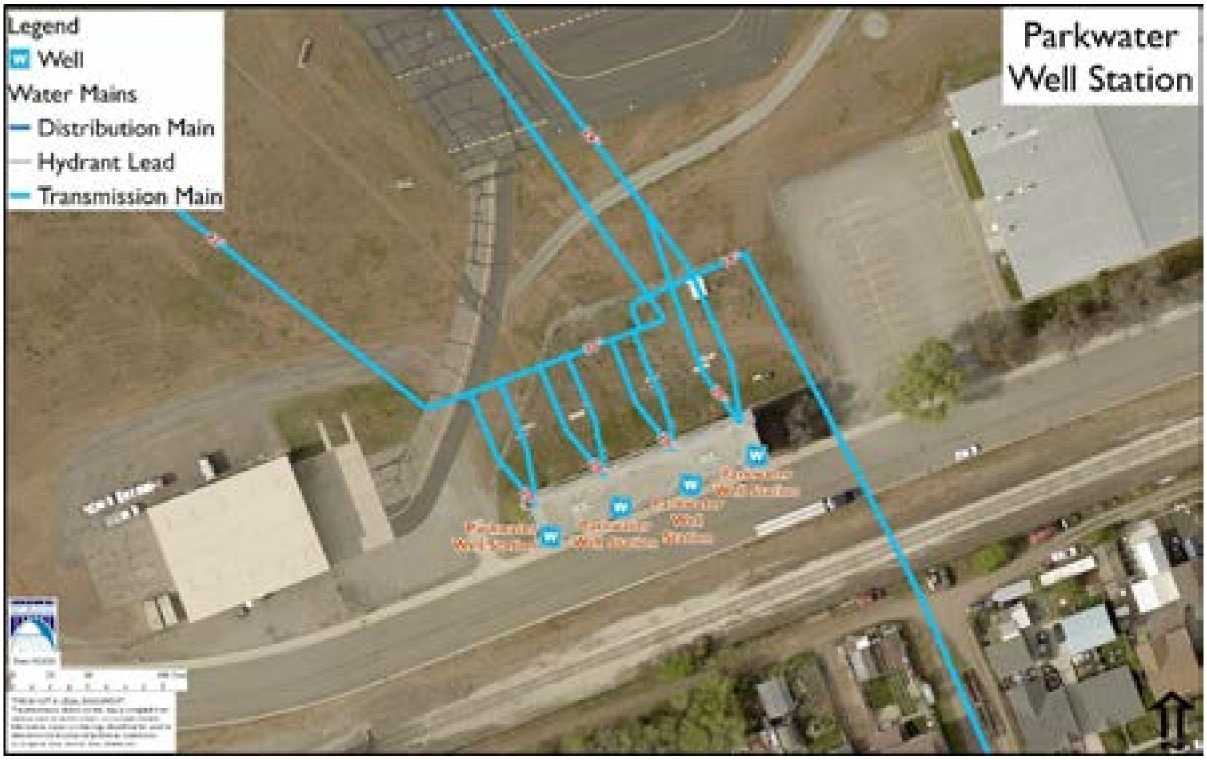


Figure 3.6 Parkwater Well Station Transmission Mains

Ray Street Well Station (Department of Health Source #S04)

The Ray Street Well Station (1937) is located at the intersection of Ray Street and Hartson Avenue at the base of the South Hill in East Central Spokane and pumps water to the Intermediate Pressure Zone. The well station houses two 24-foot diameter wells adjacent to each other in a north-south orientation. The City identifies the north well as Well Number 1 and the south well as Well Number 2. The station contains two 900 horsepower vertical turbine pumps (installed in 1941) in Well Number 1 and a single 500 horsepower vertical turbine pump in Well Number 2. There is a casing for a second pump in Well Number 2 that is expected to be installed in 2023. Failure of the Ray Street Well Station would seriously impact the water system. The Ray Street Well Station is one of four well stations that serve the Intermediate Pressure Zone and supplies 7% of the annual system-wide volume.

The maximum instantaneous withdrawal rate of the well station is 21,550 gallons per minute, which is the total nameplate capacity of the pumps. The total yield of the wells exceeds the pumping capacity, but the actual potential yield of the well station is unknown to the City. The water right allows 24,850 gallons per minute. Historically, this site has no significant variations in source capacity or water table levels.

The Risk and Resiliency Assessment did not identify any natural hazard risks for Ray Street Well Station. The 2015 condition assessment cycle concluded additional study was needed to assess the future needs of the station. As such, the station was evaluated as part of the "Well Station Evaluation Study" (GSI Water Solutions, Inc., et al. 2018-2019) to assess options for increasing the performance and reliability of groundwater production capacity from the facility and to evaluate the potential for expanding groundwater development of the site for greater operational/production redundancy. Results from the well assessment investigation concluded that caisson wells are in good condition, but the pumping needs to be better balanced between the two wells.

The City selected the alternative to rehabilitate the well station by installing one 900 horsepower pump and one 500 horsepower pump in each well. The intakes also will be lowered for the four pumps. The Ray Street Well Station Rehabilitation is included in the Six-Year Capital Water Program.

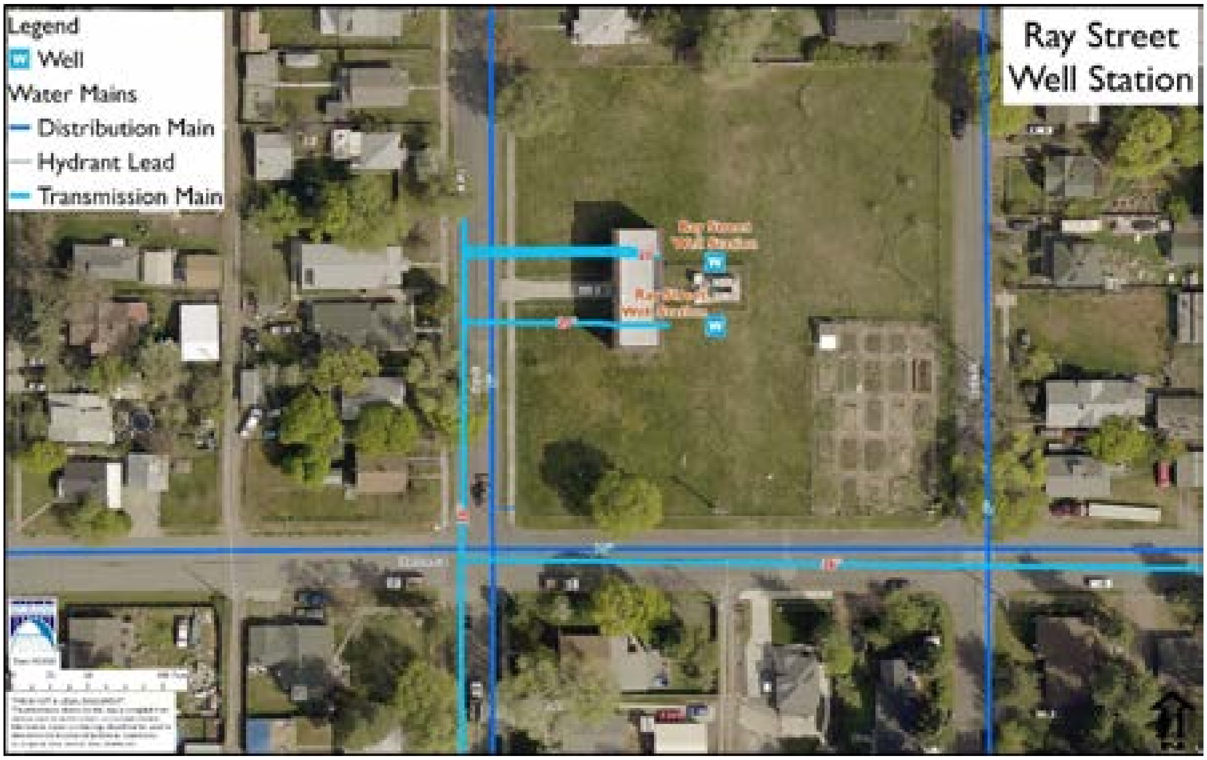


Figure 3.7 Ray Street Well Station Transmission Mains

Ray Street Well Station pumps into three 20-inch steel pipes constructed in 1950 and connects to a 36-inch pipe steel pipe in Ray Street constructed in 1936. The 36-inch pipe in Ray Street is scheduled to be replaced from the well station south to 17th Avenue in the Six-Year Capital Water Program. These pipes are shown in Figure 3.7 and connect to Hartson Avenue's Intermediate Pressure Zone transmission system. The full system of the transmission mains for Intermediate Pressure Zone discussed in Section 3.4.2 has adequate capacity in this area of the system, as verified by the model discussed in Section 3.4.3.

Hoffman Well Station (Department of Health Source #S05)

The Hoffman Well Station is located on Hoffman Avenue at the intersection of Crestline Street on the City's north side and supplies the North Hill Pressure Zone. The Hoffman Well Station houses two 16-foot diameter wells, 40 feet apart, in an east-west orientation. The City identifies the west well as Well Number 1 and the east well as Well Number 2. Hoffman Well Station would seriously impact the water system if it failed and is one of four well stations that serve the North Hill Pressure Zone.

The Risk and Resiliency Assessment did not identify any natural hazard risks for Hoffman Street Well Station. The 2015 condition assessment cycle identified several deficiencies; consequently, the Hoffman Well Station is currently undergoing renovation. The caisson for Well Number 2 is in good condition overall. Still, cracks and slight deformation in the caisson are being remedied by installing a 3-foot diameter solid steel casing liner inside the brick caisson and filling the annular space with grout seal material. A new 20-inch pump column will be installed in Well Number 2. In addition, new 5,460 gallons per minute pumps, 600 horsepower induction motors, controls, and switchgears will be installed for both Well Number 1 and Number 2. An 8-foot square permanent hatch will be installed on the roof for access.

The maximum instantaneous withdrawal rate of the well station is 10,920 gallons per minute, which will be the total nameplate capacity of the pumps. The total yield of the wells exceeds the pumping capacity, but the actual potential yield of the well station is unknown to the City. The water right allows 11,600 gallons per minute. Historically, there have been no significant variations in source capacity or water table levels at or near this site.

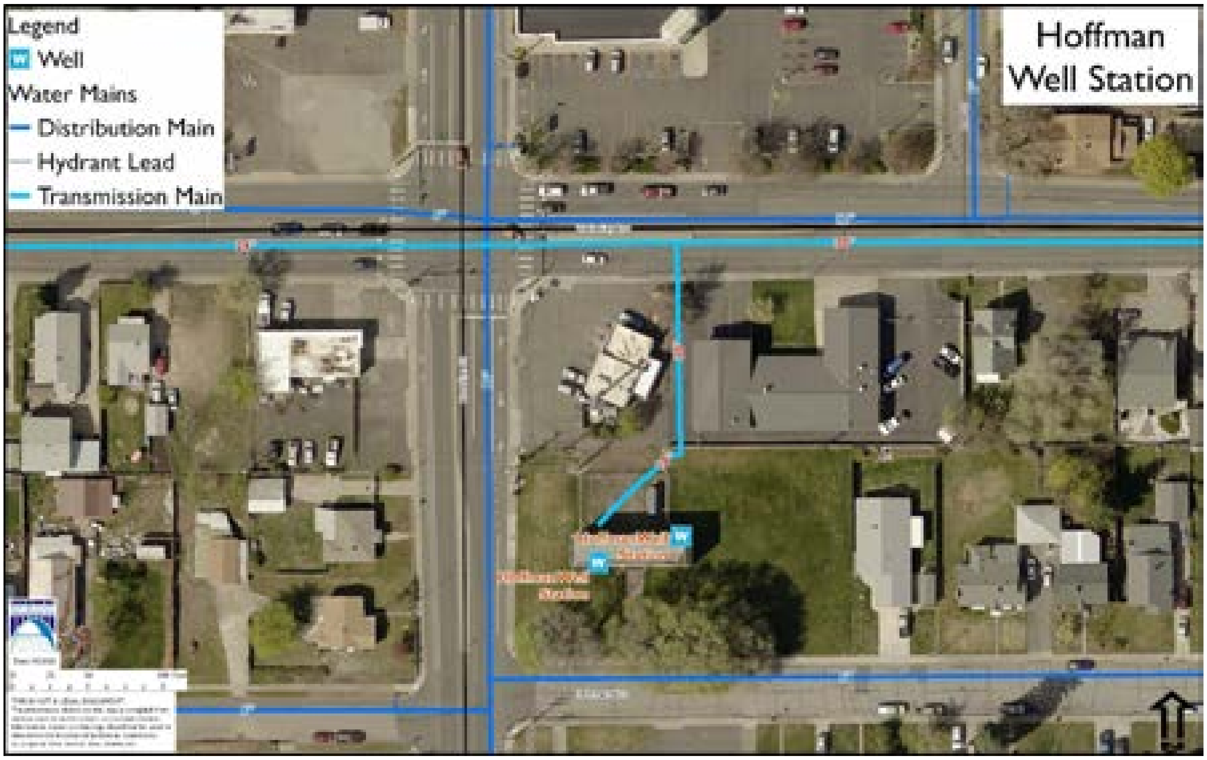


Figure 3.8 Hoffman Well Station Transmission Mains

Hoffman Well Station pumps into a 30-inch steel pipe in Wellesley Avenue, constructed in 1926, that is part of the North Hill Pressure Zone transmission system. The full system of the transmission mains for the North Hill Pressure Zone shown in Figure 3.8 has adequate capacity in this area of the system, as verified by the model discussed in Section 3.4.3.

Grace Avenue Well Station (Department of Health Source #S06)

The Grace Avenue Well Station is located directly east of the Nevada Well Station. It houses two identical 900 horsepower vertical line shaft turbine pumps that occupy a single 18-foot diameter well. Both pumps were installed in 2011 and supply water to the North Hill Pressure Zone. The Grace Well Station would seriously impact the water system if it failed, as it is one of four well stations that serve the North Hill Pressure Zone. The 2015 condition assessment concluded no major repair or rehabilitation actions are needed at this time. The Risk and Resiliency Assessment did not identify any natural hazard risks for Grace Street Well Station. The well pumps will be scheduled for replacement in 2031.

The maximum instantaneous withdrawal rate of the well station is 19,000 gallons per minute, which is the total nameplate capacity of the pumps. The total yield of the well exceeds the pumping capacity, but the actual potential yield of the well station is unknown to the City. The water right allows 31,000 gallons per minute. Historically, there have been no significant variations in source capacity or water table levels at or near this site. The well and pumps are in good condition, showing no signs of diminished performance. The well station piping also shows no signs of deterioration and is in good condition.

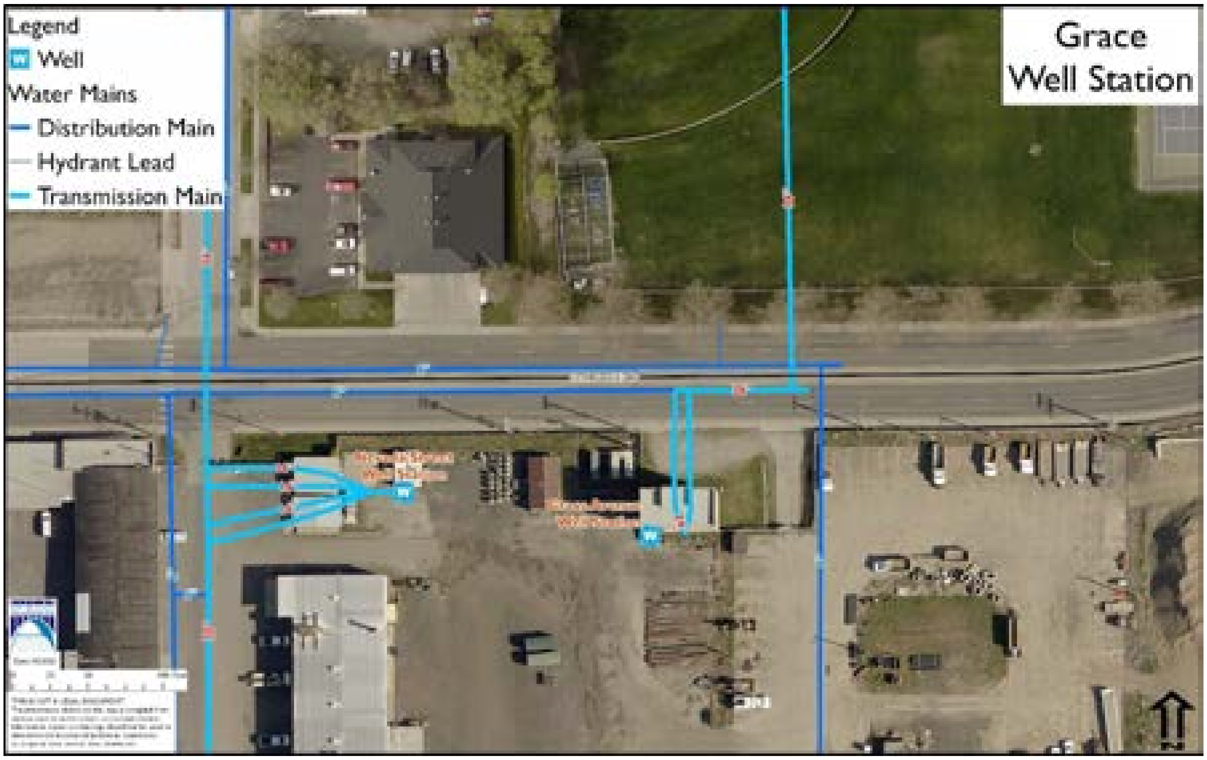


Figure 3.9 Grace Well Station Transmission Mains

The Grace Well Station pumps into two-24-inch diameter cast iron pipes constructed in 1949 to a 36-inch steel pipe in North Foothills Drive constructed in 1969 that is part of the North Hill Pressure Zone transmission system. The full network of transmission mains for the North Hill Pressure Zone shown in Figure 3.9 has adequate capacity in this area of the system, as verified by the model discussed in Section 3.4.3.

Central Avenue Well Station (Department of Health Source #S08)

The Central Avenue Well Station is the most northerly well station in the system and supplies the North Hill Pressure Zone. It is located on Central Avenue, two blocks west of Division Street. The well station has two 7-foot diameter wells. The wells are approximately 130 feet apart in a southwest-northeast orientation. The City identifies the southwest well as Well Number 1 and the northeast well as Well Number 2. The Central Avenue Well Station would have a serious impact on the water system if it failed and is one of four well stations that serve the North Hill Pressure Zone.

New pumps and motors were installed and buildings were constructed to enclose the two wells at the Central Well Station from 2015 to 2020. The 2015 condition assessment indicated the well caissons are in good condition, and no major rehabilitation or replacement upgrades are scheduled. The Risk and Resiliency Assessment did not identify any natural hazard risks for Central Street Well Station.
The maximum instantaneous withdrawal rate of the Central Well Station is 11,900 gallons per minute, which is the total nameplate capacity of the pumps. The water right allows 30,900 gallons per minute. The total yield of the wells exceeds the pumping capacity, but the actual potential yield is unknown

to the City. Historically, there have been no significant variations in source capacity or water table levels at or near this site.

Figure 3.10 Central Well Station Transmission Mains

Transmission mains for both wells is shown in Figure 3.10. Water from Central Well Station Number 1 is pumped through a 24-inch ductile iron pipe constructed in 2016 to a 30-inch steel pipe constructed in 1951 in Central Avenue. Central Well Station Number 2 pumps through two 14-inch cast iron pipes constructed in 1961 to a 24-inch steel pipe constructed in 1967 in Normandie Street.

Booster Stations Description and Conditions

Booster stations provide the means of conveying water from lower pressure zones to higher pressure zones. The City has 23 active booster stations and one inline booster station. Each booster station is inspected daily. The piping configuration in a typical booster station includes suction shutoff valves, pumps, check valves, and outlet shutoff valves. The Garden Park, Lincoln Heights, Kempe, Five Mile, and Thorpe Road Booster Stations also have surge protection devices installed.

As previously mentioned, City staff assesses booster stations approximately every five years as part of the Station Condition Assessment Program. The first assessment cycle was initiated in 2015 and was completed in 2019; data from this assessment cycle is provided for reference in Appendix 3.1. Booster stations were also considered part of the Risk and Resiliency Assessment, which identified landslide vulnerability as a potential risk for four booster stations, including Glennaire, Southview, Shawnee, and Woodridge.

The different elements of a booster station determine the station's useful life, including run times, ongoing maintenance activities, the quality of the water, and the power supply influence when repair or replacement is necessary. Based on industry standards, the City anticipates the useful life for electrical equipment and pumps is between 20 to 30 years; between 25 to 50 years for valves, and 50 to over 100 years for masonry structures.

Booster Stations Connected to Low Pressure Zone

A visual representation of these booster stations connected to the Low Pressure Zone is provided in Figure 3.11.

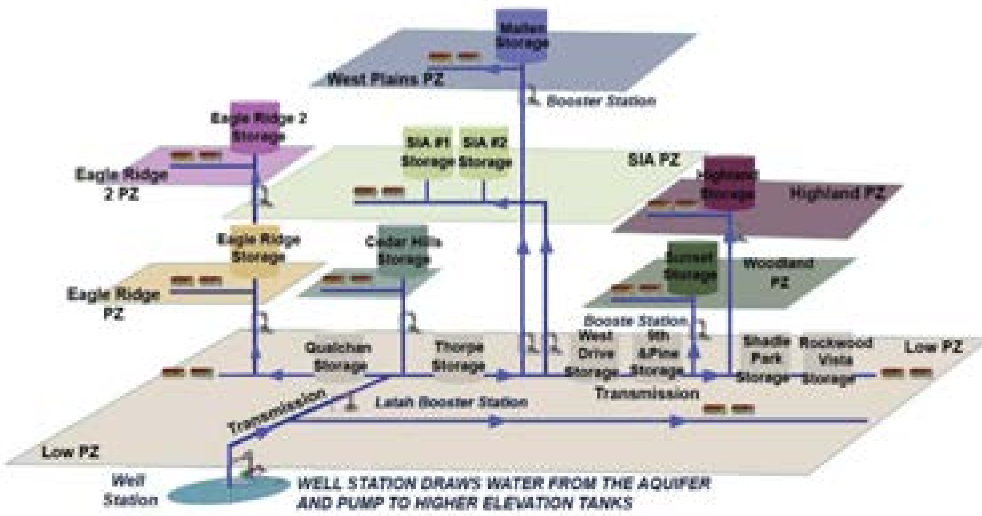


Figure 3.11 Pressures Zones Supplied by Low Pressure Zone Wells

The pump's horsepower, condition rating, and year constructed for each booster station is shown in Table 3.9. A description of each booster station follows. In the past, the 9th & E Booster Station served Woodland Heights Pressure Zone but was replaced by the West Drive Booster Station. At this time, the Ninth 9th & E Booster Station is out of service and is planned to be decomissioned in the next ten years.

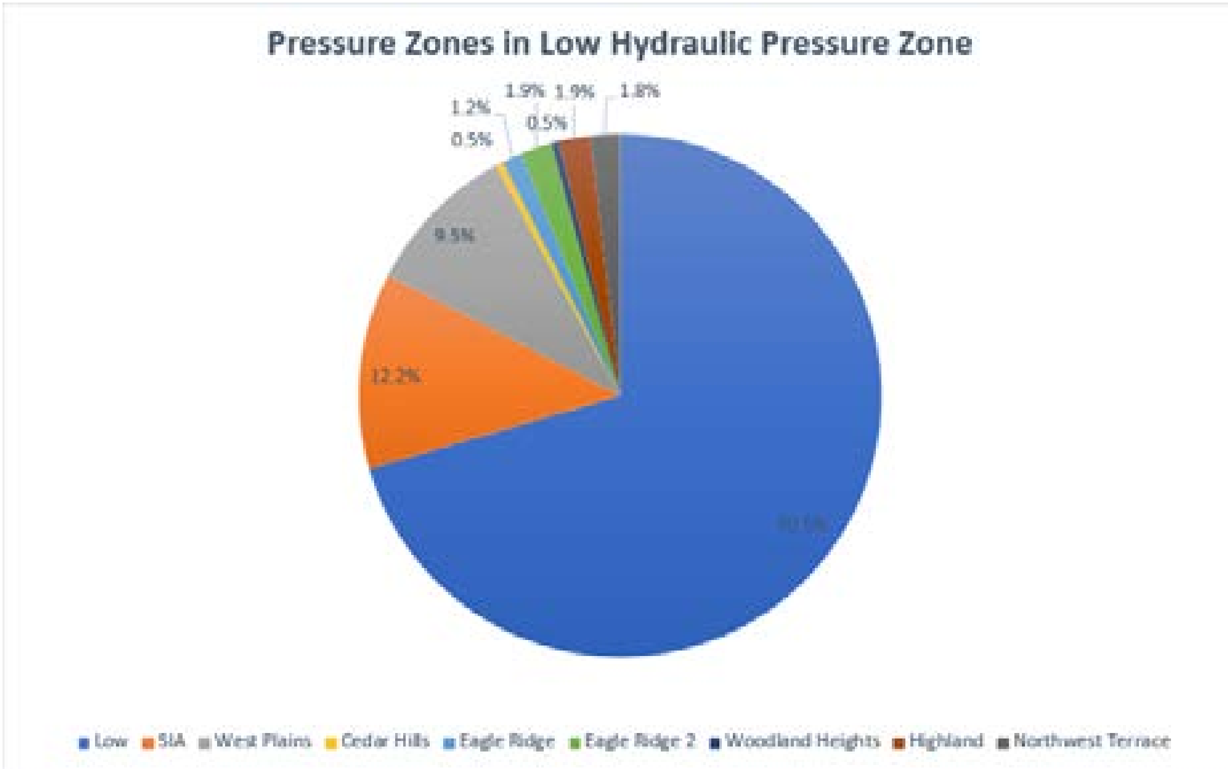


Figure 3.12 Relative Usage of Pressure Zone Served by Low Pressure Zone

The relative percentage of water usage for the pressure zones supplied by the Low Pressure Zone is shown in Figure 3.12. A narrative description of each booster station within the pressure zone, including any recent condition or criticality information, is also provided. The booster stations are generally assessed and maintained in good condition. The Milton Booster Station and Thorpe Booster Station need upgrades or rehabilitations over the next ten years.

Table 3.9 Booster Stations Connected to Low Pressure Zone Supply

Name	Pressure Zone Pumping to	Pump's hp	Year Constructed (Age in 2022)	Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
Cedar Road	Cedar Hills	25 25 25	1999 (22)	0.07	0.25	0.02
Eagle Ridge	Eagle Ridge	150 150 150 50	2006 (15)	0.13	0.42	0.06
Eagle Ridge 2	Eagle Ridge 2	250 250	2004 (17)	0.12	0.25	0.03
Milton	Highland	50 125 100	2008 (13)	0.13	0.17	0.02
West Drive	Woodland Heights and SIA	60 60 250 250 400	2006 (15)	0.06	0.08	0.01
Thorpe	SIA	300 300 200 200	1983 (38)	0.25	0.08	0.02
Spotted Road	West Plains	80 80 100 100	1983 (38)	0.05	0.75	0.04
Latah Inline	Low	300	1993 (28)	0.06	0.83	0.05

Cedar Hills Booster Station

The Cedar Road Booster Station supplies water to the Cedar Hills Pressure Zone from the Low Pressure Zone. The station contains three 25 horsepower end-suction closed couple horizontal pumps that were installed when the station was constructed in 1999. The station is in excellent condition, and no repairs or rehabilitation are recommended at this time. The estimated life expectancy of the concrete composite board structure is 25 years.

Eagle Ridge Booster Station

The Eagle Ridge Booster Station supplies water to the Eagle Ridge Pressure Zone from the Low Pressure Zone. The station was originally installed in 1995 and was upgraded in 2006. It contains three 150 horsepower single-stage horizontal split case pumps installed in 2006 and one 50 horsepower vertical turbine pump installed in 1995. The station is in good condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the masonry structure is 100 years.

Eagle Ridge 2 Booster Station

The Eagle Ridge 2 Booster Station supplies water to the Eagle Ridge 2 Pressure Zone from the Eagle Ridge Pressure Zone. Eagle Ridge 2 Booster Station contains two 250 horsepower single-stage horizontal split case pumps installed in 2004 when the station was constructed. The station is in good condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the composite structure is 100 years.

Milton Booster Station

Highland Pressure Zone is supplied water by the Milton Booster Station from the Low Pressure Zone. The station has three pumps: one 50 horsepower vertical turbine installed in the late 1990s, one 125 horsepower submersible pump installed in 1980, and one 100 horsepower vertical turbine installed in the late 1990s. The prefabricated building originally housed the Eagle Ridge Booster Station but was moved to Milton in 2008 when Eagle Ridge Booster Station was upgraded. The station is in generally good condition, with one improvement recommendation to repaint the floor. The estimated life expectancy of the prefabricated structure is at least 30 years. The station will be assessed and rehabilitated or replaced as part of the Highland Pressure Zone Capacity Improvements Project in the current Six-Year Water Program.

West Drive Booster Station

Constructed in 2006, the West Drive Booster Station is one of two booster stations that supply water to the Spokane International Airport (SIA) Pressure Zone and the Woodland Heights Pressure Zone. Pumps Number 1 and Number 2 serve the Woodland Heights Pressure Zone using two 60 horsepower horizontal pumps installed in 2006. Spokane International Airport Pressure Zone is served by three vertical turbine pumps installed in 2009: Pump Number 3 (250 horsepower), Pump Number 4 (250 horsepower), and Pump Number 5 (400 horsepower). The station is in good condition, with no repairs or rehabilitation recommended. The estimated life expectancy of the masonry structure is 100 years.

Thorpe Booster Station

The Thorpe Booster Station is one of two booster stations that supply water to the Spokane International Airport Pressure Zone from the Low Pressure Zone and was constructed in 1983. The station has four pumps: one 300 horsepower submersible pump installed in 1984, one 300 horsepower vertical line shaft pump installed in 1998, one 200 horsepower vertical turbine installed in 2006, and one 200 horsepower submersible pump installed in 1984. The building is in good condition, but the pumps and motor control centers have been recommended for replacement. This project will be added to the 2024 to 2029 Six-Year Water Program.

Spotted Road Booster Station

The West Plains Pressure Zone is supplied water by the Spotted Road Booster Station from the Spokane International Airport Pressure Zone and was constructed in 1983. The Spotted Road Booster Station has four pumps: two submersible pumps were installed in 1985, and two vertical line shaft pumps and motor control centers were installed in 2008. The station is in good condition, with no repairs or rehabilitation recommended at this time. The submersible pumps are planned for replacement in the next 20 years. The estimated life expectancy of the masonry structure is 100 years.

Latah Inline Booster Station

The Latah Booster Station is an inline booster station in the Low Pressure Zone. The booster station contains one 300 horsepower vertical turbine pump installed in 2003 when the station was constructed. The station is in excellent condition, with no repairs or rehabilitation needed. A backup power supply is recommended for this station. The estimated life expectancy of the masonry structure is 100 years.

Booster Stations Connected to Intermediate Pressure Zone

A visual representation of the booster stations supplied from the Intermediate Pressure Zone is shown in Figure 3.13. The two booster stations that pump to the Intermediate Pressure Zone and are supplied from the Low Pressure Zone are not shown in the figure. These boosters are used for summer flows or during maintenance on wells in the Intermediate Pressure Zone.

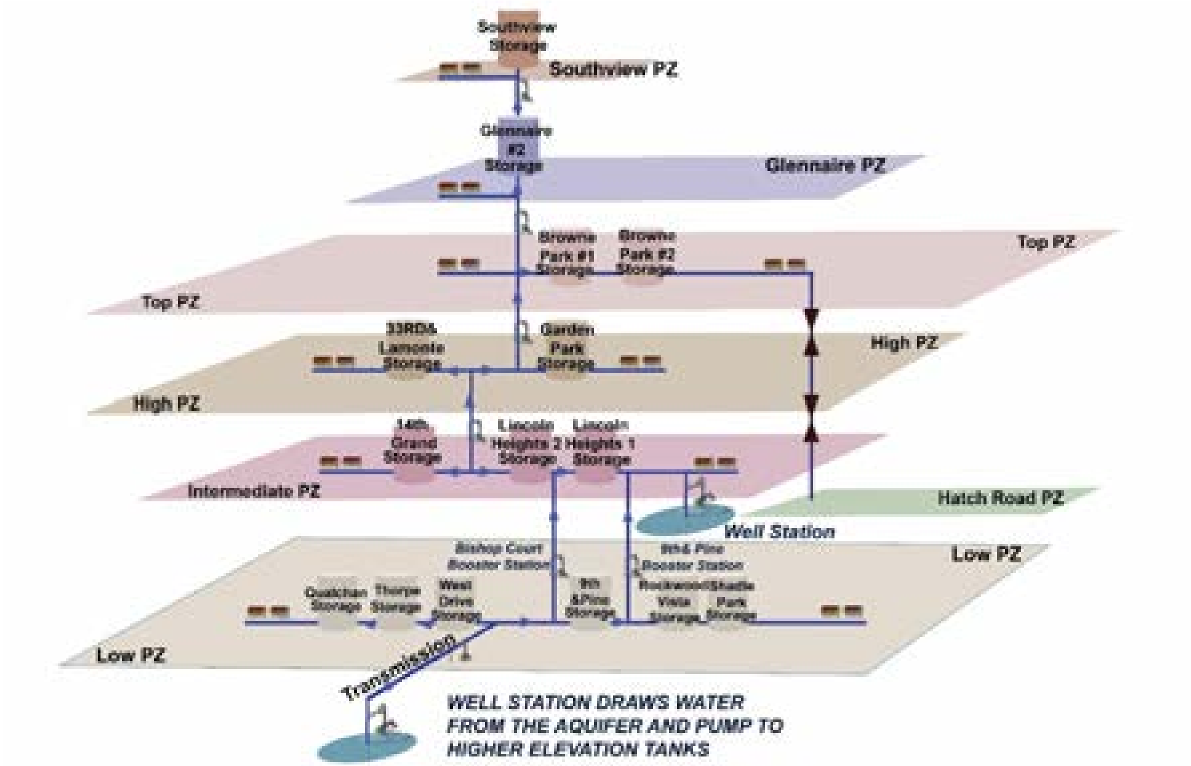


Figure 3.13 Pressures Zones Supplied by Intermediate Pressure Zone Wells

Table 3.10 summarizes key information for the booster stations supplied from the Intermediate Pressure Zone wells. The relative percentage of water usage for the pressure zones supplied by the Low Pressure Zone is shown in Figure 3.14. A narrative of each booster station describing the recent condition follows. The Ninth & Pine and the 14th & Grand Booster Stations are scheduled for rehabilitation in the next 20 years.

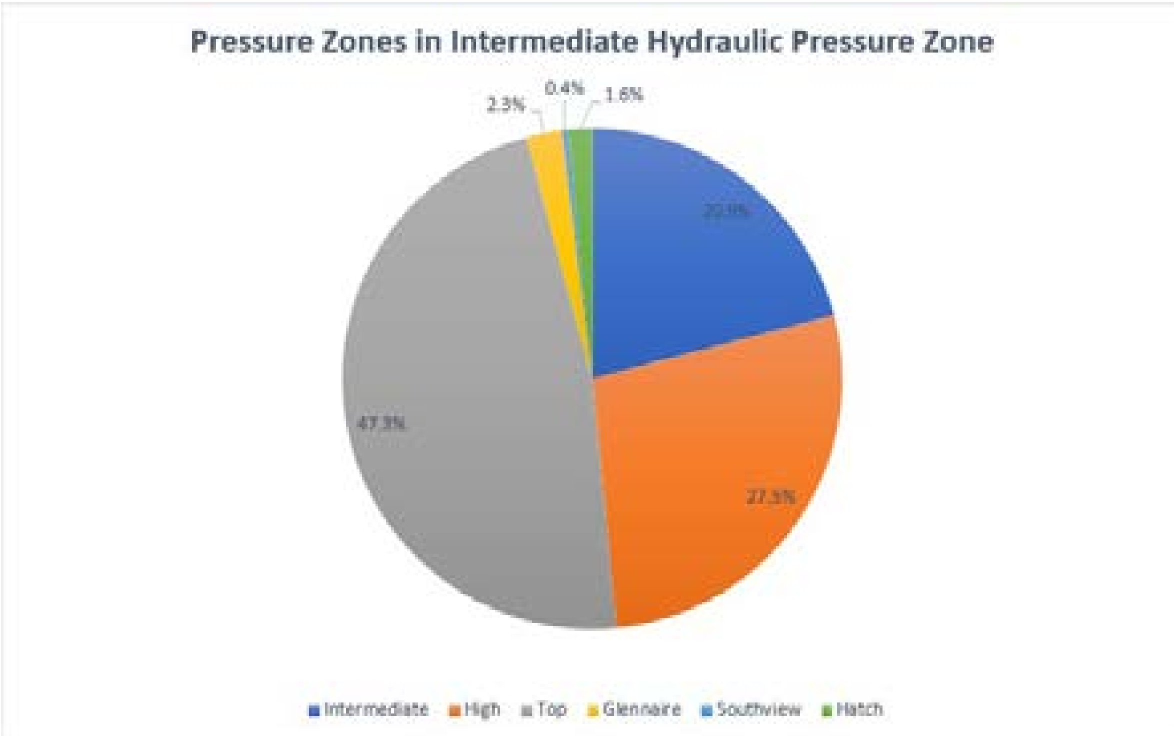


Figure 3.14 Relative Usage of Pressure Zone Served by Intermediate Pressure Zone

Table 3.10 Booster Stations Connected to Intermediate Supply

Name	Pressure Zone Pumping to	Pump's hp	Year Constructed (Age in 2022)	Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
9th & Pine	Intermediate	200	1976 (45)	0.10	0.75	0.08
Bishop Court	Intermediate	200 200	1968 (52)	0.11	0.50	0.05
Lincoln Heights	High	400 400 600 600 600	2014 (7)	0.02	0.33	0.01
14th & Grand	High	200 200	1962 (58)	0.36	0.33	0.12
Division & Manito	Top	40 40	2006 (15)	0.20	0.08	0.02
Garden Park	Top	150 150 100	2015 (6)	0.09	0.08	0.01
35th & Ray	Top	100 100 100	1980 (41)	0.18	0.08	0.02
Glennaire	Glennaire	50 50 50 60	1993 (28)	0.13	0.50	0.07
Southview	Southview	10 15 15 60	1995 (26)	0.14	0.25	0.04

Ninth & Pine Booster Station

The Ninth & Pine Booster Station supplies water to the Intermediate Pressure Zone by pumping water from the Low Pressure Zone to provide supplemental and redundant water supply in addition to the well stations serving the Intermediate Pressure Zone. This booster is typically used in the summer months when demand is high. The Ninth & Pine Booster Station was originally constructed in 1976 and currently has one 200 horsepower submersible pump in service. The second pump was removed from service in 2015 after the motor failed the Megger Test. The 2015 condition assessment concluded that the well station needed upgrades to the electrical system and pumps to meet current standards, as well as repair leaks in the roof. The entire station is planned to be reconstructed in 2023 at the same site. This project is included in the Six-Year Water Program.

Bishop Court Booster Station

The Bishop Court Booster Station is typically a summer season station to boost pressures on the western portion of the pressure zone. It also provides redundancy during construction projects for the Intermediate Pressure Zone by pumping water from the Low Pressure Zone. The station was constructed in 1968. The two centrifugal pumps were replaced in 1989. The station operates typically only during the summer and is in good condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the stucco structure is 100 years.

Lincoln Heights Booster Station

The Lincoln Heights Booster Station is one of three booster stations that serve the High Pressure Zone by pumping water from the Intermediate Pressure Zone. The Lincoln Heights Booster Station was reconstructed in 2014 and contains five vertical turbine pumps. The two 400 horsepower and three 600 horsepower pumps can be operated to meet variable seasonal demands. The station is in excellent condition, with no repairs or rehabilitation recommended at this time. The masonry structure was constructed in 2014 and has an estimated life of 100 years.

14th & Grand Booster Station

The 14th & Grand Booster Station was constructed in 1962 and is one of the two booster stations that serve the High Pressure Zone by pumping water from the Intermediate Pressure Zone. The station contains two 200 horsepower split case horizontal pumps rebuilt in 2005. The station is in good condition, with no repairs or rehabilitation recommended at this time. However, this station will need rehabilitation or replacement in the next 20 years to provide Lincoln Heights Booster Station redundancy. The estimated life expectancy of the masonry structure is 100 years.

Division & Manito Pump Station

The Division & Manito Booster Station is one of the three booster stations that serve the Top Pressure Zone by pumping water from the High Pressure Zone. The station was rebuilt in 2006 and contains two 40 horsepower split-case horizontal pumps. The station generally operates in summer and is very reliable. It is in good condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the masonry structure is 100 years.

Garden Park Pump Station

The Garden Park Pump Station is one of the three booster stations that serve the Top Pressure Zone by pumping water from the High Pressure Zone. The station was constructed in 2015 and contains two 150 horsepower split-case horizontal pumps and one 100 horsepower split-case horizontal pump. The station is in excellent condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the masonry structure is 100 years.

35th & Ray Pump Station

The 35th & Ray Pump Station is one of the three booster stations that serve the Top Pressure Zone by pumping water from the High Pressure Zone. The station was originally constructed in 1921 and was rebuilt in the 1980s. The station contains three 100 horsepower split case horizontal pumps: two were replaced in 2005, and the third pump was rebuilt in 1988. The station is in good condition, with no repairs or rehabilitation recommended at this time. The estimated life expectancy of the masonry structure is 100 years.

Glennaire Booster Station

Glennaire Pressure Zone is supplied water by the Glennaire Booster Station from the Top Pressure Zone. The Glennaire Booster Station, constructed in 1993, contains three 50 horsepower vertical turbine pumps installed in 2007 and one 60 horsepower submersible pump installed in 2008. The station is generally in good condition; roof repairs have been identified but not scheduled. This booster station was identified in the Risk and Resiliency Assessment as being at risk for landslides. The estimated life expectancy of the masonry structure is 100 years.

Southview Booster Station

Southview Booster Station supplies the Southview Pressure Zone from the Glennaire Pressure Zone. The station was constructed in 1995 and contains four horizontal close-coupled pumps: one 10 horsepower, two 15 horsepower, and one 60 horsepower. The 60 horsepower pump serves as a fire pump. The station is in excellent condition with no repairs or rehabilitation recommended at this time. This booster station was identified in the Risk and Resiliency Assessment as being at risk for landslides. The estimated life expectancy of the masonry structure is 100 years.

Booster Pump Stations Connected to North Hill Pressure Zone

A visual representation of the booster stations connected to the North Hill Pressure Zone is provided in Figure 3.15 below.

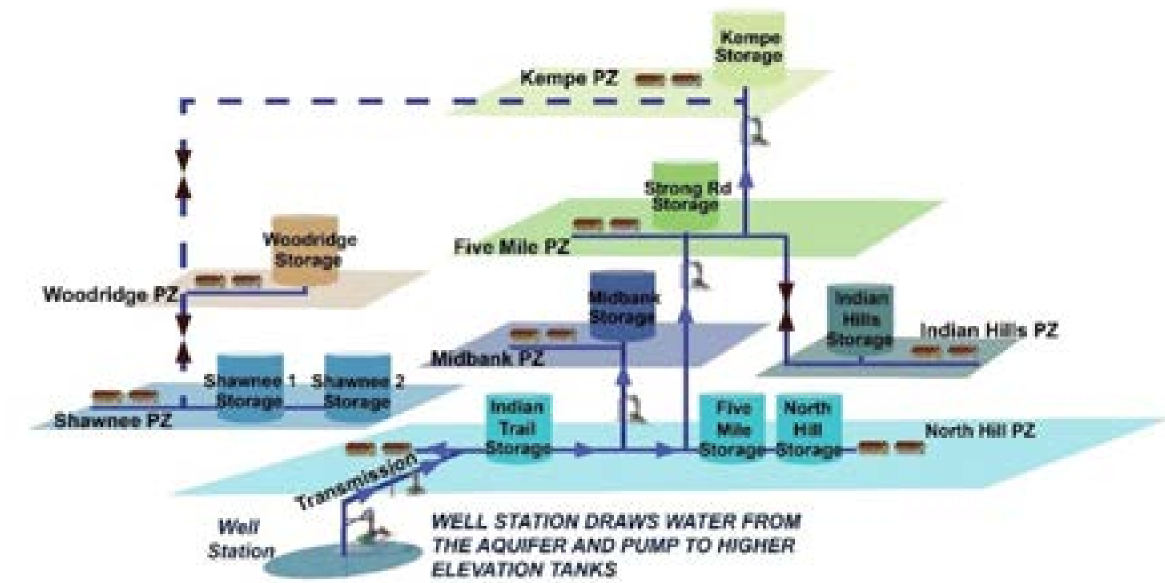


Figure 3.15 Pressures Zones Supplied by North Hill Pressure Zone Wells

Table 3.11 summarizes key information for the booster stations supplied from the Intermediate Pressure Zone wells. A narrative description of each booster station within the pressure zone, including any recent condition or criticality information, is also provided.

The relative percentage of water usage for the pressure zones supplied by the Low Pressure Zone is shown in Figure 3.16. A narrative description of each booster station within the pressure zone, including any recent condition or criticality information, is also provided. Belt Street Booster Station is planned to be rehabilitated in the next 20 years because of the age of the facility.

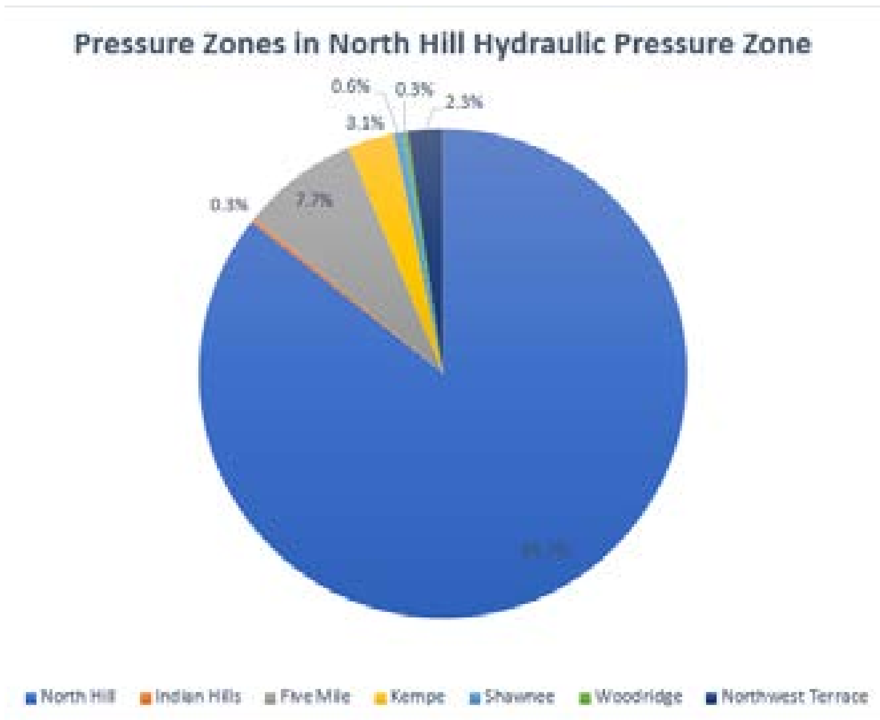


Figure 3.16 Relative Usage of Pressure Zone Served by North Hill Pressure Zone

Table 3.11 Booster Stations Connected to North Hill Supply

Name	Pressure Zone Pumping to	Pump's hp	Year Constructed (Age in 2022)	Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
Five Mile	Five Mile	250 250 350 350	2020 (1)	0.00	0.19	0.03
Kempe	Kempe	15 15 15 25 40	2010 (10)	0.07	0.07	0.02
Belt Street	Midbank	15 15 40 40	1960 (60)	0.13	0.16	0.03
Shawnee	Shawnee	30 30	2004 (16)	0.15	0.15	0.06
Woodridge	Woodridge	20 20	2005 (17)	0.15	0.18	0.03

Five Mile and Indian Hills Pressure Zones

The North Hill Pressure Zone provides supply to the Five Mile Booster Station, which provides service to the Five Mile Pressure Zone and the Indian Hills Pressure Zone through a Pressure Reducing Valve. A new booster station was constructed adjacent to the existing Five Mile Booster Station in 2020 and has three pumps: one 125 horsepower, two 250 horsepower, and two 350 horsepower pumps. The station is in excellent condition, with no repairs or rehabilitation recommended. The estimated life expectancy of the masonry structure is 100 years.

Kempe Booster Station

The Kempe Pressure Zone is supplied by the Kempe Booster Station from the Five Mile Pressure Zone. The booster station was constructed in 2010 and has three vertical turbine pumps: a 15 horsepower, a 25 horsepower, and a 40 horsepower pump. The station is in excellent condition, with no repairs or rehabilitation recommended. The estimated life expectancy of the masonry structure is 100 years.

Belt Street Booster Station

The Midbank Pressure Zone is supplied by the Belt Street Booster Station from the North Hill Pressure Zone. The booster station was constructed in 1960 and has four horizontal (close-coupled end suction) pumps: two 15 horsepower pumps installed in 1960 and two 40 horsepower pumps installed in 2006. The station is in good condition, with no repairs or rehabilitation recommended. The estimated life expectancy of the masonry structure is 100 years.

Shawnee Booster Station

The Shawnee Pressure Zone is supplied by the Shawnee Booster Station from the North Hill Pressure Zone. The Shawnee Booster Station contains two 30 horsepower single-stage horizontal close-coupled pumps installed in 2004 when the station was constructed. The station is in good condition, and no repairs or rehabilitation is recommended; however, the station is located under the street right-of-way and is difficult to access for maintenance, with no ability to modify or enlarge the station. This booster station was identified in the Risk and Resiliency Assessment as being at risk for landslides. The estimated life expectancy of the masonry structure is 100 years.

Woodridge Booster Station

The Woodridge Pressure Zone is supplied by the Woodridge Booster Station from the Shawnee Pressure Zone. The Woodridge Booster Station contains two 20 horsepower horizontal close-coupled pumps installed in 2003 when the station was constructed. The station is in good condition, with no repairs or rehabilitation recommended. This booster station was identified in the Risk and Resiliency Assessment as being at risk for landslides. The estimated life expectancy of the masonry structure is 100 years.

Storage Description and Conditions

Each pressure zone, except for the Northwest Terrace and Hatch Road Pressure Zones, has at least one storage reservoir. In geographically large pressure zones, more than one reservoir has been constructed to shorten distribution time, provide redundancy, and adequately serve the pressure zone. The City operates 33 reservoirs: six are concrete, two are riveted steel, and the remaining 25 are welded steel. Each reservoir is visually inspected weekly from the outside to assess for any reportable damage and/or deterioration, verify valve operation, and confirm instrumentation is functioning properly. In addition, internal inspections and condition assessments are conducted approximately every five years by operations staff. A summary of the City's storage by pressure zone and when it was added to the system is provided in Figure 3.17.

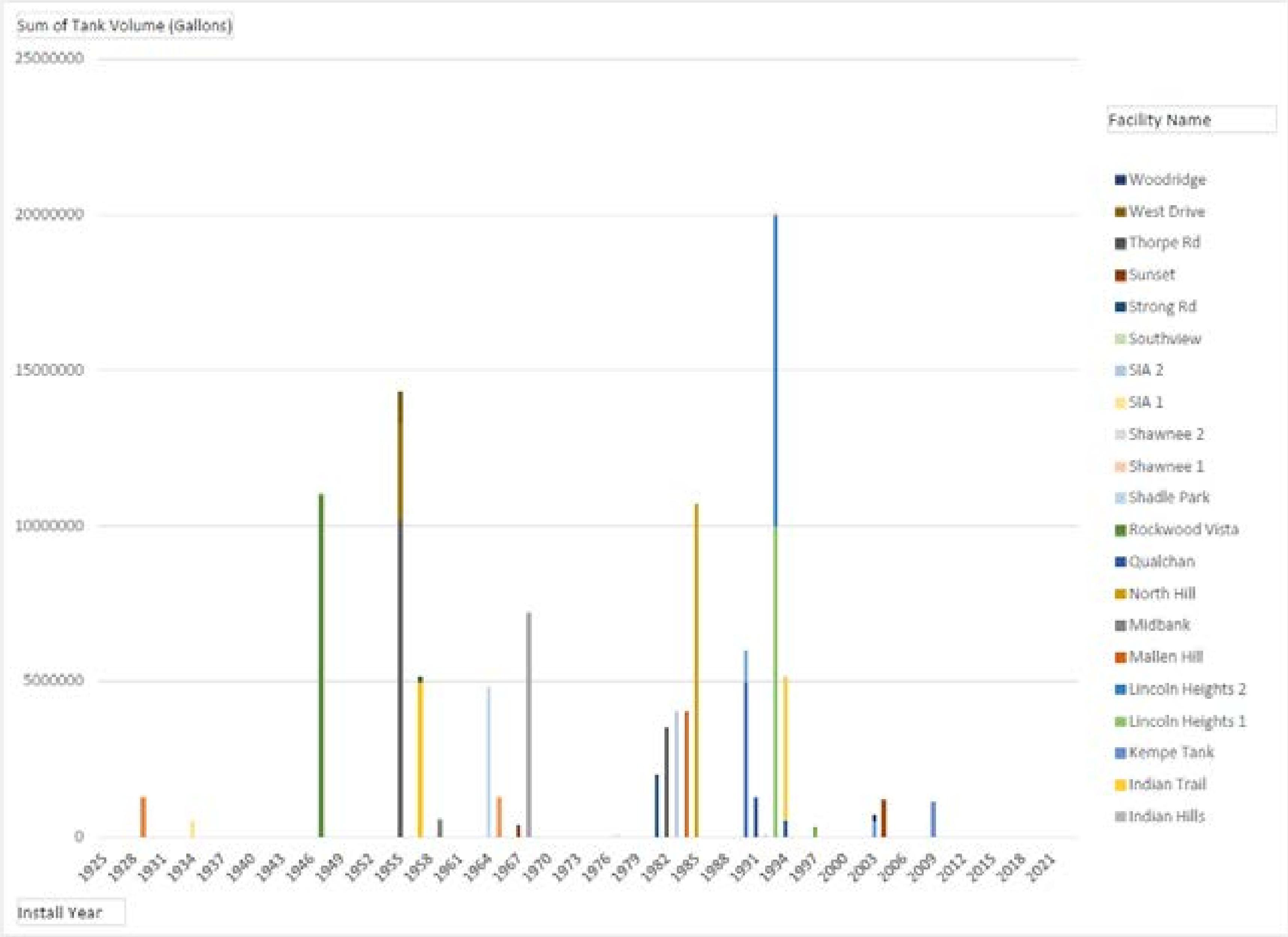


Figure 3.17 Storage by Pressure Zone

Reservoirs are organized by the connected pressure zones. For example, all the pressure zones supplied by Low Pressure Zone are grouped together. Each of the reservoirs are described at the end of this section in Tables 3.12, 3.13, and 3.14 for each of the three connected supply pressure zones. The tables contain a description and current conditions. The description of the pressure zone, location, year constructed, age, type and material, usable capacity, and the last year of inspection, cleaning, and/or coating is from the City's asset management inventory. The condition of each reservoir is also contained in the tables.

Current condition and criticality assessment are based on the inspection. The City purchased an underwater Remotely Operated Vehicle (ROV) for internal reservoir assessment, and staff is trained for internal and external inspections. Reservoirs are generally assessed within a five-year period. A criticality assessment matrix is based on the results of the assessments.

Life expectancy is dependent on material, chemistry of the water, and ongoing maintenance. The life expectancy has been based on industry standards and inspection information for each tank. The majority of the City's reservoirs are constructed from steel. If the internal and external coating on the steel is properly maintained, the material will be protected from corrosion and can have a service life of over 100 years. The City has two riveted steel reservoirs: Spokane International Airport #1, constructed in 1935, and 33rd & Lamonte, constructed in 1930. Six reservoirs in service are concrete: four with liners, one with sealer, and one underground. Concrete reservoirs maintained to prevent leaking from joints or damage to the concrete can have a service life of more than 50 years. The replacement year was calculated by adding the life expectancy to the year constructed.

Turnover of water (or residence time) is the time it takes to cycle water through the storage reservoir. The system was analyzed to determine the rate of turnover contained in Appendix 3.2. The longest cycle times generated are in the fall to winter when summer Supervisory Control and Data Acquisition (SCADA) operational controls are still active, but irrigation and other outdoor high-water use declines for the season. The City addresses stagnation issues with chlorine residuals in the system.

Risks from natural hazards were evaluated as part of the Risk and Resiliency Assessment for the water system (see Appendix 3.3). All reservoirs are at risk for extended ice storms or cold, which can cause damage by the water freezing. A few reservoir locations put them at risk for landslides and/or wildfires.

Most reservoirs connected to the Low Pressure Zone are welded steel or concrete. They are in good condition with a life expectancy beyond the planning period of this Water System Plan. Two reservoirs do not have a condition score: Rockwood Vista and Eagle Ridge 2. Rockwood Vista is an underground reservoir excavated from rock to fit the parcel dimensions and is the largest storage reservoir in the system. This reservoir does not have a condition score because there is no standard to compare it to. The reservoir is inspected monthly to ensure it is in good condition and can continue to operate. Eagle Ridge 2 Reservoir is less than 20 years old. It has yet to be evaluated.

Two reservoirs are identified as possibly needing capital upgrades in the next 20 years. Qualchan Reservoir is a concrete tank with a liner constructed in 1992. The liner has a useful life expectancy of approximately 50 years and may need to be replaced. Regular inspections and evaluations will be used to determine the actual service life of the liner. If it does need to be replaced in the next 20 years, the capital cost will be funded by the annual reservoir recoating capital project. The other reservoir that may need to be replaced in the next 20 years is Spokane International Airport #1. This elevated riveted steel reservoir was constructed in 1935 and is currently functioning well. However, inspections and evaluations may determine that it needs to be taken out of service.

Most reservoirs connected to the Intermediate Pressure Zone are welded steel or concrete. They are in good condition with a life expectancy beyond the planning period of this Water System Plan. Two reservoirs do not have a condition score: 14th & Grand and Lincoln Heights #1.

Two reservoirs are identified as possibly needing capital upgrades in the next 20 years. Glennaire 2 Reservoir is a concrete tank with a sealer liner constructed in 1991. The liner has a useful life expectancy of approximately 50 years and may need to be replaced. Regular inspections and evaluations will be used to determine the actual service life of the liner. If it does need to be replaced in the next 20 years, the capital cost will be funded by the annual reservoir recoating capital project. The other reservoir that may need to be replaced in the next 20 years is 33rd & Lamonte. This elevated steel riveted reservoir was constructed in 1930 and is currently functioning well. However, inspections and evaluations may determine that it needs to be taken out of service in the next 20 years.

All of the reservoirs connected to the North Hill Pressure Zone are welded steel or concrete and are in good condition with a life expectancy beyond the planning period of this Water System Plan. Two reservoirs do not have a condition score, namely Strong Road and Woodridge.

Table 3.12 Reservoirs Connected with the Low-Pressure Zone

Pressure Zone Served	Name (year constructed) age in 2021	Type and material	Usable capacity, gallons	Last inspection, cleaning, coating	Life Expectancy/ year replacement	Turnover of Water, days	Risk from Natural Hazards	Current Condition/ Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
Low	Shadle (1965) 56	At Grade Welded Steel	2,099,000	2010 coating; 2014 inspection; 2015 leak repair	100/ 2065	2.05	Extended Cold/Ice	Good/ 0.31	0.13	0.04
Low	Rockwood Vista (1948) 73	Underground Concrete	11,675,000	1993 repair	150/ 2098	2.05	Extended Cold/Ice	Good/ ---	0.63	--
Low	9th & Pine (1964) 57	At Grade Welded Steel	7,089,000	2017 inspection 2015 coating	100/ 2064	2.05	Extended Cold/Ice	Good/ 0.33	0.56	0.19
Low	West Drive (1956) 65	At Grade Welded Steel	940,000	2017 inspection 1989 coating	100/ 2056	2.05	Extended Cold/Ice	Good/ 0.33	0.13	0.04
Low	Thorpe (1983) 38	At Grade Welded Steel	1,852,000	2015 inspection 1985 coating	100/ 2083	2.05	Extended Cold/Ice; Wild-fire	Good/ 0.25	0.31	0.08
Low	Qualchan (1992) 29	Concrete with liner	885,000	2017 inspection 1992 lining	50/ 2042	2.05	Extended Cold/Ice; Landslide	Good/ 0.33	0.13	0.04
Highland	Highland (1966) 55	Welded Steel Standpipe	534,000	2015 inspection 1993 coating	100/ 2066	2.69	Extended Cold/Ice	Good/ 0.31	0.06	0.02
Woodland Heights	Sunset (1968) 53	At Grade Welded Steel	347,000	2015 Inspection 2019/2020 coating	100/ 2053	3.08	Extended Cold/Ice	Good/ 0.11	0.25	0.03
Cedar Hills	Cedar Hills (1999) 22	At Grade Welded Steel	324,000	2019 inspection 1999 coating	100/ 2099	3.31	Extended Cold/Ice; Landslide	Good/ 0.16	0.06	0.01
Eagle Ridge	Eagle Ridge (1995) 26	At Grade Welded Steel	525,000	2019 inspection 1995 coating	100/ 2095	2.28	Extended Cold/Ice	Good/ 0.24	0.31	0.08
Eagle Ridge 2	Eagle Ridge 2 (2005) 16	At Grade Welded Steel	830,000	2005 coating	100/ 2105	2.93	Extended Cold/Ice	Good/ ---	0.31	--
SIA	SIA #1 (1935) 86	Elevated Riveted Steel	507,000	2014 inspection 1995 coating	100/ 2035	1.85	Extended Cold/Ice	Fair/ 0.44	0.13	0.05
SIA	SIA #2 (1984) 37	Welded Steel Standpipe	1,832,000	2017 inspection 1988 coating	100/ 2084	1.85	Extended Cold/Ice	Good/ 0.33	0.31	0.10
West Plains	Mallen Hill (1985) 36	At Grade Welded Steel	3,910,000	2017 inspection 1985 coating	100/ 2084	2.02	Extended Cold/Ice; Wildfire & Landslide	Good/ 0.33	0.31	0.10

Table 3.13 Reservoirs Connected with the Intermediate Pressure Zone

Pressure Zone Served	Location (year constructed) age in 2021	Type and Material	Usable Capacity, gallons	Last inspection, cleaning, coating	Life Expectancy/ year replacement	Turnover of Water, days	Risk from Natural Hazards	Current Condition/ Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
Intermediate	14th & Grand (2005) 16	Steel Standpipe	238,000	2005 coating	100/2105	7.84	Extended Cold/Ice	--	0.50	--
Intermediate	Lincoln Heights # 1 (1995) 26	Concrete w/liner	10,152,000	2015 new liner	50/ 2065	7.84	Extended Cold/Ice	--	0.50	--
Intermediate	Lincoln Heights # 2 (1995) 26	Concrete w/liner	10,152,000	2017 inspected 2014 new liner	50/ 2067	7.84	Extended Cold/Ice	Good/ 0.33	0.50	0.17
High	Garden Park (1956) 65	At Grade Welded Steel	2,517,000	2017 inspection 1969 coating	100/ 2056	1.24	Extended Cold/Ice	Good/ 0.33	0.44	0.15
High	33rd & Lamonte (1930) 91	Elevated Riveted Steel Tank	1,240,000	2014 inspection 1989 coating	100/ 2030	1.24	Extended Cold/Ice	Good/ 0.25	0.31	0.08
Top	Browne Mountain Park 1 (1958) 63	At Grade Welded Steel	5,213,000	2017 inspection 1992 coating	100/ 2058	1.73	Extended Cold/Ice; Landslide	Good/ 0.33	0.31	0.10
Top	Browne Mountain Park 2 (1990) 31	At Grade Welded Steel	5,187,000	2014 inspection 1990 coating	100/ 2090	1.73	Extended Cold/Ice; Landslide	Good/ 0.25	0.31	0.08
Glennaire	Glennaire 2 (1991) 30	Concrete with Sealer	990,000	2017 inspection 1991 liner	50/ 2041	3.32	Extended Cold/Ice; Landslide; Wildfire	Good/ 0.33	0.25	0.08
Southview	Southview (1996) 25	Welded Steel Standpipe	48,000	2019 inspection 1996 coating	100/ 2096	1.70	Extended Cold/Ice; Landslide; Wildfire	Good/ 0.33	0.13	0.03

Table 3.14 Reservoirs Connected with the North Hill Pressure Zone

Pressure Zone Served	Location (year constructed) age in 2021	Type and Material	Usable Capacity, gallons	Last inspection, cleaning, coating	Life Expectancy/ year replacement	Turnover of Water, days	Risk from Natural Hazards	Current Condition / Condition Rating (LOF)	Criticality Rating (COF)	Weighted Risk Score (LOF x COF)
North Hill	Indian Trail (1996) 25	Concrete w/ Liner	3,579,000	2014 inspection 1999 liner repair	50/ 2046	1.89	Extended Cold/Ice; Landslide	Good/ 0.38	0.50	0.19
North Hill	North Hill (1986) 35	At Grade Welded Steel	7,543,000	2015 inspection 1986 coating	100/ 2086	1.89	Extended Cold/Ice; Landslide	Good/ 0.31	0.50	0.16
North Hill	Five Mile (1956) 65	Steel Reservoir	10,307,000	2015 inspection 1989 coating	100/ 2056	1.89	Extended Cold/Ice; Landslide	Good/ 0.35	0.50	0.18
Five Mile	Strong (1982) 39	Steel Standpipe	1,300,000	2017 inspection 1982 coating	100/ 2082	1.84	Extended Cold/Ice		0.25	0.13
Five Mile	Indian Hills (1995) 26	Steel Standpipe	28,000	2019 inspection 1996 coating	100/ 2095	1.84	Extended Cold/Ice; Landslide	Good/ 0.33	0.06	0.03
Midbank	Midbank (1960) 61	Steel Standpipe	473,000	2017 inspection 1992 coating	100/ 2060	1.98	Extended Cold/Ice; Landslide	Good/ 0.33	0.31	0.10
Shawnee	Shawnee 1 (1978) 43	At Grade Welded Steel	19,000	2017 inspection 1978 coating	100/ 2078	0.79	Extended Cold/Ice; Landslide	Good/ 0.33	0.13	0.04
Shawnee	Shawnee 2 (1993) 28	At Grade Welded Steel	55,000	2019 inspection 1994 coating	100/ 2093	0.79	Extended Cold/Ice; Landslide	Good/ 0.32	0.13	0.04
Kempe	Kempe (2010) 11	At Grade Welded Steel	890,000	2012 inspection 2019 repair 2010 coating	100/ 2110	2.42	Extended Cold/Ice; Landslide	Good/ 0.25	0.25	0.06
Woodridge	Woodridge (2003) 18	At Grade Welded Steel	223,000	2015 inspected 2015 leak repair 2003 coating	100/ 2103	4.72	Extended Cold/Ice		0.13	0.01

Conveyance System Description and Condition

The City's water conveyance system is comprised of a network of transmission mains (i.e., conveyance pipes greater than 12 inches in diameter) and distribution mains (i.e., conveyance pipes from four to 12 inches in diameter) that deliver potable water from the City's well stations to storage facilities and water customers within the service area. The system is comprised primarily of cast iron pipes, generally installed before 1960, and ductile iron pipes, installed after 1960. Both cast iron and ductile iron pipes which are undisturbed are assumed to have a life expectancy of 150 years or more, depending on joint type. All new conveyance lines are ductile iron or PVC. A system-wide overview of the age of the conveyance system transmission and distribution mains versus the size, material, and pressure zones served by those pipes is provided in Figures 3.18 – 3.21.

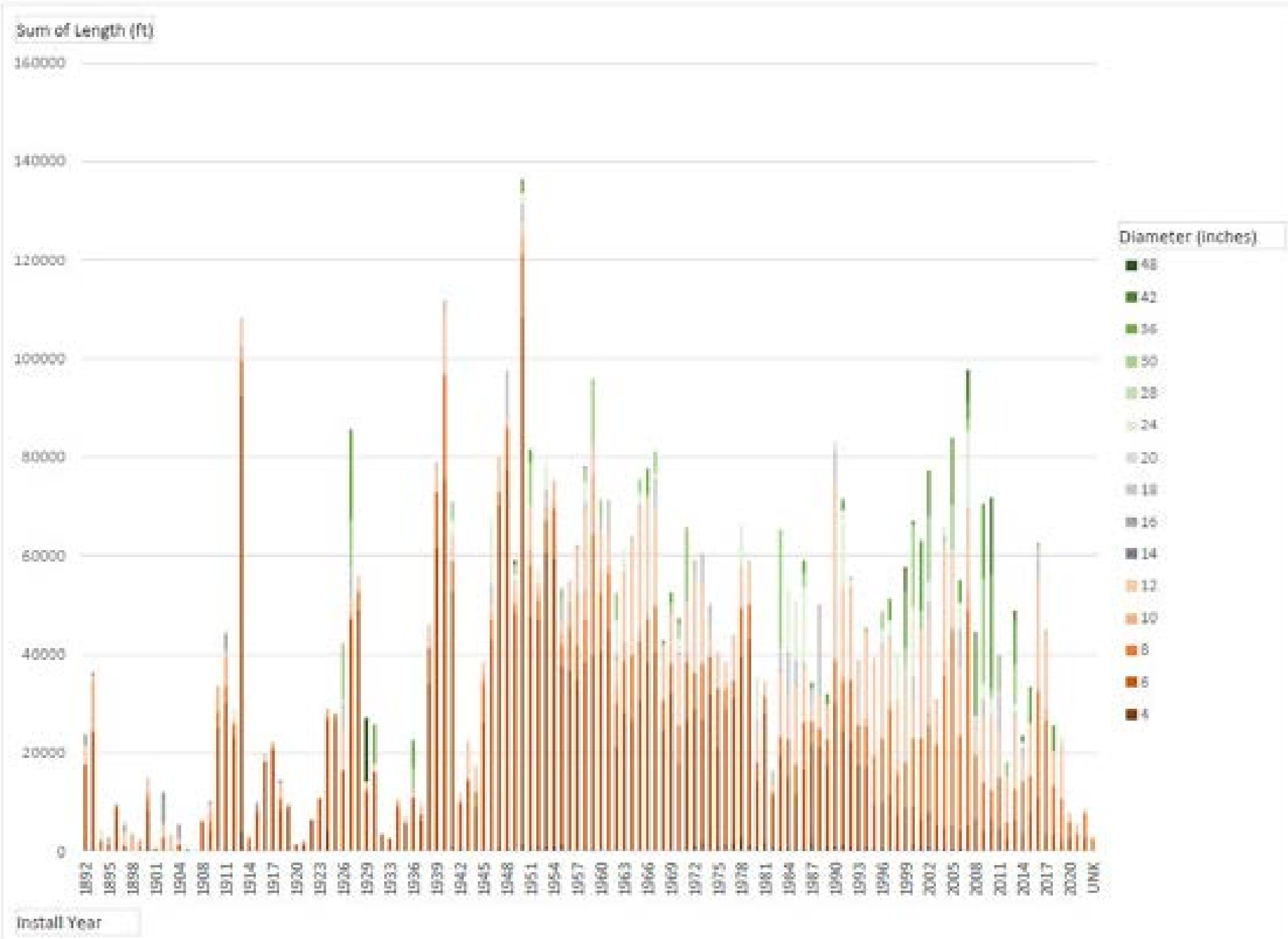


Figure 3.18 Pipe Age Compared to the Size

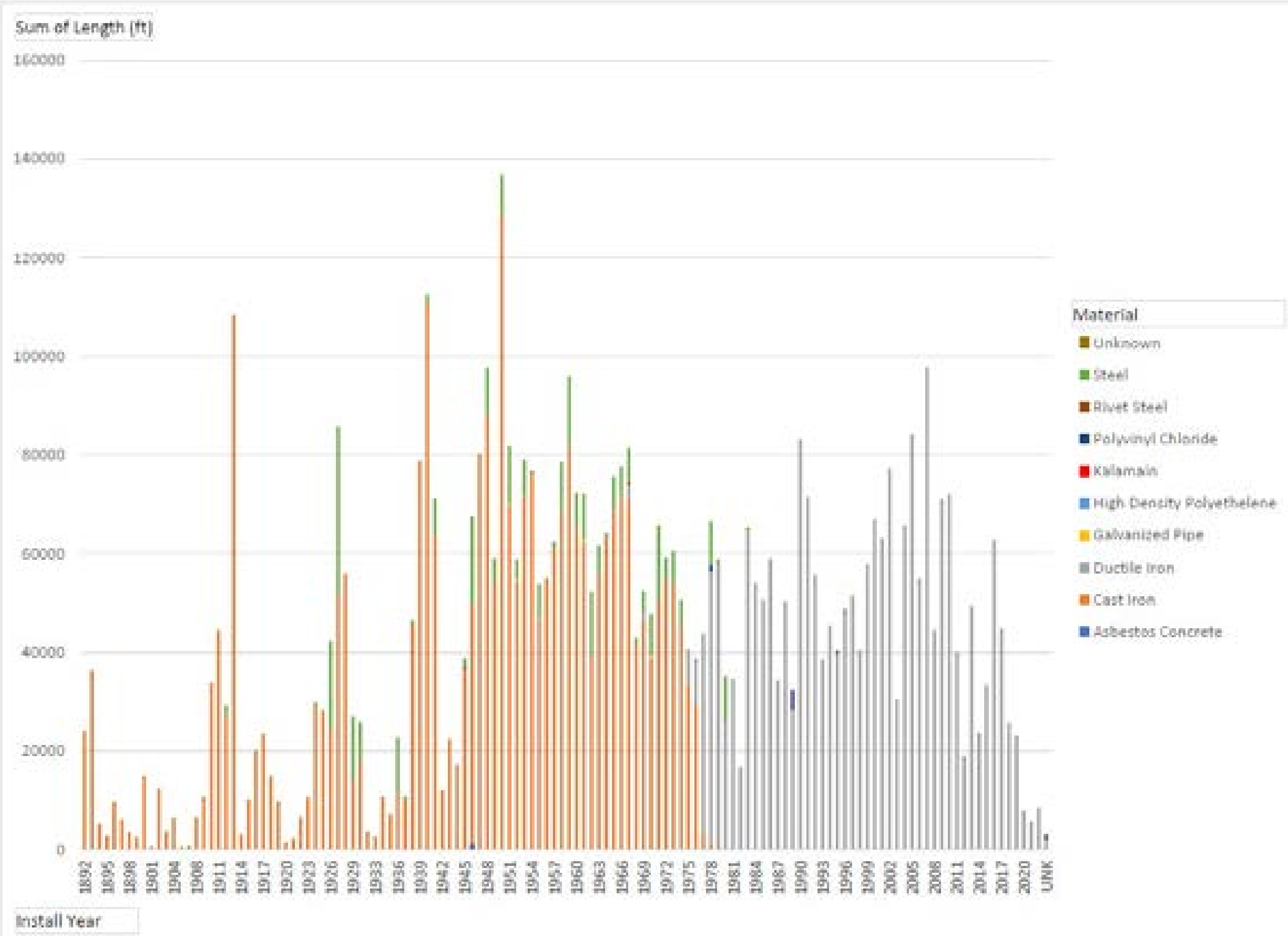


Figure 3.19 Pipe Age Compared to the Material

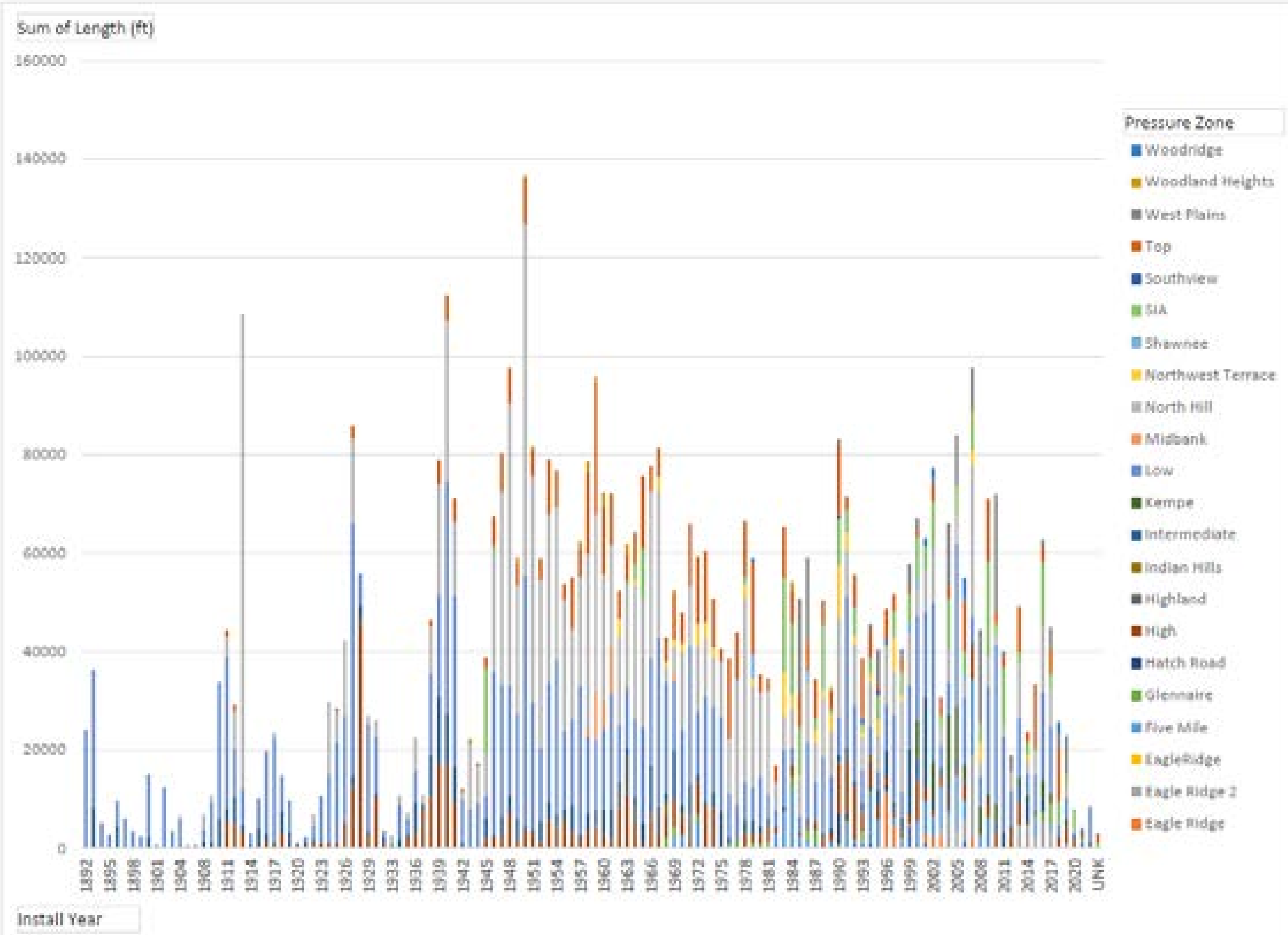


Figure 3.20 Pipe Age Compared to the Pressure Zone Served

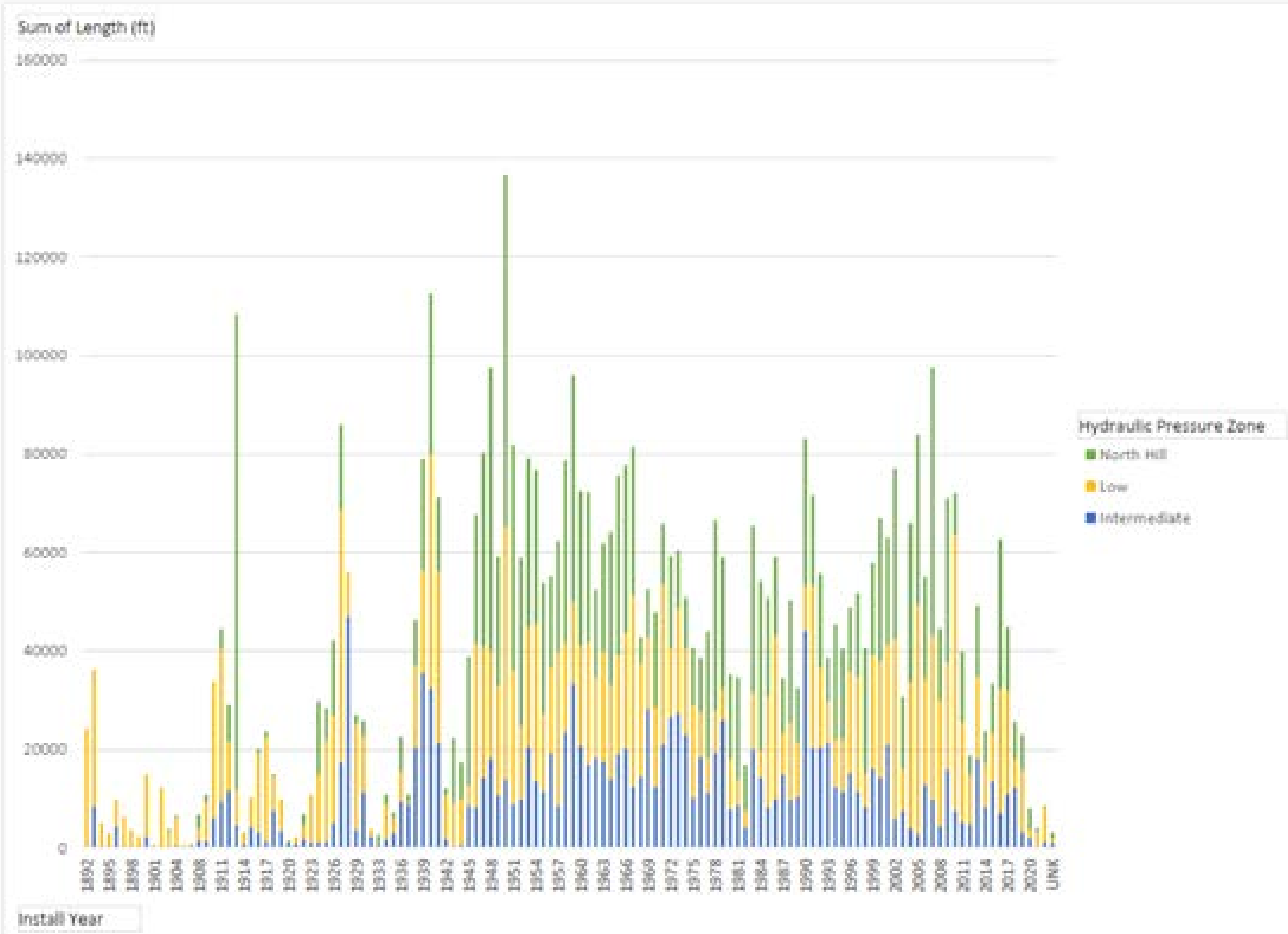


Figure 3.21 Pipe Age Compared to the Well Supplying Pressure Zones

The City's Water Department staff believe the conveyance system is in good condition due to the manageable number of pipe breaks experienced per year (approximately 74 breaks per year on average over the past decade). Based on field experience, the Water Department has determined the water chemistry from the source water (i.e., Spokane Valley/Rathdrum Prairie Aquifer) is not corrosive to the conveyance pipes; similarly, corrosive soil conditions contribute to deteriorating pipe conditions only in a few localized areas. Based on this experience, it is anticipated the City water system will deteriorate primarily due to age and not corrosion. A map showing the locations of water main leaks, breaks, and failures over the past ten years is provided in Figure 3.22. The City is in the process of defining a performance metric that aligns with the utility's expected level of service to confirm this understanding.

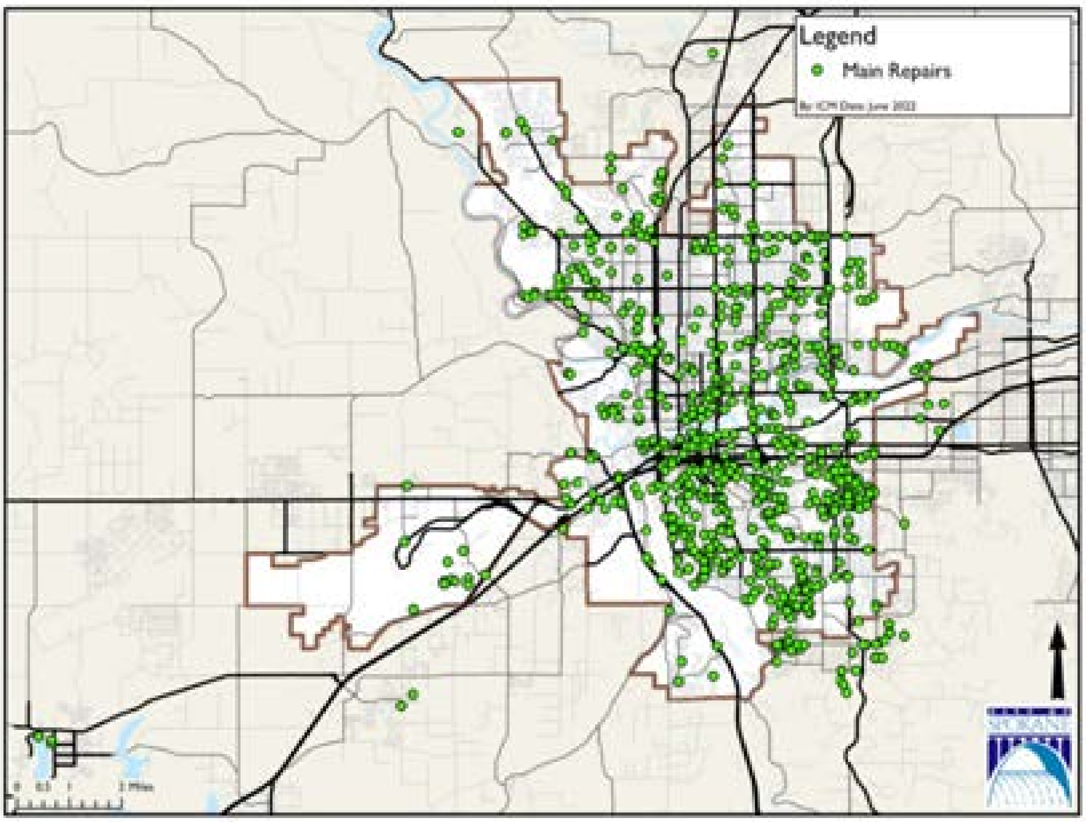


Figure 3.22 Water Main Repairs

System Pressure

Sizing guidelines presented by the Washington State Department of Health Water System Design Manual suggest that static pressures in the range of 30 pounds per square inch to 80 pounds per square inch are to be provided at the customer's point of service and are considered normal. The meters in the City's water system have been aligned to be served by the pressures zones to allow pressures to be restricted to acceptable limits throughout the system. The pressures observed in the City's water system from Supervisory Control and Data Acquisition and pressure complaints range from over 160 pounds per square inch to just above 30 pounds per square inch based on data from 2021. As a level of service, the City requires a minimum static pressure of 45 pounds per square inch. For those areas where pressures are over 80 pounds per square inch, the City requires pressure-reducing valves. A map showing the location of low-pressure complaints over the past ten years is provided in Figure 3.23.

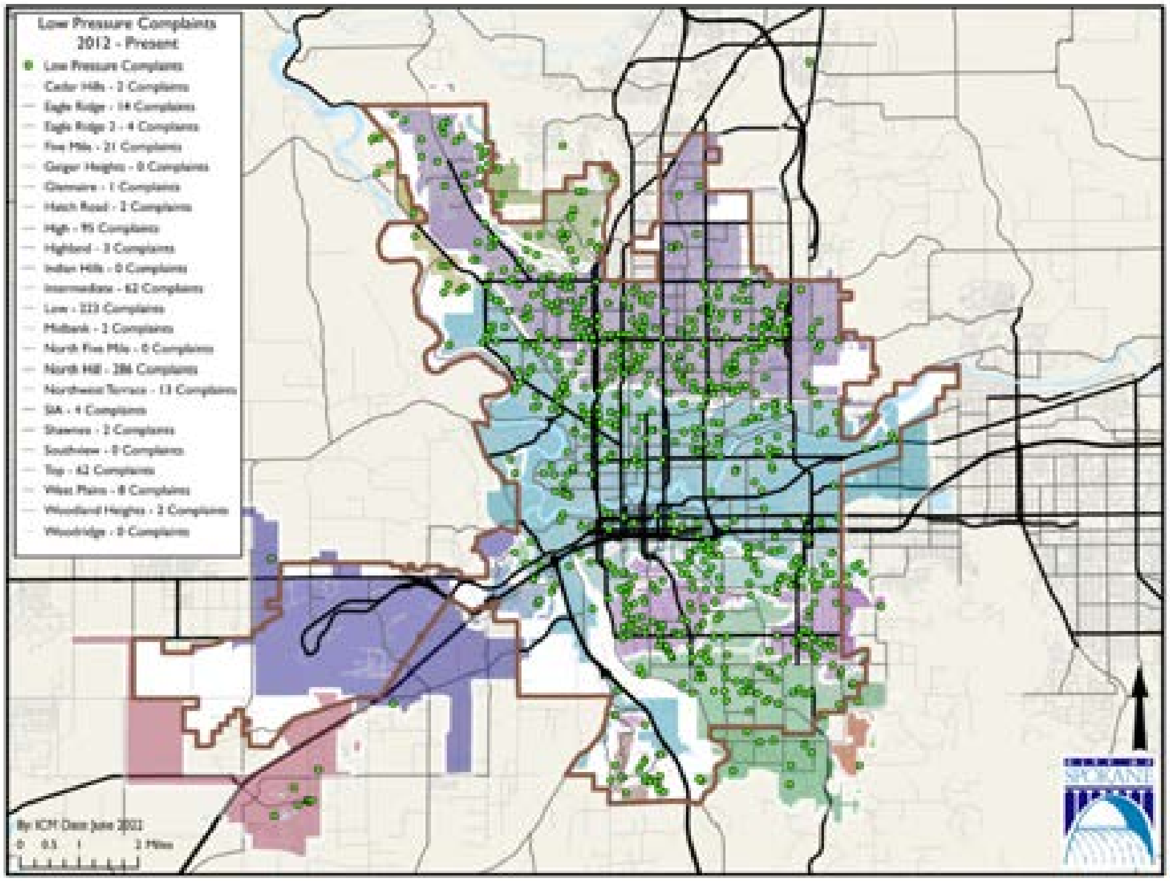


Figure 3.23 Low-pressure Complaints

Transmission Mains

The transmission main pipelines range from 12 inches to 48 inches in diameter. The water system has several different pipe materials in use, with the majority being cast iron or ductile iron. Before ductile iron was available, cast iron pipe was used for smaller piping and steel for the larger mains.

A system-wide inventory of transmission mains is presented in Table 3.15. The transmission mains have been sorted by material, size, and year of installation. The installation years have been divided based on the prominent pipe material of a given era, as summarized below:

- Cast Iron – most prominent before 1940, phased out by 1980
- Seamless steel – began in 1930s, became more prominent with production improvements in 1960s. Largely phased out by 1980.
- Ductile Iron – current material of choice, introduced in 1950s.

Table 3.15. Transmission Mains

Material	**Diameter (inches)**	**Length Installed 1980 to 2021**	**Length Installed 1940 to 1980**	**Length Installed Before 1940**	**Total Length Installed**
Asbestos Concrete	No Pipes				
Cast Iron	14	-	115	-	115
	16	-	465	19,906	20,371
	18	-	2,020	1,030	3,049
	20	-	-	1,181	1,181
	24	-	401	2,272	2,673
Cast Iron Total		-	3,001	24,388	27,389
Ductile Iron	14	17	18	-	35
	16	212	-	-	212
	18	90,676	3,146	-	93,822
	20	1,032	-	-	1,032
	24	128,008	88	-	128,095
	30	124,562	-	-	124,562
	36	146,230	-	-	146,230
	42	30,970	-	-	30,970
Ductile Iron Total		521,707	3,252	-	524,959
Galvanized Pipe	No Pipes				
High Density Polyethylene	24	445	-	-	445
High Density Polyethylene Total		445	-	-	445
Kalamein	No Pipes				
PVC	No Pipes				
Steel	14	206	-	-	206
	16	-	31	3	33
	18	2,822	58,845	12,439	74,106
	20	-	1,313	-	1,313
	24	8,586	58,268	3,974	70,828
	28	-	141	3	144
	30	447	69,711	26,225	96,382
	36	228	14,565	31,889	46,682
	42	-	1,035	-	1,035
	48	-	-	12,538	12,538
Steel Total		12,289	203,908	87,070	303,267
System-wide TOTAL (ft)		**534,441**	**210,160**	**111,458**	**856,059**
System-wide Total (miles)		**101**	**40**	**21**	**162**

The system-wide transmission mains are also shown geographically in Figure 3.24.

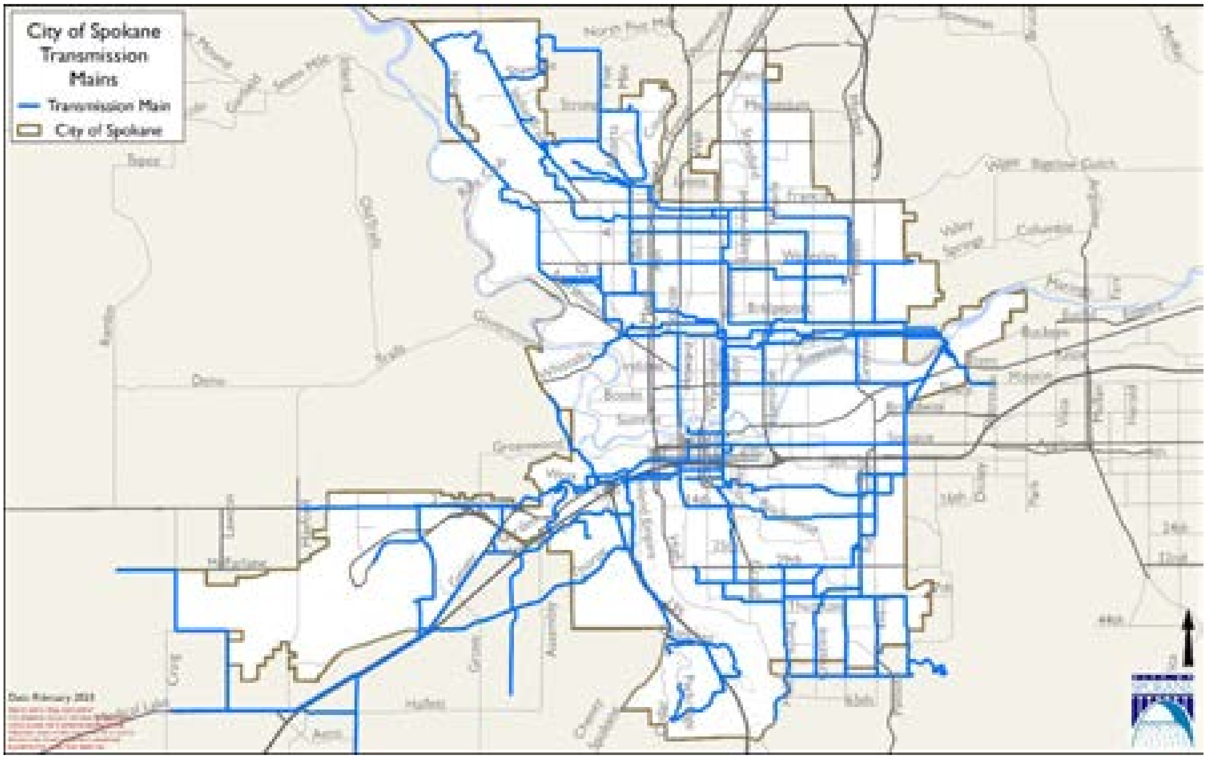


Figure 3.24 Transmission Mains

Distribution Mains

The distribution main pipelines range from four to 12 inches in size. The water system has several different pipe materials in use, with the majority being cast iron or ductile iron. A summary of the system's distribution mains is provided in Table 3.16, sorted by material, size, and year of installation. The installation years have been defined by the same eras as described in the previous transmission main section.

Table 3.16 Distribution Mains Pipe Length by Material, Size, and Construction Year

Material	**Diameter (inches)**	**Length Installed 1980 to 2021**	**Length Installed 1940 to 1980**	**Length Installed Before 1940**	**Total Length Installed**
Asbestos Concrete		-	1,055	-	1,055
Asbestos Concrete Total					1,055
Cast Iron	4	315	21,779	14,566	36,660
	6	-	1,418,825	644,673	2,063,498
	8	-	304,438	60,503	364,941
	10	-	76,685	39,421	116,105
	12	-	317,593	62,767	380,360
Cast Iron Total		315	2,139,320	821,929	2,961,564
Ductile Iron	4	28,185	6,396	-	34,581
	6	422,665	115,308	-	537,973
	8	490,491	22,075	-	512,566
	10	22,416	463	-	22,879
	12	530,365	28,050	-	558,415
Ductile Iron Total		1,494,123	172,290	-	1,666,414
Galvanized Pipe	No Pipes				
High Density Polyethylene	No Pipes				
Kalamein	4	-	-	233	233
	6	-	617	277	894
	8	-	6	-	6
	10	-	41	-	41
	12	-	659	350	1,009
Kalamein Total		-	1,324	860	2,184
PVC	4	273	-	-	273
	6	3,938	-	-	3,938
	8	1,451	-	-	1,451
	12	60	-	-	60
PVC Total		5,721	-	-	5,721
Steel	6	363	322	86	771
	8	-	2,224	-	2,224
	10	-	984	21	1,005
	12	222	3,915	185	4,322
Steel Total		585	7,445	292	8,321
System-wide Total (ft)		**1,500,744**	**2,321,434**	**823,081**	**4,645,260**
System-wide Total (miles)		**284**	**440**	**156**	**880**

Approximately 18% of the City's distribution mains were installed prior to 1940, while 50% of the lines were installed between 1940 and 1980. Approximately 32% of the distribution lines were installed after 1980. A geographical representation of distribution main lines installed before and after 1940 is provided in Figure 3.25 below.

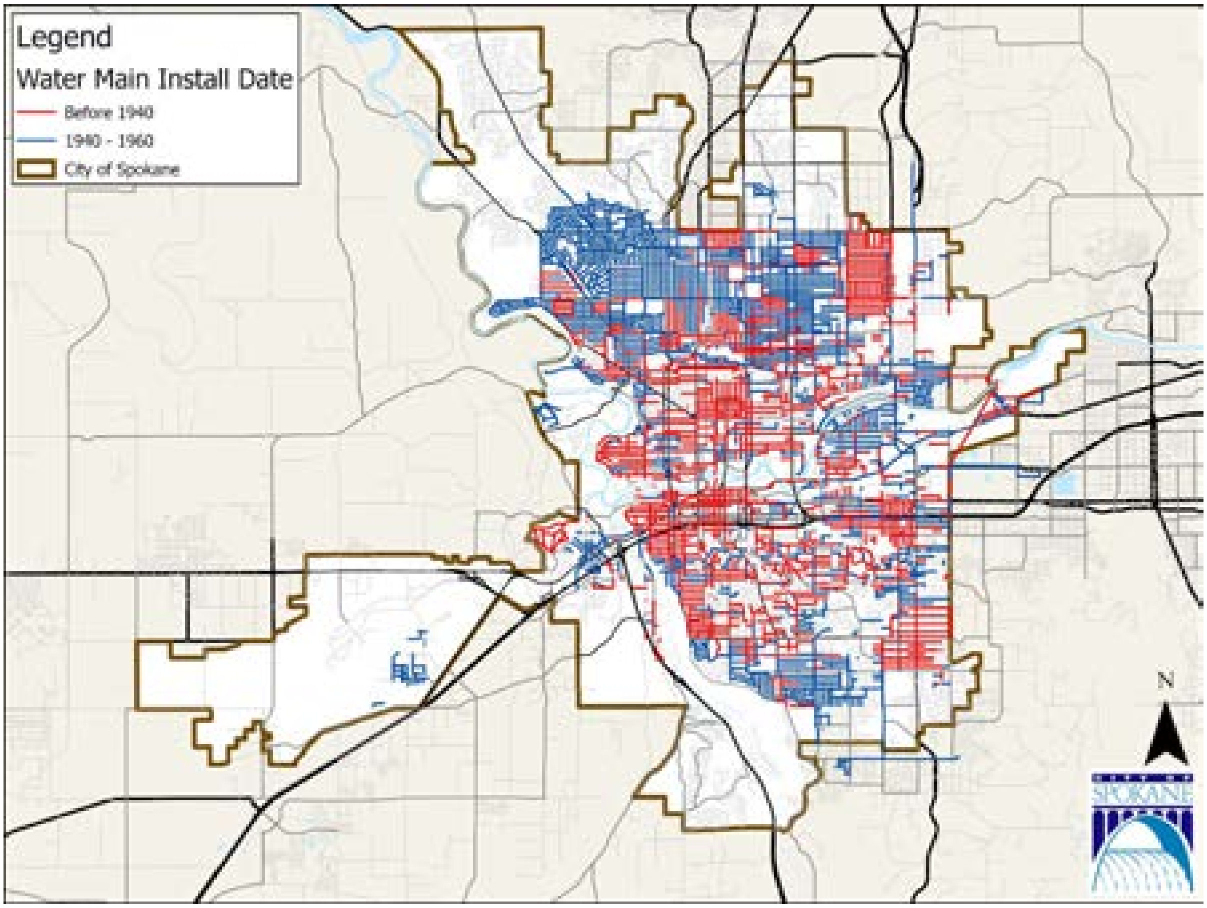


Figure 3.25 Date of Installation for Distribution Mains

Distribution/Transmission System Replacement Program

The Water Department uses several considerations to prioritize replacement of both transmission and distribution system water mains. The utility believes in an integrated approach to pipeline replacement and strives to initiate replacement as part of other capital projects, such as street or sewer driven projects. This is done in an effort to reduce overall project costs and minimize impacts to ratepayers. Planned water main replacements as a result of the considerations identified below are described further in Chapter 8 – Capital Improvement Program.

System Integrity

The age of a water main is a major factor used when making decisions relative to maintaining water system integrity. It is important to note, however, that there are water mains in the system still in service today that were installed over 100 years ago. In many cases these old water mains still have decades of reliable service left in them. A better indicator of the condition of a portion of the system is the amount of maintenance required to keep it in operation. Areas where the maintenance effort is recognized to be above the norm are given top priority for replacement. Maintenance activities are described in more detail in Chapter 6.

Concrete Paving

Replacement of asphalt with concrete in major intersections is now a fairly common practice. Concrete provides higher durability than asphalt but makes accessibility during maintenance more challenging and costly. The expected useful life of concrete roadways is 50 years; as such, the Water Department generally seeks to replace any water mains below proposed concrete roadway segments or under roundabouts to mitigate future maintenance activities for the road's lifespan. Additionally, whenever possible, valves or other appurtenances which require periodic maintenance are also relocated beyond the bounds of the area where the concrete intersection is constructed.

Asphalt Paving Projects

Water mains and services under proposed street reconstruction or resurfacing projects are evaluated for replacement during the design phase to avoid scenarios where newly rehabilitated streets are cut/patched to conduct repairs to the water system. Consideration is given to the age of the system, the type of joints (leadite being of primary concern), and the results of leak surveys in determining whether the water system needs major reconstruction ahead of any proposed paving project. Generally, pipes are replaced if the remaining useful life is determined to be 20 years or less.

Cast Iron Pipe with Leadite Joints

Leadite-jointed cast iron pipe is similar to a lead-jointed pipe. Leadite jointed piping has been associated with devastating types of main breaks. These breaks almost always originate at a leadite-poured bell and cause an entire length of pipe to break spirally from end to end. The resulting damage to the street and surrounding area can be severe. There are almost never any warning signs of an impending break of this type. Most frequently, 12-inch cast iron leadite-poured joint pipe is involved. Efforts are now being directed at identifying where in the system this joint type exists for purposes of evaluating and prioritizing replacement.

Replacement Due to Leaks

Priority is given to pipeline replacement projects that replace sections of pipe that are leaking. Although sometimes difficult to identify in long-term planning and management programs, those areas that have been known to have troublesome leaking are added to the replacement program. Currently, there are no large capital projects identified in the program for replacement due to leaks but are managed through ongoing maintenance.

In addition to these considerations, the City also utilizes the 2019 Risk and Resiliency Assessment to consider system vulnerabilities and replacement needs. The assessment has identified some distribution pipelines within the City which could be at risk for landslides; however, both the likelihood and consequence of failure were minimal. The 16th Avenue main located under Latah Creek has been included in the Six-Year Water Program for replacement to protect the pipe from erosion of the creek bank.

These considerations may be revised or updated as part of the utility's plan to develop a comprehensive asset management program.

Pressure Reducing Valve Stations

The varied terrain found in the City can cause localized high pressures. To reduce and maintain acceptable pressures within the distribution system, pressure-reducing valve stations are installed within localized areas of several pressure zones. In addition, pressures in the entire pressure zones of both Northwest Terrace and the Hatch Road Pressure Zones are controlled with pressure-reducing valve stations. Table 3.17 lists the locations of pressure-reducing valve stations within the distribution piping system.

The Water Department requires property owners to install pressure-reducing valves on individual water services when pressures are above 80 pounds per square inch. In areas that exceed 100 pounds per square inch, a pressure-reducing valve station within the distribution system, as described above, plus individual pressure-reducing valves on services are required.

Table 3.17 Pressure-reducing Valve Stations Data

Location	Valve Sizes (inches)	Inlet (Psi)	Outlet (Psi)	From To Pressure Zones
Panorama & Walnut Court	6 & 2	110	56	Five Mile to Five Mile
Walnut St. & Cedar Rd.	6 & 2	80	66	Five Mile to Five Mile
Prairie Dr. & Fleetwood Ct.	8 & 2	113	63	Woodridge to Shawnee
Hiawatha Dr. & Lincoln Rd.	6 & 2	95	9	Five Mile to Indian Hills
Barnes Road (upper)	6 & 2	100	50	Five Mile to Five Mile
Barnes Road (lower)	6 & 2	100	45	Five Mile to Five Mile
Sundance Dr. & Acoma Dr. Upper Intertie	10 & 4	115	26	North Hill to Northwest Terrace
Mason Ln. & Maximilian Ln.	10 & 4	150	110	Northwest Terrace to Northwest Terrace
Birchwood & 9 Mile Road	8 & 2	120	55	Northwest Terrace to Northwest Terrace
Regency Ln. & Park View Ln.	8 & 3	80	8	Low to Northwest Terrace
River Ridge & Sand Ridge	10 & 6 & 3	120	65	Low to Low
River Ridge & Inland	10 & 6 & 3	110	55	Low to Low
F St. & Woodland	6 & 2	120	38	Woodland Heights to Low
16th Ave. & Milton	10 & 6 & 3	175	55	Highland to Highland
Westwood Ln.	10 & 4	124	40	Highland to Highland
Electric & Soda	6 & 2	108	42	West Plains to West Plains
Craig & McFarlane	8 & 2	100	50	West Plains to SIA
Latah Hills Ct. & Shelby Ridge	6 & 3	95	55	Eagle Ridge to Eagle Ridge
Summerwood & Shelby Ridge	8 & 3	95	55	Eagle Ridge to Eagle Ridge
Moran View & Woodland Court	6 & 3	123	68	Eagle Ridge to Eagle Ridge
Hatch Road #1 (6200 South)	10 & 4	110	35	Hatch Road to Hatch Road
Hatch Road & Tomaker Ln. #2	10 & 4	125	45	Hatch Road to Hatch Road
Shoshone & Lincoln	6 & $1^{1/2}$	120	65	High to High
Hartson & Sherman	6 & 2	105	70	Intermediate to Low
Lincoln Way & Osprey Heights	10 & 4	90	58	Eagle Ridge 2 to Eagle Ridge 2
Indian Canyon Golf Course	10 & 6 & 2	105/110	50/55	SIA to SIA
33rd & Division	6	90	48	Top to High
Abbot Booster	4 & 2	52	40/44	SIA to Highland

System Control Facilities

In 1985, a Control Center was established at the Upriver Complex with the installation of a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system provides operational control and monitoring of all major facilities within the water system. As with most computer applications, the

SCADA system is subject to frequent updating. The SCADA system's latest update was fully operational by June 2007. Major updates to both the hardware and software will be needed in the next 20 years.

Some of the functions that SCADA monitors and/or controls are:

- Storage reservoir levels
- Pump starts, stops, and run times
- Well drawdown elevations
- System chlorine residuals
- Dam and hydroelectric powerhouse

The Control Center is staffed 24 hours a day, seven days a week, by State of Washington Department of Health Certified Water Distribution Managers.

Instrumentation is added to new facilities to connect to the SCADA system. Hardware and software are periodically updated to meet changes in technology and system upgrades.

Method of Recording Changes

The Water Department maintains a Geographic Information System (GIS) detailing the location and condition of all pipes (transmission and distribution), valves, hydrants, fittings and appurtenances, service locations, pressure zones, booster stations, well stations, and reservoirs. Information from the GIS system is always available in a digital format for both office and field personnel (mobile users).

Additional products are published regularly from the GIS systems in various formats (tabular reports, map graphics, field atlas books, and digital web content).

All updates to the water system GIS are completed in a timely manner as need dictates. Updates generally result from new development, infrastructure improvement, and field verification of system infrastructure. The utility of the GIS system is extended with connections to infrastructure management and utility billing database systems. These systems are operated in such a way that information tracked by outside departments is not unnecessarily reproduced. Additionally, the GIS system is also an information source for both a steady state and extended periods analysis model. This model tracks and predicts water quality and monitors system growth.

The prioritization of the GIS system for the Water Department has been defined as follows:

1. Maintain the quality and accuracy of the existing GIS system;
2. Extend the cross-functionality of Water Department computer systems; and
3. Ensure the security, reliability, and ease of use for Water Department computer system users.

3.1.3 Future Asset Management Program

The City currently uses CityWorks to manage maintenance of the water system. Concurrent with the development of this Water System Plan, the City of Spokane is developing a 20 year water strategy defining the City's water utility priorities and major capital projects over the next two decades. As part of this effort, the City is updating its Level of Service goals to better align with the comprehensive plan and community expectations. Once the water utility's Level of Service goals have been refined, the City will develop a more comprehensive and robust asset management program to align with the updated priorities.

3.2 Water Quality

This section provides an overview of the City's source water and distribution system water quality. Water quality sampling is conducted by the City's Water Department Water Quality Laboratory, certified by the Department of Ecology, to perform both bacteriological and analytical tests. The bacteriological tests consist of Heterotrophic Plate Counts, Colilert Total/Fecal Coliform Presence/Absence, and Colilert Total/Fecal Coliform Enumeration. The analytical tests include total and residual chlorine analysis, alkalinity, total dissolved solids, turbidity, pH, conductivity, and total hardness.

3.2.1 Source Water Quality

The Spokane Valley/Rathdrum Prairie Aquifer has been the City of Spokane's sole water source since 1909. The aquifer provides high-quality potable water, and there have been no Maximum Contaminant Level exceedances for any parameters reported to date. While the aquifer has very few microbes, the City still elects to disinfect the source water with gaseous chlorine, which is added at every pump, in every well. This is done to support the City's defined Level of Service to maintain at least a 0.2 mg/L residual chlorine level in the distribution system.

A high-level discussion of source water quality by monitored parameters is provided below; additional detail is provided in section 6.3:

- **Turbidity and Total Organic Carbon:** experiences very low turbidity and very little total organic carbon (TOC).
- **Arsenic:** contains low levels of naturally occurring arsenic. Element has a Maximum Contaminant Level of 5 µg/L and is monitored annually at every well. The maximum measured value of arsenic in the source water was 5.13 µg/L from the Ray Street well in 2009.
- **Barium:** contains low levels of naturally occurring barium. Element has a Maximum Contaminant Level of 2 mg/L and is monitored annually at every well. The maximum measured value of barium was 0.0595 mg/L from the Ray Street well in 2018.
- **Nitrate:** contains anthropogenic nitrate. Historically there were more than 30,000 septic tanks over the Spokane Valley/Rathdrum Prairie Aquifer within Spokane County. A program to connect these to a central sewage collection and treatment system began in 1980. As homes and businesses have been connected to the system, there has been a documented reduction in nitrate levels. Nitrate levels are considerably lower than the Maximum Contaminant Level of 10 mg/L. In 2020, the average source water nitrate level was 1.12 mg/L, measured in our seven source wells.
- **Radon/Radionuclides:** contains naturally occurring radon and radionuclides. Radon levels are between 300 and 600 picocuries per liter. The Environmental Protection Agency has not established a Maximum Contaminant Level for radon. The City measures gross alpha particle activity and radium 228 as part of the radionuclide rule. The Maximum Contaminant Level for gross alpha particle activity is 15 picocuries per liter and five picocuries per liter for Radium 226/228 combined.
- **Calcium Carbonate:** as a groundwater source, the water naturally contains high levels of calcium carbonate. Water with calcium carbonate in the range of 121 to 180 gm/L is classified as hard. The City's water is classified as hard, with an average calcium carbonate level of 136 mg/L.

3.2.2 Distribution System Water Quality

The City is required to collect a minimum of 150 coliform bacteria samples per month based on the population served (approximately 245,000). However, the City elects to analyze closer to 165 samples per month. The Water Department maintains a network of sample collection sites at either existing facilities, such as booster stations, or dedicated sample stations in the distribution system.

The City has not had a confirmed coliform bacteria detection from routine monitoring activities in over 40 years. There was, however, an isolated water quality incident in July 2019. This incident was due to contamination from landscaping hydroseed material that was accidentally injected into the water system via a fire hydrant. The contamination event was localized and impacted approximately 30 blocks of residential users. Coliform bacteria and E. coli were detected in the impacted area. The affected area of the distribution system was isolated, flushed, hyper-chlorinated, and flushed again until repeated testing did not detect coliform bacteria. The event lasted approximately five days, during which bottled water was distributed to impacted customers.

A map of all distribution system water quality complaints issued by customers over the last ten years is provided in Figure 3.26. The water quality complaints from the hydroseed contamination event represent the grouped cluster of complaints in the northeast part of the service area.

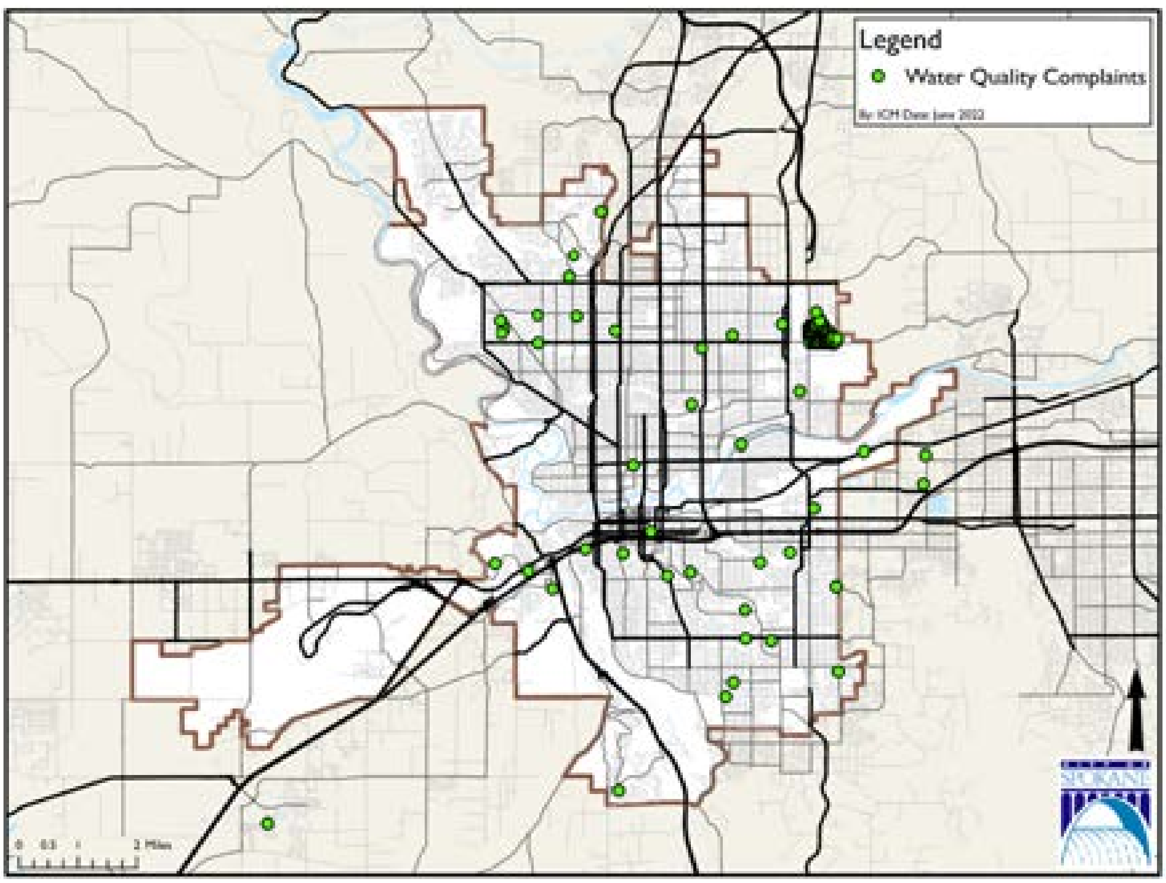


Figure 3.26 Water Quality Complaints

3.3 Design Standards

This section provides a discussion of the standards that the City of Spokane uses to design capital water facility projects. Water quality standards are discussed in Chapters 5 and 6. Standards used for operation of the water system are discussed in Chapter 6. Water system-adopted design standards, ordinances, standard drawings and specifications for new development and redevelopment are discussed in Chapter 7.

All construction projects for capital facilities use the latest Washington State Department of Transportation Specifications for Road, Bridge, and Municipal Construction. The City Design Standards reference the latest American Waterworks Association Standards, this updated Water System Plan, Water Systems Design Manual, and Recommended Standards for Water Works (10 State Standards).

Capital project planning and design follow the Water System Design Manual:

- Storage requirements. City of Spokane Design Standards 8.15 - Reservoirs. Above ground, steel and either standpipe, hydropillar or spheroid in design. All reservoirs shall have an internal passive water mixing system. Capacity based on Water Systems Design Manual and SCADA data and operations.
- Pipe velocities. For distribution mains, nominal velocity is limited to five feet per second for maximum day demand and 15 feet per second for fire flow and head losses not to exceed five feet per 1,000 feet of water pipeline. For transmission mains, velocity must be 2.5 to eight feet per second, and head losses not to exceed 3.5 feet per 1,000 feet of water pipeline.
- Fire flowrate and duration. A water system should have a supply, storage, and distribution system grid of sufficient capacity to provide firefighting needs while maintaining adequate service to residential and commercial customers.

Minimum required fire flows are set by the Spokane Fire Department for projects within its jurisdiction and by the Fire Marshal for those Fire Districts for projects within that district's area of jurisdiction. Additionally, for projects outside the City of Spokane, Spokane County may choose to set the required fire flows for a project. The City of Spokane Design Standards specifies that fire flows be determined by the Fire Marshal for the area served.

Fire flow volumes are typically calculated based on the largest fire flow that could occur in a pressure zone. The fire flow volume is determined by multiplying the designated fire flow by the duration to calculate the storage volume. The City of Spokane Fire Department use the International Fire Code, which dictates the storage requirements as follows:

- Residential Units < 3,600 sq. ft. = 120,000 gallons (1,000 gpm for 2 hours)
- Residential Units > 3,600 sq. ft. = 210,000 gallons (1,750 gpm for 2 hours)
- Multifamily Residential = 675,000 gallons (3,750 gpm for 3 hours)
- Retail Centers (large) = 960,000 gallons (4,000 gpm for 4 hours)
- Storage Centers (warehouse) = 1,440,000 gallons (6,000 gpm for 4 hours)

Where the area served by the reservoir is relatively small and water quality could be affected by large storage volumes, the duration requirement may be reduced, but to not less than 30 minutes, when approved by the Fire Marshal and the Water Department. In considering such a reduction, factors such as home size, density, topography, landscaping, and traffic flow are evaluated. Fire flow requirements for commercial and industrial areas are determined by the Fire Marshal on a case-by-case basis.

The City generally exceeds the conservative Insurance Services Office (ISO) of Washington State fire flowrates and the fire flow requirements set forth by the Washington Administrative Code (WAC 246-293-640), resulting in a very good insurance rating for the City.

3.3.1 Minimum System Pressure

City of Spokane Design Standards (Section 8.3 Water Pressure) establishes a minimum pressure for maximum day demand conditions and during fire flow demand.

Due to the varying topography of the areas served, the system is divided into separate pressure zones to control maximum and minimum pressures. The City of Spokane's water system has 23 pressure zones. These zones allow pressures to be restricted to acceptable limits throughout the system.

Since 1995, the normal minimum and maximum static water system pressure required in new developments (at the water meter) ranges from 45 to 80 pounds per square inch, respectively. Exceptions to the static pressure standards must be made because streets and water mains do not conveniently follow ideal ground contours. If the maximum pressure exceeds 80 pounds per square inch, but is less than 100 pounds per square inch, an individual pressure-reducing valve on water services is required per the Uniform Plumbing Code. If the pressure exceeds 100 pounds per square inch, a pressure-reducing valve station is installed within the distribution system, plus the individual pressure-reducing valves on services is required. For pressures below 45 pounds per square inch, specific written approval is required from the City of Spokane Water Department before a service is provided.

3.3.2 Minimum Pipe Sizes

City of Spokane Design Standards (Section 8.4 Size of Pipe) establishes 6-inch diameter pipe is the minimum, except pipes on permanent cul-de-sacs without hydrants may be 4 inches.

The determination of minimum pipe sizes is based on domestic water demand in addition to fire flow requirements and the overall grid or loop system found in the water system. The function of the distribution system is to convey water to customers at adequate service pressures and to provide fire flow. An analysis is required by the Water Department for the sizing of water mains. In most cases, the analysis will include a computer model analysis.

3.3.3 Telemetry Systems

In 1985, the Water Department installed its first Supervisory Control and Data Acquisition (SCADA) system. The data was transmitted from the remote sites to the SCADA system computer control center via dedicated phone lines. The SCADA system was upgraded in 2007 to utilize distributed control technology that transmits data via a broad-spectrum radio system.

The SCADA system is in a continual state of upgrades and improvements. The communication system between the Central Control Client Server site and the remote Programmable Logic Controllers located at the various water facilities throughout the water system is fully operational. The Programmable Logic Controllers are designed to be "stand alone." Thus, in the event of a loss of communication, the Programmable Logic Control can continue to provide limited control using system pressures at the remote facility.

Transmitted information is processed by the Central Control Client Server control system located at the Upriver Complex that monitors the Programmable Logic Controllers. The control functions of the various components in the water system are monitored by the Water System Operator. The Water System Central Control Room is staffed 24 hours a day and seven days a week by certified operators.

Some of the functions that SCADA monitors and/or controls are:

- storage reservoir levels;
- pump starts stops, and run times;
- well drawdown elevations;
- system chlorine residuals;
- intruder alarms and station security; and
- dam and hydroelectric powerhouse.

3.3.4 Backup Power Requirements

The City has permanent backup electrical generation facilities for the Well Electric and Parkwater Well Stations. These well stations are equipped for dual electric service. Typically, the Well Electric Well Station and the Parkwater Well Station operate on electric power supplied by the Water Department's Upriver Dam. However, power is also available from Avista Corporation for these two well stations. The ability to operate the Well Electric and Parkwater Well Stations with such backup power provides considerable redundancy for supplying water to the Low, Intermediate, and North Hill systems.

All other pumping facilities are largely dependent on Avista power for operations. Electrical outages are infrequent in the Spokane area, and there is extensive storage capacity to meet emergency water demands on a short to medium-term basis in the event of power outages. The most significant power outage the City has experienced was during a windstorm in November 2015. Restoring power to the City's pumping facilities is placed on a high priority by Avista, which includes providing portable diesel-powered generators for booster stations until power is restored. In the case of this windstorm, power was restored within ten days to all pumping stations which lost power.

The Avista electrical system in Spokane is strong with considerable gridding and redundancy, which is further strengthened by the presence of the Avista Utilities corporate offices in Spokane, providing locally based field staff readily available for responding to emergency power outages. Thus, historically, power outages are of short duration. However, to ensure a higher level of reliability of its water pumping capability, the Department maintains three portable generators driven by diesel engines available on standby status. The two largest generators are a 687.5 kVa and a 500 kVa, respectively, with a 3-phase, 480V unit capable of driving the largest pump in any of the City's pumping stations, except for the Well Stations and the 9th & Pine Booster Station, which operate on a different voltage (2,300V) than the rest of the stations. The third 100kVa generator is capable of driving the pumps in the smaller outlying booster stations able to reach the furthest extents of the water system. Permanent emergency backup generators are installed at the Southview Booster Station and Five Mile Booster Station. The Havana Well Station, currently under construction, will also have a permanent onsite generator capable of running a well pump into the Low Pressure Zone and a well pump into the Intermediate System simultaneously. A transformer has been installed at Lincoln Heights Booster to run one 400 horsepower pump (one of the smaller pumps) with one of the bigger portable generators.

3.3.5 Booster Station Requirements

Minimum design standards for booster stations are provided in the Design Standards of the City of Spokane (Section 8.14 Booster Stations). The City requires three pumps in new booster stations for flexibility in system operations. The total capacity of multiple pumps in each booster station should be approximately twice the calculated Maximum Day Demand for the pressure zone the station serves. This allows a pump, even the largest pump, to be removed from service and repaired without severely reducing supply capability.

All booster stations are required to include a telemetry system to allow the station to be operated and monitored remotely. Generally, backup power systems are not required for booster stations in the City water system where multiple booster stations provide water to the pressure zone. All systems or pressure zones supplied by booster stations within the City are also served with at least one reservoir.

3.4 Capacity Analysis

This section provides an assessment of the legal and physical capacity of the City's water system based on available water rights, sources, storage, and distribution components. This analysis is intended to satisfy the requirements of WAC 246-290-100(4)(e)(iii). The capacity analysis illustrates whether the water system can adequately serve existing customers and keep pace with future demand as well as consumer expectations (level of service). The result of the analysis is discussed in Section 3.5.

3.4.1 Water Rights

This section discusses the City's capacity to supply water. The information from the Water Rights Self-Assessment Form, contained in Appendix 2.6, is summarized in this section.

The City of Spokane currently has water rights to the Spokane Valley/Rathdrum Prairie Aquifer from eight well stations. The water rights for specific sites date back to 1948, with the year of priority dating to 1907. All well stations are within the central and eastern parts of the City and conform to the main body of the aquifer. Figure 3.27 maps the well station locations as they relate to the aquifer.

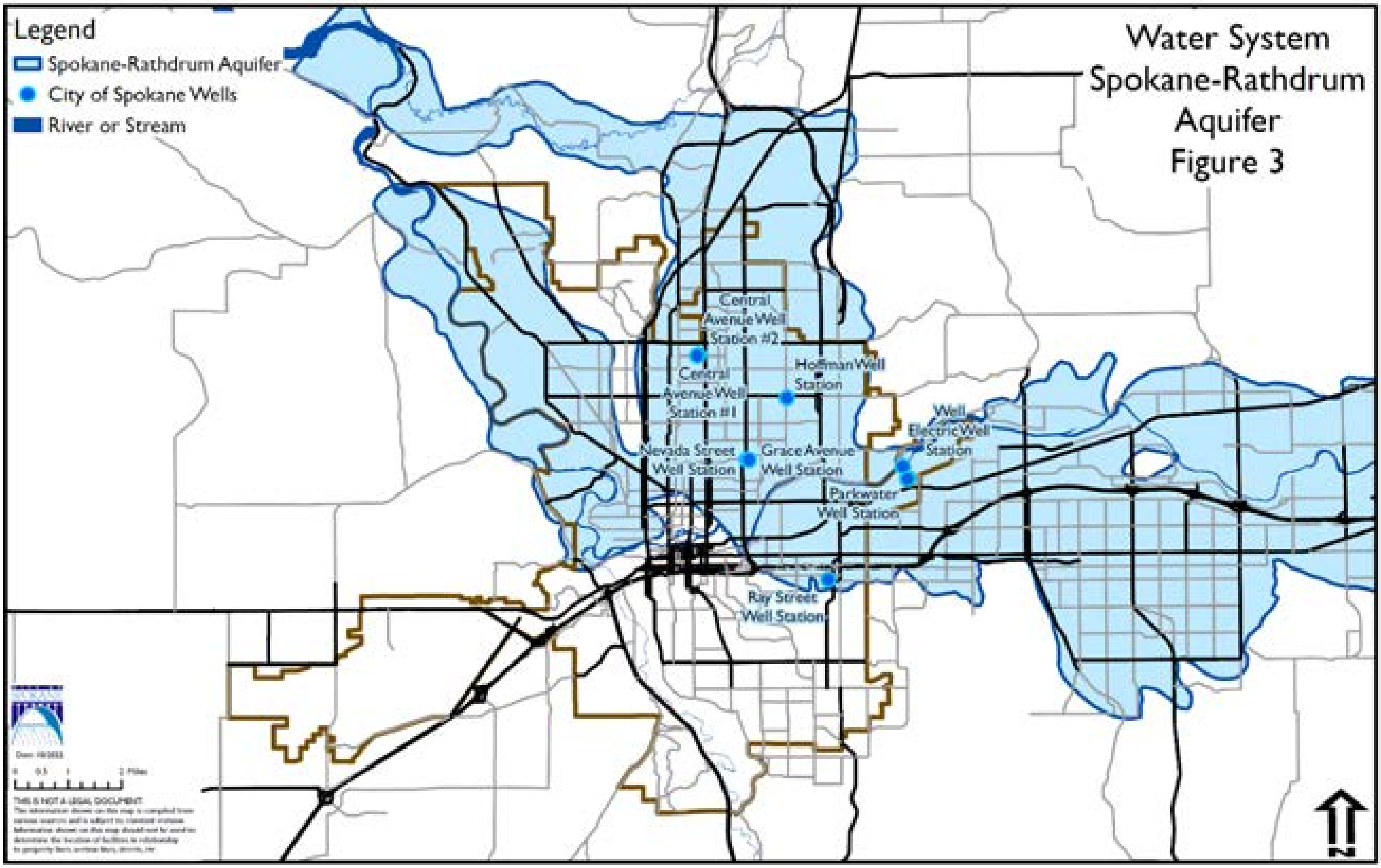


Figure 3.27 Well Station Locations within the Aquifer Area

Currently, the total combined nameplate pumping capacity of all operational well stations is 196,000 gallons per minute. When the Havana Well Station construction is completed, an additional 11,250 gallons per minute total nameplate capacity will be added for a total capacity of 207,000 gallons per minute. The permitted instantaneous flowrate is 242,280 gallons per minute. On an annual basis, the historical average maximum water volume distributed over the service area from 2018 through 2020 has been about 74,000 acre-feet per year. The permitted volume is 148,450 acre-feet per year. Table 3.18 identifies the existing water rights and compares them with current water usage. The current usage includes actual intertie use from Airway Heights, Fairchild Air Force Base, Medical Lake, Vel View Water District, and Spokane County Water District #3.

In 2014, the City requested a Change of Application with the Washington State Department of Ecology to modify the City's existing water rights. This change application referenced Parkwater and Well Electric's water rights and redistributed them to existing and proposed new wells. Ecology approved the change application in 2015. The rewritten water rights increased operational flexibility, allowed for the construction of the Havana Well Site, and relocated the ability to draw water further away from the Spokane River without increasing the overall water rights quantities.

In 2015, the Future Water Service Area Buildout Demand Estimate (Varela & Associates Engineering 2015) was completed to compare supply with the future service area demand. The analysis reviewed the full planned service area, associated land use types, population counts, existing vacant lots in developed areas, and redevelopment areas. The report also reviewed the 2010 water use, population, and water usage by acreage. The analysis showed that the total buildout future demand is expected to be 150,600 acre–ft. The City entered into two new agreements for intertie connections after this analysis was completed. In general, water demands from existing interties have also increased since 2015. The report is found in Appendix 3.4.

The 10-year and 20-year forecasted production, which includes only existing intertie usage, is compared to existing water rights in Tables 3.19. The surplus water rights for the future forecasted production were calculated in these tables. The City has sufficient water rights to supply demands beyond the 20-year planning period, or additional supply that may be requested from current interties.

Table 3.18: Water Rights and Current Production compared to Current Demands

WFI SOURCE NUMBER / WELL NAME	WATER RIGHT PERMIT NO.	EXISTING WATER RIGHTS		CURRENT SOURCE PRODUCTION (BASED ON 2020 DATA)			
		Primary Qi (Maximum Rate Allowed: Estimated Per Site) **gpm**	**Primary Qa** (Maximum Volume Allowed: Estimated Per Site) **Acre-ft**	**Total Qi** (Maximum Instantaneous Flow Rate Withdrawn) **gpm**	**Current Qi** Surplus (or Deficiency) **gpm**	**Total Q_a** (Maximum Annual Volume Withdrawn) **Acre-ft**	**Current Qa** Surplus (Or Deficiency) **Acre-ft**
S 01 NEVADA ST	3199-A 504-D* 548-A*	25,000	20,000	23,905	1,095	3,830	16,170
S 02 WELL ELECTRIC	504-D* 548-A*	54,750	36,000	36,583	18,167	16,949	19,051
S 03 PARKWATER	548-A* 504-D*	63,000	51,240	34,198	28,802	33,406	17,834
S 04 RAY STREET	505-D 503-D 504-D* 507-D**	14,000 7,000 1,250 2,600	1,870 350 2,000 520	16,001	8,849	5,633	(893)
S 05 HOFFMAN AVE	506-D 504-D* 548-D*	11,600	1,280	5,447	6,153	1,582	(302)
S 06 GRACE AVE	728-A 503-D 504-D* 548-A*	11,000 20,000	4,080 1,000	17,005	13,995	3,866	1,214
S 08 CENTRAL AVE	3903-A 503-D 4503-A 728-A	7,000 7,000 7,900 9,000	11,480 350 12,640 4,760	8,830	22,070	5,558	23,672
S 10 HAVANA ***	504-D* 548-A*						
TOTAL		**241,100**	**147,570**	**141,969**	**99,131**	**70,824**	**76,746**

*Certificates 504-D and 548-A submitted for and received Certificates of Change in 2016. The Report of Examination for Water Right Change specific to each certificate is included in Appendix 3.5. Under this change, the place of use of the water right is anywhere within the City's service area so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2) rather than the place of use is tied to a specific well location. All other City water rights certificates remain unchanged and have the place of use designated as described in the table above.

** Baxter Well water rights officially decommissioned in 2003, with water rights transferred to the Ray Street Well, as shown. The priority date is January 12, 1945.

***Havana Well Station is in construction and not operational; therefore, no observed production data is available and no specified maximum rate or maximum volume per site was specified.

Table 3.19: Water Rights and Current Production compared to 10-year and 20-year Forecasted Future Demands

		Existing Water Rights		**10-Year Forecasted Source Production**				**20-Year Forecasted Source Production**			
WFI Source Number / Well Name	**Water Right Permit No.**	**Primary Qi** (Maximum Rate Allowed: Esimated Ratioed Per Site) **gpm**	**Primary Qa** (Maximum Volume Allowed: Estimated Ratio Per Site) **Acre-ft**	**Total Qi** (Maximum Instantaneous Flow Rate in 10 Years) **gpm**	**10-Yr Forecasted Qi** Surplus (or Deficiency) **gpm**	**Total Q_a** (Maximum Annual Volume in 10 Years) **Acre-ft**	**10-Yr Forecasted Qa** Surplus (Or Deficiency) **Acre-ft**	**Total Qi** (Maximum Instantaneous Flow Rate in 20 Years) **gpm**	**20-Yr Forecasted Qi** Surplus (or Deficiency) **gpm**	**Total Q_a** (Maximum Annual Volume in 20 Years) **Acre-ft**	**20-Yr Forecasted Qa** Surplus (Or Deficiency) **Acre-ft**
S 01 NEVADA ST	3199-A 504-D* 548-A*	25,000	20,000	26,880	(1,880)	4,179	15,821	30,672	(5,672)	4,620	15,380
S 02 WELL ELECTRIC	504-D* 548-A*	54,750	36,000	40,202	14,548	18,265	17,735	44,816	9,934	19,929	16,071
S 03 PARKWATER	548-A* 504-D*	63,000	51,240	37,520	25,480	36,222	15,018	41,756	21,244	39,780	11,460
S 04 RAY STREET	505-D 503-D 504-D* 507-D**	14,000 7,000 1,250 2,600	1,870 350 2,000 520	17,992	6,858	6,146	(1,406)	20,531	4,319	6,795	(2,055)
S 05 HOFFMAN AVE	506-D 504-D* 548-D*	11,600	1,280	6,125	5,475	1,726	(446)	6,989	4,611	1,908	(628)
S 06 GRACE AVE	728-A 503-D 504-D* 548-A*	11,000 20,000	4,080 1,000	19,121	11,879	4,218	862	21,819	9,181	4,663	417
S 08 CENTRAL AVE	3903-A 503-D 4503-A 728-A	7,000 7,000 7,900 9,000	11,480 350 12,640 4,760	9,929	20,971	6,064	23,166	11,330	19,570	6,704	22,526
S 10 HAVANA ***	504-D* 548-A*			1,867	(1,867)	456	(456)	4,246	(4,246)	1,031	(1,031)
TOTAL		**241,100**	**147,570**	**159,636**	**81,464**	**77,276**	**70,294**	**182,158**	**58,942**	**85,432**	**62,138**

*Certificates 504-D and 548-A submitted for and received Certificates of Change in 2016. The Report of Examination for Water Right Change specific to each certificate is included in Appendix 3.5. Under this change, the place of use of the water right is anywhere within the City's service area so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2) rather than the place of use is tied to a specific well location. All other City water rights certificates remain unchanged and have the place of use designated as described in the table above.

** Baxter Well water rights officially decommissioned in 2003, with water rights transferred to the Ray Street Well, as shown. The priority date is January 12, 1945.

***Havana Well Station is in construction and not operational; therefore, no observed production data is available and no specified maximum rate or maximum volume per site was specified.

3.4.2 Physical Capacity Analysis

The water system's physical capacity was evaluated using a holistic approach to produce a full system view that takes into consideration the complexity of many relevant factors. This approach referenced multiple data sources and used spreadsheet and computer model analysis.

- Multiple sources were referenced to calculate both demands and capacities. The data referenced included Supervisory Control and Data Acquisition (SCADA) data, bi-monthly and monthly meter billing data, pump flow data recorded every other day or every third day, climate reporting, and the model calibration process. Climate usage differences between months and years, along with changes in consumer usage, vary from year to year and impacts demands.
- Differences in data were evaluated. Every source of data had inherent errors, either through monitoring variances, limited data availability, general record variances, or human data entry variances.
- Calculations were repeatedly analyzed, verifying different assumptions, time periods, and sources of data using the information the City understood about its own data.
- The capacity calculations and resulting capital improvement projects were examined at multiple levels, from the global system-wide level down to the pressure ranges provided at a meter.
- Operational field changes are made regularly on a seasonal basis. The impact of these changes was considered in capacity calculations.
- A complete calibrated water model is required to understand the interaction and interrelation of all the pressure zones in the system. A calibrated water model was used to confirm the City's water system capacity of each system component and the network as a whole to ensure adequate quality, quantity, and pressure during minimum supply and maximum demand scenarios.
- Capacity calculations based on the Water System Design Manual were completed for each individual pressure zone during specific scenarios to ensure the water system will be able to serve existing and future Equivalent Residential Units.
- Another aspect of this approach was to consider development. The City tracks the type and location of planned development. The western portion of the water system (West Plains, Spokane International Airport, Highland, northwest area of North Hill, Five Mile, Woodridge, west area of Low, and Eagle Ridge Pressure Zones) have the most development interests.

3.4.3 Systemwide Hydraulic Analysis

The model of the City's water system was created in InfoWater Pro, a software program from Innovyze Inc., a subsidiary of the AutoDesk Company.

Water system Geographic Information System (GIS) data was imported into the model and operational data. Current demands were averaged from billing records and were modified for Maximum Day Demand and winter using multipliers per pressure zone from the Equivalent Residential Unit Memo (see Appendix 2.1). Peak Hour Demands per pressure zone were calculated based on Water System Design Manual methodology. The baseline model using the current demand was calibrated by referencing different operating seasons to confirm the components of the model were correctly represented. The 20-year water demand growth projections for Average Day Demand, Maximum Day Demand, and Peak Hour Demand were estimated on a pressure zone basis and applied to the existing water model demands for future modeling analysis.

Critical scenarios were then analyzed for the system's physical capacity to serve water while meeting minimum pressures during peak or minimal seasonal usages for now and into the future. Well, pump stations, storage reservoirs, transmission mains, and distribution mains were analyzed using this model.

For additional details on the model capacity review, see Appendix 3.6 and Appendix 3.7 for the Water Model Calibration Memo (Murraysmith 2021) and Model Capacity Analysis Report, respectively.

This section describes the methodology and outcomes for the capacity analysis for source well stations, booster stations, storage reservoirs, fire suppression, and the transmission and distribution system. Pump capacity is based on field testing.

As earlier indicated in this chapter, the well supplied zones – Low, Intermediate, and North Hill – have well pump stations. All the other zones have booster stations that draw from those well-supplied zones that supply the upgradient pressure zones. The capacity analysis in this section is analyzed by well-supplied zones. The pumping capacity used in this section is based on field-tested results and SCADA results from 2017 through 2021. For this analysis, it was assumed that all existing regularly operable pumps will continue to be maintained and remain in service for the next 20 years.

The existing demands are explained in Section 2.3, and future growth is in Section 2.6.

3.4.4 Source Capacity Analysis for Well Stations

The source capacity analysis begins with the well station. Booster stations are also included in this section to analyze the system's capacity to deliver supply to the higher elevation pressure zones.

Well Stations

This section compares the current well station capacity to the existing and future Maximum Day Demand for each supplying pressure zone. Source well station capacity must meet Maximum Day Demand now and, in the future, (Water System Design Manual 4.4.2.4).

The current pumping capacity used in this analysis was based on field inspections and SCADA from 2017 through 2021. The source volume capacity (V_T) assumes 1200 minutes (20 hours) of pumping per day is based on Equation 4-1 from the Water System Design Manual. Several well station projects are planned in the next six years, and the increased capacity was included in this analysis. Northwest Terrace Pressure Zone is currently supplied from both Low Pressure Zone and North Hill Pressure Zone. The capacity analysis assumed future demands will be equally supplied from these two pressure zones.

Non-emergency intertie demands used in this analysis are based on the maximum values as set out in the intertie agreement. If there is not a value set forth in the intertie agreement, then the actual amount of water supplied through the intertie is used. The amount of water supply to interties serving the West Plains as a result of contamination to the Grande Ronde Aquifer has increased more than anticipated in the City's previous waster system plans. While a specific demand rate has not been assumed, the potential impact of increased supply to the West Plains has been noted in this analysis. Any changes to intertie agreements must be approved by Spokane City Council.

Low Pressure Zone and Hydraulic Dependent Pressure Zones

Wells from the Low Pressure zone supply seven dependent pressure zones (see Section 3.1.2 and Figure 3.28 below), a portion of the Northwest Terrace Pressure Zone from a pressure-reducing valve, the Intermediate Pressure Zone, and interties. Existing annual and Maximum Day Demand data are found in

Section 2.3. Future growth is in Section 2.6. Currently, Low Pressure Zone also supplies Intermediate Pressure Zone through Bishop Court and Ninth & Pine Booster Stations. In addition, the Low Pressure Zone supplies non-emergency interties for Airway Heights, Fairchild Air Force Base, and Spokane County Water District #3, seasonal supply to the City of Medical Lake, and the emergency intertie to supply Airway Heights while finding a permanent water supply.

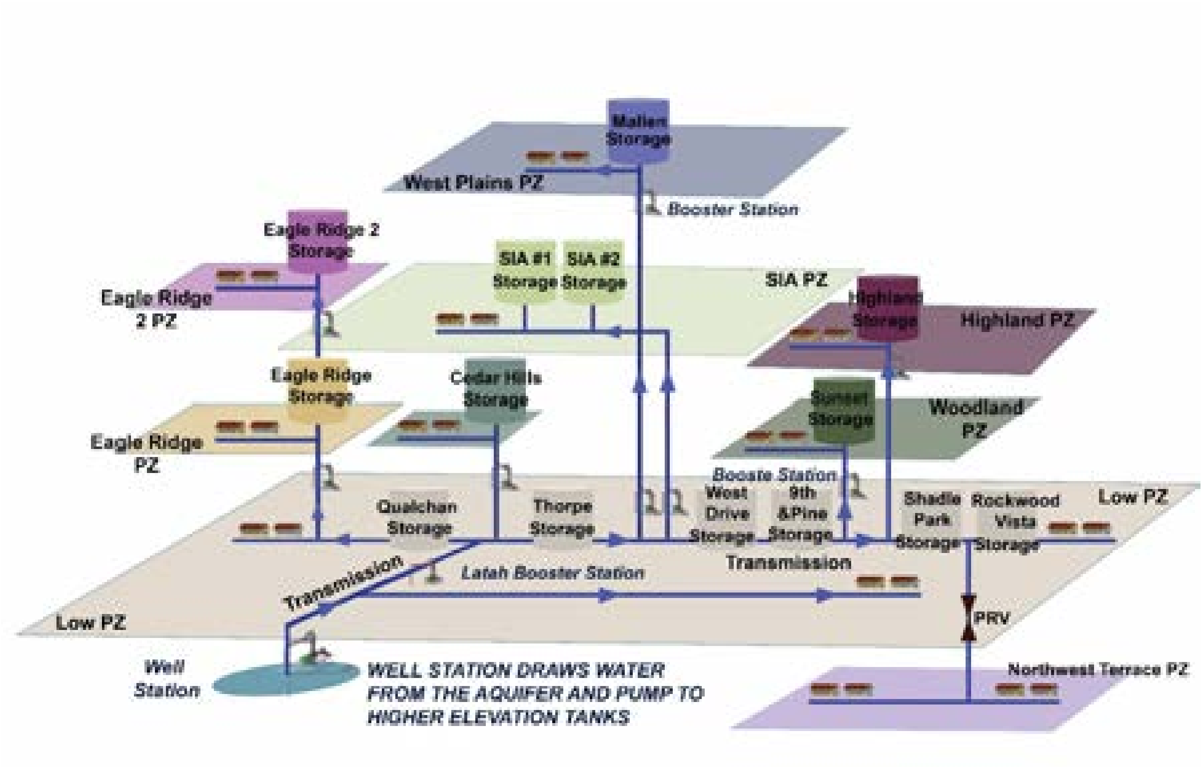


Figure 3.28 Pressure Zones Served by Low Pressure Zone Wells

Low Pressure Zone is supplied by Nevada, Well Electric, and Parkwater Well Stations, and the capacity analysis of the current pumps for these well stations is shown in Table 3.20.

Table 3.20 Low Pressure Zone Wells

Well Station	Current Pumping Capacity with all Pumps In Service, gpm	Source Volume Capacity, V_T gpd
Nevada	32,700	39,240,000
Well Electric	13,200	15,840,000
Parkwater	47,700	57,240,000
Total	**93,600**	**112,320,000**

Current and 20-year demands to the pressure zones supplied by Low Pressure Zone are compared to well capacity in Table 3.21. Demand in Low Pressure Zone includes uncategorized uses attributed to Upriver Dam operation, Streets, and Fire Department water consumption needs, as well as other unmetered water use. Intertie and uncategorized demands for this analysis used current values for the year 2040 projected demands and were not increased for this forecast.

Low Pressure Zone wells are expected to have sufficient capacity to supply demands through 2040; however, the available source volume capacity will be approximately 79% (or 97% if supplied to the

Intermediate Pressure Zone). The Well Electric New Well Station project will drill new wells and build a new well station at the existing site. Because the City may need more supply in the next 50 years and Well Electric wells have inchoate water rights, the new well station analysis will estimate projected demands for 100 years. The existing Well Electric Well Station is over 100 years old, and planning aspects for the new well station will consider the use for another 100 years.

In addition, the City has constructed three well caissons and completed plans for a well station at the new Havana Well Station to supply the Low Pressure Zone. Havana Well Station is located at the boundary of the Low and Intermediate Pressure Zones, and transmission mains for both pressure zones are adjacent to the site. The immediate needed capacity is for Intermediate Pressure Zone and the part of the well station is expected to be completed in 2023. Havana Low Pressure Zone Well Station provides redundancy and resiliency in the event of contamination or major loss for the other well stations in the Low Pressure Zone. Construction is planned at the end of the 20-year planning window but will be evaluated with the construction of Well Electric Well Station.

The wells have capacity to meet the Peak Hour Demand in Low Pressure Zone and supply Maximum Day Demand to the upgradient pressure zones.

Table 3.21 Current and Future Maximum Day Demand in Pressure Zones Service by Low Pressure Zone Wells

Condition	**MDD, gpm**	**MDD, gpd**	**Available Source Volume Capacity great than MDD, gpd**
Current MDD	45,300	65,279,400	47,160,600
Current MDD + Current Interties Supply	48,600	69,960,900	42,479,100
Current MDD + Intermediate Pumping + Current Interties Supply	62,600	90,120,900	22,319,100
2040 MDD + Current Intertie Supply	61,900	89,103,300	23,336,700
2040 MDD + Current Intermediate Pumping + Current Interties Supply	75,900	109,263,300	3,176,700

When Havana Well Station is operational to supply Intermediate Pressure Zone, then the City will have additional capacity in the future to serve approximately the pumping capacity needed for the Intermediate Pressure Zone, or approximately 14,000 gpm. However, upgrades to booster pump station and larger transmission mains will be needed if additional supply to the West Plains in the dependent pressure zones is needed beyond the current intertie flowrates.

Intermediate Pressure Zone and Hydraulic Dependent Pressure Zones

Wells from the Intermediate Pressure Zone supply five dependent pressure zones (see Section 3.1.2.1 and Figure 3.29) and interties. Currently, Intermediate Pressure Zone also is supplied from Low Pressure Zone through Bishop Court and Ninth & Pine Booster Stations.

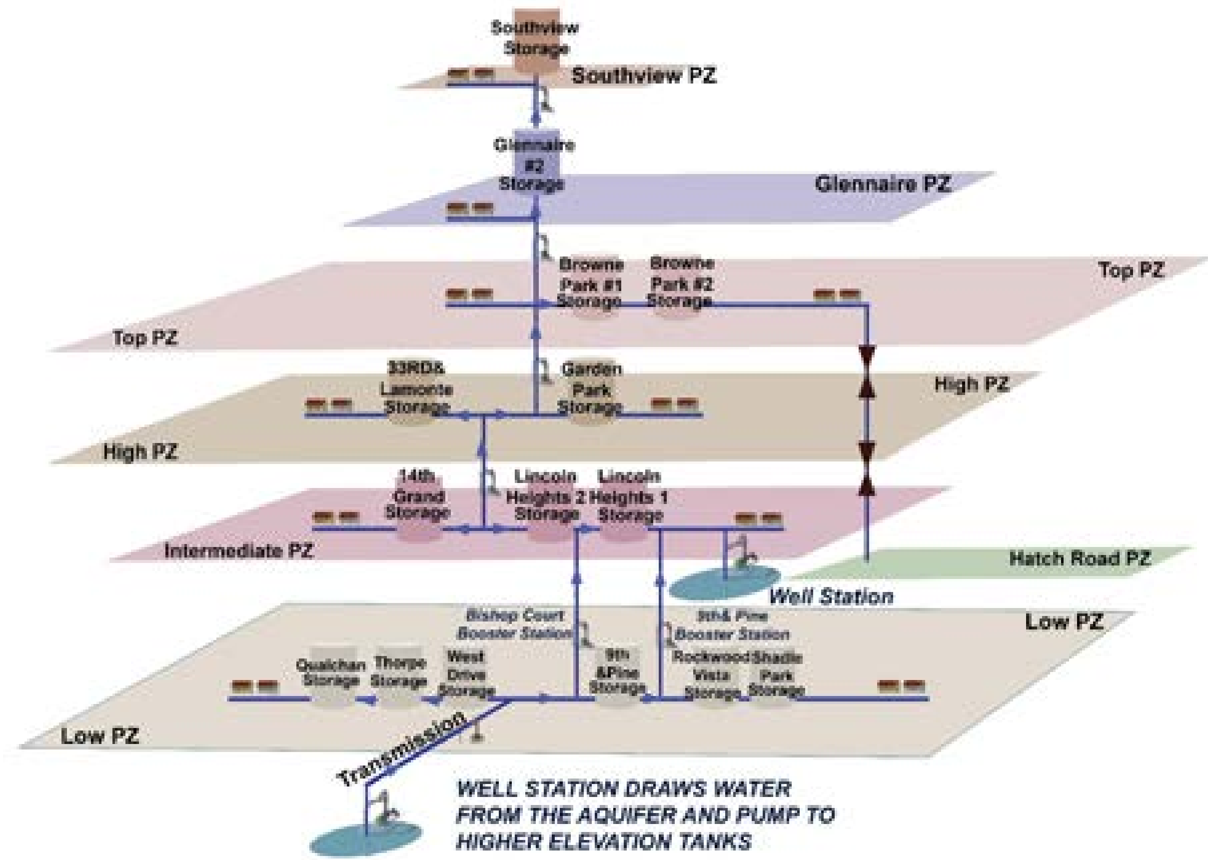


Figure 3.29 Pressure Zones Served from Intermediate Pressure Zone

Capacity analysis for Well Electric, Parkwater, and Ray Street Well Stations that supply Intermediate Pressure Zone is shown in Table 3.22. Ray Street Well Station is currently operating with three out of four well pumps, but a fourth pump will be added with the rehabilitation project in the Six Year Capital Program. This capacity calculation references the three operable well pumps for Ray Street. It includes the increase after the fourth pump is installed, assuming the new pump will have equal capacity to the existing 500 horsepower pump. The new Havana Well Station is under construction, with completion anticipated in 2023, and the capacity of the completed well station is included in the calculation. Bishop Court and Ninth & Pine Booster Stations can be used to augment the demands in surplus of Intermediate Pressure Zone well stations and for redundancy.

Table 3.22 Current Capacity for Intermediate Pressure Zone Wells

Well Station	Current Pumping Capacity with all Pumps In Service, gpm	Source Volume Capacity, V_T, gpd
Well Electric	6,500	7,800,000
Parkwater	12,600	15,120,000
Ray Street (Current Capacity)	17,000	20,400,000
Total	36,100	43,320,000
Ray Street – Increased capacity after rehabilitation	3,900	4,680,000
Havana – New well station	11,250	13,500,000
Total	51,250	61,500,000
Low Pressure Zone Booster Pumps to Intermediate		
Bishop Court	5,600	6,720,000
9th & Pine	8,000	9,600,000
Total with Low to Intermediate Boosting	64,850	77,820,000

Current and 20-year demands to the pressure zones supplied by Intermediate Pressure Zone are compared to well capacity in Table 3.23 both with and without the supplemental supply from Low Pressure Zone. Non-emergency supply is to interties for Spokane County Water District #3 (Water Service Area 3 and Water Service Area 8). Current intertie agreements do not specify a limit on the usage value; therefore, actual usages were used for this analysis.

Table 3.23 Current and Future Maximum Day Demand in Pressure Zones Service by Intermediate Pressure Zone Wells

Condition	MDD, gpm	MDD, gpd	Available Source Volume Capacity Greater than MDD, Use, gpd without Low Pressure Zone Supply	Available Source Volume Capacity Greater than MDD, Use, gpd with Low Pressure Zone Supply
Current MDD	31,400	45,240,000	(1,920,000)	14,400,000
Current MDD with Interties Current Supply	31,700	45,621,000	(2,302,000)	14,018,000
2040 MDD	34,400	49,574,000	(6,254,000)	10,066,000
2040 MDD + Interties Current Supply	34,700	49,956,000	(6,636,000)	9,684,000

Intermediate Pressure Zone wells can only meet current demands with supply from the Low Pressure Zone until Havana Well Station is operational. After the construction of the Havana Well Station and completion of the rehabilitation project for Ray Street Well Station, sufficient capacity will be available to supply demands through 2040 without supply from the Low Pressure Zone. The available source volume capacity will be approximately 85% without Low Pressure Zone supplement. The Low Pressure Zone booster stations provide a level of redundancy and resiliency to Intermediate Pressure Zone as well as capacity for growth into the future.

The wells in the Intermediate Pressure Zone with the two booster stations pumping from the Low Pressure Zone have capacity to meet the Peak Hour Demand while supplying Maximum Day Demand in all the upgradient pressure zones.

North Hill Pressure Zone and Hydraulic Dependent Pressure Zones

Wells from the North Hill Pressure Zone supply six dependent pressure zones (see Section 3.1.2 and Figure 3.30), a portion of Northwest Terrace Pressure Zone from a pressure-reducing valve, and interties.

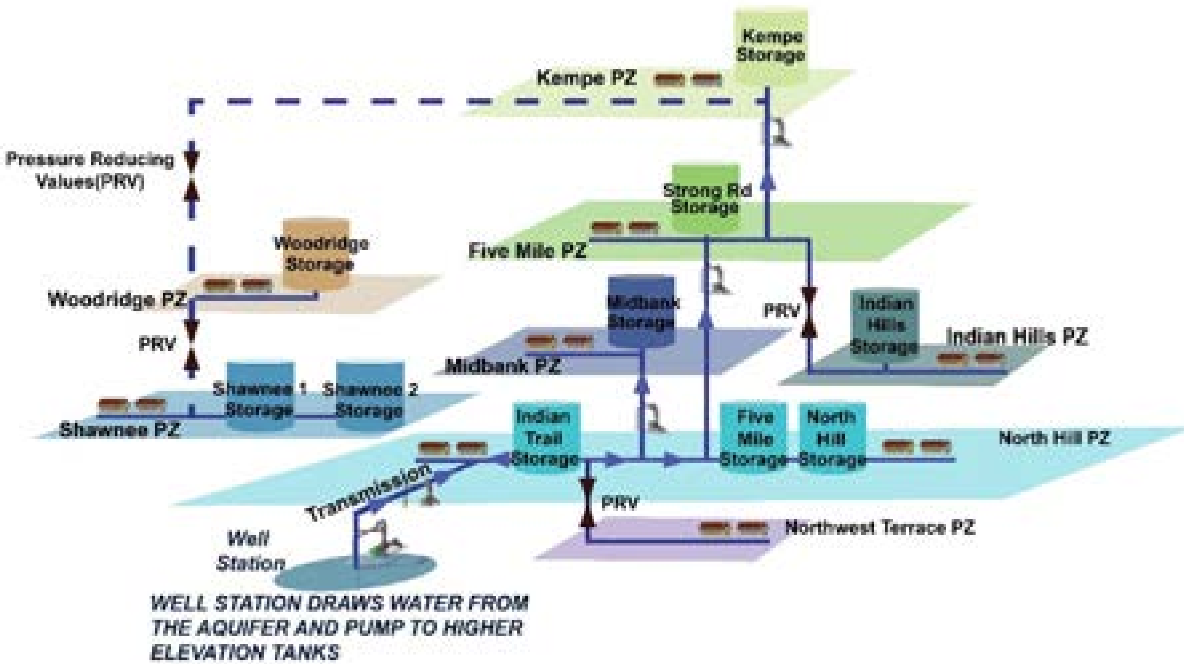


Figure 3.30 Pressure Zones Served by North Hill Pressure Zone Wells

Capacity analysis of the current system for North Hill Pressure Zone is shown in Table 3.24. Well Electric, Hoffman, Grace, and Central Well Stations currently supply this pressure zone. Hoffman Well Station is currently in construction for well pump upgrades; however, capacity from the well station is not expected to increase.

Table 3.24 North Hill Pressure Zone Wells

Well Station	Current Pumping Capacity with all Pumps In Service, gpm	Source Volume Capacity, Total V_T EQ 4-1, gpd
Well Electric	16,800	20,160,000
Hoffman	5,500	6,600,000
Grace	18,100	21,720,000
Central	16,000	19,200,000
Total	**56,400**	**67,680,000**

Current and 20-year demands to the pressure zones supplied by North Hill Pressure Zone are compared to well capacity in Table 3.25. The intertie actual usages included are Spokane County Water District #3, Vel View Water District #13, North Spokane Irrigation District #8, and Whitworth Water District.

Table 3.25 Current and Future Maximum Day Demand in Pressure Zones Service by North Hill Pressure Zone Wells

Condition	MDD, gpm	MDD, gpd	Source Volume Additional Capacity Above Max Day Use, gpd
Current MDD	36,400	52,370,000	15,310,000
Current MDD with Interties Current Supply	36,400	52,420,000	15,260,000
2040 MDD	41,900	60,340,000	7,340,000
2040 MDD + Interties Current Supply	41,900	60,390,000	7,290,000

North Hill Pressure Zone wells are expected to have sufficient capacity to supply demands through 2040; however, the available source volume capacity will be approximately 90% of demand. The Well Electric New Well Station project will drill new wells and build a new well station at the existing site. Because the City may need more supply in the next 50 years and Well Electric wells have inchoate water rights, the new well station analysis will estimate projected demands for 100 years. The existing Well Electric Well Station is over 100 years old, and planning aspects for the new well station will consider use for another 100 years.

Central Well, or the nearby vicinity, has been identified as a possible solution for an additional well to add capacity to the North Hill Pressure Zone. The growth in the service area has been and is expected to continue to be largely focused on the west. The Central Well is strategically located close to transmission mains to serve the areas northwest of the North Hill Pressure Zone and supply to the upgradient pressure zone. The City has not initiated any serious study or evaluation of the possibility of wells in this area but plans to pursue a study within the next 20 years.

The wells have capacity to meet the Peak Hour Demand in the North Hill Pressure Zone for current demands while supplying Maximum Day Demand to all of the upgradient pressure zones. By 2040, additional well capacity or additional storage will be needed to meet the Peak Hour Demand.

Booster Pumping Supply Capacity

This section describes the capacity analysis for the booster pump stations to supply demand to the higher elevation pressure zones from the well stations. Booster pump stations must meet Maximum Day Demand to the pressure zone supplied while maintaining minimum pressures. If booster pumps cannot meet the Peak Hour Demand, then equalizing storage must be provided. For this analysis, the system was assumed at Maximum Day Demand, and only the pressure zone supplied by the booster station is at the Peak Hour Demand. For pressure zones where booster stations cannot meet Peak Hour Demand, equalization storage is analyzed in Section 3.4.2. The current pumping capacity used in this analysis was based on field inspections and SCADA data from 2017 through 2021 and assumed all pumps were in service and operating. For booster stations that supply the upgradient pressure zone, the Peak Hour Demand was used in the primary pressure zone, and Maximum Day Demand for the upgradient pressure zones.

Minimum pressures were analyzed using a hydraulic computer model, and the results are in Section 3.4.2. Fire flow demand and fire storage are analyzed together in Section 3.4.2.

Booster Stations Hydraulically Connected to Low Pressure Zone Supply

The Low Pressure Zone supplies seven pressure zones through booster stations. Each pressure zone has one booster station except for Spokane International Airport (SIA) and Eagle Ridge 2 Pressure Zones, which both have two booster stations. A small new booster station is required for the new development and is currently under construction. It will draw water from Cedar Hills to Eagle Ridge 2 for the purpose of supplementing the Eagle Ridge Booster Station. The booster station will have a total pumping capacity of 250 gallons per minute. Only 250 gallons per minute capacity was added to the Cedar Hills demand and the remainder to the Eagle Ridge demand. This small temporary booster station will likely be required for several years and is included in the 20-year capacity calculations.

Booster station capacity is compared to current booster station capacity with all pumps operating to serve current and future demand as shown in Tables 3.26 and 3.27.

Table 3.26 Booster Pump Station Capacity Compared to Current Demand for Pressure Zones Hydraulically Connected to Low Pressure Zone

Booster Station Name	Primary Pressure Zone Supplied	All Pressure Zone(s) Served (Primary + Upgradient)	Total Pumping Capacity per Pressure Zone (gpm)	Current Demand-MDD in Primary + upgradient +Interties (gpm)	Current Demand-PHD in Primary + MDD in upgradient + Interties (gpm)	Remaining Boosting Capacity to Serve Current PHD (gpm)
Cedar Road	Cedar Hills	Cedar Hills + Eagle Ridge 2	1,125	301	718	407
Eagle Ridge	Eagle Ridge	Eagle Ridge + Eagle Ridge 2	5,672	1,689	2,450	3,222
Eagle Ridge 2	Eagle Ridge 2	Eagle Ridge 2	7,033			
Cedar to Eagle Ridge 2			250			
Total Eagle 2 Pressure Zone			7,283	997	1,845	5,438
Milton	Highland	Highland	2,826	1,215	2,247	579
West Drive	Woodland Heights	Woodland Heights	1,615	446	1017	598
West Drive	SIA	SIA + West Plains	7,184			
Thorpe			7,530			
Total SIA Pressure Zone			14,714	15,213	19,547	(4,833)
Spotted Road	West Plains	West Plains	6,577	6,941	10,315	(4,738)

Pumping capacity for the booster stations in Cedar Hills, Eagle Ridge, Eagle Ridge 2, Highland, and Woodland Heights has adequate capacity for current Peak Hour Demand and the next 20 years. SIA and West Plains Pressure Zones demand has exceeded the current pumping capacity, and additional capacity is needed to meet the current Peak Hour Demand. While the Eagle Ridge Booster Station has adequate capacity, the 12-inch discharge transmission main in Eagle Ridge Boulevard limits the amount of flow to Eagle Ridge Pressure Zone due to high velocities. Before additional development in the Eagle Ridge and Eagle Ridge 2 Pressure Zones can occur, the discharge transmission main will need to be upsized or another booster station and transmission main will need to be constructed. The Latah Hangman Sub Analysis in Appendix 3.8 and the Eagle Ridge Development Memo in Appendix 3.9 describe the Eagle Ridge area and capital infrastructure alternatives for growth. The existing pump station will be inappropriately sized when the new Eagle Ridge Booster Station is constructed and will need the pumps and motors right sized for the operations.

Current pump station capacity is insufficient in the SIA and West Plains Pressure Zones to supply more flow to the West Plains interties.

Table 3.27 Booster Pump Station Capacity Compared to Future Demand for Pressure Zones Hydraulically Connected to Low Pressure Zone

<table>
<tr><th>Booster Station Name</th><th>Primary Pressure Zone Supplied</th><th>All Pressure Zone(s) Served (Primary + Upgradient)</th><th>Total Pumping Capacity per Pressure Zone (gpm)</th><th>Future Demand-MDD in Primary + upgradient + Interties (gpm)</th><th>Future Demand-PHD in Primary + MDD in upgradient + Interties</th><th>Remaining Boosting Capacity to Serve Current PHD (gpm)</th></tr>
<tr><td>Cedar Road</td><td>Cedar Hills</td><td>Cedar Hills + Eagle Ridge 2</td><td>1,125</td><td>465</td><td>1,112</td><td>13</td></tr>
<tr><td>Eagle Ridge</td><td>Eagle Ridge</td><td>Eagle Ridge + Eagle Ridge 2</td><td>5,672</td><td>3,863</td><td>5,582</td><td>90</td></tr>
<tr><td>Eagle Ridge 2</td><td rowspan="2">Eagle Ridge 2</td><td rowspan="2">Eagle Ridge 2</td><td>7,033</td><td rowspan="2" colspan="3"></td></tr>
<tr><td>Cedar to Eagle Ridge 2</td><td>250</td></tr>
<tr><td colspan="3">Total Eagle 2 Pressure Zone</td><td>7,283</td><td>2,300</td><td>4,256</td><td>3,027</td></tr>
<tr><td>Milton</td><td>Highland</td><td>Highland</td><td>2,826</td><td>1,528</td><td>2,826</td><td>0</td></tr>
<tr><td>West Drive</td><td>Woodland Heights</td><td>Woodland Heights</td><td>1,615</td><td>453</td><td>1,033</td><td>582</td></tr>
<tr><td>West Drive</td><td rowspan="2">SIA</td><td rowspan="2">SIA + West Plains</td><td>7,184</td><td rowspan="2" colspan="3"></td></tr>
<tr><td>Thorpe</td><td>7,530</td></tr>
<tr><td colspan="3">Total SIA Pressure Zone</td><td>14,714</td><td>22,463</td><td>29,655</td><td>(14,941)</td></tr>
<tr><td>Spotted Road</td><td>West Plains</td><td>West Plains</td><td>6,577</td><td>9,726</td><td>14,910</td><td>(8,333)</td></tr>
</table>

Pumping capacity for the booster stations for Cedar Hills, Eagle Ridge, Eagle Ridge 2, Highland, and Woodland Heights Pressure Zones have adequate capacity for future Maximum Day Demand. SIA, and West Plains Pressure Zones will need additional capacity to meet future demands.

With the completion of the third storage reservoir for the SIA Pressure Zone, this pressure zone will have adequate capacity to meet the requirements of the Peak Hour Demand. A new booster station is needed to meet Maximum Day Demand. The new pump station is planned to be constructed adjacent and in addition to the Thorpe Booster Station.

The storage reservoir for West Plains Pressure Zone has adequate capacity to meet the requirements of the Peak Hour Demand. A new booster station is needed to meet Maximum Day Demand. The current Six Year Program contains a West Plains Booster Station project. The new pump station is planned to be constructed adjacent to the Spotted Road Booster Station.

Latah Inline Booster Station is needed to supply the west side of the pressure zones supplied from Low Pressure Zone wells. The total capacity of Latah Inline Booster is 16,000 gallons per minute and will need

3,100 gallons per minute more to meet the current Maximum Day Demand and approximately 15,000 gallons per minute for the future Maximum Day Demand.

If additional supply is sent to the West Plains interties, the pumping capacity of the Thorpe, Spotted Road, and Latah Inline Boosters will need to be increased. Additional booster stations may be needed if the flowrate supplied is larger than the pipe capacity or the property available for construction.

Booster Stations Hydraulically Connected to Intermediate Pressure Zone Supply

The Intermediate Pressure Zone supplies four main pressure zones through booster stations. The fifth pressure zone, Hatch, is supplied by pressure reducing station from the Top Pressure Zone. Southview and Glennaire Pressure Zones each have one booster station. High and Top Pressure Zones have multiple boosters. Booster station capacity is compared to current booster station capacity with all pumps operating to serve current and future demand as shown in Tables 3.28 and 3.29.

All the pressure zones supplied by the Intermediate Pressure Zone have sufficient pumping capacity for the current Maximum Day Demand. The booster stations in Glennaire and Top Pressure Zones have insufficient pumping to currently serve Peak Hour Demand.

Pumping capacity for Southview and High Pressure Zones will be adequate for the next 20 years. Glennaire and Top Pressure Zones need additional capacity to meet the current and future Peak Hour Demand. The existing booster stations for Glennaire and Top Pressure Zones will be upgraded to add capacity.

Table 3.28 Booster Pump Station Capacity Compared to Current Demand for Pressure Zones Hydraulically Connected to Intermediate Pressure Zone

Booster Station Name	Primary Pressure Zone Supplied	All Pressure Zone(s) Served (Primary + Upgradient)	Total Pumping Capacity per Pressure Zone (gpm)	Current Demand-MDD in Primary + upgradient + Interties (gpm)	Current Demand-PHD in Primary + MDD in upgradient + Interties (gpm)	Remaining Boosting Capacity to Serve Current PHD (gpm)
Southview	Southview	Southview	818	92	292	526
Glennaire	Glennaire	Glennaire + Southview	1,822	1090	2,126	(304)
Division & Manito	Top + Hatch Rd	Top + Glennaire + Southview	2,174			
Garden Park			14,785			
35th & Ray			9,070			
Total Top Pressure Zone			26,029	16,834	26,444	(415)
Lincoln Heights	37,260	High + Top + Glennaire + Southview	37,260			
14th & Grand	5,579		5,579			
Total High Pressure Zone			42,839	25,348	30,614	12,225

Table 3.29 Booster Pump Station Capacity Compared to Future Demand for Pressure Zones Hydraulically Connected to Intermediate Pressure Zone

Booster Station Name	Primary Pressure Zone Supplied	All Pressure Zone(s) Served (Primary + Upgradient)	Total Pumping Capacity per Pressure Zone (gpm)	Future MDD in Primary + Upgradient + Interties (gpm)	Future PHD in Primary + MDD in Upgradient (gpm)	Remaining Boosting Capacity to Serve Future PHD (gpm)
Southview	Southview	Southview	818	92	298	520
Glennaire	Glennaire	Glennaire + Southview	1,822	1,103	2,154	(327)
Division & Manito	Top + Hatch Rd	Top + Glennaire + Southview	2,174			
Garden Park			14,785			
35th & Ray			9,070			
Total Top Pressure Zone			26,029	18,931	29,833	(3,804)
Lincoln Heights	High	High + Top + Glennaire + Southview	37,260			
14th & Grand			5,579			
Total High Pressure Zone			42,839	27,528	33,845	9,994

Booster Stations Hydraulically Connected to North Hill Pressure Zone Supply

The North Hill Pressure Zone supplies five main pressure zones through booster stations. Indian Hills Pressure Zone is supplied by a pressure reducing station from the Five Mile Pressure Zone and is included with demand of that pressure zone. All the pressure zones supplied by North Hill Pressure Zone each have one booster station. Booster station capacity is compared to current booster station capacity with all pumps operating to serve current and future demand as shown in tables 3.30 and 3.31.

Table 3.30 Booster Pump Station Capacity Compared to Current Demand for Pressure Zones Hydraulically Connected to North Hill Pressure Zone

Booster Station Name	Primary Pressure Zone Supplied	All Pressure Zone(s) Served (Primary + Upgradient)	Total Pumping Capacity per Pressure Zone (gpm)	Current Demand-MDD in Primary + upgradient + Interties (gpm)	Current Demand-PHD in Primary + MDD in upgradient (gpm)	Remaining Boosting Capacity to Serve Current PHD (gpm)
Kempe	Kempe	Kempe	4,975	1,284	2,360	2,615
Belt	Midbank	Midbank	2,329	777	1,559	770
Woodridge	Woodridge	Woodridge	420	137	412	8
Shawnee	Shawnee	Shawnee + Woodridge	1,247	400	797	450
Five Mile	Five Mile + Indian Hills	Kempe + Indian Hills + Five Mile	8,750	4,486	6,880	1,870

All the booster pump stations have adequate capacity to meet both current Maximum Day Demand and the PHD.

Table 3.31 Booster Pump Station Capacity Compared to Future Demand for Pressure Zones Hydraulically Connected to North Hill Pressure Zone

Booster Station Name	Primary Pressure Zone Supplied	All Pressure Zone(s) Served (Primary + Upgradient)	Total Pumping Capacity per Pressure Zone (gpm)	Future Demand-MDD in Primary + upgradient + interties(gpm)	Future Demand-PHD in Primary + MDD in upgradient (gpm)	Remaining Boosting Capacity to Serve Future PHD (gpm)
Kempe	Kempe	Kempe	4,975	1,708	3,147	1,828
Belt	Midbank	Midbank	2,329	819	1,647	682
Woodridge	Woodridge	Woodridge	420	151	460	(40)
Shawnee	Shawnee	Shawnee + Woodridge	1,247	438	867	380
Five Mile	Five Mile + Indian Hills	Kempe + Indian Hills + Five Mile	8,750	6,383	11,505	(2,755)

The Kempe, Midbank, and Shawnee Pressure Zones have adequate pumping capacity for meeting 20 years of projected growth for both Maximum Day Demand and the Peak Hour Demand. The Woodridge and Five Mile Pressure Zones have adequate capacity to supply future Maximum Day Demand, but both require additional capacity to meet the future Peak Hour Demand. Additionally, Kempe storage provides an additional water supply via an interconnection between Kempe and Woodridge storage. The Five Mile Booster Station was constructed in 2020 with the ability to add capacity to the booster station of 12,500 gallons per minute. Within the next 20 years, pumps and motors will be added or upsized for the Five Mile Booster Station to meet demand. The Shawnee Booster Station is planned for a maintenance upgrade and will be evaluated for the full buildout of the Shawnee and Woodridge Pressure Zones at that time.

3.4.5 Storage Capacity Analysis

Each individual pressure zone was analyzed for storage adequacy. Capacity based on storage must consider both volume and pressure. Elevation within a reservoir determines the pressure that can be supplied and, subsequently, the type of service it can supply. The elevation delineates storage volume within a reservoir, as illustrated in Figure 3.31. The Water System Design Manual describes the types of service as Operational Storage, Equalization Storage, Standby Storage, and Fire Suppression Storage. The storage elements do not have individual capacity requirements, but act as one, and all need to be considered in the analysis.

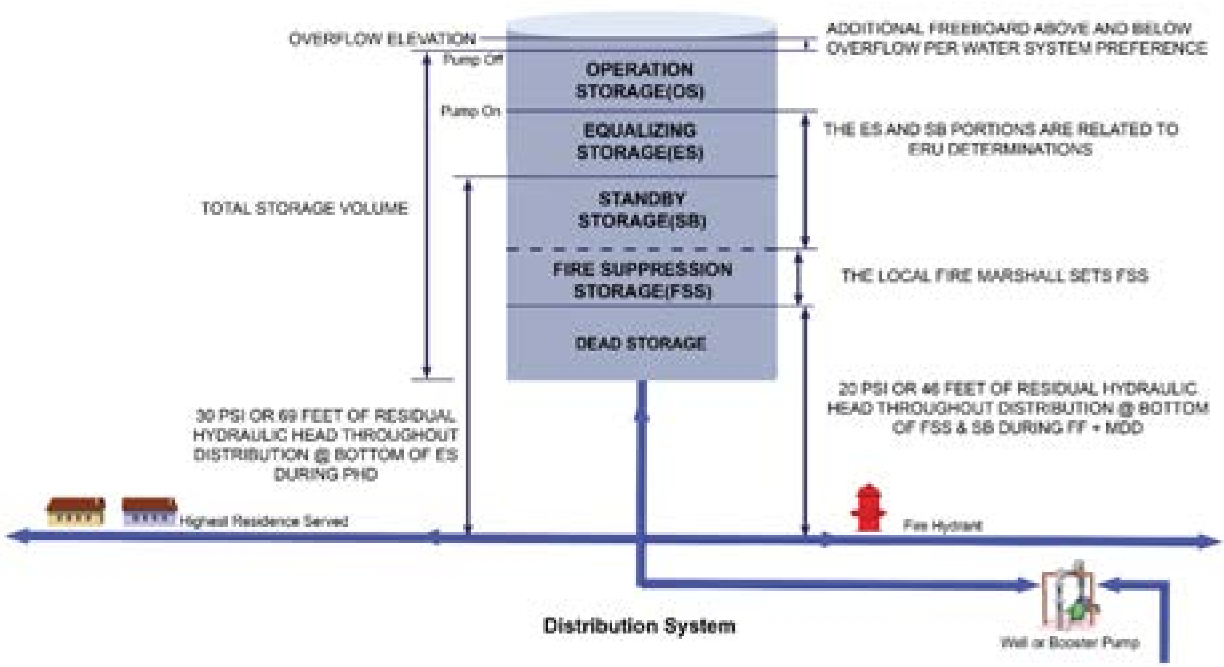


Figure 3.31 Reservoir Storage Components

The expected useful life of a storage reservoir is 100 years or longer. The storage analysis has focused on the 20-year demand requirements; however, new reservoirs will be sized to serve the projected 50 to 100-year growth or full buildout. Analysis of each of the storage components is detailed in this section.

Operational Storage (OS) volume is needed for daily operation and controls the pump on and off elevations. Operational Storage is not directly related to system capacity but must be provided for reliable and efficient operations. The City's Level of Service goal for daily operations is to supply a minimum of 45 psi. For some of our older pressure zones, this cannot be achieved 100% of the time, particularly during peak summer use, but the required minimum non-emergency pressure of 30 psi can be achieved. Operational Storage was analyzed using the hydraulic model (see Section 3.4.3) and spreadsheet calculations.

Equalization Storage (ES) is the volume needed to meet Peak Hour Demand requirements and is required for system capacity. Equalization Storage is required for pressure zones that have insufficient Peak Hour

Demand pumping capacity. If pumps cannot keep up with Peak Hour Demand for a pressure zone during the peak summer use, then Equalization Storage is required. Equalization Storage was calculated for pressure zones with insufficient pumping capacity to meet Peak Hour Demand and used Equation 4-6 from the Water System Design Manual.

Standby Storage (SB) and **Fire Suppression Storage (FSS)** can be consolidated or "nested" if approved by the designated Fire Marshal. The larger of the two volumes is the minimum storage required rather than adding the two volumes together. A letter from the Fire Marshal allowing the practice of consolidating the Fire Suppression Storage and the Standby Storage is contained in Appendix 3.10. With the consolidation, or nesting, of the fire suppression storage and the standby storage, the Water System Design Manual dictates that the larger of these two storage elements, plus any required equalization storage, becomes the "required storage" for the system. The City determined the larger of the two storage elements to analyze this storage capacity

Standby Storage (SB) is a volume of water reserved when supply becomes partially or completely unavailable for use during abnormal operating conditions such as a power outage, equipment failures, operational errors, transmission main breaks, SCADA communication failures, or source contamination. The Water System Design Manual recommends a volume equal to the Maximum Day Demand for a pressure zone, but the Standby Storage volume should be sized based on locally adopted standards. The storage volume for Maximum Day Demand includes outdoor water use and is four to six times the average day use for the City. The large volume of water used for Maximum Day Demand does not reflect emergency conditions but would create large and costly reservoirs with possible stagnation issues. The City has chosen the minimum standard recommended by Water System Design Manual of 200 gallons per Equivalent Residential Unit.

Fire Suppression Storage (FSS) is the volume reserve for fighting fires and does not relate directly to system capacity. Fire Suppression Storage has been determined for each pressure zone by the City of Spokane Fire Department or appropriate fire protection authority in locations of the service area outside the City of Spokane. Fire Suppression Storage for each pressure zone is not anticipated to increase in the next twenty years, but fire flowrates and duration for new development will be monitored for any changes. The amount of the Fire Suppression Storage required is based on the largest fire demand anticipated as dictated by building types within the pressure zone. Fire Suppression Storage has been analyzed in Section 3.4.2.

Dead Storage (DS) is the portion of the reservoir that does not provide the required minimum pressure of 20 psi at the highest elevation in the pressure zone. This portion of the storage is considered "non-effective." In 2021, the Water Department provided an extensive in-field analysis reviewing the 20 psi service elevation for each pressure zone and area. This information was used to update the Dead Storage elevation within each storage. Dead Storage does not directly impact storage capacity but is needed to determine the effective or usable storage volume.

Operational Storage Analysis

The current operational storage volume is compared to the operational storage required, which is shown in Table 3.32. The current operational storage represents the volume calculated between the elevations of summer operations to turn pumps on and off multiplied by the volume per foot. For pressure zones with multiple reservoirs, the volume per foot was summed for all the storage facilities. The Water System Design Manual recommends the minimum operational storage capacity should be 7.5 minutes times the pressure zone's boosting capacity. The City selected 30 minutes of pumping capacity because operational water levels can change rapidly during the summer months, and SCADA system data scans can be greater than 12 minutes. For these reasons, 30 minutes was selected for the calculation rather than 7.5 minutes. The High Pressure Zone needs additional operational storage.

Table 3.32 Operation Storage Volumes

Pressure Zone	Reservoir Names	Current Storage Used for Operation (gallons)	Current Operational Storage Required (gallons)	Future Operational Storage Required (gallons)
Low				
Cedar Hills	Cedar Hills	95,312	33,800	33,800
Eagle Ridge	Eagle Ridge	198,194	170,200	170,200
Eagle Ridge 2	Eagle Ridge 2	225,591	211,000	218,500
Highland	Highland	140,995	84,800	84,800
Woodland Heights	Sunset	88,122	48,500	48,500
SIA*	SIA #1 & SIA #2	708,440	215,500	889,600
West Plains	Mallen Hill	1,293,744	197,300	447,300
Low	Combine of 6 reservoirs	12,068,423	2,808,000	2,808,000
Intermediate				
Southview	Southview	32,241	24,500	24,500
Glennaire	Glennaire 2	313,933	54,700	64,600
Top	Brown Mountain Park 1 & 2	2,857,492	780,900	895,000
High	Garden Park & 33rd & Lamonte	1,016,437	1,285,200	1,285,200
Intermediate	Lincoln Heights 1 & #2, & 14th & Grande	9,569,920	1,537,500	1,537,500
North Hill				
Five Mile	Strong	382,081	262,500	345,100
Kempe	Kempe	445,367	149,300	149,300
Midbank	Midbank	84,597	69,900	69,900
Shawnee	Shawnee 1 & 2	39,948	37,400	37,400
Woodridge	Woodridge	113,994	12,600	13,800
North Hill	North Hill & Five Mile	13,839,333	1,692,000	1,692,000

SIA and High Pressure Zones are the only pressure zone that will need more Operational Storage in the future to meet minimum storage requirements. Current operational storage is used for all other pressure zones.

Equalization Storage Analysis

The pressure zones that do not have sufficient pumping capacity to meet the Peak Hour Demand are listed in Table 3.33. The volume has been calculated as the Peak Hour Demand minus the pumping capacity multiplied by 150 (Equation 4.5 from the Water System Design Manual). The volume has only been calculated using the 20-year demand. Increasing pumping or storage is required to meet the Peak Hour Demand requirements. The selected solution is shown the Table 3.33.

Table 3.33 Pressure Zones Requiring Equalization Storage

Pressure Zone	**Future Required ES Volume, gallons**	**Selected Solution**
Five Mile	413,200	Increased pumping capacity at Five Mile Booster Station
Glennaire	49,100	Increased pumping capacity at Glennaire Booster Station
SIA	2,241,100	New storage facility
Top	570,600	Increased pumping capacity at 35th & Ray Booster Station
West Plains	1,250,000	New storage facility
Woodridge	5,980	Utilization of existing connection to Kempe Storage Reservoir

Nested Standby and Fire Suppression Storage Analysis

The minimum volume required for nested storage is the larger volume between Standby Storage and Fire Suppression Storage. The required current and future standby storage volume requirements and the current Fire Suppression Storage are shown in Table 3.34. In general, the Fire Suppression Storage is larger for smaller pressure zones, and Standby Storage is larger for larger pressure zones**.**

Table 3.34 Nested Storage Volumes

Pressure Zone	Required Current SB (gallons)	Required Future SB (gallons)	Required FSS (gallons)	Larger Volume-SB compared to FSS
Low				
Cedar Hills	45,400	70,304	210,000	210,000
Eagle Ridge	92,400	208,623	210,000	210,000
Eagle Ridge 2	188,000	363,829	210,000	363,829
Highland	189,000	233,670	675,000	675,000
Woodland Heights	62,800	66,012	210,000	210,000
SIA	1,174,200	1,948,432	1,440,000	1,948,432
West Plains	966,400	1,484,823	1,440,000	1,484,823
Low	10,779,300	12,476,432	1,440,000	12,476,432
Intermediate				
Southview	8,800	8,664	FIRE PUMP	8,664
Glennaire	106,000	107,477	210,000	210,000
Top	2,461,400	2,947,643	960,000	2,947,643
High	2,033,400	2,053,200	960,000	2,053,200
Intermediate	1,966,000	2,283,422	960,000	2,283,422
North Hill				
Five Mile with Indian Hills	424,600	617,581	210,000	617,581
Kempe	117,000	244,670	210,000	244,670
Midbank	182,600	123,496	210,000	210,000
Shawnee	33,200	36,012	210,000	210,000
Woodridge	13,600	66,012	210,000	210,000
North Hill	8,260,300	9,206,845	1,440,000	9,206,845

Table 3.34 compares current storage volumes with Standby Storage that will be required in 2040.

Overall Storage Requirements for Current Conditions and 20-Year Projections

The Operational Storage requirements are based on pump operations and service pressures within the pressure zone. Operational Storage is assumed to be the same in the future. Equalization Storage was calculated for the future Peak Hour Demand and is assigned to pressure zones where future Peak Hour Demand will not be met from pump station upgrades. The total available storage is compared to the future storage needed in each pressure zone in Table 3.36. Note that the Spokane International Airport #3

Reservoir is not included in this evaluation, but construction is expected to be finished by 2024. SIA #1 Reservoir is included in the Table 3.36 because it is expected to remain in service until repairs become financially in feasible. The new High System Reservoir at Hamblen School and 33rd & Lamont Reservoir are not included in the calculations for High Pressure Zone.

Several pressure zones need additional storage for future growth. The storage requirements will be met by new storage reservoirs or by connecting to a pressure zone at a higher elevation. A detailed description follows.

- A project has been identified for Cedar Hill (titled Fire Suppression System Upgrades) in the Six Year Program.
- A new storage reservoir for Highland Pressure Zone is in the 2023 to 2028 Six Year Program; however, the primary deficit is SB/FSS Nested Volume. A fire pump has been installed at Sunset Reservoir in Woodland Height Pressure Zone and a PRV at Abbot Road from SIA Pressure Zone to resolve this deficit.
- A new storage reservoir is undergoing construction for the Spokane International Airport Pressure Zone. In addition to the new SIA #3 Reservoir, SIA #1 Reservoir will need to be replaced to meet projected future storage needs.
- A portion of the storage in Low Pressure Zone storage will be met by Thorpe Reservoir #2, currently in the Six Year Program. A second reservoir adjacent to Qualchan Reservoir will be constructed in the next 20 years to provide storage necessary for growth.
- Additional storage will be needed for growth in the West Plains Pressure Zone. The City has purchased additional property adjacent to Thomas Mallen Reservoir that services West Plains Pressure Zone in anticipation of additional storage needed for growth. A second reservoir is planned in the next 20 years at this site.
- A new storage reservoir is undergoing construction for the High Pressure Zone next to Hamblen Elementary School.
- Storage deficits in Woodridge Pressure Zones are currently being managed by the connection to the Kempe Reservoir, but this capacity will be needed for growth. An additional reservoir will be needed to provide storage for Shawnee and Woodridge Pressure Zones.
- North Hill Pressure Zone will need additional storage for growth in the next 20 years.

The capacity analysis shows Eagle Ridge has sufficient capacity; however, the discharge pipe is too small to allow flow to the reservoir. An additional reservoir is planned for Eagle Ridge Pressure Zone to accommodate growth based on the analysis described in Appendix 3.9.

Table 3.35 Storage Reservoir Summary

Pressure Zone	Future Operational Storage (gallons)	Future ES Volume Needed, gallons	Future Total SB/FSS Nested Volume Needed, gallons	TOTAL Future Storage Volume Needed, gallons	Current Storage Volume, gallons	Future Surplus or (Deficit) Storage , gallons
Low						
Cedar Hills	95,312	0	210,000	305,312	295,468	(9,844)
Eagle Ridge	198,194	0	210,000	408,194	445,355	37,161
Eagle Ridge 2	225,591	0	303,321	589,420	759,867	170,447
Highland	140,995	0	675,000	815,995	507,205	(308,790)
Woodland Heights	88,122	0	210,000	298,122	304,607	6,485
SIA	889,649	2,241,144	1,948,432	5,079,225	2,245,311	(2,833,914)
West Plains	1,293,744	1,249,952	1,484,823	4,028,519	3,763,230	(265,289)
Low	12,068,423	0	12,476,432	24,544,855	22,304,434	(2,240,421)
Intermediate						
Southview	32,241	0	0	32,241	43,318	11,077
Glennaire	313,933	0	210,000	523,933	912,059	388,126
Top	2,857,492	0	2,947,643	5,805,135	10,053,861	4,248,726
High	1,016,437	0	2,053,200	3,338,400	2,209,276	(1,129,124)
Intermediate	9,569,920	0	2,209,437	11,853,342	19,938,117	8,084,775
North Hill						
Five Mile	382,081	0	617,581	999,662	1,239,897	240,235
Kempe	445,367	0	244,670	690,037	847,809	157,772
Midbank	84,597	0	210,000	294,597	454,943	160,346
Shawnee	39,948	0	210,000	249,948	60,422	(189,526)
Woodridge	113,994	5,979	210,000	329,973	203,117	(126,856)
North Hill	13,839,333	0	9,206,845	23,046,178	19,979,392	(3,066,786)

3.4.6 Transmission and Distribution System Capacity Analysis

Capacity was analyzed for transmission mains to deliver flow from the sources (well and booster stations) to storage and with the computer model. Distribution mains were analyzed using the computer model based on results of pressure, velocity, and head loss.

Transmission Mains Analysis

The City assessed the capacity of suction and discharge pipe surrounding each well or booster station in the system for each individual station. The capacity calculations include transmissions on a system basis and the additional demands to upgradient pressure zones from the stations. Transmission mains were assessed for the suction and discharge transmission mains located near the well and booster station, usually around 500 feet or less, in conjunction with the Well Station and Booster Pump Station assessment in Section 3.2.2. A more intensive analysis using the complete model was performed for multiple scenarios, reviewing velocities, head loss, and pressures for the three well-supplied systems.

The individual analysis compared the booster or well station pumping flowrate to the transmission pipe capacity based on a pipe velocity of five feet per second or less up to joining the large transmission network. The results of transmission capacity for each well station capacity are shown in Table 3.37. Pressure zones supplied include all the upgradient pressure zones supplied by either Low, Intermediate, or North Hill wells. The total pumping capacity was used in this analysis because the existing well station capacity is sufficient to meet the 20-year projected demands. The transmission mains needed for capacity in the next twenty years are shown in Figure 3.32

Transmission mains from Parkwater for the well are needed in the future for full station pumping capacity. The transmission mains from Well Electric New Well Station will be designed to deliver the flow from the new pumps and with the construction of the new well station. Transmission mains for Grace Well Station may operate at velocities greater than five feet per second for short time periods during the summer season but not greater than eight feet per second, and additional pipes are not expected to be needed in the next 20 years.

Table 3.36 Transmission Main Capacity for Total Pumping Capacity for Well Stations

Pressure Zone Supplied	Well Station Name	Total Pumping Capacity per Pressure Zone (gpm)	Transmission Main Size	Transmission Combined Capacity (gpm)	Remaining Capacity in All Transmission Main (gpm)
Low	Nevada	32,700	Three 30-inch & Three 36-inch	54,000	21,300
Low	Well Electric	13,300	36-inch	16,000	2,700
Low	Parkwater	47,700	18-inch & 42-inch	26,000	(21,700)
Intermediate	Well Electric	6,500	30-inch	11,000	4,500
Intermediate	Parkwater	12,600	24-inch	7,000	(5,600)
Intermediate	Ray Street (Current + future)	17,000 + 3900 = 20,900	36-inch	32,000	15,000
Intermediate	Havana (in construction)	11,250	Shared 36-inch	16,000	4,750
North Hill	Well Electric	16,800	30-inch to 36-inch to 42-inch	11,000	(5,800)
North Hill	Hoffman (In construction)	11,000	Two 30-inch	22,000	11,000
North Hill	Grace	18,000	36-inch	16,000	(2,000)
North Hill	Central	16,000	30-inch & 24-inch	44,000	28,000

The results of transmission capacity for each booster station capacity are shown in Table 3.38. The booster station total pump capacity is compared to the future Peak Hour Demand, including upgradient Maximum Day Demand, to determine the impact growth will have on transmission capacity. Future flowrates represent the 20-year projected flows.

The discharge transmission mains for Eagle Ridge, Highland, and West Plains Pressure Zones do not have enough capacity for either current or future flowrates. The discharge transmission main for the Five Mile Pressure Zone does not have enough capacity for future flowrates. Both the suction and discharge of the Eagle Ridge 2 Pressure Zone will need additional transmission capacity for future growth. While the combined capacity of Spokane International Airport Pressure Zone transmission is sufficient, the growth in the West Plains Pressure Zone and the planned expansion of Thorpe Booster Station will focus more flow to the southern area of the pressure zone. Additional suction and discharge main capacity will be needed with the construction of the Thorpe Booster Station upgrade and additional capacity. The Top Pressure Zone will need additional transmission main capacity and booster station capacity planned for the 35th & Ray Booster Station. The transmission mains will be evaluated with the design of the 14th & Grand Booster Station rehabilitation projects.

Additional supply to the West Plains interties may require additional or larger pipes from the wells and booster stations. Additional modeling and analysis will be needed to determine pipe sizes and additional pipes when for the requested flowrates.

Table 3.37 Transmission Main Capacity for Total Pumping Capacity for Booster Stations

Pressure Zone Supplied	Booster Station Name	Current Total Pumping Capacity (gpm)	Current PHD + Upgradient MDD(gpm)	Future PHD + Upgradient MDD (gpm)	Suction Side of Booster Station		Discharge Side of Booster Station	
					Size	Capacity (gpm)	Size	Capacity (gpm)
Low								
Cedar Hill	Cedar Road	1,125	968	968	24-inch	7,000	12-inch	1,700
Eagle Ridge	Eagle Ridge	5,672	2,642	5621	12-inch	1,700	12-inch	1,700
Eagle Ridge 2	Eagle Ridge 2	7,033	1,189	2,314	12-inch	1,700	12-inch	1,700
Eagle Ridge 2	Cedar to Eagle Ridge	250	0	250	12-inch	1,700	8-inch	800
Highland	Milton	2,826	2,290	3,420	12-inch	11,000	12-inch	1,700
Woodland Heights	West Drive (Two Pumps)	1615	984	1,027	Shared 36-inch	16,000	Two 12-inch	3,400
SIA	West Drive (Three Pumps)	7,184	13,413	25,281	Shared 36-inch	16,000	36-inch	16,000
SIA	Thorpe	7,530			30-inch	11,000	30-inch	11,000
West Plains	Spotted Road	6,577	10,785	15,389	18-inch & 30-inch	15,000	24-inch	7,000
Intermediate								
Intermediate	Bishop Court	5,600	5,600	5,600	30-inch	11,000	18-inch	4,000
Intermediate	9th & Pine	8,000	8,000	8,000	36-inch	16,000	Two 24-inch	14,000
Southview	Southview without fire pump	818	292	298	12-inch	1,700	12-inch	1,700
Glennaire	Glennaire	1,827	2,130	2,158	36-inch	16,000	Two 12-inch	3,400
Top	Division & Manito	2,174	26,215	29,762	18-inch	4,000	18-inch	4,000
Top	Garden Park	14,785			24-inch	7,000	30-inch	11,000
Top	35th & Ray	9,070			24-inch	7,000	24-inch	7,000
High	Lincoln Heights	37,260	30,193	33,201	30-inch & 36-inch	27,000	30-inch & 36-inch	27,000
High	14th & Grand	5,579			Two 24-inch	14,000	24-inch	7,000

Pressure Zone Supplied	Booster Station Name	Current Total Pumping Capacity (gpm)	Current PHD + Upgradient MDD(gpm)	Future PHD + Upgradient MDD (gpm)	Suction Side of Booster Station		Discharge Side of Booster Station	
					Size	Capacity (gpm)	Size	Capacity (gpm)
North Hill								
Kempe	Kempe	4,975	2,360	3,285	24-inch	7,000	24-inch	7,000
Midbank	Belt	2,329	1,559	1,623	30-inch Shared	11,000	12-inch	1,700
Woodridge	Woodridge	420	412	488	12-inch	1,700	8-inch	800
Shawnee	Shawnee	1,247	797	900	12-inch	1,700	12-inch	1,700
Five Mile	Five Mile	8,750	6,810	11,246	Two 36-inch and 24-inch	32,000	Two 18-inch	8,000
West Side	Latah Inline Booster	16,000	19,000	31,000	30-inch	11,000	30-inch	11,000

Transmission mains were identified from the InfoWater Computer Model results to increase looping and provide additional resiliency and redundancy. Transmission main size will be finalized before project design because oversizing may cause major stagnation and debris buildup while under sizing the mains will lead to high velocities, higher energy usage, and needed additional capacity. The City may be willing to accept high velocities in the transmission mains for a short term while the transmission project scope and funding are determined.

The Marshall Road Transmission Main project will provide adequate flow to the southwest area of the service area, south of Thorpe Road. This capacity is required to fill Qualchan storage and reduce the high velocities in mains along US Highway 195 to Eagle Ridge Boulevard. Marshall Road transmission is needed to supply this area, plus the Cedar Road Transmission Main. The Thorpe Booster to Eagle Ridge 12-inch transmission pipe was not sized for future growth.

The Latah Inline Booster Station on the west side of the City to Thorpe Reservoir in the Low Pressure Zone needs additional transmission mains. Growth in this area is expected to have the largest increase in demand over the next 20 years. Velocities are currently approaching five feet per second during the Maximum Day Demand scenarios.

Transmission mains supplying Northwest Terrace Pressure Zone currently have velocities greater than 12 feet per second, and growth is expected in this pressure zone over the next 20 years. New transmission mains and additional pressure-reducing valves (PRV) projects are in the Six Year Program.

The Low Pressure Zone to Spokane International Airport and Woodland Heights Pressure Zone is the Whistalk's Way Transmission Main Replacement and Upsize project to increase capacity and looping to these pressure zones.

Operations have specifically identified that the Top Pressure Zone is difficult to keep supplied. Initially, tanks were considered to be the concern, but pumps cannot keep up with current demands, and growth is expected in this pressure zone. Additionally, velocities are high around 35th and Ray to the Garden Park Booster Station. The 35th and Ray station is located directly south of the new Havana Well Station and will provide transmission south from the new well.

Freya Street Transmission Main, Garland Avenue to Francis Avenue, is required to replace aging pipe and provide growth capacity in the North East Public Development Authority.

Large undeveloped areas in the Highland Pressure Zone are expected to develop in the next 20 years. Milton 12-inch transmission pipe will not be able to support future 20-year growth demands alone. A secondary booster station and transmission main are needed to feed the Highland Pressure Zone.

The North Hill Pressure Zone needs additional transmission mains for high velocities and head loss, leading to low flow and pressures in the northwest portion of the service area. Transmission mains are needed from Division Street to Indian Trail Road and in the Indian Trail area for current demand and future growth.

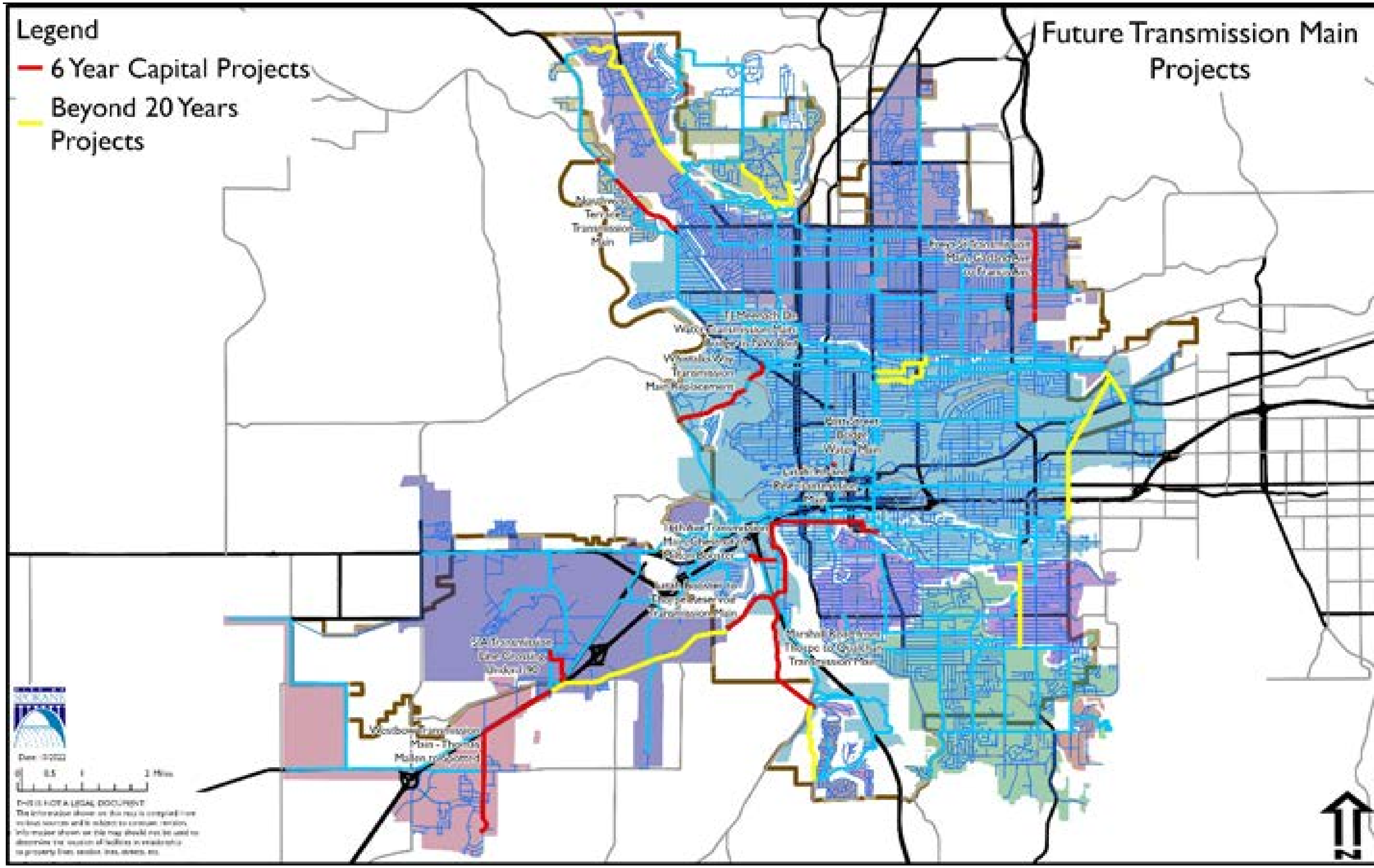


Figure 3.32 Future Transmission Main Projects

Distribution System Analysis

Distribution system capacity is based on delivering Peak Hour Demand while maintaining pressure levels of 30 pounds per square inch and not less than 20 pounds per square inch for existing systems (See Section 4.4.4). The water system was analyzed using the InfoWater Computer Model. This analysis focused on pipe velocities with associated head loss and the resulting pressure.

Modeled Scenarios

Winter, Average Day Demand, Maximum Day Demand, and Peak Hour Demand steady scenarios were developed within the model for existing and future scenarios, as mentioned. Winter and Summer Extended Period Simulation scenarios were developed from the calibrated Winter and Summer Extended Period Simulation scenarios. Future demand projections were added to the Maximum Day Demand, Peak Hour Demand, and Extended Period Simulation Summer scenarios. The intertie usage was increased to specified agreement levels.

Results Pressures

Pressures range greatly across all pressure zones for both existing and future conditions. Generally, pressures range from 45 to 80 pounds per square inch. Pressures range from over 120 pounds per square inch in transmission mains to below 30 pounds per square inch at the base of the water storage location, but not typically at the service location. Pressure complaints are tracked, and meters with higher pressures have pressure-reducing valves within the property. The pressure results for the current and future Maximum Day Demand Scenario and Peak Hour Demand Scenario are found in Table 3.39.

Generally, pressures are reduced when comparing the existing and future Maximum Day Demand and Peak Hour Demand scenarios. Pressures further reduce slightly from Maximum Day Demand to Peak Hour Demand scenarios but did not change significantly because reservoir water elevations were not modified from current operations. The Kempe, North Hill, and Spokane International Airport Pressure Zones experienced lower pressures due to increased future demands. The Low Pressure Zone experienced lower pressures because this is the oldest pressure zone with a small operational head range, and a small increase in demand has a greater impact. No specific capital projects are recommended from the pressure analysis review alone, however the capital projects planned for reservoirs, booster stations, and transmission mains will be needed to ensure the reservoir water elevations can be maintained.

Table 3.38 Model Result System Pressures per Pressure Zone

	Existing Pressure for MDD		Existing Pressure for PHD		Future Pressure for MDD		Future Pressure for PHD	
Pressure Zone	**Highest (psi)**	**Lowest (psi)**	**Highest (psi)**	**Lowest (psi)**	**Highest (psi)**	**Lowest (psi)**	**Highest (psi)**	**Lowest (psi)**
Cedar Hills	133	35	131	34	134	35	132	34
Eagle Ridge	159	39	152	33	158	39	154	35
Eagle Ridge 2	87	49	111	51	86	49	107	51
Five Mile	155	40	148	33	156	47	146	34
Glennaire	178	60	170	56	178	60	170	55
Hatch Road	120	30	116	30	120	30	118	30
High	141	35	132	33	138	33	137	32
Highland	211	42	202	40	197	42	192	40
Indian Hills	122	67	122	67	122	67	122	67
Intermediate	151	32	147	29	151	31	148	29
Kempe	71	41	65	35	71	41	36	18
Low	157	29	147	22	156	28	150	25
Midbank	112	52	108	47	112	52	109	48
North Hill	121	30	108	30	121	30	109	17
Northwest Terrace	118	30	116	30	119	30	117	30
Shawnee	101	53	97	52	102	53	97	52
SIA	161	41	147	35	160	40	134	23
South View	109	56	105	52	109	56	105	52
Top	108	32	104	28	117	38	114	36
West Plains	114	35	109	33	113	35	107	33
Woodland Heights	139	83	123	57	138	83	136	84
Woodridge	116	43	114	42	116	43	115	43

Velocities Results

According to current City Design Standards, velocities can be up to five feet per second for Maximum Day Demand and 15 feet per second during fire flow conditions but do not specify acceptable velocities for Peak Hour Demand. The American Water Works Association standards recommend velocities to remain below eight feet per second or provide water hammer analysis. The design standards are further described in Section 3.3.

A few locations have high velocities other than the suction and discharge side of booster stations. The known locations of high pipe velocities are:

- The Pressure Reducing Valve feed from Low to Northwest Terrace
- The transmission that feeds Indian Hill tank from Five Mile Pressure Zone
- Eagle Ridge area transmission main,

- Milton Booster Station and south Highland area
- Latah Booster Station
- 35th and Ray Booster Station, Garden Park Booster Station, Well Electric and Parkwater, Grace, and Nevada Well Station pipes are undersized for pumping capacities.
- Northwest Terrace PRVs were monitored in 2018-2019, and monitoring results showed that during summer periods, the PRVs could experience a velocity of 12 feet per second. Selected capital projects are selected based on model results and additionally other capital projects planned.

The future Maximum Day Demand and Peak Hour Demand scenarios show a slight increase in velocities. In general, the velocities were slightly higher in the same areas as the existing system scenario. The velocity increase was not significant enough to identify additional projects.

Head Loss Results

High head loss areas in the water system network are located mostly in 6-inch distribution mains or smaller. Areas identified with high head loss are generally due to pipe age and material and include:

- The downtown area
- West Central neighborhood
- Emerson Garfield neighborhood near Monroe Street
- Portions of the Highland and Woodland Heights Pressure Zones
- Eagle Ridge 2
- Freya and Ray Street area from 18th Avenue to 37th Avenue.

Head loss was not considered when selecting capital projects because oftentimes, higher head losses are associated with high velocities in larger-diameter pipes. Otherwise, many pipes are older or made with a “rougher” material and should be replaced with the pipe replacement program.

Head loss results changed slightly from the current conditions to future conditions. The quantity of higher head loss pipes increased. High head loss areas in the water system network are located mostly in six-inch distribution mains, older cast iron pipes, or riveted steel pipes. Where there is high velocity is also associated with high head loss. Downtown and Milton also have higher head losses due to the age and material type located in those areas. The transmission main from Five Mile storage to the Indian Trail transmission main and the furthest northwest extent of the Spokane service area also can experience high head loss. The capital program to replace water main pipes will slowly address this issue.

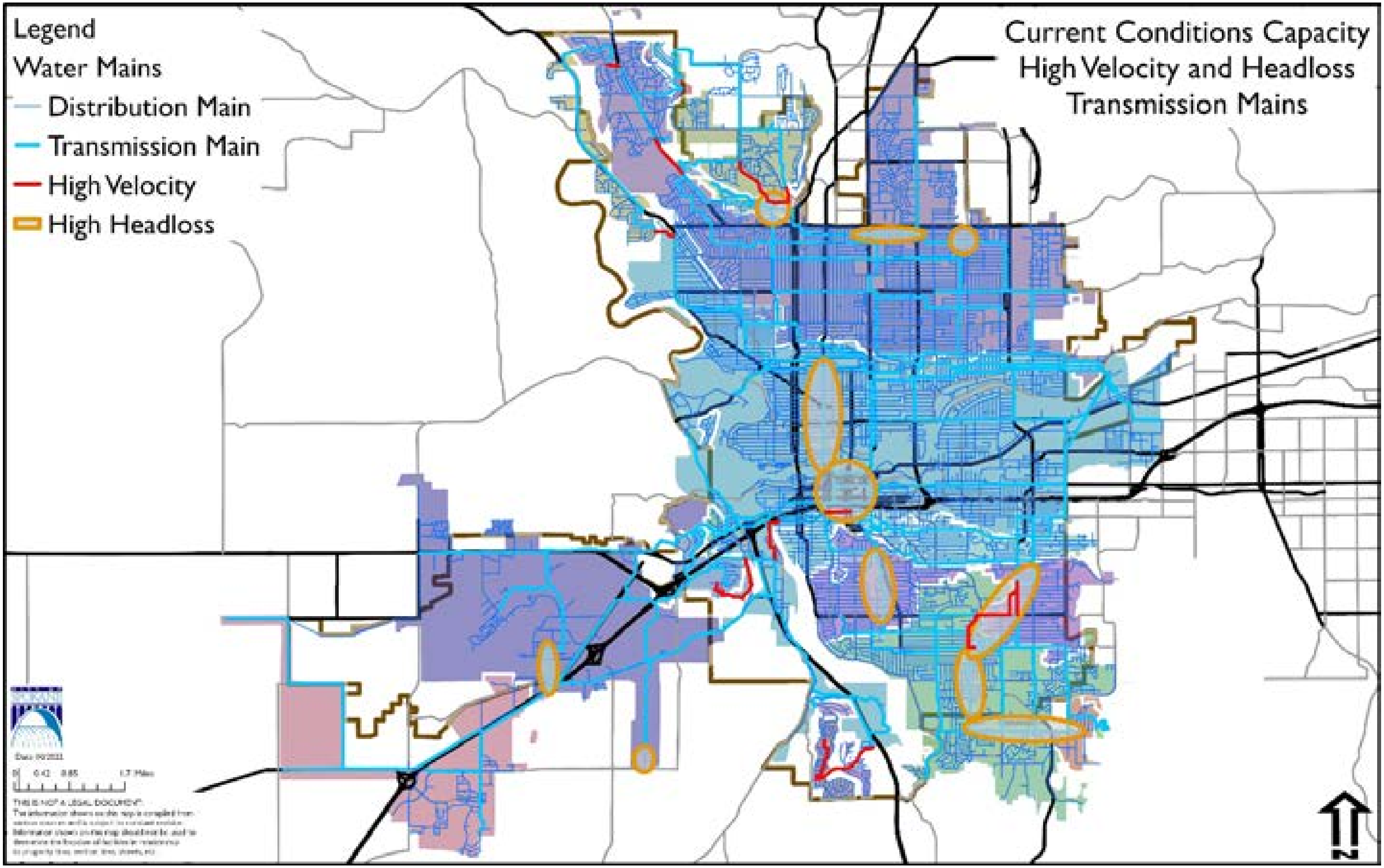


Figure 3.33 The Current Transmission Conditions Model Capacity Analysis

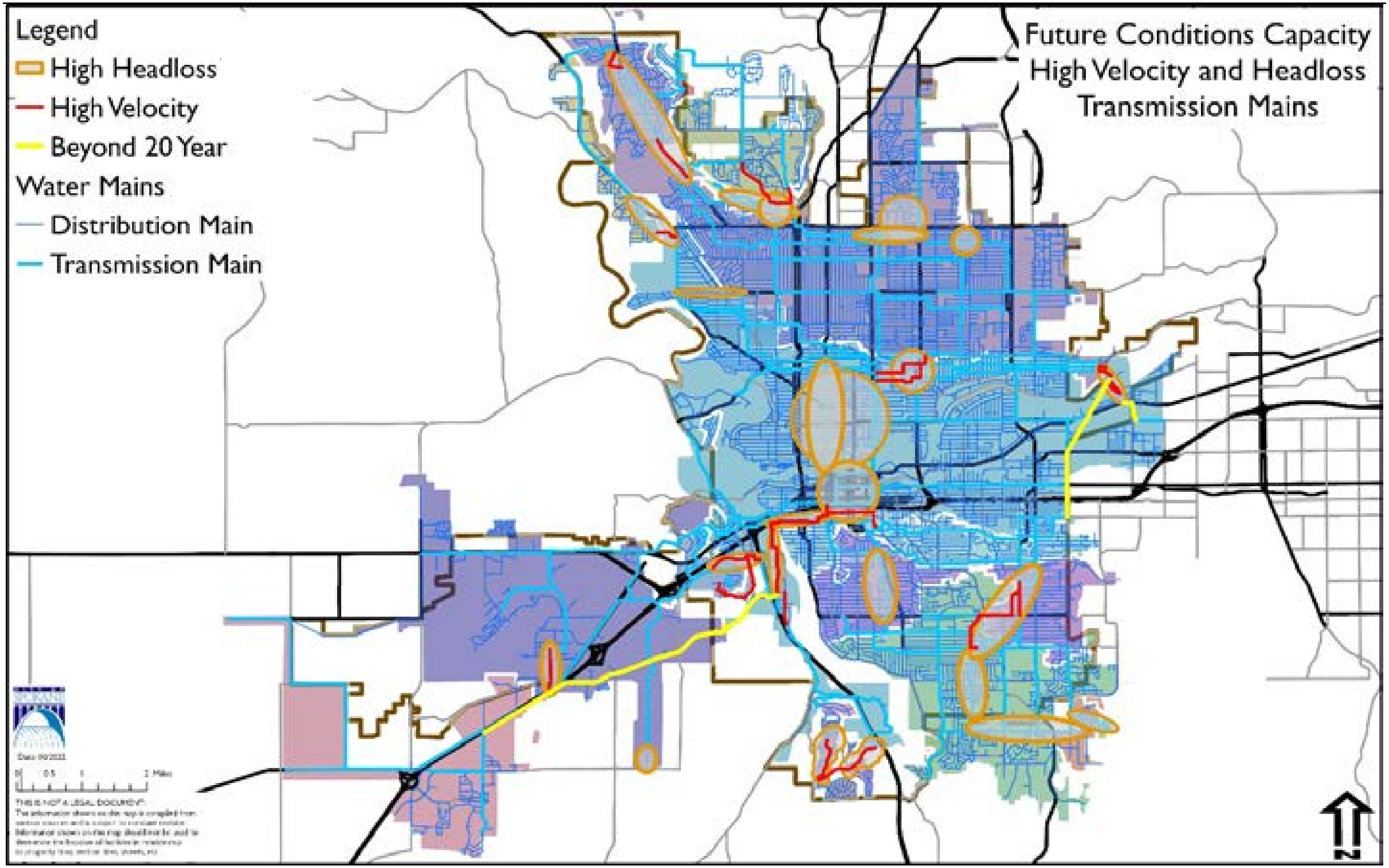


Figure 3.34 ***The Future Transmission Conditions Model Capacity Analysis***

Summer Extended Period Simulation Scenario Results

Extended Period Simulation scenarios for summer demands reveal whether the system can keep up with demands as it increases or decreases throughout the day for both existing and future conditions.

In the existing Extended Period Simulation scenario, starting at hour 32 of the 48-hour simulation, the system starts to strain to keep up with demands. This is the second morning represented in the model when people get up to start the day, and irrigation systems turn on. The tanks' drain and filling cycles can be seen in the graphs in the Model Capacity Analysis Report in Appendix 3.7.

The model results confirmed planned capital projects in the future Extended Period Simulation scenario. There is also some modeling instability with the future demands and no additional six-year capital program infrastructure implemented.

The results of the future Extended Period Simulation scenarios:

- The Kempe to Woodridge transmission main connection was opened because Woodridge would drain completely otherwise.
- The model results further validated that a Spokane International Airport #3 tank is required because tank levels were empty.
- The model results further validate that the West Plains Pressure Zone requires additional pumping to keep up with intertie demands and future growth.
- Shawnee also requires additional storage and pumping. Woodridge maintains fullness only due to the Kempe to Woodridge interconnection, activated in the future Extended Period Simulation Summer Scenario.
- The model further validates the need for improvements in Spokane's northwest area.

Extended Period Simulation Minimum Pressures and Maximum Velocities

The minimum pressures and max velocities experienced during the existing and future Extended Period Simulation Summer Scenario are in the same locations as identified in the steady state scenarios. No additional capital projects are required from the Extended Period Simulation Summer Scenario. Areas of concern are already noted. The Five Mile Booster Station increased pumping and velocities increased to keep supply of the Indian Hills tank and to supply the upgradient pressure zones. Additionally, Central Well Station was activated to support the additional draw from Five Mile. Northwest Terrace and the pressure-reducing valve area transmission mains within the Low and North Hill Pressure Zones conditions worsen. The Latah Booster Station transmission condition worsens on both the suction and discharge transmission mains. The transmissions between the Lincoln Booster Station and 35th and Ray and Garden Park also worsen. The Eagle Ridge Booster Station transmission mains worsen as well.

3.4.7 Fire Suppression Analysis

The ability of the City's water system to suppress fire was analyzed in two ways. The first method was spreadsheet calculations based on the Water System Design Manual, and the second method was using the InfoWater Computer Model. This analysis assumes fire suppression will be required in only one pressure zone at a time.

Following the Water System Design Manual, fire suppression can be provided by storage reservoirs, booster stations, or multiple sources. The Fire Suppression Storage volume can be reduced if all the conditions of Water System Design Manual 7.1.1.4 are met, as shown in Figure 3.35. For every condition, a minimum pressure of at least 20 psi needs to be maintained.

Water systems with multiple sources

Design engineers may justify a reduction of FSS volume based on meeting all of the following conditions:

1. Exclude the capacity of the largest producing supply source from the calculations.
2. Each source of supply (excluding the largest source) is:
    a. Supplied by permanent on-site auxiliary power that starts automatically when the primary power feed is disrupted.
    b. Capable of operating for the full duration of the maximum fire at the source's designated flow rate.
3. Maintain at least 20 psi under needed fire flow plus MDD conditions throughout the distribution system for the full duration of the maximum fire.
4. The engineer obtains the local fire protection authority's written consent for the design approach taken.

Figure 3.35 Fire Suppression Conditions

The storage capacity analysis in Section 3.4.2 identifies Fire Suppression Storage needed for each pressure zone as part of larger volume in the nested storage with standby storage. The Fire Suppression Storage volumes are met in most pressure zones, as shown in Table 3.40. The Spokane International Airport #3 Reservoir, currently under construction, will provide the additional Fire Suppression Storage needed. A new reservoir is planned for the Highland Pressure Zone in the current Six Year Program for water. A pipeline has been installed from the Kempe Reservoir to the Woodridge Reservoir to supply Fire Suppression Storage. The Woodridge Pressure Zone can also feed the Shawnee Reservoir from the Kempe Pressure Zone. The Cedar Hills Booster Station will meet the small deficit in the Cedar Pressure Zone. The Southview Pressure Zone has a fire pump with permanent onsite auxiliary power with adequate capacity to meet the fire protection flowrate.

Table 3.39 Pressure Zones with Adequate Fire Suppression Conditions

Pressure Zone	Required FSS (gallons)	Current FSS Volume, gallons	Deficit or Surplus Storage, gallons
Low			
Cedar Hills	210,000	200,156	(9,844)
Eagle Ridge	210,000	247,160	37,160
Eagle Ridge 2	210,000	534,276	324,276
Highland	675,000	366,210	(308,790)
Woodland Heights	210,000	216,486	6,486
SIA	1,440,000	883,493	(556,507)
West Plains	1,440,000	2,469,487	1,029,487
Low	1,440,000	6,939,343	5,499,343
Intermediate			
Southview	FIRE PUMP	11,077	fire pump

Glennaire	210,000	251,352	41,352
Top	960,000	7,143,730	6,183,730
High	960,000	1,466,796	506,796
Intermediate	960,000	8,954,711	7,994,711
North Hill			
Five Mile with Indian Hills	210,000	857,816	647,816
Midbank	210,000	370,346	160,346
Kempe	210,000	402,442	192,442
Shawnee	210,000	20,474	(189,526)
Woodridge	210,000	89,123	(120,877)
North Hill	1,440,000	4,964,258	3,524,258

Future Fire flow Scenarios

In the past, there have fires exceeding that required fire flowrates of 10,000 gallons per minute for buildings not constructed with fire sprinklers. Several factors could require higher fire flow, including multiple fire locations, the extent of fire growth prior to responder arrival, building age, or level of building maintenance.

An extreme fire flow scenario was created in the model where 59 hydrants were activated with selected fire flowrates based on critical buildings throughout all pressure zones. These 59 hydrants are all activated during the scenario. The model scenario created had future 20-year flow demands without the planned six-year capital projects, while tank water levels were all set to the top of the fire flow storage, and the booster station pumps were all activated except for the largest pump. These hydrants all simultaneously operated during the fire flow scenario. Hydrant fire flowrate was selected based on the type of structure that the hydrants were nearby and the required fire flowrate for the entire pressure zone. These fire flowrates and locations are described in the Model Capacity Analysis Report included in Appendix 3.7. The model was tested with many of the pressure zones' summed hydrant fire flow demand rate per pressure zone and was larger than the required fire flowrate for that pressure zone. The model was solved, and the selected hydrants, tested flow, residual pressure, and actual flow available for each hydrant are shown in Figure 3.35. Not every hydrant could meet the fire flow demands required, but the combination of hydrants within the looping water system network were able to meet the required demands. Figure 3.35 shows the hydrant locations tested.

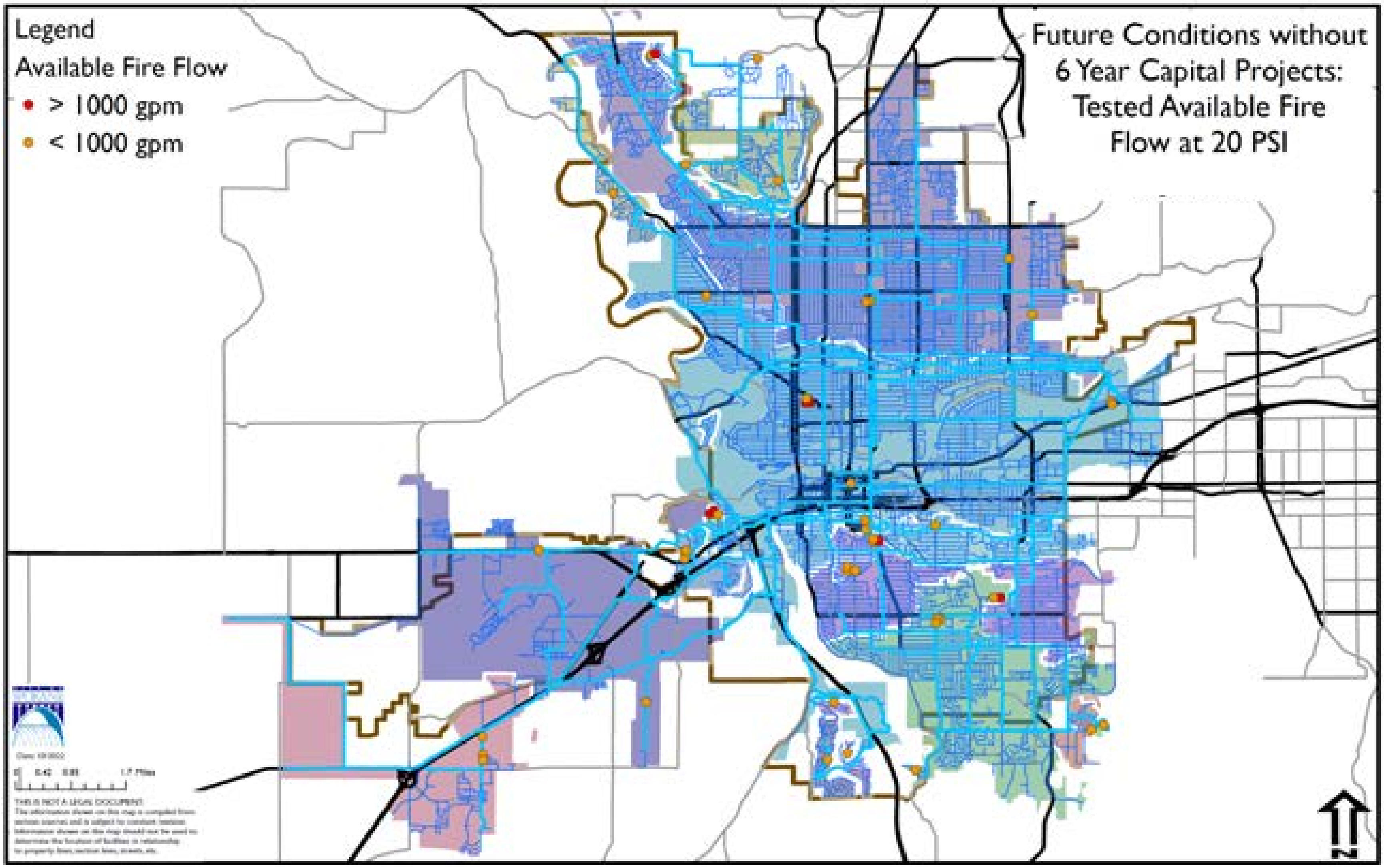


Figure 3.35 Fire Flow for Future Conditions without Capital Project

3.4.8 New Source of Supply Analysis

The City’s water source, the Spokane Valley/Rathdrum Prairie Aquifer, has no signs of reduced capacity in the future, as discussed in Section 2.5. Local purveyors have wellhead protection plans to reduce the risk of contamination. Currently, the City does not need to request additional water rights within the planning horizon of this Water System Plan. The current well stations have sufficient supply for growth within the next20 years.

Supply to the water system is located on the City's eastern side. In the future, evaluation of increased production in the vicinity of the Central Well to supply increased demand on the west side of the system may conclude additional wells are feasible and necessary to provide adequate service.

3.4.9 New Development

The analysis in this chapter has focused on the City’s water system and the necessary capital to maintain adequate service for the next 20 years. In addition, private developments will construct portions of the City’s water system that will be reviewed and accepted as described in Chapter 7. The Beacon Hill Booster Station is currently under construction and will be added to the City’s assets when it is operational. A reservoir will also be required for development at Beacon Hill.

3.5 Summary of System Deficiencies

Deficiencies are defined in this section as water infrastructure needed for the 20-year planning horizon and include additional capacity needed for growth as well as replacement and rehabilitation to the existing system. Deficiencies in the City’s water system have been identified from conditional assessments of the existing system, capacity analysis of the existing system, Emergency Response Plan results for improved resiliency, fire flow requirements, and projected demands for development.

System deficiencies have been organized by the type of facility (well station, booster station, reservoir, transmissions, distribution, or Supervisory Control and Data Acquisition). The type of deficiency is based on the analysis earlier in this chapter. Table 3.41 summarizes the deficiencies and proposed solutions. Most project solution solve multiple type of deficiencies as noted the table. Chapter 8 discusses the Capital Improvement Program for the next 20 years. The financial capacity is discussed in Chapter 9.

Table 3.40 Summary of Deficiencies and Solutions

Type of Facility	Project Solution	Pressure Zone	Project Deficiency and Solution	Type of Deficiency	Discussion	Priority
Booster Station	Cedar Road Booster Station Backup Power	Cedar Hill	The pump station is needed to meet fire flow requirements in addition to the Cedar Hills Reservoir. To meet Washington State regulations to provide fire flow with a pump station, onsite backup power is required. Backup power is constructed with operational capital projects.	Public Safety/ Fire Flow, Reliability, Resiliency	3.4.2	High
Booster Station	Eagle Ridge Booster Rehabilitation	Eagle Ridge	Adding another pump station to Eagle Ridge Pressure Zone will change the hydraulics of the pressure zone. The existing station pumps and associated equipment will need to be right-sized.	Reliability and Energy Efficiency	3.1.2	Medium
Booster Station	Eagle Ridge Second Booster Station	Eagle Ridge	A new booster station is needed to supply new development in the western portion of Eagle Ridge Pressure Zone and the upgradient Eagle Ridge 2 Pressure Zone.	Reliability, Energy Efficiency, and Growth	3.4.2	High
Booster Station	Milton Booster Rehabilitation	Highland	The booster station has been identified as needing upgrades because of the facility's age. Additional capacity may be required but will be evaluated with the new Highland Booster Station project.	End of Useful Life & Reliability	3.1.2	Medium
Booster Station	Latah Inline Pump Station Backup Power	Low	This pump station supplies five pressure zones and the western portions of Low Pressure Zone. Onsite backup power generation will be added to the station. Backup power is constructed with operational capital projects.	Public Safety/ Fire Flow, Reliability, and Resiliency	3.1.2	High
Booster Station	Latah Inline Pump Station Upgrade	Low	A second pump will be added to supply the west side of the service area and for growth.	Reliability, Resiliency, and Growth	3.4.2	High
Booster Station	Thorpe Booster Station Rehabilitation	SIA	Pump and motors will need to be replaced as part of the scheduled maintenance for the booster pump station. The size of pumps will be evaluated before they are purchased to determine if additional capacity is needed.	End of Useful Life, Reliability, Resiliency, and Growth	3.1.2 and 3.4.2	Medium
Booster Station	New Thorpe Booster Station	SIA	More capacity is needed for SIA Pressure Zone. A new booster station will be constructed adjacent to Thorpe Booster Station.	Growth	3.4.2	High
Booster Station	New SIA Booster Station	SIA	A new booster station will be needed for growth. The location of this booster station has not been selected. The capacity of this booster station may need to be increased for additional supply to the West Plains interties.	Growth	3.4.2	Medium
Booster Station	Spotted Road Booster Station Rehabilitation	West Plains	Submersible pumps will be replaced.	End of Useful Life, Reliability	3.1.2	Low
Booster Station	Plains New Booster	West Plains	A new booster station will be constructed adjacent and in addition to the existing Spotted Road Booster Station. This booster is expected to have a capacity similar to the existing Spotted Road Booster of approximately 6500 gpm.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Booster Station	New West Plains Booster #3	West Plains	A new booster station will be needed for growth. The location of this booster station has not been selected. The capacity of this booster station may need to be increased for additional supply to the West Plains interties.	Growth	3.4.2	Medium
Booster Station	Glennaire Booster Station Upgrade	Glennaire	The Glennaire Booster Station will be upgraded to add capacity to meet the future PHD.	Reliability, Resiliency, and Growth	3.4.2	Medium
Booster Station	14th & Grand Booster Station Rehabilitation	High	This station is the redundant supply to High and upgradient Pressure Zones and needs additional capacity to be a backup to Lincoln Heights Booster. The booster station needs rehabilitation because of the age of the facility. The transmission main will be evaluated as part of the project.	End of Useful Life, Reliability, Resiliency	3.1.2 and 3.4.2	High
Booster Station	9th and Pine Booster Station Replacement	Intermediate	A new booster station will be constructed at the same site. The building, electrical system, pumps, and motors are beyond their useful life.	End of Useful Life and Resiliency	3.1.2 and 3.4.2	High
Booster Station	Bishop Court Booster Station Replacement	Intermediate	A new booster station will be constructed at the same site. The building, electrical system, pumps, and motors are beyond their useful life.	End of Useful Life and Resiliency	3.1.2 and 3.4.2	Low
Booster Station	35th and Ray Booster Station Upgrade	Top	The 35th and Ray Booster Station will be upgraded to add capacity to meet the future PHD.	Reliability, Resiliency, and Growth	3.4.2	Medium
Booster Station	Five Mile Pressure Zone Pump Capacity Improvements	Five Mile	The new Five Mile Booster station was designed with the ability to increase pumping capacity to 12,500 gpm within the new station. The booster station pumps and equipment will be upsized when it is needed for growth.	Reliability and Growth	3.4.2	Low
Booster Station	Belt Street Booster Station Rehabilitation	Midbank	The booster station will need rehabilitation because of the age of the station.	End of Useful Life and Reliability	3.1.2	Low
Booster Station	Shawnee Booster Station Rehabilitation	Shawnee	Shawnee's storage reservoir is undersized, and Shawnee's Booster Station was not designed to support Woodridge’s full buildout. Its current location is difficult to maintain because it is in the roadway with no space to upgrade. The booster will be designed for full buildout of the Shawnee and Woodridge Pressure Zones.	End of Useful Life, Reliability, Resiliency, and Growth	3.1.2 and 3.4.2	High
Booster Station	Woodridge Booster Station Upgrade	Woodridge	The booster station needs an upgrade to meet the future PHD.	Reliability, Resiliency, and Growth	3.4.2	Low

Type of Facility	Project Solution	Pressure Zone	Project Deficiency and Solution	Type of Deficiency	Discussion	Priority
Booster Station	Backup Power for Booster Stations	System Wide	Backup power will be assessed at well and booster stations to determine upgrades that are necessary to improve operation during potential power outages. Backup power is constructed as part of operations capital projects.	Public Safety/ Fire Flow, Reliability, and Resiliency,	3.3.4	Medium
Distribution System	Main Replacement Program	System Wide	Continuous effort. This includes maintenance activities to replace existing pipes and the pipes replaced as part of street, sewer, or stormwater projects. Two projects have been selected: Brown's Addition Pipe Replacements and West Central Pipe Replacements. The replacement projects will be prioritized based on the process developed by the Asset Management Program currently underway.	End of Useful Life	3.1.2	High
Reservoir	New Eagle Ridge Reservoir #2	Eagle Ridge	A second reservoir is needed for growth in the pressure zone.	Growth	3.4.2	High
Reservoir	New Qualchan Reservoir #2	Low	Low Pressure Zone needs SB storage. A new reservoir adjacent to the existing Qualchan Reservoir will add approximately 1.0 MG storage.	Public Safety/ Fire Flow, Resiliency, and Growth	3.4.2	Medium
Reservoir	Qualchan Reservoir Rehabilitation	Low	The liner in the concrete reservoir will need to be replaced.	End of Useful Life	3.1.2	Low
Reservoir	Thorpe Reservoir #2	Low	Low Pressure Zone needs SB storage. A new reservoir adjacent to the existing Thorpe Reservoir will add approximately 1.7MG storage.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Med
Reservoir	SIA #1 Reservoir	SIA	The reservoir is approaching the end of its useful life. Removal and replacement will be required in the future.	End of Useful Life, Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.1.2	Low
Reservoir	SIA Pressure Zone Additional Reservoir	SIA	Storage capacity is currently required, and SIA #3 Reservoir is under construction.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Reservoir	Thomas Mallen Reservoir #2	West Plains	Storage capacity is needed for growth.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Medium
Reservoir	33rd & Lamonte Reservoir Replacement	High	The reservoir is approaching the end of its useful life. Rehabilitation will be required in the future.	End of Useful Life, Reliability, Resiliency	3.1.2	Low
Reservoir	Glennaire 2 Reservoir Rehabilitation	Glennaire	The liner in the concrete reservoir will need to be replaced.	End of Useful Life (replacement)	3.1.2	Low
Reservoir	New High Pressure Zone Reservoir	High	Storage capacity is needed for current operations, additional storage is needed in this pressure zone and growth.	Reliability, Resiliency, and Growth	3.4.2	High
Reservoir	Indian Trail Area Pressure Zone Additional Reservoir	North Hill	Additional SB storage is needed in this pressure zone and for growth. A new reservoir is needed on the western portion of the pressure zone. The precise location has not been selected.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Med
Reservoir	Shawnee Pressure Zone Additional Reservoir	Shawnee	Additional storage is needed in this pressure zone in the next20 years. This project will be evaluated and possibly constructed with additional storage in Woodridge Pressure Zone.	Public Safety/ Fire Flow, and Resiliency	3.4.2	Medium
Reservoir	Woodridge Pressure Zone Additional Reservoir	Woodridge	Additional storage is needed in this pressure zone and capacity is needed for growth. This project will be evaluated and possibly constructed with additional storage in Shawnee Pressure Zone.	Public Safety/ Fire Flow, Resiliency, and Growth	3.4.2	Low
SCADA	SCADA System upgrades	System Wide	Technology upgrades or replacements required to keep SCADA system functioning.	End of Useful Life (replacement), Reliability, Resiliency, and Growth	3.1.2	Medium
Transmission	Eagle Ridge 2 Pressure Zone transmission	Eagle Ridge 2	Additional transmission capacity is needed for existing conditions and for growth.	Growth	3.4.2	Medium
Transmission	Cedar Road Transmission	Eagle Ridge	The new transmission main will connect the new booster station to the pressure zone system. Velocities in the transmission main in Eagle Ridge Blvd. are too high to add flow.	Reliability, Resiliency, and Growth	3.4.2	Medium
Transmission	Latah Booster to 9th & Pine Booster Station	Low	Additional transmission capacity is needed for growth in the western portion of the service area.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Transmission	9th & Pine Booster Station to Well Electric Well Station	Low	Additional transmission capacity is needed for growth in the western portion of the service area.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Transmission	Latah Inline Booster to Thorpe Reservoir	Low	Additional transmission capacity is needed for growth in the western portion of the service area.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Transmission	Marshall Road Transmission from Thorpe to Qualchan	Low	Additional transmission capacity is needed for growth in the southwest area of the service area.	Reliability, Resiliency, and Growth	3.4.2	High
Transmission	Northwest Terrace Pressure Zone Transmission Capacity	Low and North Hill	Velocities monitored in the mains that supply Northwest Terrace are over 12 ft/s. There is no resiliency, and the area has significant development interest. A new PRV station will be installed with this project.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Transmission	Thorpe Booster to Spotted Booster	SIA	Additional transmission capacity is needed for growth in the SIA and West Plains Pressure Zones.	Public Safety/ Fire Flow, Reliability, Resilience, and Growth	3.4.2	Medium

Type of Facility	Project Solution	Pressure Zone	Project Deficiency and Solution	Type of Deficiency	Discussion	Priority
Transmission	West Plains Pressure Transmission Mains	West Plains	Transmission mains from the West Plains Booster are inadequate for growth and intertie demands. With the construction of the new booster station, additional capacity will be needed.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Medium
Transmission	Whistalk's Way Transmission Main Replacement and Upsize Capacity Improvements	Low	Increase the transmission capacity to add looping within Low Pressure Zone and additional capacity to SIA and Woodland Heights Pressure Zones.	Reliability, Resiliency, and Growth	3.1.2 and 3.4.2	Medium
Transmission	Parkwater Well Station Transmission Pipe	Intermediate and Low	Additional transmission capacity from the well station is needed for growth.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Medium
Transmission	35th and Ray Booster Station Transmission Mains	Top	Additional transmission mains are needed because of high velocities and for connection to the Havana Well Station in the vicinity of 29th to 37th Avenue.	Reliability, Resiliency, and Growth	3.4.2	Low
Transmission	Highland Pressure Zone Transmission	Highland	An additional transmission main will be needed for growth to connect to the existing piping	Growth	3.4.2	Medium
Transmission	Division to Indian Trail	North Hill	Additional transmission mains are needed because of high velocities, available well capacity from Central Well station and to connect to the Indian Trail area.	Reliability, Resiliency, and Growth	3.4.2	Medium
Transmission	Five Mile Booster Station Discharge Pipe	Five Mile	The discharge main is undersized for increased flow from the capacity planned for the booster station in the next 20 years.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Low
Transmission	Indian Trail	North Hill	Additional transmission mains are needed because of high velocities from Francis Ave. to the end of Indian Trail Rd. to further support growth in the northwest service area.	Reliability, Resiliency, and Growth	3.4.2	Medium
Transmission	Freya Street Transmission Main Garland to Francis	North Hill	The main south of Wellesley needs replacement because of age. Additional transmission is needed to support growth in the northeast areas.	End of Useful Life (replacement), Reliability, Resiliency, and Growth	3.4.2	High
Transmission	Main Replacement Programs	System Wide	Continuous effort. This includes maintenance activities to replace existing pipes and the pipes replaced as part of street, sewer, or stormwater projects. Additional transmission mains needed for new development is also part of this project.	End of Useful Life; Growth	3.1.2	High
Well Station	Nevada Well Station Rehabilitation	Low	Based on the results of the station assessment study, components of the well station will be replaced, upgraded, and/or reconfigured. This may include pumps, motors, Motor Control Center (MCC), instrumentation, power, and piping.	End of Useful Life & Reliability	3.1.2	High
Well Station	Parkwater Well Station Rehabilitation	Low and Intermediate	Pump and motors will be replaced as part of the scheduled maintenance for the well station. The headers will be upgraded.	End of Useful Life & Reliability	3.1.2	High
Well Station	Well Electric New Well Station	Low, Intermediate, and North Hill	A new well station is planned to be constructed at or adjacent to the existing site. Design will consider the piping network and supply in conjunction with the Parkwater Well Station, especially under the Spokane River. The new wells are planned to be deeper to avoid hydraulic connection to the Spokane River and to support long range growth (50 to 100 years) in the entire service area. Additional capacity will be added for Low and North Hill Pressure Zones.	Water Quantity, End of Useful Life, Reliability, Resiliency, and Growth	3.1.2 and 3.4.2	High
Well Station	Havana Well Station-Low	Low	The design has been completed for the new well station at the Havana Well Station site. Further evaluation is planned to determine the construction schedule.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	Low
Well Station	Havana Well Station-Intermediate	Intermediate	The new well station currently under construction is needed to provide sufficient capacity to the Intermediate and upgradient pressure zones.	Public Safety/ Fire Flow, Reliability, Resiliency, and Growth	3.4.2	High
Well Station	Ray Street Well Station Rehabilitation	Intermediate	This well station will be rehabilitated by installing another pump, lower intakes for the four pumps, and installing new motors, Motor Control Center (MCC), and transformer.	End of Useful Life, Reliability, and Growth	3.1.2	High
Well Station	Central Well Expansion	North Hill	An evaluation of adding wells to the vicinity of Central Well will be conducted to determine the cost and feasibility of pursuing well development to future capacity in the North Hill supplied pressure zones.	Water Quantity, Resiliency, and Growth	3.4.3	Medium
Well Station	Hoffman Well Station Rehabilitation	North Hill	Well station rehabilitation is currently under construction. An additional well pump will be added.	End of Useful Life, Reliability, and Growth	3.1.2	High

References

Steel Water-Storage Tanks, Manual of Supply Practices-M42 First Edition, 1998

“Maintaining Aged Steel Water Tanks: What to Look for and Why.” E. Crone Knoy, PE Tank Industry Consultants, Inc. https://www.paintsquare.com/library/articles/maint_5-93.pdf

Chapter 4 – Water Use Efficiency Program

Table of Contents

Chapter 4 – Water Use Efficiency Program

Introduction

Water Use Efficiency promotes good stewardship for the water system. The City's Water Use Efficiency program considers improving Distribution System Loss and water conservation.

4.1 Source and Service Metering

A service connection consists of a water service tap and a service line. The water service tap is the connection of a service line to the distribution main. The service line is the pipe that extends from the service tap to the customer's property line and water meter. This service line delivers potable water to the property. Typical uses for water include domestic needs, commercial and industrial needs, irrigation, and fire protection. There are over 86,000 service connections to the City of Spokane water system.

For many years, the Water Department has metered all water consumption except hydrants and older dedicated fire lines. Dedicated fire lines are equipped with a double detector check assembly and are routinely examined for use. In addition, all source wells are metered, and the City continually tests, monitors, and calibrates source meters.

Customer Metering

City Ordinance Section 13.04.0802 addresses water service taps and meters. Generally, each building is to be served by its own water service. Planned Unit Developments are master metered at the property line. Meters two inches and under are installed at the property line and may be installed in the building under the conditions listed in the City of Spokane Rules, and Regulations for Water Service discussed in Chapter 7. Larger meters are installed either in concrete meter vaults at the property line or in the building served at the service line entry point - generally in the mechanical room. For commercial and industrial service lines, the City requires that the customer's project engineer or architect provide the determination of the service line size based on the needs of the facility for fire protection, process water, domestic needs, irrigation, etc. The City reviews the proposed service line for compliance with the City Standards. If the City review finds the service line in compliance with the City Standards, it will be approved.

Prior to the installation of a water tap and meter, a permit must be purchased from the City. Purchase of the permit supplies the meter and establishes an account to which maintenance and billing records can be attached.

If a meter is installed at the property line, the City requires that it be placed in a concrete meter box as defined in the City Design Standards and that the meter be placed so that the valve located at the property line will allow water to be shut off before entering the meter box.

Ownership and protection of the water meter are the property owner's responsibility. The City will maintain the water meter to ensure its operational integrity, but if it is determined that the owner, through neglect or damage, caused the need to repair a meter, the owner will be responsible for the costs of required repairs.

The City has implemented provisions for a remote reader capability to the existing meters and is installing Automated Metering Infrastructure. Starting in 2019, the City is in the process of installing remote read antennas for the collection of user data from remote readers throughout the City. This system will eventually allow the implementation of smart metering, which could provide instantaneous real-time readings for a service. The City currently targets an average of 400 to 500 remote read installations per month to residential meters for a goal of 4,800-6,000 installed annually.

Supply (Source) Metering

The City of Spokane meters all source production at all points of withdrawal in compliance with WAC 246-290-496(1)(a). Source meters are routinely tested and calibrated for accuracy. Source meters are replaced when the station is rehabilitated or when the accuracy of the source meter is out of specification and cannot be recalibrated. The City has implemented a source meter replacement program which is discussed in Section 4.2. A list of all source meters is provided in Appendix 4.1.

4.2 Distribution System Loss

The Water Department is diligently working to reduce its Distribution System Loss. The Distribution System Loss for the water system in 2021 stands at 12.6%, with a three-year running average of 13.5%, with years 2020 and 2019 reporting 13.4% and 14.5% Distribution System Loss, respectively. The system's Distribution System Loss is reported to the Department of Health annually for the Water Use Efficiency program performance and the Distribution System Loss reporting requirement. The previous three annual Water Use Efficiency reports and the Distribution System Loss submissions are included in Appendix 4.2.

The Distribution System Loss is calculated using source meter data for production and consumption meter data along with authorized non-metered, non-revenue use for the total authorized consumption.

Water Loss Control Action Plan

Data collection and accuracy are the first steps to reducing our Distribution System Loss. The following programs are ongoing programs to help identify apparent losses within our system. These programs center on data collection and accuracy to better assess and address actual losses.

Source Meter Program

Currently, all source wells are metered. The City began replacing the source meters at water sources in 1998 and all sources were metered in 2002. The City continually tests, monitors, and calibrates source meters. The Source Meter Replacement Program remains active with the intent of replacing older meters and meters with questionable accuracy.

Booster Station Metering Program

Starting in 2012, the Water Department implemented a program to meter all booster stations that serve different pressure zones and move water from one zone to the next. All booster stations and pressure reducing valve stations that serve pressure zones are metered. Metering booster stations and Pressure Reducing Valve Stations provides a better account for water traveling through pressure zones and helps identify potential leaks and losses through better water accounting within each pressure zone.

District Metering Program

The Booster Station Metering Program flows into the District Metering Program. District Metering is the mass balance of water into and out of a discreet district. Typically, the district will be a pressure zone, but some pressure zones are large, with multiple interconnects of water moving through the pressure zone, necessitating smaller districts for study. As of 2023, two districts have been set up and are being monitored, the Southview Pressure Zone and the Northwest Terrace Pressure Zone. Additional districts will be established, allowing a closer look into the potential water losses to target actual loss within the district.

Pressure Management Program

In coordination with the District Metering Program, areas of pressure management were identified. Areas of pressure management that have been identified are smaller sub-districts where high pressures can contribute to distribution system loss by promoting additional leakage due to higher pressure and contributing to main breaks. Three pressure management areas have been identified and are in the process of planning and implementation. The three identified areas are the Northwest Terrace Area in the Northwest Pressure Zone; Peaceful Valley, a sub-district in the Low Pressure Zone; and a sub-district of the Moran Prairie in the Glennaire Pressure Zone.

Sub-district boundaries have been identified and the design and planning of the pressure reducing valve locations are ongoing. Pressure management for the identified sub-districts is planned through pressure-reducing valves. The Northwest Terrace Pressure Zone pressure management will be addressed with the capital project planned for 2024 completion for the additional feed to the pressure zone. The Peaceful Valley sub-district poses challenges with pressure-reducing valve locations due to the narrow roadways and steep terrain, with planning and design continuing for implementation in 2024. The Moran Prairie sub-district for pressure management is expected to be installed in 2023.

Following the implementation of the planned pressure management sub-districts, consumption and use data will be reviewed to assess project district loss and determine the effect on system loss. Additional pressure management sub-districts will be explored and implemented.

Hydrant Lock Program

In 2020 the City initiated a Hydrant Lock Program starting in the West Plains area, with the first hydrant locks installed in 2022. Securing hydrants by locking is necessary to curb unauthorized use and prevent cross-connection control issues. Before implementing the hydrant lock program, it was necessary to coordinate with the City of Spokane Fire Department and all other affected Fire Districts on the type of lock that would be acceptable, secure, and functional on the varied inventory of hydrants owned and operated by the Water Department. The installation of the hydrant locks is in coordination with the installation of fill stations that will reduce or eliminate the need for contractors to use hydrants for construction activities. The first fill station was constructed in the West Plains in 2021. Hydrant lock installations in the West Plains for City of Spokane Water Department hydrants are anticipated for completion in 2023 as back-ordered stock is delivered. Future installations of fill stations and the locking of the area hydrants will continue until all City owned hydrants are secured. The installation of a Hillyard fill station is anticipated in 2023, and an Indian Trail fill station is in the planning stages for implementation in late 2023 or early 2024.

Residential Meter Replacement Program

The City has a residential meter replacement program. Meters are replaced every 20 years or when replacement is warranted from high volume use and wear. Meters are flagged for replacement based on monthly billing reads that help prioritize meter replacement for wear, zero reads, or unusually high or low seasonally adjusted readings. A work order in the City's maintenance management system, CityWorks, is generated for action. The service and meter are checked and repaired or replaced as necessary.

Commercial Meter Replacement Program

Commercial meters 2-inches and less are replaced on a 6-year schedule. Commercial meters larger than two inches are tested annually and replaced as necessary when the performance falls below 80%.

Concurrently with data collection and accuracy in assessing apparent losses, the City is continuing to progress in reducing the amount of actual losses, including the following ongoing programs.

Dedicated Leak Detection Program

The City maintains at least one full-time leak detection crew working continuously within the City. Service connections are included within the monitoring program.

Pipe Replacement

Water mains are replaced through capital projects prioritizing pipe replacement. Projects typically include integrated projects where multiple utilities are included, such as a street replacement where sewer, water, and storm replacements are integrated into the complete project to maximize the use of capital funds. Currently, pipe replacement is prioritized by the maintenance history of the pipe and pipe age. The specific era of pipes is prioritized for replacement due to joint type, such as leadite joint pipe, which is prone to full circle snaps under road rehabilitation construction. The City is currently looking to implement a more robust asset management system to prioritize pipe replacement.

In addition, the following factors can be shown to have a significant effect on the amount of non-metered non-revenue water volume affecting Distribution System Loss:

- Pipeline leakage
- Unauthorized use, such as illegal connections
- Authorized and unauthorized use of hydrants
- Unmetered uses such as system operational needs, construction use, street cleaning, line flushing, water main testing, main breaks, reservoir flushing, and firefighting

The Water Department is working to capture non-metered water use more accurately with the following programs.

Fire Suppression Use

Currently, the City receives an annual estimated use from the Spokane Fire Department on the amount of water used in fire suppression activities. Numbers received to date for accounting purposes appear low. Working with the Fire Department, the City would like to implement a better accounting system for water use, possibly by incident/training exercise, to ensure the reported estimated water use is accurate.

Hydrant Meter Cage Program

The Water Department implemented the Hydrant Meter Cage Program in 2020. The program requires contractors, City departments, and others using a City fire hydrant to use a cage that contains a meter and backflow assembly. The cage with the meter and backflow assembly is supplied by the Water Department, contractors must check them out from the Water Department and pay a deposit. Meter data from the hydrant cages is collected via cell connection at routine intervals, and the contractor is billed for water usage. The water meter and backflow assembly are tested annually by the Water Department prior to the start of the construction season. The Hydrant Meter Cage Program provides both a more accurate account of authorized hydrant uses by contractors and others who routinely utilize City hydrants and required backflow prevention measures.

Street Cleaning/Sewer Work/Other Utility Work with Water

The Water Department continually discusses estimated consumption numbers with other utilities that use City Water in their daily/weekly/monthly operations from an un-metered water source.

The City is working to decrease the Distribution System Loss to 10% or less according to State Department of Health rules. Improvements to the current programs, such as metering and hydrants, along with the ongoing implementation of newly established programs to reduce Distribution System Loss, will continue. The first step is the evaluation process, which is ongoing includes assessing data accuracies and defining real and apparent losses. The Capital program discussed in Chapter 8 includes funding for implementing the programs listed to reduce distribution system loss.

4.3 Water Use Efficiency Program

The City has established water conservation goals and measures to implement in its water efficiency program that formalized in 2006 and has been revised to meet the needs of our growing community and water system.

Water Use Efficiency Goals

The City of Spokane first addressed water conservation significantly with the adoption of Resolution 2006-0049 in 2006, adopting the City of Spokane Water Stewardship Program, which outlined goals and reporting requirements to meet WAC 246-290-840. Water Use Efficiency goals were revised and reestablished by Resolution 2014-0043 in 2014.

Since then, to maintain compliance with the Water Use Efficiency Goal Setting requirements outlined in WAC 256-290-830 and City Ordinance C35630 (Appendix 4.3), the City of Spokane Water Department evaluated and reestablished demand-side Water Use Efficiency goals as part of the 2020 Water Conservation Master Plan in Appendix 4.4.

The Spokane City Council approved Resolution 2020-0051 on July 27, 2020, adopting revised Water Use Efficiency goals and Water Conservation Master Plan following a public hearing and a public comment period. The goals provided below are established to meet the Water Use Efficiency goal settings requirements in WAC 246-290-830 as part of the Water System Plan approval. The approved resolution can be found in Appendix 4.4.

The specific strategies for the City to meet its goals and the measurable outcomes connected with the goals are reported to the City Council annually.

Water Use Efficiency Goals - Resolution 2020-0051 Water Conservation Master Plan

The Water Conservation Master Plan (Appendix 4.4) presents goals, targets, strategies, and actions to conserve and sustainably manage our water supply for future generations. The variety of water conservation activities provides opportunities to reduce demand and have been selected based on their pumping reduction potential for a reasonable cost. The vision and goals are shown in Table 4.1.

The Water Conservation Master Plan centers on the achievement of the following overarching goals:

1. Growth without Additional Pumping: Balance increasing the number of connections system-wide with reductions in consumption to ultimately eliminate or defer potential capital expense.
2. Reduction in Seasonal Demand Peaks: Peak seasonal demand relies on the distribution capacity of the system. Keeping demand within the storage capacity is safer, more reliable, and more cost-effective.

VISION: Reliable, Sustainable, Resilient Water Supply

Spokane water customers and City facilities are using water efficiently, new development construction is designed to minimize water use, and fixtures in existing developments have been upgraded to maximize water efficiency.

Goals	Key Performance Indicators	Strategies
Service Area Growth without Additional Pumping (total overall base consumption). *Annual consumption decreases from 2018 levels despite population and economic growth.*	Annual: 10 million gallons conserved for all participants	S2-S5
	Annual Residential (SF/MF): 5,000 gallon reduction per participating connection	S3-S4
	Annual City: 2 million gallon reduction for all city-owned properties	S5
	Annual Commercial: 200,000 gallon reduction per participating connection	S4
	Annual: 30 education events	S8
	Annual: 1,400 rebates issued	S2-S4, S8
	Long-Term: Conserved 500 million gallons by 2030	S1-S8
	Long-Term: 5% reduction in per capita consumption by 2030	S1-S8
Reduction in Seasonal Demand Peaks (outdoor consumption)	Annual: Reduction in MDD (maximum day demand) during active growing season	S1-S3, S5-S8
	Long-Term: 15% reduction in seasonal peak demand by 2030	S1-S8

MDD: Maximum day demand is the quantity of water supplied during the highest-use day of the year

Figure 4.1 Current Goals

City Council adopting a water conservation ordinance becoming effective on July 6, 2022. Section 13.04.1925 Water Conservation Measures prohibits outdoor watering outdoors during the hours of 10 am to 6 pm and beginning June 1, 2023, provides conditions of a drought emergency. The ordinance suggest limitation on outdoor watering to less than 2 hours per day and 4 days per week.

Water Use Efficiency Measures

The Alliance for Water Efficiency Water Conservation Tracking Tool model was used to evaluate the benefit and costs using utility-specific data and predefined values. Measures, including but not limited to those listed in the following Table 4.1 have been evaluated and implemented to meet the Water Use Efficiency goals and separated into base (indoor) and peak demand (outdoor) measures. For a list of all measures evaluated and evaluation processes, see the Water Conservation Master Plan, Appendix 4.4.

Table 4.1 Water Use Efficiency Measures

Measure	Measure Description	Base	Peak	Total
Water Use Audits (SF, MF, COM)	Correlate meter data with actual water use, providing watering schedules, and recommendations for improved water efficiency.	X	X	3
Water Use Ordinance C36209	Limits irrigation to 4 days/week and between the hours of 6 P.M. to 10 A.M.		X	1
HE Toilet Credit (SF, MF, COM)	Incentive to replace toilet with 0.8 gallons per flush models.	X		3
Low-Flow Showerhead (SF, MF, COM)	Available at customer request for zero cost.	X		3
Faucet Aerators (SF, MF, COM)	Available at customer request for zero cost.	X		3
Smart IRR Controller Credit (SF, MF, COM)	Incentive for weather-based irrigation controllers that have on-site weather sensors or rely on a signal from a central weather station.		X	3
Turf Replacement Credit (SF, MF, COM)	Incentive for replacing lawns with drought-tolerant plant material and low-volume irrigation.		X	3
Efficient Nozzle Credit (SF, MF, COM)	Incentive for installation of water-efficient irrigation equipment upgrades.		X	3
Cooling Controller Credit (COM)	Incentive for installation of conductivity controller upgrades.	X	X	1
Demonstration Gardens	Low water use demonstration gardens provide an educational tool to residents.		X	1
Education (in person)	Event tables and presentations to the public, geared to all ages Pre-K- Adult.	X	X	1
Education (website)	Dedicated website to provide info and tools about WUE.	X	X	1
Education (social media)	Campaigns and sharing of conservation program activities/opportunities.	X	X	1
Education (newsletter)	Weekly community newsletter includes conservation program information.	X	X	1
Informational Bill Inserts	Annually developed with water conservation tips and program information.	X	X	1
Consumption History on Bill	Annual comparison of water use for the customer to monitor and track changes in use.	X	X	1
Inclining Block Water Rate	Five-tiered structure for residential customers.	X	X	1
Customer Leak Notification	Assessed at billing or by a concerned citizen, department staff notifies customers of potential leaks in and outside of their structure.	X	X	1
Government Partnerships	Annual $250,000 investment in City's Parks Department for projects dedicated to WUE		X	1
Total		**13**	**16**	**33**

Conservation Program Communication & Education

The City encourages its water customers to be "Water Wise" and promotes water stewardship. The City must meet water conservation goals as part of state and federal requirements, and using less water also translates into savings on customer utility bills and helps ease the need for projects to expand the capacity of the City's water and wastewater systems.

The City uses various tools to help meet these goals, including educational and outreach efforts, hardware rebates, audit programs, and government partnerships. Outreach activities have included TV, radio, and social media campaigns aimed at reducing water usage. Utility bill inserts, attendance at local events, K-12 and higher education presentations are also included. Outreach to high users of water allows for direct education. Program activities and engagement are highlighted through digital media channels.

As detailed in other chapters, the Water Department has promoted conservation through programs to detect and repair leaks, improve metering at well sources and other locations within the distribution system, and properly account for water used for non-metered activities like fire suppression and construction needs.

Previous Results

Prior to the adoption of new Water Use Efficiency goals in July 2020, the City's adopted goals and results shown in Figure 4.2 and Table 4.2.

Table 2: 2014 Water Use Efficiency Goals

	Reduction Goal	Time Measured
1	0.5% Reduction in SF Residential Indoor	Dec 15 – February 14
2	2% Reduction in SF Residential Outdoor	July 15 – September 14
3	2% Reduction in Commercial /Industrial Outdoor	July 15 – September 14
4	2% Reduction in Governmental Outdoor	July 15 – September 14

Table 3: Water Use Efficiency Goal Results 2014-2019. Goal is measured as daily gallons consumed per connection.

Year	1 Goal / Actual (gal/day)	2 Goal / Actual (gal/day)	3 Goal / Actual (gal/day)	4 Goal / Actual (gal/day)
2014	122 / 122	516 / 513	4,318 / 4,325	4,921 / 4,759
2015	121 / 120	516 / 562	4,232 / 3,837	4,822 / 4772
2016	121 / 119	492 / 564	4,147 / 3,975	4,726 / 5,822
2017	120 / 118	479 / 638	4,064 / 4,602	4,631 / 5,410
2018	119.6 / 115	467 / 617	3,983 / 4,088	4,539 / 5,745
2019	119 / 113	455 / 553	3,904 / 3,947	4,448 / 5,189

Figure 4.2 Overview of Previous Water Use Efficiency Goals and Results 2014 to 2019

Succeeding the 2020 adoption of the Water Conservation Master Plan, the goal results are reported programmatically and quantitatively by assessing the gallons per capita day and peak season demand (measured well production from July 1 to August 31).

Table 4.2 Water Use Efficiency Goals and Results for 2020 and 2021

Year	25% Reduction by 2030 GPCD Goal / Actual	15% Reduction by 2030 Peak Demand Goal / Actual	Rebates Issued Goal / Actual
2020	151 / 185	15% / 5%	1,400 / 625
2021	151 / 201	15% / 2%	1,400 / 720

Future Conservation Program Plans

The City is working to improve and expand its water conservation program for the foreseeable future to meet the intent of Water Use Efficiency Rules and to benefit the Water Department, the Wastewater Department, and the region.

The 2021 budget for community outreach and education activities was $520,000 in addition to two Full-Time Equivalent Water Conservation Program staff. Budgets for these activities in future years will be determined annually and are expected to increase over time. A wastewater credit program, which encourages lower water use, costs an additional $700,000. The City Water-Wastewater Fund will pay all costs for the water conservation programs.

4.4 Water Use Efficiency Savings

The savings from successfully implementing the water use efficiency program in the future are based on the Technical Memorandum for City of Spokane Water Conservation Savings (Maddaus Water Management Inc., January 2023) in Appendix 4.5. Conservation savings were evaluated for the 22 measures listed in Figure 4.3. Three options to implement these measures were developed based on either is currently using or plans to use in the future. The measures for the three options are showed in Figure 4.4. All measures in Strategy A and B are part of the current program except for a direct installation of indoor fixtures program. The measures in Strategy C include measures the City is considering using in the future. The City selected Strategy B to use for the future conservation measures. The water savings were estimated for Strategy B using a Decision Support Systems Model developed for the Water Conservation Savings Memorandum in Appendix 4.5.

Figure 4.3 Conservation Measures from Water Conservation Savings Memorandum

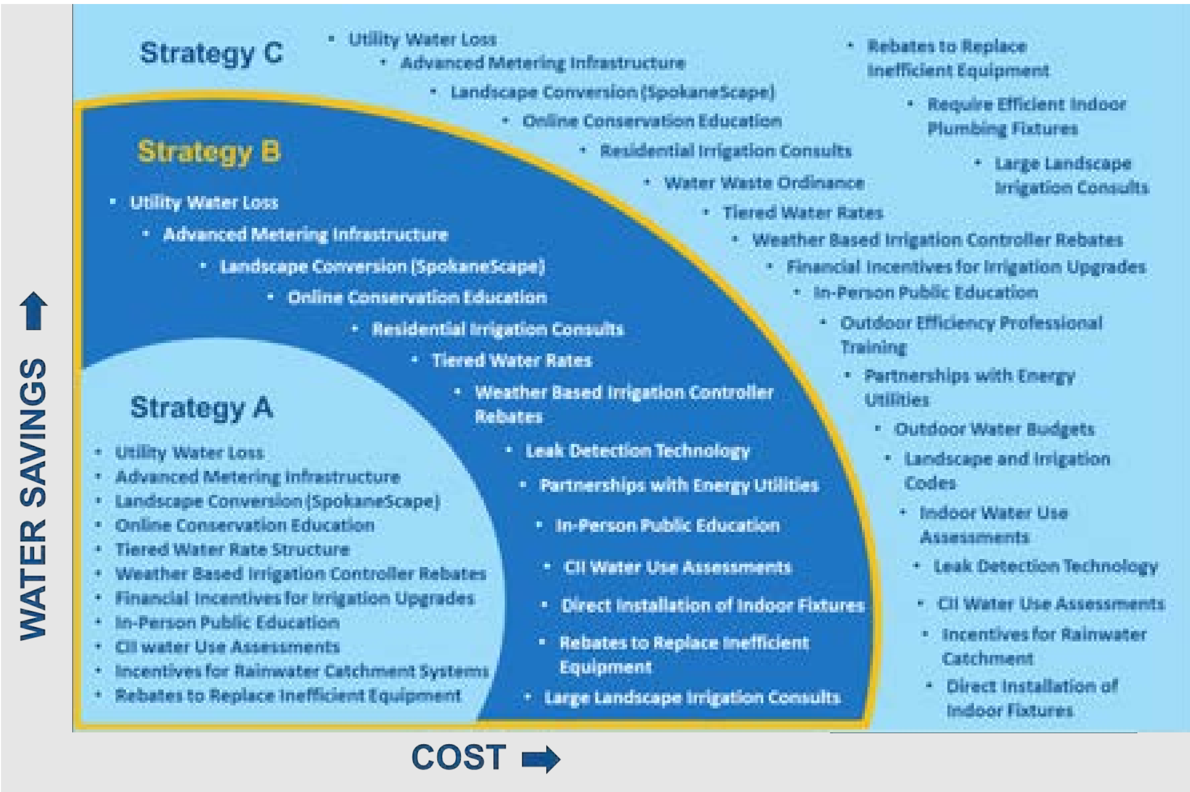


Figure 4.4 Conservation Program Options

Table 4.3 Demand Forecast Comparison

Demand Forecast with and without Projected Water Use Efficiency (WUE) Savings including projected population growth				
Year	**Average Daily Demand (ADD)**		**Maximum Daily Demand (MDD)**	
	Without WUE (mgd)	**With WUE** (mgd)	**Without WUE** (mgd)	**With WUE** (mgd)
1	63	61	146	144
2	64	62	149	142
3	64	61	150	140
4	65	62	151	137
5	65	61	152	135
6	66	62	153	133
7	66	61	153	131
8	66	61	154	129
9	66	60	155	127
10	68	62	158	126
20	74	61	174	126

The estimated demand with and without the future water use efficiency reductions is shown in Table 4.3. Average Day Demand flowrates are from the Baseline Demands Analysis TM (HDR Inc., March 1, 2022) in Appendix 4.5. The Water Use Efficiency flowrate for Average Day Demand is based on reduction from Strategy B from Water Conservation Saving memo. Average Day Demand reductions will be influenced by overall year-round water use both indoors and outdoors. Indoor water use will reduce over time from construction using updated plumbing code, installation of low-flow plumbing fixture (both new and replacement), and lower water using appliances. Maximum Day Demand is the result of summer water use, primarily irrigation. For reduction in Maximum Day Demand, the measures to reduce outdoor water uses need to be fully implemented.

Chapter 5 – Source Water Protection

Table of Contents

Chapter 5 – Source Water Protection

Introduction

The City of Spokane's source water protection program is multifaceted and involves partnerships with the other purveyors that rely on the Spokane Valley/Rathdrum Prairie Aquifer. This section describes the well-site sanitary control area, the wellhead protection program, and the watershed control program. All the City's well stations have continuously monitored security systems.

5.1 Sanitary Control Area

The sanitary control area is a minimum 100-foot radius around each well intended to be a front-line protection against contamination. The City of Spokane owns the land on which all the City's well stations are sited. The City also has control of the easements, such as the street right-of-way that may be within the 100-foot sanitary control area.

All the wells have been surveyed to identify sanitary and storm sewers located within the 100-foot radius. These sewers are identified by location, date of construction, and material. Appendix 5.1 outlines the 100-foot sanitary control areas for each well. Sanitary pipes within the sanitary control area have been lined or replaced to provide a jointless pipe union to reduce any leakage. All well station restroom toilets and urinals (black water) have been removed. Only sinks and floor drains (gray water) are still connected to the sewer service.

A high-pressure petroleum pipeline (presently referred to as the Yellowstone Pipeline) traverses the Spokane Valley. Failure of this line could affect a number of wells in the Spokane Valley area that belong to a number of different water purveyors. The pipeline passes in front of the Parkwater Well Station and is within the 100-foot sanitary control area. Failure of the pipeline in this location would have severe impacts on the Parkwater Well Station and possibly also the Well Electric Well Station. The new well station located at 6th Avenue and Havana Street is part of the City's operating strategy to reduce potential impacts from the high-pressure petroleum pipeline

5.2 Wellhead Protection Program

Details of the City's Wellhead Protection Program are provided in a separate multiple volume report, published in February 1998 titled, "Wellhead Protection Program Technical Assessment Report." This section describes a summary of the program's activities. For specific details of the wellhead program, reference should be made to this report

The City of Spokane Water Department currently operates seven well stations that draw groundwater from the Spokane Valley/Rathdrum Prairie Aquifer as its potable water supply. The relatively shallow depth to groundwater and the absence of low permeability layers that could prevent contamination from entering the groundwater makes the City's groundwater supply vulnerable to a variety of contamination threats. In 1994, in response to known groundwater contamination incidents and the existence of numerous potential contaminant sources, the City established a wellhead protection program. The purpose of the wellhead protection program is to proactively reduce the potential threat of contamination of this groundwater resource. A technical assessment report was completed and approved by the Washington State Department of Health in 1998.

The following components were required as part of the plan:

- Susceptibility assessments
- Six-month, one-year, five-year, and ten-year delineated Wellhead Protection Area ("WHPA") for each well and/or well-field
- An inventory of potential contamination sources
- Notification of Findings
- Preparation of contingency plans to provide alternate water sources
- Notifying emergency responders

The susceptibility assessments, wellhead protection delineations, and contingency plans are described in detail in the above-referenced report published in February 1998 and approved by the Spokane City Council on February 23, 1998. The Department of Health approved the Wellhead Protection Program Technical Assessment Report in 1998.

5.2.1 Susceptibility Assessments

The City of Spokane completed and submitted susceptivity assessments for each of its wells in 1998 to the Washington State Department of Health. These assessments are on file with the Washington State Department of Health.

5.2.2 Wellhead Protection Area Delineation

In the initial wellhead protection program, the City of Spokane used a finite element modeling package from MicroFEM to generate the wellhead capture areas for the times of travel as required by the federal source water protection rules. This model only depicted the Washington State portion of the Spokane Valley/Rathdrum Prairie Aquifer. The flow in the aquifer across the state line was a simulated input. Details of this work are in the exhibits of appendix of the Wellhead Protection Program Technical Assessment Report. In 2012 this model was updated to include the entire aquifer boundary. The model improvements also included information from the research used to generate the United States Geological Survey's (USGS) bi-state model and other recent hydrogeological studies.

5.2.3 Potential Contaminant Source Inventory

Potential sources of groundwater contamination and known groundwater contamination incidents within the aquifer were inventoried as part of the Wellhead Protection Plan's contamination source inventory. The sources included improperly maintained underground storage tanks, industrial and commercial activities, known hazardous material leaks, chemical spills, landfills, and potential contaminants related to both vehicle and chemical transportation.

The City compiled a list of businesses located within proposed wellhead protection areas to identify sites containing potential pollution sources. The Potential Contaminant Source Inventory provides water purveyors tools to track potential contamination sources. The Potential Contaminant Source Inventory also provides federal, state, and local agencies with information that may be critical for public health and information about possible airborne contamination or crucial clean-up contaminants in the event of a spill over the aquifer. The list is reviewed annually to keep the Potential Contaminant Source Inventory records updated. The 2022 Potential Contaminant Source Inventory is contained in Appendix 5.2.

5.2.4 Notification of Findings

The Spokane Aquifer Joint Board (SAJB) includes the local water purveyors in Spokane County. The Spokane Aquifer Joint Board provides an opportunity for regional planning efforts between all the region's purveyors. The City of Spokane has been a member of the Spokane Aquifer Joint Board since 1999. The cooperative program with the Spokane Aquifer Joint Board involves ongoing education and awareness campaigns, household hazardous waste collection programs, and maintaining the Potential Contaminant Source Inventory. The City expects to maintain its membership with the Spokane Aquifer Joint Board for at least the next twenty years.

In conjunction with Spokane Aquifer Joint Board, letters are sent out every two years to those businesses identified through the Potential Contaminant Source Inventory advising them that the business may be a potential contamination source to the aquifer and need to conduct their operations accordingly. A sample letter can be found in Appendix 5.3.

5.2.5 Contingency Plan

Contingency plans consist of a sequence of planned operational actions that may be taken in the event of an accident or when a change in groundwater quality is observed in a monitoring well, production well, or wellhead protection area. Different actions would be taken depending on the event and its proximity to a production well. The Water Department maintains a working relationship with the region's law enforcement, fire departments, and health jurisdictions. The Potential Contaminant Source Inventory is used to identify potential sources if there are changes in groundwater quality. Wellhead protection planning is also a factor in the capital improvement plan for the Water Department. Capital projects are prioritized to improve redundancy and to provide more alternatives if water quality is impaired at a production well. Detailed contingency plan information can be found in Section 5 of the previously referenced 1998 "Wellhead Protection Program Technical Assessment" report and is included in Appendix 5.4.

5.2.6 Notifying First Responders

Federal, state, and local regulatory agencies were provided copies of the listings of the potential contamination sources (referenced in 5.2.3) that received notification, as well as other pertinent wellhead protection information. The Potential Contaminant Source Inventory distribution list is included in Appendix 5.5. A template of the letter used to notify state and local agencies is included in Appendix 5.6.

5.3 Watershed Control Program

The City of Spokane Well Electric wells are designated as groundwater under the direct influence of surface water (GWI) by the Washington State Department of Health. For the purposes of source water protection, the City is not required to have a watershed control plan. The City's wellhead protection program is used for this GWI source.

The City of Spokane and the Water Department participate in watershed planning in Washington State conducted under the framework of the Watershed Management Act (ESHB 2514) passed by the Washington State Legislature in 1998. The Act enables local residents, interest groups, and government organizations to collaboratively identify and solve water-related issues in the state's sixty-two Water Resource Inventory Areas

The goal of watershed planning is to assess the water resources within each watershed and make recommendations to ensure the state's water resources are used wisely by:

- Protecting existing water rights;
- Protecting in-stream flows for fish;
- Forecasting the future water resource needs; and
- Ensuring future water availability.

The City of Spokane is the largest city within the metropolitan area and the Water Department is the largest public-owned utility within these watersheds. As such, the City often finds itself an initiating agency and is involved in four watershed planning processes.

A brief discussion on the status of each plan is presented as follows:

5.3.1 WRIA 54 – the Lower Spokane River Watershed

The Water Resource Inventory Area (WRIA) 54 Watershed involves the Spokane River and all of the tributaries that flow into the Lower Spokane River downstream of its confluence with Hangman (Latah) Creek to its confluence with the Columbia River.

The Water Resource Inventory Area 54Lower Spokane Watershed Detailed Implementation Plan was presented in December 2010, providing the framework for implementing watershed planning strategies in the 2009 Water Resource Inventory Area 54 Watershed Plan. Implementation of the Watershed Detailed Implementation Plan represents moving into Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW). The Water Resource Inventory Area 54-Lower Spokane Watershed Detailed Implementation Plan, December 2010, and the Water Resource Inventory Area 54-Lower Spokane Watershed Plan, August 2009, are available at WRIA 54 (spokanewatersheds.org).

5.3.2 WRIA 56 - Latah (Hangman) Creek Watershed

The Water Resource Inventory Area (WRIA) 56 Watershed spans two states and four counties before it outflows into the Spokane River about a mile west of the Spokane Falls in downtown Spokane. Water Resource Inventory Area 56 includes the portion of the watershed within Washington State.

The Spokane County Conservation District initiated the watershed planning process in Latah (Hangman) Creek. In 1999, the Spokane County Conservation District received funds from the Washington State Department of Ecology to establish a planning unit and develop a scope of work for the planning process. Additional funding was received for a watershed assessment and the development of a watershed management plan.

The WRIA 56 Latah (Hangman) Creek Detailed Implementation Plan, dated February 19, 2008, is intended to be used for the coordination and implementation of the sixty-eight recommendations of the Water Resource Inventory Area 56 Latah (Hangman) Creek Watershed Management Plan. The final Water

Resource Inventory Area 56 Latah (Hangman) Creek Watershed Management Plan was completed in September 2005, completing Phases 1-3. The Detailed Implementation Plan represents Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW).

The Water Resource Inventory Area 56 Latah (Hangman) Creek Watershed Management Plan and Detailed Implementation Plan are available at Water Resource Inventory Area 56 (spokanewatersheds.org). In-stream flow, water quality, and water storage are the primary issues being addressed in this watershed. The goal is to protect the watershed's in-stream resources and associated habitat balanced with the economic interests within the watershed.

5.3.3 WRIA 55 – Little Spokane River Watershed & WRIA 57 - Middle Spokane River Watershed

Water Resource Inventory Area (WRIA) 55 Little Spokane River Watershed spans three counties before it outflows into the Spokane River approximately three miles downstream of the Nine Mile Falls Dam.

Water Resource Inventory Area 57 Watershed comprises the Spokane River drainage basin that begins at the state line of Washington and Idaho and ends at its confluence with Latah (Hangman) Creek.

In 1998, the watershed planning effort was initiated when the Washington State Department of Ecology provided funding. A planning unit comprised of local agencies and various interest groups was formed to plan for future water use in the Middle Spokane and Little Spokane watersheds.

The WRIA 55/57 Watershed Plan was approved by the Planning Unit on July 6, 2005. The Watershed Plan was then presented to the initiating agencies for approval. After some minor adjustments, the Water Resource Inventory Area 55/57 Watershed Plan was adopted by the County Commissioners of Pend Oreille, Spokane, and Stevens Counties on January 31, 2006.

In January of 2018, the Washington State Legislature enacted the Engrossed Substitute Senate Bill (ESSB) 6091 to address the inability of counties, including Spokane County, to issue building permits for development with individual wells in watersheds with in-stream flow rules. ESSB 6091 was codified as Chapter 90.94 RCW. The Water Resource Inventory Area 55 Watershed Planning Unit was reconvened to update the watershed plan to meet the requirements of Chapter 90.94 RCW. The plan is an addendum to the existing watershed plan and was adopted by the Washington State Department of Ecology in January 2021.

A significant component of the Water Resource Inventory Area 55/57 Watershed Plan was the watershed simulation modeling, based on detailed data, demonstrating the strong hydraulic links between the Spokane River and the Spokane Valley/Rathdrum Prairie Aquifer. There is some indication that groundwater pumping may impact flowrates in the Spokane River.

A Detailed Implementation Plan for Water Resource Inventory Area 55/57 was approved on February 20, 2008, to coordinate the implementation of the 107 recommendations outlined in the Water Resource Inventory Area 55/57 Management Plan. These recommendations address central issues to water resource management. Implementation of the Watershed Detailed Implementation plan represents moving into Phase 4 of the process outlined in Washington's 1998 Watershed Planning Act (Chapter 90.82 RCW). Recommendations fall into the following categories:

- In-stream flow needs;

- Water conservation, reclamation, and reuse;
- Domestic exempt wells;
- Water rights and claims;
- Strategies for base flow augmentation;
- Strategies for groundwater recharge augmentation; and
- Approaches to plan implementation.

The City of Spokane Water Department has a strong interest in the programs that are being proposed in the Water Resource Inventory Area 55/57 Watershed Plan. The City of Spokane assesses opportunities to implement the recommendations of the plan. Resources, including funding, are sought out and directed to these opportunities. It is expected other purveyors will participate and share the costs of implementation.

From November 2019 to September 2021, the City of Spokane worked with other stakeholders in Water Resource Inventory Area 55 to update the watershed plan. The planning and the process for its development are available at WRIA 55 Streamflow Restoration Plan Development Process | Spokane County, WA.

Chapter 6 – Operation and Maintenance Program

Table of Contents

Chapter 6 – Operation and Maintenance Program

Introduction

This chapter describes the process, strategies, and programs that the Water Department uses to manage the water system.

6.1 Water System Management and Personnel

The Water Department's structure and how it relates to the City of Spokane government structure are shown in Figure 6.1. The Director of Water reports to the Public Works Division Director.

The Water Department's organizational structure illustrates the lines of internal communication during normal operating and maintenance modes. Five major management divisions report to the Director of Water: Operation and Maintenance; Engineering; Hydroelectric Services; Water Stewardship, and Business Office. The Director, the Superintendent of Operations and Maintenance, and other appropriate staff have mandatory water operations certification as required by the Washington State Department of Health. Detailed organization charts are shown in Figures 6.2 through 6.6.

As required in WAC 246-290-400, Waterworks Operator Certification requires Class A public water systems in Washington State to retain in their employment individuals who are certified, by examination, as competent in water supply operation and/or management. The Department of Health determines the level and number of certified positions based on the population and complexity of the water system. The Department of Health requires the City Water Department to operate with four certified water distribution managers.

The grade of certification and the number of employees holding certifications satisfies the requirements of the Department of Health. The Water Department will notify the State Certification Board should the number of certified employees fall below the Department of Health requirements.

Figure 6.1 City of Spokane Water Department Organizational Chart

Figure A

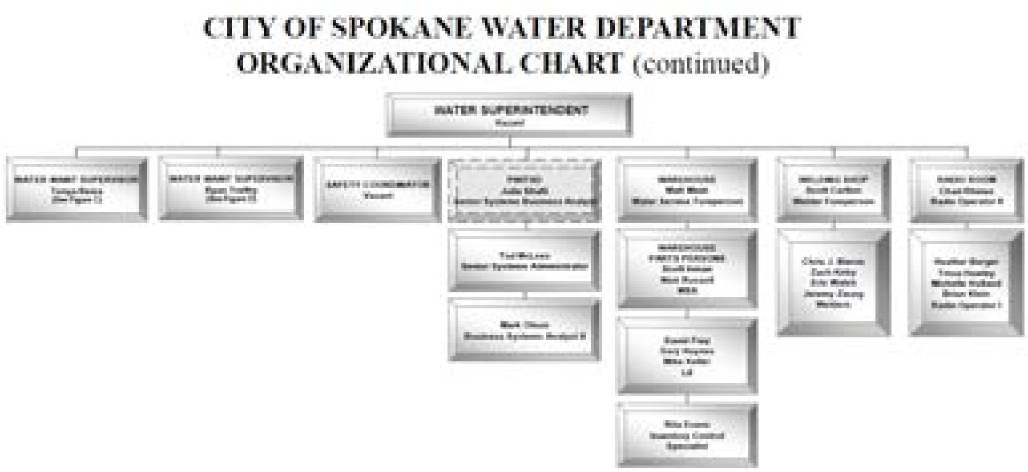


Figure B

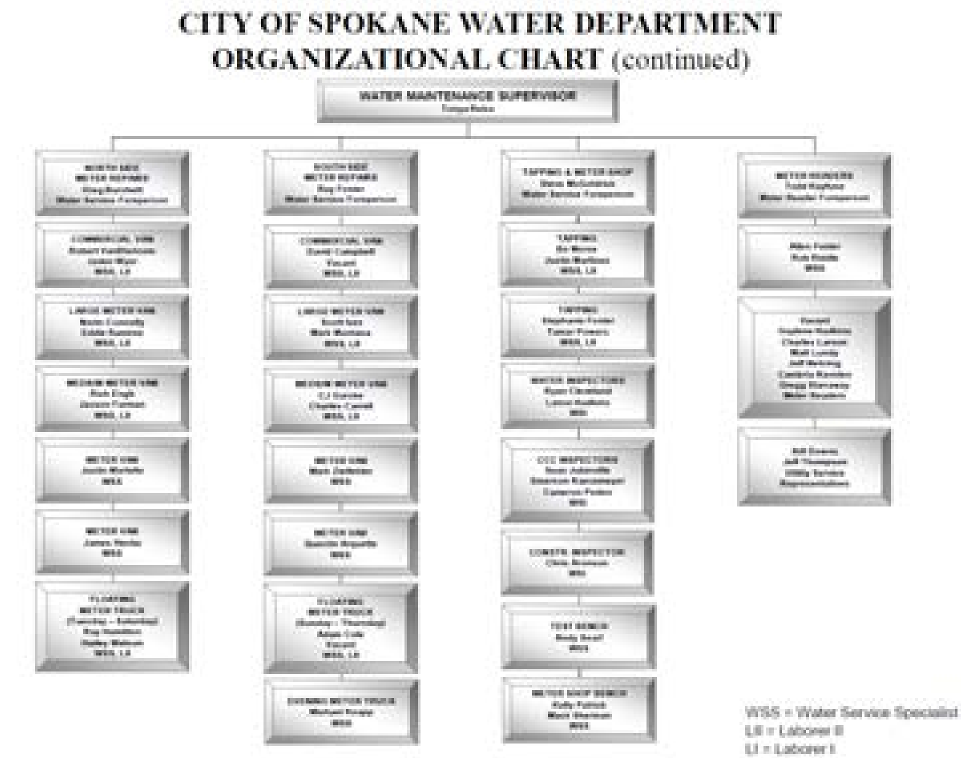


Figure C

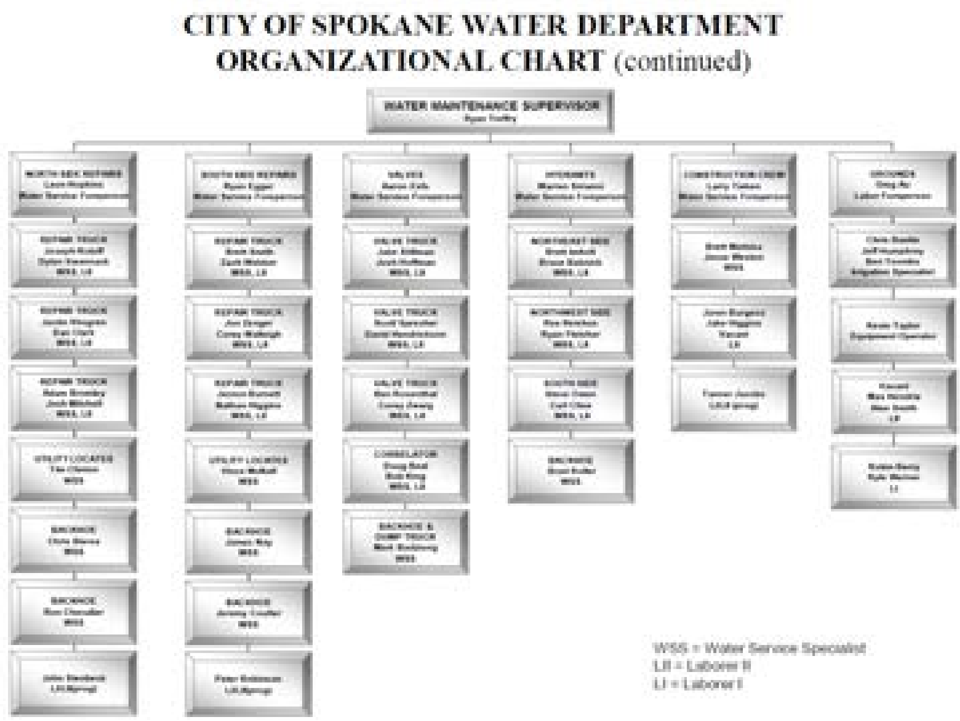


Figure D

CITY OF SPOKANE WATER DEPARTMENT
ORGANIZATIONAL CHART (continued)

Figure E

CITY OF SPOKANE WATER DEPARTMENT
ORGANIZATIONAL CHART (continued)

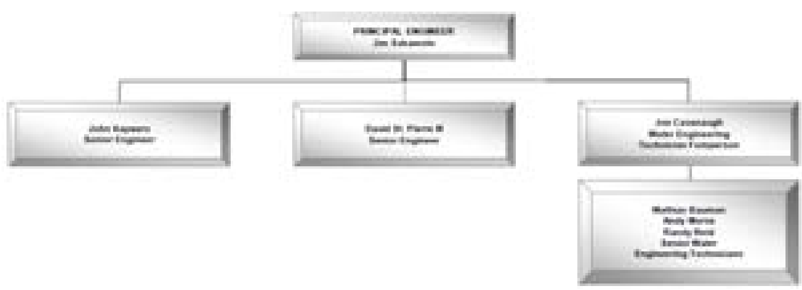
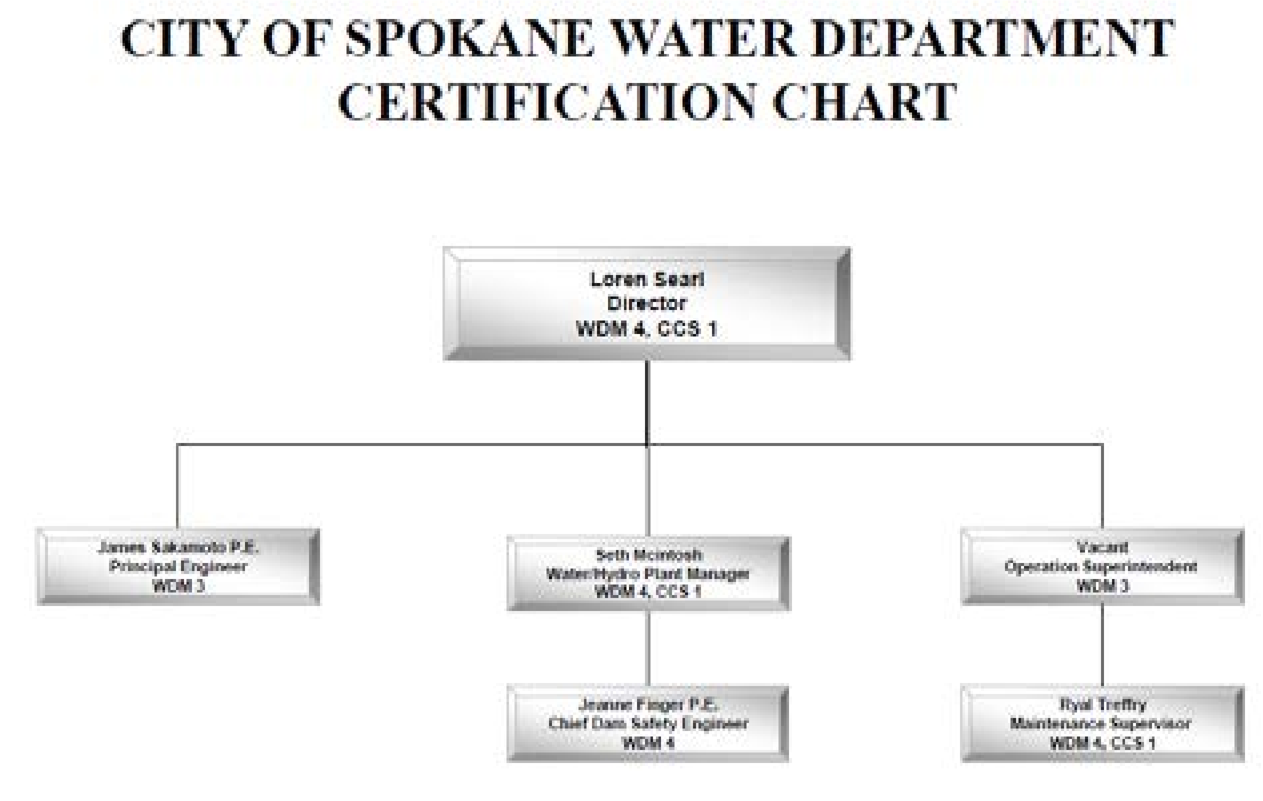


Figure F

Figure 6.2 City of Spokane Water Department Certification Chart



6.2 Operations and Preventative Maintenance

6.2.1 Routine System Operation

The City of Spokane Water Department has a Water System Control Room located at the Upriver Complex. The control room is staffed 24 hours per day, seven days per week, by a certified operator who controls the operation of all pumping facilities and reservoirs in the water system. This same operator controls the operation of the Upriver Dam and Hydroelectric Facilities. The water system operator must have a Water Distribution Manager I certification. In addition, on alternate days, a second operator visits and checks each pumping station. While at each station, readings such as pumpage and chlorine use are recorded. The operator reports any abnormalities.

Water levels in the reservoirs control the normal starting and stopping of pumps. The pumps operate as needed to maintain the reservoir levels within their normal operating range. This is done using a telemetry system to communicate to the remote stations. The telemetry system consists of a Supervisory Control and Data Acquisition (SCADA) system that uses a central computer located in the Upriver Complex Water System Control Room. The SCADA system communicates with seven well stations, 24 booster stations, and 34 reservoirs over four multiplexed leased phone lines and a broad-spectrum radio system. The Water Department is currently developing and installing a new state-of-the-art SCADA system.

Monitoring at well stations includes well level, pump operation, station voltage, motor amperage, discharge pressure, discharge flowrates, chlorine residuals, and usage. The monitoring at booster stations includes pump operation, suction and discharge pressures, station voltage, motor amperage, and discharge rates. Monitors at the reservoirs record water levels, inlet/outlet valve positions, as well as checking for flooded vaults. All facilities also are fitted with intrusion monitors that will activate an alarm. The SCADA system uses a continuous polling process that updates information to the water system control room every one to three minutes. If a station fails to respond, a communication alarm is generated.

The SCADA computer generates an alarm to alert the water system operator stationed at the water system control room. Alarms are generated when any quality falls above or below the defined normal operating range. For example, the water level alarms will activate on both high and low set point values defined for each specific reservoir. The inlet/outlet valves at the reservoirs are monitored and will also activate an alarm should the valves close. Alarms in well stations or booster stations include suction and discharge pressures, intruders, and high or low voltage or amperage use.

The operator starts or stops the well pumps based on operating procedures and their professional opinion. The SCADA system starts and stops booster pumps on an as-needed basis. The computer programs utilized in the SCADA system can be changed to suit the season or weather conditions. The operator monitors the operation of the booster stations and changes or overrides the control strategies as necessary. In the event SCADA communication fails with a well station or booster station, each pump can be manually operated.

The operation in the summer is different than in the winter because of the difference in demand. The average winter pumpage is about 33 million gallons per day. Average summer pumpage approaches 155 million gallons per day after a week of hot, dry weather. Typically, three weeks of hot, dry weather will bring with it very high demand for water. Because of the significant change in demand, some pumping stations are activated for summer use and deactivated during winter. Well stations commonly used for summer peak demands are Grace and Hoffman. Booster stations used primarily in the summer are Ninth & Pine, Bishop Court, and Division & Manito.

The Water Department's primary objective is to schedule pump operations to ensure an uninterrupted water supply in adequate quantities and at appropriate pressures throughout the water system. A secondary goal is to operate the system efficiently. Pump scheduling is changed for winter and summer operations so that the pumps that best match the demand are used first. The secondary goal of improving operating efficiency is using the most efficient pump. The most efficient pump is based on pump curves for new pumps and results from field efficiency tests.

At times, pressure considerations within the water system will override the need to operate pumps efficiently. These times are dwindling as infrastructure modifications improve the water system. Each reservoir has a defined water level range, which in turn defines when pumps are cycled on and off. Each pressure zone has a different combination of pump capacity, reservoir storage, and water demands. Thus, each pressure zone has unique control strategies. Copies of the operating strategies for each pressure zone can be found in Appendix 6.1.

Safe operating procedures and the protection of employees are the first priority. The City of Spokane has a Risk Management Department responsible for advising Water Department employees about safety requirements. The City's "Safety Manual" is furnished to supervisors, and all employees receive an employee handbook with safety measures. The City's safety procedures comply with the Washington Industrial Safety and Health Act and Occupational Safety and Health Administration standards as implemented by the Department of Labor and Industries. In addition, water system operators are trained in specific safety tasks and procedures.

Reading meters is part of routine operation. Meter readers read water meters to record water consumption. The meter readers provide the consumption data to the City of Spokane Utility Billing Department, which produces the utility bills. The meters for residential customers are read bi-monthly, while the meters for commercial customers are read monthly.

Operations Calendar

Daily/Every other day

Trapline or Station Checking

- Check all operating stations.
- Record pumpage at each station and pump hour meters.
- Record chlorine usage for each well pump.
- Assess trouble reports for deficiencies.
- Check charts for proper operation.
- Check operating pumps for noise, vibration, temperature, oil level, leaks, and proper voltage and amperage.
- Check station for security and/or vandalism.

Shift Operations

- Check station for security and/or vandalism.
- Make rounds every four hours taking readings and filling out charts and logs.

- Monitor pump operation and change control strategies as necessary.
- Respond to alarms generated by SCADA.
- Answer phones and radio calls and respond as necessary.
- Take chlorine residuals for well electric operating pumps.
- Record pumpage and chlorine usage for Well Electric and hour meters.
- Record electrical meter readings for pump load.

Weekly

Station Checking

- Take chlorine residual on all operating pumps.
- Change recording charts.

Shift Operators

- Fill and change logs and charts.

Spare Operator and Tank Checking

- Change chlorine tanks and exchange with chlorine supplier as needed.
- Check all tanks and reservoirs for vandalism.
- Record chlorine residual at all tanks.
- Check for leaks and abnormal conditions.

Monthly

Station Checker or Spare Operator

- Get end-of-month hour meter reading.
- Bring in station logs and start next month's log.
- Attend safety meetings.

Quarterly

Spare Operator

- Download information from monitoring wells.

Annually

All Operators

- Gather information necessary for annual reporting.

Maintenance Calendar

Daily

- Perform assessment work at each assigned station.
- Note deficiencies and report to the foreman.

Monthly

- Check vibration and bearing temperatures on all running pumps.
- Attend safety meetings.

Winter

- Make repairs to pumps in well stations as necessary.
- Service Well Electric pumps and auxiliaries.
- Calibrate and service flow meters.
- Clean switch gear.

Spring

- Perform pump maintenance in booster stations.
- Clean switch yards and transformers.
- Place stations in service as needed - Indian Canyon, Bishop Court, Grace, Hoffman.
- Check and service stations as the stations are put into operation.

Summer

- Respond to trouble reports to keep all units in operating condition.
- Confirm air coolers and vent fans are working properly.
- Service hydroelectric generators and other elements of the hydroelectric dam.

Fall

- Shut down and winterize stations when the station is no longer needed.
- Drain air coolers at stations.
- Check and service all heaters in vaults, sumps, and stations.
- Begin repairs of pumps that failed or need service from summer operations.
- Check the current operating pumps.

6.2.2 Preventative Maintenance Program

In addition to the daily checks made by the operator, each station is assigned a mechanic to perform maintenance on the equipment. As part of an Assessment Program, the assigned mechanic performs preventative maintenance checks on the equipment in the station. These preventative examinations include noting pump and motor bearing temperatures, pump and motor vibration, unusual noise, lack of lubrication, and servicing the electrical equipment. Air coolers, heaters, and vent fans are also included in these checks. Work beyond the Assessment Program's scope is reported to the foreman and scheduled for repair.

Typically, normal maintenance projects are scheduled during the off-season. This assures that equipment will provide reliable service during the months of high demand, and scheduling large replacement and repair jobs during the off-season provides the opportunity to be more efficient and keep costs to a minimum. Therefore, major work is scheduled for late fall, winter, and early spring when water demand is lowest for water pumps, motors, and related equipment. Significant work is scheduled for summer when river flows are low for the Water Department's hydroelectric facilities.

6.2.3 Equipment, Supplies, and Chemical Listing

The City of Spokane's water comes solely from the Spokane Valley/Rathdrum Prairie Aquifer. Water treatment is not required; however, chlorine is added at the wellhead as a disinfectant. Chlorine is the only chemical stored, and the quantity stored is the amount currently used. The chlorine is purchased on a yearly contract, and the supplier is required to maintain sufficient quantities at their storage facilities to satisfy ongoing needs. Typically, the City uses 2,000-pound and 150-pound cylinders of gaseous chlorine. Chemicals used for water testing, such as chlorine residual sampling, are provided by a chemical supplier that stores them offsite. No more than the current week's supply of chemicals are stored on the City of Spokane property, and the amount stored at any given location never exceeds 2,500 pounds at any time.

6.3 Comprehensive Water Quality Monitoring

The federal Safe Drinking Water Act provides direction for the Water Department's water quality monitoring program. The water quality monitoring program is based on compliance with WAC 246-290-300, Public Water System Rules and Regulations, as established by the State Board of Health and the Environmental Protection Agency. Enforcement of the program is the responsibility of the Department of Health, specifically the Department's Eastern Regional office in Spokane. The Safe Drinking Water Act, implemented and enforced through the Environmental Protection Agency, may drive City monitoring. Programs such as the Unregulated Contaminant Monitoring Rule require preemptive monitoring of potential emerging contaminant threats.

The Water Department's Water Quality Section manages water quality for the City of Spokane. It is comprised of two people with appropriate water quality expertise performed at an in-house laboratory. Other branches of the Water Department assist on an as-needed basis. The following provides a summary of the water quality monitoring program.

The Water Quality Section ensures that the City complies with all state and federal drinking water regulations. Responsibilities include:

- Controlled access to sampling points and maintaining all water quality records.
- Maintaining and operating a certified drinking water laboratory.
- Conducts field tests, laboratory tests, bacteriological sampling, and tests chlorine residuals in the water at designated sampling points.
- Records field data at the time of source sampling, maintains continuous monitoring instrumentation, and conducts river and GWI monitoring.
- Utilizes accredited Department of Ecology laboratories for chemical analysis.
- Collects and compiles analytical results for Consumer Confidence Report on an annual basis.
- Advises Water Department personnel and other departments on water quality issues.
- Works with regional groups regarding water quality.

The City of Spokane Water Department Water Quality Laboratory is certified by the Department of Ecology to perform both bacteriological and analytical tests. The bacteriological tests consist of heterotrophic plate counts, Colilert total/fecal coliform presence/absence, and Colilert total/fecal coliform enumeration. The analytical tests include total and residual chlorine analysis, alkalinity, total dissolved solids, turbidity, pH, and conductivity.

The City of Spokane's drinking water is recognized as high quality. To maintain this valuable asset, the City conducts many tests at varying intervals to confirm that the water delivered to customers remains a high-quality product. The Water Quality Coordinator summarizes the annual testing results in the Technical Drinking Water Report. The latest report is from 2021 and is provided in Appendix 6.2.

6.3.1 Source Water Sampling

The Washington State Department of Health Office of Drinking Water developed the Water Quality Monitoring Schedule to help water systems identify their specific water quality monitoring requirements. The current Water Quality Monitoring Schedule is in Appendix 6.3.

The City uses gaseous chlorine to disinfect all of the water supply. Source water samples are collected after treatment and prior to the entry point to the distribution system. The City utilizes the well field monitoring allowance for the source water sampling. The seven well fields have between one and four wells. All references to well sampling are for the well field. Sampling is summarized in Table 6.3.1.

Sample collection and handling follow established procedures and standards. This includes sample containers, preservatives, temperature requirements, holding times, and other considerations. The analytical laboratory provides most sampling procedures.

Asbestos

The City is no longer required to test for asbestos. Less than 3,000 linear feet of asbestos-containing pipe make up less than 0.3% of the distribution system piping.

Coliform Monitoring – Bacteriological

The City population requires collecting and analyzing a minimum of 150 samples per month from the distribution system, and 165 samples are routinely collected. The plan has the location of each sampling site. Sampling sites are located to provide uniform coverage of the distribution area while considering system hydraulics, pressure zones, and population. The follow-up sampling locations are provided in the plan. The plan also includes the sampling requirements to meet groundwater rule requirements. The current plan is in Appendix 6.4.

The City collects and tests bacterial samples monthly on raw water from all operating well stations. There are dedicated raw water sampling pumps at each well to collect unchlorinated water for bacterial analysis. This is a voluntary activity to determine the quality of the source water over time. Samples are evaluated for total coliform, E. coli, and heterotrophic plate count.

Inorganic Chemical and Physical Monitoring

Every City well is sampled a minimum of once every three years. With this sampling frequency, two or three wells are sampled each year. Sampling occurs during the third quarter of each year, typically in July. It includes all state and federal requirements plus alkalinity, magnesium, calcium, ammonia, and silica. A complete list of the parameters is found in the appendices (see Appendix 6.2, page 14).

Nitrate and Nitrite

Samples are collected annually from all City wells for nitrate and nitrite levels, usually in July. The Ray Street well is sampled quarterly for nitrate levels.

Lead and Copper

The City collects samples from a minimum of 50 homes once every three years to determine the lead and copper levels. The City has removed all known lead service lines from its residential customers. The City relies on volunteers from its residential customers to sample their taps and provide them to the City for analysis. Samples are retrieved from participating homes and transported to a certified analytical lab for evaluation. The current Lead and Copper Rule sampling plans are in Appendix 6.5.

Table 6.1 Disinfection by Products

Drinking Water Test Location and Frequencies

Test parameter	Source distribution or both	Type of sample	Required frequency per source or location
Chemistry - Inorganic			
Asbestos	Distribution	Treated	waiver
Chlorine Residual	Both	Treated	Daily
Full Inorganic Chemical Panel	Source	Treated	1 per 3 years
Copper	Distribution	Treated	50 per 3 years
Lead	Distribution	Treated	50 per 3 years
Copper	Source	Treated	1 per 3 years
Lead	Source	Treated	1 per 3 years
Nitrate	Source	Treated	1 per year
Nitrite	Source	Treated	1 per 3 years
Temperature	Source	Raw	1 per month
Turbidity	Source	Raw	1 per month
GWI Water Quality Parameters	Source	Raw	1 per week
Radionuclides			
Radon	Source	Treated	1 per 3 years
Gross Alpha	Source	Treated	1 per 3 years
Radium 226	Source	Treated	1 per 3 years
Radium 228	Source	Treated	1 per 3 years
Chemistry - Organic			
Volatile Organic Chemicals (VOC)	Source	Treated	1 per 3 years
Trihalomethanes (TTHM)	Distribution	Treated	1 per quarter
Haloacetic Acid (HAA5)	Distribution	Treated	1 per quarter
Chemistry - Synthetic Organics			
Herbicides	Source	Treated	1 per 3 years
Pesticides	Source	Treated	1 per 3 years
Soil Fumigants	Source	Treated	1 per 3 years
Insecticides	Source	Treated	1 per 3 years
Dioxin	Source	Treated	waiver
Endothall	Source	Treated	1 per 3 years
Glyphosate	Source	Treated	1 per 3 years
Diquat	Source	Treated	1 per 3 years
Bacteria			
Total Coliform and E. coli	Distribution	Treated	at least 150 per month
Total Coliform and E. coli	Source	Raw	1 per month
Heterotrophic Plate Count	Distribution	Treated	1 per month
Heterotrophic Plate Count	Source	Raw	1 per month

Disinfection Byproducts

Two sites are sampled quarterly for total trihalomethanes and haloacetic acids. The City is granted a reduced sampling requirement because the locational running annual average is less than half of the Maximum Contaminant Level of 80 µg/L for trihalomethanes and 60 µg/L for haloacetic acids. The disinfection byproduct sampling plan is in Appendix 6.6.

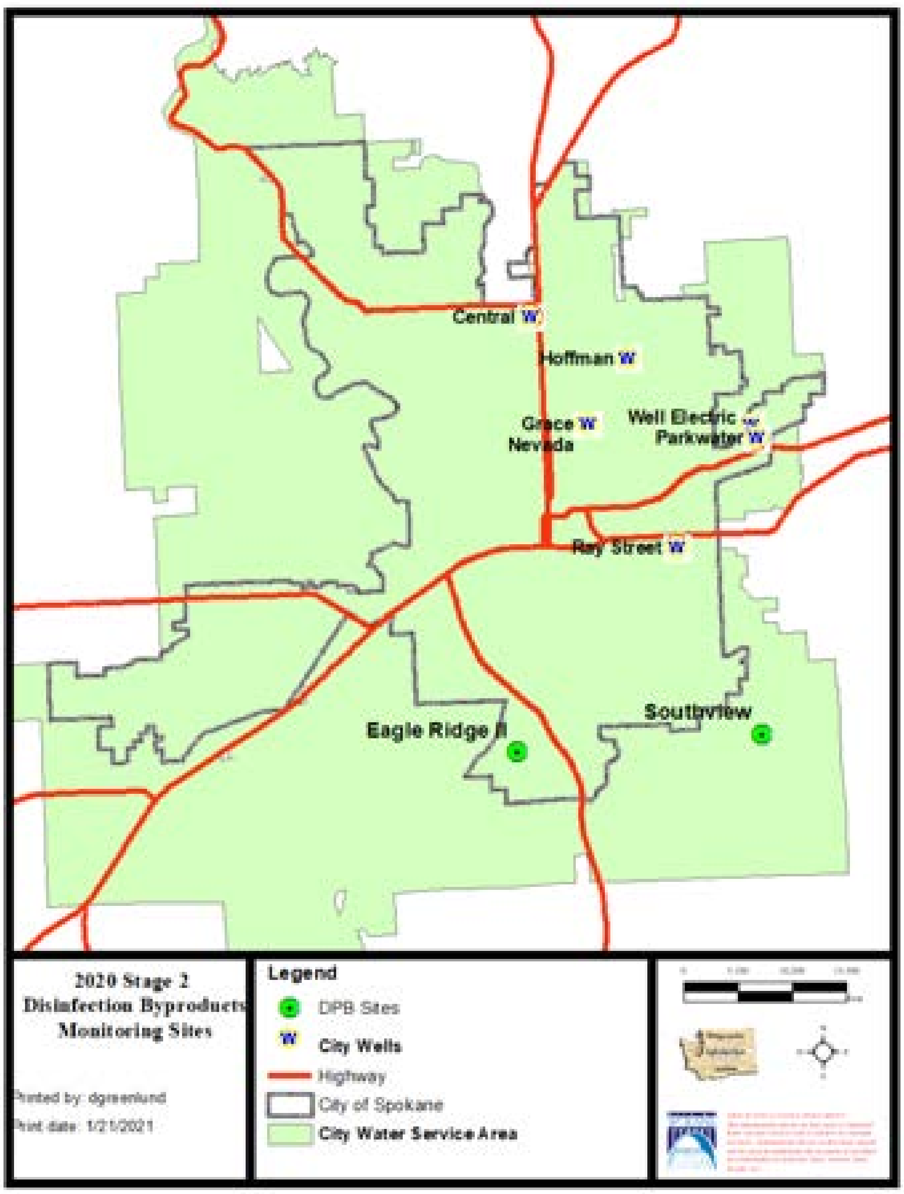


Figure 6.3 Disinfection Byproduct Monitoring Sites

Disinfectant Residuals

Free chlorine residual is monitored every weekday at many locations within the distribution system. The free chlorine residual is reported to the Department of Health monthly with the Source Disinfection Treatment Plant Report and the Coliform Bacteria Monitoring Report weekly. The free chlorine residual is also recorded with each coliform bacteria sample collected. There are also 14 inline colorimetric chlorine analyzers continuously monitoring the free chlorine residual in the distribution system.

Radon

The City samples each well once every three years for Radon 222. With this sampling frequency, two or three wells are sampled each year.

Radionuclides

As required, radionuclide samples are collected at the same frequency as the radon samples. The City's gross alpha levels have been low enough to allow them to be used in lieu of a Radium 226 sample when calculating the combined Radium 226/228 values. The gross alpha levels are also low enough for the City to postpone testing for Uranium.

Synthetic Organic Chemicals

All well fields are sampled once every three years. Sampling is primarily performed in the third quarter of each year. The City's Water Quality Monitoring Schedule allows for a waiver with a nine-year frequency on herbicides and pesticides at every well. There is a three-year waiver for soil fumigants for all wells. The state has granted complete waivers for dioxin, endothall, glyphosate, diquat, and insecticides. The City has only utilized the dioxin waiver. A complete list of the chemicals is provided in Appendix 6.2, page 15.

Volatile Organic Chemicals

All well fields are sampled once every three years. This meets the sampling frequency in the Water Quality Monitoring Schedule. With this sampling schedule, two or three well fields are sampled each year. Sampling is typically performed in the third quarter of each year in conjunction with Synthetic Organic Chemical and Inorganic Chemical sample collection. A complete list of the chemicals is provided in Appendix 6.2, page 14.

Per- and Polyfluoroalkyl Substances (PFAS)

The State of Washington initiated Per- and Polyfluorinated Substances (PFAS) monitoring effective January 2022. The United States Environmental Protection Agency also includes PFAS in the Fifth Unregulated Contaminant Monitoring Rule. The state is allowing the Unregulated Contaminant Monitoring Rule sampling to fulfill the requirements. The City will use the sampling, currently scheduled for 2024, to meet state requirements.

The City of Spokane utilized grant funding available through the Washington State Department of Health to sample our source wells for PFAS compounds. The wells were sampled in the first quarter of 2023. All available wells were sampled. Hoffman was not sampled due to maintenance on the discharge transmission main. There were detections at the Grace and Ray Street wells. These results are in Appendix 6.12. Based on these results and following the PFAS monitoring and follow up actions under WAC 246-290 the Grace and Ray Street wells were sample in the second quarter of 2023 and the Ray Street well in the third quarter. These results are in included in the table of initial results in Appendix 6.12.

Groundwater Under the Influence of Surface Water (GWI)

The Washington State Department of Health determined the City of Spokane's Well Electric wells to be under the influence of surface water, the Spokane River, in 2001. Based on microscopic particle analysis performed in 2003 and 2004, the wells were determined not to be groundwater under the influence if the City follows its plan. Part of the plan is to sample water quality parameters at Well Electric Well number 4 and Well number 5, Parkwater Well number 3, and the Spokane River. Water Quality Laboratory staff measure temperature, conductivity, pH, and turbidity each week and record along with river flow, precipitation, and air temperature. Monthly samples are collected from each location for total coliform and E. coli analysis and Heterotrophic Plate Counts. The Water Quality Parameter sampling procedure is in Appendix 6.7.

The Water Quality Laboratory works with operations to satisfy the City's CT6 reporting requirements. The City is required to maintain residual chlorine levels, which allow for disinfection of the source water prior to the first customer tap. The combination of chlorine concentration (C) in mg/L and contact time (T) in minutes must be at least six (6). Operators test the chlorine residual level for each pump at Well Electric in service at least once per shift and record those values on the Well Electric chlorination log. Water Quality Laboratory personnel collect the information and complete the Department of Health's standard form. The form is sent electronically to the Department of Health by the tenth of each month. The operations procedure and standard form are in Appendix 6.8.

6.4 Emergency Preparedness and Response

Preparedness, response mitigation, and recovery are essential elements of an emergency management plan. Mitigation planning involves performing vulnerability analysis and identifying facilities whose functions are critical to the functioning of the community, such as hospitals, critical patient homes, and the like. For a large system like the City of Spokane Water system, many of the problems that may be viewed as critical situations for a small system could be handled routinely. This plan addresses the most critical factors, and the response/notification plans are implemented to address such situations.

Emergency Response Plan

The Water Department has developed an Emergency Response Plan. The City of Spokane prepared the Emergency Response Plan to describe the utilities strategies, resources, plans, and procedures to prepare for and respond to any incident, natural or man-made, that threatens life, property, or the environment. The Emergency Response Plan was prepared to centralize and streamline other response plans developed by the City and incorporated in the appendices of the Emergency Response Plan document in accordance with America's Water Infrastructure Act of 2018 (AWIA).

Emergency Communications

The City of Spokane Public Works Division is staffed with a full-time Communications Manager trained and authorized to plan and execute external communications for the Water Department. In the event of a Water System emergency, the following protocol is used to guide communication regarding the incident to the public.

Gathering Information and Prioritizing Messaging

Operational staff notifies the Communications Manager immediately to provide as detailed a briefing as possible at the time. Many times this is done simultaneously with the Public Works Director via telephone, email, or text message.

The Communications Manager notifies or confirms notification has been given to the Mayor, City Administrator, Public Works Director, and Communications Director. The City maintains an emergency contact list and phone tree for senior leadership.

The Communications Manager is briefed alongside senior staff and administration regarding the incident including process, procedures, assessment, status, outcomes, next steps, and other important information.

Once briefed with information and details, the Communications Manager works with the Public Works Director and administration leadership to develop and prioritize messaging, establish timelines, and strategize channels to release information internally and externally.

A Communications Action Plan will be developed to include all messaging, media relations, tools, and deployment timelines. This document will remain fluid as the situation unfolds and information changes. The Communications Action Plan will be updated and provided to leadership and key staff.

The Communications Manager will assess the scope of communication needs to coordinate staffing and technology resources. The City maintains a consistent number of communications professionals: managers, information specialists, website managers, graphic designers, video and editing technicians, and programming staff.

Audiences for notification may include (not necessarily in this order):

- Specialized Groups and Partners
- Regulators
- Employees
- Law Enforcement and Fire Department
- Media
- Public
- Vulnerable populations
- Geographic targeted areas
- Others

Assessing and Determining Audiences

Water emergencies may impact a variety of stakeholders and vulnerable populations or industries. Geography, food and beverage suppliers and retailers, hospitality, healthcare facilities, and educational institutions are all susceptible to the impacts of a water emergency.

Public Information Deployment

Depending on the scope of the emergency situation, the action plan indicated in Table 6.2 will be followed, and available communication assets will be activated per Table 6.3.

Table 6.2 Action Plan Form

Action	Date/Time	Who	Time Completed	Notes
Notify Public Works Communications Manager of emergency with as many specifics as possible				
Communications Manager notifies (or confirms notification) Mayor, Public Works Director, Communications Director, Sr. Management and City Council				
Notify Department of Health Office of Drinking Water (877-481-4901) DOH Communications (360-236-4501)				
Communications (and other senior leadership) receive briefing from incident commander to determine communication response				
Develop internal and external messaging, strategy, timing				
Assess the need for communication with stakeholder and vulnerable audiences				
Review messaging and get approval by senior leadership				
Confirm notification of regulators and health officials. (SRHD, DOH)				
Coordinate messaging with regional, state, and national partner agencies for consistency.				
Distribute, implement, and execute approved Communications Plan				
Coordinate policy needs with City Council				
Establish ongoing update schedule with media and the public if necessary, depending on the expected timeline of emergency				
Assign staff to monitor and maintain documentation of information deployment and media coverage				
Prepare communications overview for after-action report exercise				

Table 6.3 Communications Inventory

Asset	Content/Platform	Lead
Website – my.SpokaneCity.org	Website	Web Manager
Facebook - @SpokaneCity	Social Media	Public Information Coordinator
Twitter - @SpokaneCity	Social Media	Public Information Coordinator
Nextdoor - @SpokaneCity	Social Media	Public Information Coordinator
Newsletter – Community Update	Email/Constant Contact	Public Information Coordinator
News Release	Media Release/Email/Web	Communications Manager/Director
News Conference and Briefings	Live/Broadcast Media	Communications Manager/Director
Onsite Live Interviews	Live/Broadcast Media	Communications Manager/Director
City5 Cable – Comcast Channel 5	Local Access Cable TV	City5 Cable Director
MySpokane 311 – City Customer Service Line	Customer Service Staff	Director of Customer Experience
Reverse 911	Broadcast/Cellular Messaging through Spokane Regional Emergency Communications	Chief of Police or Fire Chief
Alert Spokane	SMS Text Spokane Regional Emergency Communications	Chief of Police or Fire Chief

Communications Monitoring and Response

The Communications Manager will coordinate and lead the monitoring of media coverage and public response to the emergency event. Messaging will be made available for all staff and leadership providing responses. These can include talking points for interviews and news briefings, frequently asked questions linked to the website, social media responses, and talking points for customer service staff.

Communications Documentation and Review

The Communications Manager will coordinate tracking communications deployment and capturing media coverage of the emergency event. A summary of communications and media will be provided and reviewed in the incident's after-action report exercise. Analysis of the communications plan will include actions that went well and actions that need changing or improvement. Any improvements will be made to the Water System Plan Emergency Communications document.

6.5 Cross-Connection Control Program

The purpose of a cross-connection control and backflow prevention program is to protect the health of water consumers and retain a potable water supply. It is also intended to define and establish the policies and procedures necessary to properly implement a cross-connection control program established in WAC 296-290-490. and as required by Spokane Municipal Code (SMC) 13.04.0814, 13.04.0816 and 13.04.0818. The City of Spokane "Cross Connection Control Program" is presented in Appendix 6.9. The Cross-connection Control Annual Summary Report (ASR) for 2022 is contained in Appendix 6.10.

Extra attention to cross-connection control is concentrated in Table 13, Facilities and Equipment Using Hazardous Materials. An ongoing survey and inspection program is carried out to ensure approved air gaps are used for filling any tanks or containers holding hazardous material with water. An example is chemical sprays for lawns. Approved air gaps are also required for using a fire hydrant to fill a tank or container. For private parties, such as contractors, using a City hydrant requires a permit, and the adequacy of their equipment and filling procedures is determined when the permit is issued. This is managed through the Hydrant Permit Program.

6.6 Sanitary Survey

The Department of Health completes the Sanitary Survey for the City of Spokane Water system in accordance with WAC 246-290-416. The Sanitary Survey is divided into a three-year cycle to cover the required elements adequately.

The three-year cycle for the City of Spokane is summarized as follows:

- Year 1: Source including storage fed by source wells, treatment, and distribution.
- Year 2: Finished water storage and pumps, pump facilities, and controls.
- Year 3: Monitoring, reporting, data verification, system management and operation, and operator compliance.

Year one of the current cycle for the sanitary survey was completed in early summer 2022 in accordance with the outlined three-year cycle. Years two and three of this sanitary survey cycle will be completed in 2023 and 2024. The inspection report from the Department of Health for year one is included in Appendix 6.11.

6.7 Recordkeeping and Reporting

Recordkeeping

Various departments within Water and Hydroelectric Services maintain the records specific to their functions. The Water Quality Laboratory maintains the records for bacteriological analysis, chemical analysis of volatile organic chemicals, inorganic chemicals, synthetic organic chemicals, distribution system byproducts, radionuclides, groundwater under the influence of surface water monitoring, and CT6 disinfection.

The Engineering Department and support staff maintain records for projects and sanitary surveys. Annually, the Engineering Department completes the Water Facility Inventory.

Water consumption records are generated monthly by the Utility Billing Department. The Upriver Complex Water System Control Station generates water source pumpage records monthly. Water consumption and pumpage records are held at the Water Department for six years. After this period, the records are transferred offsite and stored indefinitely. The procedures followed by the Water Department for recordkeeping and reporting are in accordance with WAC 246-290-480.

Reporting

As with recordkeeping, reporting is performed by the department with that function. The Water Quality Laboratory reports coliform bacteria analysis results and system chlorine residual values weekly. CT6 disinfection reports are submitted monthly. Annual reports for Water Use Efficiency and Consumer Confidence Report distribution are submitted.

Cross-Connection Control reporting is conducted by the Water Department's cross-connection control group.

Customer Complaint Program

The current method for addressing customer complaints is as follows:

- The 24-hour radio/dispatch center receives all calls relating to customer concerns/complaints. Approximately 50 to 60 calls are taken annually.
- Based upon the dispatcher's initial line of questioning, the seriousness of the concern/complaint is determined.
- In cases where public health is not at risk, the dispatcher responds to their concerns/complaints by asking additional questions. These questions allow the dispatcher to address their concerns/complaints over the telephone.
- In cases where public health is not at risk, but a field investigation is warranted, an appointment is made with the customer at their earliest convenience—typically the following day. The City receives approximately 25 to 30 of these types of calls annually.
- In cases where the concern/complaint may be a possible risk to public health, a Water Quality staff experienced in water quality issues is dispatched to investigate the nature and scope of the concern/complaint.
- The inspector will specify the corrective action needed based on the field investigation.
- If water quality is suspected of being compromised, a water quality sample will be drawn immediately and taken to the City of Spokane laboratory for immediate analysis. This action activates the Water Emergency Communications Plan outlined in Chapter 6.
- Anytime a water quality sample is taken, a copy of the water analysis results will be mailed to the complainant, and a copy kept in the Water Department files.
- The complaints that have required a field inspection are logged into the water quality computerized database, recorded on the appropriate "repair card," and added to the water quality files.

- The Water Department has implemented a maintenance management system with a caller log form to track customer service concerns/complaints.

The Water Quality Coordinator maintains water quality complaint records. Responses to water quality complaints are added to the Water Quality computer database. Water quality complaint records become permanent records and are held indefinitely.

6.8 Operation and Maintenance Improvements

Improvements that will have financial impacts on the water system's operation and maintenance are addressed in Chapter 8.

Chapter 7 – Distribution Facilities – Design and Construction Standards

Table of Contents

Chapter 7 – Distribution Facilities – Design and Construction Standards

Introduction

This chapter includes the water system distribution facilities and design and construction standards. The City has received project report and construction document submittal exception in the past for both distribution mains and other distribution-relation projects. The City wants to opt for submittal exceptions under WAC 246-290-125 to continue for this Water System Plan.

7.1 Project Review Procedures

Several processes are used to review Water Department infrastructure project reports and construction documents. Projects may be designed in-house by City, by consultants contracted by the City, or by consultants engaged by an individual or developer for a project, including the City water facility infrastructure required for their individual needs.

- For projects designed by City engineering staff, the reports and construction documents are reviewed by the Water Department Engineering staff and by the Water Department Construction and Maintenance staff. When construction of a distribution system provides fire protection, the City Fire Department will review the plans for projects within its jurisdiction. For projects outside the City limits, the Fire Marshal of the affected Fire District reviews the plans for the project.
- For projects designed by consultants contracted by the City, reports, and construction documents are reviewed by City Engineering Services Design staff, by the Water Department Engineering staff, and the Water Department Construction and Maintenance staff. When construction of a distribution system provides fire protection, the City Fire Department will review the plans for projects within its jurisdiction. For projects outside City limits, the Fire Marshal of the affected Fire District reviews the plans for the project.
- For projects designed by a consultant engineer engaged by an individual or developer that include City water facility infrastructure improvements (*i.e.*, projects constructed by Private Contract), the reports and construction documents are reviewed by the City Developer Services Engineering staff, by the Water Department Engineering staff, and by the Water Department Construction and Maintenance staff. When construction of a distribution system provides fire protection, the City Fire Department will review the plans for projects within its jurisdiction. For projects outside City limits, the Fire Marshal of the affected Fire District reviews the plans for the project.

For all projects, the design and construction documents must reference and comply with the City's approved Design Standards which include the Standard Specifications for Road, Bridge, and Municipal Construction, as amended, and published jointly by the Washington State Department of Transportation and the American Public Works Association collectively referred to as the "Standard Specifications", and the City of Spokane General Special Provisions for Private Contracts as amended.

Any deviation from the Design Standards requires Washington State Department of Health review and approval. Changes to the City's approved Design Standards may require an addendum to the City of Spokane's Comprehensive Water Plan, which must be submitted to the Washington State Department of Health for review and approval. The most up-to-date versions of the City of Spokane Design Standards, General Special Provisions for Private Contracts, and the City of Spokane Standard Plans are available on the City of Spokane website at https://my.spokanecity.org/business/bid-and-design/.

Reports and construction documents are reviewed to ensure the project designs comply with and meet the City's minimum design standards and policies. In addition, the documents are reviewed to ensure compliance with state drinking water regulations, local ordinances, and any other applicable requirements.

Please refer to Appendices 7.1-7.3 for examples of correspondence, approvals, inspection documentation, record drawings, reports, Council actions, Washington State Department of Health correspondence, reports, and approvals.

7.2 Policies and Requirements for Outside Parties

The policy provisions for providing water service are codified in the City of Spokane Municipal Code Title 13.04, Public Utilities and Services. Additional policy provisions are identified in this Comprehensive Plan.

Formation of Local Improvement Districts

Property owners within the City's boundaries that wish to form a Local Improvement District to build a water system extension can do so by contacting the City's Planning and Development Services Center. These Departments will provide technical assistance to the property owner with all the necessary procedures. The procedures for a property owner wishing to establish a Local Improvement District outside the City are similar. Applicants are required to prepare a "Request for Local Improvement District Covenant," as shown in Appendix 7.4. The City's Hearing Examiner reviews all Local Improvement District proposals and issues a final decision.

Upsizing

The upsizing policy of water mains installed by private contracts provides the flexibility to upsize water mains to address the needs of future and downstream customers proactively. The policy was adopted in 1999 and remains in effect. The complete Water Main Upsize policy for upsizing water pipe for necessary present or future applications appear in Appendix 7.5. Oversizing water piping is subject to the approval of the Water Department Director.

Cross-Connection Program

The cross-connection program is addressed in Chapter 6 of this plan.

Service Extension Requests

Typically, the Water Department plans and finances the construction of wells, pumps, reservoirs, and transmission mains. Should developers need water service before adequate infrastructure can be constructed, the City will allow the developer to proceed at their own expense. Distribution main extensions and service connections are typically paid for by developers/property owners. All work must be designed by a licensed engineer and constructed in accordance with City design and construction standards.

Franchise Agreements

If a water main extension is required to be constructed in a right-of-way that is not within the jurisdiction of the City of Spokane, a new franchise agreement or an amendment to an existing agreement must be obtained. The agreement allows for the construction, operation, and maintenance of the water facility from the appropriate authority prior to final approval being granted. The project proponent's responsibility is to secure the agreement in the City's name.

Conditions of Service

Conditions of service are property-specific and development-specific requirements facilitate the implementation of the City of Spokane's Retail Service Area policies. They are based on location and proposed use of the property. The specific conditions of service requirements are provided to each project proponent at the time of request for water service availability. Conditions can include one or more of the following items:

- Purveyor responsibilities
- Customer responsibilities
- Specific considerations based on the proposed use of property
- Connection fee schedule
- Meter and materials specifications
- Consent agreements for inspection, maintenance, and repair activities that may disrupt water service
- Cross-connection control requirements
- Developer extension requirements, design standards, financing responsibilities, and professional engineer design requirements
- Annexation policies as addressed at the beginning of this section.
- Location within the City's Retail Service Area.

Each scenario in the process of obtaining water for a property has an established procedure governed by the City's municipal code, ordinances, and design standards, in addition to state law. The process incudes initial development of land to the purchase of an established property.

City of Spokane Responsibilities

The City's responsibility to provide for the operation and maintenance of the water system begins within the public domain and extends to the property line. For this reason, most shutoff valves are placed within the public domain and at the property line. Maintenance of the portions of the water system within the public domain is performed by City Water Department personnel with City purchased and supplied equipment. As stated in SMC 13.04.140, "The City assumes no responsibility whatsoever for any private water pipes, mains, devices, fixtures, or appurtenances not located upon public property or the public right-of-way."

City water personnel are not allowed to proceed onto the private property except at the owner's invitation (*i.e.*, inspection of existing or newly installed equipment or requested repairs).

Water taps and water meter installations are initiated through a permitting process in City Hall and scheduling with the Water Department. After the applicable work orders are completed, and the tap and/or water meter fees are collected, City employees complete the installations in the public domain using City-supplied materials. These work orders are done in compliance with "City of Spokane Water Department Rules and Regulations for Water Service Installations."

Single Family Homeowner Responsibilities within City Limits

The property owner's obligation and responsibilities are contained in SMC 13.04.100 through 13.04.120. The most straightforward process is associated with purchasing an established residence within the City's service area with all water service equipment in place. Prior to purchase, it is the responsibility of the potential homeowner to determine the condition of the water service equipment on the property. All water service equipment should be in good operating condition and must conform to the standards outlined in the City of Spokane Department of Engineering Services Design Standards.

Meters are furnished by the City and charged to the customer at cost.

Maintenance and service leak repairs on private property are the property owner's responsibility. Any repairs or equipment replacements must conform to the City's current Design Standards and be approved by a Water Department inspector prior to installation.

The property owner is responsible for informing the City Utility Billing Department of any change in ownership and ensuring the account and billing have been transferred accordingly. This includes rental properties.

City ordinances allow a homeowner to hire state-licensed and bonded qualified contractors to perform repairs and to use the street shutoff cock during the work and testing of a new service. If desired, a homeowner may hire the City Water Department to make very limited repairs on their property. Should the homeowner/contractor retain the City, an additional billing charge is applied for these services. The additional charge for those repairs is then listed on the homeowner's utility bill.

Connection Fee Schedule

The general requirements for taps and meters are described in SMC 13.04.2025 through 13.04.2028. Tap and meter fee rates are calculated based on the pipe sizes specified by the engineer/designer of the project. Charges for a 2-inch tap or smaller are addressed in SMC 13.04.2026. For services that require a tap that is 3 inches or larger, the costs are addressed in SMC 13.04.2028.

Special water service connection fees and General Facility Charges are also assessed. These fees help to offset costs associated with the installation of major water infrastructure needed to provide water service. Examples include wells, pumps, reservoirs, and large transmission mains. These fees are addressed in SMC 13.04.2042 and are calculated based on the size of the service line.

Meter and Materials Specifications

All water service meters and materials specifications are in the City of Spokane's Design Standards, the Standard Specifications for Road, Bridge, and Municipal Construction, and the City of Spokane Water Department Rules and Regulations for Water Service Installations.

The City for larger water services has defined vault dimensions. The required vault sizes are shown on the handout "Water Service Minimum Vault Dimensions" in Appendix 7.5.

Consent Agreements for Inspection, Maintenance, and Repair Activities that may Disrupt Water Service

Consent agreements to disrupt water service are not required for inspection, maintenance, and repair activities. The Water Department makes every effort to coordinate disruptions and meet customer needs. SMC 4.02.180 provides that notice shall be given prior to termination of water service due to nonpayment of water service charges.

Private Development Projects within the Retail Service Area

New development requests seeking connection to City water service within the City limits must first apply for a permit. All permits start with the Planning and Development Services Center at the City. A predevelopment conference is arranged at the developer's option, and all applicable City departments are engaged to discuss the project details.

The permitting process includes review of the property platting and a State Environmental Policy Act (SEPA) review. These documents are routed to the City's infrastructure departments (water, sewer, street, and stormwater). Following the departmental reviews, public meetings are held when applicable.

Any water system extensions required by a project must be designed by a licensed engineer and comply with all the City's design and specification standards. The Municipal Code states that the financial responsibility lies with the developer to prepare the design and install the system extensions.

Following receipt of the project information, the City reviews the project to verify conformity. When the project information complies with the City's requirements, a letter of acceptance describing the process and requirements for receiving a permit and constructing the project is sent to the developer. A letter of acceptance signed by both the developer and the City, and the issued permit must be completed before a project can proceed to construction.

The developer must coordinate and pay for the appropriate elements of the project construction and coordinate with the City for inspection services. The developer is also responsible for purchasing tap permits.

Development within the City's Water Service Area but outside the City limits must apply for a building permit from Spokane County. As part of the County's permit process, the City will evaluate and confirm capacity and availability and the location of nearby infrastructure for connection to the City's system. This will be memorialized in a written letter of water service availability and provided to the developer. The development will apply for a tap and meter permit to receive service from the City’s water system.

Plan Review

The main goals in reviewing design plans developed by a private party are to ensure that the project will satisfy City Design Standards and deliver a safe, adequate, and high-quality drinking water product. To assist the private party, the City asks that the following factors be considered as the private party makes development plans:

- The availability of an existing public water system can provide water for domestic, commercial, irrigation, and fire protection purposes with consideration for adequate water pressures and required flow volumes within the project's proximity. In the absence of these, the developer must consider the costs associated with extending or upgrading the water system to the project location. Generally, all costs associated with extending water to a project location are the property owner's or developer's responsibility.

- Water pressure evaluations—the normal pressure to be supplied at the customer service connection shall be 45 to 80 psi (pounds per square inch).
- If the pressure exceeds 80 psi, a Pressure Reducing Valve will be required on all individual services. A Pressure Reducing Valve is required to comply with the Uniform Plumbing Code to protect the building's plumbing system from excessive water pressure.
- A new water system pressure zone may be required to provide proper water pressure to avoid future problems. If the pressure is less than 45 psi, the property owner may not be able to operate all their appliances or irrigation equipment efficiently. The Water Department Director will determine the need to establish a new water system pressure zone and assess costs.
- Individual booster pumping systems for individual service connections are allowed but require backflow prevention. Such systems represent a cross connection and has the potential to create backflow conditions into the public water system. Back-flows have the possibility of contaminating the water supply. Additionally, if a water main break should occur and allows air into the pipe, the air could reach the Booster Station, potentially causing damage to the pump(s) and/or the customer's equipment.
- Generally, fire hydrants within the right-of-way are publicly owned and maintained by the Water Department. Fire hydrants not located within the public right-of-way are considered private, with maintenance requirements being the property owner's responsibility. The Water Department Director can rule on exceptions.
- The possibility of contaminating the public water supply must be eliminated to ensure that the drinking water is safe for consumption. Projects that have the potential to create a back-flow condition into the public water supply, known as a cross-connection, are required to install an approved back-flow assembly on the water service to comply with the City of Spokane Water Department Rules and Regulations and Washington State law. In some cases, cross-connection(s) can be corrected by proper plumbing system design and/or modifications to existing plumbing systems, eliminating the need to install a back-flow prevention device on the service. Water Department inspectors will assist the developer in evaluating remedial alternatives.
- The City Water Department requires project proponents to determine the amount of water and the size of services needed for a project. With advances in computer technology and water hydraulic analysis programs (water system modeling), the Water Department requires applicants for water service demonstrate via a hydraulic analysis (computer water system model) the water demands for the proposed project as well as how those water demands integrate into the overall water system. The City Water Department reviews the submitted materials for accuracy and adequacy.
- If an existing building with existing water service has been abandoned without water service (*i.e.*, meter turned off) for one year or more, a new service line may be required. An existing water service often deteriorates under such conditions, and the Water Department is committed to avoiding water quality problems.
- If an existing building with an existing water service is to be demolished and the water service has been turned off, a new service line is generally required for any new structure that is built.
- If the estimated cost of constructing necessary public water system improvements is less than $150,000, the Water Department can, by State law, contract with the project owner to construct the improvements. The Water Department charges a fee to provide a cost estimate

(firm bid). The estimate will include Water Department engineering services to design the water system improvements and for the Water Department to construct those improvements. The Department will schedule and undertake the construction only upon receiving full payment of the estimate. The owner may seek the services of private engineers and private contractors to design and construct public water main extensions. Should a private engineer develop such plans, they are subject to the full review process outlined in this Comprehensive Water System Plan.

- A hydrant installation permit is required for installing a public fire hydrant. The Water Department will schedule the job upon receiving full payment permit fee. There is a separate permit for hydrant use if this is required.
- When requested, and with payment of the required fee, the Water Department will provide field services to perform flow tests on public fire hydrants. The results of the flow tests are given to the party submitting the request. The flow tests are also added to the Water Department's file of flow test records. Results of previous flow tests are filed and maintained at the Water Department. Should the Water Department receive a request for fire flow information that already exists, that information will be made available at no additional cost.
- To recover the cost of labor, equipment, and material, the Water Department charges fees for water service and tap when an application for water service is filed.

7.3 Construction and Design Standards

The installation of water infrastructure as part of the City of Spokane's water system shall meet the construction and design standards adopted by the City of Spokane. Construction and design standards include the approved City of Spokane Design Standards, the City of Spokane General Special Provisions for Private Contracts, the City of Spokane Water Department Rules and Regulations for Water Service Installations, and the City of Spokane Standard Plans, which are maintained and updated by the City of Spokane. Additional standards also include:

- the Standard Specifications for Road, Bridge, and Municipal Construction, as amended and published jointly by the Washington State Department of Transportation and the American Public Works Association,
- the Water System Design Manual published by the Washington State Department of Health, DOH Pub 331-123 the latest revision, and
- the American Water Works Association Standards latest revisions as published by the American Water Works Association.

The City's Department of Engineering Services is responsible for maintaining and updating the City of Spokane Design Standards, the Standard Plans, and the General Special Provisions for Private Contracts, which are the City amendments to the Standard Specifications for Road Bridge and Municipal Construction. The City of Spokane Water Department maintains and updates the City of Spokane Water Department Rules and Regulations. Standards maintained by the City are reviewed annually, and the latest revisions of these standards are located on the City of Spokane website.

These Standards are developed to normalize design elements for consistency and to meet minimum public safety and health requirements. Further, the Standards govern design and construction for new construction and upgrading all streets, sewers, water lines, and other utilities in new or existing City rights-of-way, easements, or areas proposed for dedication to the City of Spokane.

Minimum design standards for water service pressure, minimum pipe diameters, maximum pipe velocity, needed fire flow, and minimum and maximum systems pressures are provided in the Design Standards of the City of Spokane.

Standard Specifications

The Standard Specifications are comprised of the following: Standard Specifications for Road, Bridge, and Municipal Construction, as amended and published jointly by the Washington State Department of Transportation and the American Public Works Association, and the City of Spokane Supplemental Specifications to the Standard Specifications for Road, Bridge, and Municipal Construction as amended—are collectively referred to as the "Standard Specifications."

Group A Public Water Systems

The Group A Public Water Systems, Chapter 246-290 WAC publication as published by the Washington State Department of Health, Division of Drinking Water, effective June 2004 edition including the most current revisions thereof or most current edition thereof are also referenced in these construction standards.

Connections to Existing System

While outside contractors often construct new water infrastructure, the City of Spokane Water Department's policy is that only Water Department staff make the final connections from a completed, inspected, chlorinated, and tested system component to the existing live system. Only Water Department crews are permitted to work on live system components. This includes all connections, tapping for services or hydrants, and the operating system valves.

Service Taps and Meters

City Ordinance Section 13.04.0802 governs Service Taps and Meters. Taps and meters are installed by the Water & Hydroelectric Services Department to the property line—generally, this is the public right-of-way line. This chapter discusses this topic in more detail in Section 7.3, Design Standards. Also, please refer to Appendix 7.6 for the City of Spokane Water Department Rules and Regulations for Water Service Installations.

The Water Department is subject to the contents of the City of Spokane Municipal Code (SMC), Section 13.04 and Section 13.08. In addition, the following publications are included as a part of the Design Standards the City references relative to system design for performance and sizing:

- Water System Design Manual as published by the Department of Health, Environmental Health Programs, Division of Drinking Water, Publication DOH #331-123, latest edition including current revisions or edition.
- The Group A Public Water Systems, Chapter 246-290 WAC publication as published by the Department of Health, Division of Drinking Water, Publication DOH #331-010, effective June 2004 edition, including current revisions edition.
- The American Water Works Association AWWA Standards.
- The American Water Works Association AWWA Manual of Water Supply Practices No. M11, Steel Pipe—A Guide for Design and Installation.
- The American Water Works Association AWWA Manual of Water Supply Practices No. M14, Recommended Practice for Backflow Prevention and Cross-Connection Control.
- The American Water Works Association AWWA Manual of Water Supply Practices No. M22, Sizing Water Service Lines and Meters.

- The American Water Works Association AWWA Manual of Water Supply Practices No. M31, Distribution System Requirements for Fire Protection.
- The American Water Works Association AWWA Manual of Water Supply Practices No. M33, Flowmeters in Water Supply.

Other Codes and Standards

Also referenced and applicable are the following:

- ANSI—American National Standards Institute
- A—American Society for Testing and Materials
- CFR—Code of Federal Regulations
- FSS—Federal Specifications and Standards, General Services Administration
- HIPS—Hydraulic Institute Pump Standards
- IEEE—Institute of Electrical and Electronics Engineers
- NEC—National Electric Code
- NEMA—National Electrical Manufacturers' Association
- NEPA—National Environmental Policy Act
- NFPA—National Fire Protection Association
- OSHA—Occupational Safety and Health Administration
- RCW—Revised Code of Washington (Laws of the State)
- SEPA—State Environmental Policy Act
- SSPC—Steel Structures Painting Council
- IBC—International Building Code
- UL—Underwriter Laboratory listing
- UPC—Uniform Plumbing Code
- IFC–International Fire Code
- WAC—Washington Administrative Code
- WISHA—Washington Industrial Safety and Health Administration

7.4 Construction and Design Standards for Water Mains

The following are design standards for the different components of the City of Spokane water system. The City is requesting waiver of the project report and construction document submittal requirements for construction of distribution and transmission mains and other pipeline appurtenances.

Pipelines

Minimum design standards for the pipe materials, valve spacing, and separation from other buried utilities are provided in the Design Standards of the City of Spokane.

- The minimum size for water mains shall be not less than 6 inches in diameter, shall be designed for fire flow, and shall be looped wherever possible.
- Four-inch diameter mains will be allowed in some permanent cul-de-sacs under special permission (see Design Standards Section 8.4) where no hydrants are connected to the main, where the length of the main is 250 feet or less, where no more than twelve dwelling units will be served, where no dwelling unit in the cul-de-sac will be no farther than 250 feet from a fire hydrant and where an engineering hydraulic analysis (computer model) demonstrates that water velocities and minimum water pressures are within acceptable ranges as provided in the City of Spokane's Design Standards (see Design Standards Sections 8.3 and 8.4).

- All public water mains shall be located in a public right-of-way unless authorized in writing by the Director of the Water Department, allowing and accepting an exclusive easement, at least 25 feet wide, to accommodate the pipeline.
- An 8 inch diameter pipe shall be the minimum size for permanent dead ends, except for cul-de-sacs. Six-inch pipe shall be the minimum size for short, dead-end streets scheduled or projected to be extended such that the proposed water main will be eventually looped, provided that adequate capacity is provided in the interim for domestic demands and fire protection.
- There will be no dead-end mains longer than 1,000 feet.
- The Water Department requires a hydraulic analysis for the sizing of water mains. In most cases, the hydraulic analysis will include a computer model analysis.
- Normal pipeline velocities should be maintained between 3 to 5 feet per second for pumped systems, allowing a maximum velocity of 7.5 feet per second for normal peak conditions. Velocities up to ten feet per second are commonly allowed within the yard piping of a pump station to reduce capital costs of appurtenances at the station. The maximum allowable velocity during a fire flow event is 15 feet per second.
- Predominantly, the depth of pipes to the invert of any water main shall be 5.5 feet (see Design Standards Section 8.7). If the water line is placed in a dedicated right-of-way, the ground surface must be rough graded within 6 inches of the approved established grade.
- No other utilities, cable, or conduit shall occupy the same trench as a water line except as approved by the Water Department. The minimum service line size shall be 1 inch. Service line pipe type shall be in accordance with Design Standards Section 8.5.
- All customer water use shall be metered. The minimum meter size shall be 3/4 inch, and all new meters shall be equipped with an approved remote radio device Automated Meter Reading. The Water Department will furnish and install the complete meter unit after proper application and fees are paid. Meters are owned by the property owner and maintained by the Water Department.

Valves

- Distribution system valves shall be spaced between every hydrant, typically at the right-of-way line entering and exiting every major intersection. Transmission main valves shall be located to isolate well-defined pipeline lengths. The maximum length between valves shall not exceed 3,000 feet.
- Valves, three inches to 12 inches in size, shall be resilient seat gate valves conforming to ANSI/AWWA C509 and Standard Specification Section 9-30.3(1). Valves 14 inches to 16 inches in size shall be gate valves conforming to ANSI/AWWA C500 and with the Standard Specifications Section 9-30.3(2). Valves 18 inches and larger in size shall be butterfly-type, conforming to ANSI/AWWA C504 and Standard Specifications 9-30.3(3). All valves shall open clockwise. Valves shall be installed in accordance with Standard Specifications Section 7-12.

Hydrants

All fire hydrants shall include a Storz fitting on the main port, a shutoff valve located at the main, and be installed in accordance with Standard Specifications Section 7-14. Fire hydrants shall conform to ANSI/AWWA C502 and Standard Specifications Section 9-30.5. For specified locations of fire hydrants, see Design Standards Section 8.8. The required fire flow shall be available with a 20 psi minimum residual at all points throughout the distribution system (see Design Standards Sections 8.2-3 and 8.3). As a rule, fire hydrant spacing shall not exceed 500 feet - typically only applicable in residential areas.

Hydrants shall, as a minimum, be located at each street intersection. In areas where high-volume fire flows are required, the fire hydrant spacing shall be adjusted to meet International Fire Code, State, and local requirements—typically not exceeding 250 feet.

Service Taps and Meters

City Ordinance Section 13.04.0802 addresses water service taps and meters. Generally, each individual building is to be served by its own water service.

Planned Unit Developments are master metered at the property line. The residential meter will be installed in an approved meter box at the first property line. Commercial meters, 1.5 inch and 2 inch meters, are installed either in meter boxes at the property line or in the building served at the service line entry point. Larger meters are installed either in concrete meter vaults at the property line or in the building served at the service line entry point—generally in the mechanical room.

For commercial and industrial service lines, the City requires that a customer's project engineer or architect provide the determination of the service line size based on the needs of the facility for fire protection, process water, domestic needs, irrigation, etc. The City reviews the proposed service line for compliance with the City Standards. If the City review finds the service line in compliance with the City Standards, it will be approved. Provisions for a remote reader receptacle shall be included to allow the meter to be read without entering the building.

7.5 Design and Construction Standards for Reservoirs and Booster Pump Stations

Details of the City’s design and construction standards for storage reservoirs and booster station area described in this section. The City is not requesting a waiver from the project report and construction documents for these projects. This information is added for context and reference.

7.5.1 Reservoirs

System storage is used in a water system to meet peak demands and provide a reliable supply for operational services in the event of a fire and for failure of supply sources. As discussed in Section 3.3, reservoir volume is the combined total of all five components of storage: operational storage, equalization storage, standby storage, fire suppression storage, and dead storage. The Supervisory Control manages level control and alarms and Data Acquisition system, described in detail in Section 3.3.

Storage Siting and Elevations

Reservoir siting criteria are related to the hydraulic grade line elevation required to operate the storage effectively with the available supply in an area and to match existing storage within the pressure zone. Storage is situated to minimize the distance that the distribution pipeline grid must convey water. Normally, the City of Spokane locates storage and supply at opposite sides of the distribution system to provide consistent pressures in the system. Often the City will prefer to site a reservoir on high ground if a site is available within a reasonable distance to the system storage needs. This provides a lower profile structure for aesthetic purposes and allows for the most storage volume within the operating range of the reservoir. Storage also is located so it may be filled by as many sources as feasible, providing for the operation of the system as normally as possible during an interruption of supply from one of the sources. The storage elevations are determined by the service at the highest elevation. The base elevation is set to provide a minimum of 20 psi to this service. The overflow elevation is set at a minimum of 1 foot above the top of the operational storage.

Basis of Storage Volume

Equalizing storage to meet peak demands that exceed the supply capacity. The Water System Design Manual identifies guidelines in determining equalizing storage requirements. The City's supply stations, whether booster stations or well stations are typically designed to meet the Peak Hourly Demand (PHD) of the pressure zone they serve with all pumps in service. These stations can typically serve the system with the Peak Hourly Demand, thereby eliminating the need for equalization storage. However, as future reservoirs are in the process of being designed, the equalizing storage component must be addressed for each particular case, taking into account potential growth in the system.

For the City of Spokane, the standby storage and fire flow storage are typically nested with each other, with the larger of the two volumes becoming the storage capacity the facilities are required to provide. Fire Suppression Storage volumes are typically calculated based on the largest fire flow that could occur in a pressure zone. The fire flow volume is determined by multiplying the designated fire flow by the expected duration to calculate the required storage volume. The Fire Marshal of the jurisdiction serving the area provides the needed fire flow volume and duration based on the zoning and planned development within the subject area.

The Water System Design Manual requires an emergency or reserve storage volume called "standby storage" to be incorporated into the design of any storage facility. Standby storage is defined as the storage necessary to meet demands during an emergency. The minimum value for standby storage is calculated as 200 times the number of Equivalent Residential Units served by the reservoir.

7.5.2 Booster Stations

Minimum design standards for Booster Stations are provided in the Design Standards of the City of Spokane.

All new booster stations require a minimum of three pumps for flexibility in system operations. The total capacity of multiple pumps in a given pump station is generally the Peak Hourly Demand for the pressure zone plus the Maximum Day Demand for the upgradient pressure zone the station serves. This allows a pump, even the largest pump, to be taken out of service and repaired without severely reducing supply capability.

All booster stations are required to include a telemetry system to allow the station to be operated and monitored remotely. The telemetry system is discussed in the Design Standards and also in Chapter 3. Within the City, all systems or pressure zones supplied by booster stations are also served with at least one reservoir. Generally, backup power systems are not required for booster stations in the City water system where multiple booster stations provide water to the pressure zone. Emergency and backup power are discussed in Chapter 3.

7.6 Construction Certification

All projects constructed that are related to the improvement of the water system are inspected by City staff or by a consultant engineer engaged by the City. In some cases where the project is particularly large or when insufficient staff time is available for proper inspection, a consultant engineer is engaged by the City for construction inspection.

Construction inspection includes the examination of construction procedures, methods of installation, a comparison of work with the construction documents and design, materials used and installed compared to that specified in the construction documents, care of handling and storage of material, safety practices, sanitary practices by the contractor's staff, and progress of work. Material samples will be taken to a lab for testing and analysis when appropriate. Pressure tests are performed by the contractor and witnessed by the City inspector prior to commissioning the project. All disinfecting of water mains, reservoirs, and pumping equipment are performed by the Water Department Construction and Maintenance staff, trained in the procedures. Water quality sampling is also performed by the Water Department Construction and Maintenance staff, trained in sampling procedures. Sample(s) are taken to a lab for testing and analysis.

Construction record drawings are prepared by City Engineering Services Construction Management staff and included in the design drawings by City Engineering Services staff. Previously, record drawings were kept in files at City Hall with a copy submitted to the Water Department. The City has updated this system to an electronic process. The record drawings are saved electronically as PDFs in the City's OnBase system. The water system facilities are updated in the City's Geographic Information System.

As required in WAC 246-290-040, within 60 days following the completion of and prior to use of the project or portions thereof, a Construction Completion Report must be completed by a professional engineer and submitted to the Washington State Department of Health Drinking Water Division Regional Engineer. This responsibility rests with the City professional engineering official in charge of the inspection and construction management for the project. Generally, this is the City Engineering Services Construction Management Principal Engineer. Alternatively, the Water Systems Engineer will submit the Construction Completion Report for projects being constructed under the inspection and construction management of the Water Department Services staff. If the completed project changes the information on the Water Facilities Inventory, an updated Water Facilities Inventory is submitted to the Department of Health with the Construction Completion Report. Appendix 7.7 has examples construction completion forms submitted to the Department of Health.

Chapter 8 – Capital Improvement Program

Table of Contents

Chapter 8 – Capital Improvement Program

Introduction

This chapter provides the estimated project costs and construction schedule of the capital improvement program needed to address the deficiencies described in Chapter 3. A detailed description of capital improvement projects is contained in the summary of deficiencies. The improvement projects are divided into three categories:

- Source Wells and Booster Stations
- Storage Systems
- Water Mains

Unless specifically identified as something else, costs for all improvements will be paid for with utility rates. Sources of these funds are addressed in Chapter 9. The City of Spokane also actively applies for low-interest loans to fund projects. These sources of low-interest loan funds consist primarily of Washington State's Drinking Water State Revolving Fund and the Public Works Trust Fund.

8.1 Prioritization

The summaries provided are divided into two timetables: the six-year capital improvement projects and the 7 to 20 year capital improvement projects. Costs reflect 2022 dollars and do not include any future inflation beyond 2022.

The six-year capital improvement projects are governed by the City of Spokane's Six-Year Capital Improvement Program, which is updated annually. The annual updates are also approved annually by the City Council in a public process. The projects in the six-year capital summary provided in this chapter are taken directly from the approved Six-Year Capital Improvement Program for 2023-2028. A copy of the current Six Year Capital Improvement Plan is included in Appendix 8.1, which includes projected funding sources and additional project details not shown in the summary tables. The anticipated completion schedule and costs are summarized in the tables. The projects in the six-year program are reviewed and updated annually.

The 7 to 20 year capital improvements projects are intended to repopulate the Six-Year Capital Improvement Plan during the annual update and approval process. As capital improvement projects are completed in accordance with the Capital Improvement Plan, projects from the 7 to 20 year capital improvement project list are prioritized and moved to the Six-Year Capital Improvement Plan during the annual update. These projects are reviewed and updated every 3 to 5 years to reflect changes in growth and system operations.

In 2020, the City of Spokane began working with a consultant on developing an asset management-based Multi-Objective Decision Analysis (MODA) approach to 20-year capital facilities planning. This approach provides a rigorous and defensible decision-making process that results in better-managed risks. Other advantages include improved levels of public confidence, internal utility coordination, communication and information, and the transfer and retention of knowledge. The development of the MODA also enables the City to better balance the costs of infrastructure by prioritizing projects to determine those to add to the Six-Year Capital Improvement Plan. The MODA will be used in the future to prioritize projects.

8.2 Source Well and Booster Station Improvements

Source well and booster station improvements involve well stations, well pumps, and booster stations. The 2023-2028 Capital Improvement Program projects include booster station rehabilitation, well rehabilitation, new wells, and studies for future well station improvements. Table 8.1 summarizes the source well and booster station improvements for 2023 to 2028. The City is making a significant investment in the next 6-years to bring up aging wells and boosters to meet the City's current needs, to increase system reliability, and for growth. This significant investment also includes a new well station at the Well Electric site, which is anticipated to cost approximately $20 million. Havana Well Station is a new well station under construction to serve Intermediate Pressure Zone. Additional funding is shown in 2026 and 2027 to complete the portion of the station that will serve Low Pressure Zone. As booster stations are upgraded, additional capacity will be added as needed to meet growth in the pressure zone served.

Additional capacity in the vicinity of Central Well Station is planned for the next 20 years. For a few sites, a second booster station will be constructed for additional capacity at the same site, and the first booster stations will need rehabilitation. Table 8.2 summarizes the 7 to 20 year proposed improvements.

Table 8.1 Source Well and Booster Station Improvements 2023-2028 Six-Year Capital Improvement Plan

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
14th and Grand Booster Station Rehabilitation	Utility Rates-IC	$0	$0	$0	$0	$300,000	$3,000,000	$3,300,000
	Total	$0	$0	$0	$0	$300,000	$3,000,000	$3,300,000
9th & Pine Booster Station	Loan-PWTF	$6,000,000	$0	$0	$0	$0	$0	$6,000,000
	Total	$6,000,000	$0	$0	$0	$0	$0	$6,000,000
Havana Well	Utility Rates-IC	$2,000,000	$0	$0	$5,000,000	$1,000,000	$0	$8,000,000
	Total	$2,000,000	$0	$0	$5,000,000	$1,000,000	$0	$8,000,000
Highland Booster Capacity Improvements		$0	$525,000	$5,250,000	$0	$0	$0	$5,775,000
	Total	$0	$525,000	$5,250,000	$0	$0	$0	$5,775,000
Hoffman Well Station Rehabilitation		$500,000	$0	$0	$0	$0	$0	$500,000
	Total	$500,000	$0	$0	$0	$0	$0	$500,000
Latah Booster Capacity Improvement	Utility Rates-IC	$0	$0	$0	$500,000	$5,000,000	$0	$5,500,000
	Total	$0	$0	$0	$500,000	$5,000,000	$0	$5,500,000
Nevada Well Station Rehabilitation	Utility Rates-IC	$0	$525,000	$5,250,000	$0	$0	$0	$5,775,000
	Total	$0	$525,000	$5,250,000	$0	$0	$0	$5,775,000
Northwest Terrace PRVs	Loan-PWTF	$300,000	$400,000	$3,500,000	$0	$0	$0	$4,200,000
	Total	$300,000	$400,000	$3,500,000	$0	$0	$0	$4,200,000
Plains System New Booster	Private	$600,000	$3,000,000	$3,000,000	$0	$0	$0	$6,600,000
	Total	$600,000	$3,000,000	$3,000,000	$0	$0	$0	$6,600,000
Ray Street Well Station Update	Utility Rates-IC	$2,500,000	$0	$0	$0	$0	$0	$2,500,000
	Total	$2,500,000	$0	$0	$0	$0	$0	$2,500,000
Shawnee Booster Station Rehabilitation	Utility Rates-IC	$0	$500,000	$0	$0	$1,000,000	$10,000,000	$11,500,000
	Total	$0	$500,000	$0	$0	$1,000,000	$10,000,000	$11,500,000
Study - Nevada Well Station Rehabilitation		$200,000	$0	$0	$0	$0	$0	$200,000
	Total	$200,000	$0	$0	$0	$0	$0	$200,000
Study - Water Capital Facilities Plan	Utility Rates-IC	$300,000	$0	$0	$0	$0	$0	$300,000
	Total	$300,000	$0	$0	$0	$0	$0	$300,000
Study - Water System Vulnerability Assessment	Utility Rates-IC	$50,000	$0	$0	$0	$0	$0	$50,000
	Total	$50,000	$0	$0	$0	$0	$0	$50,000
Study-Well Transmission Optimization	Utility Rates-IC	$150,000	$0	$0	$0	$0	$0	$150,000
	Total	$150,000	$0	$0	$0	$0	$0	$150,000
Well Electric Well Station Update	Utility Rates-IC	$1,250,000	$500,000	$5,000,000	$8,000,000	$5,000,000	$0	$19,750,000
	Total	$1,250,000	$500,000	$5,000,000	$8,000,000	$5,000,000	$0	$19,750,000
Total		**$13,850,000**	**$5,450,000**	**$22,000,000**	**$13,500,000**	**$12,300,000**	**$13,000,000**	**$80,100,000**

Table 8.2 Source Well and Booster Station Improvements 7 to 20 year

Source Wells and Booster Improvements 7 to 20 year			
Project Name	**Pressure Zone**	**Description**	**Project Estimate**
Eagle Ridge Booster Station	Eagle Ridge	New Booster Station	$5,500,000
Update Pumps at Existing Eagle Ridge Booster	Eagle Ridge	Rehabilitation Existing Station	$3,500,000
Five Mile Booster Station Update	Five Mile	Upsize Existing Station	$3,000,000
Glennaire Booster Station Upgrade	Glennaire	Upgrade Existing Station	$4,500,000
Milton Booster Station Rehabilitation	Highland	Rehabilitation Existing Station	$4,500,000
New Thorpe Booster Station	SIA	New Booster Station	$5,500,000
Bishop Ct Booster Station Rebuild	Intermediate	Rehabilitation Existing Station	$4,500,000
Backup Power for Booster Stations	System Wide	New Backup Power	$3,000,000
Five Mile Booster Station Upgrade	Five Mile	Rehabilitation Existing Station	$3,000,000
SCADA Upgrades	System Wide	SCADA Upgrades	$3,000,000
Woodridge Booster Station Upgrade	Woodridge	New Booster Station	$5,500,000
Belt Street Booster Station Rehabilitation	Midbank	Rehabilitation Existing Station	$4,500,000
35th and Ray Booster Upgrade	Top	Rehabilitation Existing Station	$4,500,000
Cedar Hill Booster Station Backup Power	Cedar Hills	Backup Power	$750,000
Spotted Road Booster Station Rehabilitation	West Plains	Rehabilitation Existing Station	$3,000,000
Central Well Capacity Expansion	North Hill	New Well	$22,000,000
New SIA Booster Station	SIA	New Booster Station	$5,500,000
New West Plains Booster #3 Station	West Plains	New Booster Station	$5,500,000
		Total	**$91,250,000**

8.3 Storage System Improvements

Additional storage capacity is needed in select areas of the water system. The improvements are for growth, fire storage, reliability, or system resiliency. Table 8.3 summarizes the storage systems improvements for 2023-2028. Table 8.4 summarizes the 7 to 20 year proposed improvements.

Table 8.3 Storage System Improvements 2023-2028 Six-Year Capital Improvement Plan

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
Fire Suppression System Upgrades		$300,000	$0	$0	$0	$0	$0	$300,000
	Total	$300,000	$0	$0	$0	$0	$0	$300,000
High System Tank	Utility Rates-IC	$3,373,486	$3,373,486	$0	$0	$0	$0	$6,746,972
	Total	$3,373,486	$3,373,486	$0	$0	$0	$0	$6,746,972
Highland Reservoir	Private	$0	$0	$0	$0	$600,000	$6,000,000	$6,600,000
	Utility Rates-IC	$0	$0	$0	$0	$200,000	$2,000,000	$2,200,000
	Total	$0	$0	$0	$0	$800,000	$8,000,000	$8,800,000
Indian Trail Reservoir Frontage Improvements	Utility Rates-IC	$440,000	$0	$0	$0	$0	$0	$440,000
	Total	$440,000	$0	$0	$0	$0	$0	$440,000
SIA System Additional Reservoir	Loan-DWSRF	$3,000,000	$0	$0	$0	$0	$0	$3,000,000
	Loan-PTWF	$2,100,000	$200,000	$0	$0	$0	$0	$2,300,000
	Utility Rates-IC	$2,900,000	$2,000,000	$0	$0	$0	$0	$4,900,000
	Total	$8,000,000	$2,200,000	$0	$0	$0	$0	$10,200,000
Thorpe Road Reservoir No. 2	Loan-DWSRF	$500,000	$5,000,000	$2,330,000	$0	$0	$0	$7,830,000
	Total	$500,000	$5,000,000	$2,330,000	$0	$0	$0	$7,830,000
Total		**$12,613,486**	**$10,573,486**	**$2,330,000**	**$0**	**$800,000**	**$8,000,000**	**$34,316,972**

Table 8.4 Storage System Improvements 7 to 20 year

Storage System Improvements 7 to 20 year			
Project Name	**Pressure Zone**	**Description**	**Project Estimate**
Qualchan Reservoir #2	Low	New Reservoir	$15,000,000
Qualchan Reservoir #1 Rehabilitation	Low	Liner Replacement	$3,000,000
Indian Trail Area Storage	North Hill	New Reservoir	$15,000,000
Thomas Mallon Reservoir #2	West Plains	New Reservoir	$15,000,000
Woodridge & Shawnee Storage #2	Woodridge	New Reservoir	$15,000,000
Eagle Ridge Pressure Zone Reservoir #2	Eagle Ridge	New Reservoir	$15,000,000
Glennaire 2 Reservoir Liner Replacement	Glennaire	Liner Replacement	$3,000,000
SIA Reservoir #1 Removal/ Replacement	SIA	New Reservoir	$15,000,000
33rd and Lamonte Reservoir Decommission or Upgrade	High	Decommission	$5,000,000
		Total	**$101,000,000**

8.4 Water Main Improvements

The transmission and distribution main projects anticipated over the next six years are shown in Table 8.5, and the 7 to 20 year proposed improvements are summarized in Table 8.6. Several projects are required because of transportation projects such as the North Spokane Corridor (NSC) and City street rebuilds. These projects combine replacing infrastructure beyond its useful life and constructing new infrastructure to accommodate growth.

Table 8.5 Water Main Improvements 2023-2028 Six-Year Capital Improvement Plan

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
12th Ave. - Deer Heights to Flint	Private	$0	$0	$30,000	$300,000	$0	$0	$330,000
	Total	$0	$0	$30,000	$300,000	$0	$0	$330,000
1st Ave., Maple to Monroe, Distribution Main Replacement	Utility Rates-IC	$0	$0	$0	$0	$5,000	$0	$5,000
	Total	$0	$0	$0	$0	$5,000	$0	$5,000
1st Ave., Monroe to Wall, Distribution Main Replacement	Utility Rates-IC	$0	$0	$0	$0	$5,000	$0	$5,000
	Total	$0	$0	$0	$0	$5,000	$0	$5,000
1st Ave., Wall to Bernard, Distribution Main Replacement	Utility Rates-IC	$0	$0	$0	$0	$5,000	$0	$5,000
	Total	$0	$0	$0	$0	$5,000	$0	$5,000
27th Ave., SE Blvd. to Ray St., Main Replacement	Utility Rates-IC	$0	$0	$0	$25,000	$175,000	$0	$200,000
	Total	$0	$0	$0	$25,000	$175,000	$0	$200,000
4th Ave. Distribution Main Replacement (Sunset to Maple)	Utility Rates-IC	$0	$0	$20,000	$200,000	$0	$0	$220,000
	Total	$0	$0	$20,000	$200,000	$0	$0	$220,000
Assessment of Existing Pipes	Utility Rates-IC	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000
	Total	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000
Broadway Ave., Ash to Post Street Main Replacement	Utility Rates-IC	$0	$0	$35,000	$300,000	$100,000	$0	$435,000
	Total	$0	$0	$35,000	$300,000	$100,000	$0	$435,000
Freya St. Transmission Main, Garland Ave. to Francis Ave.	Utility Rates-IC	$0	$0	$1,030,000	$2,050,000	$2,000,000	$0	$5,080,000
	Total	$0	$0	$1,030,000	$2,050,000	$2,000,000	$0	$5,080,000
Future Development Water Projects	Utility Rates-IC	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000
	Total	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000
Havana St., Sprague to Broadway Main Replacement	Utility Rates-IC	$0	$0	$0	$0	$70,000	$145,000	$215,000
	Total	$0	$0	$0	$0	$70,000	$145,000	$215,000
Latah Booster to Thorpe Reservoir Transmission Main	Private	$0	$0	$0	$0	$800,000	$8,000,000	$8,800,000
	Total	$0	$0	$0	$0	$800,000	$8,000,000	$8,800,000
	Private	$0	$0	$0	$0	$1,000,000	$10,000,000	$11,000,000

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
Latah-9th and Pine Transmission Main	Total	$0	$0	$0	$0	$1,000,000	$10,000,000	$11,000,000
Main Ave., Monroe St. to Browne St.	Utility Rates-IC	$0	$0	$0	$150,000	$500,000	$1,000,000	$1,650,000
	Total	$0	$0	$0	$150,000	$500,000	$1,000,000	$1,650,000
Mallon Ave., Monroe to Howard Main Replacement	Utility Rates-IC	$0	$0	$30,000	$200,000	$200,000	$0	$430,000
	Total	$0	$0	$30,000	$200,000	$200,000	$0	$430,000
Marshall Rd. from Thorpe to Qualchan Transmission Main	Utility Rates	$8,000,000	$3,050,000	$0	$0	$0	$0	$11,050,000
	Total	$8,000,000	$3,050,000	$0	$0	$0	$0	$11,050,000
Napa Distribution Replacement (2nd to Sprague)	Utility Rates-IC	$0	$0	$0	$30,000	$300,000	$0	$330,000
	Total	$0	$0	$0	$30,000	$300,000	$0	$330,000
Northwest Terrace Transmission Main	Loan-PWTF	$320,000	$3,200,000	$0	$0	$0	$0	$3,520,000
	Total	$320,000	$3,200,000	$0	$0	$0	$0	$3,520,000
NSC - 2nd Ave. Water Reroutes	Grant-WSDOT	$3,000,000	$2,200,000	$0	$0	$0	$0	$5,200,000
	Total	$3,000,000	$2,200,000	$0	$0	$0	$0	$5,200,000
NSC - 3rd Ave. Water Reroute	Grant-WSDOT	$150,000	$800,000	$85,000	$0	$0	$0	$1,035,000
	Total	$150,000	$800,000	$85,000	$0	$0	$0	$1,035,000
NSC - Napa St. Water Main Crossing	WSDOT - Grant	$125,000	$2,259,000	$150,000	$0	$0	$0	$2,534,000
	Total	$125,000	$2,259,000	$150,000	$0	$0	$0	$2,534,000
NSC - Regal St. Water Main Crossing	WSDOT - Grant	$125,000	$2,562,000	$150,000	$0	$0	$0	$2,837,000
	Total	$125,000	$2,562,000	$150,000	$0	$0	$0	$2,837,000
NSC - Trent Interchange Water Reroute	Grant-WSDOT	$700,000	$100,000	$0	$0	$0	$0	$800,000
	Utility Rates-IC	$250,000	$0	$0	$0	$0	$0	$250,000
	Total	$950,000	$100,000	$0	$0	$0	$0	$1,050,000
NSC - Trumpet Area Water Reroutes	Grant-WSDOT	$200,000	$1,000,000	$125,000	$0	$0	$0	$1,325,000
	Total	$200,000	$1,000,000	$125,000	$0	$0	$0	$1,325,000
NSC Planning from Interstate 90 to Sprague Ave.	Grant-WSDOT	$5,000	$5,000	$5,000	$5,000	$5,000	$0	$25,000
	Total	$5,000	$5,000	$5,000	$5,000	$5,000	$0	$25,000
NSC Planning from Spokane River to Sprague Ave.	Grant-WSDOT	$5,000	$5,000	$5,000	$0	$0	$0	$15,000
	Total	$5,000	$5,000	$5,000	$0	$0	$0	$15,000
NSC Wellesley Ave. PH2 - Haven St. to Market St.	Grant-WSDOT	$85,000	$0	$0	$0	$0	$0	$85,000
	Total	$85,000	$0	$0	$0	$0	$0	$85,000
Post Street Bridge Water Main	Utility Rates-IC	$10,000	$0	$0	$0	$0	$0	$10,000
	Total	$10,000	$0	$0	$0	$0	$0	$10,000

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
Ray St., 11th to Hartson Ave., Main Replacement	Utility Rates-IC	$2,500,000	$0	$0	$0	$0	$0	$2,500,000
	Total	$2,500,000	$0	$0	$0	$0	$0	$2,500,000
Ray St., 17th to 11th Ave., Main Replacement	Utility Rates-IC	$300,000	$1,000,000	$0	$0	$0	$0	$1,300,000
	Total	$300,000	$1,000,000	$0	$0	$0	$0	$1,300,000
Riverside Ave., Monroe St. to Wall St.	Utility Rates-IC	$0	$0	$110,000	$100,000	$1,000,000	$0	$1,210,000
	Total	$0	$0	$110,000	$100,000	$1,000,000	$0	$1,210,000
Riverside Ave., Monroe to Division	Utility Rates-IC	$50,000	$0	$0	$0	$0	$0	$50,000
	Total	$50,000	$0	$0	$0	$0	$0	$50,000
SIA Transmission Line Crossing Under I-90	Loan-DWSRF	$2,000,000	$3,000,000	$0	$0	$0	$0	$5,000,000
	Total	$2,000,000	$3,000,000	$0	$0	$0	$0	$5,000,000
Spokane Falls Blvd., Post to Division St. Main Replacement	Utility Rates-IC	$0	$0	$0	$200,000	$1,500,000	$500,000	$2,200,000
	Total	$0	$0	$0	$200,000	$1,500,000	$500,000	$2,200,000
Study - Asset Management Framework	Utility Rates-IC	$75,000	$75,000	$0	$0	$0	$0	$150,000
	Total	$75,000	$75,000	$0	$0	$0	$0	$150,000
Thor and Freya, Hartson to Sprague Ave. Water Upgrades	Utility Rates - Water Ops	$300,000	$0	$0	$0	$0	$0	$300,000
	Utility Rates-IC	$500,000	$0	$0	$0	$0	$0	$500,000
	Total	$800,000	$0	$0	$0	$0	$0	$800,000
TJ Meenach Dr. Water Transmission Main; Bridge to NW Blvd.	Utility Rates-IC	$865,000	$0	$0	$0	$0	$0	$865,000
	Total	$865,000	$0	$0	$0	$0	$0	$865,000
Wellesley Ave., Freya to Havana St. Main Replacement	Utility Rates-IC	$0	$70,000	$500,000	$200,000	$0	$0	$770,000
	Total	$0	$70,000	$500,000	$200,000	$0	$0	$770,000
Westbow Transmission Main - Thomas Mallen to Spotted	Private	$0	$0	$0	$800,000	$8,000,000	$0	$8,800,000
	Total	$0	$0	$0	$800,000	$8,000,000	$0	$8,800,000
Whistalks Way Transmission Main Replacement	Utility Rates-IC	$0	$0	$0	$50,000	$400,000	$100,000	$550,000
	Total	$0	$0	$0	$50,000	$400,000	$100,000	$550,000
Total		**$20,065,000**	**$19,826,000**	**$2,775,000**	**$5,110,000**	**$16,565,000**	**$20,245,000**	**$84,586,000**

Table 8.6 Water Main Improvements 7 to 20 year

Water Main Improvements 7 to 20 year			
Project Name	**Pressure Zone**	**Description**	**Project Estimate**
Cedar Street Transmission Main	Eagle Ridge	New Transmission Main	$3,700,000
Eagle Ridge 2 Pressure Zone Transmission	Eagle Ridge 2	New Transmission Main	$700,000
Five Mile Transmission Main (5 Mile to Strong)	Five Mile	New Transmission Main	$11,800,000
Highland Pressure Zone New Transmission Main	Highland	New Transmission Main	$22,100,000
Browne's Addition Pipe Replacements	Low	Distribution Main Replacements	$10,100,000
West Central Pipe Replacements	Low	Distribution Main Replacements	$39,300,000
Whistalks Way Transmission Main Connection	Low	New Transmission Main	$7,900,000
Indian Trail Transmission Main	North Hill	New Transmission Main	$17,300,000
Thorpe Reservoir to Spotted Road Booster	West Plains	New Transmission Main	$18,700,000
Ray St. 29th to 37th Transmission Main	Top	New Transmission Main	$2,400,000
Sunset Bridge Main Replacement	Low	Distribution Main Replacements	$1,100,000
Well Electric to 9th and Pine Booster	Low	New Transmission Main	$36,000,000
Parkwater Well Station Transmission Piping	Low	New Transmission Main	$4,000,000
Main Replacement Programs	All	Transmission and Distribution Replacements	$30,000,000
Division to Indian Trail Transmission	North Hill	New Transmission Main	$15,200,000
West Plains Booster Station Transmission	West Plains	New Transmission	$20,000,000
		Total	**$240,300,000**

8.5 Capital Improvements for Operations

This section includes items located in the operations sections of the 2023-2028 Capital Improvement Program. The Operations Improvements are major capital needs for system operation such as meters, backup power, and maintenance at Upriver Dam needed for operation of the water system. Vehicles and Equipment include new vehicles that need to be purchased and replace of vehicles at the end of their service life. Table 8.7 and Table 8.8 summarizes the operation improvements. Specific capital improvements for operations are not listed for 7 to 20 years; however, an annual cost has been estimated in Chapter 9.

Table 8.7 2023-2028 6-Year Capital Improvement Plan Operations Improvements

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
16th Ave. Transmission Main, Chestnut to Milton Booster	Utility Rates - IC	$300,000	$2,000,000	$1,000,000	$0	$0	$0	$3,300,000
	Total	$300,000	$2,000,000	$1,000,000	$0	$0	$0	$3,300,000
Distribution System Monitoring	Utility Rates - Water	$50,000	$250,000	$150,000	$150,000	$150,000	$150,000	$900,000
	Total	$50,000	$250,000	$150,000	$150,000	$150,000	$150,000	$900,000
Electric Vehicles (EV) Charging Station Development	Utility Rates - Water	$0	$0	$0	$300,000	$1,000,000	$0	$1,300,000
	Total	$0	$0	$0	$300,000	$1,000,000	$0	$1,300,000
FERC Part 12-D	Utility Rates-Water	$0	$165,000	$28,000	$28,000	$28,000	$28,000	$277,000
	Total	$0	$165,000	$28,000	$28,000	$28,000	$28,000	$277,000
Metering	Utility Rates - Water	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$14,400,000
	Total	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$14,400,000
Parkwater Pump and Motor Replacements	Utility Rates - Water	$640,000	$0	$700,000	$0	$0	$0	$1,340,000
	Total	$640,000	$0	$700,000	$0	$0	$0	$1,340,000
Rebuild Generators #2 and #3 in Powerhouse #1	Utility Rates - Water	$0	$1,000,000	$0	$0	$0	$0	$1,000,000
	Total	$0	$1,000,000	$0	$0	$0	$0	$1,000,000
Rebuild Generators #4 and #5 in Powerhouse #2	Utility Rates - Water	$300,000	$3,000,000	$3,000,000	$0	$0	$0	$6,300,000
	Total	$300,000	$3,000,000	$3,000,000	$0	$0	$0	$6,300,000
SCADA System	Utility Rates - Water	$200,000	$375,000	$75,000	$75,000	$75,000	$75,000	$875,000
	Total	$200,000	$375,000	$75,000	$75,000	$75,000	$75,000	$875,000
Tank Rehabilitation Fund	Utility Rates - Water	$1,500,000	$0	$100,000	$1,750,000	$0	$0	$3,350,000
	Total	$1,500,000	$0	$100,000	$1,750,000	$0	$0	$3,350,000
Upriver Dam FERC Relicensing	Water Rates - Water	$0	$0	$200,000	$100,000	$100,000	$100,000	$500,000
	Total	$0	$0	$200,000	$100,000	$100,000	$100,000	$500,000
Upriver Dam Spillway Gate Replacement	Utility Rates - Water	$1,780,000	$1,360,000	$1,475,000	$1,587,000	$0	$0	$6,202,000
	Total	$1,780,000	$1,360,000	$1,475,000	$1,587,000	$0	$0	$6,202,000
Upriver Dam Spillway Rehabilitation Phase 3a	Utility Rates - Water	$210,000	$0	$0	$0	$0	$0	$210,000
	Total	$210,000	$0	$0	$0	$0	$0	$210,000
Upriver Dam Spillway Rehabilitation Phase 3b	Utility Rates - Water	$540,000	$180,000	$2,680,000	$2,680,000	$0	$0	$6,080,000
	Total	$540,000	$180,000	$2,680,000	$2,680,000	$0	$0	$6,080,000
Upriver Dam Spillway Rehabilitation Phase 4	Utility Rates	$0	$0	$0	$800,000	$2,975,000	$2,975,000	$6,750,000
	Total	$0	$0	$0	$800,000	$2,975,000	$2,975,000	$6,750,000
	Utility Rates - Water	$0	$600,000	$300,000	$300,000	$300,000	$300,000	$1,800,000

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
Water Distribution Main Resiliency & Water Quality Program	Total	$0	$600,000	$300,000	$300,000	$300,000	$300,000	$1,800,000
Water Distribution System District Metering and Pressure Management Areas	Utility Rates - Water	$0	$435,000	$0	$0	$0	$0	$435,000
	Total	$0	$435,000	$0	$0	$0	$0	$435,000
Water Facilities Backup Power Retrofit	Utility Rates - Water	$0	$200,000	$100,000	$100,000	$100,000	$100,000	$600,000
	Total	$0	$200,000	$100,000	$100,000	$100,000	$100,000	$600,000
Water Service Replacement Program	Utility Rates - Water	$0	$240,000	$120,000	$120,000	$120,000	$120,000	$720,000
	Total	$0	$240,000	$120,000	$120,000	$120,000	$120,000	$720,000
Total		**$7,920,000**	**$12,205,000**	**$12,328,000**	**$10,390,000**	**$7,248,000**	**$6,248,000**	**$56,339,000**

Table 8.8 2023-2028 6-Year Operations Vehicles and Equipment

Project Title	Funding Source	2023	2024	2025	2026	2027	2028	6 Year Total
Backhoe	Utility Rates - Water	$350,000	$350,000	$0	$350,000	$0	$0	$1,050,000
	Total	$350,000	$350,000	$0	$350,000	$0	$0	$1,050,000
Dump Truck	Utility Rates - Water	$0	$350,000	$350,000	$0	$375,000	$0	$1,075,000
	Total	$0	$350,000	$350,000	$0	$375,000	$0	$1,075,000
Light Vehicles	Utility Rates - Water	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$900,000
	Total	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$900,000
Loader	Utility Rates - Water	$400,000	$0	$0	$0	$0	$0	$400,000
	Total	$400,000	$0	$0	$0	$0	$0	$400,000
Mechanics Truck	Utility Rates - Water	$0	$115,000	$115,000	$0	$0	$0	$230,000
	Total	$0	$115,000	$115,000	$0	$0	$0	$230,000
Service Truck Replacement	Utility Rates - Water	$0	$0	$400,000	$800,000	$400,000	$0	$1,600,000
	Total	$0	$0	$400,000	$800,000	$400,000	$0	$1,600,000
Total		**$900,000**	**$965,000**	**$1,015,000**	**$1,300,000**	**$925,000**	**$150,000**	**$5,255,000**

8.6 Spending by Project Type Summary

A summary of annual funding projections based on project type is in Table 8.9.

Table 8.9 2023 to 2028 Six-Year Funding Summary by Project Type

Project Type	2023	2024	2025	2026	2027	2028	6 Year Total
Source Wells and Booster Stations	$13,850,000	$5,450,000	$22,000,000	$13,500,000	$12,300,000	$13,000,000	$80,100,000
Storage Systems	$12,613,486	$10,573,486	$2,330,000	$0	$800,000	$8,000,000	$34,316,972
Vehicles and Equipment	$900,000	$965,000	$1,015,000	$1,300,000	$925,000	$150,000	$5,255,000
Water Mains	$20,065,000	$19,825,000	$2,775,000	$5,110,000	$16,565,000	$20,245,000	$84,586,000
Water Maintenance	$7,920,000	$12,205,000	$12,328,000	$10,390,000	$7,248,000	$6,248,000	$56,339,000
Total	**$55,348,486**	**$49,018,486**	**$40,448,000**	**$30,300,000**	**$37,838,000**	**$47,643,000**	**$260,596,972**

A summary of the funding projections based on project type for the 7 to 20 year window is listed below in Table 8.10. This table does not include capital improvements for operations, but the estimated cost is included in Chapter 9, future capital improvement costs.

Table 8.10 7 to 20 year Funding Summary by Project Type

Project Type	Cost	Total Projects
Source Wells and Boosters	$85,750,000	18
Storage Systems	$101,000,000	10
Water Mains	$240,300,000	16
Totals	**$427,050,000**	**44**

8.7 Project Tracking

Major project milestones that have been completed since the approval of the current Water System Plan include the following:

- Five Mile Booster Station (New Booster Station)
- Havana Well Station
- Central Avenue Well Station
- In-Place Pipe Assessments

The City of Spokane updates the Six-Year Capital Improvement Program every year for water projects and operations expenditures. This program identifies how projects are funded and when projects are scheduled for design and construction. The updated program is approved by the City Council each year.

The City of Spokane is a regional water purveyor, supplying water to areas outside the City and multiple interties to other water systems. As these interties continue to place additional demand on the water system, the 6-year and 20-year plans are updated to include needed projects to allow the City to provide water to these areas. Improvement programs are also adjusted as land use changes within the water service area. These changes generally require the City to add projects to accommodate development in the undeveloped parts of the water service area.

Table 8.11 includes a reconciliation of projects in the City's previous Water System Plan.

Table 8.11 Project Reconciliation

Water System Plan Project Reconciliation	
Source Wells and Booster Stations	
Project	**Status**
Central Avenue 1st Well Rehabilitationilitation	Complete
Central Avenue 2nd Well Rehabilitation	Completed-pump defective and sent back for rebuild
Hoffman Well	Under construction, complete 2023
New West Central Well	Programmed in 7 to 20 year window
Parkwater Station Upgrade	Pump and motor replacements 2023 and 2025
Ray Street Well Station	Construction scheduled 2024
Well Electric-North Hill Elements	Test Well construction 2022/2023
Parkwater-Low System Elements	Pump and motor replacements 2023 and 2025
Booster Station Metering	Completed
Five Mile Booster Replacement	Completed in 2019
Plains System New Booster	Construction 2024
Upriver Headers	Programmed 2025-2027 with Well Electric New Well
Milton Booster Upgrade	Programmed in 7 to 20 year window
Southview Booster Upgrade	Programmed in 7 to 20 year window
Sunset Booster Upgrade	Pump installation scheduled 2022-2023
9th and Pine Booster Upgrade	2023 Construction
Shawnee Booster Upgrade	2028 Construction
Five Mile #2 Booster Upgrade	Programmed in 7 to 20 year window
14th and Grand Booster Upgrade	2028 Construction
Cedar Hills Booster Upgrade	2023 Construction
Thorpe Road Booster Upgrade	Programmed in 7 to 20 year window
Bishop Court Booster Upgrade	Canceled
35th and Ray Booster Upgrade	Programmed in 7 to 20 year window
Storage Systems	
Project	**Status**
High System Tank	Construction 2023
Lincoln Heights #2	Canceled
Plains System Large Capacity Reservoir	Programmed in 7 to 20 year window (Mallen Hill #2)
Spokane International Airport System Additional Reservoir	Under construction
Tank Rehabilitation	Ongoing
Thorpe Road Reservoir #2	Construction 2024
Reservoir Rehabilitation Program	Ongoing
Five Mile Reservoir #2	Canceled

Eagle Ridge #3	Construction 2024-2026
Water Main Improvements	
Project	**Status**
16th Avenue Transmission Main, Chestnut to Milton Booster	2024 Construction
57th Avenue Transmission Main Rehabilitation/Replacement	Canceled - Pipe Assessment eliminated the need for the project
Central Well to Indian Trail	2024 Construction
Cleveland Avenue from Buckeye to Greene	Canceled
Glenrose/57th/Havana/37th	Canceled - Pipe Assessment eliminated the need for the project
Kempe to Woodridge Transmission Main	Completed 2021
Manito Boulevard from 33rd to 14th	Canceled - Pipe Assessment eliminated the need for the project
Monroe-Lincoln, 8th Avenue to Main Avenue	Completed 2016
North/South Freeway Crossings	Ongoing
13th Avenue; Wall to Bernard	Completed 2020
Clark Avenue/Water Avenue Distribution Replacement	Completed 2022
Distribution Main Rehabilitation	Ongoing
Long Service Elimination	Ongoing
Greene Street - Mission to Buckeye	Completed 2014
Waterworks-Well Electric to 11th and Myrtle	Canceled-Havana Well eliminated need for project
Parkwater Yard Piping	Programmed in the 7 to 20 year window
33rd - Manito to Howard	Completed 2019
Hatch - 9th to Rockwood Vista	Completed 2013
Jefferson - 5th to 7th	Canceled
Lincoln Heights to Lamonte -29th/33rd	Canceled
6th Avenue - Jefferson to Hemlock	Canceled
Fairview - Belt to Euclid - Atlantic	Project redefined as part of larger project in 7 to 20 year window
Latah Creek Crossing at 5th Avenue	Project redefined as part of larger project for 2028 construction
Melville Road - Thomas Mallen Road to Hayford Road Main	Canceled
Spotted Road to Mallen Tank	2027 Construction
Sunset Bridge Replacement	Programmed in 7 to 20 year window
Downtown Main Replacements	Ongoing

Chapter 9 – Financial Program

Table of Contents

Chapter 9 – Financial Program

Introduction

This chapter identifies the financial capacity of the City of Spokane to provide water service now and into the future. A comprehensive financial program is needed to implement this Water System Plan successfully and to ensure the Capital Improvement Program described in Chapter 8 can be implemented while operating and managing the City's water system.

The City of Spokane is a municipal corporation of the State of Washington. The City operates a Class A water system. As a First-Class Charter City, the City is governed by State statutes relative to the budgeting process whereby the legislative body of the City must review and approve the City's budget annually. Accordingly, the budgets for water operations and capital projects are reviewed and approved annually. The costs and associated revenues have been estimated through 2032, the planning period of this Water System Plan, and are for planning purposes. The costs and revenues will be reviewed and adjusted annually to maintain reserves and construct necessary capital projects.

9.1 Financial Viability

A water system is considered financially viable if it can obtain sufficient funds to construct, operate, maintain, and manage water service for current and future customers. The City identifies the total cost of services, the recovery of these costs, and maintenance of sufficient reserve funds to continue to manage, operate, and maintain the water system through the annual budget and six-year program update. The cost of service and rates needed to recover costs is evaluated by the City as detailed in Section 9.4. Level of service standards are updated as needed to comply with federal, state, and local requirements to continue providing high-quality water from the Spokane Valley/Rathdrum Prairie Aquifer and adequate capacity for growth.

The City accounts for the income and expenses of its water utility within an enterprise fund used by the Water Department and Integrated Capital Management Department. The Water Department operates and maintains the water system. The Integrated Capital Management Department plans and manages major water capital projects. The income and expenses for water operations and Integrated Capital Management water capital projects are combined in this chapter.

9.2 Past Income and Expenses

Spokane's water system revenues and expenses are divided into categories for operation and capital. The City uses an accrual-based accounting, which records revenues with the service is provided and expenses when transactions take place. The end-of-year fund balances for 2015 to 2021 for operations and capital have been used for this financial analysis. The current water rates are addressed in Title 13, Chapter 13.04 Spokane Municipal Code (SMC). The usage rate structure is an increasing block rate structure.

9.2.1 Past Income

The revenues for the City's water system are shown in Table 9.1. A description of revenue types follows.

Water Sales: Rates collected from customers and interties are shown as water sales. The rates have increased by 2.9% per year during this period. Water use varies primarily based on weather, particularly during summer water use. Water sales are the primary source of revenue.

Power Sales: Power generated at Upriver Dam is greater and provides more the power required than is needed to run the City's the Well Electric and Parkwater Well Stations; excess. Excess power is sold to Avista Corporation. Power generation fluctuates based on water levels in the Spokane River and the power usage at the well stations.

Jobbing and Contracting: The City charges contractors and developers for installing and connecting water service connections. This charge covers the cost of time and materials for City crews to perform this work.

Cell Towers: The City receives an annual fee for cell towers located on City properties, including on top of water reservoirs. In 2018, these Water Department revenues and Construction Management responsibilities were re-assigned to the Asset Management Department.

Rental Income: Water Department facilities are rented to other City departments for a fee.

Right of Way Landscaping Maintenance: The Water Department is reimbursed for landscape maintenance performed by the ground crews on property owned by other City departments. From in 2019 to 2021, the billing process changed, and fees were no longer collected from the other departments.

Other Miscellaneous Operating Revenue: Sales from vehicles are included in this revenue.

General Facilities Charge: Provides funding for new infrastructure needed to accommodate economic growth, primarily well station improvements, booster stations, reservoirs, and transmission mains.

Interest Income: The City invests reserve funds and accumulates interest on these funds.

Sale of Assets: The Water Department owns real property and receives income from sales of any surplus property owned by the department when the property is sold.

Public Works Trust Fund: The City was awarded loans from the Public Works Board and received reimbursement for construction costs.

Drinking Water State Revolving Fund. The City was award loans from the Public Works Board and received reimbursement of construction costs.

Contributed Capital: Developers construct water infrastructure, and the value is included in infrastructure revenue. Contributed capital are those facilities paid for by others and then turned over to the Water Department as assets to be owned and operated by the department.

Table 9.1 Past Revenues in U.S. Dollars

Revenue Type	2015	2016	2017	2018	2019	2020	2021
Water Sales	35,486,430	36,100,173	37,365,577	39,451,933	40,451,156	40,050,319	45,964,237
Power Sales	1,952,412	3,289,329	2,515,395	2,869,761	2,125,085	1,896,559	1,915,189
Jobbing & Contracting	2,655,894	2,665,326	2,985,151	2,692,943	2,703,004	2,774,397	2,746,896
Cell Towers	573,926	498,408	509,244	525,732	-	-	-
Rental Income	67,950	15,950	15,950	27,119	28,671	26,365	26,365
ROW Landscaping Maintenance	152,173	176,052	216,479	376,588	-	-	-
Other Misc. Operating Rev	42,002	134,426	148,967	208,290	(11,249)	217,090	383,727
General Facilities Charge	752,685	840,886	810,863	971,407	984,018	1,001,803	974,520
Interest Income	32,696	36,113	45,126	84,087	181,923	276,948	327,603
Sale of Assets	77,831	(10,520)	(100,661)	19,879	31,451	233,697	(7,552)
Public Works Trust Fund Loans	1,182,571	39,419	-	-	4,354	360,951	6,545
Contributed Capital	1,174,505	1,060,028	484,088	2,861,716	2,794,083	3,431,848	3,030,123
TOTAL	**44,151,075**	**44,845,589**	**44,996,179**	**50,089,454**	**49,292,496**	**50,269,976**	**55,367,653**

9.2.2 Expenses

Expenses to operate the City's water system includes operating, maintenance, and personnel expenses. City interfund charges are for computer services, payroll, legal services, billing, and accounting. Operating capital expenses include vehicle, pump, and valve replacements. Administration personnel, taxes, and the cost to maintain the landscaping in the City right-of-way are also included in operating expenses. Infrastructure expenses include debt service and capital improvements expenditures from the Six Year Water Capital Plan. Other infrastructure expenses include other capital costs not identified in the Six Year Water Capital Plan, such as new fire hydrants and taps costs. A summary of these expenses from 2015 to 2021 are shown in Table 9.2.

Table 9.2 Expenses in U.S. Dollars

Expense Type	2015	2016	2017	2018	2019	2020	2021
Operation and Maintenance	17,872,069	16,866,698	18,114,211	18,085,415	18,838,682	20,205,813	19,955,545
Administration	2,120,305	1,878,198	2,091,914	2,452,991	2,487,726	3,386,112	2,767,755
City Taxes	7,821,734	7,896,058	8,264,059	8,700,694	8,827,100	8,889,395	10,132,670
State Taxes	1,633,292	1,613,697	1,710,815	1,781,249	1,837,321	1,746,328	1,998,285
Interfund	4,792,483	4,921,834	5,138,032	5,553,126	6,708,793	6,844,104	6,934,839
Operating Capital	51,140	395,337	272,449	470,534	276,444	184,368	446,483
Right of Way Landscape Maintenance	224,714	259,974	316,751	559,168	614,467	656,256	558,074
Infrastructure Debt	919,774	894,807	919,703	715,266	492,743	491,607	506,499
Capital Six-Year Plan	2,259,670	864,441	346,716	522,228	1,708,378	2,461,383	2,207,030
Other Infrastructure	1,572,267	1,638,636	1,424,317	1,611,960	2,352,218	1,782,184	1,935,276
TOTAL	**39,267,448**	**37,229,680**	**38,598,966**	**40,452,633**	**44,143,871**	**46,647,550**	**47,442,457**

9.2.3 Past Balanced Budget

The summation of operating and infrastructure revenues and expenses from 2015 to 2021 are show in Table 9.3. The combined expenses are subtracted from the combined revenue show the year-end balances. The City uses accrual method to more accurately account for revenues and expenditures. The end of year balances contains revenues expected and expenses committed but not yet paid out to show the complete impact of capital projects underway.

Table 9.3 Summary of Total Past Income and Expenses in U.S. Dollars

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Revenue	44,151,075	44,845,589	44,996,179	50,089,454	49,292,496	50,269,976	55,367,653
Expenses	39,267,448	37,229,680	38,598,966	40,452,633	44,143,871	46,647,550	47,442,457
Balance	4,883,627	7,615,909	6,397,214	9,636,822	5,148,625	3,622,426	7,925,196

9.2.4 Past Reserve Balances

The Water Department reserve funds need a minimum amount as a balance in order to have sufficient funds for cash flow, capital projects, emergencies, and debt service. The reserve funds are collected and aggregated together for these purposes.

The change in year-end each balance shown in Table 9.4 is the actual cash on hand. Reserve balances do not account for unpaid expenses or earned revenue that has not been received. The ending cash balance has increased at a rate greater than expenses leading to an increase in cash and investments from a low value of approximately $6,000,000 in 2015 to over $41,000,000 in 2021.

Table 9.4 Balances in U.S. Dollars

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Cash & Investments - Beginning	6,111,316	14,516,494	20,230,200	26,332,089	33,175,975	35,434,232	36,510,750
Cash & Investments - Increase (Decrease)	8,405,178	5,713,706	6,101,889	6,843,886	2,258,257	1,076,517	5,278,466
Cash & Investments - Ending	14,516,494	20,230,200	26,332,089	33,175,975	35,434,232	36,510,750	41,789,215

9.3 Future Funding Plan

The future funding plan considers reserve balances, operational budgets, and capital improvements. The approval period for this Water System Plan is ten years. This section addresses the future funding which has been projected through 2032.

The projected revenues and costs for operations and capital are shown in 2022 dollars. No inflation factor has been applied to any of the future funding calculations. The City and the rest of the country have seen cost increases during the past two years based on both material and labor shortages. The City's experience does not provide any guidelines for the current economic situation. Inflation forecasts vary, and the cost of water-specific products has remained higher than other construction materials. The City will continue to evaluate revenues and costs annually with its budget and Six Year program updates to determine if adjustments are needed.

Additionally, the City is in the process of completing a rate study that will be used to determine future rate increases. Over the past decade, rates have increased by 2.9% annually. Section 9.4 provides details of the study and next steps.

9.3.1 Future Reserves

Financial planning includes a minimum amount for reserve funds available to have adequate cash flow to fund emergency repairs or capital projects and for debt payments. The reserves, at a minimum, should include three months of operating expenses, which is approximately $6,000,000 based on current operation costs. Annual debt payments have ranged from approximately $350,000 to slightly over $500,000 annually in the past. Emergency projects include, without limitation, pipe and valve replacements, reservoir repairs, or equipment replacements at well or booster stations. Based on current costs and past experiences with emergency projects, $1,500,000 is included in the reserves. Considering all these items, the City's policy is to maintain a minimum water capital reserve fund of $8,000,000 each year.

9.3.2 Future Operational Budget

The future operation budget is based on the approved 2023 budget. The future annual operations revenue and expenses are shown in Table 9.5. Revenue and expenses were estimated for the 2023 budget based on past operations. City taxes and state taxes on qualifying "Operating Revenue" are anticipated to remain at 20% and 5.029%, respectively, into the future. The future operations budget is expected to yield approximately $750,000 more revenue than expenses.

Table 9.5 Projected Annual Operations Revenues and Expenses through 2032

Revenue Type	**Expected Revenue ($)**
Water Sales	46,180,347
Power Sales	2,100,000
Jobbing & Contracting	2,854,988
Rental Income	27,895
Right of Way Landscaping Maintenance	333,334
Other Misc. Operating Revenue	115,000
TOTAL REVENUE	51,611,564

Expense Type	Expected Expenses ($)
Operation and Maintenance	23,570,746
Administration	3,218,869
City Taxes	10,152,869
State Taxes	2,169,153
Interfund	7,664,919
Operating Capital	3,481,200
Right of Way Landscape Maintenance	600,000
TOTAL EXPENSES	50,857,756
OPERATING INCOME (LOSS)	**753,808**

9.3.3 Future Capital Improvement Funding

The revenues and expenses for the Water System Plan approval period are shown in Table 9.6. The values are calculated with 2022 dollars and are based on past revenues and expenses as well as 2023 budget amounts. No inflation rate has been included in the calculations.

Utility rates and general facility charges are expected to be major contributors to future capital. Capital components are funded partially from water rates and partially from the Integrated Capital Management Fund. The forecasted rates are the portion that is expected to be allocated to water capital projects and has historically increased by 2.9% each year for the past 10 years. Actual future rates will be approved by City Council and are expected to exceed 2.9% per year. General Facility Charges listed herein are based on the actual amounts collected over the past 3 years. The General Facility Charge rates were increased in 2023 but due to a number of economic considerations, there were fewer developments in the last year. General Facility Charges are shown to be constant herein because the value varies from year to year. Revenues from interest income and the sale of assets are also included in future revenues. Interest income from investing “Cash Available” is based on an annual interest rate of 0.5%. The City expects to continue to pursue low-interest loans. Current Public Works Trust Fund and Drinking Water State Revolving Fund loans are shown in the year the revenue is estimated to reimburse costs. Future loans are estimated to add $2,000,000 annually.

Future expenses include estimated capital expenditures and debt payment. The first six years of the operations capital and capital improvements are based on the approved 2023 to 2028 Water Capital Program. The expected costs of the 20-year Capital Improvement Program have been averaged for years 2029 to 2032 because the projects have not yet been programmed. Debt repayment is included for the current loan amounts and is estimated to be approximately $500,000 per year based on borrowing an average of $2,000,000 per year.

Revenues, including loans, are estimated to sufficiently fund the future Capital Improvement Program, including operations capital and the 20-year program projects, without any rate changes while preserving a minimum reserve amount through 2025. Table 9.6 shows insufficient reserves beginning in 2026 and a short fall in funds beginning in 2027. There are several methods the City will consider to increase funds and/or reduce capital expenditures to preserve reserves and have funds available to construct necessary capital facilities.

The methods to increase funds are as follows:

- General facility charges. The City has updated its General Facility Charges. The new General Facility Charge ordinance includes an annual fee adjustment based on Engineering News

Record Construction Cost Index. A comprehensive review and update of the General Facility Charges will be conducted every 3 to 5 years to adjust fees according to the water facilities needed by development.

- Rates. The recommendations of the water rate evaluation study described in Section 9.4 will be completed in early 2024. These recommendations will be used to determine the appropriate water rate increases in the future. The current rate increases have been approved through 2023. New rates will need to be recommended and approved for 2024 and the remaining of this Water System Plan's planning period.
- Outside funding. The City will continue to seek and apply for low interest loans such as Drinking Water State Revolving Fund and Washington State Public Works Board. If greater funding is needed for capital projects, the City may seek to bond or apply for Water Infrastructure Finance and Innovation Act (WIFIA).

The 20-year Capital Improvement Program has been estimated based on current growth patterns and expected maintenance. Methods to reduce or delay capital expenditures that the City will use are as follows:

- Facilities that are needed for growth will be scheduled as needed. Projects may be delayed or constructed in phases based on development.
- The scope and estimate cost of projects identified in the 7 to 20 year time window are general. As future study, investigation, and information becomes available, the scope and cost will be refine potentially resulting is cost savings.
- As more detailed scopes are developed, a more realistic construction schedule can be created. This allows the City to match cost more closely with revenues.
- Capital projects in the Six Year Capital Program are reviewed and adjusted annually. Project cost may be reduced when integration opportunities allow cost sharing or from a better detailed scope. Projects may be delayed because assessments determine facilities are wearing slower than expected or from changes in development.
- The scope and estimated costs are refined when the project charter is prepared to initiate design. Cost savings can be found from the City's design engineer work.

Table 9.6 Capital Improvement Program Expenses, Revenues, and Calculated Reserves in U.S. Dollars

	2022	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Revenue											
Water Rates for Capital	26,832,673	26,832,673	29,999,486	27,355,965	19,144,545	30,520,140	21,220,553	29,253,437	27,268,500	27,268,500	27,268,500
GFC	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000	1,034,000
Interest Income	203,500	301,500	180,000	160,000	160,000	180,000	175,000	170,000	170,000	170,000	170,000
Sale of Assets	50,000	60,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Grants/Loans (in-hand)	12,283,000	23,231,000	5,850,000	520,000	5,000	5,000	0	0	0	0	0
Grants/Loans (future)	-	-	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Total Revenue	**40,403,173**	**51,459,173**	**37,073,486**	**29,079,965**	**22,353,545**	**33,749,140**	**24,439,553**	**32,467,437**	**30,482,500**	**30,482,500**	**30,482,500**
Expenses											
Operations Capital	10,051,234	10,474,000	15,670,000	13,373,000	11,990,000	8,173,000	6,398,000	10,908,000	10,650,000	10,650,000	10,650,000
Capital Improvements	21,115,673	46,528,486	35,849,486	27,105,000	18,610,000	29,665,000	20,622,500	28,428,996	26,500,000	26,500,000	26,500,000
Infrastructure Debt	506,633	506,633	387,609	385,187	382,766	391,738	391,738	500,000	500,000	500,000	500,000
Total Expense	**31,673,540**	**57,509,119**	**51,907,095**	**40,863,187**	**30,982,766**	**38,229,738**	**27,412,238**	**39,836,996**	**37,650,000**	**37,650,000**	**37,650,000**
Reserves - Surplus or (Deficit)											
Beginning Reserves	41,789,215	50,518,848	44,468,902	29,635,293	17,852,071	9,222,850	4,742,252	1,769,566	(5,599,993)	(12,767,493)	(19,934,993)
Ending Reserves	50,518,848	44,468,902	29,635,293	17,852,071	9,222,850	4,742,252	1,769,566	(5,599,993)	(12,767,493)	(19,934,993)	(27,102,493)

9.4 Water Rate Evaluation

The City hired an outside consultant in October 2019 to evaluate and determine the cost of service and corresponding rates for each class of customers served. The analysis provided will provide a basis for annual revisions to long-range financial plans, an annual proposal for short-term increases of existing water rates based on long-range plan findings, and tri-annual comprehensive cost-of-service study of the water utility. The overall objective of this study was to determine a rate schedule for each of the City's customer classes that will recover each class's costs of service fairly and equitably, in accordance with generally accepted practices used throughout the water industry by other municipal water utility providers. Those industry standards, published by the American Water Works Association in its Manual M1: Principles of Water Rates, Fees and Charges, are used throughout the water study and describe a series of procedures also known as cost-of-service ratemaking.

The rates are designed to recover the costs the utility expects to incur. Any difference in rates between one class and another must be attributed to differences to the extent to which each uses the system's resources. Different classes of customers use the system's resources differently. Since there is only one water system, and because it is designed and operated to meet all needs at once, there is a need to apportion costs to the customers based on their needs. Cost-of-service ratemaking determines a unit cost to match the different types of demands customers place on the system. In doing so, an appropriate rate can be determined to recover those costs.

The cost-of-service analysis included review of the City's physical assets, capital projects from the Six Year Water Program, and operational activities necessary to meet water demand. This includes repair and replacement of the existing infrastructure and recurring capital expenditures. Costs were determined from the following categories:

- Source of Supply costs are associated with extracting water from the City's wells, including all wellhead treatment processes.
- Storage costs are associated with storing water in tanks and standpipes throughout the system.
- Pumping costs are associated with pumping at the booster stations to move water to successively higher elevations or to maintain adequate system pressure.
- Transmission costs are associated with conveying water through larger-diameter pipelines through several pressure zones.
- Distribution main costs are associated with conveying water through smaller pipelines to individual meters.
- Fire hydrant costs are associated with public fire hydrants.
- Meter costs are associated with the maintenance of meter connections, including meter reading costs.
- Customer costs are associated with or related to billing and other customer support services.
- Hydroelectric costs are associated with the operation and maintenance of the hydroelectric facility.
- General costs are indirect overhead costs allocated among those listed above based on the percentage of their costs to the total.

In 2021, the analysis of the water utility was completed, and the analysis, findings, and recommendations were reported in "Water Utility Cost of Service Study" (FCS Group, November 2021) and proposed a five-year phase-in analysis. The analysis included the City's debt obligations and reserve funding requirements. The Water Utility Cost of Service Study implemented the following guidelines recommendations:

- No rates should be decreased from their current levels;
- Transition commercial classes to cost-of-service rates over three years; and
- Adjust future rates as needed to meet the costs of service.

The City has also completed an update to the General Facilities Charge (GFC) supported by FCS Group. The current rate increases have been approved through 2023. Rates for 2024 have also been approved that will remain throughout this Water System Plan's planning period.

Additional analysis is needed for specific areas to ensure rates are accurate and reflective of costs. The rate analysis is expected to be completed in 2024 and new rates implemented in 2025.