City of Issaquah

2018 Water System Plan Update

December 2018

Prepared by HDR, Inc. 2018

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Certification

This 2018 Water System Plan for the City of Issaquah was prepared by HDR Engineering, Inc., and City of Issaquah staff, under the direction of the following Registered Professional Engineers:

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Approval

Reviewed by Washington State Department of Health in accordance with the provisions of WAC 246-290-100 and approved on ____________________.

Approved by the City of Issaquah by Resolution _____ dated ________.

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Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

µg/L	Micrograms per Liter
AC, ACP	Asbestos Cement, Asbestos Cement Pipe
ac-ft	Acre-feet
ADD	Average Day Demand
BIP	Bellevue-Issaquah Pipeline
BPS	Booster Pump Station
ccf	Hundred Cubic Feet
CCR	Consumer Confidence Report
CEU	Continuing Education Unit
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CPA	Conservation Potential Assessment
CWA	Cascade Water Alliance
CWSP	Coordinated Water System Plan
CWSSA	Critical Water Supply Service Area
DBP	Disinfection By-Product
DBPR	Disinfection By-Products Rule
DNS	Determination of Non Signifiicance
DOH	Washington State Department of Health
DSL	Distribution System Leakage
Ecology	Washington State Department of Ecology
EKC	East King County
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
ft	Feet
ft/s, fps	Feet per Second
FTE	Full Time Employee
GAC	Granular Activated Carbon
gal	Gallon
GFC	General Facility Charge
GMA	Growth Management Act
gpcpd	Gallons per Capita per Day
gpm	Gallons per Minute
GWA	Ground Water Rule
HAA	Haloacetic Acids
HGL	Hydraulic Grade Line
hp	Horsepower
HVF	High-volume, Unidirectional Flushing
ICP	Issaquah Comprehensive Plan
IDSE	Initial Distribution System Evaluation
ILA	Interlocal Agreement
IMC	Issaquah Municipal Code
IOC	Inorganic Contaminants
KCC	King County Code
KCCP	King County Comprehensive Plan
LF	Linear Feet
LIVA	Lower Issaquah Valley Aquifer
LRAA	Locational Running Annual Averages
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDD	Maximum Day Demand
MFR	Multi-family Residential
MG	Million Gallons
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
MRDL	Maximum Residual Disinfectant Level
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PAA	Potential Annexation Area
pCi/L	Picocurie per Liter
PFC	Perfluorinated Compounds
PFOS	Perfluorooctanesulfonic acid
PHAL	Provisional Health Advisory Level
PHD	Peak Hour Demand
PHG	Public Health Goal
Plan	Water System Plan
PLC	Programmable Logic Controller
PNR	Public Notification Rule
PRV	Pressure Reducing Valve
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
Qa	Annual Quantity (Water Rights)
Qi	Instantaneous Quantity (Water Rights)
RAA	Running Annual Average
RCW	Revised Code of Washington
rpm	Revolutions per Minute
RTCR	Revised Total Coliform Rule
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SFR	Single-family Residential
SMCL	Secondary Maximum Contaminant Level
SMP	Standard Monitoring Program
SOC	Synthetic Organic Contaminants
SPU	Seattle Public Utilities
sq ft	Square Feet
SSS	System-Specific Study
TCR	Total Coliform Rule
TSP	Transmission Supply Plan
TTHM	Total Trihalomethane
UCMR	Unregulated Contaminant Monitoring Regulations
ULID	Utility Local Improvement District
UTRC	King County Utilities Technical Review Committee
VFD	Variable Frequency Drive
VOC	Volatile Inorganic Contaminants
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
WSP	Water System Plan
WUCC	Water Utility Coordinating Committee
WUE	Water Use Efficiency

Executive Summary

The City of Issaquah (City) 2018 Water System Plan (Plan) has been prepared according to Washington State Department of Health (DOH) requirements as described in Washington Administrative Code (WAC) 246-290. These regulations require the City to update and submit to DOH a water system plan for approval every 10 years. This plan updates and supersedes the 2012 Water System Plan Update.

This Plan summarizes Issaquah's existing water system, establishes the water utility policies and criteria in accordance with the City of Issaquah Comprehensive Plan framework, projects future water demands, analyzes the existing water system and recommends improvements to correct deficiencies and meet future water service needs. The Plan provides the City with a guide to continued effective and efficient management of its water utility, particularly in the light of challenges associated with continued growth throughout its service area and redevelopment in the Central Issaquah area.

The Plan was developed collaboratively by City staff and HDR Engineering, Inc. in 2017 and 2018. The planning period includes a short-term horizon (10 years, through 2027) and long-term horizon (20 years, through 2037).

ES.1 Introduction

The City owns and operates a Group A public water system with water system identification number 363505.

The City's earliest known water supply was from a series of surface water springs flowing from the East Issaquah Watershed, purchased from the Gilman Water Company in 1923. The City's primary water supply was groundwater wells until 1998.

In 1999, the City joined the Cascade Water Alliance (CWA). The City currently provides portions of its service area with CWA water, with other areas receiving groundwater from its own wells. The City also has the ability to blend its groundwater with Cascade water in some portions of the system.

ES.2 Existing System

The City has defined a Retail Service Area in this Plan, approximately 8.4 square miles in size, representing the area of existing and near-term future service. The City has also identified a Future Service Area, comprised of areas to which the City intends to ultimately provide water service. This area is consistent with that depicted in the East King County Coordinated Water System Plan with exceptions to some areas that have been assumed by the City's system since the coordinated water system plan was last updated. The Retail and Future Service Area boundaries are presented in Figure ES-1.

Other water purveyors that are adjacent to the City's system are: City of Bellevue, Sammamish Plateau Water, Water District 90, Edgehill Water Association. The City has four interties with the City of Bellevue, two emergency interties with Sammamish Plateau Water, and two interties with Cascade's regional transmission main.

The topography of Issaquah has a direct impact on the location and configuration of distribution, storage and pumping facilities. The Retail and Future Service Areas consist of 14 existing operating areas and three proposed operating areas. Concentrated commercial development resides in the valley and residential development on the plateaus and hillsides.

ES.3 Water Utility Policies and Criteria

The City manages its water utility in accordance with established federal and state regulations for public water systems. City policies and standards provide a consistent framework for the planning, design, construction, maintenance, operation, and service of the City's water system and water supply sources. The City's policies are grouped in major categories including:

- Service Area and Extensions
- Customer Service
- System Reliability
- Fire Protection
- Emergency Management Plan
- Coordination/Cooperation with Other Utilities
- Water System Design
- Environmental Stewardship
- Water Conservation
- Financial Policies

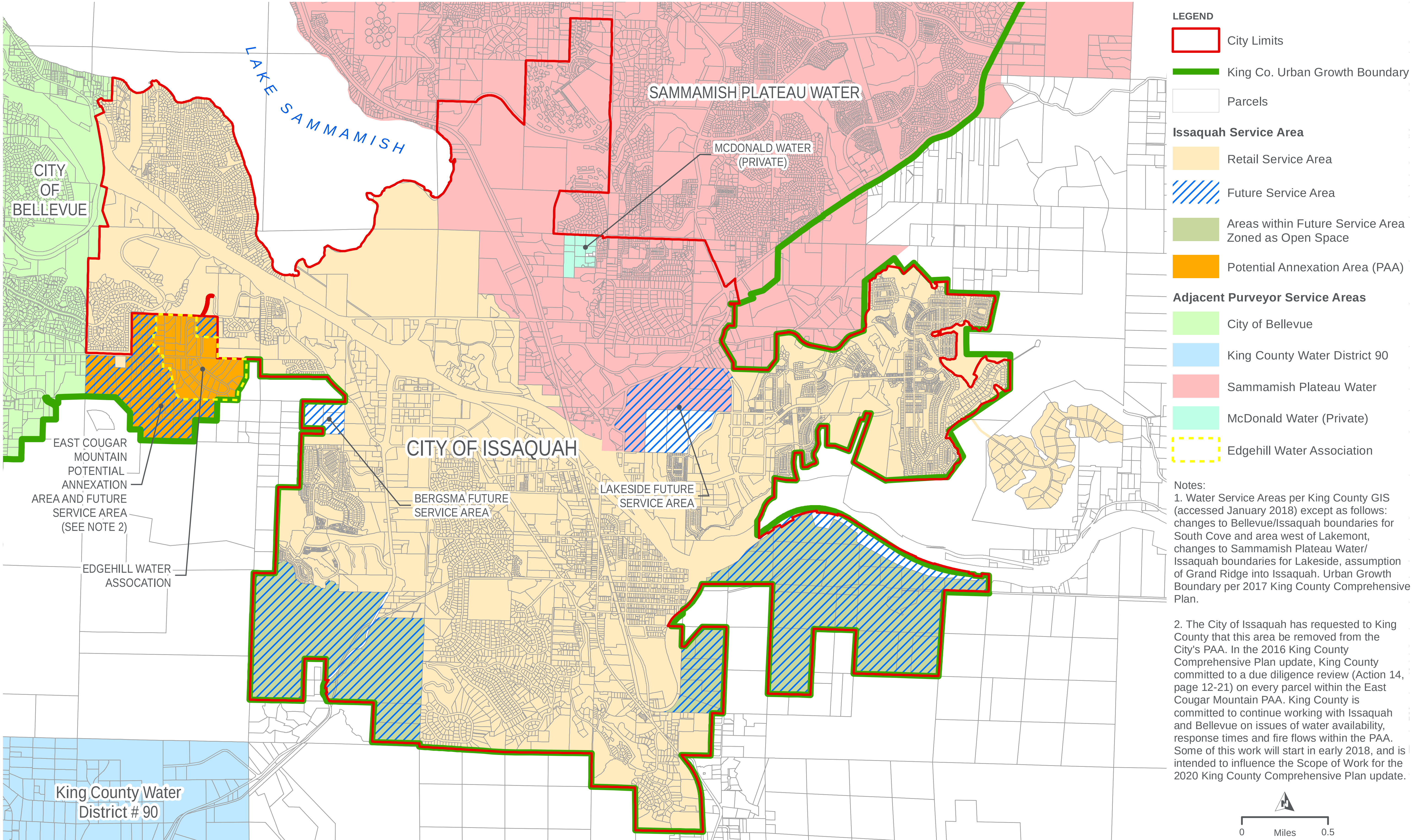
ES.4 Planning Considerations

This Plan has been developed consistent with the policies, land use, and zoning established in the City's 2017 Comprehensive Plan. The population within the City is estimated to grow from 37,000 in 2017 to approximately 50,000 by 2027, with much of that growth and associated commercial redevelopment occurring in the Central Issaquah area in the valley, particularly within the Regional Growth Center.

ES.5 Water Requirements

Quantifying realistic water demand is necessary for planning infrastructure projects and securing adequate water supply to meet future needs. This Plan includes a water demand forecast by first analyzing recent historical water production and customer usage data to understand the water consumption characteristics specific to the City. Based on a review of the data from 2014 to 2016, the recent typical average daily demand (ADD) water use for a single-family residence (SFR) in Issaquah has been 145 gallons per day (gpd). However, for planning purposes, a value of 150 gpd is used to project demand associated with future SFR development. This value of 150 gpd is referred to as an equivalent residential unit (ERU) of demand.

On average from 2014 through 2016, SFR customers have comprised 35 percent of total system water production, while MFR and commercial customers have represented 19 and 21 percent, respectively. Approximately 15 percent of production is comprised of irrigation and public account



HDR CITY OF ISSAQUAH WASHINGTON

ISSAQUAH SERVICE AREA

FIGURE ES-1

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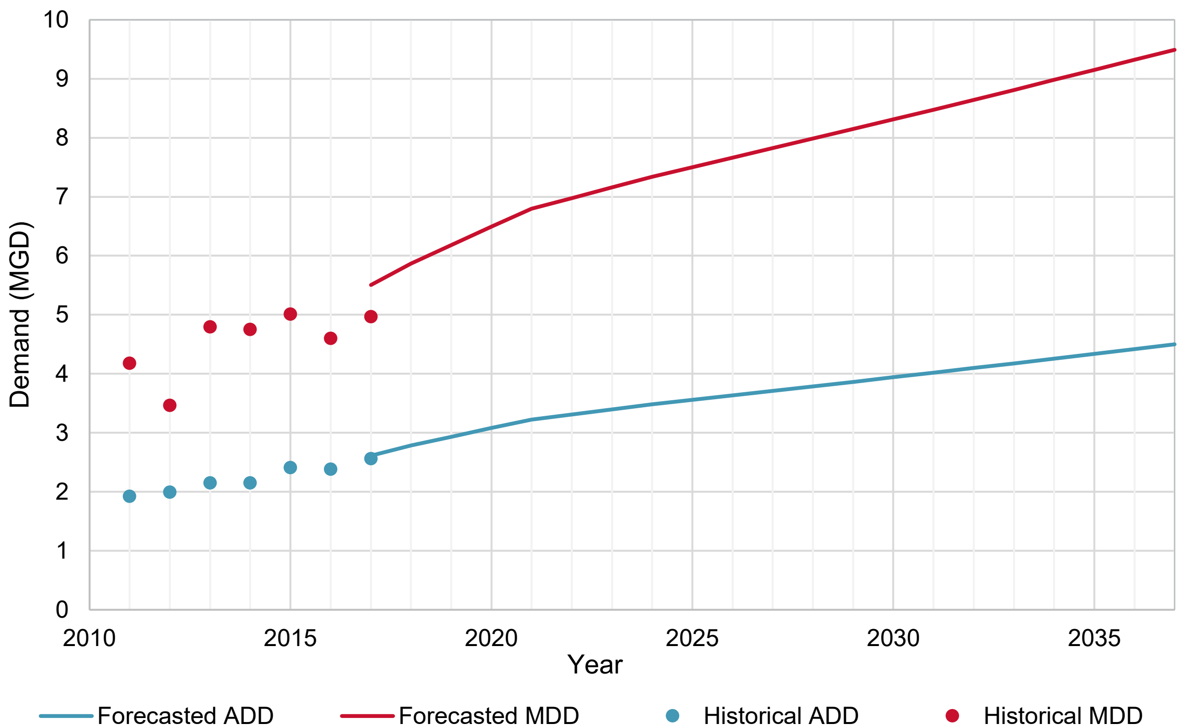
usage. The remaining 10 percent of total water production is comprised of non-revenue water, with distribution system leakage accounting for 6.4 percent.

Total system-wide ADD is projected to increase from 2.61 MGD in 2017, to 4.50 MGD in 2037. Maximum day demand (MDD) is projected to increase during this same time period from 5.51 MGD to 9.49 MGD. The demand forecast is summarized in Figure ES-2.

Figure ES-2. System-Wide Demand Forecast



ES.6 Water Use Efficiency

Conservation is termed a demand-side management program. As a supply alternative, it serves to decrease consumption, allowing a utility to delay procurement of additional water supplies, reduce withdrawals and associated impacts from existing water resources, manage peak demand and reduce wastewater flows. This Plan summarizes the City's conservation program that is mandatory through the State Water Use Efficiency (WUE) Rule.

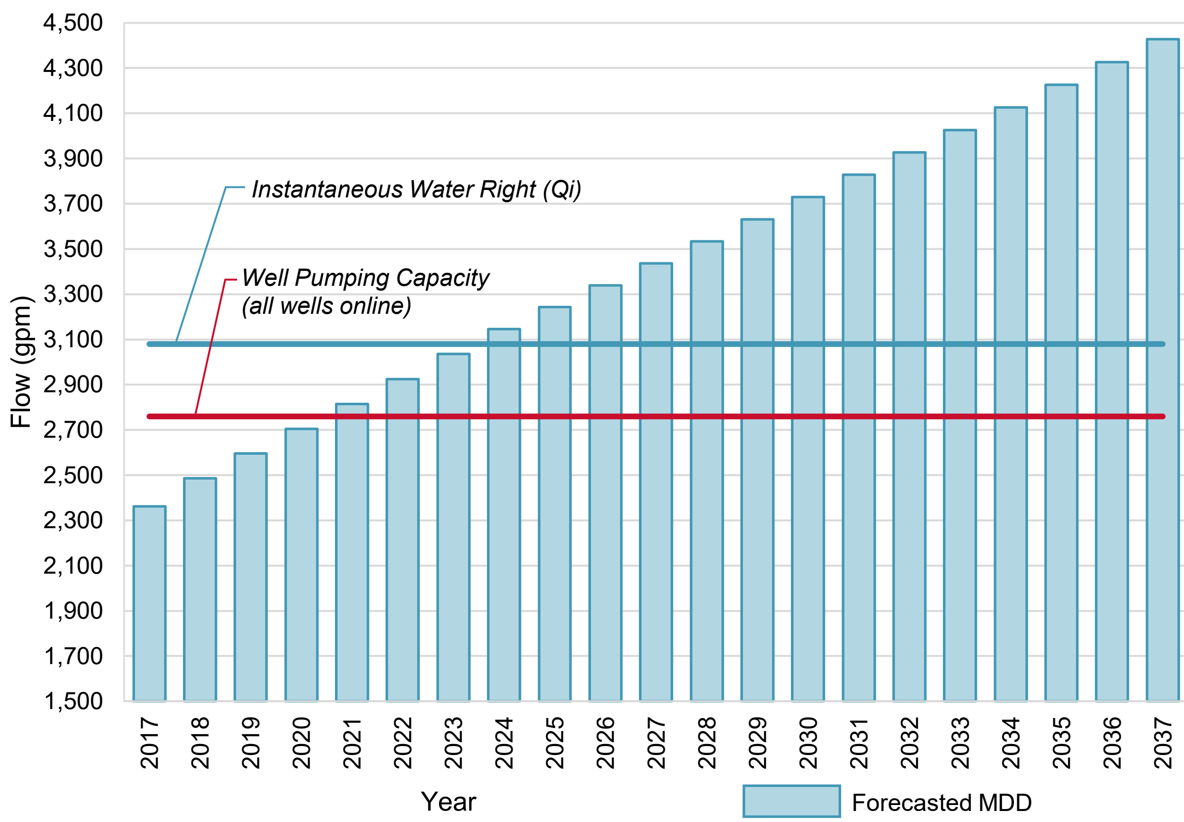
Since 2004, the City has worked with CWA to plan, design, and implement coordinated conservation programs across all CWA member areas. As a member of CWA, the City participates in the regional efforts that are tied to the adopted regional water use efficiency goals CWA has established for its member water utilities in consultation with the DOH. As such, CWA's WUE goal is adopted by the City as its formal WUE goal, and is stated as: "Cascade will dedicate resources necessary to achieve a cumulative drinking water savings of 0.6 million gallons per day on an annual basis and 1.0 million gallons per day on a peak season (June – September) basis by 2020." – Adopted by CWA's Board of Directors, October 23, 2013 for the period 2014 to 2019. The City continues to implement multiple conservation measures in support of meeting CWA's regional goal.

ES.7 Supply Evaluation

Historically the City's primary sources of supply have been wells in the Issaquah Valley Aquifer. In addition, the City purchases regional surface water supply from CWA. According to the CWA Interlocal Contract, CWA is obligated to provide a Full Supply Commitment to each founding member, one of whom is Issaquah, to meet current and future supply needs within the member's Retail Service Area. As a result of this agreement, Issaquah will be able to meet projected water demands within the 20-year planning period of this Plan.

A large portion of the City's existing service area has historically been served solely by its groundwater wells. Due to projected growth in these areas, the City's existing groundwater rights and pumping capacities will not be sufficient to fully serve these areas into the future. Based on the demand projections developed for this Plan, current well pumping capacity is capable of meeting MDD in the well-supplied areas until 2021. At that point, regional CWA water will be needed to supplement groundwater supplies in order to meet peak season demands. This is indicated in the comparison of groundwater well capacities and projected well-supplied area demands presented in Figure ES-3.

Figure ES-3. Maximum Day Demand of Well Supplied Areas



sufficient capacity to meet current and future MDD for the operating areas served by each. All BPSs have adequate capacity through the next 20 years per DOH requirements.

ES.8 Water Quality

The City of Issaquah must comply with the drinking water standards of the federal Safe Drinking Water Act (SDWA) and its amendments. The DOH adopted the federal standards under WAC 246-290. This Plan summarizes anticipated future regulations that will affect the City, summarizes the City water treatment practices, and presents the City's more recent water quality sampling data. The City is in compliance with all DOH water quality and reporting requirements.

ES.9 Facility Evaluation and Recommendations

A hydraulic analysis of the City's water system was conducted to identify many projects for incorporation into the Capital Improvement Program (CIP). A hydraulic model was used to evaluate compliance with the DOH's minimum requirements and the City's policies and criteria under existing and future conditions. This includes evaluating minimum pressure requirements, reservoir storage, and fire flows.

The volumes and elevations of existing storage facilities were evaluated against DOH requirements and City policies. Existing storage volumes are sufficient to meet all current and future needs in the City, with the exception of the Valley area, where additional storage volume is required to meet future needs. This is accommodated through the planned Spar Reservoir included in the CIP.

The hydraulic analysis identified high velocities throughout portions of the distribution system. Many of the areas requiring high fire flows (3,500 gpm) are located in the Valley area and are supplied by piping 8 inches in diameter and smaller. Projects to correct these deficiencies have been included in the CIP.

ES.10 Operations and Maintenance

The Public Works Engineering (PWE), Public Works Operations (PWO), and Finance Departments all work in coordination to manage water utility functions. The PWE Department provides design, construction, and inspection of projects related to the water system. The PWO Department performs daily activities including infrastructure maintenance, inspections, utility locating, water quality monitoring, and cross-connection control program management. The Finance Department provides financial functions for the water utility including utility billing services and customer water sales records.

ES.11 Capital Improvement Program

Improvements necessary for meeting the City's current and future needs are managed through the CIP. The CIP is a strategic plan for investing in the City's water infrastructure through 2037, with emphasis on the improvements needed between 2018 and 2027. The improvements listed in the CIP are based upon the evaluation of the existing system facilities, reports from the operations staff, and the analyses performed while preparing this Plan.

Table ES-1 provides a summary of the CIP costs, organized by project type. In total, the CIP amounts to approximately $53 million of investment in the 2018-2027 time period, with an additional $8.3 million in investment in the following 10 year period. Nearly 50% of the near-term CIP cost is associated with the planning, design, and construction of a new water treatment plant to upgrade the treatment associated with the City's wells to support the blending of groundwater and regional CWA water to serve areas that are presently only served by City groundwater.

Table ES-1. Summary of Capital Improvement Plan Costs

Project Category	2018-2027	2028-2037	Total 2018-2037
Distribution Projects	$11,370,000	$8,320,000	$19,690,000
Pump Station Projects	$6,175,000	$0	$6,175,000
Storage Projects	$7,036,000	$0	$7,036,000
Water Supply and Treatment Projects	$28,330,000	$0	$28,330,000
Total Budget	**$52,911,000**	**$8,320,000**	**$61,231,000**

ES.12 Financial Program

The City's water utility is operated as a separate enterprise fund, and is required to be financially self-sufficient from other City departments. In addition to the operating fund, separate funds have been established for capital improvements and bond redemption for the utility. Water system operation, maintenance, and capital improvements are paid for through water rates paid by customers connected to the water system and the one-time general facility charges that are paid by future customers at the time the permit for development is issued.

The analysis conducted as part of this Plan indicated that City rates may need to be modified to support the revenue requirements needed to fund planned water system improvements. However, the details of such changes will be identified in subsequent water utility cost of service and rate studies, which will propose a detailed financial plan for funding the CIP and associated future annual expenditures.

Chapter 1. Introduction, System History, and Related Plans

1.1 Purpose and Scope

This Water System Plan Update (Plan) has been prepared according to Washington State Department of Health (DOH) regulations under Washington Administrative Code (WAC) 246-290-100. These regulations require the City of Issaquah (City) to update and submit a water system plan for approval to DOH every ten years.

This plan updates and supersedes the 2012 Water System Plan Update (completed in November 2013). This Plan summarizes the City's existing water system, documents the water utility policies and criteria in accordance with the City of Issaquah 2017 Comprehensive Plan (Comprehensive Plan) framework, projects future water demands, analyzes the existing water system, and recommends improvements to correct deficiencies and meet future needs. The Plan provides the City with information to evaluate the impacts of future proposed development, land use, and growth on the water system; as well as evaluating potential operational changes related to the use of in-city groundwater supply versus regional water supplies, expansion of operating areas, and changes to water regulations .The Plan is organized as follows:

- **Chapter 2:** Provides an overview of the existing water system including adjacent purveyors, the boundary of the service area, operating areas, and supply, storage and distribution system facilities.
- **Chapter 3:** Reviews and updates the water utility policies and criteria for operation, design and planning to ensure future improvements and expansions are consistent with the City's Comprehensive Plan.
- **Chapter 4:** Estimates the effect of future land uses on demographic trends within the service area.
- **Chapter 5:** Analyzes historical production and water sales to develop future demand projections.
- **Chapter 6:** Updates the City's water use efficiency goals and identifies the role that water conservation will have in reducing future water requirements and how the City's water conservation program will be implemented.
- **Chapter 7:** Documents existing water resources available to the City and analyzes the ability to meet future water resource needs. This includes an evaluation of options for providing long-term treatment needs for the City's supplies.
- **Chapter 8:** Reviews existing water quality data for the system and discusses existing and forthcoming regulatory requirements applicable to the City water system.
- **Chapter 9:** Assesses the capability of the existing water system to meet existing and future demands using a hydraulic model, and documents system deficiencies.
- **Chapter 10:** Documents operations and maintenance (O&M) programs.
- **Chapter 11:** Presents a Capital Improvement Program (CIP), indicating priorities for construction, to address potential future water system deficiencies.

- **Chapter 12:** Documents the City's financial program for the water utility and identifies steps to be taken in order to ensure adequate funding of the water system in the future.

1.2 General Water System Information

The City owns and operates a public water system that currently serves customers within the retail service area. The following is a summary of information on the City's water system for the year 2017. This information is consistent with data on file with DOH.

Water System Name	Issaquah Water System
Water System ID No.	363505
Water System Classification	Group A
Type of Ownership	Local Government (Community)
Owner No.	2776
Address	1775 12th Avenue NW PO Box 1307 Issaquah, WA 98027-1307
System Contact Person	Bret Heath – Public Works Operations & Emergency Management Director
Limit on Number of Service Connections	This system does not have a limit on the number of approved service connections

1.3 Approval Process

This Plan is required to meet state, county, and local requirements. The Plan complies with the requirements of DOH and the Washington State Department of Ecology (Ecology) as set forth in WAC 246-290 for Group A Public Water Supplies as well as the Revised Code of Washington (RCW) 35.58.220 (Powers Relative To Water Supply), RCW 70.116 (Public Water System Coordination Act Of 1977), and RCW 70.119A.180 (Water Use Efficiency Requirements - Rules). This Plan is also consistent with King County Code (KCC) 13.24 (Water and Sewer Comprehensive Plans) with respect to water system planning.

The City will submit this document to adjacent utilities and local governments having jurisdiction to assess consistency with ongoing and adopted planning efforts. Additionally, King County and DOH must review and approve the Plan. In King County, the approval is accomplished through the Utilities Technical Review Committee (UTRC) that reviews all proposed Water System Plans prior to submittal to the County Council with a recommendation. The City Council will approve the final Plan following all other approval processes. The Adopting Resolution will be included in Appendix A, upon Plan approval by the City Council. See Appendix B for the agency/adjacent purveyor comments.

1.4 Environmental Assessment

The City has determined this Plan does not have a probable significant adverse impact on the environment and has issued a Determination of Non Significance (DNS) under the State Environmental Policy Act (SEPA). This decision was made after review of the completed environmental checklist and other information on file with the lead agency. It should be noted, however, that each CIP project presented in the Plan would undergo subsequent project-specific environmental review (or determination if project is categorically exempt from environmental review) as part of the preliminary and final design process. The SEPA Checklist and environmental DNS issued by the City for the Plan is provided in Appendix C.

1.5 Water System History

Table 1-1 lists the key events in the history and development of the water system from previous Water System Plans.

The City's earliest known water supply was from a series of surface water springs flowing from the East Issaquah Watershed (Lake Tradition Plateau) purchased from the Gilman Water Company in 1923. In 1967, Risdon Well No. 1 was drilled and became the primary source of potable water until Risdon Well No. 2 came on-line in 1969.

The East Issaquah Watershed springs remained in service until 1970 when construction of Interstate 90 disrupted the flow. As a result of this disruption of flow, in 1976 the Washington State Department of Transportation (WSDOT) drilled two new wells, the Gun Club Wells No. 3 and 3A, to replace the supply that was lost. As a condition for the new wells, the City relinquished its water rights to the springs. Although the City relinquished the water rights, it retains property ownership of the East Issaquah Watershed.

From 1970 to 1987, the City relied solely on groundwater produced by the Risdon and Gun Club Wells for its potable water supply. Two additional wells, Gilman No. 4 and No. 5, were added to the system in 1987. The Gun Club Well are now offline after being decommissioned in 1987 and 1988.

In 1989 and 1990 the City entered into an agreement with the City of Bellevue to provide service up to a maximum of 600 multi-family units and 700 equivalent residential units (ERUs) for the Lakemont Triangle and Montreux developments, respectively. The primary reasons for connection to the Bellevue water system for these areas were related to cost and efficiency. Existing Bellevue water mains were closer to the developments and allowed for gravity supply, whereas water from the City would have required pumping and installation of longer water mains.

In February 1997, to meet increasing system future demand, the City entered into another wholesale water agreement with Bellevue. The agreement provided a substantial amount of the City's water supply; up to 4.2 mgd on a maximum day demand (MDD) basis. The Bellevue–Issaquah Pipeline (BIP) was constructed in 2002, and connected to Bellevue's existing 24-inch line along Newport Way, east of Bellevue's Eastgate inlet from Seattle.

In 1999, the City joined the Cascade Water Alliance (CWA) in anticipation of future population growth in the region. CWA is committed to meeting all current and future water supply needs of its members. The BIP was acquired by CWA in 2004. CWA water is wheeled through Bellevue mains to supply some areas of the City's water system.

In 2012, the City installed a blending system allowing a combination of CWA and well water to be used in the Issaquah Highlands.

In 2015 and 2016 the City upgraded two pump stations in the distribution system that were nearing the end of their service life and were vulnerable to seismic events. Reservoir rehabilitation projects were completed in 2016 and 2017 in the Forest Rim, Mt. Hood, Wildwood, South Cove, and Grand Ridge Operating Areas.

In 2016, a granular activated carbon (GAC) system was installed at Well 4 (one of the Gilman Wells) to reduce levels of perfluorooctane sulfonate (PFOS). The currently installed GAC system is designed to be temporary.

In 2017, the City of Issaquah assumed service of the South Cove area from the City of Bellevue.

Table 1-1. Water System History

Year	Event
1923	East Issaquah Watershed purchased from Gilman Water Company.
Late 1940s	200,000-gallon concrete holding tank constructed in the East Issaquah Watershed.
1960	Wildwood ground-level reservoir (60,000 gallons) and Wildwood pump station constructed.
1962	East Hill reservoir revisions: new chlorination building. Comprehensive plan completed by Richard E. Wolf, Consulting Engineer.
1963	Downtown 10 and 12-inch supply grid constructed. Twin Cemetery 500,000-gallon reservoirs constructed.
1967	Risdon Well No. 1 drilled, becoming City's primary source of water.
1968	Wildwood pump house constructed. Twin Highwood 250,000-gallon tanks constructed. Sycamore booster pump station constructed by private contractor.
1969	Risdon Well No. 2 drilled. Wildwood pump station revisions and pump house constructed.
1970	Automatic control and telemetry system installed. Construction of I-90 disrupts flow from East Issaquah Watershed springs.
1973	Constructed 12-inch transmission main to northwest industrial area.
1976	Wildwood reservoir capacity increased. Mountain Park booster pump station and Mount Hood reservoir constructed. East Issaquah Watershed springs abandoned. Gun Club Wells No. 3 and No. 3a drilled to replace supply lost from East Issaquah Watershed springs.
1978	Mt. Hood booster pump station constructed. Forest Rim booster pump station constructed.
1979	Forest Rim standpipe constructed.
1986	Westside 2 MG reservoir constructed.
1987	Gilman Wells Nos. 4 and 5 drilled.
1988	Terra II booster pump station constructed.
1989-90	City approves wholesale water agreements with the City of Bellevue to serve the Montreux and the Lakemont Triangle operating areas.
1993	Terra II booster pump station reconfigured and Cougar Ridge standpipes constructed.
1994	City and Sammamish Plateau Water District approve an agreement for a two-way intertie for standby and emergency water supply and lease of standby storage from the 297 Tank.
1997	City entered into wholesale water agreement with the City of Bellevue to supply Issaquah with up to 4.2 mgd peak day demand from city of Seattle.
1998	Issaquah Highlands (formerly Grand Ridge) 3 million-gallon reservoir, pump station and transmission/distribution piping constructed.

Table 1-1. Water System History

Year	Event
1999	City entered a contract to form Cascade Water Alliance to provide the long-term water supply needs of its members.
1999	City approves agreement with Port Blakely to construct transmission main (BIP) from Bellevue to service the Issaquah Highlands and Talus Projects.
2001	Holly 1 pump station modified and Holly 2 pump station constructed.
2002	Forest Rim reservoirs constructed to replace reservoir damaged in February 2001 earthquake.
2002	12th Avenue pump station constructed to serve and move water to the 480 zone.
2002	Talus Shangri-La 616 Reservoir, pump stations and transmission/distribution piping constructed.
2002	The 24” regional main (BIP) from Bellevue to Issaquah was constructed.
2003	Issaquah Highlands Summit 1234 Reservoir and booster pump station constructed.
2003	City constructed and began operations of a chlorination treatment facility at Gilman Wells #4 and #5 and at Risdon Wells #1 and #2.
2004	Cascade acquired the 24” regional main from Port Blakely Communities and Issaquah.
2005	Bellevue and Issaquah signed revised agreement to wheel Cascade water to Issaquah through Bellevue’s system.
2005	Cougar Ridge reservoirs condemned due to structural inadequacy.
2006	The Bellevue Issaquah Pipe line (BIP) began operating to supply water to Issaquah Highlands and Talus areas.
2008	Construction of new Wildwood pump station to replace existing, aging pump station.
2008	Construction of new Cougar Ridge reservoirs to replace existing reservoir due to latent defects and damage in Nisqually quake.
2008	Sequestration Treatment facility was added to Well #4 and #5 at the Gilman pump house to remedy the presence of manganese.
2008	Fluoridation Treatment facility was added to Talus Booster pump station to allow blending of ground water and surface water.
2011	Fluoridation Treatment facility was added to Holly Booster pump stations to allow future blending of groundwater and surface water.
2012	Installed blending facility to allow regional and groundwater to be used in Issaquah Highlands
2015	Completed Mountain Park Booster Pump Station Upgrade
2015	Assumed Ownership of Water System for the Grand Ridge Community
2016	Installed GAC System on Well 4 to remove PFOS
2016	Completed Mt. Hood Booster Pump Station Upgrade
2017	Assumed Water Service of South Cove/Greenwood Point (from Bellevue)
2017	Completed Wildwood Reservoir Rehabilitation
2017	Completed Mt. Hood Reservoir Rehabilitation

1.6 Related Plans

1.6.1 City of Issaquah Comprehensive Plan

The City Comprehensive Plan (effective March 2017) has a number of required elements, for which the City has adopted goals, objectives, and policies. The objectives for each of the elements address the vision residents and local businesses have identified and Council has adopted for the next 20 years. The policies and criteria in Chapter 3 of this plan are consistent with those of the City's Comprehensive Plan.

Additionally, Washington State's Growth Management Act (GMA) requires municipalities to establish the boundaries within which "urban services" will be provided and to evaluate the capacity of their utility systems to accommodate the projected demands for these services. This is also established in the City's Comprehensive Plan. The City intends growth to be accommodated within the existing city limits first and then within the potential annexation area (PAAs). Future land use and growth projections are presented. Household and commercial growth projections for the City that are presented in Chapter 4 of this Plan were developed based on information provided in the City's Comprehensive Plan.

1.6.2 Central Issaquah Plan

The Central Issaquah Plan (first adopted in 2012 and last amendment effective March 2017) supplements the City's Comprehensive Plan by providing detailed goals, and policies for the Central Issaquah area. The Central Issaquah Plan provides details on projected growth for both the Central Issaquah area and the Regional Growth Center within it (also known as the Central Issaquah Urban Core). These are used by this Water System Plan in projecting future water demands. The Central Issaquah Plan also incorporates elements of the Rowley Development Agreement.

1.6.3 Cascade Water Alliance Transmission and Supply Plan (2012)

CWA adopted in 2012 a Transmission and Supply Plan (TSP) which supplements information on regional supply presented in each CWA member's individual water system plans. The plan includes information on CWA's mission, utility membership, and structure; water supply and operations; conservation; long-term water demands and sources of supply; infrastructure needs; and financial requirements.

Water for CWA is sourced from Seattle Public Utilities (SPU) which provides for a "declining block" of supply that will be reduced in five-year increments beginning in 2024. Major CWA infrastructure related to Issaquah includes the Bellevue-Issaquah Pipeline (BIP) which directly delivers CWA water to the Issaquah distribution system (a portion of CWA water is wheeled through Bellevue through intertie connections).

The TCP outlines regional-scale water conservation practices and goals for its members.

The TCP also evaluates CWA's supply portfolio through 2060, and outlines future water supply sources for CWA which include:

- Growth of production from CWA member's own supplies
- Supply from former CWA member Covington Water District providing surplus water from their Regional Water Supply Partnership with Tacoma Water, and delivering that water to CWA

members using a future transmission pipe (Tacoma-Cascade Pipeline). The TCP envisioned this beginning around 2024.

- Supply from the Lake Tapps Reservoir project which the TCP plans for this beginning around 2030.

Cascade continually monitors the balance between demand and supply. At this time it appears the projects identified for new development and transmission may be pushed out considerably compared with the 2012 TSP.

1.6.4 Coordinated Water System Plan (2005)

In February 2005, a Memorandum of Understanding on Water Resource and Supply Planning between Cascade and King County was signed regarding Coordinated Water System Plans for King County.

This stated that carrying out its authority under the Coordination Act, King County had previously declared four areas within King County, specifically South King County, Skyway, Vashon, and East King County (EKC), which includes Issaquah, to be critical water supply service areas (CWSSAs). King County has ratified a Coordinated Water System Plan (CWSP) for each of these areas. DOH subsequently approved each CWSP. King County believes that all four of these plans should be reviewed and updated as authorized and necessary under the Coordination Act to achieve the following goals:

- Consistency and compliance with current provisions of state law.
- Incorporation of updated water supply planning documents, including Cascade's Transmission and Supply Plan.
- Ensure the planned and coordinated delivery of safe and reliable water throughout King County in order to meet the population and economic growth needs identified under GMA through credible, objective, transparent, and accessible methodologies for projecting future demands.
- Provide for the assessment of the feasibility of proposals for shared source, transmission, storage facilities, and interties.
- Provide support for the development of long-term water supply capacity by water systems within King County to deliver safe and reliable water.
- Clarification of processes and responsibilities for addressing failing water systems.

On October 31, 2005, the Planning Framework Summary was developed to prepare the framework of technical information and planning efforts to address major water resource management and regional water supply planning issues in and around the King County region. The framework includes a regional demand forecast, supply alternatives analysis for King County, climate change analysis, reclaimed water opportunities, source exchange strategies, small water systems strategy, implementing the Municipal Water Law, and prioritization of tributaries that are to be addressed through source substitution for fish flow enhancement.

On May 3, 2006, a Clarifying Statement approved by the Coordinating Committee’s Regional Water Supply Planning Process was issued which stated:

> *Multiple agencies and organizations are voluntarily participating in a regional water supply planning process for the purpose of identifying, compiling information on, and discussing*

many of the key issues that relate to or may affect water resources of the region. The goal is to develop the best available data, information, and pragmatic tools that the participants may use, at their discretion, to assist in the management of their respective water systems and resources, and in their water supply planning activities. Information developed by each technical committee is advisory only and development of that information in no way expands or limits the authority of any entity. All information generated will be shared among all those interested in receiving it. The planning process is not required by statute, but is expected to provide useful data that may support other processes that any participant may use to address water resource and water supply issues. Each of the participants is free to accept or reject the results of this process.

A synthesis of the Regional Water Supply Planning Process was published in April 2009, by King County Department of Natural Resources and Parks, which summarizes the contents, recommendations, and conclusions from each technical committee report, and offers possible next steps for each topic. Included is a matrix of tools and methodologies developed or reviewed either by the technical committees that may be useful to water utilities in their own planning and management activities or in other regional processes. The report closes with broad conclusions and possible next steps for King County, noting that King County anticipates using information, data, and tools developed through this process where appropriate in its own various planning and management activities and in partnerships with others.

East King County Coordinated Water System Plan

King County Council formally declared EKC a CWSSA (Ordinance 7893, December 22, 1986) (pursuant to the Public Water System Coordination Act of 1977 (Chapter 70.116 RCW)). As a result of this action, a Water Utility Coordinating Committee (WUCC) was formed for the purpose of preparing a Critical Water Supply Plan in EKC. The WUCC consisted of representatives of water system agencies having 50 or more service connections.

On September 8, 1987, the King County Council formally adopted the external boundaries of the CWSSA through Ordinance 8214.

In October 1989, the three-year regional water system planning effort culminated in the adoption of the EKC CWSP. The plan is significant in that it establishes the framework for water system planning in EKC.

East King County Coordinated Water System Plan (Updates through November 1996)

Update looked at specific issues:

1. Water demand forecasts.
2. Boundaries among the utilities.
3. Regional water supply options.
4. Conservation programs.
5. Minimum design standards for water systems.
6. Requirements of E2SSB 5448 which amended RCW 70.116, 70.119, and 70.119A; and connections among the 1990 Growth Management Act, the 1994 King County Comprehensive Plan, and the CWSP water demand forecasts.

The EKC CWSP shows the Critical Water Supply Service Area Boundary for Issaquah. This boundary extends beyond the Urban Growth Boundary limits and corporate city limits, most notably extending to the south to the Four Lakes/Mirrormont service areas. It is the City's intent that the Water Service Boundary coincide with the city corporate limits, PAAs and the urban growth boundary. The City's service area has changed over the years through annexations and extensions. The King County Water Service Planning Area map, dated June 2006, will be updated with these revisions. The EKC CWSP Update's main component was the assessment of the water supply needs in eastern King County. The plan was developed under the guidance of the WUCC. The goal of the plan was to assist area utilities in establishing an effective process for planning and developing public water systems.

1.6.5 King County Comprehensive Plan

The King County Comprehensive Plan (KCCP) (with updates most recently adopted in December 2016) is a long-range guiding policy document for all land use and development regulations in unincorporated King County, and for regional services throughout the County including transit, sewers, parks, trails and open space. The KCCP provides projected growth within unincorporated King County by designating where growth will occur through policies, goals, plans, and regulations. The KCCP includes a land-use map of unincorporated King County. The KCCP includes a zoning map of unincorporated King County that identifies land-use types and densities that will accommodate the projected growth. An urban growth boundary is also defined in the KCCP to direct most of the projected growth into more urban areas. Cities, like Issaquah, have annexed urban unincorporated areas and assumed service delivery, zoning, and all other responsibilities for these areas. The County, in turn, revises its land use and zoning maps to reflect the revised jurisdictional authority.

1.6.6 Issaquah Creek Valley Groundwater Management Plan (March 1999)

This plan encompasses an area of 93 square miles located east and southeast of Lake Sammamish. The City's wells are all located within the boundaries of the Management Plan area. The plan recommends 18 specific goals to protect groundwater quality and quantity with 66 management strategies overall, recognizing the vulnerability of the lower Issaquah Valley aquifer system and its importance in supplying all the potable water in the area. The plan notes that currently stable groundwater levels may be affected by new development in the area. The plan recommends forming the Issaquah Creek Valley Management Committee with representatives from King County, City of Issaquah, Sammamish Plateau Water and Sewer District, Muckleshoot Indian Tribe, and representatives from the Issaquah Creek Valley Groundwater Management Committee. The Plan recommends that the King County Council and the City authorize a ballot measure to create an Aquifer Protection Area to provide funding for the implementation of the Plan.

1.6.7 East King County Groundwater Management Plan (December 1998)

The area encompassed by this plan includes the north central portion of King County. The Issaquah Creek Valley Groundwater Management Area is adjacent to the EKC Groundwater Management Area to the west; the City's service area is near to, but does not overlap with the EKC Groundwater Management Area. The goal of developing the plan was to protect the existing excellent groundwater quality. This goal is to be achieved through a combination of conservation, education and long-term monitoring and data collection. The plan recommends the formation of a management committee to oversee all groundwater protection activities in the area. The committee has been inactive since 2004.

A project is planned for 2018 to update the Critical Aquifer Recharge Area boundary within the plan.

1.6.8 Lower Issaquah Valley Wellhead Protection Plan (1993)

This is the current Wellhead Protection Plan for the Lower Issaquah Valley aquifer (LIVA) and assesses the hydrogeologic conditions of the LIVA. The City's wells draw from this aquifer, which is the same aquifer described in the Issaquah Creek Valley Groundwater Management Plan. Approximately 40 square miles was delineated as the wellhead protection area based on a conceptual model of the aquifer and hydrogeologic mapping. A contaminant source inventory was most recently completed in 2017 and is included in Appendix P. A risk screening has also been completed. A number of wellhead protection strategies were proposed to manage land-use and prevent groundwater contamination including: aquifer management zones, land-use zoning and control, special permitting, hazardous materials handling regulations, public education, engineering, spill response planning, water supply contingency planning, and monitoring and further technical studies.

1.7 Development Agreements

In 1996, the City adopted the urban village zone. Each area with this zoning has a development agreement that dictates the rules and entitlements associated with that urban village during its specified build-out period. These agreements include the allowable build-out for the development as measured in ERUs.

Chapter 2. Existing System

This chapter describes the existing components of the City's water system. Included are descriptions of the service area, adjacent water purveyors and interties, physical features, supply sources, operating areas, distribution piping, pressure reducing valve stations and booster pump stations.

2.1 Service Area

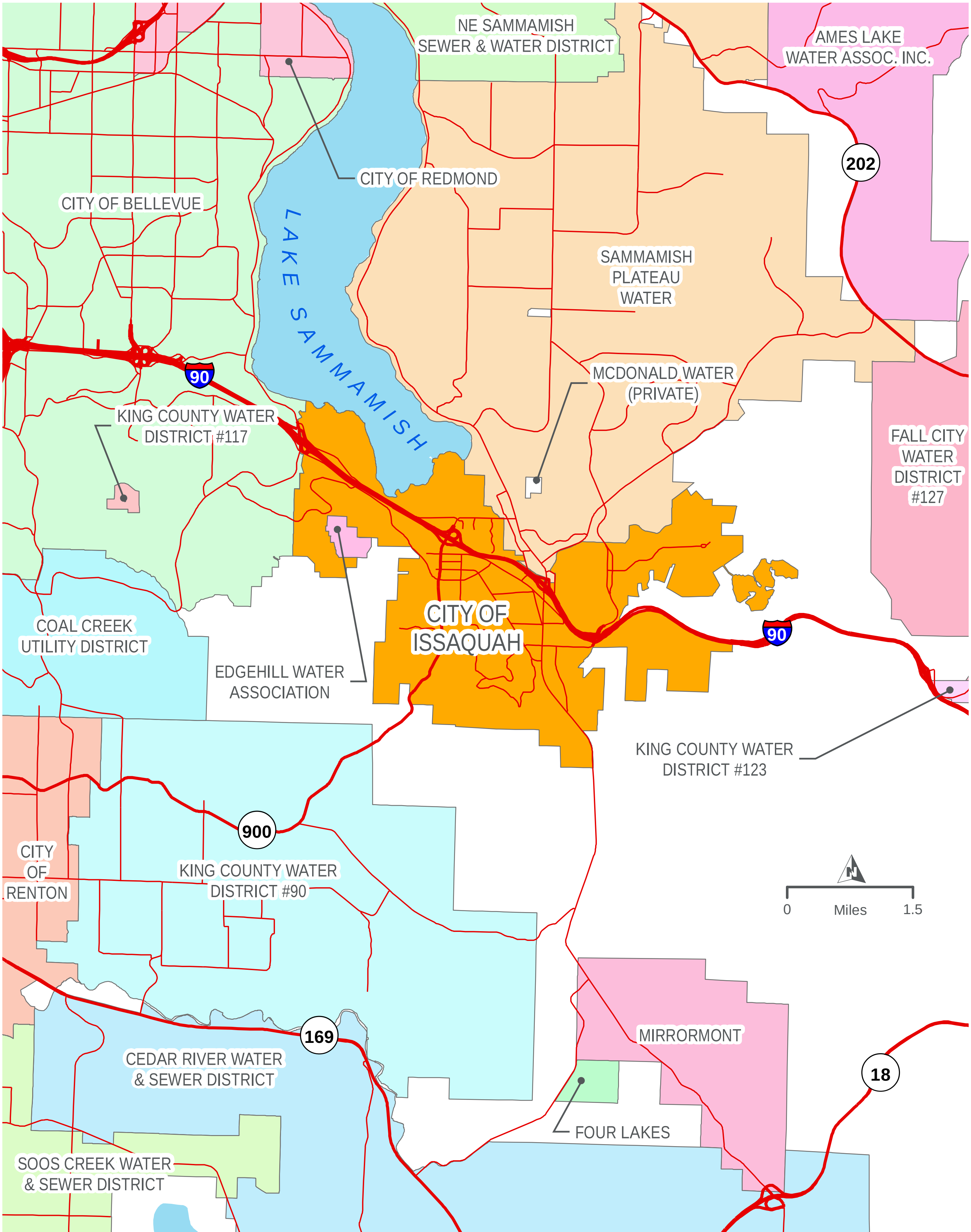
Issaquah's service area and the service areas of adjacent water purveyors are shown in Figure 2-1.The adjacent water purveyors include Bellevue, Edgehill Water Association, Water District 90, and Sammamish Plateau Water (SPW).

The service area includes both the retail service area as well as the future service area. The retail service area is the area that current has distribution system piping available that can supply water. The future service area is the area that the water system will have the exclusive opportunity to provide water to in the future if desired by the water system. The future service area include future operating areas anticipated to be added to the City's water system within the 20-year planning horizon of this Plan (to 2037). Both the retail service area and future service area are shown in Figure 2-2 which also shows the City's current limits and the King County Urban Growth Boundary. The combination of the retail service area and future service area comprise the service area of the water system.

2.2 Adjacent Purveyors, Regional Suppliers, and Interties

Bellevue, SPW, Water District 90, and Edgehill Water Association are the adjacent water purveyors. The City's water system has interties with Bellevue and SPW. The City also has two interties with the regional water supplier Cascade Water Alliance's (CWA's) Bellevue-Issaquah Pipeline (BIP). It is important that the City coordinate operation with these adjacent purveyors and regional water supplier. Highlights of the adjacent purveyors and their relationship to the City's system are explained below.

Summary information on each of these systems can be found in each purveyor's water system plan. Table 2-1 summarizes pertinent information about each of the City's connections to adjacent purveyors. The location of each intertie is shown in Figure 2-3.



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SERVICE AREAS OF ADJACENT WATER PURVEYORS

FIGURE 2-1

Table 2-1. Existing Intertie Connections

Name	Location	Pressure Zone Supply	Operating Area Served	Purveyor	Meter Size (inch)	Primary Purpose
Montreux Intertie	SE 60th and 180th (1800 SE 60th Street	1150	Montreux	Cascade Water Alliance/City of Bellevue	6-inch	Supply for 700 ERU
Lakemont Triangle Intertie	SE Newport Way and Lakemont Boulevard (17200 SE Newport Way)	520	Lakemont Triangle	Cascade Water Alliance/City of Bellevue	12-inch[a]	Supply for 600 MF units
Talus Regional Intertie	Newport Way and 17th Ave	520	None (Talus Foothills, Talus Shangri-La in the future)	Cascade Water Alliance	10-inch	Future supply for several operating areas
Highlands Regional Intertie	Holly Street BPS	520	IH Summit, IH Central Park	Cascade Water Alliance	8-inch	Supply for several operating areas
1st Avenue NE Emergency Intertie	1st Avenue NE and Juniper Street (940 1st Avenue NE)	297	Valley 297	Sammamish Plateau Water and Sewer District	6-inch	Emergency
SE 56th Street Emergency Intertie	SE 56th Street and 221st Avenue SE	297	Valley 297	Sammamish Plateau Water and Sewer District	8-inch	Emergency
South Cove Intertie	4300 block W Lake Sammamish Parkway SE	271	South Cove	Cascade Water Alliance/City of Bellevue	12-inch	Supply for 1,600 ERU
South Cove Emergency Intertie	4200 block 181st Avenue SE	271	South Cove	Cascade Water Alliance/City of Bellevue	8-inch	Emergency

[a] A master meter is not located at the Lakemont Triangle Intertie. The 12-inch size refers to the pipe size for the intertie. Demands through the intertie connection are estimated using the sum of individual customer meter volumes in the operating area.

2.2.1 Cascade Regional Transmission Main

The City is a founding member of the Cascade Water Alliance (CWA), which was formed in 1999 as an organization that replaced the City of Seattle in the responsibility of providing wholesale water to CWA members. Membership in CWA includes the cities of Issaquah, Bellevue, Kirkland, Redmond, and Tukwila; as well as SPW, and Skyway Water and Sewer District. CWA has a long-term supply agreement to purchase water from the cities of Seattle and Tacoma. The City began receiving water from CWA in 2006 and all water received through the Bellevue interties is supplied by CWA. The City constructed the regional transmission main and facilities for the BIP. After CWA was formed, the City's regional facilities were transferred to CWA ownership. The March 2012 CWA Interlocal Agreement details CWA's commitment to supplying Issaquah's water needs (Appendix D).

The regional transmission main connects to Bellevue's system on 161st Avenue SE and travels east along Newport Way and Dogwood Street into the City. The regional transmission main supplies the City with regional water through two interties: the Talus intertie and the Highlands intertie. Both of these interties connect to the Valley 297 Operating Area. The regional transmission main also supplies SPW.

CWA Intertie

The CWA intertie to the regional transmission main is located at Newport Way and 17th Avenue (State Route 900) for service to the Talus Foothills and Talus Shangri-La Operating Areas. Talus is currently typically served solely by City groundwater supplies. However, the City is capable of serving Talus with CWA water at any time based on groundwater operational considerations. The City fluoridates the groundwater for Talus when it enters the Talus system, so there is consistency in fluoride being deliver to Talus whether City groundwater or CWA water is being used.

Highlands Intertie

The Issaquah Highlands Summit and Central Park Operating Areas are capable of receiving a blend of City well and regional CWA water. A blending station allows the selection of a blend of well and CWA water before going to the Holly Street BPSs. However, currently the blend station is only supplying CWA water to the Issaquah Highlands Summit and Central Park Operating Areas. CWA water is supplied from the regional transmission main through the Highlands intertie located near the Holly Street I and II BPSs at a rate of up to 0.75 mgd.

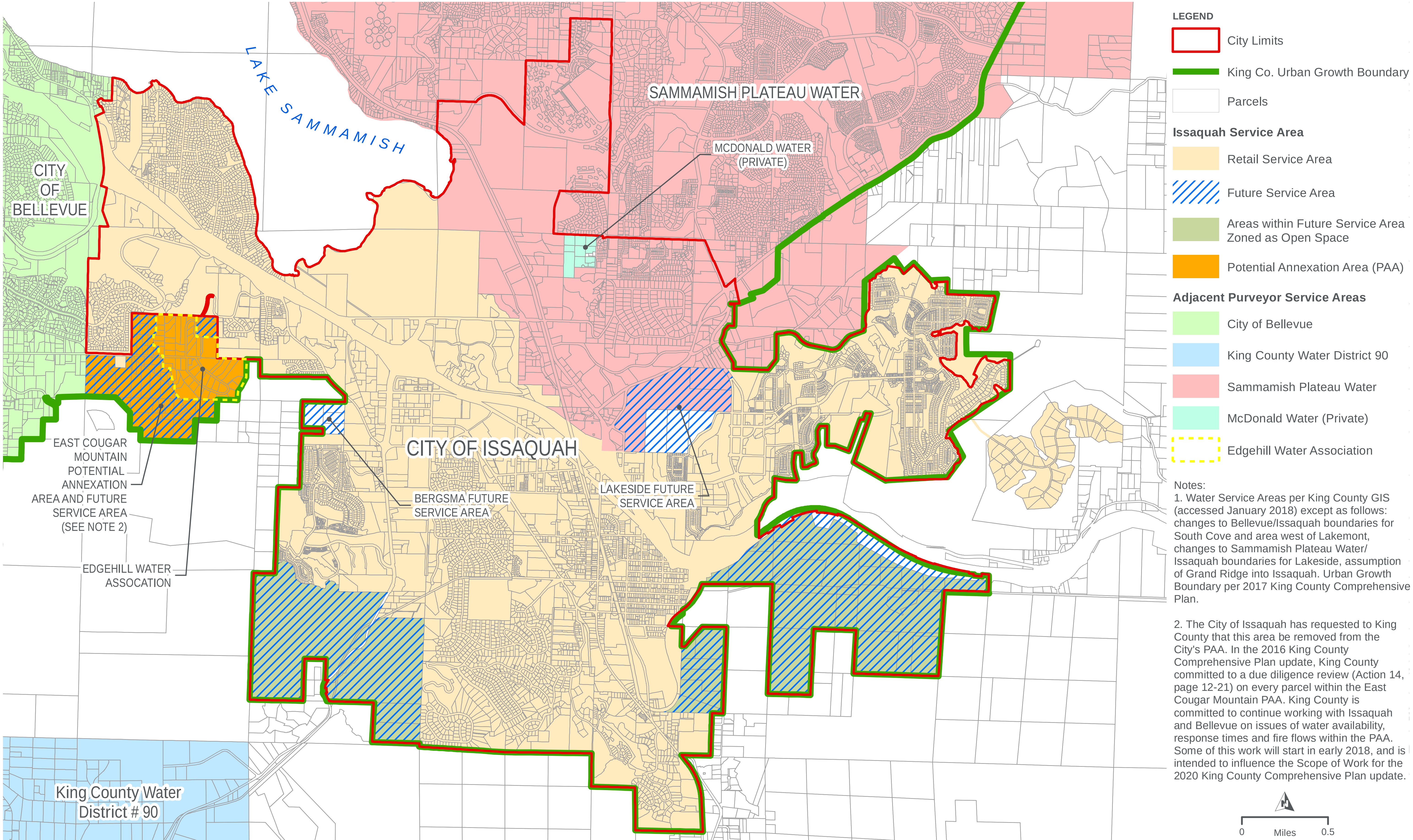
2.2.2 City of Bellevue

Bellevue is the adjacent water purveyor to the west. In 1989, Bellevue and the City signed an interlocal agreement to serve the Montreux and Lakemont Triangle areas. This was revised in 2005 to address the change of the regional water supplier from Seattle Public Utilities (SPU) to CWA (Appendix D). This was then amended to include Issaquah assuming service to the Greenwood/South Cove Area. According to the amended agreement, Bellevue currently wheels CWA water through its system to the City through three existing interties (Montreux, Lakemont, and South Cove) and will wheel water through one future intertie to supply a redundant feed to the South Cove Reservoir.

Montreux Intertie

The first wholesale service agreement, Resolution 5159, in 1989, with Bellevue provided supply for up to 700 ERU in the City's Montreux area (historically referred to as Glacier Ridge). This intertie is located at SE 60th Street and 180th Avenue SE. Bellevue supplies water from its 1150 operating zone through a 6-inch meter with a maximum fire flow rate of 2,500 gpm.

The 1989 agreement was revised in 2001 to supply no more than 150 ERU of the total 700 ERU supply from Bellevue's 1465 operating zone to serve the future Cougar Mountain Operating Area. The area to be served was clearly defined in the revised agreement with boundary revisions that follow property lines and therefore eliminate bisected properties. The revised agreement also describes additional facilities needed to supply water from Bellevue's 1465 operating zone. The additional facilities are to be provided in response to development activity in the Cougar Mountain Operating Area and have not yet been constructed. The agreement was modified most recently in



Notes:

1. Water Service Areas per King County GIS (accessed January 2018) except as follows: changes to Bellevue/Issaquah boundaries for South Cove and area west of Lakemont, changes to Sammamish Plateau Water/ Issaquah boundaries for Lakeside, assumption of Grand Ridge into Issaquah. Urban Growth Boundary per 2017 King County Comprehensive Plan.

2. The City of Issaquah has requested to King County that this area be removed from the City's PAA. In the 2016 King County Comprehensive Plan update, King County committed to a due diligence review (Action 14, page 12-21) on every parcel within the East Cougar Mountain PAA. King County is committed to continue working with Issaquah and Bellevue on issues of water availability, response times and fire flows within the PAA. Some of this work will start in early 2018, and is intended to influence the Scope of Work for the 2020 King County Comprehensive Plan update.

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ISSAQUAH SERVICE AREA

FIGURE 2-2

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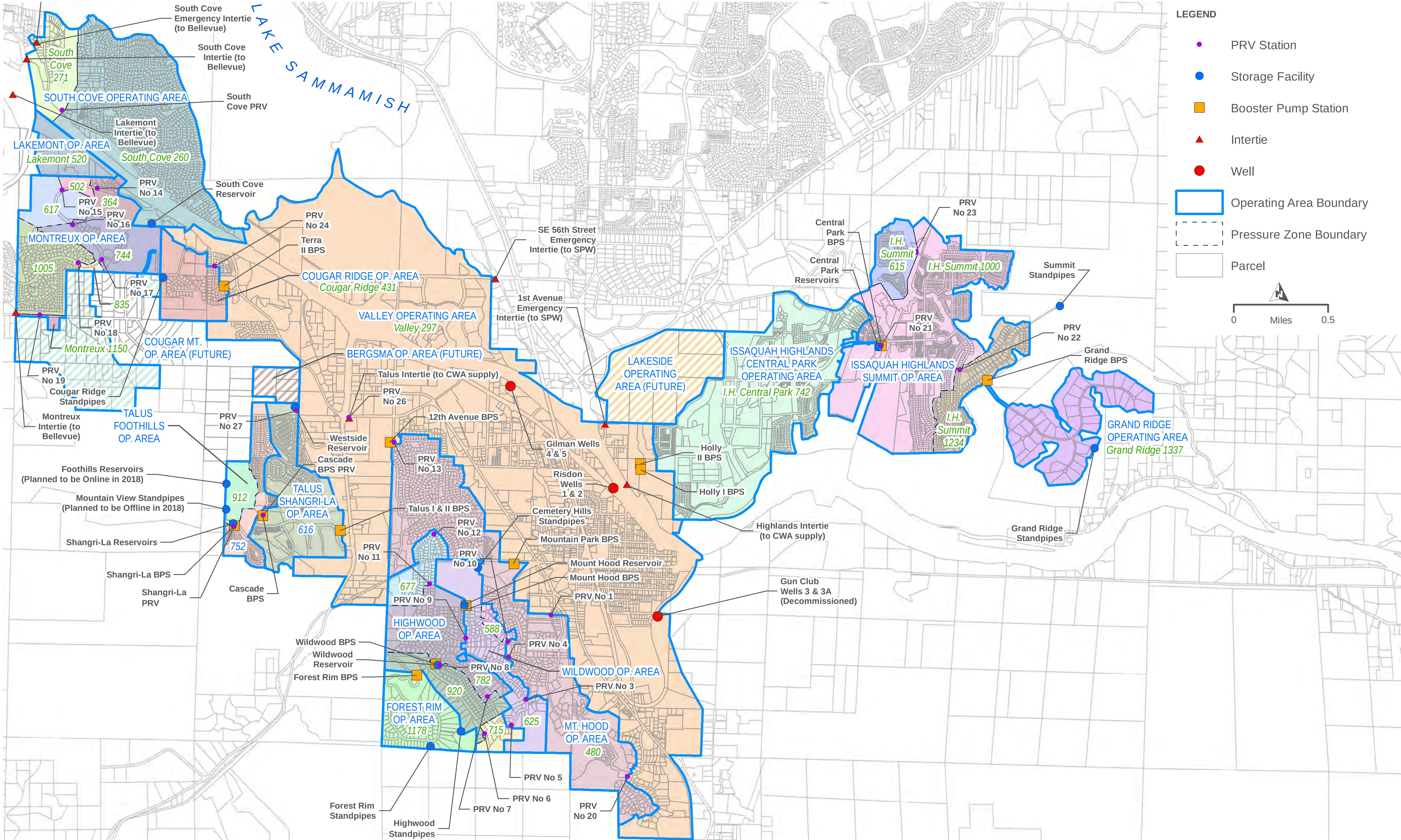

OPERATING AREAS, PRESSURE ZONES, AND MAJOR FACILITIES

FIGURE 2-3

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2005 to become a facilities agreement in which Bellevue allows the City to use its system to wheel CWA water to the Montreux intertie to serve up to 700 ERU (Appendix D).

Lakemont Triangle Intertie

In 1990, a second wholesale service agreement, Resolution 5232, with Bellevue was completed that provides water to the Lakemont Triangle Area for 600 multi-family units. Bellevue provides water from a 12-inch diameter main in the 520 Zone to the 17300 block of Newport Way SE with a maximum fire flow rate of 2,000 gpm. The City constructed approximately 6,350 linear feet (LF) of water main within the Bellevue service area to extend the main to the Lakemont Triangle area. The 6,350 LF of the main was owned, operated, and maintained by the City until ownership was transferred to CWA. The agreement was modified most recently in 2005 to become a facilities agreement in which Bellevue allows the City to use Bellevue's system to wheel CWA water to the Lakemont intertie to serve up to 400 ERU (600 multi-family units) (Appendix D).

No intertie meter is in place at this connection. The City plans to construct a master meter for this intertie (see Chapter 11 – Capital Improvement Program).

South Cove Intertie

The latest version of the water facilities agreement includes assumption of the South Cove area by Issaquah from Bellevue. Bellevue provides water to the South Cove area through two interties: a 12-inch main at the 4300 block of W Lake Sammamish Parkway SE that serves as the primary intertie, and an 8-inch main at the 4200 block of 181st Avenue SE for emergencies. The primary intertie has a maximum capacity for fire flows of about 1,000 gpm. The primary intertie has a master meter.

The agreement allows the City to use the Bellevue system to wheel CWA water to the South Cove intertie to serve up to 1,600 ERU.

2.2.3 Sammamish Plateau Water

SPW is the adjacent water purveyor to the northeast. At the present time, the SPW water system has two operating interties with the City. The governing agreement, including emergency intertie information, is included in Appendix D.

1st Avenue NE Emergency Intertie

The agreement for interties was approved in 1994. The first intertie described in the agreement is the 1st Avenue NE intertie. This connection is two-way and metered at 940 1st Avenue NE, enabling the City and SPW to exchange water between their respective 297 pressure zones. The intertie was constructed and is currently owned by SPW. SPW personnel manually operate the intertie valve. At the present time, this connection is operated for emergencies only.

SE 56th Street Emergency Intertie

The SE 56th Street Intertie connects the City and SPW systems at SE 56th Street near East Lake Sammamish Parkway SE and 221st Avenue SE. The intertie provides emergency supply for both the City and SPW.

Future SPW Interties

In 1996, the City and SPW amended the original 1994 Agreement for Interties to include a third emergency intertie on Black Nugget Road. At this time, the intertie has not been constructed.

2.2.4 King County Water District 90

King County Water District 90 is the water purveyor to the south of the City. Currently the water systems for the City and Water District 90 are not connected. An intertie between these systems is not anticipated at this time.

2.2.5 Edgehill Water Association

Edgehill Water Association is a water purveyor west of the City's limits, but within the service area. Edgehill currently has 39 connections of the maximum 51 service connections in the Cougar Mountain area. Cougar Mountain is a potential annexation area (PAA) of the City. There is no physical connection between the City's and the Edgehill's water systems.

2.3 Vicinity Characteristics

2.3.1 Topography

The topography of the City's service area has a direct impact on the location and configuration of distribution, storage, and pumping facilities. Three distinct topographic features exist: 1) the lowland valley; 2) the Tradition Lake and Grand Ridge plateaus; and 3) the moderate to steep hillsides adjacent to the valleys. Issaquah has concentrated commercial development in the valley and residential development on the plateaus and hillsides. As development has reached farther up the mountain slopes, more pressure zones, pumping facilities and reservoirs have been required, thereby adding complexity to the system. The mid-century development of neighborhoods on Squak Mountain created multiple additional pressure zones.

The service area is situated primarily in the southern-most part of the Sammamish River Valley, south and east of Lake Sammamish. This portion of the valley is approximately 4.5 miles long with a maximum width of approximately 1.5 miles at the north end, narrowing to a width of 0.5 miles at the south end. The valley slopes range from one to six percent, with high elevations of approximately 160 feet at the southern end and a low elevation of 26 feet along the shore of Lake Sammamish.

There are two large plateaus located east of the valley: Tradition Lake and Grand Ridge. These plateaus are separated from the valley by 20 to 40 percent slopes and from each other by the valley of the East Fork of Issaquah Creek that contains I-90. The typical slope on the plateaus is six percent, and the average elevation is approximately 500 feet. Hillsides, which represent a majority of the service area, have slopes ranging from 20 to 40 percent.

The highest elevation in the service area, at approximately 2,020 feet, is the top of Squak Mountain in the southern portion of the service area.

The City lies within the lower reaches of the Issaquah Creek Drainage Basin, which is a tributary to Lake Sammamish. The service area is drained by a series of small creeks:

- Tibbetts Creek, draining Cougar and Squak Mountains.
- Main stem of Issaquah Creek drains Squak and Tiger Mountains.

- East and North Forks of Issaquah Creek drains the south slopes of Grand Ridge and the north valley floor.

2.3.2 Climate

The service area has a west coast, marine-type climate influenced by moist air masses coming from the Pacific Ocean. In late fall and winter, these air masses rise along the mountain foothills, causing the air to cool and moisture to fall out as precipitation throughout the area. Average annual rainfall is about 40 inches, generally occurring between October and March. Average annual snowfall is 8.6 inches. The temperatures are in the mid-70s Fahrenheit (F) in the summer, in the 40s F during the winter, with an overall average of 50 degrees F.

As is common in the Puget Sound area, climate has a significant impact on water consumption since customers use more or less water depending on the weather. During hot, dry weather, water consumption increases as a result of lawn watering and other outdoor water uses; during cool and wet weather, consumption decreases. See Chapter 5 for a comparison of the water demands for the City between winter and summer months.

2.3.3 Geology

A detailed description of the Issaquah area's geology is provided in the Lower Issaquah Valley Wellhead Protection Plan, Volume I Report[1]. Broadly defined, the Lower Issaquah Valley is a deep pre-glacial bedrock bowl filled with relatively coarse glacial advance and recessional outwash sediments. These sediments allow relatively easy lateral movement of large quantities of water.

General geologic conditions in the Sammamish Valley, on the adjacent hillsides and on the northeasterly slopes of Squak Mountain include:

- The valley floor is generally composed of layers of unconsolidated sedimentary deposits, sand, gravel, silt, and clay to an approximate depth of 100 feet, lying over clays. Deep under the clay layer, between approximately 200 and 400 feet deep, there is another water-bearing layer. This material is deepest at the north end of the valley near Lake Sammamish and shallowest at the south end.
- On the hillsides, there are deposits of stratified glacial drift that may be up to 100 feet thick.
- Squak Mountain's northeasterly slopes contain ancient lake sediments that are typically associated with landslide hazards.

An analysis of soils and topography is essential to determine the physical constraints on development within the service area. Five soil factors will affect development on both the valley floor and the hillsides:

- Erosion potential.
- Landslide hazard.
- Water table.
- Suitability for individual drain fields.
- Flooding Potential

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[1] Lower Issaquah Valley Wellhead Protection Plan, Volume I Report, Golder Associates, November 1993.

Erosion and landslide hazard will influence hillside development the most, including placement of water system facilities, whereas the other factors will be more instrumental in limiting development on the valley floor and on the plateaus.

2.4 Supply Sources

2.4.1 Groundwater Supply Sources

The City currently operates four production wells to provide groundwater to its customers. These wells are called the Risdon Wells and Gilman Wells and appear Figure 2-3. A summary of the amount of water withdrawn from the production wells is summarized in Chapter 7.

Risdon Wells

Risdon Wells No. 1 and 2 were constructed in 1967 and 1969, respectively, and are located just south of I-90, east of SE 72nd Street. Well No. 1 has an authorized instantaneous quantity (Qi) of 630 gpm (0.91 mgd) and an annually quantity (Qa) of 1,000 acre-feet (ft/year) (0.89 mgd). Well No. 2 has an authorized Qi of 1,200 gpm (1.73 mgd) and a Qa of 1,600 ac-ft/year (1.43 mgd).

Gilman Wells

The Gilman Wells No. 4 and 5 were constructed in 1987 and are located southeast of where I-90 crosses Issaquah Creek. Gilman Well No. 4 has an authorized Qi of 250 gpm (0.36 mgd) and a Qa of 200 ac-ft/year (0.18 mgd). Well No. 5 is supplemental to the primary water rights for the Risdon Wells with an authorized Qi of 1,000 gpm (0.144 mgd) and a Qa of 1,600 ac-ft/year (1.43 mgd).

2.4.2 Purchased Water Supply

In addition to groundwater supplies, the City also purchases water from CWA. The water is delivered through interties discussed in Section 2.2. Regional water is used to serve the Issaquah Highlands. The City has facilities in place to potentially deliver CWA water to Talus and to provide a blend of CWA and groundwater to the Issaquah Highlands. The City anticipates that the entire service area may be served blended regional/well water in the future.

The Montreux intertie to Bellevue has the capacity to serve a maximum of 700 ERU in the Montreux Operating Area and a portion of the future Cougar Mountain Operating Area according to the terms of the Bellevue facilities agreement. The connection to Bellevue's water system that serves Lakemont may serve up to 600 multi-family units according to the facilities agreement with Bellevue, and the connection to Bellevue's water system that serves South Cove may serve up to 1,600 ERU (Appendix D).

2.5 Operating Areas

The City's water system is currently comprised of 14 hydraulic operating areas, further divided into a total of 27 individual pressure zones. There are two proposed operating areas to serve future growth within the service area: Cougar Mountain and Bergsma.

The major hydraulic operating areas each comprise a separate portion of the overall water distribution system, containing separate storage facilities. The operating areas, and associated pressure zones, are shown in Figure 2-3 and summarized in Table 2-2. Connections between operating areas are via booster pump stations (BPSs) from lower to higher elevation operating areas or through pressure reducing valve (PRV) connections.

In a few locations, where pipes cross hydraulic boundaries, closed valves separate the operating areas. In some hydraulic operating areas, the variation in elevation within the area is too great to be served by a single pressure zone. Under these circumstances, multiple PRVs are installed, forming separate pressure zones, to avoid system pressures outside of the accepted range. Pressure zones depend on the same supply and storage facilities as the rest of the operating area.

Currently, supply for the majority of the City's service area is from the Gilman and Risdon wells, described in the previous section. The Lakemont, South Cove, and Montreux Operating Areas are not currently served by these wells; they are supplied through separate interties with Bellevue. The Issaquah Highlands development is currently supplied only with CWA water but the system has the capability of delivering a blend of water from City wells and from CWA. This production strategy enables the City to maximize total production from its own wells, and to meet higher demand in the summer season. Water purchased from CWA supplement Issaquah's well production to meet the summer peaking demand. See Chapter 7 for a summary of the amount of water purchased from CWA.

A hydraulic profile of the existing water system is shown in Figure 2-4.

Table 2-2. Existing Hydraulic Operating Areas and Pressure Zones

Operating Area / Pressure Zone	Highest Service Elevation	Supply Facilities	Storage Facilities
Valley 297	229	Risdon Well & Gilman Wells	Cemetery Hills Reservoir & Westside Reservoir
Mt. Hood 480	397	Mt. Park & 12th Ave BPSs	Mt. Hood Reservoir
Wildwood 625 Sub-Zone 588 Sub-Zone	 517 421	Mt. Hood BPS	Wildwood Reservoir
Highwood 920 Sub-Zone 782 Sub-Zone 715 Sub-Zone 677 Sub-Zone	 770 640 619 530	Wildwood BPS	Highwood Reservoir
Forest Rim 1178	1080	Forest Rim BPS	Forest Rim Reservoir
Cougar Ridge 430	319	Terra II BPS	Cougar Ridge Reservoir
Lakemont 520	312	City of Bellevue 520 Zone	Multiple 520 Zone Reservoirs (Bellevue)
Montreux 1005 Sub-Zone 835 Sub-Zone 744 Sub-Zone 617 Sub-Zone 502 Sub-Zone 364 Sub-Zone	 862 717 592 475 375 260	City of Bellevue 1150 Zone	Cougar Mountain 1150 Reservoir (Bellevue) [a]
Issaquah Highlands Central Park 742	666	Holly Street BPSs	Central Park 742 Reservoir

Table 2-2. Existing Hydraulic Operating Areas and Pressure Zones

Operating Area / Pressure Zone	Highest Service Elevation	Supply Facilities	Storage Facilities
Issaquah Highlands Summit 1234 Sub-Zone 1000 Sub-Zone 615 Sub-Zone	 1079 882 652	Central Park BPS	Summit 1234 Reservoir
Talus Shangri-La 616	530	Talus BPSs	Shangri-La 616 Reservoir
Talus Foothills Talus Foothills 912 [b] Talus Foothills 752	 800 565	Shangri-La BPS Cascade BPS	Foothills 912 Reservoir [b]
Grand Ridge 1337	1200	Grand Ridge BPS	Grand Ridge 1337 Reservoir
South Cove South Cove 271 South Cove 260	 207	 City of Bellevue 270 Zone	 Multiple 520 Zone Reservoirs (Bellevue) South Cove Reservoir

[a] Additional storage is provided from higher zones via PRVs

[b] Foothills 912 Reservoir will be brought online in 2018 creating the Talus Foothills 912 Zone. Currently, the Talus Mountain View 752 Zone is served by the Mountain View 752 Reservoir which will be decommissioned when the 912 level reservoir is brought online.

2.5.1 Valley Operating Area

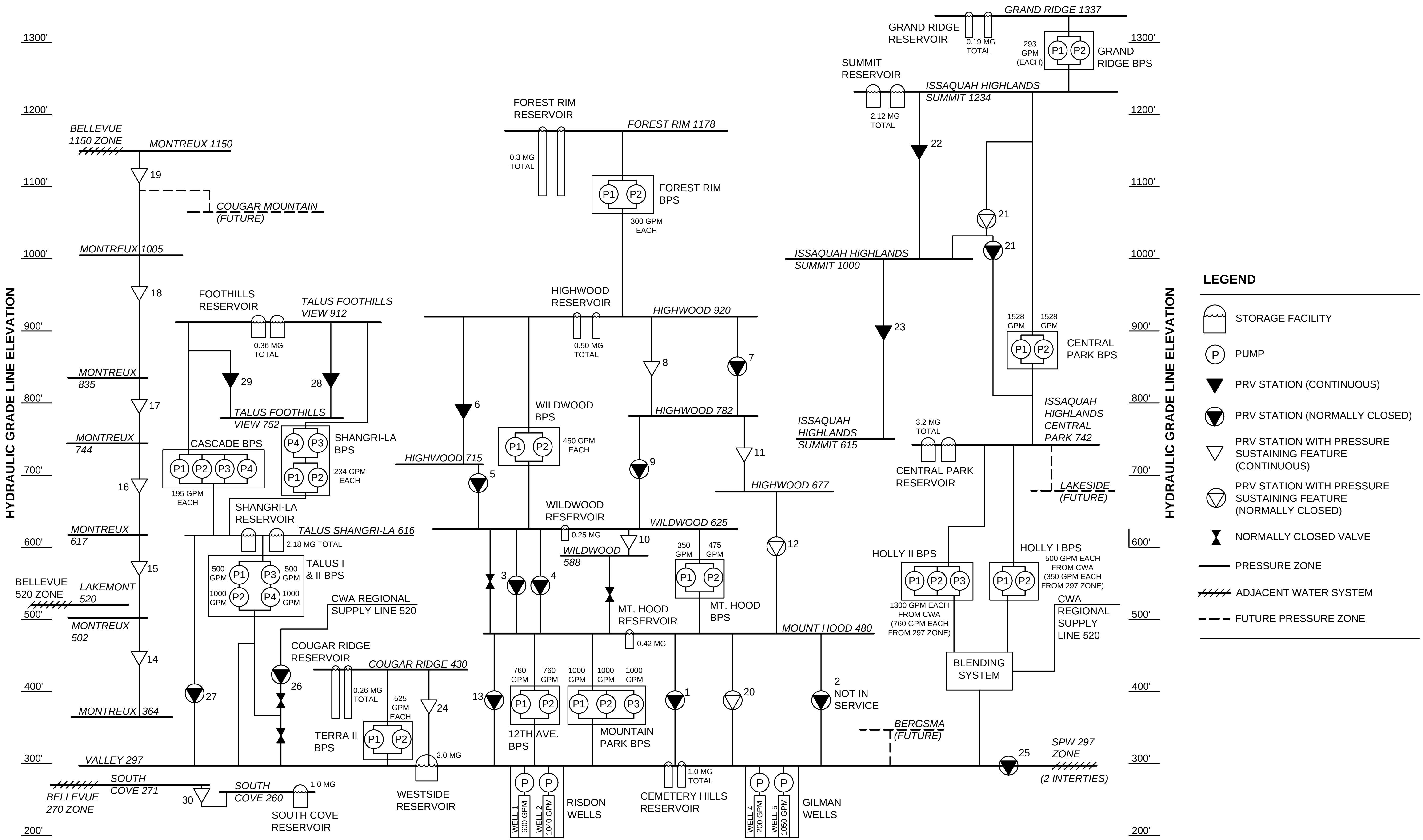
The Valley Operating Area is the City's oldest and largest. It dates back to 1923 when a series of springs, in what is now known as the Lake Tradition Plateau, was purchased from the Gilman Water Company. The operating area encompasses the valley floor, between Squak Mountain and Tiger Mountain in the southern portion of the City, and is bounded by Cougar Mountain and Lake Sammamish to the north. The I-90 corridor runs through the northern portion of the operating area. Most of the City's commercial and industrial development is located in this operating area, primarily along the I-90 Corridor.

The City's well supply system is located in the Valley Operating Area. The wells pump to the Westside Reservoir and Cemetery Hills Reservoir, which nominally operate on the 297-foot hydraulic gradient. The Valley Operating Area is not subdivided into additional pressure zones.

2.5.2 Mt. Hood Operating Area

The Mt. Hood area operates at a typical hydraulic elevation of 480 feet and is located on the northern and eastern portions of Squak Mountain. The majority of the Mt. Hood Operating Area is single-family residential, with some multi-family developments. There are no commercial or industrial zoned areas within the Mt. Hood Operating Area. The operating area is bounded to the north and east by the Valley Operating Area and to the south by the Wildwood and Highwood Operating Areas. The Mt. Hood Operating Area extends from the southeast to the northwest, roughly adjacent to, and southwest of, NW Newport Way and Front Street South.

The Mt. Hood Operating Area is not subdivided into additional pressure zones. Water is pumped from the Valley Operating Area to Mt. Hood Operating Area via the Mountain Park and 12th Avenue



HDR CITY OF ISSAQUAH WASHINGTON

EXISTING HYDRAULIC PROFILE

FIGURE 2-4

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NW BPSs. Storage is provided by the Mt. Hood reservoir. Emergency connections exist between Mt. Hood and the Valley Operating Areas, through PRVs 1, 13 and 20. PRV 2 is bypassed, but could be manually put into service in an emergency.

2.5.3 Wildwood Operating Area

The Wildwood Operating Area occupies a higher elevation of Squak Mountain, adjacent to, and to the southwest of, the Mt. Hood Operating Area. The area currently consists of single-family developments. The majority of the Wildwood Operating Area functions at a 625-foot hydraulic gradient. Wildwood Operating Area is served by the Mt. Hood BPS. The Wildwood reservoir provides storage for the Operating Area, operating on the 625-foot gradient. The Wildwood 588 sub-zone is supplied from the Wildwood 625 Zone, via PRV 10. Emergency connections exist between Wildwood and Mt. Hood Operating Areas, through PRV 3 and 4.

2.5.4 Highwood Operating Area

The Highwood Operating Area rests at still a higher elevation on Squak Mountain, adjacent and to the southwest of Mt. Hood and Wildwood. The Highwood Operating Area contains four pressure zones. The Wildwood BPS serves Highwood Operating Area, pumping water to the 920-foot hydraulic gradient from the Wildwood 625 Zone.

Storage for the Highwood Operating Area is twin standpipes, which “float” on the 920-foot gradient. The Highwood 782 Zone is served by the 920 Zone, via PRV 7 and 8. The Highwood 715 Zone is also served from the 920 Zone, through PRV 6. The Highwood 677 Zone is served from the 782 Zone through PRV 11. Emergency connections exist between Highwood and Mt. Hood through PRV 12, and through PRVs 5 and 9 to Wildwood.

2.5.5 Forest Rim Operating Area

The Forest Rim Operating Area contains the highest hydraulic gradient on Squak Mountain at 1,178 feet. The Forest Rim Operating Area is located adjacent and to the southwest of the Highwood Operating Area. The Forest Rim Operating Area is served by the Forest Rim BPS, pumping water from the Highwood 920 Zone. Storage for this operating area is provided by twin standpipes. The Forest Rim Operating Area is zoned for single-family residential development. The operating area is not subdivided into additional pressure zones. No emergency connections exist between the Forest Rim and Highwood Operating Areas.

2.5.6 Cougar Ridge Operating Area

The Cougar Ridge Operating Area is located in the northwest portion of the city, just south of the I-90 corridor. Cougar Ridge is zoned single-family. The area is served by the Terra II BPS, pumping water from the Valley Operating Area to the Cougar Ridge 431-foot hydraulic gradient. Storage for Cougar Ridge is provided by twin standpipes, which operate on the 431- foot gradient.

2.5.7 Lakemont Operating Area

The Lakemont Operating Area, also known as the Lakemont Triangle, is located at the northwest corner of the service area, and is located between the Montreux Operating Area and the I-90 corridor. Lakemont is served by an intertie with Bellevue’s water system, the Lake Hills 520 Zone. The 12-inch water main that serves the Lakemont Operating Area is not metered; Bellevue bills wheeling charges from the domestic meter readings the City provides. Lakemont does not have its own BPS or reservoir, but relies on Bellevue's 520 Zone reservoir to provide service and storage at the proper operating pressures. The Lakemont Operating Area is not subdivided into additional pressure zones.

2.5.8 Montreux Operating Area

The Montreux Operating Area is also located in the northwest corner of the City. The operating area is bounded by the Cougar Ridge Operating Area to the east, the Lakemont Operating Area to the west and the Valley Operating Area to the north and the future Cougar Mountain Operating Area to the south. The southern boundary of Montreux sits adjacent to Bellevue's water service boundary, the 1150 Zone.

Montreux is served from a 12-inch water main from Bellevue's 1150 Zone through a 6-inch master meter. Montreux does not require a dedicated BPS, relying instead on the 1,150-foot hydraulic gradient supply from Bellevue, and storage from Bellevue's Cougar Mountain 1150 reservoir. The Montreux Operating Area consists of seven individual pressure zones, more than any other operating area. PRV 19 reduces Bellevue's 1,150-foot gradient to the 1,005-foot level of Montreux's second highest pressure zone. PRVs 18, 17, 16, 15, and 14 systematically reduce the 1,005-foot gradient to levels required for the five additional pressure zones, 835-foot, 744-foot, 617-foot, 502-foot, and 364-foot gradients, respectively.

2.5.9 Talus Shrangri-La Operating Area

The Talus Shangri-La Operating Area (aka Talus 616) is located in the Talus development, in Issaquah's southern city limits. The operating area is bounded by the Valley Operating Area to the south and east, by the Talus Foothills Operating Area to the west, and to the south by Issaquah city limits. The Talus Shangri-La Operating Area operates at the 616- foot hydraulic gradient. It is not subdivided into additional pressure zones.

The Talus Shangri-La Operating Area is supplied by the Talus I & II BPSs. The stations have been constructed as two identical, attached stations; each station functioning as a separate, and therefore redundant, pump station. Each station is capable of boosting water from either the City's groundwater source (297 Zone) or the Regional Water main (520 Zone), to the Shangri-La Reservoir at the 616 gradient line. The Shangri-La Reservoir is supplied by the Talus II BPSs and rests at a hydraulic gradient of 616 feet.

2.5.10 Talus Foothills Operating Area

The Talus Mountain View Operating Area currently rests at the 752-foot gradient. However, changes to the Shangri-La BPS and Mountain View Reservoir planned for 2018 will change the hydraulic grade of the operating area to the 912-foot gradient and create two pressure zones (Talus Foothills 912 and Foothills Talus 752) also located in the Talus development. At this time, the operating area would be referred to at the Talus Foothills Operating Area instead of Talus Mountain View. The operating area is bound by the Talus Shangri-La Operating Area to the east, the Valley Operating Area and the future Cougar Mountain Operating Area to the north, and the retail service area boundary to the west. The Talus Foothills Operating Area is supplied by the Shangri-La BPS and Cascade BPS, drawing water from the Shangri-La Operating Area and pumping to the Foothills 912 Reservoir. Once planned modifications to the operating are completed, PRVs will allow flow from the Talus 912 Zone to supply the Talus 752 Zone.

2.5.11 Issaquah Highlands Central Park Operating Area

The Issaquah Highlands Central Park Operating Area is located in the eastern portion of the City's service area, at the southern end of the Sammamish plateau. The operating area is bounded by the Valley Operating Area to the west, I-90 corridor to the south, the Issaquah Highlands Summit Operating Area to the east and SPW boundary to the north and northeast. The hydraulic gradient of the Issaquah Highlands Central Park Operating Area is 742 feet. The Issaquah Highlands Central Park Reservoir is supplied by the Holly Street BPSs No. 1 and No. 2. The Holly Street BPSs are designed to work in parallel with the Holly Street No. 1 BPS as lead (flowing first) providing a flow range up to 800 gpm while the Holly Street No. 2 BPS will provide flows up to 2,200 gpm if additional flows are needed beyond the Holly Street No. 1 BPS's capacity. Both pumping stations are able to convey water from the Valley 297 Zone or from the 520 Zone (24-inch Regional Water main) to the Central Park reservoir.

2.5.12 Issaquah Highlands Summit Operating Area

The Issaquah Highlands Summit Operating Area rests at the 1,234-foot gradient, northeast of the Issaquah Highlands Central Park Operating Area. The Summit Zone is bound to the south by I-90, to the east by King County Rural Boundary and the Grand Ridge Operating Area, and to the north by SPW boundary. The 1234 Zone is the highest hydraulic gradient in the City's retail service area and is fed by twin, steel reservoirs. In addition, there is PRV 22 which serves a 1000 Zone from the 1234 Zone and a 615 Zone is fed by the 1000 Zone through PRV 23. PRV 21 is normally closed, but if opened, is able to feed the main 742 Zone from the 1234 Zone.

The Issaquah Highlands Summit Operating Area is supplied by water from the Central Park BPS located adjacent to the Central Park Reservoir. The water is pumped to the Summit Reservoir through a dedicated water supply line located on the hillside east of the Central Park BPS and the urban growth boundary.

2.5.13 Grand Ridge Operating Area

Added to the system since the 2012 water system plan update, the Grand Ridge Operating Area rests at the 1,337-foot gradient, east of the Issaquah Highlands Summit Operating Area. The area is supplied by the Grand Ridge BPS which takes water from the Issaquah Highlands Summit 1337 Pressure Zone. Storage for the area is provided by the Grand Ridge Reservoir.

2.5.14 South Cove Operating Area

Added to the system in January 2017, the South Cove Operating Area rests at the 271-foot gradient. The area is bounded by the Lakemont and Montreux Operating Areas to the south, Lake Sammamish to the north and east, and the Bellevue water service area to the west. The operating area is supplied by an intertie with Bellevue's 270 Zone.

The operating area is divided into two pressure zones. The South Cove 271 Zone is directly supplied by the Bellevue 270 Zone through an intertie whose storage is provided by the Bellevue 520 Zone and consists of the higher elevation parcels within the South Cove area. The South Cove 271 Zone makes up less than 10% of the operating area's water demand. A PRV station is located along Lake Sammamish Parkway which serves the South Cove 260 Zone (at a 260-foot gradient) from the South Cove 271 Zone. Storage for the South Cove 260 Zone is provided by the South Cove Reservoir. The PRV station was installed in 2017 to create the South Cove 271 Zone which historically operated at a 260-foot gradient and had low pressure issues, and to allow the South Cove Reservoir to be fully controlled by the City instead of having to rely on Bellevue. This allows the City to operate the PRV station, which has SCADA and solenoid controlled PRVs, to be actuated in a manner to promote increased turnover of the South Cove Reservoir to maintain water quality.

2.6 Distribution Piping

The existing distribution system contains approximately 135 miles of pipeline ranging in size from 4- to 16-inches in diameter, with the largest categories being 8- and 12-inch. Table 2-3 summarizes approximate pipe lengths for each type of material. Over 87 percent of the pipe is ductile iron. About eight percent of the system's pipe is cast iron. Cast iron pipe that has been examined recently was found to be mortar lined. PVC/HDPE and asbestos cement pipe comprise the rest of the system piping.

Table 2-3. Distribution Pipe Materials and Length

Diameter (inches)	PVC / HDPE	Asbestos Cement	Cast Iron	Ductile Iron	Total (ft)	Total (miles)	% of Total
4	2,300	260	20	29,100	31,680	6.0	4.4%
6	0	9,590	9,910	42,250	61,750	11.7	8.6%
8	1,030	19,430	12,770	290,360	323,590	61.3	45.3%
10	230	0	6,130	23,920	30,280	5.7	4.2%
12	630	3,320	24,480	225,380	253,810	48.1	35.5%
16	0	0	0	13,370	13,370	2.5	1.9%
Total (ft)	4,190	32,600	53,310	624,380	714,480	135.3	100.0%
Total (miles)	0.8	6.2	10.1	118.3	135.3		
Percent	0.6%	4.6%	7.5%	87.4%	100.0%		

Source: City GIS

Note: Table includes pipes with diameters of 4-inch and larger. Smaller diameter lines are typically associated with cleanouts and PRV stations. Table does not include the CWA regional transmission main.

2.7 Pressure Reducing Valve Stations

The City has 30 PRV stations within its distribution system. PRV 2 was bypassed in October, 2000 when the Mt. Hood Operating Area was re-zoned. The station is still installed and could be put back into service in an emergency situation. PRV 26, the Talus intertie with the regional main, is currently not used. The Montreux Operating Area has the largest number of PRV stations with six PRVs. PRV stations are located at the zone boundaries, supplying water from upper to lower gradient pressure zones at the appropriate (reduced) pressures. Each PRV station contains large and small-demand pressure reducing valves, in parallel. The smaller valve is typically set to maintain a higher downstream pressure gradient than the larger valve, and therefore opens first, supplying lower flows to the lower zone. The larger valve is set to maintain a lower downstream gradient and opens only during periods of high demand and lower pressure in the lower gradient zone.

PRV stations are set to provide either continuous supply to the lower gradient zone, or to open only during emergency situations when the pressure drops significantly. Of the 30 PRV stations, 16 operate continuously, 13 are normally closed and used for emergency operation, and PRV 2 has been bypassed. Normally-closed PRVs are typically set 5-10 psi below the normal operating pressure of the downstream operating areas.

Eleven PRV stations are configured with a pressure sustaining feature. The PRV stations equipped with this feature supply water to lower gradient zones in the same manner as regular PRV stations, but also monitor pressure on the higher gradient side of the station, closing if this pressure drops to a predetermined level. Pressure sustaining-equipped stations will close if a failure in the lower pressure zone occurs, such as a water main break, preventing excessive water from discharging from the upper to lower pressure zone. Table 2-4 summarizes existing PRV station data for the City's distribution system.

Table 2-4. Pressure Reducing Valve Stations

PRV Station No.	Location	Size (inches)			Upstream Pressure Zone	Downstream Pressure Zone	Normally Closed	Continuous	Pressure Sustaining
		Main	Large Valve	Small Valve					
1	345 Mine Hill Rd. SW	12	10	3	Mt. Hood 480	Valley 297	●		
2	735 Wildwood Blvd. SW	12	10	3	Mt. Hood 480	Valley 297	*Not in Service*		
3	925 Wildwood Blvd. SW	6	6	2	Wildwood 625	Mt. Hood 480	●		
4	415 SW Forest Drive	6	6	2	Wildwood 625	Mt. Hood 480	●		
5	1065 SW Ridgewood Circle	8	6	2	Highwood 715	Wildwood 625	●		
6	1130 SW Ridgewood Place	8	6	1.5	Highwood 920	Highwood 715		●	
7	1045 Greenwood Blvd. SW	6	4	1.25	Highwood 920	Highwood 782	●		
8	740 Highwood Drive SW	8	8	2	Highwood 920	Highwood 782		●	●
9	770 Mt. Park Blvd. SW	8	6	2	Highwood 782	Wildwood 625	●		
10	530 Mt. Park Blvd. SW	8	6	2	Wildwood 625	Wildwood 588		●	●
11	170 Mt. Olympus Dr. SW	8	6	2	Highwood 782	Highwood 677		●	●
12	170 Mt. Olympus Dr. NW	8	6	2	Highwood 677	Mt. Hood 480	●		●
13	720 12th Ave. NW	10	8	3	Mt. Hood 480	Valley 297	●		
14	Village Park Dr. NW #1	8	8	3	Montreux 502	Montreux 364		●	●
15	Village Park Dr. NW #2	8	8	3	Montreux 617	Montreux 502		●	●
16	Village Park Dr. NW #3	8	8	3	Montreux 744	Montreux 617		●	●
17	Village Park Dr. NW #4	8	8	3	Montreux 835	Montreux 744		●	●
18	Village Park Dr. NW #5	8	8	3	Montreux 1005	Montreux 835		●	●
19	SE 60th St at 182nd Ave	12	8	3	Bellevue 1150	Montreux 1005		●	●
20	1495 Sycamore Dr. SE	12	6	2	Mt. Hood 480	Valley 297	●		
21	1901 Park Dr NE	12	8	3	Summit 1234	Central Park 742	●		

Table 2-4. Pressure Reducing Valve Stations

PRV Station No.	Location	Size (inches)			Upstream Pressure Zone	Downstream Pressure Zone	Normally Closed	Continuous	Pressure Sustaining
		Main	Large Valve	Small Valve					
22	1693 30th Ave NE	8	8	4	Summit 1234	Summit 1000		●	
23	NE Natalie Way	8	8	4	Summit 1000	Summit 742		●	
24	1700 Pine View Dr	8	6	2	Cougar Ridge 431	Valley 297		●	●
25	NW Sammamish Pkwy at 221st	12	8	3	SPW 297	Valley 297	●		
26	NW Newport Way at SR900	12	6	6	Cascade 520	Valley 297	●		
27	Westside Reservoir	-	-	-	Talus Shangri-La 616	Valley 297	●		
28	Shangri-La BPS	12	8	1.5	Talus 912	Talus 752	●		
29	Talus Dr and Shangri-La Way	12	6	-	Talus 912 (Cascade BPS Discharge)	Talus 752	●		
30	Sammamish Pkwy at 188th Ave SE	12	8	3	South Cove 271	South Cove 260		●	●

2.8 Booster Pump Stations

The City operates 14 BPSs (when Talus I and II are counted separately, though housed in the same building) that transfer water from the Valley Operating Area to higher elevation pressure zones. These BPSs operate collectively by moving water from one operating area to the next-higher operating area. Each BPS is configured for connection to a portable, auxiliary power supply in the event of a power outage. BPS data is summarized in Table 2-5. The table identifies pump station location, typical flow rates, operating pressures, supply and discharge operating areas, and other pertinent information. The BPSs are also shown schematically in Figure 2-4.

The City's BPSs contain two or more pumps that operate on an alternating basis. Pumps are turned on and off automatically based on water levels in the reservoirs that the pumps feed. Reservoirs are identified in the Telemetry Control Parameter column of Table 2-5. As the water level drops in a reservoir to a determined level, the first (lead) pump for the associated BPS will start. If the water level continues to drop, reaching a second determined level, the second (lag) pump will start. As water level in the reservoir subsequently rises to a determined water level, the lead pump will shut off. As the water level continues to rise to the determined height for maximum water level height, the lag pump will then turn off. Lead and lag pumps alternate for every pumping cycle.

Table 2-5. Booster Pump Stations

Name / Year of Installation or Last Upgrade	Location	Total Capacity (gpm)	Upstream Pressure Zone	Downstream Pressure Zone	Controlled By
Mountain Park 2015	W. Sunset Way	3,000	Valley 297	Mt. Hood 480	Mt. Hood Reservoir level
12th Avenue NW 2002	12th Ave. NW	1,450	Valley 297	Mt. Hood 480	Mt. Hood Reservoir level
Mt. Hood 2016	Mt. Hood Dr SW	825	Mt. Hood 480	Wildwood 625	Wildwood Reservoir level
Wildwood 2008	Highwood Dr SW	900	Wildwood 625	Highwood 920	Highwood Reservoir level
Forest Rim 2018 (planned replacement)	Mt. Side Dr SW	400 [c]	Highwood 920	Forest Rim 1178	Forest Rim Reservoir level
Terra II 1993	NW Pine Cone Dr	1,000	Valley 297	Cougar Ridge 431	Cougar Ridge Reservoir level
Holly Street I [a] 2001	1st Ave NE	1,025	Valley 297 or Regional	Central Park 742	Central Park Reservoir level
Holly Street II [a] 2001	1st Ave NE	4,200	Valley 297 or Regional	Central Park 742	Central Park Reservoir level
Talus I/II [a] 2002	NW Talus Dr	1,890	Valley 297 or Regional	Talus Shangri-La 616	Shangri-La Reservoir level
Shangri-La 2018 (planned upgrade)	Shangri- La Way NW	500	Talus 616	Talus 912 [b]	Foothills Reservoir level
Central Park 2002	IH Central Park	3,020	Central Park 742	Summit 1234	Summit Reservoir level
Cascade 2018 (planned construction)	Shangri-La Way NW	780	Talus 616	Talus 912	Foothills Reservoir level
Grand Ridge 2015	Grand Ridge Dr	538	Grand Ridge 1337	Summit 1234	Grand Ridge Reservoir

[a] Pump stations which may be operated from the RM (Regional Main) and/or City Wells.

[b] Shangri-La BPS currently pumps to the Talus 752 Zone. However, modifications to the Talus Mountain View Operation Area (planned for 2018) will have the Shangri-La BPS pumping to the Talus 912 Zone.

[c] Planned replacement is anticipated as having two 200 gpm pumps.

2.8.1 Mountain Park Booster Pump Station

The Mountain Park BPS provides the initial step in moving water from the Valley Operating Area to the higher-elevation operating areas on Squak Mountain. The Mountain Park and 12th Avenue pump stations discharge into a transmission main to the Mt. Hood reservoir and ultimately supply all the water used by the Mt. Hood, Wildwood, Highwood and Forest Rim Operating Areas. The original Mountain Park BPS was constructed in 1970. In 2015 a new Mountain Park BPS was constructed due to the original pump station reaching the end of its useful life and its susceptibility to damage from seismic events. The new pump station also has an increased pumping capacity that resolves a deficiency in fire flow storage in the Mt. Hood Operating Area by supplementing fire suppression storage in the Mt. Hood Reservoir. The new pump station has three 1,000 gpm pumps and an on-site generator for backup power. The pump station is controlled by the water level in the Mt. Hood Reservoir.

2.8.2 12th Avenue NW Booster Pump Station

The 12th Avenue Pump Station located at 721 12th Avenue NW in the Tibbetts Valley Park upper parking lot, together with Mountain Park, provides the initial step in moving water from the Valley to the higher elevation operating areas on Squak Mountain. As stated previously, the 12th Avenue and Mountain Park pump stations discharge to a transmission main to the Mt. Hood reservoir and ultimately supply all the water used by the Mt. Hood, Wildwood, Highwood and Forest Rim Operating Areas.

The underground concrete building houses two 700-gpm pumps and was constructed in 2002 and brought on line in January 2003. There is also electrical transfer switchgear that supports an auxiliary generator power supply.

2.8.3 Mt. Hood Booster Pump Station

The Mt. Hood BPS supplies water to the Wildwood Operating Area from the Mt. Hood 480 Zone. The pump station discharges into a transmission main from the Mt. Hood Operating Area to the Wildwood Operating Area. The pump station is a concrete masonry structure built in 1977 and located adjacent to the Mt. Hood reservoir. The pump station houses two 450-gpm pumps. There is also electrical transfer switchgear that supports an auxiliary generator power supply. Pump operation is controlled by the water level in the Wildwood reservoir. The pumps and building are in good condition.

2.8.4 Wildwood Booster Pump Station

The Wildwood BPS pumps from the Wildwood to the Highwood Operating Area. The pump station, located adjacent to the Wildwood reservoir was originally constructed in 1967 and completely rebuilt in 2009. The pump station discharges to the Highwood distribution system and the Highwood 920 twin reservoirs. The new pump station is a reinforced concrete building housing two 450 gpm pumps. Pump operation is controlled by water level in the Highwood Reservoir. There is also electrical transfer switchgear that supports an auxiliary generator power supply.

2.8.5 Forest Rim Booster Pump Station

The Forest Rim BPS pumps to the Forest Rim Operating Area. The pump house, constructed in 1979, is concrete masonry with a wood frame roof. The pump station currently houses two 300 gpm pumps. There is also electrical transfer switchgear for an auxiliary generator power supply. However, the pump station is nearing the end of its design lifespan and is also susceptible to seismic damage. A new, replacement pump station is planned for construction in 2018.

2.8.6 Terra II Booster Pump Station

The Terra II BPS supplies water to the Cougar Ridge Operating Area, from the Valley Operating Area. The pump station discharges to the Cougar Ridge operating zone. The pump station is a partially buried, reinforced concrete structure built in 1985. The pump station houses two 500 gpm. This is the only BPS with an on-site emergency power generator.

Pump operation is controlled by the water level in the twin standpipes. The partially-buried wall and roof need sealing to eliminate water intrusion, but the pumps and building are in good condition.

2.8.7 Holly Street Booster Pump Stations I & II

The Holly Street BPSs supply water to the Central Park Operating Area from the Valley 297 Zone, or the Regional Water Supply at the 520-foot gradient line. The pump stations discharge into a transmission main located in Park Drive NE, to the Central Park Operating Area. Holly St BPS I provides flow in the range of approximately 0 gpm to 800 gpm while the Holly Street BPS II provides flow in the range of approximately 900 gpm to 2200 gpm. Both stations are located in the southwest portion of Issaquah Highlands, next to the Public Works Operations Maintenance Facility. Both are concrete masonry buildings.

Holly Street BPS I was constructed in 1997, has two 60-hp vertical turbine canned booster pumps and motors, and each rated for 350 gpm. Holly Street BPS I also contains return bypass piping with a pressure sustaining/pressure regulating control valve to allow flow into the 297 Zone from the 742 Zone, under emergency conditions. The pump station also has a 250-gallon bladder surge tank as well as electrical transfer switchgear which support an auxiliary generator power supply. Holly Street BPS I is the lead station for pumping to the 742 Zone.

Holly Street BPS II was constructed in 2002, also to boost potable water to the Central Park 742 Zone. This station was designed and installed to work in parallel with the Holly Street BPS I. Because neither Holly Street BPSs have Variable Frequency Drive (VFD) equipment, the pumps at Holly Street BPS II were sized to augment the maximum flow from Holly Street BPS I in order to minimize water surge at startup from Holly Street BPS II's 1,000-gpm pumps. Holly Street BPS II has three 200-hp vertical turbine motors and pumps, rated for 1,000 gpm at 450 feet of head. Holly Street BPS II has a 250-gallon (discharge) and a 500-gallon (suction) bladder surge tank, and electrical transfer switchgear that supports an auxiliary generator power supply.

2.8.8 Central Park Booster Pump Station

Central Park BPS is located adjacent to the Central Park 742 Zone reservoir in Issaquah Highlands. Water is pumped from the Central Park Operating Area to the Summit area through a transmission main located on the hillside east of Central Park BPS and the urban growth boundary. Central Park BPS was built in 2002. The building is a concrete masonry structure, located immediately adjacent to the reservoir. Also installed is electrical transfer switchgear that supports an auxiliary generator power supply.

Central Park BPS houses two, 250-hp vertical turbine motors, each capable of pumping 1,750 gpm. There is a 500-gallon bladder surge tank connected to the pump discharge manifold on the south side of the pump building, installed to reduce impacts on the water system related to surges in pressure caused by daily operations and unexpected pump failures. Also part of the station infrastructure is a connection from the 1234 Zone piping to the 1000 pressure zone on the north side of the station building. This connection consists of two pressure reducing/back pressure sustaining valves, each valve (one three-inch and one eight-inch) is on a separate line with isolation valves, and each can be operated independently. These valves are set to maintain pressure in the 1000 Zone

If necessary, water can be bypassed to the 742 Zone through two control valves on the northwest side of the building connected to the 1000 Zone piping. These valves are both angle-type valves; one a three-inch pressure relief/backpressure sustaining valve and the other is a six-inch valve with backpressure sustaining features. The three-inch valve is for relieving excess pressure in the 1000 Zone. The six-inch valve is intended for circulating water between zones during low demands and transferring water from the Summit 1250 Zone to the 742 Zone during emergency conditions.

2.8.9 Talus Booster Pump Stations 1 & 2

Talus BPSs I & II are redundant booster stations, equal in all aspects. The two stations reside in one building and are separated by a common wall. Constructed in 2002, the stations are located in the southeastern portion of the Talus Development on Talus Drive. Each station pump is capable of boosting water from either the 297-groundwater pressure zone or the 520 Zone Regional Water Supply main, up to the Shangri-La 616 Zone reservoir and distribution system. Each station has the capability of running separately, including the ability to operate separately while on an auxiliary power generator.

Each station is supplied with two 1,770-rpm (maximum nominal speed), 60-hp, variable speed vertical turbine pumps, each pump having a capacity of 550-gpm. Each VFD has the capability of operating between 800 and 1,770 rpm.

Each station is supplied with surge control valves on the suction side of each of the pumps and at either end of the discharge manifold. These surge anticipator valves are pilot-actuated, hydraulically operated, diaphragm-type globe valves. Their function is to limit line surges on pump start and stop, especially during instances of power failure when pumps stop abruptly. Also, a pressure reducing valve is provided on the pump suction manifold between BPS I and BPS II and acts to maintain a constant downstream pressure regardless of varying upstream pressure. The pressure reducing valve is intended to provide an emergency intertie between the 297 Zone and the 520 Zone and, except in emergency situations, will remain inactive.

2.8.10 Shangri-La Booster Pump Station

The Shangri-La BPS, constructed in 2002, is located adjacent to the Shangri-La 616 Zone reservoir. The station boosts water from the Shangri-La Operating Area to the Foothills Operating Area. The station consists of four 60-hp vertical turbine canned suction pumps, individually able to deliver 250 gpm. The Shangri-La BPS differs from The City's other BPSs in that the on-site concrete building houses only the electrical and telemetry equipment; the motor/pump assemblies are submersible and located outside in two vaults.

Modifications to the pump station are planned for completion in 2018 to support the creation of a new Talus 912 Pressure Zone. One pair of pumps boosts water from the Talus 616 Pressure Zone to the Talus 752 Zone. A second pair of pumps takes some of the flow coming off the first pair of pumps and further boosts the water from the Talus 752 Pressure Zone to the Talus 912 Pressure Zone.

2.8.11 Cascade Booster Pump Station

The Cascade BPS, constructed in 2016, is located on the boundary between the Talus 616 and 752 Pressure Zones. The station boosts water from the Shangri-La Operating Area (Talus 616) to the

Foothills Operating Area (Talus 912). The station consists of four 25-hp vertical in-line centrifugal pumps, individually able to deliver 195 gpm.

2.8.12 Grand Ridge Booster Pump Station

The Grand Ridge BPS is located on Grand Ridge Drive and boosts water from the Issaquah Highlands Summit 1234 Pressure Zone into the Grand Ridge 1337 Pressure Zone. The pump station was original constructed in 2008 but was revised in 2015. The current pump station has two 269 gpm pumps and operates off of the Grand Ridge Reservoir.

2.9 Storage Facilities

Storage facilities are provided at 13 locations throughout the City's water system. Total reservoir volume is approximately 13.8 MG. All City reservoirs are covered, ground-level reservoirs or standpipes. There are no elevated tanks within the system. The City utilizes a supervisory control and data acquisition (SCADA) system for reservoir telemetry. Table 2-6 summarizes the physical characteristics of the City's storage facilities.

Table 2-6. Storage Facilities

Reservoir Name	Location	Volume (MG)	Overflow EL (ft)	Base EL (ft)	Pressure Zones Served	Material
Valley Operating Area Storage						
Cemetery A	695 W. Sunset	0.50	298.7	267.5	Valley 297	Welded Steel
Cemetery B	695 W. Sunset	0.50	298.7	267.5	Valley 297	Welded Steel
Westside	James Bush Road	2.00	300.0	280.5	Valley 297	Welded Steel
Cougar Ridge Operating Area Storage						
Cougar Ridge A	SE 56th St.	0.13	431.0	353.3	Cougar Ridge 430	Welded steel
Cougar Ridge B	SE 56th St.	0.13	431.0	353.3	Cougar Ridge 430	Welded steel
Mt. Hood Operating Area Storage						
Mt. Hood	Mt Hood Dr. SW	0.42	483.5	464.5	Mt. Hood 480	Cast-in-place concrete
Wildwood Operating Area Storage						
Wildwood	Highwood Dr. SW	0.25	634.5	621.0	Wildwood 625, 588	Concrete
Highwood Operating Area Storage						
Highwood A	Idylwood Dr. SW	0.25	953.0	924	Highwood 920, 782, 715, 677	Welded steel
Highwood B	Idylwood Dr. SW	0.25	953.0	924	Highwood 920, 782, 715, 677	Welded steel

Table 2-6. Storage Facilities

Reservoir Name	Location	Volume (MG)	Overflow EL (ft)	Base EL (ft)	Pressure Zones Served	Material
Forest Rim Operating Area Storage						
Forest Rim A	Squak Mt. Loop SW	0.15	1,201	1,091	Forest Rim 1178	Welded steel
Forest Rim B	Squak Mt. Loop SW	0.15	1,201	1,091	Forest Rim 1178	Welded steel
Issaquah Highlands Central Park Operating Area Storage						
Central Park A	NE Park Dr.	1.60	742.1	716.8	Central Park 742	Integral cast-in-place concrete
Central Park B	NE Park Dr.	1.60	742.1	716.8	Central Park 742	Integral cast-in-place concrete
Issaquah Highlands Summit Operating Area Storage						
Summit A	Harrison Dr	1.06	1234.5	1191.7	Summit 1234, 1000	Welded steel
Summit A	Harrison Dr	1.06	1234.5	1191.7	Summit 1234, 742	Welded steel
Talus Shangri-La Operating Area Storage						
Shagri-La A (inner ring)	Shangri La Way NW	1.09	616.0	586	Talus 616	Two cell concentric ring, Concrete
Shagri-La B (outer ring)	Shangri La Way NW	1.09	616.0	586	Talus 616	Two cell concentric ring, Concrete
Talus Foothills Operating Area Storage						
Foothills A [a]	Shangri La Way NW	0.18	913	864.5	Talus 912	Welded Steel
Foothills B [a]	Shangri La Way NW	0.18	913	864.5	Talus 912	Welded Steel
Grand Ridge Operating Area Storage						
Grand Ridge A	270th Pl SE	0.10	1,237	1,294	Grand Ridge 1337	Welded Steel
Grand Ridge B	270th Pl SE	0.10	1,237	1,294	Grand Ridge 1337	Welded Steel
South Cove Operating Area Storage						
South Cove	Newport Way NW	1.03	259.5	224.5	South Cove 260	Prestressed Concrete

[a] The Mountain View Reservoir currently has an overflow elevation of 752.3 ft. A new reservoir (Foothills Reservoir) will be built in the Talus Foothills Operating Area in 2018 with an overflow of 913 ft to support a new Talus 912 Zone. At that time, the existing reservoir will be decommissioned and removed.

Chapter 3. Policies and Criteria

The City has established policies and criteria that govern various facets of water utility operations. These policies guide the development and financing of water system infrastructure and provide guidance to achieve the desired level of service in a geographically and environmentally challenging area. While the City has discretion in setting performance, design and standards criteria for its water system, the criteria must meet or exceed the minimum standards for public water systems set by DOH through WAC Chapter 246-290. Used together, the criteria provide the desired level of service to water utility customers.

The policies described in this chapter are established by the City to provide the water utility a framework for design, operation and ongoing maintenance. The policies seek to provide uniform treatment to all utility customers and to provide information to current water system customers, as well as those considering service from the City. It should be noted these policies are limited to those items related to the water system's design and operation. The City has other policies (and criteria) related to land use, development and finance that may indirectly influence the water system in addition to the requirements related specifically to the water system.

The City's design criteria, also described in this chapter, provide the details needed to implement the policies established for the water system. They focus on design parameters and other details that have been developed to establish consistency and to ensure that adequate levels of service are provided throughout the system. These criteria and standards relate to storage volume, distribution piping, pressure zones, pump stations, and system operation. The criteria also provide the planning process with a measuring tool to identify any areas of the existing system that need to be improved to achieve the desired level of customer service. Additionally, other City publications such as the Water Standards, document the design standards and procedures for extension of the water system. These Water Standards are periodically updated. The current version is included in Appendix E.

The Issaquah Comprehensive Plan (ICP) establishes the following goals for utilities and public services that apply to the water utility system:

- Goal U-A: Facilitate the development of all utilities and public services at the appropriate levels of service to accommodate Issaquah's planned growth and ensure reliability of utilities and public services.
- Goal U-B: Integrate utility plans and the Land Use Element to ensure that utility services are available to support development that is consistent with anticipated growth targets.
- Goal U-C: Provide for the City's immediate and long term water needs by: protecting the aquifer and recharge areas; providing reliable levels of water service for domestic use and fire protection; and ensuring future water supplies by implementing conservation and reuse measures and pursuing additional sources.

The Comprehensive Plan also establishes the following goals of the Capital Facilities Plan that apply to the water utility system:

- Goal CF-B: Level of service standards shall be used to evaluate adequate public facilities and services and projected needs based upon the future population estimates in Table L-3 Population and Household Projection of the Land Use Element.

In order to achieve the above goals, the City has implemented the following policies and criteria.

3.1 Service Area Extensions

3.1.1 Retail Service Area

Under the 2003 Municipal Water Law (RCW43.20.260), the City is required to plan for and provide direct retail water service to all properties within the City's retail service area as defined by the adopted Water System Plan Update, Chapter 2 (ICP Policy U-C1 Service Area).

Discussion

The City will meet its "Duty To Serve" under the 2003 Municipal Water Law (RCW43.20.260) by providing direct service to all properties within its retail service area boundaries in a timely and reasonable manner. Prior to receiving water service, provision of water service within the City's retail service area is conditioned on the developer/development providing water system infrastructure improvements that conform to the City's criteria and standards. These improvements include capital improvements as defined and/or identified in the City's Water System Plan. The City also has identified expansion of its retail service area for areas within the City's current corporate limits and its potential annexation areas.

3.1.2 Service Area Extension

The City will provide water system service extensions if:

1. The development is within the City's retail service area, and;
2. The development is consistent with all adopted codes and policies, including the provisions of Issaquah Municipal Code (IMC) 13.88 as now exists or as hereafter may be amended, and;
3. A parcel meets special circumstances as defined with this Water Comprehensive Plan and codes, and;
4. The service extension shall have no cost to the City except as it chooses to participate to benefit the overall system.

Discussion

Property owners shall be responsible for extending the water system through the full extent of their property as needed for service to the development and along their frontage as required by the City Code. The City may extend the water system to ensure orderly system development, in which case, the property owner shall be responsible for an equitable share of extension costs at the time of connection to the City's system. Water system extensions shall be constructed to current City criteria and standards and shall be sized to serve the level of development anticipated in the ICP.

3.1.3 Adequate Water System

The City will require the provision of adequate water system facilities by the applicable public or existing privately-owned community provider as a condition for approval for all development applications. (ICP Policy U-C3 Adequate Water System, consistent with ICP policy CF-C2)

Discussion

In addition to the City's groundwater sources, the City has a Water Supply Agreement with Cascade Water Alliance. Later chapters in this water system plan which discuss the forecasted demands (Chapter 5) and compares that to supply sources (Chapter 7) indicate that there is adequate capacity for future development within the City based on current groundwater sources and Water Supply Agreements.

3.1.4 Satellite Systems

The City will provide direct service to water system customers within the City service area. If no other options are deemed feasible by the City, the City may enter into a satellite system written agreement with the satellite water system owner.

Discussion

The City requires connection to its water utility or other Class A utility serving within the City limits and does not allow the use of exempt wells to meet development requirements. The decision to allow a satellite system to provide service within the City service area is solely the City's. The conditions for City operation of a satellite system are determined on a case-by-case basis.

3.1.5 Water Certification Availability

Certificates of Water Availability shall only be issued if the Public Works Director determines that there is potential for a significant shortage of available water supply therefore necessitating the need to track supply quantities available to serve customers within the service area.

Discussion

Certificates of Water Availability will be required from the water purveyor prior to Land Use approval for development projects located within City of Issaquah Corporate Limits where water utility service is provided by another water purveyor instead of the City.

3.2 Customer Service

3.2.1 Service Ownership

The City requires ownership by the City of the service line leading from the main to the meter, the meter itself, and the meter box. The property owner shall own and maintain the service line and other facilities such as pressure reducing valves, pumps, or cross-connection devices beyond the meter. Where onsite fire hydrants are required, the City shall own the mains and hydrants. Easements shall be acquired for the mains and hydrants including that portion located on public property. Fire suppression system lines on private property are the responsibility of the property owner beginning at the first valve off of the City's water main.

Discussion

Meters are used by the City to monitor and charge for water consumption. The meter provides a logical separation between City and private ownership and responsibility, with exception of Fire Suppression Lines.

3.2.2 Service Pressure and Flow

The City's goal is to provide domestic water to all utility customers in sufficient quantity to meet demand conditions at a pressure that meets or exceeds minimum applicable regulations, except during emergency conditions. For new developments, a higher-pressure requirement is imposed as detailed in the Water System Planning and Design, Section 3.7.

Discussion

The City's goal is to provide a system pressure of at least 40 psi to meet normal residential needs based on ADD flow conditions. The pressure shall be measured at the second floor elevation with the storage at the lowest Equalizing Volume elevation.

At minimum, the City will meet WAC 246-290-230(5), which states, "New public water systems or additions to existing systems shall be designed with the capacity to deliver the design peak hour demand (PHD) quantity of water at 30 psi (210 kPa) under PHD flow conditions measured at all existing and proposed service water meters or along property lines adjacent to mains if no meter exists, and under the condition where all equalizing storage has been depleted."

During a fire, system pressures must be maintained above the minimum of 20 psi at all points throughout the distribution system consistent with DOH regulations described in WAC 246-290-230(6) during maximum day demand (MDD) conditions.

3.2.3 Water Quality Responsibility

The City will provide water that meets all state and federal water quality standards to all water system customers.

Discussion

The City will continue to take the actions necessary to ensure that water quality standards are met. This includes monitoring compliance with all Department of Health and Federal Environmental Protection Agency water quality regulations applicable to drinking water systems.

3.3 System Reliability

3.3.1 Service Reliability

The City will invest the resources necessary to construct, maintain and rehabilitate water system infrastructure and equipment to ensure that customers are provided consistent, reliable service in accordance with WAC 246-290-420. In addition, all new developments shall meet the requirements set forth in WSP Policy 3.7.3, Water System Planning and Design (ICP Policy U-C4).

Discussion

Wherever possible, the City should anticipate system interruptions by designing and operating the system to minimize the impact of such interruptions on customers. The City establishes reliability criteria for water system components as an element of its water system criteria. The goal is to have 100 percent operational redundancy in the system. Fore new development, the water system infrastructure, storage facilities, water mains, hydrants, pump stations, and related facilities, shall be designed to meet all applicable codes, criteria, and standards in force at the time of permit issuance.

Implementing Criteria:

General System Reliability. The City continues to evaluate the water system to ensure redundancy wherever possible. For all new developments and future CIP projects, a thorough evaluation of the affected water system will be completed. Site specific measures will be taken to assist in making the system more reliable, in the event of an emergency. Evaluation of City facilities will consider potential power outage situations. The evaluation will consider such events as windstorms, snow, and ice that interrupts power distribution within the City, minimizing the probability of a water supply outage for customers during these times.

Mechanical Equipment. For mechanical equipment that might be occasionally out-of-service for repair or maintenance, the City has redundant components and equipment in place, significantly limiting interruption of service.

Supply System. Supply reliability is critical to provide an uninterrupted level of service to City utility customers. Malfunction of any of several supply components could cause a temporary limitation of the supply capacity.

Storage Reservoirs. The goal is to provide redundant storage reservoirs to help maximum the probability of uninterrupted service to City utility customers.

Booster Pump Stations. Primary malfunctions that would limit pump station capacity to boost water are pump failure, motor failures and electrical power failure. Redundancy criteria, described in Water System Design Criteria section 3.7, significantly limit the time required to correct any problems with pumps, motors, or electrical gear.

Distribution System. The most common malfunction of the distribution system is pipeline failure. Under such conditions it is important to have a distribution network that allows water to be re-routed to affected customers. Therefore, providing system looping and redundant pipeline connections are important distribution system criteria. Providing redundant connections between service zones is particularly important. Distribution system reliability also depends upon maintaining an inventory of pipe and pipe repair materials on hand for the most commonly used pipe materials and sizes.

3.4 Fire Protection

3.4.1 Fire Fighting

The City will provide, maintain, and improve the infrastructure system necessary to supply water for fire fighting purposes to all utility customers (ICP Policy U-C5). The water supply shall meet or exceed all minimum applicable standards and regulations for fire flow, storage and peak-use periods, except under emergency conditions created by major disasters such as earthquake or flood.

Discussion

Additions to the water system shall be designed to meet all applicable codes at the time of permit issuance. The City maintains, repairs, or replaces mains, lines, hydrants and valves as necessary to provide adequate water service to all customers.

3.4.2 Fire Flow Requirements

Fire flow requirements for building-specific fire flow and the municipal water system level of service must both be provided as a condition of development and as a condition of any extension of the City water system (consistent with ICP Policy CF-B1).

Discussion

The level of service standard has two parts to the water system fire flow requirements within the City service area. The first is a fire flow requirement established as a building-specific fire flow based on building use and materials of construction. The second is the system-wide fire flow criteria for single-family or other uses as established in this Water System Plan Update for the entire water system.

Implementing Criteria

Fire Flow Rates. The quantity or flow rate of water available for fire fighting establishes an important level of service for a water system. The system-wide fire flow rates are summarized in Table 3-2.

Fire flow rates are to be provided during MDD at the pressure requirements as discussed in Water System Design, Section 3.7. The fire flow rates are required for the water line that is providing the fire protection supply to hydrants immediately adjacent to or surrounding a facility, and is therefore not required from an individual hydrant.

For new construction, fire flow demands shall not cause water velocity in any main to exceed seven (7) feet per second. These criteria apply to all improvement projects within the water system, including those necessary to provide service to new customers or to serve modified property uses or occupancies by existing customers.

Pipe diameters that would be acceptable to use for a development without prior approval from the public works department to achieve a desired fire flow and velocity of 7 ft/s are summarized in Table 3-1.

Table 3-1. Minimum Pipe Sizes without Public Works Department Approval

Development Type Served	Minimum Pipe Size
Single Family Residential via Looped Water Main	8-inch
Multi-family Residential, Commercial, and Non-Residential via Looped Water Main	12-inch

The fire flow criteria described above are minimum requirements. Fire flows in excess of the above criteria may be required to provide fire protection for specific types of building construction and use. If it is determined that higher fire flows are required, the higher flow will be the criterion used to determine the required system improvements.

Fire Flow Duration. The time or duration for which a fire flow is to be provided is dependent on the required fire flow rates. Minimum fire flow durations are defined in the International Fire Code Appendix B. Any fire flow requirement 3,500 gpm or greater shall have duration of four hours. The City has adopted criteria for fire flow durations, summarized in Table 3-2.

Table 3-2. Fire Flow Duration Criteria

Type of Construction	Minimum Fire Flow (gpm) [a]	Duration (hours)	Volume (gal)
Single-family residential (8-foot property line setback)	1,000	2	120,000
Single-family residential (No setback requirement)	1,500	2	180,000
Multi-family, commercial and non-residential	3,500	4	840,000

[a] The design fire flow rate may be increased to provide fire protection for specific types of building construction and use.

3.4.3 Fire Flow Improvements

The minimum fire flow requirements for existing structures and uses or occupancies are those that were required at the time of permit issuance, as determined by the City. For existing water system infrastructure upgrades, the City may allow pump stations to supplement fire flow volume provided by storage if the additional pumping does not degrade other pressure zones.

Discussion

Based on the discretion of the public works department, minor improvements to existing structures are not required to upgrade the water system to meet current fire flow and development standards unless the addition increases the fire flow requirements significantly. Similarly, the City shall not be obligated to upgrade the existing water system infrastructure to meet current fire flow criteria and standards as a result of structural improvements that do not change the use or occupancy of the building. The City may allow fire flow volume from storage to be supplemented by pump stations on existing systems provided the additional pumping does not degrade other pressure zones. New development and redevelopment, including changes in use or occupancy, shall meet the full fire flow and storage requirements without pumping. The developer shall be responsible for installing all necessary facilities needed to serve their property and for complying with the City's development, design and construction standards in order to meet these requirements.

3.4.4 Fire Flow Improvement Program

As resources become available, the City shall make water system improvements to meet current fire flow criteria. When prioritizing and scheduling system improvements, the City Capital Facilities planning procedures will consider the severity of deficiencies. The City seeks opportunities to make improvements in conjunction with other City projects to achieve economic efficiency. The City will only correct existing velocity deficiencies when other deficiencies exist. (ICP Policy U-C6 Fire Flow Improvement Program)

3.5 Emergency Management Plan

3.5.1 Emergency Management Plan

Regularly update the Emergency Management Plan as part of the City's operations program. The Plan will assist in verifying that adequate emergency provisions are in place to provide for and organize responses to the most likely kinds of emergencies that may endanger public health and safety or operation of the water system, and will focus on problems created by major disasters, such as earthquakes, wind storms, or floods.

Discussion

It is key that the City respond to the needs of customers during a time of crisis. The focus of the emergency management plan is to address problems created by major disasters, such as a wind storms or other disasters that may cause system interruption. The continued availability of potable water during a disaster is critical.

3.5.2 Water Supply Shortage Response

Take reasonable actions to increase the probability that the essential needs of its customers are met and that available supplies are equitably distributed to all affected customers in the event of a water-supply shortage caused by a drought or supply interruption. (ICP Policy U-C7 Water Supply Shortage Response)

Discussion

This provision requires that the necessary steps be taken by the City and its customers to reduce the demand if an unforeseen water supply shortage occurs. The City will take the necessary steps to increase the likelihood that all essential uses are met, such as customers with medical problems that require water service. Additionally, the City will continue to monitor well aquifer levels in an effort to prepare for and manage water shortage emergencies.

3.6 Coordination / Cooperation with Other Utilities

3.6.1 Regional Participation

The City will coordinate and cooperate with other adjacent and regional water purveyors and state regulators to identify, protect and maintain a reliable and sustainable water supply. Withdrawals from the aquifer greater than the sustainable yield for water supply needed to meet concurrency requirements shall not be allowed as per water rights law.

Discussion

Regional planning efforts promote compatible planning that provides the framework for coordinated water system improvement and new sources of supply to be anticipated and planned on a timely basis. Additionally, the City will continue to coordinate and cooperate with other adjacent and regional water purveyors and state regulators to identify, protect and maintain the sustainable yield of the aquifer and other water supplies.

3.6.2 Assumptions of Other Jurisdictions

The City shall assume (or use some other method) municipal and special purpose district water utilities to provide direct retail service within the City of Issaquah Corporate Limits. Work cooperatively with neighboring municipalities and special purpose districts during the assumption of special purpose districts within the City limits or potential annexation areas (ICP Policy U-C9).

Discussion

Where possible, per City policy, the City prefers to be the provider of direct retail service within the City of Issaquah Corporate Limits. The City prefers to accomplish these assumptions through cooperative, collaborative, and cost-efficient measures. The City's intent is to provide direct retail service to all citizens within the City Limits. However, the City has an Interlocal Agreement (ILA) with Sammamish Plateau Water that precludes, until 2026, a unilateral assumption of that portion of Sammamish Plateau Water within the City Limits.

3.6.3 Emergency Interties

Support emergency interties with adjacent water systems where there is a benefit to the water systems.

Discussion

Interties increase reliability of water systems during emergencies and other unusual operating circumstances.

3.6.4 Water Supply Interties

The City will consider water supply interties on a case-by-case basis.

Discussion

Water supply interties should provide clear benefits to Issaquah and should not compromise the City's ability to serve its existing customers or its future water supply needs.

3.6.5 Wheeling Water

Allow wheeling water (transporting water through the City water system for the benefit of another municipality or special-purpose district) if the proposal supports regional water supply needs, is consistent with adopted City policies, and is at no cost to the City except as it chooses to participate to benefit the overall system.

Discussion

This enables the City to provide resources to another purveyor that may request water supply assistance. Wheeling water through the City water system to neighboring purveyors supports the City's goals of regional water supply coordination and cooperation.

3.6.6 Mutual Aid Agreement

Participate in a mutual aid agreement. Coordinate and cooperate with adjacent and regional water purveyors and state regulators to identify, protect and maintain a reliable and sustainable water supply. (ICP Policy U-C8)

Discussion

A mutual aid agreement allows agencies to share with each other to provide services. This enables agencies to provide resources to agencies that request assistance to handle a disaster or emergency.

3.7 Water System Design

3.7.1 Water Supply Source

Pursue a combination of strategies to extend existing water supplies and obtain additional new sources of water supply needed to meet the needs of the City that balance the environmental and economic cost. (ICP Policy U-C10 Water Supply Source)

Implementing Criteria

Future Water Supply. Future water demands will be estimated using existing water usage patterns and projected future populations provided by the City and Puget Sound Regional Planning Council. Effects of future water conservation, based upon current conservation levels considered to be current standards of the industry will be factored into projecting future water needs.

System Water Supply Requirements. The City should have sufficient water supply facilities available to meet the Maximum Daily Demand (MDD) from supply facilities under normal conditions. Because any of the City's supply facilities might fail as a result of a rare or catastrophic emergency event, system-wide supply facilities should be able to meet MDD with the single largest supply facility out of service.

Operating Areas - Water Supply Requirements. The City should provide sufficient supply facility capacity to meet MDD as a minimum for the operating areas of the water system. In case of an emergency, demand management will be implemented to meet supply requirements.

Environmental Stewardship. City water supplies should avoid or reduce, minimize and mitigate regional and local environmental impacts to water quality, habitat and natural resources. Additional consideration shall be made for endangered or threatened species and be based upon scientific data, studies and adaptive management practices and principles.

Climate. Evaluate and incorporate changing climate conditions into long-term system water supply plans. In addition, the utility should implement measures to assess and reduce its climate impact as a result of system operations.

3.7.2 Water Supply Separation

The Council should consider and evaluate blending of water supplies to meet the demands projected within the City based on future demand forecasts. Approval by the City Council of the blending of water supplies for these purposes shall be considered, if beneficial. The City may blend water supplies in emergency situations if needed to stay in compliance with State law or when supply is needed.

Discussion

The Issaquah Highlands are currently supplied only with CWA water but can be delivered a blend of groundwater/CWA water, and Talus (currently supplied by groundwater) can be switched between the two supplies. Blended water may be considered to meet applicable water quality criteria and, to meet future demands, potentially the entire water system will eventually be served with blended water.

3.7.3 Water System Planning and Design

Plan and design water system facilities that can deliver continuous, safe water supply to meet customer demands under normal conditions, consistent with all applicable federal, state and local regulations. If the water system facilities are required to be installed or up-graded as a result of a developer's impact, this shall be accomplished at the developer's expense. (Consistent with ICP Policy CF-C4)

Discussion

New water system facilities that are required as a result of developer extension shall be planned and designed to meet the City's current policies and criteria for the water system. If upgrading existing water system facilities to meet current regulation creates a substantial financial or environmental impact to the City, the City may choose to allow a deviation for the improvement. However, the deviation shall still remain in compliance with State law.

Implementing Criteria:

Storage Volume. Storage facilities are required for each operating area serving single-family residential and non-single-family service areas. In single-family residential service areas, a maximum of three cascading pressure zones can be served by a storage facility[1]. Each operating area shall be provided with at least two separate storage facilities, where the volumes of each facility are divided nearly equally. The total volumes of these facilities when added together shall equal at least the total storage requirement for the operating area.

System storage volume requirements consist of four separate components: operational, equalizing, fire flow and standby/emergency volumes. Storage facilities may also contain a "dead storage" component of volume that is unused primarily due to the configuration of the facility. Storage facilities shall be sized to accommodate the four required volume components.

For new construction or redevelopment of storage facilities, fire flow and standby/emergency storage shall be stacked.

- <u>Operational Volume</u>
  Operational Volume is the volume of distribution storage associated with source or booster pump cycling times under normal operating conditions (WAC 246-290-010). The Operational Volume is included within the Equalizing Volume, and is large enough to allow normal cycling of source or booster pumps.

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[1] The Montreux Operating Area has seven cascading pressure zones; however, supply is from an intertie with Bellevue and no City of Issaquah storage facilities are within the operating area.

- Equalizing Volume
  Equalizing Volume is the total volume required to satisfy peak system demands that exceed the capacity of the supply and pumping facilities. Equalizing Volume requirements are greatest on the day of maximum demand and must be located at an elevation that provides the minimum pressure requirements to all customers served by the tank.
- Fire Flow Volume
  Washington Administrative Code (WAC 246-290-230) and Department of Health (DOH) design criteria require that new or expanding water systems have the storage capacity to provide design fire flows during MDD conditions. Fire flow volume requirements are computed based on the size and duration of the largest required fire flow within the service area of the storage facility. For multi-family, commercial and high-risk areas, fire flow volume is calculated based on a minimum 3,500 gpm fire flow for a four-hour duration (i.e., 840,000 gallons). Fire flow volume requirements are calculated based on 1,000 gpm fire flow for two hours (i.e. 120,000 gallons) for single-family detached dwellings in residential zones requiring a minimum eight (8) foot property line setback or 1,500 gpm fire flow for a two-hour duration (i.e. 180,000 gallons) in residential zones allowing a property line setback of less than eight (8) feet. This criterion is a minimum requirement for defining and providing an important level of service for the water system. Fire flow volumes in excess of the above criteria may be required to provide fire protection for specific types of building construction and use.
- Emergency and Standby Volume
  Emergency and standby volume is required to supply reasonable system demands during a foreseeable system emergency or outage, such as major pipeline failure, power outage, valve failure, or another system outage. Emergency and reserve volume requirements are dependent upon system demand, duration of the system outage and available remaining supply capacity to the system at the time of the emergency. These volumes can be shared within the valley operating areas supplied by the City wells and regional supply line. The City has established a minimum standby storage volume criterion of 200 gallons per equivalent residential connection (consistent with DOH guidelines).

Pressure and Velocity. The function of the distribution system is to convey water to customers at adequate service pressures for typical system demand conditions. The distribution system should also provide fire flows with adequate minimum residual pressures throughout the service area. During a fire, system pressures must be maintained above the minimum of 20 psi at all points throughout the distribution system consistent with DOH regulations described in WAC 246-290-230(6).

The City has established a criterion for all new facilities to provide a minimum pressure within the distribution system of 40 psi at the second floor elevation, with the storage at the lowest Equalizing Volume elevation. For existing facilities, the City should meet WAC minimum requirements. WAC 246-290-230(5) states, “New public water systems or additions to existing systems shall be designed with the capacity to deliver the design peak hour demand (PHD) quantity of water at 30 psi (210 kPa) under PHD flow conditions measured at all existing and proposed service water meters or along property lines adjacent to mains if no meter exists, and under the condition where all equalizing storage has been depleted.”

The City’s goal is that maximum static pressure at the lowest elevation should not exceed 100 psi. Recognizing the complexity involved in restricting maximum pressures to 100 psi in developments located on the surrounding hills, a maximum pressure in the water mains of up to 150 psi is permitted. Individual PRVs are required on service lines where pressures exceed 80 psi. Pipe velocities should not exceed seven feet per second during MDD plus fire flow conditions for new construction. In addition, the distributions system must also meet conditions in WAC 246-290-230 - Distribution Systems.

Materials and Configuration. The minimum size for new distribution piping shall be 8-inch diameter for single family residential and 12-inch diameter for all other uses. All new developments shall be looped.. Pipe material for new pipes shall be cement mortar lined ductile iron, class 52, minimum, however if exceptional conditions warrant other materials may be considered on a case by case basis. Pipe sizes larger than stated above may be required for major transmission and distribution lines, or to meet fire flow requirements. Fire hydrants shall be spaced per City Code (currently every 500 feet along distribution system mains in residential areas and every 300 feet in all other areas). Closer fire hydrant spacing may be required to serve specific developments.

Where the distribution system is divided into separate hydraulic operating areas (zones), each zone should have multiple supplies, i.e. booster pumps or PRVs, to reduce the likelihood that failure of a single component interrupts service. Two supplies feed into each new operating area and looping of distribution systems in all zones shall be required. Where practical, additional benefits for two supply feeds include improved water quality, redundancy, reliability and increased fire flow capacity. Water system looping will often require off-site improvements to developing areas. Off-site improvements required to meet a development's needs will be done at the developer's expense.

Pump Stations. Redundancy in pump station facilities should be required to supply water to new operating areas, where feasible. The pump stations shall not be located within the same hazard area. A minimum of two pumps are required at each pump station to provide flexibility and system redundancy. The pumps in booster stations shall be sized so that the station can meet MDD conditions with the largest pump out of service.

To increase emergency reliability, each pump station should be supplied with on-site standby power or have the capability to connect to a portable power supply. This capability allows some emergency supply capacity, even during a general power outage.

Pump Stations that are required to provide a portion fire flow should be supplied with on-site standby power capable of providing 125 percent of the station needs with an automatic startup/transfer feature to supply power during a general power outage. Pump systems that provide a portion of the fire flow must also be capable of maintaining a minimum pressure of 20 psi at all points where required in a pressure zone while supplying fire flow under the MDD condition as described in WAC 246-290-230(6).

Unaccounted for Water. Through a regular program of leak detection, meter testing, metering of mainline flushing and other appropriate measures, the City should maintain levels of unaccounted for water at less than 10 percent (WAC 246-290-820).

3.7.4 Sustainability in Design and Operations

Design and operate water system facilities to minimize total life cycle costs of facility construction, operation and maintenance. Design and operations of facilities should also minimize negative environmental impacts, energy use, and associated air and climate emissions. The water utility should conduct audits of the water system and identify, prioritize and implement associated improvements which meet sustainability objectives. Regularly monitor energy use and consider renewable energy systems where appropriate.

3.8 Environmental Stewardship

3.8.1 Environmental Protection

Develop, implement, monitor and adapt: programs, procedures and practices to improve and protect water quality, habitat, the aquifer and other environmental values in areas where the City must construct, operate, maintain, or replace water system infrastructure. (ICP Policy U-C11 Environmental Protection)

Discussion

The programs, procedures and practices developed should include consideration of best management practices and adaptive management concepts. Consideration shall be given to threatened or endangered species identified under the provisions of the National Endangered Species Act or other applicable environmental legislation.

3.8.2 Wellhead Protection Implementation

Implement the Wellhead Protection Program to protect the City's groundwater supplies from degradation (based on the Wellhead Protection Plan (Golder Associates)) and coordinate implementation with SPW. These methods shall include but not be limited to:

1. Regulation of land use;
2. Public outreach and education;
3. Construction of capital facilities in appropriate areas, which will aid in protection of the wellheads.

Discussion

Minimize the risk to, and protect the aquifer recharge quantity and quality through the regulation of types of land use allowed and mitigation required on the uses within the identified recharge areas and wellhead capture zones.

3.8.3 Facility Abandonment

Facility abandonment will be conducted in a safe and environmentally sound manner, consistent with all applicable federal, state and local regulations at the time of abandonment. Abandoning water system infrastructure shall not leave remaining, unutilized, pressurized sections since this may become a source of leaks, breaks, and/or contamination.

Discussion

The City may no longer need the use of particular water system infrastructure. For example, when asbestos cement (AC) pipe is no longer in use, the pipe should be abandoned in-place whenever feasible to minimize the release of asbestos fibers. Metal or iron water mains should also be abandoned in-place to significantly lessen the financial burden of capital costs to the City. The City shall document all abandoned infrastructure in perpetuity.

3.9 Water Conservation

3.9.1 Water Conservation

Continue implementation and enhance the current conservation program that addresses the need for adequate supply and protection of water resources. Water conservation measures shall be consistent with, and strive to exceed, all local, state, and federal laws and regulations, as well as any contractual obligations of any water purchase agreements that Issaquah is party to.

Discussion

Efforts may include, but are not limited to: public education, water reuse and reclamation, encouraging use of native and/or drought resistant landscaping, water conservation kit distribution, conservation rate structures, leak detection and monitoring, and utility financed retrofits and rebates.

3.9.2 Water Right Usage

Limit the amount of well production such that it does not exceed the City's water rights. The City shall monitor water consumption to ensure that there is sufficient warning of production that approaches water right constraints.

Discussion

As the demand for water increases, the available well production will approach the limits of the water rights. The City will monitor the well production data and increased consumption to determine that the annual (Qa) and instantaneous (Qi) capacities are not exceeded.

3.9.3 Sustainable Yield

Identify, protect and maintain the sustainable yield of the aquifer in order to avoid permanently affecting water tables in a manner which would damage related ecosystems.

3.9.4 Aquifer Recharge

Protect the aquifer recharge quantity and quality through the regulation of types of land use allowed, encouraging low impact development, and mitigation required on the uses within the identified recharge areas and wellhead capture zones. (ICP Policy U-C12 Aquifer Recharge)

3.9.5 Sustainable Development and Best Available Conservation Technology

Design, develop, construct, operate and maintain new development in such a manner as to encourage for efficient and non-wasteful use of water that incorporates the best available proven water conservation technology prevailing at the time of development.

Discussion

Examples of best available conservation technology include dual flush low-volume toilets, evapotranspiration-based irrigation scheduling, retention or replacement of native soils or soils of equivalent quality in landscaped areas. These examples demonstrate effective conservation strategies and are consistent with and support the City's environmental stewardship policies and practices.

3.9.6 Reclaimed Water Use

Issaquah will support Cascade Water Alliance's (CWA) study of reclaimed water use opportunities and will work with CWA and others to identify potential reclaimed water demand.

3.10 Financial Policies

3.10.1 Fiscal Stewardship

Manage the water utility funds and resources in a manner that is in compliance with applicable laws, regulations and city financial policies.

Discussion

Responsible fiscal stewardship requires on-going monitoring of revenues and expenses in order to make prudent business decisions and report to city officials, as needed, regarding the status of utility operations.

3.10.2 Self-Sufficient Funding

Maintain the water utility fund as a self-supporting enterprise fund. General Fund revenues may also be used to fund water utility programs if specifically budgeted.

Discussion

Water utility revenues come primarily from customer charges and are dependent upon established rates. The Revised Code of Washington requires that utility funds be used only for stated utility purposes. Although General Fund revenues can be used to fund water utility programs, the City has a general policy of not doing so. The City budgeting process should include a balanced and controlled annual water utility budget. This requires careful preparation of expense and revenue projections that may be reviewed by City management, the public, and the City Council before approval of any rate increases.

3.10.3 Capital Improvement Program Level

Fund the Capital Improvement Program (CIP) at a level necessary to ensure system integrity over the long term to allow the water system to function well both today and into the future.

Discussion

To the extent that the annual level of the CIP investment can be managed by scheduling and scoping of projects, the funding should be provided at a fairly uniform level in order to avoid significant fluctuations and to reduce the impact on the operating budget and related rate increases. The City should maintain reasonable level of reserves in the CIP fund in order to manage cash flow variation caused by the nature of the cost and timing of projects. Utility sold revenue bonds, Utility Local Improvement Districts (ULID), State Public Works Trust Fund loans, any available grants, general facility charge (GFC), and developer contributions should be considered for funding the future Capital Improvement Program projects.

Implementation Criteria

CIP Prioritization. Projects identified in the Capital Improvement Program shall initially be prioritized within the Water System Plan Update and will be updated annually during the City budget process. The highest priority shall be given to improvements that benefit all customer classes and that protect health and safety. Projects that provide increased fire protection within the water system shall be given a high priority, such as pipeline improvements and booster pump station upgrades. Prioritization should also be given for projects that increase the system reliability by providing redundancy.

3.10.4 Capital Facilities Plan

Adopt and update a Capital Facilities Plan as required by the Washington State Growth Management Act.

Discussion

The Plan should include capital projects for the water utility for a ten-year period. Projects should be financially constrained and broken-down into capacity and non-capacity projects.

3.10.5 Development Charge Cost Recovery

Maintain fees and charges to recover City costs related to development. General Facility Charges (GFCs) shall be charged to all new development properties to reimburse the utility for historical and future asset investments that provide overall benefits to the City's water system.

Discussion

Fees shall be established by City Ordinance for routine services such as meter installation. Developers shall pay the fees and charges in effect at the time that the permits are picked up. All new connections to the water system shall be charged a service installation fee to recover the costs of connecting to the water line and setting a service meter. These rates should be reviewed periodically to ensure that the cost methodology is appropriate and adjusted as needed.

In addition, when another developer or the City has, at its own expense, constructed new water mains, new customers connecting to that portion of the water main shall pay appropriate fees and charges for connection. The City may enter into a recovery contract with the party constructing the improvement to recover appropriate costs from the new customers when they connect to the system.

GFCs will also be used to charge new developments. In general, the purpose of a GFC is to bring equity between existing customers and new (future) customers connecting to the City's water system. An important nexus for a GFC is the connection between the anticipated future growth on the system and the needed facilities required to accommodate that growth. The GFC is based on the planning and engineering design criteria of the City's water system, the value of the existing assets, and past financing of the system. By establishing cost-based water GFCs, the City attempts to have "growth pay for growth" and existing water customers should then be sheltered from the financial impacts of growth. Additionally, the GFC should be implemented according to the capacity requirement or impact each new development has on the water system. This way, the GFC is related to the impact the customer places on the water system, and to the benefit they derive from the service provided.

3.10.6 Water Rate Levels

Establish Water Rate levels, to be reviewed annually, that cover utility expenses, infrastructure improvements, encourage conservation and maintain reserves.

Discussion

Water rates are set as low as possible while providing for the on-going promotion of conservation, maintenance of reserves, operations, maintenance, repair, replacement, capital improvement, and administration of the water utility. The City's budget process should be used as an opportunity to increase or reduce current rate levels. The final budget should include the total authorized expenses and establish the amount of revenue and /or use of reserves required for balancing the expenses.

3.10.7 Frequency of Water Rate Adjustments

Evaluate Water Rate levels, to be reviewed as part of the water utility budgeting process.

Discussion

This will ensure that budgeted expenses are reflected in current rates.

3.10.8 Water Rate Structure

Support water conservation and wise use of water resources objectives. The water rate structure shall allocate costs equitably among customers.

Discussion

Rates should be established on a "Cost of Service" basis so that each customer class pays its prorata share of the total costs needed to operate and maintain the water utility. A Cost of Service and Rate Study should be performed periodically to ensure on-going equity between customer classes.

3.10.9 Operational Fiscal Responsibility

Operate the water system in compliance with applicable laws and regulations in a manner that minimizes operational costs to the City.

Discussion

Operating the system with a fiscal perspective will minimize excessive costs.

3.10.10 Rate Assistance Programs

Provide rate assistance programs for low-income senior citizens and other low-income customers. (City Code section 13.92)

Discussion

Provides water-rate assistance for senior citizens and low-income citizens who meet the qualifications and requirements.

3.10.11 Water Financial Reserve Levels

Maintain water utility cash balances to serve as a contingency reserve fund.

Discussion

The working capital component should be based on no less than 75 days of the current year's average budgeted operation and maintenance expenses.

3.10.12 Infrastructure Asset Management

Pursue an asset management approach to evaluating and managing capital investments and infrastructure operations and maintenance in order to reduce overall total life cycle costs of the water system while meeting level of service standards, environmental and sustainability goals and regulatory requirements.

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Chapter 4. Planning Considerations

This chapter reviews the planning considerations that are pertinent to the City's water system. Included are descriptions of the City's land use, population and estimates of households and commercial development within the service area.

4.1 Land Use

Land-use designations and regulations provide an important factor in determining future water requirements. Land use determines the area available for various types of development including both single-family residential (SFR) and multi-family residential (MFR) development, as well as commercial and other types of land use that provide the economic base necessary to support residential development.

The City is geographically located within a valley, surrounded by mountains and plateaus, and bordered on the northeast by Lake Sammamish. Over the last several decades, Issaquah has evolved from a small, relatively independent community supported primarily by coal mining, agriculture, forest products and fisheries, to a suburban area made up of a series of communities and neighborhoods. Each of these communities is unique. Currently most of Issaquah's new developments are in the Issaquah Highlands and Talus urban communities, which are a mix of commercial, retail, SFR, and MFR zoning. However, new growth is planned for the Lakeside area and substantial redevelopment within the Central Issaquah area—particularly within the Regional Growth Center.

Existing business services for Issaquah area residents include office parks, hotels and motels; limited light industry including retail, financial, insurance, and real estate services; and transportation, communication, and utility services. Darigold operates a dairy processing plant located in downtown Issaquah.

Land use within Issaquah is governed by the City of Issaquah Comprehensive Plan. The plan addresses current land use within the City and proposed future land use. The City has seven land-use areas: conservancy, community facilities, low density residential, MFR, retail, commercial/office, and urban village. The largest categories by area are low-density residential and urban village. Figure 4-1 illustrates the City's land use map.

All zoning within the city limits conforms to the Issaquah Comprehensive Plan (ICP), as required by the Growth Management Act. Figure 4-2 is the City zoning map. It should be noted that for unincorporated areas of King County, there might be minor discrepancies between the ICP and King County's Comprehensive Plan. King County planning takes precedence in these unincorporated areas and should be referenced for specific zoning and planning information until the area in question is annexed to the City.

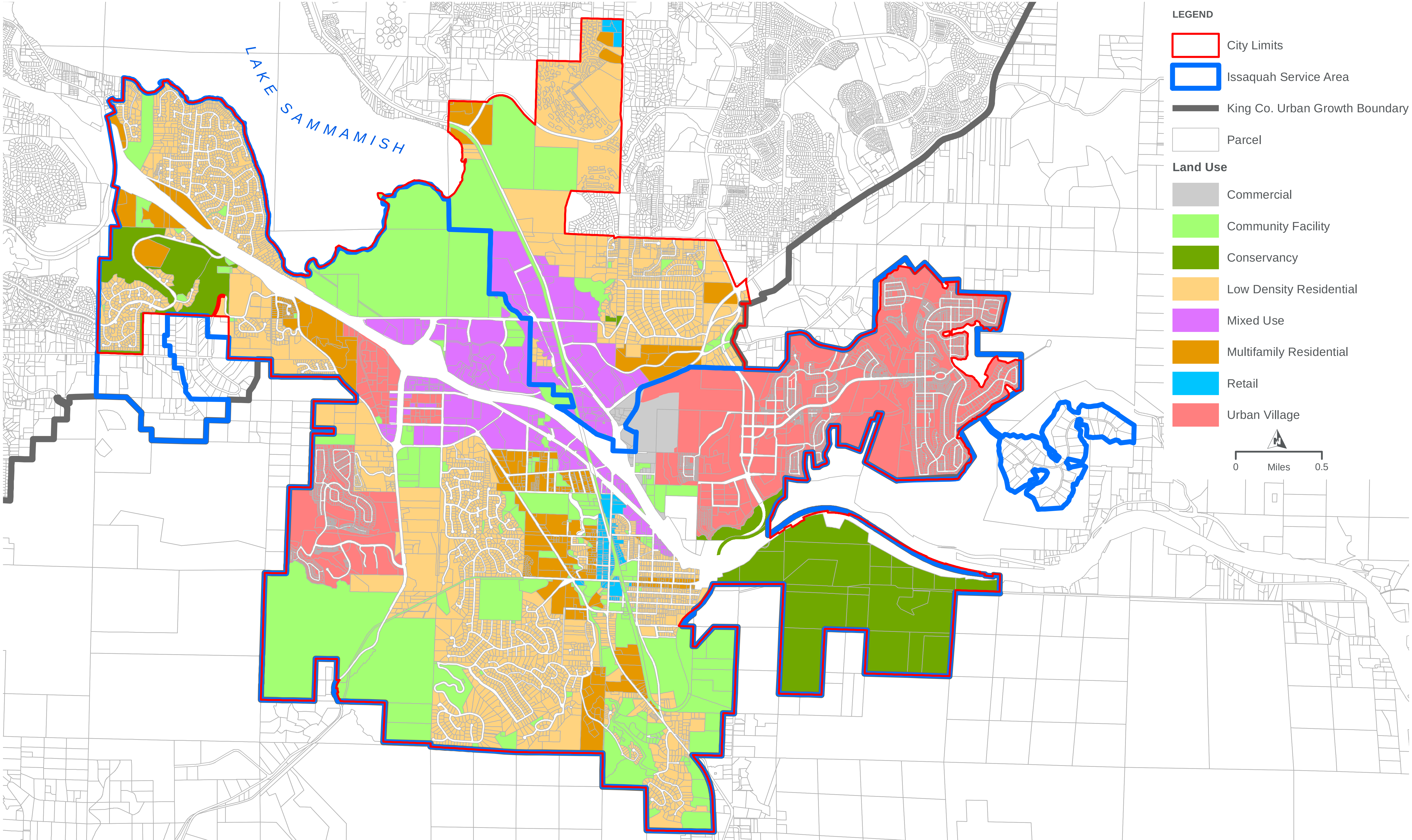
Table 4-1 represents the zoning districts for each land-use designation. The "intent statements" for each land-use designation are in Table L-3 of the ICP Land Use Element. Consult the City's official zoning map for specific zoning boundary information and the Table of Permitted Land Uses in the City's Land Use Code for allowable uses within the zoning districts.

Future land-use patterns for the service area are expected to correspond to existing uses. The Comprehensive Land Use Plan was developed based on the projected needs of the City for 20 years. The King County Comprehensive Plan used similar approaches for the unincorporated portion of the City's service area. This consistency of approach is encouraged by the Washington State Growth Management Act and should result in predictable and stable land uses over longer planning periods.

While it is likely the City will annex much of the unincorporated lands within the City's potential annexation areas (PAAs) in the service area, over the next 20 years annexation should have little impact on current land-use patterns. The ICP recognizes the need for a variety of residential land uses and anticipates that areas to be annexed to the City will remain primarily residential as defined in existing county planning documents.

Table 4-1. Comprehensive Plan Land Use and Zoning

Comprehensive Plan Land-Use Designations	Comparable Zoning Districts	
Conservancy	TP-NRCA C-REC	Tradition Plateau-Natural Resource Conservation Area Conservancy Recreation
Community Facilities	CF-OS CF-R CF-F	Community Facilities – Open Space Community Facilities – Recreation Community Facilities - Facilities
Low Density Residential	C-RES SF-E SF-S SF-SL SF-D	Conservancy Residential – 1du/5acs Single-family Estates – 1.24 du/ac Single-family Suburban – 4.5 du/ac Single-family Small Lot – 7.26 du/ac Single-family Duplex – 7.26 du/ac
Multi-family Residential	MF-M MUR MF-H VR	Multi-family Medium – 14.52 du/ac Mixed Use Residential – 14.52 du/ac Multi-family High – 29 du/ac Village Residential
Retail	PO CBD	Professional Office Cultural and Business District
Mixed Use	UC MU DR	Urban Core Mixed Use Destination Retail
Commercial	IC M	Intensive Commercial Mineral Resources
Urban Village	UV UV-EV UV-R UV-L	Urban Village – the UV designation recognizes that master planning of larger parcels provides the opportunity for mixed-use development, clustering, phasing of infrastructure, and protection of critical areas. The UV designation is implemented by the adoption of a UV development agreement and UV zoning by City Council. A UV development agreement has been adopted for Issaquah Highlands and Talus.



HDR CITY OF ISSAQUAH WASHINGTON

LAND USE MAP

FIGURE 4-1

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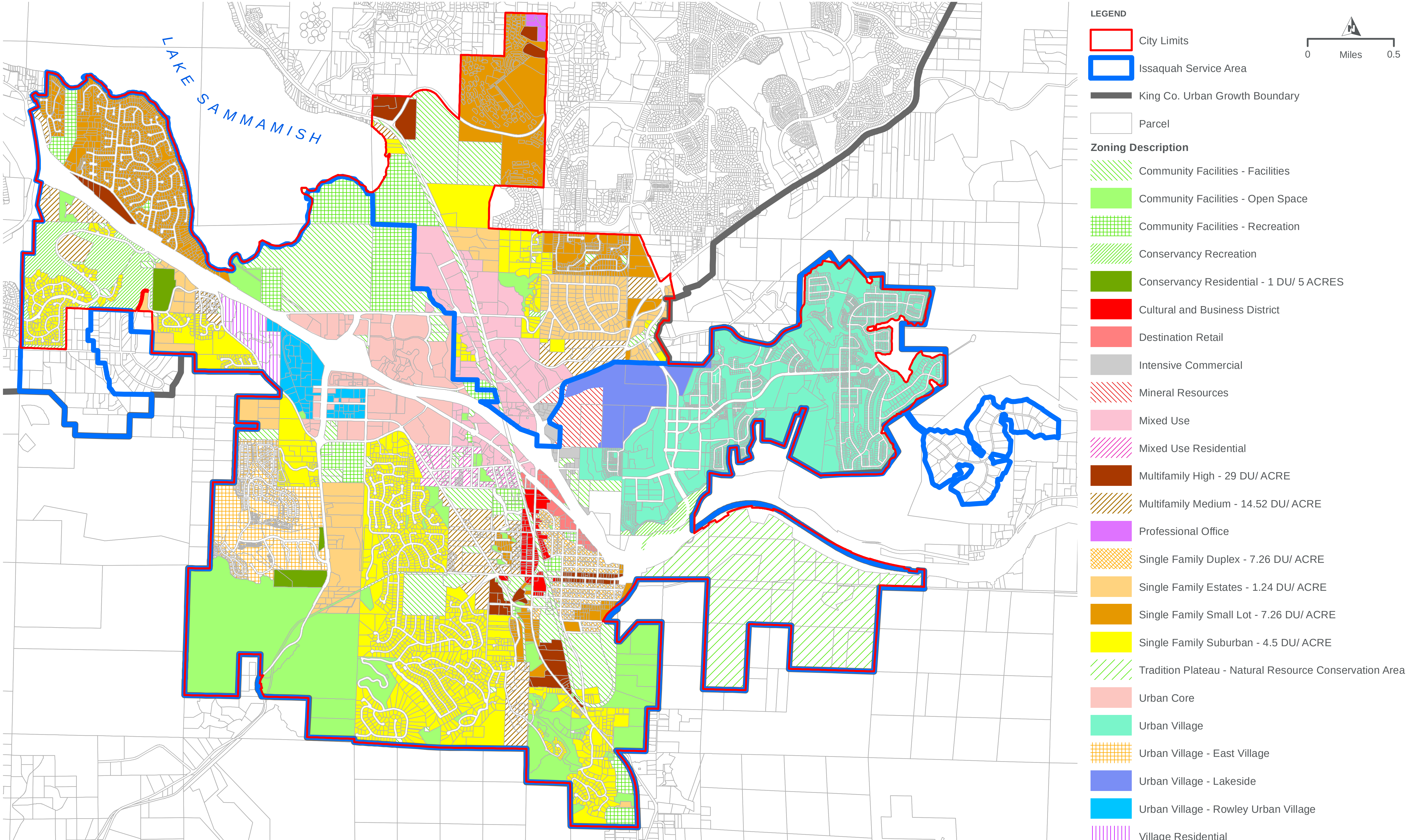

HDR CITY OF ISSAQUAH WASHINGTON

ZONING MAP

FIGURE 4-2

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4.2 Population

The City was incorporated in 1892 and has evolved from a small, relatively independent community to a suburban community with an economy that is integrated with the economy of the Seattle metropolitan area.

Table 4-2. Historical Population and Growth Rate

Year	Population	Average Annual Growth Rate
1930	763	0.6%
1940	812	1.6%
1950	955	7.0%
1960	1,870	8.7%
1970	4,313	2.5%
1980	5,536	3.5%
1990	7,786	3.7%
2000	11,212	10.5%
2010	30,434	2.8%
2017	37,000	--

The City currently has a population of approximately 37,000 (in 2017) within its 10.85 square miles with about 29,700 jobs. By 2023 it is expected that there will be 33,800 jobs and by 2038 there will be 49,700 jobs. The City is experiencing economic growth due to an increasing residential community as well as substantial commercial development. Continued residential and commercial expansion is expected in addition to the potential for substantial annexations.

The City has seen steady growth with periods of rapid growth over the past four decades as shown in Table 4-2.

The City's future population has been projected by the City Planning Department and is summarized in Table 4-3. The population in the city limits is projected to increase at an annual rate of approximately 1.6 percent as indicated in the Comprehensive Plan Table L-3, in Appendix F. The Issaquah Highlands and Talus urban village developments are expected to be built-out by approximately 2020 with an estimated population of 11,400 persons, for both developments combined. Group quarters refer to living situations that do not reflect ordinary household life; primarily represented in Issaquah by nursing homes.

Table 4-3. Population Projections

Area	2016	2020	2025	2031
City Limits minus Urban Villages and Regional Growth Center	22,963	23,842	24,728	26,003
Urban Villages and Regional Growth Center	11,272	19,076	24,486	32,680
Group Quarters	353	365	434	634
Total City Population	**34,588**	**43,283**	**49,648**	**59,317**
PAA	227	231	236	250
Total in City & PAA	**34,815**	**43,514**	**49,884**	**59,567**

Source: Table L-3 of 2017 Issaquah Comprehensive Plan

4.3 Households and Commercial Building Areas

The service areas existing demographics include approximately 5,500 SFR households, 6,400 MFR households, and 9.9 million square feet of commercial building floor area[1]. This is an increase of approximately 23 percent, 38 percent, and 63 percent, respectively, from the 2012 Water System Plan.

[1] SFR based on the number of SFR connections billed in 2016. MFR based on the number of MFR households in 2017 assuming a 95% occupancy, and commercial square footage is based on the square feet of commercial space in 2017 assuming an 80% occupancy.

Chapter 5. Water Requirements

The existing water demand and projected water requirements for the City's service area are presented in this chapter. Future water demands are used as input conditions for the water system analysis and for development of the capital improvement program. Historical and existing sales and production data were used to develop the water consumption value of an equivalent residential unit (ERU).

5.1 Historical Water Consumption

5.1.1 Historical Demand by Water Use Classification

The City divides its water users into eight customer billing categories, plus non-revenue water. The billing categories are single-family, duplex, multi-family, apartment, commercial, private irrigation, public irrigation, and public. For the purpose of this water system plan, the billing categories are consolidated into five water use classes: single family residential, multifamily residential (includes multifamily residential, duplex, and apartment billing categories), commercial, public, and irrigation (includes public and private irrigation billing categories). The demand forecast also includes non-revenue water (which includes the difference between retail water sales and water production).

Table 5-1 provides a summary of the number of active service connections by water use class while Table 5-2 provides the historical annual consumption. Figure 5-1 shows the historical annual consumption for the entire system broken down by the source of supply. Table 5-3 summarizes each water use class's percentage of production. Figure 5-2 provides a summary of typical water consumption by month. No water is sold to other water systems.

Table 5-1. Number of Active Service Connections by Water Use Class

Water Use Class	2014	2015	2016	2017
Single Family Residential	5,385	5,586	5,714	6,720
Multifamily Residential	606	630	632	667
Commercial	458	464	463	464
Public	38	38	39	38
Irrigation	293	311	306	313

Note: Numbers shown include the total number of unique water meters billed in the calendar year.

Table 5-2. Historical Annual Consumption by Water Use Class

Water Use Class	Consumption (MG)		
	2014	2015	2016
Single Family Residential	284.5	304.2	293.4
Multifamily Residential	157.0	162.8	172.2

Table 5-2. Historical Annual Consumption by Water Use Class

Water Use Class	Consumption (MG)		
	2014	2015	2016
Commercial	152.3	174.1	216.3
Public	8.9	8.7	10.8
Irrigation	105.6	136.2	106.7
Non-Revenue	79.4	96.0	72.1
TOTAL	787.6	881.9	871.6

Figure 5-1. Historical Annual Consumption

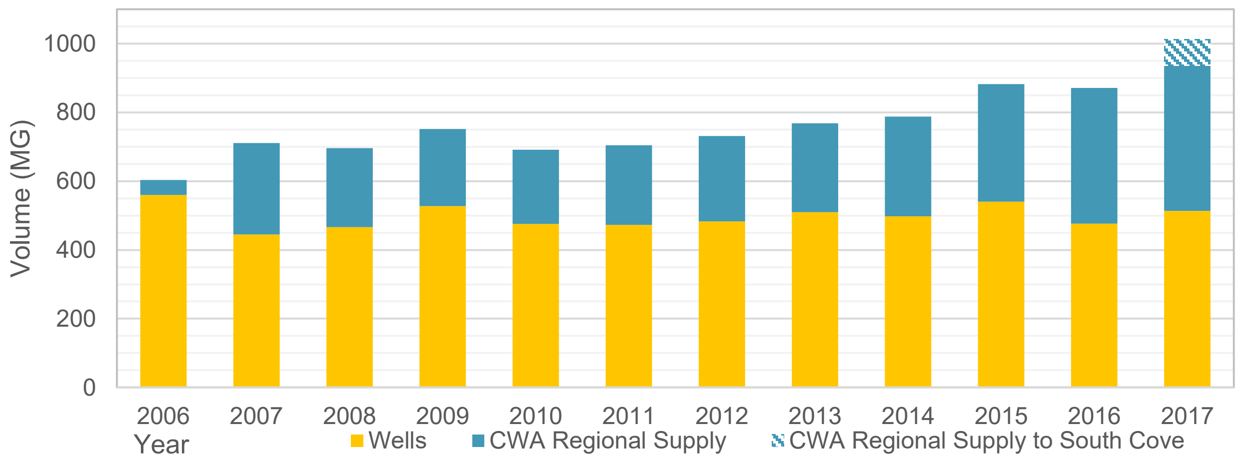
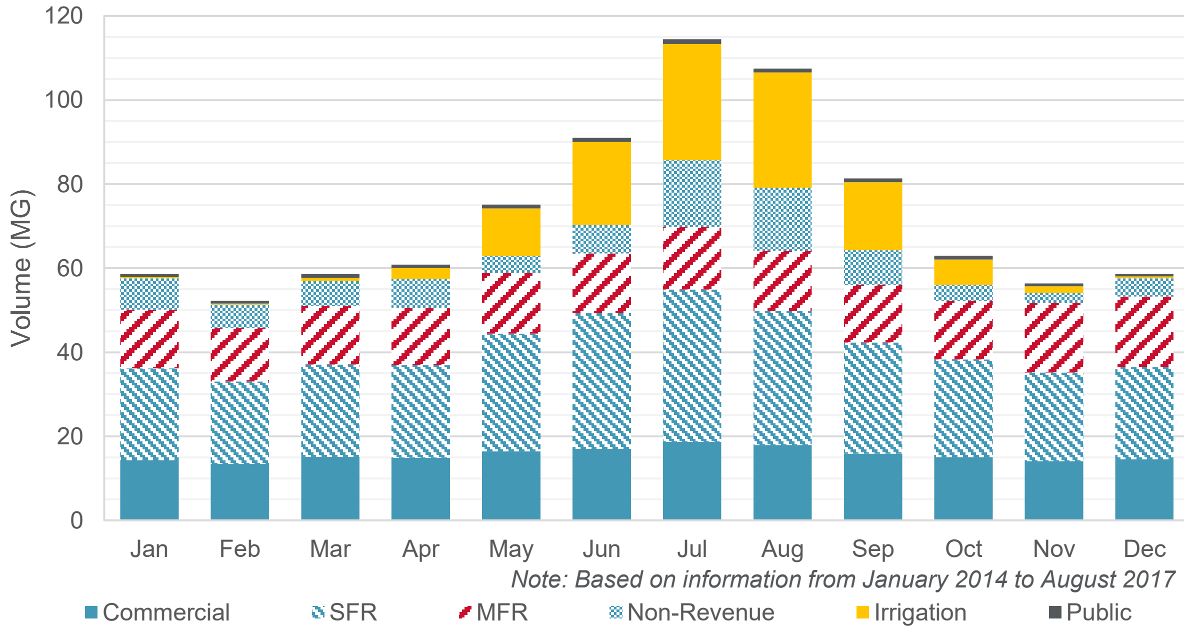


Table 5-3. Historical Water Use Percent of Total Production by Water Use Classification

Water Use Class	2014	2015	2016	2014 – 2016 Average
Single Family Residential	36.1%	34.5%	33.7%	34.8%
Multi-family Residential	19.9%	18.5%	19.8%	19.4%
Commercial	19.3%	19.7%	24.8%	21.3%
Public	1.1%	1.0%	1.2%	1.1%
Irrigation	13.4%	15.4%	12.2%	13.7%
Non-Revenue	10.1%	10.9%	8.3%	9.7%

Note: Multifamily residential water use class includes multifamily residential, duplex, and apartment billing categories; irrigation water use class includes public and private irrigation billing categories.

Figure 5-2. Average Monthly Consumption by Customer Class



5.1.2 Water Use Classifications

Single-Family Residential

The single-family residential (SFR) water use class is the group with the largest water usage in the City. Approximately 35 percent of total water production goes to single-family residential water use[1]. The water is used for domestic purposes and landscape irrigation for single family residences on individual lots (without separate irrigation meters). The water used within this class can double in the summer, primarily due to landscape watering and other outdoor recreation activities.

Multi-family Residential

The multi-family residential (MFR) water use class includes duplex, multiplex (apartment) units, and trailer courts. Approximate 19 percent of total water production goes to multi-family water use. The MFR category does not have high peak seasonal use compared to single-family customers. This can be attributed to the separation of irrigation demands, for which there are separate irrigation meters for most multiplex accounts.

Commercial

The accounts in this category include commercial businesses, office complexes, light industrial, mineral resources, restaurants, and shopping centers. Commercial demand almost doubles in the summer peak periods with the majority of this demand occurring between 7 a.m. and 7 p.m. Seasonal variations are greater for the commercial class than for single-family, likely as a result of commercial landscape irrigation. Approximately 21 percent of total water production goes to commercial water use.

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[1] Total water production is equal to the total amount of water produced by the City's wells, plus water delivered to the City through interties.

Public

The accounts in this category include schools, parks and other public facilities as well as city-owned vacant property and fire meters. Approximately 1 percent of total water production goes to public water use.

Irrigation

The irrigation water use class includes both private and public irrigation use where the use is measured using a separate meter. Approximately 14% of total water production goes to irrigation water use with that demand occurring mostly in the drier parts of the year.

Non-Revenue

The difference between the total water produced and the total water sold comprises the amount of non-revenue water. The total water produced includes the master meter records at the well sources plus the supplies from Cascade Water Alliance (CWA) and Bellevue interties. Non-revenue water may include system flushing, construction hydrant usage, and distribution system leakage (DSL). Non-revenue water use makes up about 10 percent of total water production. Further discussion of DSL is contained in Section 5.3.

5.1.3 Seasonal Variation

The seasonal variation of total water production and of the various water use classes is shown in Figures 5-2 through 5-7. Note that the vertical scale varies from one chart to the next. (Customer class data depict consumption up to July 2017, while source production is shown through the end of 2016, the most recent information available at the time of writing.)

Figure 5-3. Seasonal Variation of Total Production

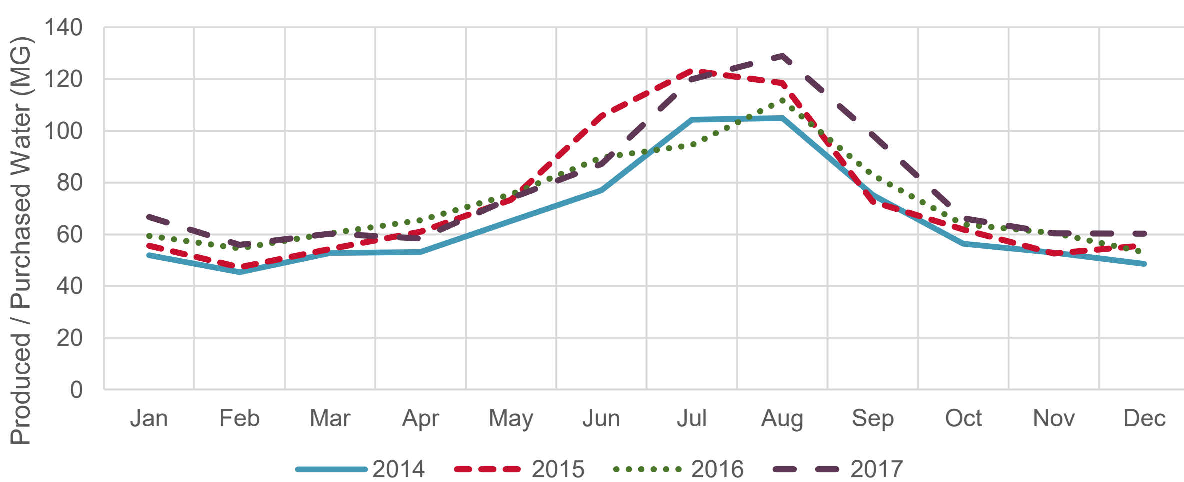


Figure 5-4. Single Family Residential Seasonal Variation

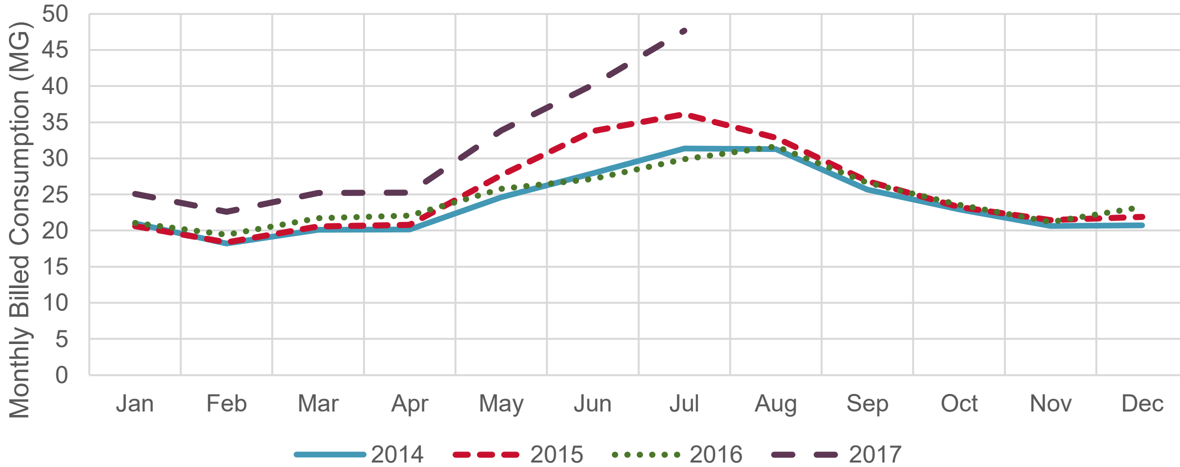


Figure 5-5. Multi-Family Seasonal Variation

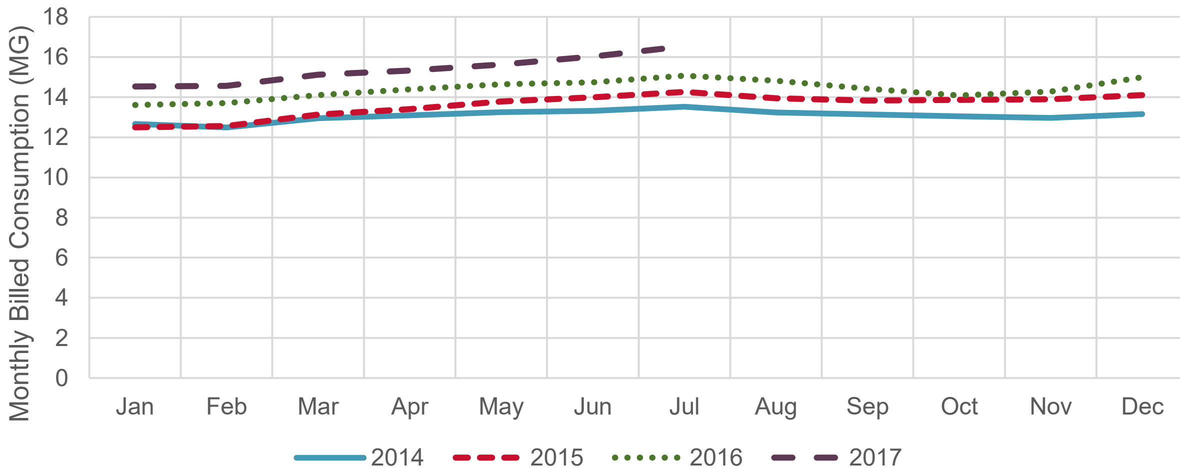


Figure 5-6. Commercial Seasonal Variation

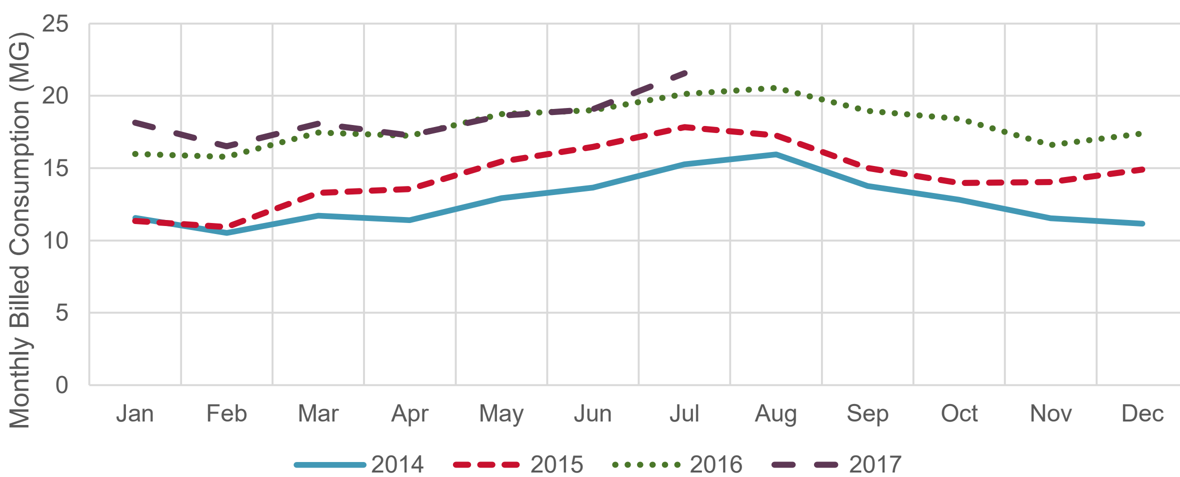


Figure 5-7. Public Seasonal Variation

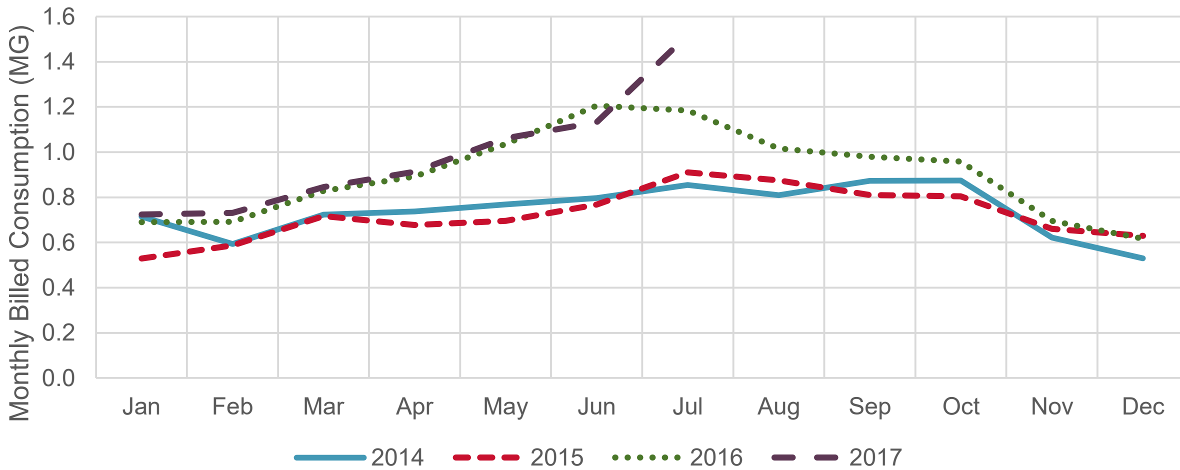
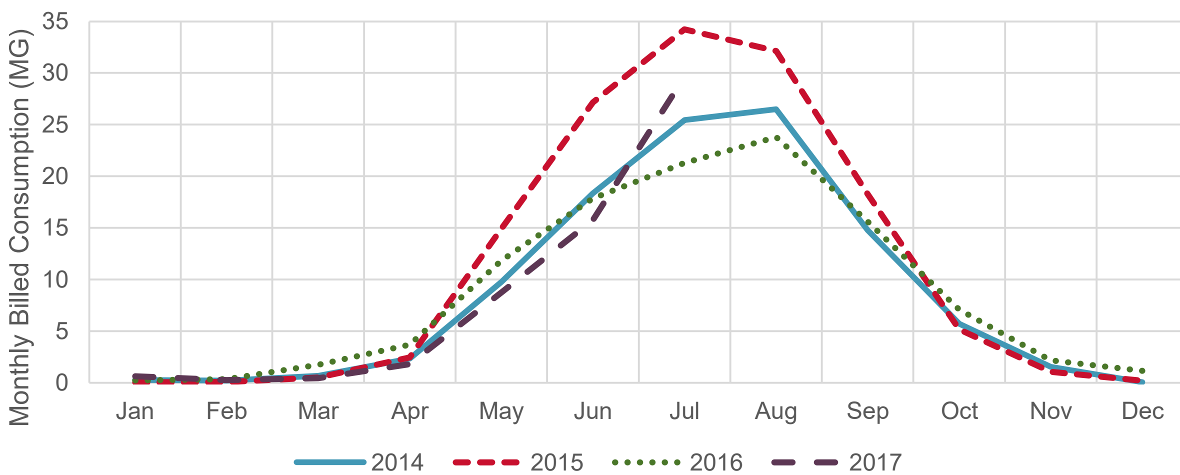


Figure 5-8. Irrigation Seasonal Variation



5.2 Historical Water Production

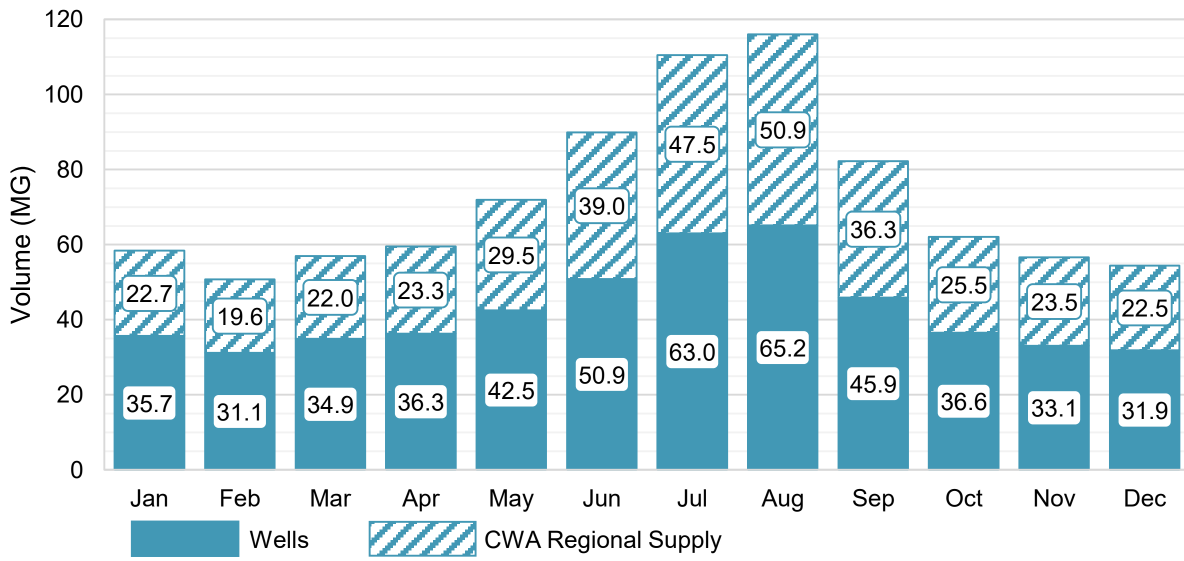
Water provided to the system comes from the City's four active groundwater wells and from the CWA regional supply. The CWA regional supply is provided either directly through the Bellevue-Issaquah Pipeline (BIP), or by wheeling through the Bellevue water system and delivered through Bellevue-Issaquah interties (as is the case for the South Cove, Montreux, and Lakemont Operating Areas). The historical annual source production is summarized in Table 5-4. The typical monthly water production by source is shown in Figure 5-9.

As seen in Table 5-4, there has been a trend of increasing proportions of water from the CWA Regional Supply being used to supply the system's demand. Part of this is due to new growth in areas that are typically supplied by the CWA Regional Supply (Issaquah Highlands Summit and Central Park Operating Areas). However, part of this is due to a decrease in well use related to the discovery of elevated levels of Perfluorooctane Sulfonate (PFOS) in Well 4. Groundwater use may begin increasing with the treatment system now installed and operational at Well 4.

Table 5-4. Historical Source Production

	2011	2012	2013	2014	2015	2016	2017	‘15 – ‘17 Average
Total Annual Production (MG)								
Wells	472.7	482.8	510.3	497.7	540.2	476.4	513.6	510.1
CWA Regional Supply	231.8	248.8	257.7	289.9	341.6	395.2	499.3	412.1
Total Production	704.4	731.6	768.0	787.6	881.9	871.6	1,012.9	922.1
% of Total Production								
Wells	67.1%	66.0%	66.4%	63.2%	61.3%	54.7%	50.7%	55.6%
CWA Regional Supply	32.9%	34.0%	33.6%	36.8%	38.7%	45.3%	49.3%	44.4%

Figure 5-9. Average Monthly Source Production



Note: Monthly values based on average production from 2015 through 2017.

5.3 Distribution System Leakage

Distribution system leakage (DSL) is a component of non-revenue water use. Per WAC 246-290-820, DSL includes all unauthorized uses, water system leakage, and any authorized use the water system does not estimate or track. DSL forms a part of non-revenue water, with the other part of non-revenue water being authorized consumption that is tracked (maintenance flushing, fire-fighting, cleaning water tanks, etc.).

For the City’s water system, total DSL was between 5.0 percent and 10.1 percent of the total production from 2011 through 2016, with the latest three year average (2014 – 2016) being 6.4 percent. The historical values of DSL are given in Table 5-5. DOH requires that the three-year average DSL not exceed 10 percent. Issaquah’s record of approximately 6.4 percent DSL meets this standard.

Table 5-5. Historical Distribution System Losses

	2011	2012	2013	2014	2015	2016	'14 – '16 Average
Total Production (MG)	**704.4**	**732.6**	**768.0**	**787.6**	**881.9**	**871.6**	**847.0**
Accounted for Water (MG)							
Total Retail Sales	614.6	659.2	669.9	708.2	785.9	799.5	764.5
Wholesale (Grand Ridge) [a]	0.7	0.9	0.8	2.56	0	0	0.9
Leak Adjustments [b]	3.4	8.1	5.5	4.4	6.9	9.5	6.9
Non-Revenue, Accounted For Water [c]	14.8	19.2	28.1	16.6	27.2	19.3	21.0
Total Accounted for Water	**633.5**	**687.4**	**704.3**	**731.8**	**820.0**	**828.2**	**793.3**
Distribution System Losses							
Distribution System Losses (MG) (= Total Production – Accounted for Water)	70.9	45.2	63.7	55.8	61.8	43.4	53.7
Distribution System Losses [d] (Percent of Production)	10.1%	6.2%	8.3%	7.1%	7.0%	5.0%	6.4%

[a] Wholesale deliveries made to Grand Ridge through 2014. Grand Ridge was assumed into the water system after 2014.

[b] Leak adjustments account for adjustments made to retail sales numbers when a leak on the customer side of the meter is removed from billing.

[c] Includes uses such as pipe flushing, firefighting, analytical equipment, system maintenance, etc.

[d] The numbers presented in the table for 2014 – 2016 are marginally different than the DSL numbers previously to DOH. The calculations used for the water system plan analysis of DSL used a different method for totaling monthly retail consumption by accounting for meters being read in the middle of the month and for bi-monthly read meters. For example, if a meter is read in the middle of the month, this analysis allocated a portion of the demand to the month of the meter read as well as to the previous month instead of assuming the total demand in the month of the meter read.

5.4 Water Use Factors

A water use factor provides consumption per unit for a given customer class. Water use factors used in the demand forecast include equivalent residential units (ERUs), typical water use per multifamily household, and typical water use per commercial building square foot.

5.4.1 Equivalent Residential Units

The demand of each customer class can be expressed in terms of ERUs for forecasting and planning purposes. One ERU is defined as the average quantity of water consumed per day by one typical, full-time, single-family residence. It is calculated by dividing the total annual consumption of the SFR classification by the number of SFR accounts for a given year. The historical values of an ERU are given in Table 5-6. The most recent three year average (2014 – 2016) of annual ERU values is 145 gpd per ERU. A peak ERU value of 149 gpd per ERU occurred in 2015. For planning purposes, an ERU value of 150 gpd per ERU will be used to forecast future demand, which is the same as the value used in the 2012 Water System Plan.

Table 5-6. Historical Equivalent Residential Unit Values

	2013	2014	2015	2016	2014 – 2016 Average	Value Used for Planning
Equivalent Residential Unit Value (gpd/ERU)	128	145	149	141	145	150

5.4.2 Typical Multifamily Demand

The typical water use of a household within a multifamily development was calculated by using the total 2016 multifamily demand and dividing it by the total number of occupied multifamily household units. The number of occupied multifamily household units was assumed to be 95%[2] (a value used in past water system planning) of the total number of multifamily household units within the water service area[3]. This equates to a typical multifamily household unit water use of 84 gpd per MF household, or approximately 0.6 ERU per multifamily household unit. However, this is a significant decrease from the 2012 Water System Plan which used a value of 124 gpd per household unit, which was calculated using a similar approach. The decrease in the value may be attributed to a combination of the potential for more units to be unoccupied due to new developments being constructed but not yet filled during 2016, and by multifamily complexes having a trend of using separate irrigation meters from domestic demand. The demand per unit of multiple multifamily complexes that were constructed in the last 10 years were examined and it was found that water consumption (when considering irrigation demands) were closer to the 2012 Water System Plan value. To account for irrigation demands for future multifamily growth and to not underestimate water demand, the 2012 Water System Plan value of 124 gpd per multifamily household unit was used in the demand forecast.

5.4.3 Typical Commercial Demand

The typical water use of a commercial customer was calculated by using the total 2016 commercial billing category water demand and dividing it by the total occupied square feet of commercial building space. The occupied square feet of commercial building space was calculated by assuming 80% of the total square feet of commercial building space within the water service area[4] (a value used in past water system planning). This equates to a typical commercial water use of 73 gpd per 1,000 square feet of commercial building space, or approximately 0.5 ERU per 1,000 square feet of commercial building space. This is a decrease from the 2012 Water System Plan which used a value of 92 gpd per 1,000 square feet of commercial building space, which was calculated using the same approach. However, demands for commercial customers can vary greatly depending on the type of commercial property (i.e. offices, warehouse, retail, etc.). To account for these possible variations and irrigation demands, the 2012 Water System Plan value of 92 gpd per 1,000 square feet of commercial building space was used in the demand forecast.

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[2] The University of Washington Runstad Center for Real Estate Studies reported an apartment vacancy of 3.4 percent for King County for Spring 2017. A vacancy of 5 percent will be assumed for Issaquah.

[3] Determined by using the number of multifamily units per parcel from the King County Assessor's office.

[4] Determined by using the square footage of commercial building space per parcel from the King County Assessor's office.

Table 5-7. ADD Water Use Factors Assumed for Planning

Customer Class	Water Use Factor
Single Family Residential	150 gpd / household
Multifamily Residential	124 gpd / household unit
Commercial	92 gpd / 1,000 square feet

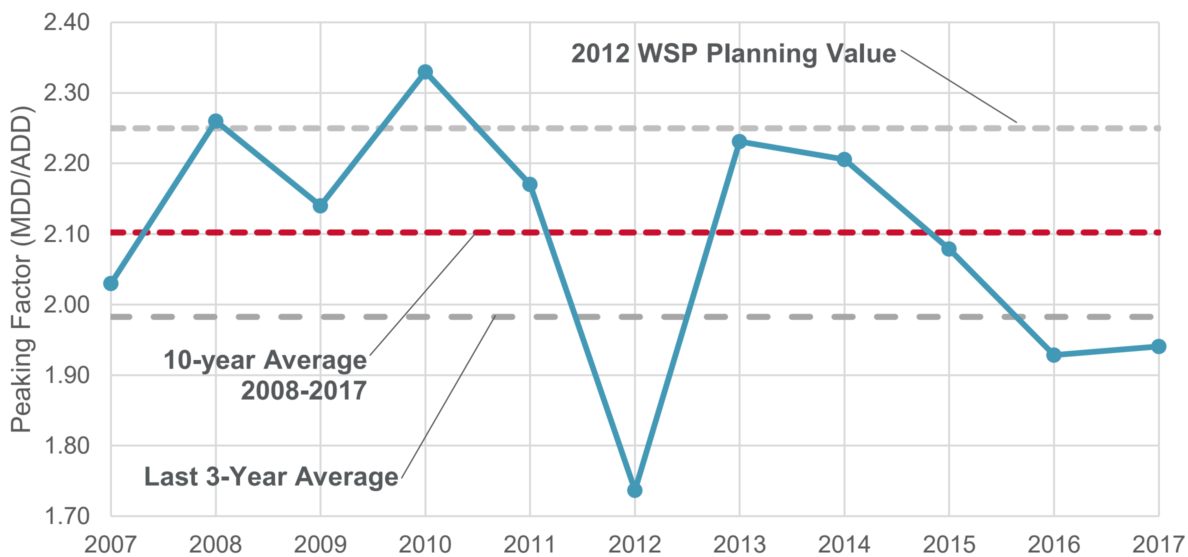
5.5 Peaking Factors

Peaking factors are used to convert an average day demand (ADD) to either a maximum day demand (MDD) or peak hour demand (PHD).

5.5.1 MDD Peaking Factor

The peaking factor for converting ADD to MDD is calculated as the ratio of the maximum day production for a year to the average day production for that year. The historical peaking factors are shown in Figure 5-10 and summarized in Table 5-8. The most recent three year average (2015 – 2017) of peaking factors is 1.98 while the most recent ten year average (2008 – 2017) is 2.10. The demand forecast uses a peaking factor of 2.11 (the ten year average for 2007-2016[5]) for converting ADD to MDD. The ten year average was chosen over the most recent three years of data because, although peaking factors have been trending lower, partial annual water use data for 2017 (see Section 5.1.3) indicate that peaking factors for 2017 may increase over previous years, so the more conservative value was used. The 2.11 peaking factor is a decrease from the 2012 Water System Plan which used a value of 2.25.

Figure 5-10. Historical Peaking Factors (MDD/ADD)



[5] At the time of beginning work on the demand forecast analysis, 2016 was the most current year of available peak day data.

Table 5-8. Historical Peaking Factors (MDD/ADD)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Peaking Factor (MDD/ADD)	2.03	2.26	2.14	2.33	2.17	1.74	2.23	2.21	2.08	1.93	1.94
3-year (2014-2016) Average									**1.98**		
10-year (2007-2016) Average									**2.10**		
MDD/ADD Peaking Factor Assumed in Demand Forecast									**2.11**		

5.5.2 PHD Peaking Factor

For determining the PHD, equation 5-1 of the DOH Water System Design Manual is used. The equation calculates PHD based on the number of ERUs within the area being analyzed (whether that is system-wide or an individual pressure zone) and the MDD of the area. Therefore the PHD peaking factor depend on the demand of the area being analyzed. However, for the total system the PHD to ADD peaking factor is 3.41. PHD is used in the storage capacity analysis found in Chapter 9.

5.6 Demand Forecast

5.6.1 Methodology

The demand forecast predicts future water use for the water system plan's 20-year planning horizon. Since 2017 was not complete at the time the forecast was prepared, the demand forecast uses a starting baseline demand (demand for 2017) based on the average of demands from 2015 and 2016.

Because the water system assumed the South Cove area at the start of 2017, the South Cove demand was added to the historical baseline demand by using current retail consumption trends of the South Cove area and assuming the same percentage of non-revenue water in South Cove as the rest of the water system.

Different growth rates were assumed for different parts of the water service area, as described below. These growth rates were based on a combination of information from the Issaquah Comprehensive Plan (effective October 2017), Central Issaquah Plan (effective March 2017), and development agreements with the City.

Valley Operating Area

Within the Valley Operating Area is the "Central Issaquah" area as defined in the Central Issaquah Plan. The Central Issaquah Plan provides projections of additional residential households and commercial square footage within Central Issaquah. Typical water use factors for the SFR, MFR, and commercial customer classes were applied against the planned quantity of additional development for the Central Issaquah area per the Central Issaquah Plan. It was assumed that commercial growth in Central Issaquah would be linear with 30 percent of planned commercial growth occurring by 2031 and build-out of commercial growth by 2064 (approximately 2.1% of total planned commercial growth added per year). It was also assumed that residential growth in Central Issaquah would be linear with 70 percent of residential growth completed by 2031 and build-out of residential growth occurring by 2037 (approximately 5% of total planned residential growth added per year). The resulting demand was then added to the current demand to determine the total future demand of the Central Issaquah Area.

Outside of the "Central Issaquah" area, the rest of the Valley Operating Area assumed a 1.6 percent annual growth in all customer billing categories. In addition to that growth, an elementary school is planned to be built within the King County Island area which was annexed in 2017. The forecast assumed the school would be in place in 2018 with a demand of 67 ERU[6].

Lakeside Operating Area

The Lakeside Operating Area is comprised of the Lakeside Development. A portion of the Lakeside Development (neighborhood "A") has already been constructed and is included in demands for the Issaquah Highlands Central Park Operating Area. The rest of the development is included in its own operating area with projected demands based on the 2013 Lakeside Development Agreement. The agreement shows a total of 1,500 ERUs at build-out in 2043. The agreement's annual projections are used, but exclude the demands associated with neighborhood "A."

Montreux, Lakemont, and Issaquah Highlands Summit Operating Areas

The Montreux, Lakemont, and Issaquah Highlands Summit Operating Areas are assumed to be at build-out currently, so water demands are held constant in the demand forecast.

Talus Shangri-La and Talus Foothills Operating Areas

The forecast assumes that build-out will occur in 2024 in both Talus operating areas, per the Talus Development Agreement. Based on City planning information, the remaining number of residential units and commercial area to be built were applied to the build-out year, and typical water use factors were applied to these quantities. A linear growth in water demand was then assumed between 2017 and 2024. Build-out demand is estimated to be 1,978 ERUs.

Issaquah Highlands Central Park Operating Area

The Issaquah Highlands Central Park Operating Area assumes that build-out will occur in 2021. Based on City planning information, the remaining number of residential units and commercial area to be built were applied to the build-out year, and typical water use factors were applied to these quantities. A linear growth in water demand was then assumed between 2017 and 2021. Build-out demand is estimated to be 4,318 ERUs.

Grand Ridge Operating Area

It is assumed that the Grand Ridge Operating Area will have a total build-out of 60 ERUs taking place by 2027. A linear growth was assumed from the current 2017 demand to the build-out demand in 2027.

Cougar Mountain Operating Area

The Cougar Mountain Operating Area is a future potential operating area and is not currently within the water service area. The area is currently served by a combination of the Edgehill Water Association and by private wells. The demand forecast assumes the area is served before the 6-

[6] 67 ERU demand based on assuming a school with 500 pupils and a water demand of 20 gpd/pupil per Table 5-2 of the DOH Water System Design Manual (2009).

year (2023) planning horizon with a 1.6% annual growth in demands. The area is estimated to have 122 ERUs by 2037.

Bergsma Operating Area

The Bergsma Operating Area is a future potential operating area and is not currently within the water service area and does not have any growth. The demand forecast assumes the area has a linear growth in water use from zero demand in 2017 to a build-out of 34 ERUs by 2025.

All Other Operating Areas

In all operating areas of the system not mentioned above (i.e. Forest Rim, Highwood, Wildwood, and Mount Hood) the forecast assumes a 1.6 percent annual growth in all customer billing categories except for commercial. No commercial growth is expected in these areas.

5.6.2 Projected Equivalent Residential Units by Operating Area

The ERUs for each operating area were determined for the current (2017), 6-year, 10-year, and 20-year planning horizons. This information is summarized in Table 5-9.

Table 5-9. Projected Equivalent Residential Units by Operating Area

Operating Area	2017	2023	2027	2037
Cougar Ridge	75	81	86	99
Forest Rim	117	129	137	161
Grand Ridge	26	46	60	60
Highwood	439	483	514	603
Issaquah Highlands Central Park	2,790	4,318	4,318	4,318
Issaquah Highlands Summit	1,932	1,932	1,932	1,932
Lakemont	274	274	274	274
Montreux	311	311	311	311
Mount Hood	1,045	1,150	1,225	1,436
South Cove	1,313	1,444	1,539	1,803
Talus Foothills	509	649	672	672
Talus Shangri-La	986	1,260	1,305	1,305
Valley	7,462	9,932	11,557	15,708
Wildwood	116	128	136	160
Bergsma (future service area)	0	26	34	34
Cougar Mountain (future service area)	89	98	104	122
Lakeside (future service area)	0	358	516	996
Total for Current Service Area	**17,395**	**22,137**	**24,068**	**28,842**
Total Include Future Service Areas	**17,484**	**22,619**	**24,723**	**29,994**

5.6.3 System-wide Demand Forecast

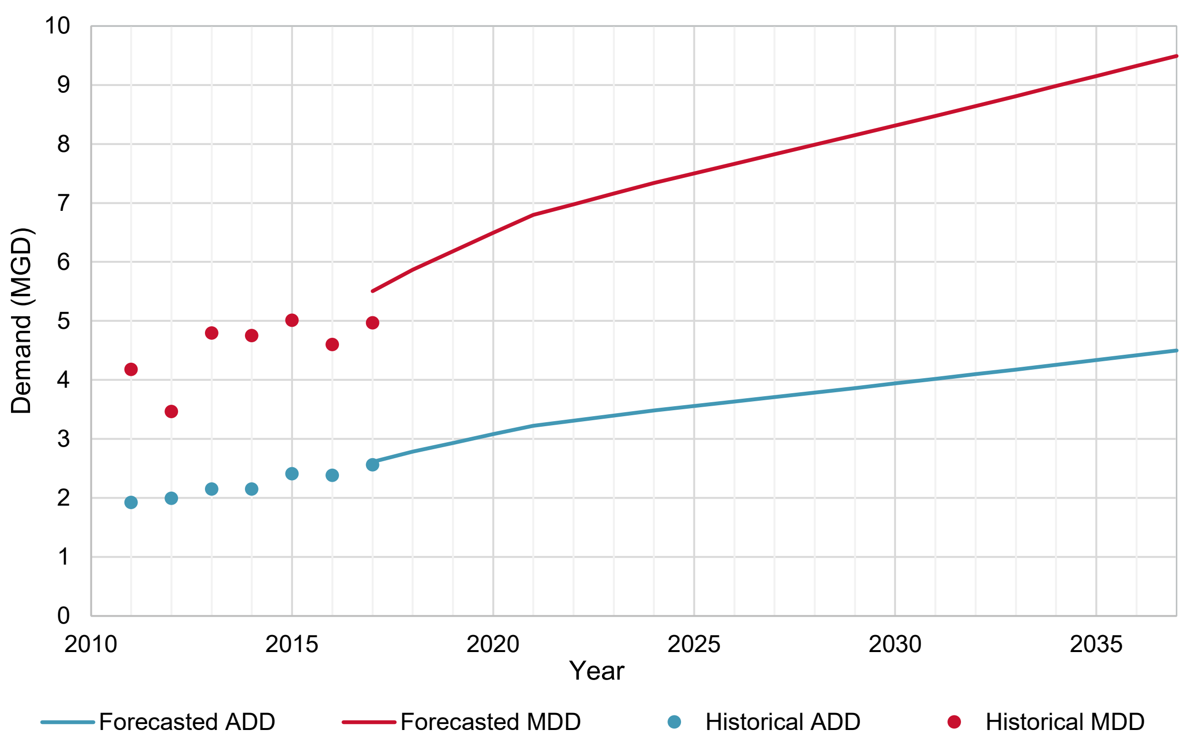
The demand forecast for the entire system is provided in Figure 5-11. This includes projected demands for the current service area as well as the future retail water service area. Table 5-10 provides the forecasted demands for the current, 6-year, 10-year, and 20-year planning horizons.

The demand forecast when incorporating water use efficiency is given in Chapter 6.

Table 5-10. System-Wide Demand Forecast

Demand (MGD)	2017	2023	2027	2037
Average Day Demand	2.61	3.39	3.71	4.50
Maximum Day Demand	5.51	7.16	7.82	9.49

Figure 5-11. System-Wide Demand Forecast



Chapter 6. Water Use Efficiency

Conservation is termed a demand-side management program. As a supply alternative, it serves to decrease consumption, allowing a utility to delay procurement of additional water supplies, reduce withdrawals and associated impacts from existing water resources, manage peak demand and reduce wastewater flows. A conservation program is now mandatory through the State Water Use Efficiency Rule for all utilities of sufficient size, and DOH has established requirements for water system planning, metering, distribution system leakage, goal setting and annual reporting. Water conservation must be addressed in all water system plans.

Water conservation is the implementation of structural and nonstructural programs designed to improve water use efficiency and reduce current demand as well as reducing the rate of increase of demand. The City's water conservation program is described in this chapter. Example components of the program include City ordinances that encourage efficient use of water, the establishment of inverted block water rates designed to make the efficient use of water economically attractive, efficient plumbing fixtures in new construction, meter testing, leak detection and repair, promoting the use of efficient irrigation practices, and increased storm water reuse to irrigate parks, open spaces and home landscapes.

6.1 History of Water Use Efficiency Goals

6.1.1 1989 East King County Regional Water Association Coordinated Water System Plan

In 1989, the East King County Regional Water Association (EKC RWA) formed to develop a Coordinated Water System Plan (CWSP). The CWSP included a water conservation element outlining regional and local conservation objectives, including a target 6.5 percent reduction in usage per ERU by the year 2000, for purveyors such as the City, with less than 10,000 customers at that time. The City met this goal by reducing its water usage by 9 percent from 1996 to 2000, to 209 gallons per day per ERU. No target reductions have been established by the EKC RWA beyond 2000.

6.1.2 1996 Conservation Program

The City's 1996 Water Conservation Program specified an objective of 13 percent reduction in the water used per ERU from the year 1996 to the year 2015. This would have reduced the 1996 ADD water usage of 228 gpd per ERU to an ADD usage of 198 gpd per ERU by 2015. The interim goal for 2000 was approximately 221 gpd per ERU. By 2000 the City (with the exception of Montreux) achieved a reduction in water usage of 9 percent or 209 gpd per ERU, exceeding the interim target.

6.1.3 2001 Conservation Program

In 2001, with the update to the City's Water System Plan, the City accelerated its conservation goal by establishing a plan to reduce ADD consumption to 198 gpd per ERU by the year 2010 and ultimately to 195 gpd per ERU by 2015. This represents a reduction of 6.7 percent from 209 gpd per ERU in 2000. An extensive conservation program was implemented in 2002 to foster the achievement of this goal.

These goals have been met to date; the 2010 usage was approximately 150 gpd per ERU, while usage was 149 gpd per ERU in 2015.

6.1.4 Cascade Water Alliance Conservation Coordination

Since 2004, the City has worked with the Cascade Water Alliance (CWA) to plan, design, and implement coordinated conservation programs across member areas. In 2005, a regional conservation potential assessment (CPA) was completed, analyzing costs, market size and potential savings for 22 water conservation measures across five sectors. The CPA was completed for 6-year and 20-year timeframes, to coincide with the 2005 Transmission and Supply Plan (TSP).

A regional CWA water conservation plan was adopted in 2008. Following the adoption of the State Water Use Efficiency Rule in 2007, the City adopted additional interim water use efficiency goals in January 2008 based upon work with CWA. These goals set into place additional procedures for monitoring distribution system leakage and established annual reporting of conservation and leakage reduction program activities to the community. They also provided goals for a reduction in water use of 51,000 gallons per day on an annual average basis and 67,000 gallons per day during the peak season by 2013.

CWA's commitment to conservation was reinforced by the conservation plan goals and elements incorporated in the 2012 TSP. Chapter 3 of the TSP (Water Conservation Program) can be referenced for more information regarding the regional conservation efforts that underpin the City's conservation program.

6.1.5 Historical Water Savings

As shown in Table 6-1, usage has decreased in the single-family, commercial, and public authority customer classes due to conservation efforts. The ADD water use for an ERU has decreased to 141 gallons per day per 2016 data; however, the demand forecast uses a planning value of 150 gallons per day to be conservative in determining the needs of future facilities. Additional detail regarding recent usage by various customer classes can be found in Chapter 5.

Table 6-1. ADD Water Use by Customer Class

Customer Class	Units	1996	2001	2010	2016	Apparent Reduction from 2010 to 2016 [a]
Single-family	Gpd/connection	228	209 [b]	150	141	6%
Multi-family	Gpd/unit	135	135	124	84	32%
Commercial	Gpd/1000-sq ft floor space	181	134	92	73	22%
Public Authority	% of total production	4%	3%	2.6%	1.2%	
Non-Revenue, accounted for water	% of total production	10%	10%	2.2%	2.2%	
Distribution System Leakage	% of total production			9.6%	5.0%	

Notes:

[a] Apparent reduction in water use may be due to new developments coming on line in 2016 (eg. Atlas Apartments).

[b] Excludes Montreaux.

[c] Values exclude South Cove.

Overall, recent system-wide average day savings are depicted in Table 6-2. This reflects a continued trend in water savings.

6.2 Regulatory Requirements and City Response

The DOH established Water Use Efficiency (WUE) requirements in 2007 (WAC 246-290). The WUE requirements include five primary components: meters, data collection, planning requirements, distribution system leakage, and annual reporting. A summary of these requirements is included below.

Table 6-2. Water Savings From Issaquah Conservation Programs

Year	GPD Saved
2011	14,388
2012	12,000[a]
2013	10,377
2014	9,330
2015	6,662
2016	7,912

Source: Cascade Water Alliance
[a] Estimated

6.2.1 Water Meters

The State Water Use Efficiency (WUE) requirements specify both production and service meters be installed by 2007 and 2017, respectively.

The City has had both production meters and service meters in place for several decades. Production meters are located at all production well facilities. All primary and emergency interties with the exception of Lakemont have meters. All service connections are metered.

6.2.2 Data Collection

Collection of source, intertie, and service meter data is required on a monthly, annual, and seasonal basis, depending upon the meter type. In addition, water supply characteristics must also be described.

Production and intertie meters provide data on water produced, purchased and wheeled through the City's water system. This data is collected on a monthly and annual basis. Service meter data is collected on a bi-monthly basis. Water supply characteristics are described in detail in Chapter 5.

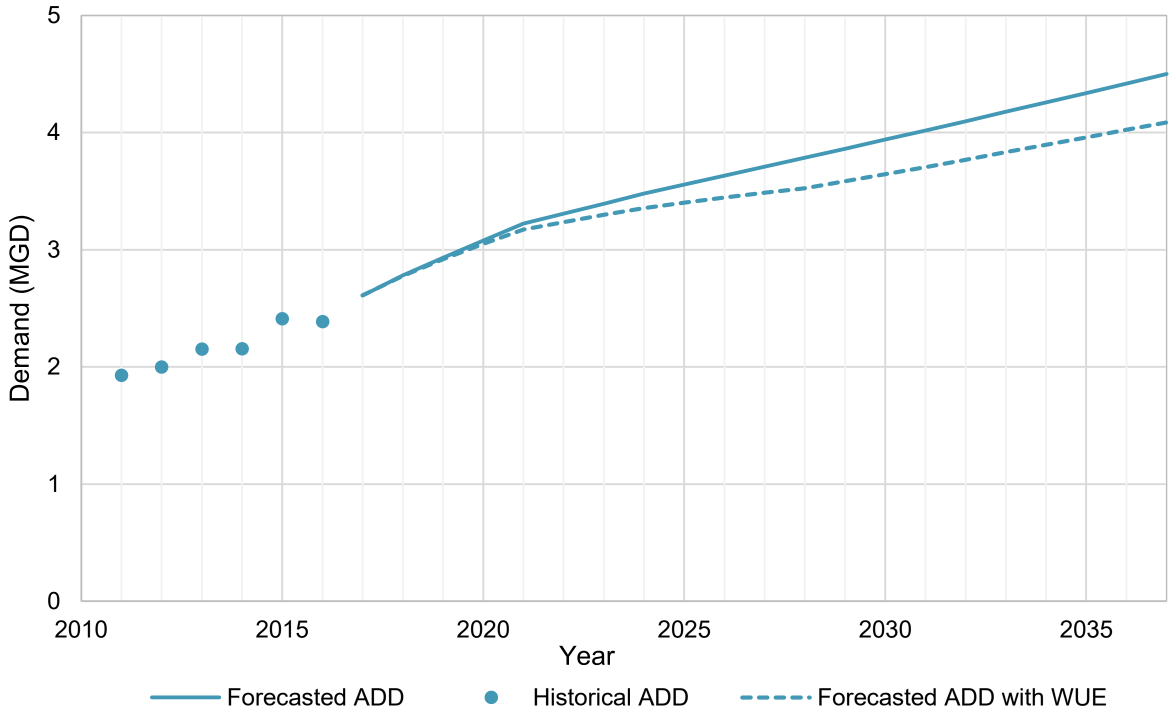
6.2.3 Demand Forecasting

Demand forecasts must project demand with and without savings from conservation program measures. In addition, a third demand forecast including all cost-effective water use efficiency measures is required if all cost-effective measures are not selected for implementation.

The baseline (i.e., without conservation) water system demand forecast is presented in detail in Chapter 5. Figure 6-1 presents the baseline average day demand forecast along with one that incorporates savings from conservation. Details regarding assumed savings associated with conservation are provided in Section 6.3.

Because the City is implementing more than the required minimum number of measures, a demand forecast reflecting 'all cost effective' measures is not required.

Figure 6-1. Water Demand Forecast with Water Use Efficiency



6.2.4 Water Use Efficiency Program

A water use efficiency program is required to be implemented and must be included in water system plan updates.

The City's water conservation program is detailed later in this chapter.

6.2.5 Evaluation of Rate Structure

A rate structure that encourages water demand efficiency is required to be considered.

The City's current rate structure is based upon customer classes and includes five inclining blocks for single-family residential, four inclining blocks for duplex, and two inclining blocks for apartments, trailer courts, commercial and public authority. In addition, irrigation rates are separate and feature a two-step inclining rate structure. The overall rate structure encourages conservation and avoidance of wasting water. Separation of irrigation water use also reflects peak season demand and the higher relative cost of this water. Bills are designed to show water use history to provide customers a basis for comparison of their current consumption with their historical consumption patterns.

6.2.6 Evaluation of Reclaimed Water Opportunities

Water systems with 1,000 or more connections must collect information on reclaimed water opportunities and include information in planning documents.

Cascade Water Alliance evaluated the potential sources and users of reclaimed water as part of its Transmission and Supply Plan. This evaluation identified King County's Brightwater Treatment Plant in Woodinville and South Treatment Plant in Renton as potential suppliers which are not located near the Issaquah service area. The cost of reclaimed water distribution piping and distance from reclaimed water sources was identified as the primary obstacle to reclaimed water use. Issaquah will continue to consider regional efforts to develop reclaimed water supplies, where appropriate.

At this time, reclaimed water does not appear to be an economically viable option in Issaquah due to the City not located near reclaimed water sources. However, the City continues to work with CWA and other regional suppliers to identify and evaluate other feasible opportunities.

Emerging technologies such as on-site water recycling and zero discharge facilities are not precluded or discouraged by this policy. Such facilities operating independently from Issaquah's water and/or sewer systems may be subject to the jurisdiction of plumbing codes, King County Public Health Department, and/or the Washington State Department of Health.

6.2.7 Distribution System Leakage

Water systems must measure and calculate distribution system leakage and implement a distribution system leakage standard of 10% on a rolling three-year average. Transmission lines are not required to meet a leakage standard, but transmission line leakage and efforts to control leakage must be described in planning documents.

Since 2007, the City monitors and reports transmission and distribution system leakage on an annual basis. Leakage between 2014 and 2016 has averaged 6.4 percent as noted in Table 5-5 in Chapter 5.

Leakage data is reported to customers in the annual distribution of the City's Consumer Confidence Report.

6.2.8 Goal Setting and Performance Reporting

Water systems must set water use efficiency goals through a public process. Goals must be adopted by the governing body for the water system. Water use efficiency performance must be reported to the DOH and the public.

The City's current water use efficiency goals are described in the following section.

6.3 Current Water Use Efficiency Goals

Water use efficiency goals were first established in January 2008, following public notice and a public meeting on January 10, 2008. These goals have been modified over time as interim milestones have been achieved. Annual reports have been prepared for DOH and the information has been communicated to the public through incorporation into the City's Consumer Confidence Report, which has been mailed to all water customers by July 1st of each year since 2008.

As a member of CWA, the City participates in the regional efforts that are tied to the adopted regional water use efficiency goals CWA has established for its member water utilities in consultation with the DOH. As such, CWA's WUE goal is adopted by the City as its formal WUE goal, and is stated as: "Cascade will dedicate resources necessary to achieve a cumulative drinking water savings of 0.6 million gallons per day on an annual basis and 1.0 million gallons per day on a peak season (June – September) basis by 2020." – Adopted by CWA's Board of Directors, October 23, 2013 for the period 2014 to 2019.

As stated in its 2016 WUE annual report, the City notes that CWA's conservation programs and services resulted in approximately 20,000 direct customer interactions promoting water efficiency and a savings of an estimated 257,728 gallons of water per day, or 43 percent of CWA's 2014 – 2019 WUE goal.

For the purpose of presenting a demand forecast that incorporates continued savings from water conservation, the City has established a target of reducing water usage to 134 gpd per ERU by 2026, representing a 5 percent reduction in water use from actual ERU water use seen in 2016, and a 11 percent reduction as compared to the ERU planning value (150 gpd per ERU) used in the demand forecast. For context, in the 2012 WSP, the City established a target of reducing water use to 141 gpd per ERU by 2020. With the observed value of an ERU being 141 gpd per ERU in 2016, the pervious WSP's target has been met.

As discussed in Chapter 5, data show a major decrease in the water use factors for commercial and multi-family water use. Because of the large decrease that has been seen in recent years, a smaller reduction is assumed in the future for commercial and multi-family water use factors, assuming that many conservation-based gains have been met. The City has established a target of reducing commercial water use to 71 gpd per 1,000 square feet of commercial space by 2026, representing a 2 percent reduction in the water use factor from the 2016 observed water use factor, and a 23 percent reduction in the planning water use factor used in the demand forecast.

For multi-family water use, the City has established a target of reducing multifamily water use to 82 gpd per dwelling by 2026, representing a 2 percent reduction in water use factor from the 2016 observed water use factor, and a 34 percent reduction in the planning water use factor used in the demand forecast.

Given the above targets, in 10 years (i.e., in 2027) the annual savings would be 228,000 gpd. During the period of 2018-2027, this equals an annual average savings of 89,000 gpd, relative to the baseline forecast. This is depicted in the demand forecast with conservation, presented previously in Figure 6-1. This assumes that baseline water use is based on the planning water use factors (Chapter 5) from 2017 with the conservation-based forecast represented by a straight-line decrease to the target water use factors in 2026.

Through the 2018 Water System Plan adoption process, the regional CWA water use efficiency goal and the City-specific target have been highlighted for discussion in public meetings, including the City's Utilities, Technology and Environment Committee meetings and full Council meetings. The adoption of the water conservation goal occurs in tandem with overall water system planning to ensure the integration of measures into demand forecasting and overall system considerations for future local and regional design and permitting.

6.4 Historical and Ongoing Water Use Efficiency Program

As noted previously, the City's conservation program makes use of the programs and services provided by CWA. In 2016 CWA administered 15 distinct activities including showerhead and aerator installation at commercial accounts, residential gardening classes, irrigation system upgrade rebates, classroom presentations on water topics, free online ordering of shower timers, rain gauges, and other conservation items through CWA's website, water audits at King County Housing Authority and Hopelink properties, free conservation items shipped to multifamily properties, training for landscape contractors, parks and school district staff, students, and others on the fundamentals of efficient irrigation management, and implementation of a WaterSense Labeled New Homes program for builders.

Specific activities undertaken recently specifically by the City, as documented in the 2016 WUE annual report, include:

- In 2016, the City focused on reducing peak-season demand from commercial irrigation. Customers received reminders to adjust their irrigation settings, and heard more about best practices to use water efficiently, while also saving money.
- The City also participated in the National Mayor's Water Conservation Challenge which encourages residents to pledge to conserve water.
- The City continues to encourage water efficiency in new construction through the City's green building program, internal Green Building and Infrastructure Team, green building permit incentives, landscape code, soil amendment standards, inclining block and irrigation only rates and rate structures. City continues work on aging watermain replacement and has established procedures to manage water loss for water main flushing

6.5 Evaluation of Potential Program Measures

The City currently provides conservation programs through a combination of local and regional efforts. The City works in partnership with CWA to develop regional water conservation measures to be implemented throughout its member utility service areas. In previous years, the City has also implemented local conservation programs such as the Powerful Choices school program, toilet distributions, irrigation and landscape classes, neighborhood natural yard care program, sustainable building program, commercial irrigation audits and other measures that complement regional efforts.

CWA has produced several documents that plan for conservation activities throughout its regional wholesale service area: Conservation Potential Assessment, 2005; Regional Water Conservation Plan, 2008; and Water Conservation Study, 2011.

The Conservation Potential Assessment provided a detailed review of the water saving potential of 22 conservation measures across three sectors. The associated costs and service area considerations provide a foundation for development of the measures, which have been included in both the City’s and the Regional Water Conservation Plan.

6.6 Cost/Benefit Analysis

In 2012, four packages of conservation investments were evaluated at the regional level through the CWA conservation program, assessing total program cost and return on investment of different approaches. This analysis considered implementation costs and water savings, but did not account for natural resource, societal or customer costs or benefits directly. The packages incorporated a range of conservation measures including rebates, direct installation, education, promotion and other measures, which are included in the City’s Water Use Efficiency Program. The regional conservation package is estimated to provide an average day conservation savings of 2.2 mgd and a peak season conservation savings of 3.1 mgd from 2011 to 2020 throughout the region. Each of the conservation packages were assessed for cost-effectiveness, providing a range of $0.26 to $0.71 per ccf of saved water. Additionally, the rate of return of the conservation packages evaluated ranged from approximately 9.2–14.5 percent overall. Additional detail is available from CWA.

6.7 Future Water Use Efficiency Program

The City is committed to continuing its water conservation efforts. This will involve continued participation in CWA's regional conservation programs, with additional emphasis placed on the activities described in Section 6.4.

In 2017, the City evaluated water use by neighborhood and by season. This data will be used in future years to target the location and types of conservation programs and outreach. The City also passed a Sustainable Building Action Strategy which takes a holistic approach to sustainable building and will help the City conserve its natural resources in the future, including water.

Chapter 7. Supply Evaluation

This supply evaluation includes a description of the City's groundwater sources of supply, existing water rights, summary of purchased water supply, the areas in the system in which groundwater or surface water supply is used, and recommendations for future supply facilities.

7.1 Groundwater Supply Sources

7.1.1 Aquifer Conditions

The City's wells are in the Issaquah Valley Aquifer, a highly productive glacial sand and gravel delta deposit. These sand and gravel deposits were once the bottom of Lake Sammamish and are hundreds of feet thick. The nature of these deposits can be seen in the Lakeside Gravel Pit adjacent to I-90. The aquifer is estimated to be approximately 300 feet thick and, on a regional scale, acts as a single unconfined aquifer (Golder, 1993). Hydraulic conductivity of the aquifer is estimated to be between 200 and 300 feet per day (Golder, 1993). Groundwater recharge occurs primarily along the more permeable surficial sediments located along the margins of the aquifer, including the Lake Tradition Plateau, western Grand Ridge and possibly the upper reaches of Issaquah Creek.

The City's wells are completed at depths of 97 to 412 feet in the aquifer. The thickness and lithology of the aquifer varies locally and strongly affects well production. Where the aquifer is thick (75 to 80 feet) and consists of clean sand, gravel and cobbles, well yields of up to 2,000 gpm are reported. Wells completed in thinner areas of the aquifer, less than 40 feet thick, with considerable amounts of fine silty materials, yield approximately 100 to 200 gpm. A detailed description of the Issaquah aquifer conditions is provided in the Lower Issaquah Valley Wellhead Protection Plan, Volume I Report[1].

7.1.2 Existing Supply Facilities

Prior to 1967, the City received its water from a series of surface water springs flowing from the East Issaquah Watershed. The City relinquished this surface water right, #1087, on October 2, 1970. The City currently operates four of its six wells. These wells, grouped as the Risdon, Gun Club, and Gilman Wells, are shown in Chapter 2's Figure 2-3 and are described in detail below.

Risdon Well No. 1

Constructed in 1967, Risdon Well No. 1 is located just south of the I-90 right-of-way, east of SE 72nd Street. It has a primary, certificated water right, Ground Water Certificate No. 6343-A, (G1-*08632CWRIS) with a priority date of March 30, 1967. Well No. 1 has an authorized Qi of 630 gpm (0.91 MGD) and a Qa of 1,000 ac-ft/year (0.89 MGD). It is located within the NW 1/4 SW 1/4 Sec. 27, T24N, R6E.

Well No. 1 was constructed to a depth of 107 feet with a 12-inch casing and screen. The screen is set with a #60 slot size between depths of 90 feet and 106 feet. Well No. 1 is equipped with a vertical turbine pump driven by a 60-horsepower (hp) motor with a capacity of 450 gpm. Well No.1 pumps directly to the 297 Zone which is hydraulically tied to the Westside Reservoir and the

[1] *Lower Issaquah Valley Wellhead Protection Plan, Volume I Report*, Golder Associates, November 1993.

Cemetery Reservoir. Well No. 1 serves as a primary well supply to the Valley 297 Pressure Zone and is normally controlled by the water level in the Westside Reservoir. The well has produced an annual average of 0.30 MGD in the last four years (2014-2017).

Risdon Well No. 2

Constructed in 1969, Risdon Well No. 2 is located in the same location as Well No.1, just south of the I-90 right-of-way, east of SE 72nd Street. It is a primary, certificated water right, Ground Water Certificate No. 7031-A, (G1-*10071CWRIS), with a priority date of March 11, 1969. Well No. 2 has an authorized Qi of 1,200 gpm (1.73 MGD) and a Qa of 1,600 ac-ft/year (1.43 MGD). It is located within the NW 1/4 SW 1/4 Sec. 27, T24N, R6E.

Well No. 2 was constructed to a depth of 200 feet with a 12-inch diameter casing and screen. The screen is set with a #40 slot size between a depth of 82 feet and 87 feet and with a #100 slot size between depths of 87 feet to 97 feet. Well No. 2 is equipped with a vertical turbine pump driven by a 100-HP motor and has a capacity of 1,050 gpm.

Well No. 2 pumps directly to the Valley 297 Pressure Zone. The well has produced an annual average of 0.55 MGD in the last four years (2014-2017).

The wells and equipment are housed in the same masonry building. Disinfection (12.5 percent sodium hypochlorite) is provided at Well No. 1 and Well No. 2. The pump house is equipped with a transfer switch for a portable engine-generator.

Gun Club Well No. 3

Constructed in 1976, Gun Club Well No. 3 is located east of Gun Club Rd. SE on SE Evans St., 200 feet north of Well No. 3a. It is a certificated water right with a non-additive annual quantity water right (G1-22734C) to the primary rights for the Risdon Wells, with a priority date of September 1, 1976. Well No. 3 has an authorized Qi of 500 gpm (0.72 MGD) and a Qa of 645 ac-ft/year (0.58 MGD). The well is located within the SE1/4 NW1/4 Sec. 34, T24N, R6E.

Well No. 3 was constructed to a depth of 205 feet with an 8-inch diameter casing and screen. The well was decommissioned in 1988 and has been abandoned following the sale of the property to the Issaquah School District.

Gun Club Well No. 3a

Constructed in 1975, Gun Club Well No. 3a is located east of Gun Club Rd. SE on SE Evans Street. It is a certificated water right (G1-22733C) with a non-additive annual quantity water right to the primary water rights for the Risdon Wells, with a priority date of September 1, 1976. Located within the SE 1/4 NW 1/4 Sec. 34, T24N, R6E, Well No. 3a has an authorized Qi of 300 gpm (0.43 MGD) and a Qa of 119 ac-ft/year (0.11 MGD).

Well No. 3a was constructed to a depth of 168 feet with an 8-inch casing and screen. The screen is open to the aquifer between depths of 160 feet and 180 feet. The well was decommissioned in 1988 and has been abandoned following the sale of the property to the Issaquah School District.

Gun Club Wells – Change in Point of Withdrawal

Because certificated water rights for the Gun Club Wells are on file at the Ecology, the City has some options for reestablishing the use of these wells. The first option is to drill new wells as replacement wells within the published location of the existing wells. Alternatively, applications for change can be filed to change the points of withdrawal for the Gun Club wells' water rights. These two wells have non-additive water rights and while they cannot be used as a new annual supply, the wells can provide additional instantaneous supply to meet peak demands.

In May 1997, the City submitted applications to change the point of withdrawal from the two Gun Club Wells to a new location. The test-drilling program located new point of withdrawal and the City submitted revised applications in February of 1998. The new site was proposed at 525 1st Avenue NW in the SE 1/4 Sec. 28, T24N, R6E. The applications for change of point diversion were denied by Ecology on the basis that the proposed changes would be detrimental to the public interest. This was based on the potential impact of the proposed changes in point of withdrawal to streamflows in East Fork of Issaquah Creek and Issaquah Creek. Copies of the file materials for this are in Appendix G.

The City intends to perform a study to investigate options for future utilization of the Gun Club water rights.

Gilman Well No. 4

Constructed in 1987, Gilman Well No. 4 is located south and east of where I-90 crosses Issaquah Creek. It is a primary, certificated water right (G1-24809CWRIS), with a priority date of March 10, 1986. Well No. 4 has an authorized Qi of 250 gpm (0.36 MGD) and a Qa of 200 ac-ft/year (0.18 MGD). It is located within the NW 1/4 NE 1/4 Sec. 28, T24N, R6E.

Gilman Well No. 4 was constructed to a depth of 112 feet with a 16-inch casing and screen. The screen is open to the aquifer between depths of 77 feet and 102 feet. Well No. 4 is equipped with a 250-gpm, vertical turbine pump driven by a 30-HP motor. Well No. 4 pumps directly to the Valley 297 Pressure Zone. It acts as a secondary well and operates during peak demand periods to refill the Westside Reservoir. The well is normally controlled by the water level in the Westside Reservoir and has produced an annual average of 0.17 MGD in the last four years (2014-2017).

In Gilman Well No. 4, the presence of perfluorinated compounds (PFCs), principal of which is perfluorooctanesulfonic acid (PFOS), was found. Currently, the EPA has no regulatory limit for PFOS in drinking water. However, the EPA has established a Provisional Health Advisory Level (PHAL) for PFOS which concentrations in the well currently exceed. A temporary PFOS treatment system is located at the well, further details of which are discussed in Chapter 8. Chapter 8 also includes an evaluation of long-term treatment options for the City.

Gilman Well No. 5

Constructed in 1987, Gilman Well No. 5 is located south and east of where I-90 crosses Issaquah Creek in the same location as Well No. 4. It is a certificated water right (G1-24633CWRIS), with a priority date of April 3, 1985. Well No. 5 is non-additive to the primary water rights for Risdon Wells with an authorized Qi of 1,000 gpm (0.1.44 MGD) and a Qa of 1,600 ac-ft/year (1.43 MGD). It is located within the NW 1/4 NE 1/4 Sec. 28, T24N, R6E.

Gilman Well No. 5 was constructed to a depth of 412 feet with a 16-inch casing and screen. The screen is open to the aquifer between depths of 323 feet and 405 feet. Well No. 5 is equipped with a vertical turbine pump driven by a 125-HP motor that has a capacity of 1,150 gpm. Well No. 5 pumps directly to the Valley 297 Pressure Zone. Well No. 5 acts as a secondary well, operates during peak demand periods to refill the Westside Reservoir, and is normally controlled by the water level in the Westside Reservoir. The Gilman Wells are also used when necessary to increase the pH of the water supply. The well has produced an annual average of 0.37 MGD in the last four years (2014-2017).

The wells and equipment are housed in the same masonry building. Disinfection (12.5 percent sodium hypochlorite) is provided for both Well No. 4 and Well No. 5. The building is wired to a portable engine generator for emergency power.

Gilman wells No. 4 and No. 5 are operated in conjunction in order to meet several water quality objectives: 1) lower arsenic levels, 2) increased pH, and 3) lower manganese levels. Blending the sources is accomplished by utilizing the City SCADA system with well start/stop setpoints.

Currently, no results have shown PFOS levels above the practical quantification limit (0.04 ug/L) in Well No. 5); however, there is a concern that if Well No. 4 is taken offline that PFOS will spread to the aquifer drawn by Well No. 5. In 2006, the Cascade Water Alliance (CWA) Board of Directors (See "Purchased Water" section), agreed to obligate members to maximize production of member-owned water sources. Issaquah-owned water sources would have to increase production to meet CWA's production minimum standard. Because an increase in production would come from Well No. 4 and Well No. 5, with the latter being a significant aesthetic issue due to increased manganese levels, manganese sequestrate equipment was installed in 2008 for injection before disinfection.

7.2 Water Rights and Water Right Self-Assessment

The City holds Ecology certificated rights to annually withdraw 2,800 acre-feet (2.50 MGD) of groundwater with a maximum instantaneous withdrawal of 3,880 gpm (5.59 MGD) including the Gun Club well rights. Copies of the Certificates of Water Rights and supporting file materials are provided in Appendix G.

The DOH Water Right Self-Assessment Form can be found in Table 7-1 and Table 7-2.

7.3 Purchased Water Supply

All of the City's purchased water is supplied by CWA. The City has three connections with Bellevue, as shown on Figure 2-3, for the purpose of wheeling water provided by CWA through Bellevue to serve the Lakemont, Montreux, and South Cove operating areas. There are two additional supply connections to the CWA regional transmission main (Bellevue-Issaquah Pipeline).

The terms of the CWA supply agreement are detailed in the Cascade Water Alliance Interlocal Contract, Amended and Restated in March 2012 (Appendix D). According to this agreement, CWA is obligated to provide a Full Supply Commitment to each founding member to meet current and future supply needs within the member's service area. Modification or extensions of the service area must be approved by CWA to guarantee CWA's commitment of full supply. Any Full Supply Commitment is subject to shortages; if the needed supply is not available, the shortage is shared by all CWA members in accordance with CWA's shortage management plan.

Table 7-1. Water Right Self-Assessment

Water Right Certificate # and Well Name	WFI Source #	Existing Water Rights				Current (2016) Source Production				10-Year (2027) Forecasted Source Production				20-Year (2037) Forecasted Source Production			
		Primary Qi	Non-Additive Qi	Primary Qa	Non-Additive Qa	Total Maximum Qi	Current Qi Excess or (deficiency)	Total Qa	Current Qa Excess or (deficiency)	Total Maximum Qi	Current Qi Excess or (deficiency)	Total Qa	Current Qa Excess or (deficiency)	Total Maximum Qi	Current Qi Excess or (deficiency)	Total Qa	Current Qa Excess or (deficiency)
G1-*08632CWRIS Risdon No. 1	S01	630	0	1,000	0	600	30	382.3	617.7	3,436	**(356)**	2,627	173	4,427	**(1,347)**	3,385	**(585)**
G1-*10071CWRIS Risdon No. 2	S02	1,200	0	1,600	0	1,056	144	701.5	898.5								
G1-24809CWRIS Gilman No. 4	S04	250	0	200	0	355	**(105)**	195.4	4.6								
G1-24633CWRIS Gilman No. 5	S05	1,000	0	0	1,600	1,078	**(78)**	182.8	**(182.8)**								
G1-22733C Gun Club No. 3a	S03	300	0	0	119	0	300	0	0	0	800	0	0	0	800	0	0
G1-22734C Gun Club No. 3	S03	500	0	0	645	0	500	0	0								
TOTALS		3,880 *A*		2,800 *B*		3,089 *C*	791 *=A-C*	1,462 *D*	1,338 *=B-D*	3,436 *E*	444 *=A-E*	2,627 *F*	173 *=B-F*	4,427 *G*	**(547)** *=A-G*	3,385 *H*	**(585)** *=B-H*

Notes:

1. Qi = Instantaneous Water Right in units of gpm, Qa = Annual Volume Water Right in units of ac-ft/year
2. Current and forecasted production is based on demands by operating areas currently served by the ground water wells and does not include areas served by interties with Bellevue or by CWA regional supply.
3. Gun Club wells are both currently inactive.
4. Table does not include water supplied to Issaquah from CWA (either wheeled through Bellevue through interties or delivery through the Bellevue-Issaquah Pipeline. CWA. Discussion of water supplied from CWA is discussed in Section 7.4.
5. There are no pending water right applications or interruptible water rights.

Table 7-2. Water Right Self-Assessment - Interties

Name of Wholesaling System Providing water	Quantities Allowed in Contract		Expiration Date of Contract	Currently (2016) Purchased				10-Year (2027) Forecasted Purchase				20-Year (2037) Forecasted Purchase			
	Maximum Qi	Maximum Qa		Maximum Qi	Current Qi Excess or (deficiency)	Maximum Qa	Current Qa Excess or (deficiency)	Maximum Qi	Current Qi Excess or (deficiency)	Maximum Qa	Current Qa Excess or (deficiency)	Maximum Qi	Current Qi Excess or (deficiency)	Maximum Qa	Current Qa Excess or (deficiency)
Cascade Water Alliance	17,280 *A*	13,442 *B*	None	2,716 *C*	14,564 *=A-C*	1,213 *D*	12,229 *=B-D*	1,998 *E*	15,282 *=A-E*	1,527 *F*	11,915 *=B-F*	2,165 *G*	15,115 *=A-G*	1,655 *H*	11,787 *=B-H*

Notes:

1. Qi = Instantaneous Water Right in units of gpm, Qa = Annual Volume Water Right in units of ac-ft/year
2. Current and forecasted production is based on demands of operating areas currently not served by the ground water wells.
3. CWA is obligated to provide the City with a Full Supply Commitment, which is not defined by any flow limit. The “Quantities Allowed in Contract” shown in the table are based on the maximum flow capacity of the Issaquah-Bellevue Pipeline.

In October 2005, CWA and Tacoma Public Utilities (Tacoma) executed a contract for the wholesale purchase of water from Tacoma by CWA. Tacoma's available excess supply helps fulfill CWA's supply needs. A portion of the water purchased (4 MGD average daily supply) is a permanent supply for CWA. Tacoma will also reserve an additional 6 MGD (average daily supply) for CWA through 2026. From 2026 through 2030, the amounts of water reserved for CWA decline. The contract provides a schedule of minimum annual purchase amounts through 2025. CWA may request additional water if Tacoma has excess supply available.

In late 2008, CWA and Seattle Public Utilities approved amendments to the 50 Year Declining Block Agreement effective January 1, 2009. The 2008 amendments created a supplemental block of supply that is available to CWA until 2023.

In 2009, CWA completed the purchase of Lake Tapps and associated water rights and infrastructure from Puget Sound Energy with the intent of converting it to a municipal water supply project. In 2010 final water rights needed for this conversion were issued by the State of Washington.

7.3.1 Historical Water Consumption and Production

A summary of the City's annual water consumption and production from 2014 through 2016 is presented in Table 7-3. Total water production includes well production and the amount of wholesale water purchased from CWA through Bellevue. Table 7-4 represents water use for the entire service area. Chapter 5 includes additional details on production and consumption.

Table 7-3. 2014-2016 Annual Consumption and Production

	Million Gallons (MG)				
	Average 2014-2016	2014	2015	2016	2017
Supply					
Well Production	504.77	497.70	540.22	476.39	513.55
Wholesale Purchase	342.25	289.90	341.65	395.20	499.30
Total Supply	847.02	787.60	881.86	871.59	1,012.85
Consumption					
Metered Retail Consumption	764.53	708.22	785.89	799.47	N/A [a]
Non-Revenue Use	82.49	79.37	95.98	72.12	N/A [a]

[a] At time of writing, retail use day for 2017 was not yet available.

The total annual well production and additional purchased water is shown graphically in Figure 7-1. A breakdown of the production from each individual well is shown in Figure 7-2. Variations in water production between years typically reflect changes in customer demands based on a variety of factors such as seasonal weather patterns, growth within the service area and City policies.

Figure 7-1. 2014-2016 Annual Well Production and Purchased Water

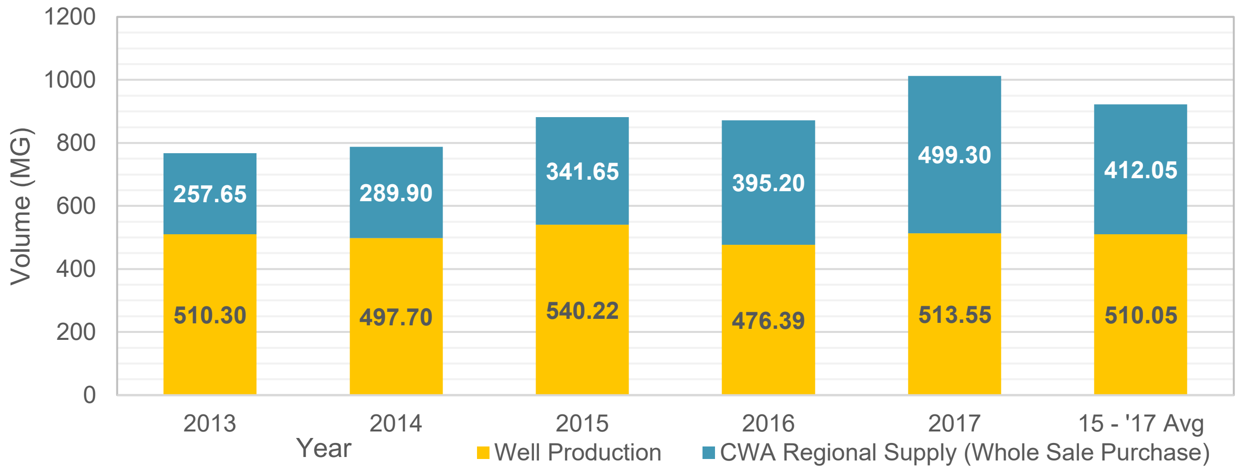
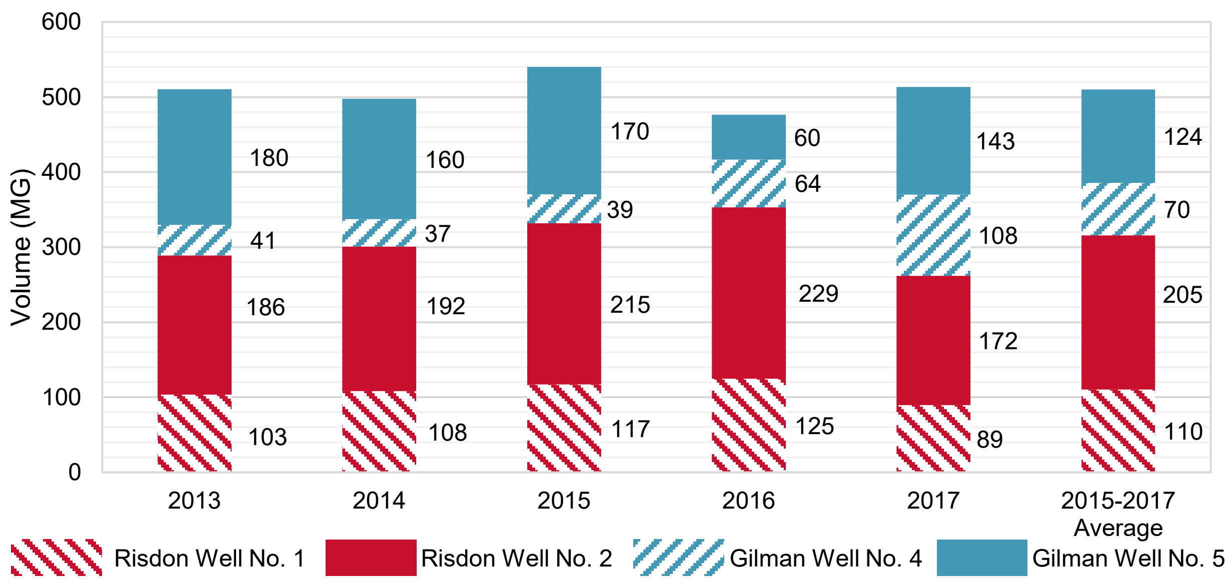


Figure 7-2. Breakdown of 2013-2017 Annual Well Production



7.4 Supply Evaluation and Strategies

This section takes a look at the water supply into different parts of the water system given current and forecasted water demands. Several different levels of the water system are considered as described below:

- **System-Wide Supply** – A look at the supply of water for the entire water system.
- **Groundwater / CWA / Bellevue Supply Areas** – A look at the supply to groupings of operating areas that have a common main supply. This includes (1) the operating areas served by Bellevue interties (South Cove, Montreux, and Lakemont), (2) the operating areas served by groundwater wells, and (3) the operating areas served by the CWA regional supply.
- **Operating Areas** – A look at each booster pump station and the operating area(s) each booster pump station serves to determine their adequacy across the planning horizon.

7.4.1 System-Wide Supply

The City has developed a water supply strategy comprised of multiple elements to help meet projected future demands and to increase reliability. Brief descriptions of each element are provided below:

- **Groundwater Supplies.** The City has historically been served by quality groundwater supplies. It is the City's goal to continue using its existing groundwater wells as its primary source of supply into the future utilizing the groundwater rights as much as feasible. The water rights and capacities of the City wells are not sufficient to accommodate demands through the planning horizon of 2037. Therefore, the City plans to utilize CWA water as needed to fully meet its water demands.
- **Regional Supplies.** As a member of CWA, the City obtains regional water either directly through the Issaquah-Bellevue Pipeline or by wheeling CWA water through Bellevue interties. The CWA water currently supplies Issaquah Highlands, Montreux, Lakemont, and South Cove. The regional pipeline and connections owned by CWA could be used to supply the entire City in the event of multi-well failure.
- **Sammamish Plateau Water (SPW) Interties.** These emergency interties allow the City or SPW to provide mutual aid in the event of either party losing its water supply. An emergency supply from Lake Sammamish, including treatment and transmission to distribution systems, is being considered (SPW would be involved in any development of an emergency supply to determine whether the supply would be an acceptable alternative for both the City and SPW).

The water from CWA is surface water originating from the City of Seattle. Seattle adds fluoride at the source whereas Issaquah does not fluoridate the well supply. Purchased water is currently delivered to Lakemont, Montreux, South Cove, and Issaquah Highlands, and only these operating areas currently receive fluoridated water. The water booster stations for the Issaquah Highlands have fluoridation equipment installed for when the City chooses to pump any percent of groundwater to these urban villages. These developments will be delivered fluoridated well water and then purchased water will be used to meet peaking demands by blending the two supplies together.

The Issaquah Highlands Operating Areas have the capability to be served by City groundwater, CWA water, or blended. The Talus Operating Areas can be served by either City groundwater or CWA water. Current operation has the Issaquah Highlands served with CWA water and Talus with groundwater. The City plans to eventually serve the entire retail service area except Montreux, Lakemont, and South Cove with blended well/regional water. In the event of a disruption of the regional water main supply, the four wells could supply the City with groundwater with necessary restrictions on the amount of water used, except for Montreux, Lakemont, and South Cove.

To evaluate supply adequacy, the future water demand for each supply area as summarized in Chapter 5 was compared to sources of supply capacities. Table 7-4 summarizes this comparison for the entire system. CWA is obligated to provide the City with a Full Supply Commitment[2], which is not defined by any flow limit. The physical supply delivery capacity of the regional transmission main is 13.0 MGD. The regional transmission main supplies both the City and SPW. The current minimum

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[2] A "Full Supply Commitment" means those needs, as projected in the Cascade Water Supply Plan and as agreed to by Issaquah shall be met from the CWA supply, net of Issaquah's own supply (ground water wells), and will be provided on an equal parity with other CWA members with Full Supply Commitments.

purchase requirements are 0.75 MGD for the City and 1.0 MGD for SPW. The regional transmission main could be upgraded in the future to deliver greater supply quantities. As the pipe capacity is approached, regional demands will be evaluated and provided by CWA. The regional supply capacity available to Issaquah shown in Table 7-4 reflects the physical delivery capacity of the regional transmission main of 13.0 MGD minus the forecasted values (extrapolated) for water needed from additional sources to serve SPW's demands from SPW's 2010 water system plan.

Table 7-4 shows that on a system-wide perspective, total supply exceeds total forecasted demand.

Table 7-4. Evaluation of Operational Supply Capacities

Source of Supply	Capacity (MGD)							
	2017		2023		2027		2037	
	Ave Day	Max Day	Ave Day	Max Day	Ave Day	Max Day	Ave Day	Max Day
City Wells [a]	2.5	4.4	2.5	4.4	2.5	4.4	2.5	4.4
Regional Supply [b]	10.1	10.1	9.0	9.0	8.2	8.2	6.2	6.2
Total Supply	12.6	14.5	11.5	13.4	10.7	12.6	8.7	10.6
Demand Based on Current Trends								
Total Demand	2.6	5.5	3.4	7.2	3.7	7.8	4.5	9.5
Supply Surplus	10	9.0	8.1	6.2	7.0	4.8	4.2	1.1

[a] Average day capacity of 2.5 MGD based on total Qa of water rights of 2,800 ac-ft. Maximum day capacity of 4.4 MGD based on total Qi of water rights excluding the Gun Club Wells (which are currently not used).

[b] Based on CWA's obligation to supply full capacity of the regional transmission main of 13.0 MGD less the difference in SPW forecasted peak demand to their current well sources per SPW's 2010 Water System Plan.

7.4.2 Bellevue Intertie Supply Evaluation

Future demand for the Montreux, Lakemont, South Cove, and Cougar Mountain operating areas must be compared against the facility limitations expressed in the 2016 Water Facilities Agreement between the City and Bellevue (Appendix D), which allows the City to use Bellevue's water system infrastructure for the delivery of a limited amount of water to these zones. Table 7-5 presents a comparison of the demand to facilities limitations for these four operating areas. The limits are met for all operating areas for the 20-year planning horizon except for South Cove. The agreement may need to be revisited as growth occurs in this area or another supply connection may need to be revisited in the 20 year planning horizon.

Table 7-5. Comparison of Bellevue Intertie Demand and Facility Limits

Operating Area	Limit	Demand (ERUs)			Compliance with Agreement
		2017	2027	2037	
Lakemont	400 ERUs or 600 MF Units	274	274	274	Complies for 20-year planning horizon.
Montreux	700 ERUs less Cougar Mountain Demand	311	311	311	Complies for 20-year planning horizon.

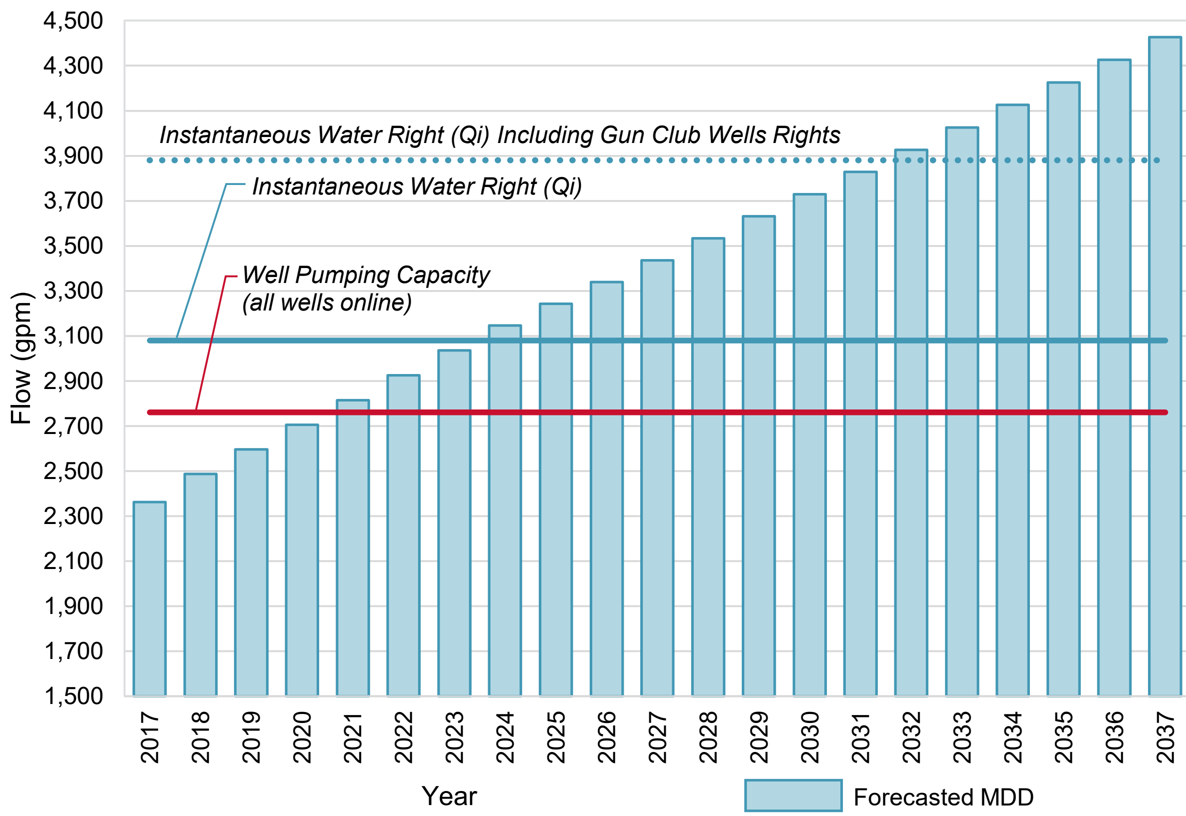
Table 7-5. Comparison of Bellevue Intertie Demand and Facility Limits

Operating Area	Limit	Demand (ERUs)			Compliance with Agreement
		2017	2027	2037	
South Cove	1,600 ERUs	1,313	1,539	1,803	Complies for 10-year planning horizon. Exceeds agreement for 20-year planning horizon. A new CWA connection to supply South Cove would be provided to prevent exceeding agreement.
Cougar Mountain	150 ERU	89	104	122	Complies for 20-year planning horizon

7.4.3 Supply Evaluation for Areas Supplied by Wells

The City's groundwater wells serve as the primary supply to the Valley, Cougar Ridge, Mount Hood, Wildwood, Highwood, and Forest Rim Operating Areas. Well water is not fluoridated. Areas receiving water exclusively from the groundwater supply receive unfluoridated water. Areas receiving CWA regional supply water, or a blend of groundwater and CWA water, is fluoridated (such as the case for the Issaquah Highlands and Grand Ridge Operating Areas. Figure 7-3 shows the MDD of the well supplied operating areas compared to the well pumping and instantaneous well water right (Qi) capacities.

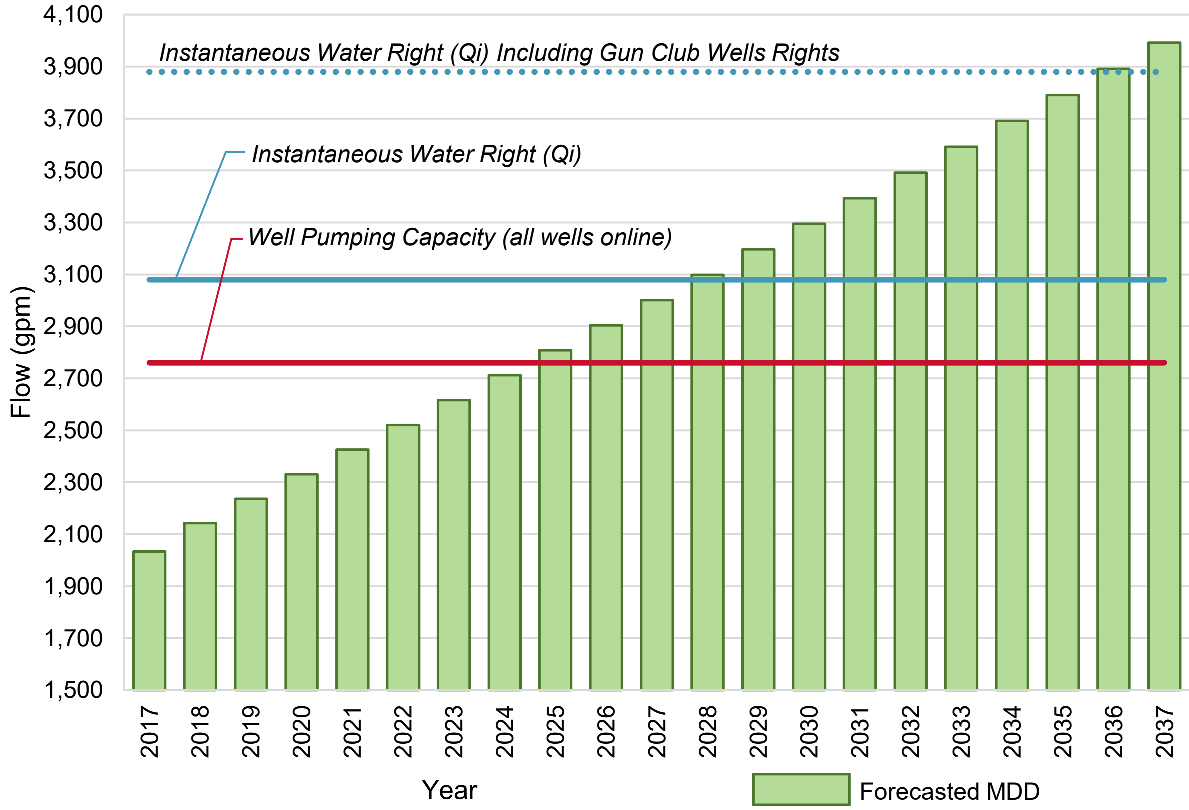
Figure 7-3. Maximum Day Demand of Well Supplied Areas



capable of meeting MDD until 2021. If well pumping capacity is expanded to take advantage of the complete instantaneous water right of the Risdon and Gilman Wells, the wells would be capable of meeting MDD until 2024.

The supply evaluation was also completed without the demand of the Talus Operating Areas (under a scenario in which they become fully supplied with CWA regional water). This is shown in Figure 7-4.

Figure 7-4. Maximum Day Demand of Well Supplied Areas without Talus Operating Area



pumping capacity is capable of meeting MDD until 2025. If well pumping capacity is expanded to take advantage of the complete instantaneous water right of the Risdon and Gilman Wells, the wells would be capable of meeting MDD until 2028. If the water rights of the Gun Club Wells are also utilized, MDD could be met until 2036.

A comparison of demands was also made to the annual volume of water rights (Qa) which is shown in Figure 7-5 and Figure 7-6. The figures show that the annual volume of water rights would be exceeded in 2030. When looking at the forecasted annual demand excluding Talus, the annual volume of water rights would be exceeded in 2034.

Figure 7-5. Annual Demand of Well Supplied Areas

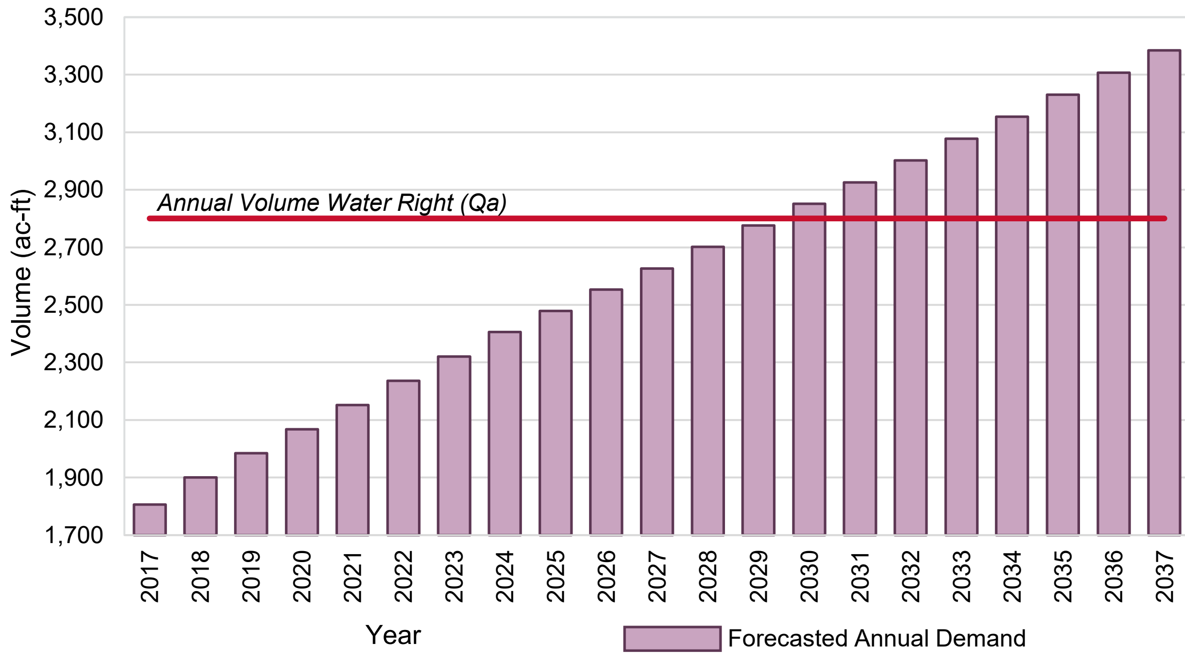
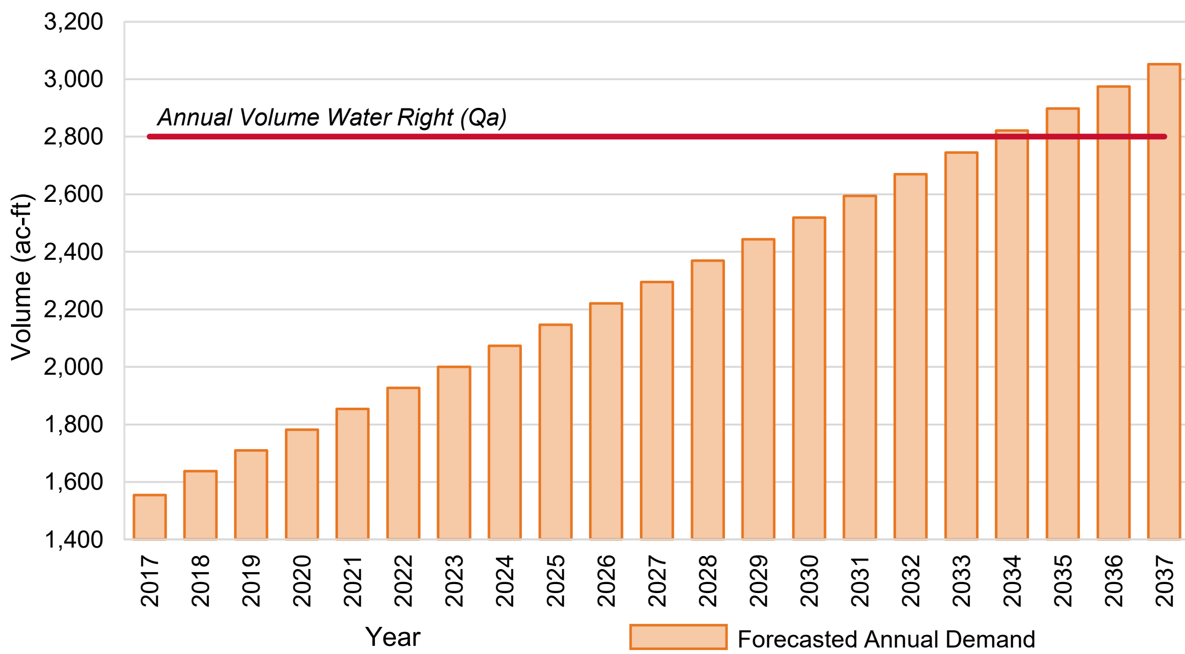


Figure 7-6. Annual Demand of Well Supplied Areas without Talus Operating Area



Summary of Supply Evaluation for Areas Supplied by Wells

The analyses shown in Figure 7-3, Figure 7-4, Figure 7-5, and Figure 7-6 show that well supply capacity is limited first by pumping capacity, followed by instantaneous water rights, and finally by annual water rights. The figures also show that the wells would be capable of continuing to supply the current set of operating areas served until 2021. At that time, improvements would need to be made to increase pumping capacity to optimize the use of the available instantaneous water rights or the Talus Operating Areas would need to switch to being supplied solely with CWA regional water. If changing the Talus Operating Areas to regional water, the existing wells would be capable of supplying the remaining operating areas until 2025.

Table 7-6 provides a summary of the amount of CWA regional supply necessary to supplement well supply to areas currently served by the wells.

Table 7-6. Required CWA Regional Supply for Areas Currently Served by Wells

	CWA Regional Water Necessary [a]	
	To Meet Maximum Day Demand Limited by Current Pumping Capacity (gpm)	To Meet Annual Demands Limited by Annual Water Right Volume (ac-ft)
Year CWA Water Necessary	2021	2030
10-year Planning Horizon (2027)	969	0
20-year Planning Horizon (2037)	1,667	584.5

[a] Calculated as the difference between: a) what is available from current pumping capacity or water rights, and b) projected demands for areas currently supplied by wells.

7.4.4 CWA Supply Analysis

Table 7-7 provides an analysis of the water supply needs using CWA regional water and variations in those demands across the planning horizon.

Table 7-7. CWA Supply Analysis

Water Supply Area	Demands Based on Current Trends			
	2017 [e]	2023	2027	2037
Maximum Day Demand (gpm)				
Bellevue Interties [a]	417	468	490	552
Issaquah Highlands BIP Connection [b]	1,044	1,463	1,500	1,606
Talus BIP Connection [c]	0	420	435	435
Total	1,461	2,351	2,425	2,593
Annual Demand (MG)				
Bellevue Interties [a]	104	116	122	137
Issaquah Highlands BIP Connection [b]	260	364	374	400
Talus BIP Connection [c, d]	0	105	108	108
Total	364	585	604	645

Notes (Table 7-7):

[a] Includes the Cougar Mountain (in 2023 and beyond), Montreux, Lakemont, and South Cove Operating Areas.

[b] Includes the Lakeside (in 2023 and beyond), Issaquah Highlands Summit, Issaquah Highlands Central Park, and Grand Ridge Operating areas.

[c] Includes the Talus Foothills and Talus Shangri-La Operating Areas.

[d] Values based on Talus being fully supplied by CWA water year-round once CWA water is needed to meet MDD (Table 7-6).

[e] 2017 is forecasted based on 2015-2016 data. Actual 2017 water supply values may differ from the forecast.

7.5 Operating Area Supply Analysis

This section provides a supply analysis for individual and groups of operating areas by looking at the capacities of the existing booster pump stations (BPSs) to determine if there is sufficient firm capacity to meet current and future MDD. Firm capacity is the capacity of the pump station with the largest pump out of service. It is also a City design policy that two separate BPSs supply water to new operating areas where each BPS is capable of meeting MDD. The analysis also includes a demand associated with replenishing depleted fire suppression storage within 24-hours per City design policy.

Equivalent Residential Units (ERUs)

The tables in the Operating Area Supply Analysis include the projected number of ERUs. This does not correlate to the number of single family residential (SFR) lots within the area being analyzed. The projected ERUs represents the number of SFR units with average consumption that would equal the projected demand for the area.

An important consideration in this analysis is the fact that some pump stations serve several operating areas. For example, water supplied to the Forest Rim Operating Area must pass through the Mountain Park, Mount Hood, Wildwood and Forest Rim BPSs to reach the Forest Rim Operating Area. In these cases, each pump station must supply the combined downstream MDD.

Forest Rim BPS

As shown in Table 7-8, the Forest Rim BPS has adequate capacity for the 20-year planning horizon.

Table 7-8. Forest Rim BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Forest Rim 1178 Zone	117	129	137	161
Projected Demand (gpm)				
Average Day Demand	12.2	13.4	14.3	16.7
Maximum Day Demand	25.7	28.2	30.1	35.3
Flow to Replenish Fire Suppression Storage in 24 hours	83.3	83.3	83.3	83.3
Sources (gpm)				
Pump 1 [a]	300	300	300	300
Pump 2 [a]	300	300	300	300
Total Capacity with Largest Pump Offline	300	300	300	300
Source Surplus/(Deficiency) (gpm)	**191.0**	**188.4**	**186.6**	**181.4**

Wildwood BPS

As shown in Table 7-9, the Wildwood BPS has adequate capacity for the 20-year planning horizon.

Table 7-9. Wildwood BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Forest Rim 1178 Zone	117	129	137	161
Highwood 920, 782, 715, 677 Zones	439	483	514	603
Total ERUs	**556**	**611**	**651**	**763**
Projected Demand (gpm)				
Average Day Demand	58	64	68	80
Maximum Day Demand	122	134	143	168
Flow to Replenish Fire Suppression Storage in 24 hours	83	83	83	83
Sources (gpm)				
Wildwood BPS				
Pump 1	450	450	450	450
Pump 2	450	450	450	450
Total Capacity with Largest Pump Offline	450	450	450	450
Source Surplus/(Deficiency) (gpm)	**245**	**232**	**224**	**199**

Mount Hood BPS

As shown in Table 7-9, the Mount Hood BPS has adequate capacity for the 20-year planning horizon.

Table 7-10. Mount Hood BPS Capacity Analysis

	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalent Residential Units (ERUs)				
Forest Rim 1178 Zone	117	129	137	161
Highwood 920, 782, 715, 677 Zones	439	483	514	603
Wildwood 625, 588 Zones	116	128	136	160
Total ERUs	**672**	**739**	**787**	**923**
Projected Demand (gpm)				
Average Day Demand	70	77	82	96
Maximum Day Demand	148	162	173	203
Flow to Replenish Fire Suppression Storage in 24 hours	83	83	83	83
Sources (gpm)				
Mount Hood BPS				
Pump 1	500	500	500	500
Pump 2	500	500	500	500
Total Capacity with Largest Pump Offline	500	500	500	500
Source Surplus/(Deficiency) (gpm)	**269**	**254**	**244**	**214**

12th Avenue and Mountain Park BPSs

The storage analysis for the Mt. Hood Reservoir (Chapter 9) found that the reservoir does not have the capacity to fully contain the entire fire suppression storage volume. It is assumed that the difference between the firm pumping capacity (capacity with largest pump offline) for the operating area and the maximum day demand is fully utilized for fire flows with the remainder of the fire flow provided by fire suppression storage within the Mt. Hood Reservoir as shown in Table 7-11. Using this assumption, the BPSs have adequate firm capacity to serve the fire flow demand during maximum day demand if the largest pump is offline. However, there is not enough capacity to meet fire flows during maximum day demand if the largest pump station is completely offline.

Table 7-11. 12th Avenue and Mountain Park BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Forest Rim 1178 Zone	117	129	137	161
Highwood 920, 782, 715, 677 Zones	439	483	514	603
Wildwood 625, 588 Zones	116	128	136	160
Mount Hood 480 Zone	1,045	1150	1225	1436
Total ERUs	**1,717**	**1,889**	**2,013**	**2,359**
Projected Demand (gpm)				
Average Day Demand	179	197	210	246
Maximum Day Demand	377	415	442	518
Fire Flow Available for Mt. Hood Zone [a]	3,143	3,105	3,078	3,002
Sources (gpm)				
12th Avenue BPS				
Pump 1	760	760	760	760
Pump 2	760	760	760	760
Mountain Park BPS				
Pump 1	1,000	1,000	1,000	1,000
Pump 2	1,000	1,000	1,000	1,000
Pump 3	1,000	1,000	1,000	1,000
Total Capacity with Largest Pump Offline	3,520	3,520	3,520	3,520
Source Surplus/(Deficiency) (gpm)	**0**	**0**	**0**	**0**
Total Capacity with Largest BPS Offline	1,520	1,520	1,520	1,520
Source Surplus/(Deficiency) (gpm)	**(2,000)**	**(2,000)**	**(2,000)**	**(2,000)**

[a] Storage for Mt. Hood Zone does not have capacity to include entire fire suppression storage volume. It is assumed that the difference between the pumping capacity with the largest pump offline for the operating area and the maximum day demand is used for fire flows (leading to zero surplus/deficiency). The remainder of the fire flow is provided through fire suppression storage in the Mt. Hood Reservoir.

Cascade and Shangri-La BPSs

As shown in Table 7-12, the Cascade and Shangri-La BPSs have adequate capacity for the 20-year planning horizon.

Table 7-12. Cascade and Shangri-La BPS Capacity Analysis

	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalent Residential Units (ERUs)				
Talus Foothills 912, 752 Zones	509	649	672	672
Projected Demand (gpm)				
Average Day Demand	53	68	70	70
Maximum Day Demand	112	143	148	148
Flow to replenish fire suppression storage in 24 hr	125	125	125	125
Sources (gpm)				
Cascade BPS				
Pump 1	195	195	195	195
Pump 2	195	195	195	195
Pump 3	195	195	195	195
Pump 4	195	195	195	195
Shangri-La BPS				
Pump 1	250	250	250	250
Pump 2	250	250	250	250
Total Capacity with Largest Pump Offline	1,030	1,030	1,030	1,030
Source Surplus/(Deficiency) (gpm)	**793**	**762**	**757**	**757**
Total Capacity with Largest BPS Offline	500	500	500	500
Source Surplus/(Deficiency) (gpm)	**263**	**232**	**227**	**227**

Talus I/II BPS

The storage capacity analysis for the Shangri-La Reservoir (Chapter 9) shows that for a static condition the reservoir has adequate storage capacity. However, modeling determined that due to pipe friction losses, fire flow goals were not being met for a multifamily development without pressures dropping below 20 psi. To increase the available head with fire suppression storage depleted, it is assumed that the Talus I/II BPS provide a portion of the required fire flow as shown in Table 7-13. As shown in Table 7-13, the Talus I/II BPS has adequate capacity for the 20-year planning horizon.

Table 7-13. Talus I /II BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Talus Foothills 912, 752 Zones	509	649	672	672
Talus Shangri-La 616 Zone	986	1,260	1,305	1,305
Total ERUs	**1,495**	**1,909**	**1,978**	**1,978**
Projected Demand (gpm)				
Average Day Demand	156	199	206	206
Maximum Day Demand	329	420	435	435
Fire Flow to Talus Shangri-La 616 Zone	1,065	1,065	1,065	1,065
Sources (gpm)				
Talus I/II BPS				
Pump 1	500	500	500	500
Pump 2	500	500	500	500
Pump 3	500	500	500	500
Pump 4	500	500	500	500
Total Capacity with Largest Pump Offline	1,500	1,500	1,500	1,500
Source Surplus/(Deficiency) (gpm)	**106**	**15**	**0**	**0**

Terra II BPS

As shown in Table 7-14, the Terra II BPS has adequate capacity for the 20-year planning horizon.

Table 7-14. Terra II BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Cougar Ridge 431 Zone	75	81	86	99
Projected Demand (gpm)				
Average Day Demand	7.8	8.5	9.0	10.3
Maximum Day Demand	16.5	17.9	18.9	21.8
Flow to Replenish Fire Suppression Storage in 24 hours	125.0	125.0	125.0	125.0
Sources (gpm)				
Terra II BPS				
Pump 1	525	525	525	525
Pump 2	525	525	525	525
Total Capacity with Largest Pump Offline	525	525	525	525
Source Surplus/(Deficiency) (gpm)	**383**	**382**	**381**	**378**

Grand Ridge BPS

As shown in Table 7-15, the Grand Ridge BPS has adequate capacity for the 20-year planning horizon.

Table 7-15. Grand Ridge BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Grand Ridge 1337 Zone	26	46	60	60
Projected Demand (gpm)				
Average Day Demand	2.7	4.8	6.3	6.3
Maximum Day Demand	5.7	10.2	13.2	13.2
Flow to Replenish Fire Suppression Storage in 24 hours	83.3	83.3	83.3	83.3
Sources (gpm)				
Grand Ridge BPS				
Pump 1	293	293	293	293
Pump 2	293	293	293	293
Total Capacity with Largest Pump Offline	293	293	293	293
Source Surplus/(Deficiency) (gpm)	**204**	**199**	**196**	**196**

Central Park BPS

As shown in Table 7-16, the Central Park BPS has adequate capacity for the 20-year planning horizon.

Table 7-16. Central Park BPS Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Grand Ridge 1337 Zone	26	46	60	60
Issaquah Highlands Summit 1234, 1000, 615 Zones	1,932	1,932	1,932	1,932
Total ERUs	**1,958**	**1,979**	**1,992**	**1,992**
Projected Demand (gpm)				
Average Day Demand	204	206	208	208
Maximum Day Demand	430	435	438	438
Flow to Replenish Fire Suppression Storage in 24 hours	583	583	583	583
Sources (gpm)				
Central Park BPS				
Pump 1	1,528	1,528	1,528	1,528
Pump 2	1,528	1,528	1,528	1,528
Total Capacity with Largest Pump Offline	1,528	1,528	1,528	1,528
Source Surplus/(Deficiency) (gpm)	**514**	**510**	**507**	**507**

Holly I & II BPSs

As shown in Table 7-17, the Holly I and II BPBs have adequate capacity for the 20-year planning horizon except for the case of the largest pump station being offline in the present.

Table 7-17. Holly I & II BPSs Capacity Analysis

	Year			
	2017	2023	2027	2037
Projected Equivalent Residential Units (ERUs)				
Grand Ridge 1337 Zone	26	46	60	60
Issaquah Highlands Summit 1234, 1000, 615 Zones	1,932	1,932	1,932	1,932
Central Park 742 and Lakeside Zones	2,790	4,676	4,834	7,306
Total ERUs	**4,748**	**6,655**	**6,827**	**7,306**
Projected Demand (gpm)				
Average Day Demand	495	693	711	761
Maximum Day Demand	1,044	1,463	1,500	1,606
Flow to Replenish Fire Suppression Storage in 24 hours	583	583	583	583
Sources (gpm)				
Holly I BPS				
Pump 1	500	500	500	500
Pump 2	500	500	500	500
Holly II BPS				
Pump 1	1,300	1,300	1,300	1,300
Pump 2	1,300	1,300	1,300	1,300
Pump 3	1,300	1,300	1,300	1,300
Proposed SPAR Pump Station				
Pump 1		1,000	1,000	1,000
Pump 2		1,000	1,000	1,000
Pump 3		1,000	1,000	1,000
Total Capacity with Largest Pump Offline	3,600	6,600	6,600	6,600
Source Surplus/(Deficiency) (gpm)	**1,973**	**4,554**	**4,516**	**4,411**
Total Capacity with Largest BPS Offline	1,000	4,000	4,000	4,000
Source Surplus/(Deficiency) (gpm)	**(627)**	**1,954**	**1,916**	**1,811**

7.6 Water Supply Reliability Analysis

Analysis of the water supply reliability evaluates the sources and water rights for adequacy in consistent, uninterrupted delivery throughout the distribution system. Water supply shortages or interruptions in service can cause many problems when zero or negative main pressure occurs. Examples of such problems include backflow of contaminated water from industrial, commercial, retail, or domestic service connections into the City's water mains or leaching of surrounding groundwater into the water mains through existing main leaks or cracks. While the City actively surveys its distribution system, the potential for main leaks will always exist. Another key issue with a nonconsistent water supply is deficient service to customers caused by interrupted delivery.

The City's primary sources are the four city-owned groundwater wells. The other sources are CWA water delivered through Bellevue and the Bellevue-Issaquah Pipeline.

In the case of an emergency in which the city wells become inoperable, the City would rely on CWA water and also water supplied through the two emergency interties with SPW to serve the City. If CWA water became unavailable the City could supply its entire retail service area with groundwater from the City wells and additional water from the SPW emergency interties, if necessary, with the exception of Montreaux, Lakemont, and South Cove Operating Areas.

To be prepared for a catastrophic supply disruption event in which both CWA water and City wells are impacted, the City has a Water Shortage Contingency Plan (2001) that serves as a guide to making management decisions related to a shortage of supply due to drought as well as abrupt emergencies. The plan covers a phased approach beginning will voluntary curtailment followed by increasing levels of mandatory curtailment.

Within the distribution grid, the City has built redundancy into each pressure zone by interconnecting zones with normally-closed pressure reducing valves and providing redundant reservoirs and booster stations where possible. Currently, the South Cove Operating Area does not have a secondary source of supply, relying solely on water from Bellevue. A capital improvement project is planned to add a secondary source of supply from the Bellevue-Issaquah Pipeline (BIP) supplying CWA water to the operating area as a safety measure. When feasible, the City has made a priority to connect dead-end water mains within the water system by looping to provide a more reliable distribution system.. The City also has a fleet of mobile emergency power generators, capable of providing temporary power to any booster or well station as demand necessitates.

7.7 Groundwater Hydraulic Continuity and Water Rights

Hydraulic continuity refers to the natural interrelationship between surface waters and groundwater. The issue of hydraulic continuity has come to the forefront with respect to water supply planning for communities with groundwater sources. The central issue is that these water resources are viewed by Ecology as an integrated hydro-geologic system.

The Water Resources Act of 1971 charges Ecology to consider the "natural interrelationships of surface and groundwater" in administering water rights and making water allocation decisions (RCW 90.54.020 (8)). In addition, the 1945 groundwater code states that the right to use groundwater which adversely affects the flow of any spring, water course, lake, or other body of surface water must be considered junior to any water rights already in existence for the use of the surface water (RCW 90.44.030).

Under current laws, Ecology considers that an application for a groundwater withdrawal, shown to be in hydraulic continuity with surface water, must be treated the same as if the request was for surface water. Therefore, whenever a surface water source has limitations on it, such as instream flow requirements, permits for appropriation of groundwater are required to have limitations to protect the surface water source. Closure of a stream or a surface water source requires that applications for the appropriation of groundwater in hydraulic continuity with the surface waters be denied unless the effect on the surface water can be fully mitigated.

Because of Ecology's mandate to manage surface and groundwater as an integrated unit, the City would face significant challenges in terms of securing new permits for additional appropriation of groundwater within this aquifer. Ecology's policy is to place the burden on groundwater permit applicants to provide the technical information necessary to demonstrate the absence of hydraulic continuity in cases where adequate information is lacking.

This is demonstrated in the denial of the applications for change in point of withdrawal for the Gun Club wells discussed in Section 7.1.2. However in this denial, Ecology has also left it open in the Report of Examination for these change applications that the City could consider drilling replacement wells for the Gun Club wells. Replacement wells drilled within the same legal description as the original wells do not require a change application.

Any proposed change in location of the Gun Club wells where the proposed well would not be within the same legal description as the original well locations as it was advertised in the newspaper would require a change application and would be subject to the same rigorous review described above that Ecology followed in their denial of the change applications for the Gun Club wells.

Given these groundwater development constraints, the City is not looking to the Lower Issaquah Valley aquifer to provide future additions to its source water. Alternatively, the City plans to purchase water from CWA to meet future demands.

Chapter 8. Water Quality

8.1 Introduction

The City of Issaquah is defined as a Group A – Community Water System and must comply with the drinking water standards of the federal SDWA and its amendments, as regulated by the United States Environmental Protection Agency (EPA). The DOH adopted the updated federal standards under WAC 246-290, of which the most recent version became effective November 1, 2010.

Delivering the best quality drinking water is the City's primary concern. The City's water is supplied by groundwater wells and regional water interties, as described in Chapter 7, that are tested for the presence of contaminants at the frequencies prescribed by DOH regulations. The City's water quality results show compliance with DOH water quality requirements. The City is also in compliance with all DOH reporting requirements, including publication and distribution of an annual Consumer Confidence Report (CCR) that keeps consumers informed as to the quality of the City's water supply and water delivery systems.

This chapter includes the following components:

- Descriptions of current water quality regulations and the City's monitoring requirements.
- Summary of proposed and anticipated regulations applicable to the City.
- Summary of the City's existing water quality and compliance with EPA and DOH regulations.
- Summary of water quality monitoring plans used by the City.
- Recommendations for treatment practices or changes to existing monitoring plans based on existing or proposed regulations.
- Evaluation of long-term options for addressing emerging contaminants, including polyfluoroalkyl substances (PFAS), and other water quality issues.

This chapter utilizes information from the *Department of Health Water Quality Monitoring Schedule for the Year 2017* (Appendix H), the City's *Water Facilities Inventory (WFI) Form* (Appendix I), and the City's annual *Water Quality Reports* from 2012 to 2016 (Appendix J).

8.2 Regulatory Requirements

The SDWA of 1974, amended in 1986 and 1996, established specific roles for the federal government, state government, and water system purveyors, with respect to water quality monitoring. The EPA is authorized to develop national drinking water regulations and oversee the implementation of the SDWA. State governments are expected to adopt the federal regulations and accept primary responsibility or "primacy" for administration and enforcement of the Act. States can also regulate contaminants and set advisory levels. Public water system purveyors are assigned the day-to-day responsibility of meeting regulations by incorporating monitoring, record keeping, and sampling procedures into their operation and maintenance programs.

The SDWA regulations are summarized in Table 8-1 and are divided into those that address source water quality, distribution system water quality, surface water treatment, and reporting requirements. The City currently receives treated surface water from Cascade Water Alliance (CWA) as a constant source of supply for the Issaquah Highlands development. Although, the City can also send blended groundwater to the Issaquah Highlands development. As CWA is responsible for meeting all surface water treatment requirements for this source, surface water treatment rules are only summarized briefly herein. All other rules are summarized and monitoring requirements under each rule are noted below. This section ends with a summary of anticipated future regulatory requirements.

Table 8-1. Drinking Water Regulations

Rule	CFR	WAC 246-290	Affected Contaminants	Publication Date of Final Rule
Source Water Quality				
National Primary and Secondary Drinking Water Standards	See below	Part 4, 300, 310, and 320	Bacteriological, IOC, VOC, SOC, Asbestos, Radionuclides, TTHMs, Lead/Copper, Phase 1, Phase II/V	Phases 1 through V promulgated 1987 through 1992
Radionuclides Rule	40 CFR 141.15 141.25 141.26	Part 4 , 300 (8), 310(6), and 320	Radionuclides	Published December 7, 2000
Arsenic Rule	40 CFR 141.23 141.24 141.16	Part 4, 300(4) and 310(3)	Arsenic	Promulgated February 2002, compliance required by January 23, 2006
Unregulated Contaminants Monitoring Rule 4		N/A	Various contaminants considered for future regulations	Promulgated December 20,2016
Groundwater Rule		Part 4, 300(3) and 320(2)	Fecal indicators in groundwater	Promulgated January 8, 2007
Distribution System Water Quality				
Total Coliform Rule/ Revised Total Coliform Rule		Part 4, 300, 310(2), and 320(2)	Total Coliform Bacteria	TCR promulgated 1989, RTCR February 2013 with minor corrections April 2014.
Lead and Copper Rule	40 CFR 141.86 141.87 141.88	Part 4, 300(4), 310(3), and 320(4)	Lead and Copper	Promulgated January 12, 2000 Compliance by January 2003
Stage 1 Disinfectants/Disinfection Byproduct Rule	40 CFR Parts 9, 141, 142 63 FR 69390	Part 4, 300, 310, and 320	Trihalomethanes, haloacetic acids, chlorite, bromate, and disinfectant residuals	Promulgated February 16, 1999, Compliance by December 1, 2003
Stage 2 Disinfectants/ Disinfection Byproduct Rule	40 CFR Part 141, Subpart V 71 FR 388	Part 4, 300,310, and 320	Trihalomethanes and haloacetic acids	Promulgated January 4, 2006, Effective March 6, 2006

Table 8-1. Drinking Water Regulations

Rule	CFR	WAC 246-290	Affected Contaminants	Publication Date of Final Rule
Surface Water Treatment Rules				
Information Collection Rule	40 CFR, Part 141, Subpart M		Large Surface Water Systems: Bacteriological, DBP, IOCs	Promulgated June 18, 1996
Surface Water Treatment Rule	40 CFR 141		Large Surface Water Systems, Bacteriological, Viruses, *Giardia lamblia*	Promulgated June 1989
Interim Enhanced Surface Water Treatment Rule	63 FR 69478		Large Surface Water Systems: Bacteriological, incorporate *Cryptosporidium* into watershed plans	Promulgated November 1998
Long Term 1 Enhanced Surface Water Treatment Rule	40 CFR Parts 9, 141, 142	Part 4, 300	Bacteriological, Cryptosporidium	Promulgated February 13, 2002, compliance by March 15, 2005
Long Term 2 Enhanced Surface Water Treatment Rule	40 CFR Parts 9, 141, 142	Part 4, 300	Bacteriological	Promulgated in 2006
Reporting Requirements				
Consumer Confidence Report Rule	40 CFR 141 Part O	Part 7, Subpart B	Reporting Only	Published August 19, 1998
Public Notification Rule	40 CFR 141 Part Q	Part 4, 320	Reporting Only	Promulgated 2000

8.2.1 Source Water Quality

Regulations applicable to the City's water system that address source water quality are described herein.

National Primary and Secondary Drinking Water Standards

National Primary Drinking Water Standards are currently set for 87 contaminants. Maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) have been established for 77 contaminants, while the remaining ten have treatment technique requirements. A constituent's MCL is generally based on its public health goal (PHG), which is the level of a contaminant in drinking water below which there is no known or expected health risk. Regulated constituents include microbial contaminants, inorganic chemicals (IOCs), volatile organic chemicals (VOCs), synthetic organic chemicals (SOCs), radionuclides, and disinfection by-products (DBPs). Regulations affecting DBPs are discussed below in the distribution system water quality section.

The EPA regulates most of the chemical contaminants through the rules known as Phase I, II, IIb, and V. The EPA issued the four rules regulating 69 contaminants over a five-year period as it gathered, updated, and analyzed information on each contaminant's presence in drinking water supplies and its health effects. The Phase I Rule was promulgated July 8, 1987 and included eight VOCs. The Phase II and IIb Rules (published January 30 and July 1, 1991) updated or created new limits for 38 contaminants. The Phase V Rule (published July 17, 1992), set standards for 23 additional contaminants. These rules form the basis of the Washington Department of Health regulations, WAC 246-290. Since the Phase V Rule, MCLs for additional contaminants have been established through new regulations, such as the Arsenic Rule, and must be adopted by the DOH.

The EPA has also established secondary standards for 15 contaminants to address the aesthetic quality of drinking water; these secondary standards have also been adopted within the WAC. Because the federal standards primarily address taste and odor, rather than health issues, they are often used only as a guideline. For new community water systems, the DOH requires treatment for secondary MCL (SMCL) exceedances under WAC 246-290-320 (3)(d). For existing public water systems, the WAC stipulates that the required follow-up action be determined by the DOH based on the degree of consumer acceptance of the water quality and their willingness to bear the cost of meeting the secondary standard.

Current primary and secondary MCLs for inorganic and organic constituents, respectively, are documented in the following subsections.

Inorganic Chemicals

Regulated inorganic chemicals include elemental metals such as mercury, arsenic, and iron. Some non-metallic constituents such as chloride, fluoride, and sulfate are also included in this category. Physical properties of IOCs that affect water quality in this category include turbidity, specific conductivity, total dissolved solids, and color. WAC 246-290 specifies primary and secondary MCLs for IOCs, which are summarized in Table 8-2 and Table 8-3, respectively. Asbestos samples are collected from the distribution system since the source of asbestos is asbestos cement pipe. As such, this requirement is discussed in Distribution System Water Quality 8.2.2.

Table 8-2. Primary MCLs for Inorganic Chemicals

Contaminant	Primary MCL(mg/L) [a]
Antimony	0.006
Arsenic	0.01
Asbestos	7 million fibers/liter (length >10 microns)
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Copper	1.3 [b]
Cyanide	0.2
Fluoride	4
Lead	0.015 [b]
Mercury	0.002
Nitrate	10
Nitrite	1

Table 8-2. Primary MCLs for Inorganic Chemicals

Contaminant	Primary MCL(mg/L) [a]
Selenium	0.05
Sodium	20 [c]
Thallium	0.002

[a] Source: State Department of Health Drinking Water Regulations (246-290), effective July 2008

[b] Lead and copper have established action levels, rather than MCLs. These are discussed further in the Lead and Copper Rule, under the Distribution System Water Quality section.

[c] EPA has established a recommended level of 20 mg/L for individuals that have restrictions on daily sodium intake. This is not an enforceable standard

Table 8-3. Secondary MCLs for Inorganic Chemicals

Contaminant	Secondary MCL(mg/L) [a]
Aluminum	0.05 to .2
Chloride	250
Color	15 Color Units
Copper	1
Corrosivity	Non-Corrosive
Fluoride	2
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 TON (threshold odor number)
pH	6.5 - 8.5
Silver	0.1
Sulfate	250
Total Dissolved Solids (TDS)	500
Zinc	5

[a] Source: State Department of Health and Drinking Water Regulations (246-290), effective July 2008

MONITORING REQUIREMENTS

Monitoring requirements are described in the City's Water Quality Monitoring Schedule for the Year 2017, as presented in Appendix H. The City's groundwater sources must be sampled for IOCs once every nine years. Nitrate samples are required for all sources annually. Since nitrates are included in

IOC sampling, additional samples are not required in years when a complete IOC sample is taken from the source. The City does not have any current monitoring waivers for IOCs.

Volatile Organic and Synthetic Organic Chemicals

Volatile organic chemicals (VOCs) are manufactured, carbon-based chemicals that vaporize quickly at normal temperatures and pressures. VOCs include many hydrocarbons associated with fuels, paint thinners, and solvents. This group does not include organic pesticides, which are regulated separately as synthetic organic chemicals (SOCs). VOCs are divided into the two following groups:

- Regulated VOCs that have been determined to pose a significant risk to human health.
- Unregulated VOCs for which the level of risk to human health has not been established.

There are currently 21 regulated volatile organic chemicals (VOCs) and 33 regulated synthetic organic chemicals (SOCs). A list of these compounds and their MCLs is included in Table 8-4.

Table 8-4. Regulated Volatile and Synthetic Organic Chemicals

Organic Chemical	Federal Regulation	Primary MCL (mg/L)[a]	Organic Chemical	Federal Regulation	Primary MCL (mg/L)[a]
Volatile Organic Chemicals (VOCs)					
Vinyl chloride	Phase I	0.002	Monochlorobenzene	Phase II	0.1
Benzene	Phase I	0.005	Ortho-Dichlorobenzene	Phase II	0.6
Carbon Tetrachloride	Phase I	0.005	Styrene	Phase II	0.1
1,2-Dichloroethane	Phase I	0.005	Tetrachloroethylene	Phase II	0.005
Trichloroethylene	Phase I	0.005	Toluene	Phase II	1
Para-Dichlorobenzene	Phase I	0.075	Trans-1,2-Dichloroethylene	Phase II	0.1
1,1-dichloroethylene	Phase I	0.007	Xylenes (total)	Phase II	10
1,1,1-Trichloroethane	Phase I	0.2	Dichloromethane	Phase V	0.005
Cis-1,2-Dichloroethylene	Phase II	0.07	1,2,4-Trichloro-benzene	Phase V	0.07
1,2-Dichloropropane	Phase II	0.005	1,1,2-Thrichloro-ethane	Phase V	0.005
Ethylbenzene	Phase II	0.7	Chlorobenzene		0.07
Synthetic Organic Chemicals (SOC)					
Arochlor	Phase II	0.002	Benzo(a)pyrene	Phase V	0.0002
Atrazine	Phase II	0.003	Dalapon	Phase V	0.2
Carbofuran	Phase II	0.04	Di(2-ethylhexyl) adipate	Phase V	0.4
Chlordane	Phase II	0.002	Di(2-ethylhexyl) phthalate	Phase V	0.006

Table 8-4. Regulated Volatile and Synthetic Organic Chemicals

Organic Chemical	Federal Regulation	Primary MCL (mg/L)[a]	Organic Chemical	Federal Regulation	Primary MCL (mg/L)[a]
Dibromochloro-propane	Phase II	0.0002	Dinoseb	Phase V	0.007
2,4-D	Phase II	0.07	Diquat	Phase V	0.02
Ethylene dibromide	Phase II	0.00005	Endothall	Phase V	0.1
Heptachlor	Phase II	0.0004	Endrin	Phase V	0.002
Heptachlor epoxide	Phase II	0.0002	Glyphosate	Phase V	0.7
Lindane	Phase II	0.0002	Hexachlorobenzene	Phase V	0.001
Methoxychlor	Phase II	0.04	Hexachloro Cyclopentadiene	Phase V	0.05
Polychlorinated biphenyls (PCBs)	Phase II	0.0005	Oxamyl (vydate)	Phase V	0.2
			Picloram	Phase V	0.5
Pentachlorophenol	Phase II	0.001	Simazine	Phase V	0.004
Toxaphene	Phase II	0.003	2,3,7,8-TCDD (dioxin)	Phase V	3x10-8
2,4,5-TP	Phase II	0.05	Oxamyl (vydate)	Phase V	0.2

[a] Source: State Department of Health Drinking Water Regulations (246-290), effective July 2008

MONITORING REQUIREMENTS

Monitoring requirements are described in the City's Water Quality Monitoring Schedule for the Year 2017, as presented in Appendix H. Per DOH requirements, VOCs and SOCs must be sampled once every three years, unless a waiver is in place. The state grants a waiver if a chemical is not in use or previous monitoring indicates contamination would not occur. The City must apply for waivers through DOH. There are two types of waivers, risk-based or area-wide. The risk-based waiver requires a susceptibility analysis and DOH charges a fee for these waivers (purchased waivers). Area-wide waivers are issued if a chemical is not used within a region, thus DOH does not charge for these waivers. While the state issues both types of waivers, an area-wide waiver is referred to as a "State waiver."

A waiver is in place until December 2019, during which time there are no requirements for monitoring. However, once a waiver expires, the monitoring frequency for VOCs and SOCs is one sample every three years. State waivers have been issued for Dioxin, Endothall, Diquat, Glyphosate and Insecticides.

The City has been granted waivers for all four of their active wells for Herbicides through December 2022 as well as for Insecticides through December 2019.

Radionuclides

In December 2000, the EPA announced updated standards for radionuclides. This rule became effective December 2003. All community water systems are required to meet the MCLs listed in

Table 8-5, and requirements for monitoring and reporting. The radionuclides requirements described in 40 CFR 141.26 have been adopted by DOH in WAC 249-290.

All systems were required to complete initial monitoring and phase-in the monitoring requirements between December 8, 2003 and December 30, 2007. Initially, utilities were required to undergo four consecutive quarters of monitoring for gross alpha, combined radium-226/-228, and uranium. Only systems that were considered “vulnerable” were required to monitor for gross beta (quarterly samples), tritium, and strontium-90 (annual samples). The initial monitoring was used to determine if the system would have to perform reduced or increased monitoring.

Table 8-5. Primary MCLs for Radionuclides

Contaminant	Primary MCL[a]
Alpha Particles	15 pCi/L
Beta Particles and Photon Emitters	4 millirem/year [b]
Radium 226 and 228	5 pCi/L[b]
Uranium	30 µg/L[b]

[a] Environmental Protection Agency, 40 CFR 141.66.

[b] According to EPA 40 CFR 141.66, “average annual concentration of beta particle and photon radioactivity from man- made radionuclides in drinking water must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year.” The MCLs for Tritium and Strontium-90 are assumed to produce body organ doses equivalent to 4 millirem/year.

MONITORING REQUIREMENTS

Monitoring requirements are described in the City’s Water Quality Monitoring Schedule for the Year 2017, as presented in Appendix H. Radium 228 and gross alpha sampling was conducted by the City in 2015 for all four wells as part of standard DOH compliance. All results were non-detect except for Risdon Well No. 2. The next radionuclide sampling for all four wells is scheduled for 2020.

Arsenic Rule

In January 2001, the EPA promulgated a new standard that requires public water systems to reduce arsenic levels in drinking water. The final rule became effective in 2006 and applies to all community water systems and non-transient, non-community water systems, regardless of size. The rule not only establishes an MCL for arsenic (0.010 mg/L), based on a running annual average (RAA) of quarterly results and an MCGL for arsenic (zero), but also lists feasible and affordable technologies for small systems that can be used to comply with the MCL. However, systems are not required to use the listed technologies in order to meet the MCL. The arsenic rule has been adopted by the DOH as a revision to the arsenic MCL under WAC 249-290-310.

MONITORING REQUIREMENTS

The City is required to do one complete IOC sample between 2011 and 2019 for each well, which will include arsenic sampling, as listed in the Water Quality Monitoring Schedule for the Year 2017 (Appendix H). The most recent IOC sampling occurred in 2016.

Groundwater Rule

The EPA enacted the final Groundwater Rule (GWR) January 8, 2007, for the purpose of providing increased protection against microbial pathogens in public water systems that use untreated groundwater. The GWR applies to public water systems that serve groundwater as well as to any system that mixes surface and groundwater, if the groundwater is added directly to the distribution system and is provided to customers without providing disinfection contact time

To implement the GWR, the EPA has taken a risk-based approach to protect drinking water from groundwater sources that have been identified as being at the greatest risk of fecal contamination. This strategy includes four primary components:

1. **Sanitary Surveys.** Sanitary surveys must be conducted every three years and meet the provisions of the 1998 Interim Enhanced Surface Water Treatment Rule as it relates to populations served. In addition, the sanitary survey shall implement the eight elements of the EPA/State Joint Guidance on Sanitary Surveys. These elements relate to source protection; identification of the physical components and their condition; and description and implementation of programs for treatment, distribution, storage, pumping, monitoring, operation and maintenance; and operator certification.
2. **Source Water Monitoring.** Source water monitoring is triggered when a system does not sufficiently disinfect drinking water to achieve 4-log (99.99 percent) virus removal and identifies a positive routine sample during its Total Coliform Rule monitoring and hydrogeologic sensitivity assessment monitoring (at state discretion) targeted at high- risk systems. Once a total coliform-positive sample is found within a distribution system, the system is required to collect one source water sample per source and monitor for a fecal indictor. Washington State may choose to issue a waiver if the groundwater source has a hydrogeologic barrier.
3. **Corrective Action.** Corrective action is required for any system with a significant deficiency or evidence of source water fecal contamination. Corrective actions must be taken by "groundwater systems that have a significant deficiency or have detected a fecal indicator in their source water." EPA guidelines recommend that corrective actions take place within 90 days, or longer if approved by the state. The problem should be solved by eliminating the contaminate source, correcting the significant deficiencies, or providing an alternate source of water supply.
4. **Compliance Monitoring.** Compliance monitoring ensures that treatment technology installed to treat drinking water reliably achieves 4-log virus inactivation. Compliance monitoring applies to all groundwater systems that disinfect as a corrective action. Systems serving greater than 3,300 individuals must continuously monitor their disinfection treatment process. If disinfection concentrations are below the required level, the system must restore disinfection concentration within four hours.

The compliance date for triggered source water monitoring and the associated corrective actions, as well as compliance monitoring, was December 1, 2009. Because assessment monitoring is at the discretion of the state, there is no timeframe associated with assessment monitoring. Initial sanitary surveys were required to be completed by December 31, 2012. However, for community water systems that have been identified by the state as outstanding performers (generally those that have treatment that provides 4 log virus inactivation or removal at all sources), the initial sanitary survey was required to be completed by December 31, 2014.

Many of the requirements of the GWR are determined by the individual state agencies. The requirements of the GWR were adopted by DOH into WAC 246-290 in November 2010. In addition, the DOH has provided a Fact Sheet for Group A utilities with recommended actions to prepare for the GWR. These actions include the following:

- Correct deficiencies from the last sanitary survey.
- Install a sample tap at each wellhead.
- Know specifically where each well's water goes. Triggered source water monitoring will require monitoring of all sources, unless it can be shown that the area of concern in the distribution system is only served by a limited number of sources.
- Update your emergency response plan, to be ready to provide alternate water, if needed.

If you currently treat groundwater from a well, contact your regional office engineer to confirm whether you currently achieve 4-log virus inactivation. Systems that treat to this level will not be required to conduct triggered source water monitoring, but will instead be required to meet treatment technique monitoring requirements.

MONITORING REQUIREMENTS

The City began chlorinating its groundwater sources in November of 2005. Because the City's wells are not under the influence of surface water, treatment design was approved to maintain detectable free chlorine residual in the system and 4-log inactivation was not required by DOH. However, the City is required to continuously monitor disinfectant residual concentration to maintain a residual of 0.2 mg/L in the distribution piping. The City is subject to triggered source water monitoring if a coliform-positive sample is detected.

Unregulated Contaminant Monitoring Rule

The 1986 amendments to the Safe Drinking Water Act require public water systems to monitor for unregulated contaminants every five years and submit these data to the states. The intent of this program is to gather scientific information on unregulated contaminants to determine if regulations are required to protect human health. Both the 1993 and 1996 amendments to the act added new lists of contaminants, which led EPA to develop a revised program for monitoring. The new program became known as the Unregulated Contaminant Monitoring Regulations (UCMR 1999). The new UCMR program began in 2001, and produces a new list of unregulated contaminants for monitoring every five years. UCMR3 was finalized in December, 2016.

Under the UCMR program, EPA asks large systems to take two sets of samples for unregulated contaminants at six-month intervals. There is one tiers of contaminants in UCMR4; List 1 - Assessment Monitoring. All systems serving more than 10,000 persons will be required to monitor for 10 List 1 cyanotoxins during a 4-consecutive month period from March 1, 2018 and November 31, 2020. All system serving more than 10,000 persons will also be required to monitor for 20 List 1 additional contaminants during a 12-month period between January 1, 2018 and December 31, 2020. The 20 List 1 additional contaminant consist of metals, pesticides, HAA, alcohols, semivolatile chemicals, and indicators.

MONITORING REQUIREMENTS

The City was required to conduct monitoring under the UCMR3. It is uncertain at this time if the City will be selected for monitoring under UCMR4.

8.2.2 Distribution System Water Quality

Regulations that address distribution system water quality are described herein.

Revised Total Coliform Rule

Coliform bacteria describe a broad category of organisms routinely monitored in potable water supplies. Though not all coliform bacteria are pathogenic in nature, they are relatively easy to identify in laboratory analysis. If coliform bacteria are detected, then pathogenic organisms may also be present. Bacterial contamination in a water supply can cause a number of waterborne diseases, therefore these tests are strictly monitored and regulated by DOH.

The EPA published the Revised Total Coliform Rule (RTCR) in February 2013 with minor corrections in February 2014. The RTCR is the revision to the 1989 Total Coliform Rule (TCR) and is intended to improve public health protection. Provisions of the RTCR include:

- Setting a maximum contaminant level goal (MCLG) and maximum contaminant level (MCL) for E. coli for protection against potential fecal contamination.
- Setting a total coliform treatment technique (TT) requirement.
- Requirements for monitoring total coliforms and E. coli according to a sample siting plan and schedule specific to the PWS.
- Provisions allowing PWSs to transition to the RTCR using their existing TCR monitoring frequency, including PWSs on reduced monitoring under the existing TCR.
- Requirements for seasonal systems to monitor and certify the completion of state-approved start-up procedures.
- Requirements for assessments and corrective action when monitoring results show that PWSs may be vulnerable to contamination.
- Public notification (PN) requirements for violations.
- Specific language for CWSs to include their Consumer Confidence Reports (CCRs) when they must conduct an assessment or if they incur an E. coli MCL violation.

MONITORING REQUIREMENTS

The City's Coliform Monitoring Plan (Appendix K) was updated in 2017. The City currently collects 30 samples per month from locations throughout the distribution system. The City is in compliance with the rule and is designated a disinfected system.

Asbestos

Asbestos is the name for a group of naturally occurring, hydrated silicate minerals with fibrous morphology. Included in this group are chrysotile, corcidolite, amosite, and the fibrous varieties of anthophyllite, tremolit, and actinolite. Most commercially-mined asbestos is chrysotile. Historically, the flexibility, strength, and chemical and heat resistance properties of asbestos have adapted it to many uses including building insulation, brake linings, and water pipe.

In recent years, there has been much concern with the health risks associated with the use of asbestos in the everyday environment. Several studies and case histories have documented the hazards to internal organs as a result of inhalation of asbestos fibers. Data is limited on the effects of ingestion of asbestos fibers or on the effects of inhalation exposure from drinking water. Ingestion studies have not caused cancer in laboratory animals, though studies of asbestos workers have shown increased rates of gastrointestinal cancer.

MONITORING REQUIREMENTS

The reporting period for asbestos is nine years, with the latest period ending December 2010. Because of the City's aggressive water main replacement program, specifically targeting asbestos cement (AC), wrapped steel, and undersized water mains, fewer than one percent (1 percent) of the City's water mains are AC. Since the City's water distribution system has less than ten percent (10 percent) asbestos cement pipe, an asbestos sample is not required by DOH.

Stage 1 Disinfectants and Disinfection By-Products Rule

The Stage 1 Disinfectants and Disinfection By-Products Rule (DBPR) was promulgated in December 1998 and is applied to systems that apply a chemical oxidant/disinfectant. The portions of the Stage 1 DBPR relevant to the City are the MCLs for total trihalomethanes (TTHMs) and haloacetic acids (HAA5) of 0.080 and 0.060 mg/L, respectively. The four regulated trihalomethanes are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The five regulated HAAs are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. Compliance with the TTHM and HAA5 MCLs is based on a system-wide running annual average (RAA) of quarterly samples taken in the distribution system. The Stage 1 DBPR also introduced a maximum residual disinfectant level (MRDL) of 4 mg/L for free chlorine, based on an RAA of samples collected concurrent with TCR monitoring.

Stage 2 Disinfectants and Disinfection By-Products Rule

The Stage 2 DBPR was promulgated by the EPA on January 4, 2006 and was adopted by DOH in WAC 246-290. The key provisions of the Stage 2 DBPR consist of:

- An Initial Distribution System Evaluation (IDSE) to identify distribution system locations with high DBP concentrations. Further information is provided below.
- Site-specific locational running annual averages (LRAAs) instead of system-wide RAAs to calculate compliance data. LRAAs will strengthen public health protection by eliminating the potential for groups of customers to receive elevated levels of DBPs on a consistent basis.

The MCLs for TTHM and HAA5 remain unchanged from the Stage 1 DBPR at 0.080 and 0.060 mg/L, respectively, although they will now be calculated as LRAAs.

The IDSE is the first step in Stage 2 DBPR compliance. Its intent is to identify sampling locations for Stage 2 DBPR compliance monitoring that represent distribution system sites with high TTHM and HAA5 levels. For systems serving more than 500 people, three options were available for the IDSE:

- 40/30 Waiver, which allows systems with no samples exceeding TTHM and HAA concentrations of 40 and 30 µg/L, respectively, during 8 consecutive quarters to apply to waive the IDSE requirements.
- Standard Monitoring Program (SMP), which involves a 1-year distribution system monitoring effort to determine locations that routinely show high THM4 and HAA5 concentrations.
- System-Specific Study (SSS), based on historical data and a system model.

MONITORING REQUIREMENTS

The City performed an IDSE in 2008, which included bimonthly sampling at eight sites to identify locations in the distribution system with elevated disinfection by-product concentrations. The IDSE Report is included in Appendix M. Transition from Stage 1 DBPR to Stage 2 DBPR monitoring protocol occurred in 2012. Under Stage 1, the City conducted TTHM/HAA5 monitoring quarterly at 12 sites. For Stage 2 DBPR, the City is required to conduct TTHM/HAA5 monitoring quarterly at four distribution system locations as described in the City's Stage 2 DBPR Compliance Monitoring Plan (Appendix L).

Lead and Copper

In 1991, the EPA promulgated the Federal Lead and Copper Rule (LCR). The State of Washington adopted this rule in 1995 with minimal changes. The LCR is intended to reduce the tap water concentrations that can occur when corrosive source water causes lead and copper to leach from water meters and other plumbing fixtures. Possible treatment techniques to reduce lead and copper leaching include addition of soda ash or sodium hydroxide to the source water prior to distribution.

The LCR establishes an action level (AL) of 0.015 mg/L for lead and 1.3 mg/L for copper based on 90th percentile level of tap water samples. The most recent revisions (2007) added the following requirements (required as of 12/10/09):

1. **Monitoring.** The rule adds a new reduced monitoring requirement, which prevents water systems above the lead action level to remain on a reduced monitoring schedule.
2. **Treatment.** Water systems must provide advanced notification and gain the approval of the primacy agency for intended changes in treatment or source water that could increase corrosion of lead.
3. **Consumer notification.** All utilities must now provide a notification of tap water monitoring results for lead to owners and/or occupants of homes and buildings who consume water from the taps that are part of the utility's sampling program.
4. **Lead service line replacement.** Utilities must reconsider previously "tested-out" lines when resuming lead service line replacement programs. This provision only applies to systems that have:
    a. Initiated a lead service line replacement program;
    b. Complied with the lead action level for two consecutive monitoring periods and discontinued the lead service line replacement program; and
    c. Subsequently were re-triggered into lead service line replacement.
    d. All previously "tested-out" lines would then have to be tested again or added back into the sampling pool and considered for replacement.

Exceedance of the AL is not considered a violation but can trigger other requirements that include water quality parameter monitoring, corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.

Samples must be collected at cold water taps in homes/buildings that are at high risk of lead/copper contamination as identified in 40 CFR 141.86(a). The number of sample sites is based on system size.

MONITORING REQUIREMENTS

The City completed two initial six-month home tap monitoring periods and the required follow-up testing. Lead and copper action levels were not exceeded during the initial monitoring periods. Based on their approved reduced monitoring schedule, the City must collect 30 lead/copper samples every three years. In the future, the City will assess the need for corrosion mitigation studies, pH adjustment treatment, corrosion inhibitor application, and removal of lead plumbing materials.

8.2.3 Surface Water Treatment Rules

The wholesale water purchased from CWA is from a surface water supply. As discussed above, CWA is responsible for ensuring its surface water supply meets all surface water treatment rule requirements. The main requirement affecting the City is maintenance of a disinfectant residual in 95 percent of distribution system samples. In addition, due to this supply, the City is classified as a Subpart H system under the Stage 1 and 2 DBPRs, with increased TTHM/HAA monitoring requirements.

8.2.4 Reporting Requirements

Federal regulations related to reporting requirements are discussed herein.

Consumer Confidence Report (CCR)

Each July, community water systems must provide an annual report to customers providing information as to the quality of their drinking water supply. These reports are referred to as “Consumer Confidence Reports” (CCR). These reports let customers know whether their water meets state and federal drinking water standards. The CCR includes information on the water source, the regulated and unregulated contaminants that have been detected during the year and their concentrations. The report also provides information on disinfection byproducts or microbial contaminants and the potential health effects of the contaminants at concentrations greater than the MCL. The likely source of the contaminants is identified and a summary of any violations in monitoring, reporting, or record keeping is included. The reports can assist customers with special health needs to make informed decisions regarding their drinking water. CCRs provide references and telephone numbers as to health effects data and available information about the water system in general.

The Consumer Confidence Report Rule was finalized on September 19, 1998. The City issues its annual *Water Quality Report* prior to every July, as the rule requires. The 2012 through 2016, *Drinking Water Reports* are included in Appendix J.

Public Notification Rule

The Public Notification Rule (PNR) requires that public water systems notify their customers when they violate EPA or State regulations (including monitoring requirements) or otherwise provide drinking water that may pose a risk to consumers’ health. The original public notification requirements were established in the SDWA; the revised PNR was promulgated in 2000 as required by the 1996 SDWA amendments.

The PNR establishes three notification levels:

- Immediate Notice (Tier 1): In a situation where there is the potential for human health to be immediately impacted, notification is required within 24 hours.

- Notice as Soon as Possible (Tier 2). In a situation where an MCL is exceeded or water has not been treated properly, but there is no threat to human health, notification is required as soon as possible and within 30 days.
- Annual Notice (Tier 3). In a situation where a standard is violated that does not directly impact human health, notice must be provided within one year, likely within the system's CCR.

Notification requirements are briefly summarized herein.

IOC/VOC/SOC Reporting Procedures

If routine sampling indicates a violation of primary or secondary MCL violation, then the water purveyor must collect confirmation sample(s), remove the source from service, and report the violation to DOH within 24 hours. If DOH determines the violation poses an acute health effect, then the purveyor must provide notice of the violation water customers within 24 hours of the violation. If it is determined that the violation does not pose an acute health risk, then the purveyor must mail a notice to customers within 30 days.

Bacteriological Reporting Procedures

If bacteriological presence is detected in a routine sample, the following reporting requirements will take effect:

- Each total coliform-positive routine sample must be tested for the presence of E.coli.
- If fecal coliform or *E. coli* is detected in routine sample, the City is required to notify DOH by the end of the day that the PWS is notified.
- Within 24 hours of learning a total coliform-positive sample result, at least three repeat samples must be collected and analyzed for total coliform.
- If one or more repeat sample is coliform-positive, the sample must be analyzed for the presence of E.coli. If the repeat sample is also E. coli-positive, the sample result must be reported to the state by the end of the day the PWS is notified.

Unregulated Contaminant Reporting Procedures

Reporting procedures for unregulated contaminants are similar to the reporting requirements for IOCs, VOCs, and SOCs. If the unregulated contaminant has a proposed MCL, then the reporting requirements are the same as those stated for IOCs, VOCs, and SOCs. If a detected unregulated contaminant does not have a proposed MCL, DOH must be contacted, and DOH will determine the reporting procedures.

8.2.5 Future Regulatory Requirements

Anticipated future regulatory requirements are summarized in Table 8-6. This table includes ongoing programs to introduce new regulatory requirements, under the Unregulated Contaminant Monitoring Rule and the Contaminant Candidate List, as well as specific rules and regulations currently under consideration. A brief description of anticipated requirements under each rule is provided herein.

Table 8-6. Future Regulatory Requirements

Proposed Rule	Affected Contaminants	Proposed Publication Date [a]
Perchlorate	Perchlorate	2019
Lead and Copper Rule Long-Term Revisions	Lead and Copper	2018

[a] Effective and compliance dates were obtained from the Federal Register and EPA's Drinking Water Hotline and represent the best information available as of the date of this report.

Perchlorate

The EPA is considering implementation of an MCL goal (MCLG) for perchlorate. Additional research may be required to derive an MCLG. EPA's current statutory deadline for proposing a perchlorate drinking water regulation is the end of 2019.

Lead and Copper Long-Term Revisions

Stakeholder meetings were held in November 2010 to discuss the potential long-term revisions that will replace the short-term revisions made in 2007. Items to be addressed are partial lead service line replacement, sample site selection, tap sampling, corrosion control, and public education about copper. These revisions are projected to be finalized in 2018.

8.3 Current Sources and Treatment

The City has two main sources of supply: groundwater from its own wells, and wholesale water purchased from CWA. All operating areas currently receive either CWA or City well water that is not blended. However, the City is looking into serving all operating areas with blended water in the future. Treatment and monitoring requirements specific to these supplies is discussed herein. This section only discusses monitoring requirements related to monitoring of treatment performance; general source water monitoring requirements are discussed under the applicable regulations in the above sections.

8.3.1 Groundwater Treatment

Risdon Wells 1 and 2

Risdon Well Nos. 1 and 2 are chlorinated using 12.5 percent sodium hypochlorite. There is currently no other treatment being implemented at the Risdon wells, however, long term treatment options are being considered for the centralized treatment of all four of the City's groundwater sources and are discussed in Section 8.6.

Gilman Wells 4 and 5

A temporary treatment system was installed in 2016 at the Gilman well sites. Currently, Gilman Well No. 4 is treated using granular activated carbon for polyfluoroalkyl substances (PFAS) removal. Well No. 4 is then blended with Well No. 5 to meet several water quality objectives 1) lower arsenic levels, 2) increased pH, and 3) lower manganese levels. Water is then disinfected with 12.5 percent sodium hypochlorite before being sent to the distribution system. In addition, sequestrate is injected on the combined Well No. 4 and 5 treated water line to prevent manganese deposits throughout the distribution system.

The temporary treatment system was designed to allow future treatment of both Well Nos. 4 and 5 if PFAS contamination ever reached Well No. 5. Further, long term treatment options for PFAS removal are being considered and are discussed in Section 8.6.

8.3.2 Wholesale Water Agreements

The City maintains interties with the City of Bellevue and the CWA supply transmission main. CWA water is wheeled through Bellevue to supply the Lakemont and Montreux communities. CWA water from the transmission main feeds Issaquah Highlands.

Monitoring Requirements

Monitoring requirements associated with disinfected surface water sources are documented in WAC 246-290-692(5) and WAC 246-290-694(8). These rules require that the City monitor disinfectant residual concentrations at representative points of the distribution system on a daily basis, and at the same time and location as TCR samples. A disinfectant residual must be detectable in at least 95 percent of samples collected in a calendar month.

8.4 Water Quality Compliance

The section evaluates the existing water quality conditions in relation to existing and future drinking water regulations for the City of Issaquah. Compliance has been evaluated and recommendations regarding treatment practices and/or existing monitoring plans based on existing or proposed regulations are presented. The City's water currently meets all state and federal drinking water standards. In addition, the City complies with all DOH monitoring and reporting requirements. The 2012 to 2016 Drinking Water Reports are included in Appendix J.

8.4.1 Overview of Water Quality

Source Water Quality

This section discusses source water quality compliance with existing primary and secondary MCLs, as well as anticipated future regulatory requirements.

National Primary and Secondary Drinking Water Regulations

In accordance with WAC 246-290-300 for systems supplied by groundwater, the City collects samples and tests them for inorganic chemical and physical contaminants once every nine years. IOC samples were most recently taken in 2016. The 2016 data in Table 8-7 show that concentrations of regulated inorganic chemical and physical contaminants are lower than MCL values for all well supplies, with the exception of manganese at Gilman Well No. 5. Elevated manganese concentration at Well No. 5 is mitigated by blending with Well No. 4 and injecting sequestrate at the station. Treatment to remove manganese at Well No. 5 is discussed in Section 8.6.

Table 8-7. 2016 Sampling Data – Inorganic Chemical and Physical Contaminants

Inorganic Chemical	MCL[a] (mg/L)		Well No. 1	Well No. 2	Well No. 4	Well No. 5
Antimony	0.006	P	ND [f]	ND	ND	ND
Arsenic	0.01	P	0.002	0.002	0.003	0.009
Asbestos [b]	72	P	NA	NA	NA	NA
Barium	2	P	ND	ND	ND	ND
Beryllium	0.004	P	ND	ND	ND	ND
Cadmium	0.005	P	ND	ND	ND	ND
Chromium	0.1	P	ND	ND	ND	ND
Copper	1.3	A	ND	ND	ND	ND
Cyanide	0.2	P	ND	ND	ND	ND
Fluoride	4.0 / 2.0	P/S	ND	ND	ND	ND
Lead	0.015	A	ND	ND	ND	ND
Mercury	0.002	P	ND	ND	ND	ND
Nickel	0.1	P	ND	ND	ND	ND
Nitrate-N	10	P	0.54	0.49	ND	0.49
Nitrite-N	1	P	ND	ND	ND	ND
Selenium	0.05	P	ND	ND	ND	ND
Sodium [c]	--	--	8.6	9	8.1	23.2
Thallium	0.002	P	ND	ND	ND	ND
Chloride	250	S	ND [f]	ND	ND	ND
Iron	0.3	S	ND	ND	ND	ND
Manganese	0.05	S	ND	ND	0.02	0.062
Silver	0.1	P	ND	ND	ND	ND
Sulfate	250	P	ND	ND	9.2	ND
Zinc	5	P	ND	ND	ND	ND
Alkalinity	--	P	NA	NA	NA	NA
Conductivity [d]	700	P	160	158	248	293
Color [e]	15	P	ND	ND	ND	ND
pH	--	P	NA	NA	NA	NA

[a] MCL (maximum contaminant level): P = primary MCL, S = secondary MCL, A = action level
[b] Asbestos MCL is measured as "million fibers/liter".
[c] MCL not established; however, it is included in inorganic chemical monitoring to public health concern.
[d] Conductivity is measured as "micromhos/cm".
[e] Color is measured as "color units".
[f] ND = not detected; NA = Not analyzed.

The latest VOC monitoring for Wells No. 1 and 2 was completed in 2015; the latest analysis for Wells No. 4 and No. 5 was completed in 2012. No VOCs were detected at any of the wells. The latest SOC monitoring in 2016 resulted in no detection of SOCs at any well sources. The City has a waiver on SOC sampling through 2022 for all wells.

Distribution Water Quality

The City has no current or anticipated challenges in meeting distribution system water quality requirements. The water quality data relevant to each regulation are summarized herein.

Revised Total Coliform Rule

The City installed chlorination at each of the well sources in 2003. Prior to installation of disinfection, non-repeat positive coliform samples were detected in years 2000 to 2002.

From 2012 through 2017 no positive coliform samples were observed in the system, so the City did not have anyviolations.

Stage 1 and 2 Disinfectants and Disinfection By-Products Rules

Samples from throughout the distribution system are tested for HAA5 and TTHM levels. Running annual average (RAA) results for the years 2012 to 2016 are shown in Table 8-8 below. The City has not violated any DBPR requirements.

Table 8-8. Haloacetic Acids and Total Trihalomethanes Monitoring

Regulation	MCL	Lower Issaquah Valley Aquifer	CWA-Cedar Supply	CWA –Tolt Supply
HAA5 (ppb)				
2012	60	1.08	29.55	29.55
HAA5 (ppb)				
2012	60	1.08	29.55	29.55
2013	60	NA	23.55	23.55
2014	60	NA	27.43	27.43
2015	60	NA	31.43	31.43
2016	60	NA	36.9	36.9
TTHM (ppb)				
2012	80	4.83	36.9	36.9
2013	80	NA	42.975	42.975
2014	80	NA	40.85	40.85

Table 8-8. Haloacetic Acids and Total Trihalomethanes Monitoring

Regulation	MCL	Lower Issaquah Valley Aquifer	CWA-Cedar Supply	CWA –Tolt Supply
2015	80	NA	56.1	56.1
2016	80	NA	47.4	47.4

Lead and Copper Rule

Lead and copper tap water samples were performed most recently in 2006, 2009, and 2012. The results are shown in Table 8-9 below. The City did not violate any Lead and Copper Rule requirements.

Table 8-9. Lead and Copper Monitoring

Year		Copper (ppm)	Lead (ppb)
	Action Level	1.3	15
	MCLG	1.3	0
2012	Amount detected (90^{th} %tile)	0.342	1
	Sites Above Action Level/Total Sites	0/49	0/49
2015	Amount detected (90^{th} %tile)	0.364	0.001
	Sites Above Action LevelTotal Sites	0/51	0/51

8.4.2 Use of Certified Laboratories

The EPA requires that all laboratories become certified to analyze drinking water samples and that they use analytical methods approved by the EPA. The City of Issaquah uses the following three certified laboratories to analyze drinking water samples:

- Edge Analytical (https://www.edgeanalytical.com/contact/)
- AMTEST Laboratories (http://amtestlab.com/contact_us.asp)
- Anatek Labs, Inc – PFAS (http://www.anateklabs.com/moscow/)

8.4.3 Water Quality Compliance Summary

Table 8-10 summarizes the City's compliance with current regulations.

Table 8-10. Summary of Existing Regulatory Compliance

Regulation	Compliance
National Primary and Secondary Drinking Water Standards	Yes – System wide sampling fell below MCLs.

Table 8-10. Summary of Existing Regulatory Compliance

Regulation	Compliance
Radionuclides Rule	Yes – No source has detected positive results for radionuclides.
Arsenic Rule	Yes – The arsenic sources (Gilman Well Nos. 1 and 2) are blended to reduce arsenic levels.
Unregulated Contaminants Monitoring Rule 3	Yes – Although not currently regulated, PFAS were detected in Gilman Well Nos. 4 and 5. Treatment has since been implemented and all levels have been under the practical quantification limit since the treatment system has been online.
Groundwater Rule	Yes – All requirements are met
Total Coliform Rule/ Revised Total Coliform Rule	Yes – The City has a sampling program in place and have had no positive coliform samples since 2009.
Lead and Copper Rule	Yes – The City is in compliance with the LCR.
Stage 1 and 2 Disinfectants/Disinfection Byproduct Rule	Yes – System wide annual averages all below the TTHM and HAA5 MCLs.
Information Collection Rule	Yes – The City is in compliance.
Interim Enhanced Surface Water Treatment Rule	Yes – The City is in compliance.
Long Term 1 Enhanced Surface Water Treatment Rule	Yes – The City is in compliance.
Long Term 2 Enhanced Surface Water Treatment Rule	Yes – The City is in compliance.
Consumer Confidence Report Rule	Yes – Consumer Confidence Reports are issued prior to every July.
Public Notification Rule	Yes

8.4.4 Procedures for Customer Inquiries and Complaints

The City of Issaquah utilizes a complaint/concern database online where customers are able to submit complaints and or concerns with regards to health and safety in the community.

8.5 Water Quality Protection Programs

8.5.1 Groundwater Management and Wellhead Protection

Protecting the Issaquah Valley aquifer from contamination is important for the City's continued use of groundwater as a supply source. In order to protect groundwater supplied, the City and SPWSD prepared, adopted, and implemented a Wellhead Protection Plan for the Lower Issaquah Valley in 1993, which is still current at the time of this writing. It is included as Appendix N.

In 2010, the EPA enacted Stage II of the National Pollutant Discharge Elimination System (NPDES). While this enactment is targeted at stormwater discharges, groundwater will benefit as well due to the City's active inspection, inventory and proactive management, and education related to on-site containment of pollutants, primarily in the industrial and retail sections of the City.

The City makes ongoing efforts to improve its management of groundwater quality. Recent efforts include:

- **Contaminant Source Inventory**: The City prepared a Contaminant Source Inventory in 2012, which is included as Appendix P.
- **Water quality impact assessments**: Extensive assessments were completed as part of the Wellhead Protection Plan, identifying potential sources of aquifer contamination.
- **Wellhead protection strategies**: The City is very conscious of the value of its aquifer and actively pursues improvements to protect this resource. An example of required improvements stemming from the Wellhead Protection Plan is the approximate two mile of I-90 freeway storm drainage retrofitting undertaken by Washington State Department of Transportation (WSDOT) to protect the aquifer.
- **Aquifer recharge impacts of planned development**: Since groundwater recharge is an important factor for the aquifer, the storm drainage impacts of the Issaquah Highlands development were addressed in an Environmental Impact Statement for the development.
- **Adoption of aquifer protection policies**: The City revised its Issaquah Municipal Code (IMC) Title 18.06 to protect the wellhead area. IMC Title 18.06 includes language permitting the City to disallow any use within the wellhead protection area that would be inconsistent with protecting wellheads. The wellhead protection area also includes the aquifer that the well field draws from.
- **Spill response procedures and personnel**: Eastside Fire and Rescue fills the role of spill response for the City in addition to the City's Standard Operating Procedure for City crews to respond to spills and similar accidents.

One sample project undertaken by the City with potential positive impacts on groundwater recharge water quality is the Water Resources Action Plan. This project supports the Issaquah Stream Team and staff to implement the Aquatic Resource Monitoring Plan. This program monitors stream channels, effectiveness of stormwater management and water quality. Given the aquifer recharge role of the local streams, this program could yield significant benefits for the City.

8.5.2 Cross Connection Control Program

The purpose of the City's Cross Connection Control Program, which is included as Appendix O, is to protect the health of water consumers by preventing backflow of contaminated water into the water distribution system. The program establishes minimum operating policies, backflow prevention assembly installation, and testing practices. The City has the authority to enforce the practices and policies outlined in the program through the IMC Chapter 13.13.

The City is responsible for prevention of contamination of the water distribution system by inspecting cross connections, providing guidance for new installations and existing connections, maintaining records on backflow prevention devices, and responding to customer inquiries. The City is responsible for cross-connection control beginning at the water supply source and ending at the point of delivery to the consumer's water system. Water customers are responsible for eliminating cross connections by controlling them through the installation, regular testing, and maintenance of approved backflow prevention assemblies.

8.5.3 Treatment Practices and Recommendations

The City of Issaquah conducts frequent water quality monitoring to meet state monitoring requirements. Monitoring is required both at the source and throughout the distribution system. Table 8-11 presents recommendations for treatment practices and existing monitoring plans to help remain in compliance with existing and proposed regulations.

Table 8-11. Treatment Practices and Monitoring Plan Recommendations

Monitoring or Treatment Practice	Recommendation
Revised Total Coliform Rule Compliance	Develop a distribution water quality strategy to establish system wide baseline data that can be used to ensure optimized corrosion control, inform O&M decisions, inform asset management decisions, and provide better baseline data with which to compare in an emergency contamination situation.
E. Coli Response Plan	Develop an E.Coli Emergency Response Plan in case the system should have an MCL violation.
PFAS Monitoring and Treatment	Continued monitoring from Gilman Wells 4 and 5 and evaluate long-term treatment options.

8.6 Long-term Treatment Options for Perfluorinated Compounds and Other Water Quality Issues

In 2013, the City of Issaquah (City) detected then-unregulated per- and polyfluoroalkyl substances (PFAS) in Gilman Well No. 4 as part of the UCMR 3 sampling event. In response to the PFAS detections, the City shut down Gilman Well No. 4 and evaluated a number of alternatives to eliminate the contamination from Well No. 4. A temporary granular activated carbon (GAC) filtration system was installed to treat water from Well No. 4 with the ability to be expanded to treat Well No. 5 if the PFAS migrated to the lower Well No. 5 aquifer. PFAS levels have been below the USEPA Method 537 detection limits in Well No. 4 finished water since the system went online in 2016.

In addition to PFAS in Well No. 4, the City has other water quality challenges, including manganese and arsenic, ammonia, and low pH, which adversely affect the City's groundwater supply. To further address these water quality issues, and to plan for the eventual introduction of regional water from the Cascade Water Alliance into the Valley Zone (which will require blending of groundwater and regional water in the Valley Zone), the City is evaluating long-term treatment options for PFAS and the other water quality issues. The following long-term treatment options were:

- Option 1: Centralized Treatment: Risdon Wells 1 and 2, Gilman Wells 4 and 5, and CWA water would be treated at a single location.
- Option 2: Wellhead Treatment – Abandon Gilman Well Nos. 4 and 5 and provide wellhead treatment at Risdon Well Nos. 1 and 2 and wellhead treatment at Well No. 6.

Due to the small site at Gilman Wells 4 and 5, additional wellhead treatment is not feasible at this location. The City has another existing undeveloped well, Well No. 6, which is not currently used as a potable water source. This well is considered as a part of the treatment evaluation as water rights from the existing potable water wells could potentially be transferred to this well in the future. The complete long-term water treatment alternatives evaluation can be found in Appendix Q.

8.6.1 Treatment Goals

The City desires the removal of anthropogenic PFAS contamination to non-detect levels as based on USEPA Method 537. Continued partial treatment and blending to below regulatory limits was not considered for PFAS in the evaluation. Blending to achieve lower concentrations of naturally occurring arsenic and manganese, however, was considered in the evaluation. The long-term treatment goals considered in the evaluation were:

1. Reduction of manganese concentrations to 0.015 mg/L.
2. Reduction of arsenic to at least half of the MCL (0.005 mg/L).
3. Removal of PFAS to levels below the USEPA Method 537 detection limits.
4. Optional fluoridation to 0.7 mg/L to match that of the regional water supply.
5. Disinfection to maintain a minimum of 0.2 mg/L chlorine residual throughout the distribution system.
6. Corrosion control to adjust the groundwater pH target to 8.1, to be consistent with the pH of the regional water supply.

These goals were used to determine the equipment sizes and footprints that would be needed for each option.

8.6.2 Options Evaluation Summary

Option 1 – Centralized Treatment

The centralized treatment plant was evaluated to treat water from both the Risdon and Gilman wells at a centralized location. This option would require the City to select a treatment plant location for the new treatment plant. The centralized treatment plant location would be at a location between the Risdon and Gilman well sites and south of the Interstate-90 corridor.

This option would require the installation of new transmission mains from the Risdon and Gilman wells to convey water to the centralized location and the installation of equipment to meet the long-term treatment goals. Overall, this option would be feasible for this City and would allow them to address the water quality issues from both the Risdon and Gilman wells.

Option 2 – Wellhead Treatment

Wellhead treatment was evaluated for the Risdon Well site as well as a new site at the City's undeveloped Well No. 6. It was determined that it was not feasible to install wellhead treatment at the Risdon well site due the limited space on the site. Wellhead treatment at the undeveloped Well No. 6 could be possible if the City was able to transfer water rights their existing water rights from the Gilman Wells to their Well No. 6. Overall, to meet the overall water quality goals and water demands, wellhead treatment at each site was not feasible without consideration of purchasing more land and transferring water rights. Well No. 6 is located on future Confluence Park property.

8.6.3 Long-Term Treatment Option Selection

Based on the long-term treatment evaluation, the City's preferred long-term option to meet the established treatment goals is through a centralized treatment plant that would receive and treat water from both Risdon and Gilman wells. A centralized treatment plant at a new location would give the City the ability to expand treatment based on future regulations and emerging contaminant issues. Future efforts in development of this long-term option include a treatability study, land acquisition, environmental site assessment, zoning and permitting, and a geotechnical investigation.

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Chapter 9. Facility Evaluation

This chapter provides a hydraulic evaluation of the City's water system. This include an evaluation of the system's storage facilities, pressures, and fire flows to meet Department of Health requirements and City design policies. An evaluation of pump station capacities is included in Chapter 7 – Supply Evaluation.

9.1 Storage Capacity Analysis

The following storage analysis reviews the policies and criteria established by the City that dictate storage requirements, reviews the available storage, establishes the storage requirements, and evaluates the possible storage deficit in each service level. The analysis considers demand and supply projections for the year 2017, 2021, and 2031 scenarios.

For the Lakemont and Montreux Operating Areas, storage is provided in the City of Bellevue's system per agreement and therefore are not analyzed in this chapter[1].

9.1.1 Storage Components

The storage capacity analysis compares the volume of existing water storage provided by reservoirs and standpipes in the water system, to the volume of storage required to serve current and projected water demands.

The storage capacity analysis only looks at supply/demand flow rates, existing reservoir volumes, and system elevations for determining the capacity of the storage facilities. Additional analysis that takes into consideration the movement of water through the distribution system and associated impacts on pressure (such as head loss) are completed as part of the distribution system analysis (Section 9.2).

There are five types of storage volumes that must be accounted for per Washington Administrative Code (WAC) 246-290-235. These are described below and shown in Figure 9-1.

- **Operational Storage** - the volume of storage associated with source or booster pump normal cycling times under normal operating conditions. This is calculated as the volume of water that is delivered to the system from the storage facility between the storage facility's sources switching from off to on. Operating storage must be provided at a pressure of at least 30 psi per DOH requirements. The City has established a policy that all new facilities be designed to provide this storage at 40 psi at the second floor. The analyses presented in this chapter are based on the assumption of an operating band with a 2 ft height will a maximum fill height to 6 inches below a storage tank's overflow elevation. Actual operating bands use for the reservoirs depend on time of year and observed water quality.
- **Equalizing Storage** - the volume of storage needed to supplement supply to consumers when the peak hourly demand exceeds the total source pumping capacity. The City has established a policy that all new facilities be designed to provide a minimum pressure within the distribution

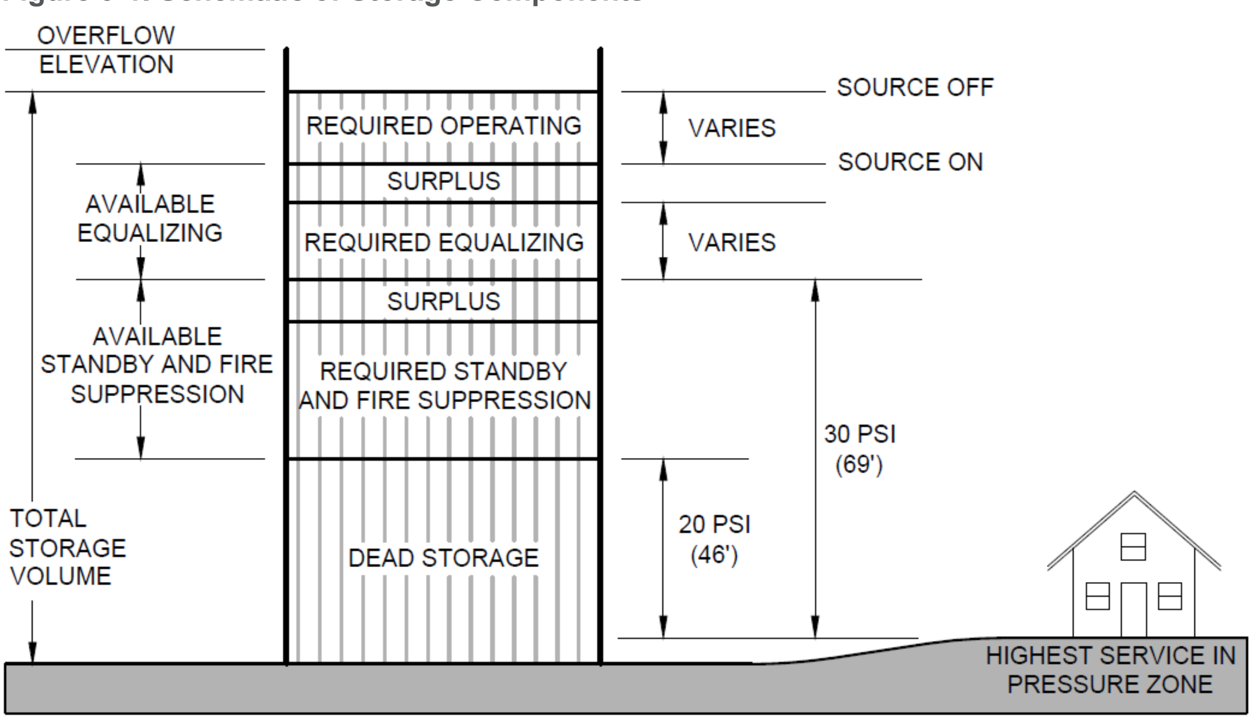
[1] Additional information on storage for the Lakemont and Montreux Operating Areas can be found in the City of Bellevue's 2016 Water System Plan, Volume 1, pages 4-28; and in Volume 2, Appendix K, Tables 12 and 14.

system of 40 psi at the second floor elevation where all equalizing storage has been depleted. However, the storage analysis of existing facilities performed for this Plan were based on the DOH regulatory requirement of 30 psi at the meter.

- **Standby Storage** - the volume of stored water available for use during a loss of source capacity or power, or similar short-term emergency. This storage component is equal to the greater of (1) the amount of storage required to meet average day demands for two days if the largest source supplying the storage facility is out of service, or (2) 200 gallons per the number of ERUs served by the facility. Standby storage must be provided at a pressure of at least 20 psi during maximum day demand (MDD).
- **Fire Suppression Storage** - the volume of stored water available during fire suppression activities. This is calculated to be the volume associated with the highest fire demand (flow × duration) served by the storage facilities. The standby storage and fire suppression storage can be "nested" meaning the larger of the two becomes the required storage volume. However, for future development, the City currently plans on having fire suppression storage and standby storage be additive. Fire suppression storage must be provided at a pressure of at least 20 psi.
- **Dead Storage** - the volume of stored water not available to all consumers at the minimum required design pressures.

The total storage volume required is equal to the greater of standby and fire suppression storage added to the sum of operational and equalizing storage; the volumes of which must be provided at the pressures shown in Figure 9-1.

Figure 9-1. Schematic of Storage Components



9.1.2 Methodology

The storage capacity analysis is based on an evaluation of the existing storage reservoirs and their ability to meet the demands and minimum pressure requirements in the areas they serve. The evaluation is based upon two primary calculations:

1. An evaluation of the ability of existing storage facilities to provide required operational and equalizing storage volumes under current and future conditions at a minimum of 30 psi to the highest customer in the service area.
2. An evaluation of the ability of existing storage facilities to provide required operational, equalizing, standby, and fire suppression storage volumes under current and future conditions at a minimum of 20 psi to the highest customer in the service area.

Required storage volumes for each of the storage components follows the methodologies provided in the Washington State Department of Health (DOH) Water System Design Manual.

The analysis is divided by operating area. For each operating area, the required volumes for operational, equalizing, standby, and fire suppression storage are calculated. These storage volumes are based upon the demands of the individual pressure zones each reservoir directly serves in the operating area. In the analysis, where possible, if there is a surplus of storage that is available at 20 psi or more for a pressure zone, that storage is made available to the next lower pressure zone for use in meeting standby or fire suppression storage needs. PRVs in the distribution system allow for movement of water from upper to lower zones under certain pressure conditions.

Assumed Operating Levels

The storage capacity analysis assumes that reservoirs are operated to their full capacity by assuming an operating band that fills to 6 inches below the overflow with an operating band height of 2 ft. Actual operating bands use for the reservoirs depend on time of year, water quality, and design criteria.

9.1.3 Storage Requirements Compared to Available Storage

This section provides a comparison of the calculated required storage volume compared to the existing storage volume available at elevations that satisfy DOH requirements and City policies regarding system pressures. This comparison is made within each operating area. Table 9-1 provides a brief summary of compliance while the tables on pages 9-5 through 9-16 provide details on the storage analysis for each operating area.

Table 9-1. Summary of Storage Ability to Meet DOH Requirements and City Policies

Operating Area	Compliance with DOH Requirements (20 psi and 30psi Pressures)	Compliance with City Policy (40 psi at 2nd Story)
Forest Rim	**Adequate**	**Adequate**
Highwood	**Adequate**	**Adequate**
Wildwood	**Adequate**	**Deficiency** to supply pressure at all service connections per City policy. However, DOH requirements are met.
Mount Hood	**Adequate** if 12th Avenue BPS and Mt. Park BPS used to provide a portion of fire flows.	**Deficiency** to supply pressure at all service connections per City policy. However, DOH requirements are met.

Table 9-1. Summary of Storage Ability to Meet DOH Requirements and City Policies

Operating Area	Compliance with DOH Requirements (20 psi and 30psi Pressures)	Compliance with City Policy (40 psi at 2nd Story)
Grand Ridge	**Adequate**	**Adequate**
Issaquah Highlands Summit	**Adequate**	**Adequate**
Issaquah Highlands Central Park	**Adequate**	**Deficiency** to supply pressure at all service connections per City policy. However, DOH requirements are met.
Talus Foothills	**Adequate**	**Adequate**
Talus Shangri-La	**Adequate** if Talus I/II BPS used to provide a portion of fire flows.	**Deficiency** to supply pressure at all service connections per City policy. However, DOH requirements are met.
Cougar Ridge	**Adequate**	**Adequate**
Valley	**Future Deficiency** resolved through construction of the SPAR Reservoir.	**Deficiency** to supply pressure at all service connections per City policy. However, DOH requirements are met.
South Cove	**Future Deficiency** resolved if nesting allowed for operating area.	**Adequate**

Forest Rim Operating Area

Table 9-2 shows that storage within the Forest Rim Operating Area is sufficient for the 20-year planning horizon.

Table 9-2. Forest Rim Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 1,080.00 ft			
Largest Fire Demand	1,000 gpm	for	2 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) [1]				
Forest Rim 1178 Zone	117	129	137	161
Projected Demand (gpm) [2]				
Average Day	12.2	13.4	14.3	16.7
Maximum Day	25.7	28.2	30.1	35.3
Peak Hour Demand	85.9	91.0	94.7	105.0
Sources (gpm)				
Forest Rim BPS				
Pump 1	300	300	300	300
Pump 2	300	300	300	300
Total Available Source, All Sources Online	600	600	600	600
Total Available Source, Largest Source Offline	300	300	300	300
Required Storage Calculations				
Operational Storage (gal) [3]	5,288	5,288	5,288	5,288
Equalizing Storage (gal) [4]	0	0	0	0
Standby Storage (gal) [5]	23,370	25,706	27,391	32,103
Fire Suppression Storage (gal)	120,000	120,000	120,000	120,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) [6]	5,288	5,288	5,288	5,288
Greater than 20 psi at highest meter (gal) [7]	148,658	150,993	152,678	157,390
Existing Storage Greater than 30 psi				
Forest Rim Tank A (gal)	67,649	67,649	67,649	67,649
Forest Rim Tank B (gal)	67,649	67,649	67,649	67,649
Total Existing Storage at 30 psi (gal)	135,298	135,298	135,298	135,298
Storage Surplus/(Deficiency) at 30 psi (gal)	130,010	130,010	130,010	130,010
Existing Storage Greater than 20 psi				
Forest Rim Tank A (gal)	98,196	98,196	98,196	98,196
Forest Rim Tank B (gal)	98,196	98,196	98,196	98,196
Total Existing Storage at 20 psi (gal)	196,393	196,393	196,393	196,393
Storage Surplus/(Deficiency) at 20 psi (gal)	47,734	45,399	43,714	39,002
Storage Surplus/(Deficiency) at 20 psi (gal) (excluding standby storage)	71,105	71,105	71,105	71,105
Existing Storage Greater than 40 psi @ 2nd Story				
Forest Rim Tank A (gal)	21,239	21,239	21,239	21,239
Forest Rim Tank B (gal)	21,239	21,239	21,239	21,239
Total Existing Storage at 40 psi @ 2nd Story (gal)	42,478	42,478	42,478	42,478
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	37,190	37,190	37,190	37,190

Notes (apply to all storage capacity analysis tables):

[1] ERUs calculated as average day demand / ERU water use factor (150 gpd/ERU)

[2] Projected demands taken from Chapter 5.

[3] Required operational storage assumes a 2 ft high operating band for each reservoir with a high fill elevation at 0.5 ft below the reservoir overflow.

[4] Required equalizing storage = (PHD – total available source) × 150 minutes, but no less than zero.

[5] Required standby storage = greater of 2 × (ADD – total source with largest source out of service) or 200 gallons per ERU.

[6] Equal to the combined volume of operational and equalizing storage.

[7] Equal to the combined volume of operational, equalizing, standby, and fire suppression storage.

Highwood Operating Area

Table 9-3 shows that storage within the Highwood Operating Area is sufficient for the 20-year planning horizon.

Table 9-3. Highwood Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 743.00 ft			
Largest Fire Demand	1,000 gpm	for	2 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Highwood 920, 782, 715, 677 Zones	439	483	514	603
Projected Demand (gpm) (2)				
Average Day	45.7	50.3	53.6	62.8
Maximum Day	96.5	106.1	113.0	132.5
Peak Hour Demand	219.1	236.4	248.3	279.4
Sources (gpm)				
Wildwood BPS				
Pump 1	450	450	450	450
Pump 2	450	450	450	450
Total Available Source, All Sources Online	900	900	900	900
Total Available Source, Largest Source Offline	450	450	450	450
Required Storage Calculations				
Operational Storage (gal) (3)	33,935	33,935	33,935	33,935
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	87,767	96,537	102,865	120,561
Fire Suppression Storage (gal)	120,000	120,000	120,000	120,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	33,935	33,935	33,935	33,935
Greater than 20 psi at highest meter (gal) (7)	241,702	250,472	256,800	274,496
Existing Storage Greater than 30 psi				
Highwood Tank A (gal)	241,787	241,787	241,787	241,787
Highwood Tank B (gal)	241,787	241,787	241,787	241,787
Total Existing Storage at 30 psi (gal)	483,574	483,574	483,574	483,574
Storage Surplus/(Deficiency) at 30 psi (gal)	449,639	449,639	449,639	449,639
Existing Storage Greater than 20 psi				
Highwood Tank A (gal)	241,787	241,787	241,787	241,787
Highwood Tank B (gal)	241,787	241,787	241,787	241,787
Surplus Storage from Forest Rim Zone at 20 psi (gal)	47,734	45,399	43,714	39,002
Total Existing Storage at 20 psi (gal)	531,309	528,974	527,288	522,577
Storage Surplus/(Deficiency) at 20 psi (gal)	289,607	278,501	270,488	248,081
Existing Storage Greater than 40 psi @ 2nd Story				
Highwood Tank A (gal)	241,787	241,787	241,787	241,787
Highwood Tank B (gal)	241,787	241,787	241,787	241,787
Total Existing Storage at 40 psi @ 2nd Story (gal)	483,574	483,574	483,574	483,574
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	449,639	449,639	449,639	449,639

Wildwood Operating Area

Table 9-4 shows that storage within the Wildwood Operating Area is sufficient for the 20-year planning horizon for DOH requirements. However, a deficiency exists for delivering operational and equalizing storage to all services at 40 psi at the 2nd story. The locations that have a pressure below 40 psi at the 2nd story is shown in Figure 9-3.

Table 9-4. Wildwood Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 539.00 ft			
Largest Fire Demand	1,000 gpm	for	2 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Wildwood 625, 588 Zones	116	128	136	160
Projected Demand (gpm) (2)				
Average Day	12.1	13.3	14.2	16.6
Maximum Day	25.5	28.1	29.9	35.1
Peak Hour Demand	85.6	90.7	94.4	104.7
Sources (gpm)				
Mount Hood BPS				
Pump 1	500	500	500	500
Pump 2	500	500	500	500
Total Available Source, All Sources Online	1,000	1,000	1,000	1,000
Total Available Source, Largest Source Offline	500	500	500	500
Required Storage Calculations				
Operational Storage (gal) (3)	38,177	38,177	38,177	38,177
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	23,245	25,568	27,244	31,930
Fire Suppression Storage (gal)	120,000	120,000	120,000	120,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	38,177	38,177	38,177	38,177
Greater than 20 psi at highest meter (gal) (7)	181,422	183,745	185,421	190,107
Existing Storage Greater than 30 psi				
Wildwood Reservoir (gal)	248,150	248,150	248,150	248,150
Total Existing Storage at 30 psi (gal)	248,150	248,150	248,150	248,150
Storage Surplus/(Deficiency) at 30 psi (gal)	209,973	209,973	209,973	209,973
Existing Storage Greater than 20 psi				
Wildwood Reservoir (gal)	248,150	248,150	248,150	248,150
Surplus Storage from Highwood Zone at 20 psi (gal)	289,607	278,501	270,488	248,081
Total Existing Storage at 20 psi (gal)	537,757	526,651	518,638	496,231
Storage Surplus/(Deficiency) at 20 psi (gal)	356,335	342,907	333,217	306,123
Existing Storage Greater than 40 psi @ 2nd Story				
Wildwood Reservoir (gal)	0	0	0	0
Total Existing Storage at 40 psi @ 2nd Story (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	(120,000)	(120,000)	(120,000)	(120,000)

Mount Hood Operating Area

Table 9-5 shows that storage within the Mount Hood Operating Area is sufficient for the 20-year planning horizon. However, this is due to the pump stations (12th Avenue BPS and Mountain Park BPS) supplying a significant portion of fire suppression storage. It is assumed that the pumps stations supply a fire flow equal to the difference in the pumping firm capacity (largest pump out of service) and maximum day demand. This means that any pumping capacity with the largest pump out of service greater than the maximum day demand is allocated toward fire flows. The remaining required fire flow is provided from fire suppression storage in the reservoir.

However, a deficiency exists for delivering operational and equalizing storage to all services at 40 psi at the 2nd story. The locations that have a pressure below 40 psi at the 2nd story is shown in Figure 9-3.

Table 9-5. Mount Hood Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 403.00 ft			
Largest Fire Demand	3,500 gpm	for	4 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Mount Hood 480 Zone	1,045	1,150	1,225	1,436
Projected Demand (gpm) (2)				
Average Day	109	120	128	150
Maximum Day	230	253	269	316
Peak Hour Demand	435	472	498	572
Sources (gpm)				
12th Avenue BPS				
Pump 1	760	760	760	760
Pump 2	760	760	760	760
Mountain Park BPS				
Pump 1	1,000	1,000	1,000	1,000
Pump 2	1,000	1,000	1,000	1,000
Total Available Source, All Sources Online	3,520	3,520	3,520	3,520
Total Available Source, Largest Source Offline	2,520	2,520	2,520	2,520
Required Storage Calculations				
Operational Storage (gal) (3)	42,301	42,301	42,301	42,301
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	209,091	229,984	245,060	287,216
Fire Suppression Storage (gal)	85,793	94,843	101,376	119,640
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	42,301	42,301	42,301	42,301
Greater than 20 psi at highest meter (gal) (7)	337,185	367,128	388,737	449,157
Existing Storage Greater than 30 psi				
Mt. Hood Reservoir (gal)	225,783	225,783	225,783	225,783
Total Existing Storage at 30 psi (gal)	225,783	225,783	225,783	225,783
Storage Surplus/(Deficiency) at 30 psi (gal)	183,482	183,482	183,482	183,482

Table 9-5 (continued). Mount Hood Operating Area Storage Capacity Analysis

Storage Surplus/(Deficiency) at 30 psi (gal)	[illegible]	[illegible]	[illegible]	[illegible]
Existing Storage Greater than 20 psi				
Mt. Hood Reservoir (gal)	391,287	391,287	391,287	391,287
Surplus Storage from Wildwood Zone at 20 psi (gal)	356,335	342,907	333,217	306,123
Total Existing Storage at 20 psi (gal)	747,622	734,194	724,504	697,410
Storage Surplus/(Deficiency) at 20 psi (gal)	410,437	367,066	335,767	248,253
Storage Surplus/(Deficiency) at 20 psi (gal) (excluding standby storage)	619,527	597,049	580,827	535,469
Existing Storage Greater than 40 psi @ 2nd Story				
Mt. Hood Reservoir (gal)	0	0	0	0
Total Existing Storage at 40 psi @ 2nd Story (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	(42,301)	(42,301)	(42,301)	(42,301)

Grand Ridge Operating Area

Table 9-6 shows that storage within the Grand Ridge Operating Area is sufficient for the 20-year planning horizon.

Table 9-6. Grand Ridge Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 1,194.00 ft			
Largest Fire Demand	1,000 gpm	for	2 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) [1]				
Grand Ridge 1337 Zone	26	46	60	60
Projected Demand (gpm) [2]				
Average Day	3	5	6	6
Maximum Day	6	10	13	13
Peak Hour Demand	35	49	56	56
Sources (gpm)				
Grand Ridge BPS				
Pump 1	293	293	293	293
Pump 2	293	293	293	293
Total Available Source, All Sources Online	586	586	586	586
Total Available Source, Largest Source Offline	293	293	293	293
Required Storage Calculations				
Operational Storage (gal) [3]	9,028	9,028	9,028	9,028
Equalizing Storage (gal) [4]	0	0	0	0
Standby Storage (gal) [5]	5,198	9,279	12,000	12,000
Fire Suppression Storage (gal)	120,000	120,000	120,000	120,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) [6]	9,028	9,028	9,028	9,028
Greater than 20 psi at highest meter (gal) [7]	134,226	138,307	141,028	141,028
Existing Storage Greater than 30 psi				
Grand Ridge Standpipes (gal)	189,589	189,589	189,589	189,589
Storage Surplus/(Deficiency) at 30 psi (gal)	180,561	180,561	180,561	180,561

Table 9-6 (continued). Grand Ridge Operating Area Storage Capacity Analysis

Existing Storage Greater than 20 psi				
Grand Ridge Reservoir (gal)	189,589	189,589	189,589	189,589
Storage Surplus/(Deficiency) at 20 psi (gal)	55,363	51,281	48,561	48,561
Storage Surplus/(Deficiency) at 20 psi (gal) (excluding standby storage)	60,561	60,561	60,561	60,561
Existing Storage Greater than 40 psi @ 2nd Story				
Grand Ridge Reservoir (gal)	171,834	171,834	171,834	171,834
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	162,806	162,806	162,806	162,806

Issaquah Highlands Summit Operating Area

Table 9-7 shows that storage within the Issaquah Highlands Central Park Operating Area is sufficient for the 20-year planning horizon.

Table 9-7. Issaquah Highlands Summit Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 1,095.00 ft			
Largest Fire Demand	3,500 gpm	for	4 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) [1]				
Issaquah Highlands Summit 1234, 1000, 615 Zones	1,932	4,318	4,318	4,318
Projected Demand (gpm) [2]				
Average Day	201	450	450	450
Maximum Day	425	949	949	949
Peak Hour Demand	747	1,586	1,586	1,586
Sources (gpm)				
Central Park BPS				
Pump 1	1,528	1,528	1,528	1,528
Pump 2	1,528	1,528	1,528	1,528
Total Available Source, All Sources Online	3,056	3,056	3,056	3,056
Total Available Source, Largest Source Offline	1,528	1,528	1,528	1,528
Required Storage Calculations				
Operational Storage (gal) [3]	99,291	99,291	99,291	99,291
Equalizing Storage (gal) [4]	0	0	0	0
Standby Storage (gal) [5]	386,452	863,574	863,574	863,574
Fire Suppression Storage (gal)	840,000	840,000	840,000	840,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) [6]	99,291	99,291	99,291	99,291
Greater than 20 psi at highest meter (gal) [7]	1,325,743	1,802,865	1,802,865	1,802,865
Existing Storage Greater than 30 psi				
Summit Standpipes (gal)	2,099,995	2,099,995	2,099,995	2,099,995
Storage Surplus/(Deficiency) at 30 psi (gal)	2,000,704	2,000,704	2,000,704	2,000,704
Existing Storage Greater than 20 psi				
Summit Reservoir (gal)	2,099,995	2,099,995	2,099,995	2,099,995
Surplus Storage from Grand Ridge Zone at 20 psi (gal)	55,363	51,281	48,561	48,561
Total Existing Storage at 20 psi (gal)	2,155,357	2,151,276	2,148,556	2,148,556
Storage Surplus/(Deficiency) at 20 psi (gal)	829,615	348,411	345,691	345,691
Storage Surplus/(Deficiency) at 20 psi (gal) (excluding standby storage)	1,216,067	1,211,986	1,209,265	1,209,265
Existing Storage Greater than 40 psi @ 2nd Story				
Summit Reservoir (gal)	1,716,072	1,716,072	1,716,072	1,716,072
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	1,616,782	1,716,072	1,716,072	1,716,072

Issaquah Highlands Central Park Operating Area

Table 9-8 shows that storage within the Issaquah Highlands Central Park Operating Area is sufficient for the 20-year planning horizon. However, a deficiency exists for delivering operational and equalizing storage to all services at 40 psi at the 2nd story. The locations that have a pressure below 40 psi at the 2nd story is shown in Figure 9-3.

Table 9-8. Issaquah Highlands Central Park Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 658.00 ft			
Largest Fire Demand	3,500 gpm	for	4 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Issaquah Highlands Central Park and Lakeside Zones	2,790	4,676	4,834	5,313
Projected Demand (gpm) (2)				
Average Day	291	487	504	553
Maximum Day	613	1028	1063	1168
Peak Hour Demand	1048	1712	1768	1936
Sources (gpm)				
Holly I BPS				
Pump 1	500	500	500	500
Pump 2	500	500	500	500
Holly II BPS				
Pump 1	1,300	1,300	1,300	1,300
Pump 2	1,300	1,300	1,300	1,300
Total Available Source, All Sources Online	3,600	3,600	3,600	3,600
Total Available Source, Largest Source Offline	2,300	2,300	2,300	2,300
Required Storage Calculations				
Operational Storage (gal) (3)	249,319	249,319	249,319	249,319
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	557,918	935,198	966,865	1,062,698
Fire Suppression Storage (gal)	840,000	840,000	840,000	840,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	249,319	249,319	249,319	249,319
Greater than 20 psi at highest meter (gal) (7)	1,647,237	2,024,517	2,056,184	2,152,017
Existing Storage Greater than 30 psi				
Central Park Reservoirs (gal)	1,779,517	1,779,517	1,779,517	1,779,517
Storage Surplus/(Deficiency) at 30 psi (gal)	1,530,198	1,530,198	1,530,198	1,530,198
Existing Storage Greater than 20 psi				
Central Park Reservoir (gal)	3,091,557	3,091,557	3,091,557	3,091,557
Surplus Storage from IH Summit Zone at 20 psi (gal)	829,615	348,411	345,691	345,691
Total Existing Storage at 20 psi (gal)	3,921,172	3,439,969	3,437,248	3,437,248
Storage Surplus/(Deficiency) at 20 psi (gal)	2,273,934	1,415,451	1,381,064	1,285,230
Existing Storage Greater than 40 psi @ 2nd Story				
Central Park Reservoir (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	(249,319)	(249,319)	(249,319)	(249,319)

Talus Foothills Operating Area

Table 9-9 shows that storage within the Talus Foothills Operating Area is sufficient for the 20-year planning horizon.

Table 9-9. Talus Foothills Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 804.60 ft			
Largest Fire Demand	1,500 gpm	for	2 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Talus Foothils 912, 752 Zones	509	649	672	672
Projected Demand (gpm) (2)				
Average Day	53	68	70	70
Maximum Day	112	143	148	148
Peak Hour Demand	247	296	304	304
Sources (gpm)				
Cascade BPS				
Pump 1	195	195	195	195
Pump 2	195	195	195	195
Pump 3	195	195	195	195
Pump 4	195	195	195	195
Shangri-La BPS				
Pump P1, P3	250	250	250	250
Pump P2, P4	250	250	250	250
Total Available Source, All Sources Online	1,280	1,280	1,280	1,280
Total Available Source, Largest Source Offline	1,030	1,030	1,030	1,030
Required Storage Calculations				
Operational Storage (gal) (3)	14,888	14,888	14,888	14,888
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	101,849	129,792	134,449	134,449
Fire Suppression Storage (gal)	180,000	180,000	180,000	180,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	14,888	14,888	14,888	14,888
Greater than 20 psi at highest meter (gal) (7)	296,737	324,680	329,337	329,337
Existing Storage Greater than 30 psi				
Foothills Reservoir (gal)	287,160	287,160	287,160	287,160
Storage Surplus/(Deficiency) at 30 psi (gal)	272,271	272,271	272,271	272,271
Existing Storage Greater than 20 psi				
Foothills Reservoir (gal)	357,321	357,321	357,321	357,321
Storage Surplus/(Deficiency) at 20 psi (gal)	60,584	32,641	27,984	27,984
Existing Storage Greater than 40 psi @ 2nd Story				
Foothills Reservoir (gal)	25,807	25,807	25,807	25,807
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	10,918	10,918	10,918	10,918

Talus Shangri-La Operating Area

Table 9-10 shows that storage within the Talus Shangri-La Operating Area is sufficient for the 20-year planning horizon. However, a deficiency exists for delivering operational and equalizing storage to all services at 40 psi at the 2nd story. The locations that have a pressure below 40 psi at the 2nd story is shown in Figure 9-3.

Table 9-10. Talus Shangri-La Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 513.00 ft			
Highest Hydrant Elevation	EL 544.00 ft			
Operating area serves fire flows for MFR areas in Talus 912 zone. Highest EL of these hydrants used for determining available 20 psi storage.				
Largest Fire Demand	3,500 gpm for 4 hours			
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) [(1)]				
Talus Shangri-La 616 Zone	986	1,260	1,305	1,305
Projected Demand (gpm) [(2)]				
Average Day	103	131	136	136
Maximum Day	217	277	287	287
Peak Hour Demand	414	510	527	527
Sources (gpm)				
Talus I & II BPS				
Pump 1, 2	500	500	500	500
Pump 3, 4	500	500	500	500
Total Available Source, All Sources Online	1,000	1,000	1,000	1,000
Total Available Source, Largest Source Offline	500	500	500	500
Required Storage Calculations				
Operational Storage (gal) [(3)]	146,668	146,668	146,668	146,668
Equalizing Storage (gal) [(4)]	0	0	0	0
Standby Storage (gal) [(5)]	197,184	251,962	261,092	261,092
Fire Suppression Storage (gal)	584,324	584,324	584,324	584,324
DOH Required Storage				
Greater than 30 psi at highest meter (gal) [(6)]	146,668	146,668	146,668	146,668
Greater than 20 psi at highest meter (gal) [(7)]	928,176	982,954	992,084	992,084
Existing Storage Greater than 30 psi				
Shangri-La Reservoirs (gal)	2,163,353	2,163,353	2,163,353	2,163,353
Storage Surplus/(Deficiency) at 30 psi (gal)	2,016,685	2,016,685	2,016,685	2,016,685
Existing Storage Greater than 20 psi				
Shangri-La Reservoirs (gal)	1,854,128	1,854,128	1,854,128	1,854,128
Surplus Storage from Talus Mt. View at 20 psi (gal)	60,584	32,641	27,984	27,984
Total Existing Storage at 20 psi (gal)	1,914,712	1,886,769	1,882,112	1,882,112
Storage Surplus/(Deficiency) at 20 psi (gal)	986,536	903,815	890,028	890,028
Existing Storage Greater than 40 psi @ 2nd Story				
Shangri-La Reservoirs (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	(146,668)	(146,668)	(146,668)	(146,668)

In addition to serving the demands within the Talus Shangri-La 616 Zone, the Shangri-La Reservoir also feeds pipes which serve fire flows for multifamily residential units within the Talus Foothills 752 zone (domestic water service and hydrants are in separate mains and separate pressure zones for multifamily residential units). Because of this, storage required at 30 psi is based on the highest service connection elevation while storage required at 20 psi is based on the highest hydrant elevation.

Table 9-10 shows surplus/deficient storage based on static conditions. Hydraulic modeling of the area found that due to head losses in the system when flowing 3,500 gpm to the MFR areas in the Talus 752 zone with fire suppression storage depleted, pressures dropped below 20 psi.

Assuming a portion of the fire flow is provided by the Talus I & II BPS provides enough head for pressures to remain above 20 psi while delivering the non-residential fire flow goal of 3,500.

Cougar Ridge Operating Area

Table 9-11 shows that storage within the Cougar Ridge Operating Area is sufficient for the 20-year planning horizon.

Table 9-11. Cougar Ridge Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 323.00 ft			
Largest Fire Demand	1,500 gpm	for	2 hours	
Nesting of Fire Flow Storage?	Yes			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) [1]				
Cougar Ridge 430 Zone	75	81	86	99
Projected Demand (gpm) [2]				
Average Day	8	8	9	10
Maximum Day	17	18	19	22
Peak Hour Demand	65	68	71	78
Sources (gpm)				
Terra II BPS				
Pump 1	525	525	525	525
Pump 2	525	525	525	525
Total Available Source, All Sources Online	1,050	1,050	1,050	1,050
Total Available Source, Largest Source Offline	525	525	525	525
Required Storage Calculations				
Operational Storage (gal) [3]	6,792	6,792	6,792	6,792
Equalizing Storage (gal) [4]	0	0	0	0
Standby Storage (gal) [5]	15,019	16,296	17,217	19,794
Fire Suppression Storage (gal)	180,000	180,000	180,000	180,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) [6]	6,792	6,792	6,792	6,792
Greater than 20 psi at highest meter (gal) [7]	186,792	186,792	186,792	186,792
Existing Storage Greater than 30 psi				
Cougar Ridge Reservoir (gal)	129,637	129,637	129,637	129,637
Storage Surplus/(Deficiency) at 30 psi (gal)	122,845	122,845	122,845	122,845

Table 9-11 (continued). Cougar Ridge Operating Area Storage Capacity Analysis

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Existing Storage Greater than 20 psi				
Cougar Ridge Reservoir (gal)	208,109	208,109	208,109	208,109
Storage Surplus/(Deficiency) at 20 psi (gal)	21,318	21,318	21,318	21,318
Storage Surplus/(Deficiency) at 20 psi (gal) (excluding standby storage)	36,337	37,614	38,535	41,111
Existing Storage Greater than 40 psi @ 2nd Story				
Cougar Ridge Reservoir (gal)	10,414	10,414	10,414	10,414
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	3,622	3,622	3,622	3,622

Valley Operating Area

Table 9-12 shows that storage within the Valley Operating Area is currently sufficient to the 10-year planning horizon. However, forecasted growth in the Valley Operating Area increases both standby and equalizing storage volumes. Additional storage (South SPAR Reservoir) will be required to provide the additional storage volume for the 20-year planning horizon.

Additionally, a deficiency exists for delivering operational and equalizing storage to all services at 40 psi at the 2nd story. The locations that have a pressure below 40 psi at the 2nd story is shown in Figure 9-3.

The analysis calculates available storage based on a highest service connection elevation of 200 ft within the Valley 297 Zone. Four services are higher than 200 ft, all of which are located at the western end of NW Goode Place. A project has been identified to move these services to the Talus 616 Zone from the Valley 297 Zone.

Table 9-12. Valley Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 200.00 ft			
Largest Fire Demand	3,500 gpm	for	4 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
Valley 297, Bergsma Zones	7,462	9,891	11,524	15,675
Projected Demand (gpm) (2)				
Average Day	777	1030	1200	1633
Maximum Day	1640	2174	2533	3445
Peak Hour Demand	2691	3546	4120	5580
Sources (gpm)				
Risdon Well No. 1	550	550	550	550
Risdon Well No. 2	990	990	990	990
Gilman Well No. 4	200	200	200	200
Gilman Well No. 5	1,020	1,020	1,020	1,020
Total Available Source, All Sources Online	2,760	2,760	2,760	2,760
Total Available Source, Largest Source Offline	1,740	1,740	1,740	1,740
Required Storage Calculations				
Operational Storage (gal) (3)	262,127	262,127	262,127	262,127
Equalizing Storage (gal) (4)	0	117,861	204,029	422,958
Standby Storage (gal) (5)	1,492,343	1,978,174	2,304,874	3,134,939
Fire Suppression Storage (gal)	840,000	840,000	840,000	840,000
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	262,127	379,988	466,156	685,085
Greater than 20 psi at highest meter (gal) (7)	2,594,470	3,198,163	3,611,030	4,660,024

Table 9-12 (continued). Valley Operating Area Storage Capacity Analysis

Existing Storage Greater than 30 psi				
Westside Reservoir (gal)	1,757,442	1,757,442	1,757,442	1,757,442
Cemetary Hills Standpipes (gal)	917,445	917,445	917,445	917,445
Proposed SPAR Reservoir (gal)	0	1,896,516	1,896,516	1,896,516
Total Existing Storage at 30 psi (gal)	2,674,887	4,571,403	4,571,403	4,571,403
Storage Surplus/(Deficiency) at 30 psi (gal)	2,412,760	4,191,415	4,105,248	3,886,318
Existing Storage Greater than 20 psi				
Westside Reservoir (gal)	1,757,442	1,757,442	1,757,442	1,757,442
Cemetary Hills Reservoir (gal)	975,430	975,430	975,430	975,430
Proposed SPAR Reservoir (gal)	0	2,535,539	2,535,539	2,535,539
Surplus Storage from Talus Shangri-La at 20 psi (gal)	986,536	903,815	890,028	890,028
Surplus Storage from Cougar Ridge at 20 psi (gal)	21,318	21,318	21,318	21,318
Surplus Storage from Mount Hood at 20 psi (gal)	410,437	367,066	335,767	248,253
Total Existing Storage at 20 psi (gal)	4,151,163	6,560,610	6,515,525	6,428,011
Storage Surplus/(Deficiency) at 20 psi (gal)	1,556,693	3,362,447	2,904,496	1,767,987
Westside Reservoir (gal)	0	0	0	0
Cemetary Hills Standpipes (gal)	0	0	0	0
Proposed SPAR Reservoir (gal)	0	0	0	0
Total Existing Storage at 40 psi @ 2nd Story (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	(262,127)	(379,988)	(466,156)	(685,085)

South Cove Operating Area

Table 9-13 shows that storage within the South Cove Operating Area has a deficiency for the 10-year planning horizon. The analysis assumes that 1,000 gpm of the 3,500 gpm is provided by the Bellevue intertie (the largest allowable fire flow per agreement).

However, the deficiency could be resolved by allowing nesting in the area. No storage projects are planned at this time for South Cove.

The analysis assumes zero operational storage for the South Cove Reservoir because it is not fed through a booster pump station.

Table 9-13. South Cove Operating Area Storage Capacity Analysis

Highest Service Connection Elevation	EL 175.00 ft			
Largest Fire Demand	3,500 gpm	for	4 hours	
Nesting of Fire Flow Storage?	No			
	Year			
	2017	**2023**	**2027**	**2037**
Projected Equivalen Residential Units (ERUs) (1)				
South Cove 260 Zone	1,216	1,338	1,425	1,671
Projected Demand (gpm) (2)				
Average Day	127	139	148	174
Maximum Day	267	294	313	367
Peak Hour Demand	495	538	569	655
Sources (gpm)				
Bellevue Intertie	1,000	1,000	1,000	1,000
Required Storage Calculations				
Operational Storage (gal) (3)	0	0	0	0
Equalizing Storage (gal) (4)	0	0	0	0
Standby Storage (gal) (5)	364,875	401,335	427,643	501,209
Fire Suppression Storage (gal)	600,000	600,000	600,000	600,000

Table 9-13 (continued). South Cove Operating Area Storage Capacity Analysis

Fire Suppression Storage (gal)	[illegible]	[illegible]	[illegible]	[illegible]
DOH Required Storage				
Greater than 30 psi at highest meter (gal) (6)	0	0	0	0
Greater than 20 psi at highest meter (gal) (7)	964,875	1,001,335	1,027,643	1,101,209
Existing Storage Greater than 30 psi				
South Cove Reservoir (gal)	430,596	430,596	430,596	430,596
Storage Surplus/(Deficiency) at 30 psi (gal)	430,596	430,596	430,596	430,596
Existing Storage Greater than 20 psi				
South Cove Reservoir (gal)	1,012,303	1,012,303	1,012,303	1,012,303
Storage Surplus/(Deficiency) at 20 psi (gal)	47,428	10,968	(15,340)	(88,906)
Existing Storage Greater than 40 psi @ 2nd Story				
South Cove Reservoir (gal)	0	0	0	0
Storage Surplus/(Deficiency) at 40 psi @ 2nd Story (gal)	0	0	0	0

9.2 Distribution System Analysis

9.2.1 Hydraulic Model

Background

A hydraulic model of the water system was utilized to analyze water system performance capabilities and define improvements necessary to meet system pressure and velocity criteria. The modeling software used is Infowater by Innovyze. The model was used to perform the following:

- Evaluate existing system-wide hydraulic performance and identify deficiencies.
- Evaluate future system-wide performance and identify deficiencies.
- Identify system improvements required to resolve deficiencies.

The physical parameters of the model were checked and updated as needed. This work included updating the model with changes to pipe sizes and materials, PRV settings, pump operational rules, water system facilities (pump stations and storage reservoirs), and updating model node elevations based on the most recent contour data available. After the physical parameters of the model were updated, demands were then allocated into the model.

Demand Allocation

Demands are allocated to junction nodes in the model. Junctions are located at the intersections of pipe mains and, in some locations, between intersections. Junction nodes are not included for every service connection.

A GIS database of water meters in the system includes current water demands by customer class. The demands in this database also included non-revenue demands distributed based on the size of the revenue demand of a water meter. The meter demands were then spatially linked to the nearest pipe in the model. The “meter-pipe” allocation method in the Demand Allocation module in InfoWater was used to allocate demands in the model. The method takes a point (meter) demand and allocates it between the junctions on each end of the particular model pipe segment that demand was spatially linked to. The split between junctions is weighted by distance.

For future forecast years, increases in demand for pressure zones was typically distributed by multiplying each demand junction in a pressure zone by the same factor. However, for the Valley 297 Zone, areas inside and outside of the Central Issaquah area were allocated separately, while in the Talus Foothills 912 Zone demands were allocated only to specific areas where planned development will occur.

Calibration

A steady-state calibration of the model was completed using data collected from 15 fire hydrant flow tests performed throughout the distribution system (see Figure 9-2). The static and residual pressures measured from the flow tests were then compared to the predicted values in the model. Each test had multiple locations in which static and residual pressures were read including the residual hydrant near the flow test along with locations in the applicable pressure zone in which pressures are recorded by the City's SCADA system (PRVs and pump stations). Between the 15 tests, there were 92 points of data for both static and residual conditions in which model and field data were compared to inform the calibration.

Calibration of the model was performed primarily by adjusting roughness factors for pipes and by adjusting PRV station settings where applicable.

There are no standard industry adopted criteria for calibrating a water system model. Since the model is being used for general water system planning, calibration goals were to have:

- Predicted (model) pressure results to within 4.3 psi (10 ft of water column) or 5%, whichever is greater, of measured values for 90 percent of data points
- Predicted pressure results to within 8.6 psi (20 ft of water column) or 15%, whichever is greater, of measured values for 100 percent of data points
- Drop in pressure (from static to residual conditions) within 5 psi of measured values for 90 percent of data points.

Table 9-14 provides a summary of the calibration of the model compared to the calibration goals. All goals were met except for one measurement point within Test No. 15 in which one location measured during the test had measured static and residual pressures whose difference from model values exceeded the 8.6 psi / 15 percent limit. However, the measured and predicted drop in pressures for the location were within 5 psi. The assumed elevations of measurement locations involved in the test and the pressures measured during the test at those locations was used to calculate HGL elevations for the points. A large difference in HGL elevation was seen between these measurement points during flow conditions which can be expected, but also for static conditions where HGL elevations should remain relatively flat across a pressure zone if there is no major

Table 9-14. Calibration Accuracy

	5 psi Pressure Drop Difference	4.3 psi (10 ft) / 5% Difference		8.6 psi (20 ft) / 15% Difference	
		Static	Residual	Static	Residual
Data Points Within Calibration Goal	59	56	58	61	61
Tests Outside of Calibration Goal	3	6	4	1	1
% Acceptable	95.2%	90.3%	93.5%	98.4%	98.4%
% Acceptable Goal	90%	90%	90%	100%	100%

demand draws. Because of this, it is suspected that an erroneous elevation or pressure reading caused the difference.

After review of the data collected from the field and model, it was determined that any discrepancies between the field and model were within a reasonable margin of error and that the model was sufficiently calibrated to performed the required analysis.

9.2.2 Pressure Analysis

In accordance with WAC 246-290-230, a minimum pressure of 30 psi must be maintained at all customer connections under peak hour demand (PHD) conditions with operational and equalizing storage volumes depleted in the reservoirs. Additionally, the City has a design policy for new developments of keeping pressures above 40 psi at the second story (analysis assumes this is measured as 12 ft above grade).

A steady-state run of the model was completed using PHD and operational and equalizing storage depleted. The model run showed that distribution system piping (outside of PRV and pump stations) all remain below 8 ft/s during PHD conditions. Pressures in the system were also determined using the model.

Figure 9-3 illustrates areas which currently (2017 demands) have low pressures during PHD conditions. Currently, no areas are below 30 psi during peak hour demand conditions. However, as shown in Figure 9-3, some areas do have pressures below 40 psi at the 2nd story. Figure 9-4 illustrates areas which have low pressures when assuming 2027 PHD and 10-year capital improvement program (CIP) projects have been completed.

A model run was also completed to determine the maximum static pressures throughout the system. It is the City’s goal to keep pressures bellow 100 psi when possible and to restrict pressures to stay below 150 psi. Figure 9-5 shows the pressures throughout the distribution system during static (no demand) conditions with reservoirs at their overflow elevations (representing a maximum pressure condition). As seen in Figure 9-5, a few areas have pressures which exceed 150 psi given this condition.

9.2.3 Fire Flow Analysis

A fire flow run of the hydraulic model was used to determine the maximum fire flow available during maximum day demand (MDD) conditions. The maximum fire flow available is defined as the maximum flow that can be delivered to a fire flow node while keeping system pressures above 20 psi with operational, equalizing, and fire flow storage depleted as well as keeping pipe velocities under a maximum allowable velocity. This is then compared to the required fire flow for the node to determine if there is a deficiency.

Typically, the required fire flows in the model are based on the fire flow goals in Table 9-15. The values in the table are planning level fire flow goals that are used to size water mains and facilities. However, actual regulatory fire flow requirements for individual buildings may differ from these goals which are based on the International Fire Code and building construction. A few locations in the model have lower fire flow goals based on known specific requirements.

Table 9-15. Fire Flow Goal

Land Use	Fire Flow Goal
Single Family (8 ft setback)	1,000 gpm
Single Family (no setback)	1,500 gpm
Non-Residential	3,500 gpm

The available fire flow calculated in the hydraulic model is equivalent to what the distribution system can deliver to a location, not necessarily what a single hydrant on a lateral off the distribution main would be able to convey. Hydrant laterals were not included in the model.

It is the City's policy to keep pipe velocities below 7 ft/s during fire flow conditions (see Section 3.4.2). Very few existing locations in the City are able to meet the 7 ft/s policy and upgrading the existing system to meet the 7 ft/s criteria would be exceedingly costly. Therefore this criteria is not used for determining new CIP projects.

However, the hydraulic analysis (and the resulting distribution main upsize projects included in this plan) use a criterion of 10 ft/s to identify and size potential velocity-based improvements to the existing system. The 10 ft/s criterion was selected because it resulted in an array of projects that is financially more feasible than what would be required using the 7 ft/s criterion. It was also selected because velocities above 10 ft/s are increasingly more vulnerable to pressure surges. WAC 246-290-230 requires that transmission mains designed to convey velocities greater than 10 ft/s include a water hammer (pressure transient) analysis in the design. Available fire flows were also determined using a 20 ft/s criterion as well as having no velocity constraint to determine different levels of priority for identified deficiencies.

Given current (2017) demands, operating rules, and infrastructure, fire flow deficiencies given no velocity constraint (20 psi pressure constraint only), 10 ft/s velocity constraint, and a 20 ft/s velocity constraint are given in Figure 9-6, Figure 9-7, and Figure 9-8.

As shown on Figure 9-8, there are some areas in the system that are not able to meet the fire flow goal while keeping pressures at service connections above 20 psi. Some of these are located at dead-end mains that have higher, non-residential fire flow goals.

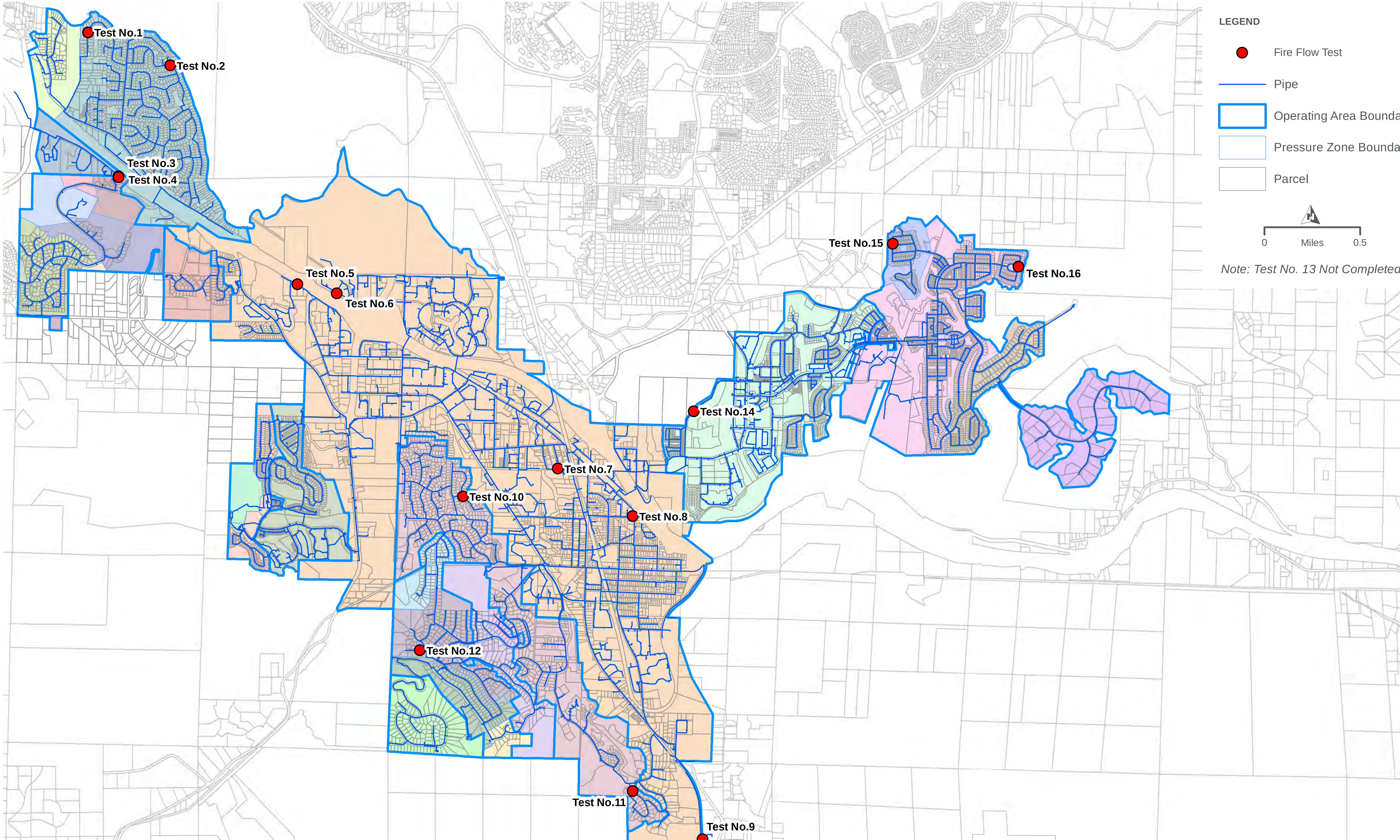
Others are located at far ends of a pressure zone away from sources. There are three instances of this in the Valley 297 Zone. In the northwest part of the zone, deficiencies exist along Newport Way east of the Cougar Ridge 430 Pressure Zone. These deficiencies will be resolved given new mains that will be installed in the area as part of the Gateway Apartments development as well as the new planned pipe crossing of I-90.

Another location is on the southwest end of the Valley 297 Zone near the Talus I & II BPS. The deficiencies in this area can be resolved by installing a PRV station between the Valley Zone and the Talus Shangri-La 616 Zone near the Talus I & II BPS.

The third area of deficiencies in the Valley 297 Zone is in the southeast end of the zone and is caused by the high, non-residential fire flow goal needing to be conveyed by a long distance of piping. This can be improved by increasing pipe sizes in this part of the system.

The other deficiencies in Figure 9-8 due to flows limited by pressure constraints, as well as deficiencies shown in Figure 9-6 and Figure 9-7 due to flows limited by velocity, can be resolved through additional pipe looping, pipe upsizing, and changes in pump operating rules. A summary of the projects to resolve these deficiencies is given in Chapter 11.

When incorporating all the projects identified in Chapter 11, the deficiencies in the system given 2027 and 2037 projected demands are shown in Figure 9-9 and Figure 9-10, respectively. Only two deficiencies still exist for both planning horizons which are for hydrants located near storage facilities. These hydrants are marked as low pressure hydrants and will not have projects to address the deficiencies.



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FIRE FLOW TEST LOCATIONS FOR MODEL CALIBRATION

FIGURE 9-2

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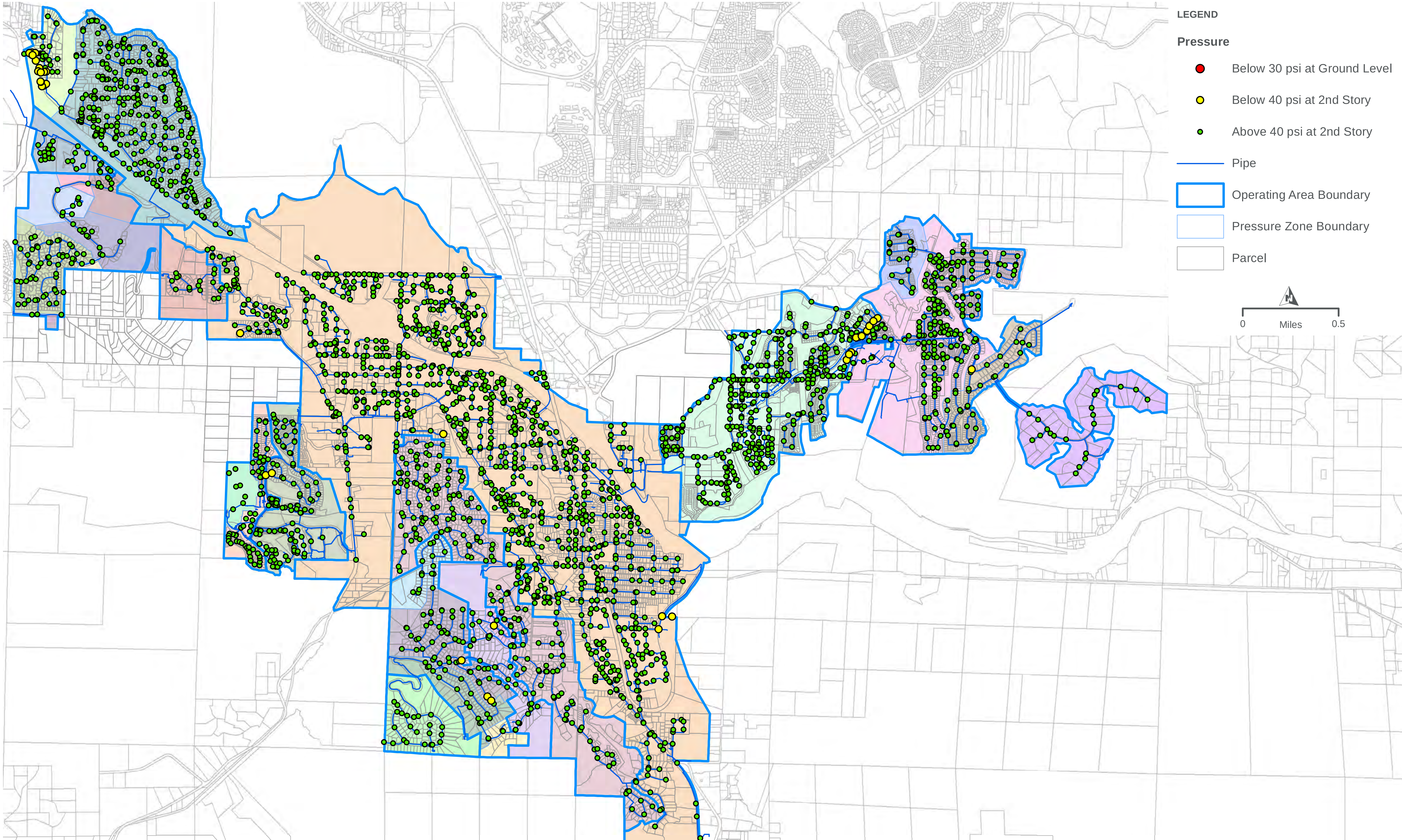

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2017 PEAK HOUR DEMAND MINIMUM SERVICE CONNECTION PRESSURES (OPERATIONAL AND EQUALIZING STORAGE DEPLETED)

FIGURE 9-3

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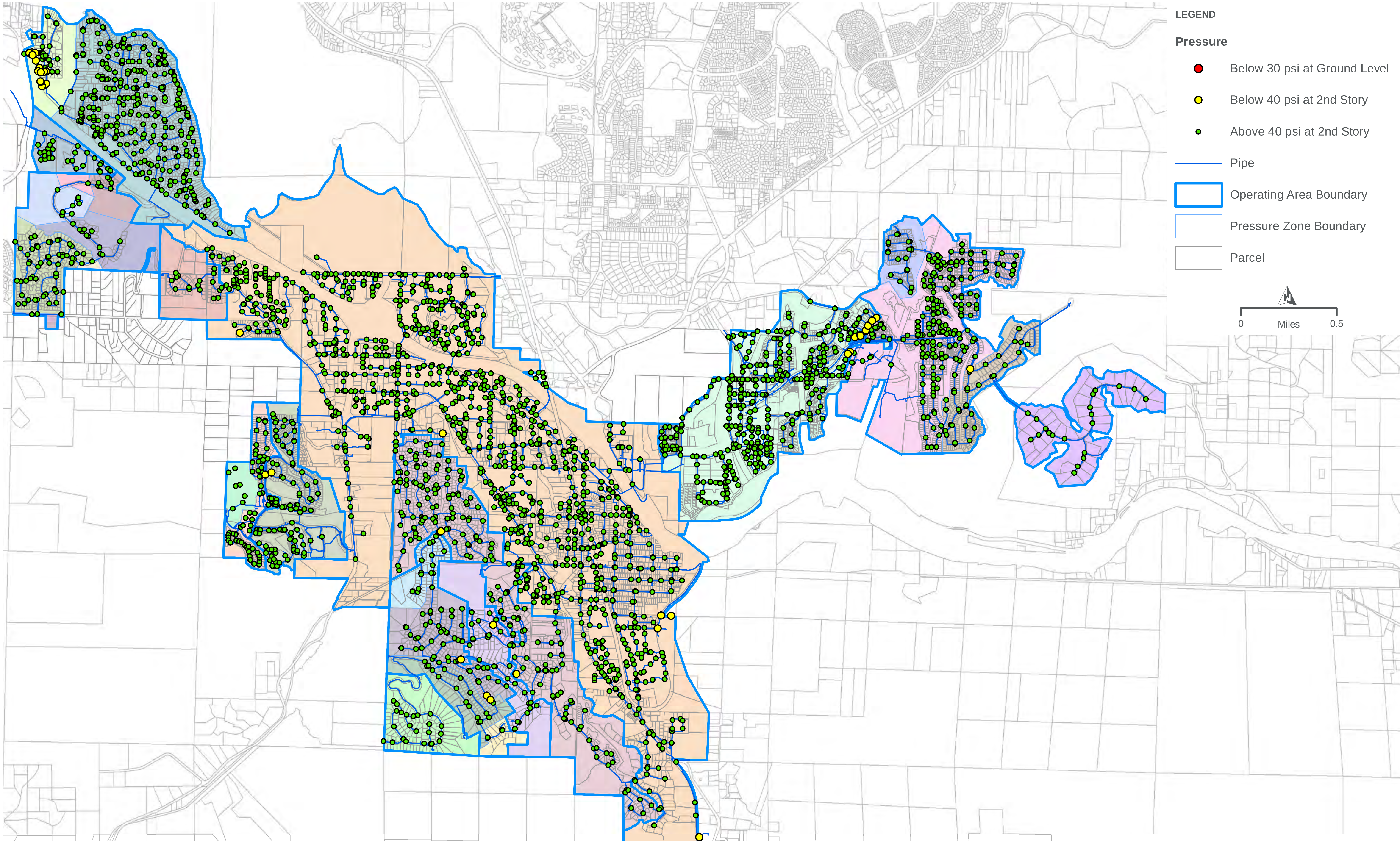

CITY OF ISSAQUAH WASHINGTON

2027 PEAK HOUR DEMAND MINIMUM SERVICE CONNECTION PRESSURES (OPERATIONAL AND EQUALIZING STORAGE DEPLETED)

FIGURE 9-4

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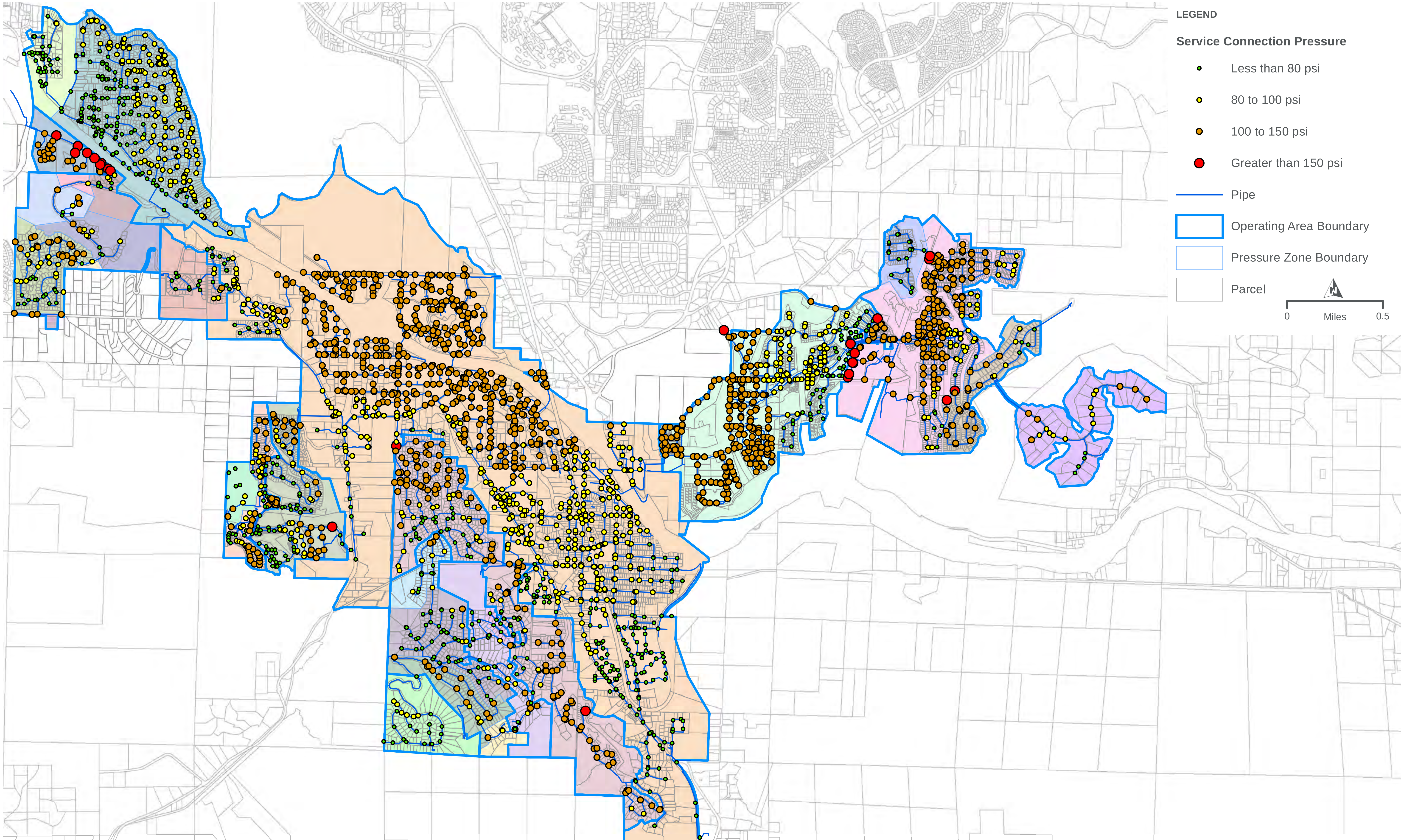

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2017 SERVICE CONNECTION MAXIUMUM PRESSURE (STATIC CONDITIONS WITH STORAGE AT OVERFLOW)

FIGURE 9-5

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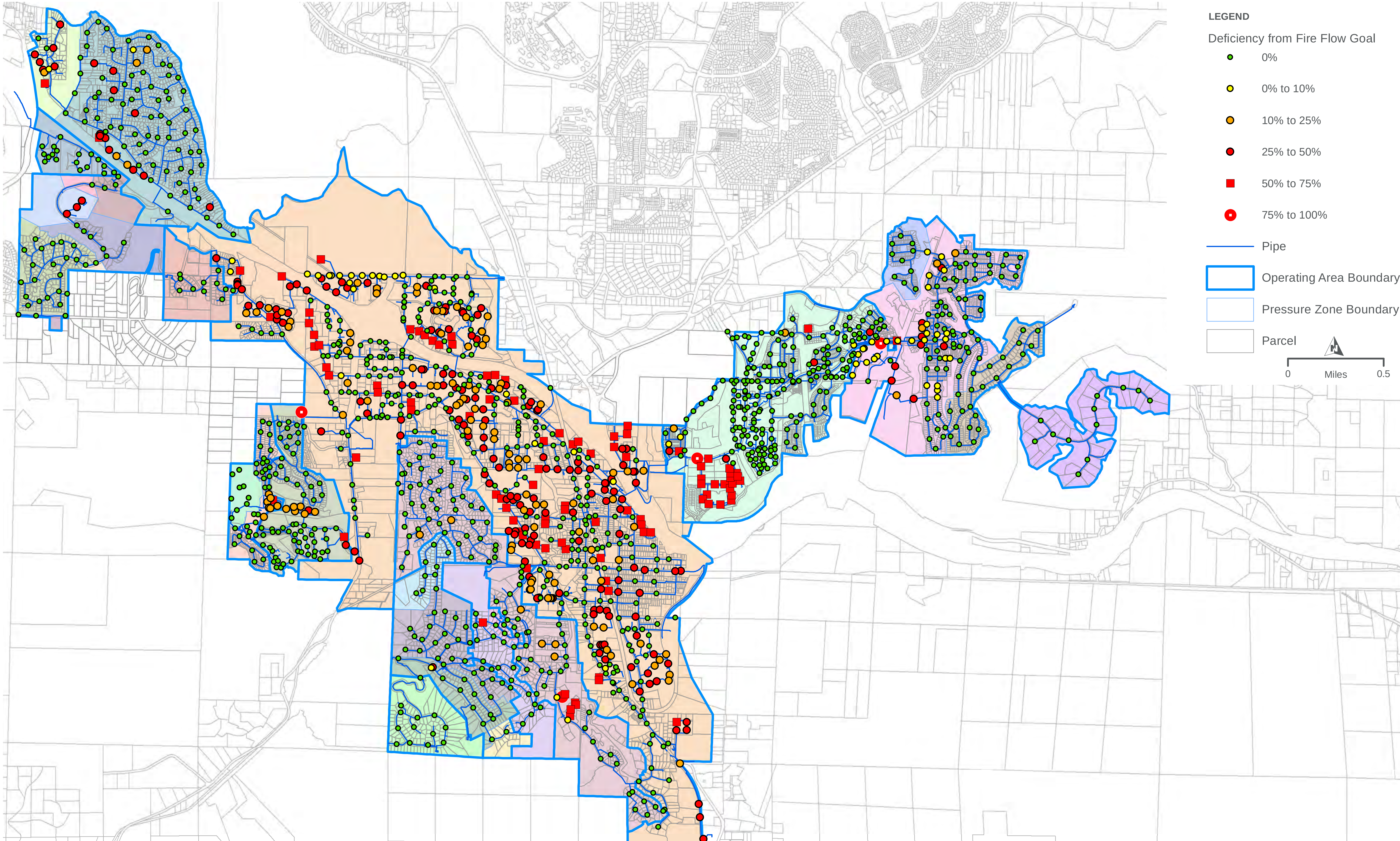

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2017 FIRE FLOW DEFICIENCIES: 10 FPS VELOCITY LIMIT

FIGURE 9-6

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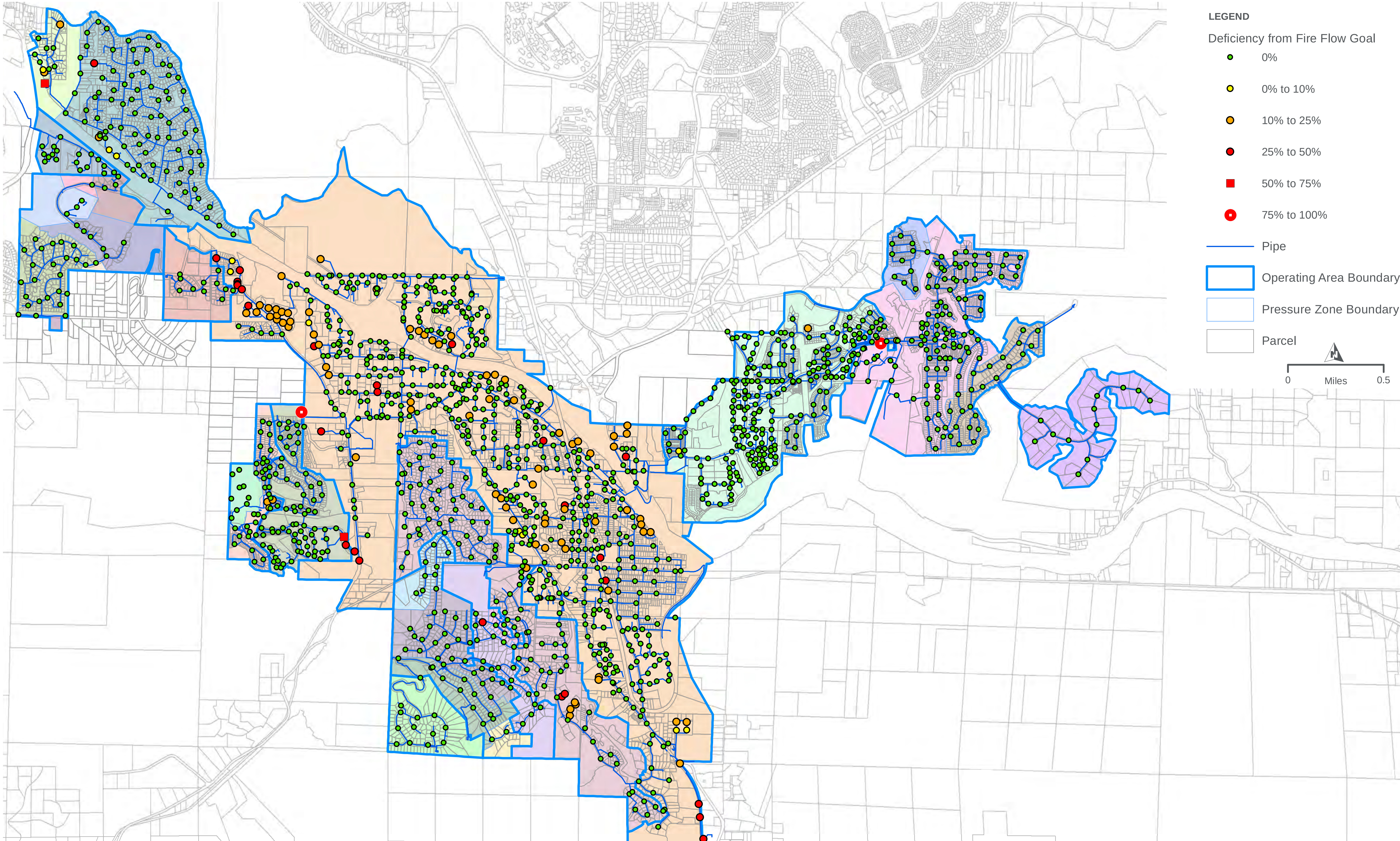

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2017 FIRE FLOW DEFICIENCIES: 20 FPS VELOCITY LIMIT

FIGURE 9-7

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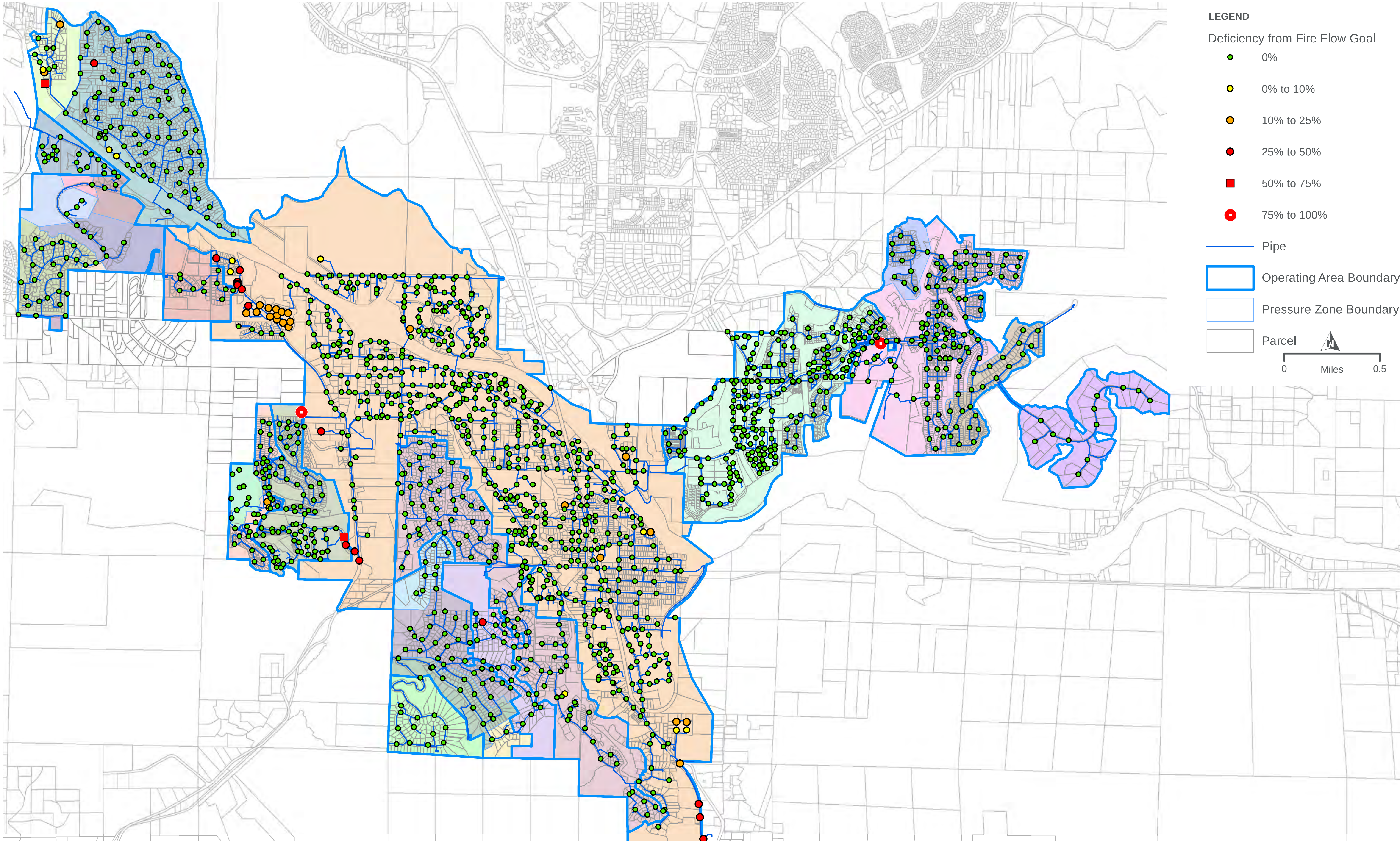

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2017 FIRE FLOW DEFICIENCIES: NO VELOCITY LIMIT

FIGURE 9-8

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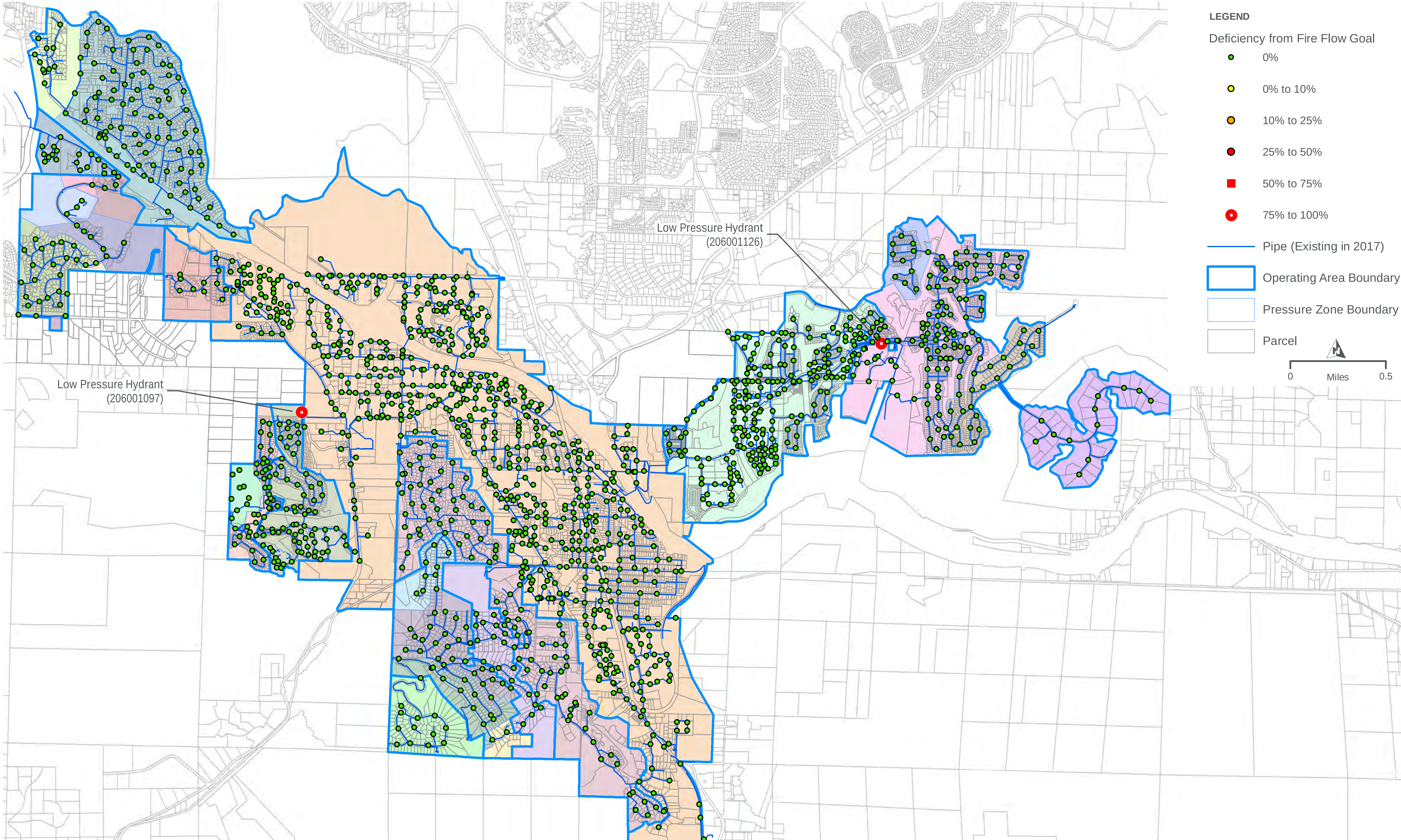

CITY OF ISSAQUAH WASHINGTON

2027 FIRE FLOW DEFICIENCIES: CIP PROJECTS WITH 10 FT/S VELOCITY LIMIT

FIGURE 9-9

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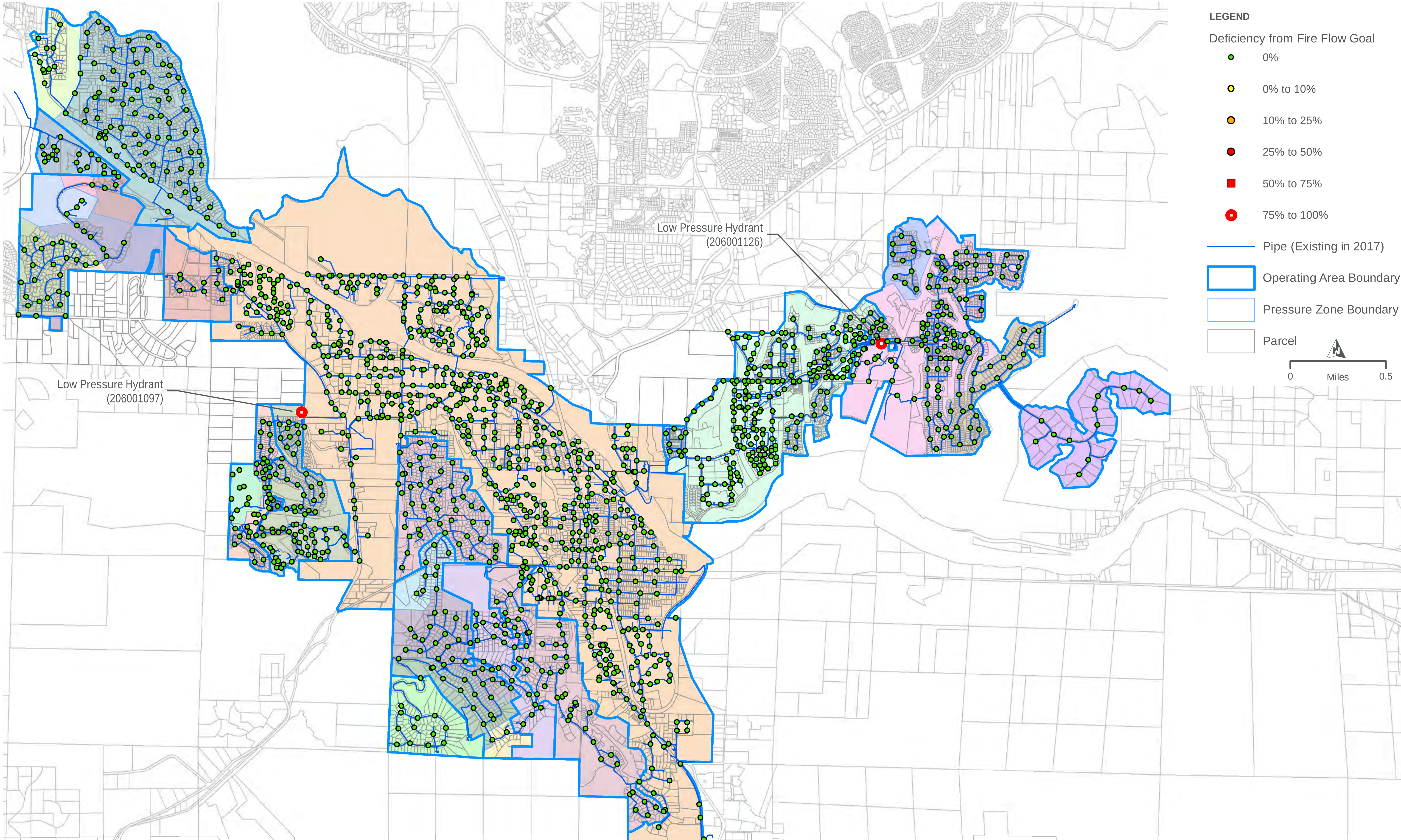

CITY OF ISSAQUAH WASHINGTON

2037 FIRE FLOW DEFICIENCIES: CIP PROJECTS WITH 10 FT/S VELOCITY LIMIT

FIGURE 9-10

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Chapter 10. Operations and Maintenance

This chapter provides an overview of the operations and maintenance functions of the City's water utility.

10.1 Water System Management and Personnel

The City's administration and management is structured to optimize use of personnel, office, and maintenance facilities. Figure 10-1 details organization of the Public Works staff.

The City has a mayor-council form of government; subsequently, the Public Works Engineering and Public Works Operations Directors report to the Mayor. The City Council Utilities, Technologies, and Environment Committee is comprised of three City Council members and provides oversight of the water utility regarding policy, planning, and management of the water system.

The City is operated as a utility enterprise under the direction of the Public Works Engineering and Public Works Operations Directors. The Public Works Departments of Engineering and Operations have the responsibility for planning, design, construction, operation, maintenance, quality control and management of the water system. The Engineering Department provides design, construction, and inspection of projects related to the water system under its Director. The Operations Department, under the direction of the Operations Director, performs daily activities including infrastructure maintenance, inspections, utility locating, water quality monitoring, and manages the Cross Connection Control Program.

The Finance Department provides all financial functions for the water utility: utility billing services and customer water sales records. Meter reading, although intricately tied to the Finance Department, is a function performed by the Operations Department.

Employees responsible for operation, maintenance and administration duties are listed in Table 10-1.

Figure 10-1. Public Works Organization Chart

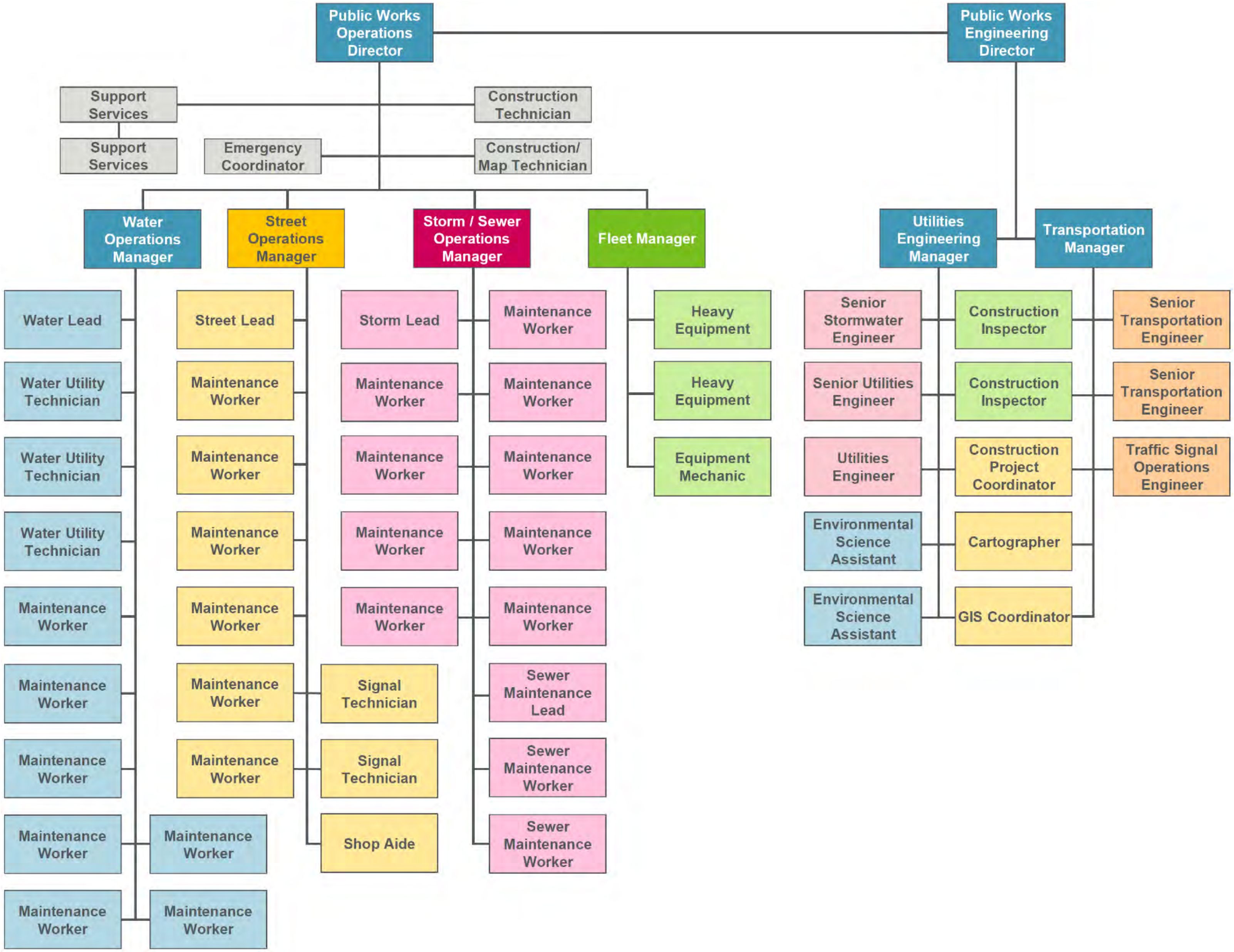

Table 10-1. Current Water Staffing Positions

Position	Number of Employees	Percent Dedicated To Department	Number of Full Time Employees (FTEs)
Public Works Operations			
Public Works Operations Director	1	25	0.25
Office Manager	1	25	0.25
Manager of Water Operations	1	100	1
Water Lead	1	100	1
Water Utility Technician	3	100	3
Water Maintenance Worker	7	100	7
Part Time Worker	1	62	0.62
Mapping Technician	1	30	0.3
Shop Aide	1	30	0.3
Administrative Staff	2	25	0.5
Fleet Supervisor(1)	1	6	0.06
Fleet Mechanic(1)	3	6	0.06
Public Works Engineering			
Public Works Engineering Director	1	25	0.25
Utilities Engineering Manager	1	33	0.33
Senior Utilities Engineer	1	50	0.50
Utilities Engineer	1	33	0.33
Construction Inspector	2	25	0.50
Construction Project Coordinator	1	25	0.25
Cartographer	1	25	0.25
GIS Coordinator	1	25	0.25
Finance Department			
Utility Services Program Coordinator	1	25	0.25
Development Services Department			
Development Services Director	1	10	0.10
Land Development Manager	1	10	0.10
Senior Engineer	2	10	0.20
Senior Planner	1	10	0.10
Assistant Planner	3	10	0.30
		TOTAL FTEs for Water Utility	**18.05**

1 Fleet Services charge a flat rate based on the prior year's service costs to each utility and department. Fleet charges in were $33,408 in 2017 and $35,068 in 2018.

10.2 Future Staffing

During the planning period to 2037, it is predicted that the water demand will increase by approximately 72 percent. It is believed that the personnel requirements for operations, maintenance and clerical duties will also increase during this time to meet the demands of operating and maintaining the system; Public Works Operations staffing may increase from 14 FTEs to approximately 24 FTEs by 2037 and Public Works Engineering staffing may increase from 3 FTEs to 5 FTEs by 2037.

10.3 Operator Certification

The City recognizes the value of having a knowledgeable and well-trained staff to operate the water utility, and encourages employees to obtain the highest level of certification available. To promote this aptitude, the City pays for annual certification fees, provides time and tuition for certification training courses and allows time during work hours for certification examinations. In addition, the City provides its staff opportunities for obtaining the continuing education required to maintain certification. Professional growth requirements for certification are met through continuing education units (CEUs).

Certification requirements for water systems are outlined in WAC 246-292. The system classifications and minimum operator certification levels for the Issaquah system are given in Table 10-2. The system must maintain a person in responsible charge at the minimum certification level or higher. Outside of regular work hours, the person in responsible charge may be one level below the minimum operator certification level.

The number of operating staff with certifications is shown in Table 10-3.

Table 10-2. Required Certification Levels

System Classifications	Classification	Minimum Operator Certification Level
Water Treatment Plant	Class 1	Water Treatment Plant Operator (WTPO) 1
Distribution System	Class 3	Water Distribution Manager (WDM) 3

Table 10-3. Public Work Operations Water Division Staff Certification

	Certification	No. of Staff with Certification
WDM-4	Water Distribution Manager 4	1
WDM-3	Water Distribution Manager 3	1
WDM-2	Water Distribution Manager 2	4
WDM-1	Water Distribution Manager 1	5
CCS	Cross Connection Control Specialist	5
BAT	Backflow Assembly Tester	3
WTPO-1	Water Treatment Plant Operator 1	5

10.4 System Operation

System operation is the control of various facilities to ensure that water is available in quantities and at locations throughout the service area, so that customer demands are met.

Public Works Operations, Water Division is located at 670 1st Ave NE, Issaquah and comprises five buildings constructed in 2003: Administration, Shops, Parking, Fleet and Decant. This facility is shared with Public Work Operations divisions of Street, Sewer, Storm Water and Fleet Maintenance.

Operation and maintenance tasks include infrastructure preventative maintenance, meter reading, maintaining water quality, repairing infrastructure, cross connection control and regulatory compliance. Private contractors are also engaged to perform tasks that require specific tools, equipment or knowledge.

Preventative maintenance programs are necessary to maintain consistency of the water system. Manufacturer's information for each piece of equipment regarding preventative maintenance is readily available and referenced by the operators. Some of these programs are:

- Source meters are inspected monthly and are calibrated every two years. Water personnel read the service meters and note any malfunction for subsequent repair. Readings are collected and compared to electronic readings gathered automatically by the City's SCADA system.
- Wells, booster pump stations, and reservoirs are checked on a weekly schedule. Personnel verify power voltage and amperage, pump and motor use, and condition; and check for excessive heat, noise, vibration, and odor. Also inspected are overall station conditions including mechanical, structural, and site anomalies. All items needing attention are forwarded to the Water Division manager or designee.
- Water mains are routinely replaced under Public Works Engineering's Water Main Replacement Program. Targeted water mains for replacement are asbestos cement, cast iron, undersized mains, and looping to address water quality and volume issues. Complementing the Main Replacement Program is Public Works Operations' Leak Detection Program. This is a continual effort, using a contracted leak detection service to sound approximately 50 miles of water main per year. The goal of these programs is to maximize water efficiency by reducing leakage, reducing repair costs, and allowing better fire flow volumes. Collectively, these goals supplement the larger goal of saving water and extending the point to where new water sources must be secured.
- Two types of water main flushing are routinely completed: high-volume, unidirectional flushing (HVF) and dead-end water main flushing. HVF is completed biennially for the entire northwest section of the Valley Operating Area, the primary distribution area for Gilman Wells 4 and 5, because of elevated manganese levels. HVF throughout the remaining city sections is performed on a rotating five-year schedule. Dead-end water main flushing points are distributed on one of three cycles determined by historical water quality data; the three flushing schedules are 6-week, 12-week, and 26-week flushes.
- Water reservoirs are cleaned and inspected on a five-year cycle to remove accumulated silt and verify coating conditions. Recoating the interior would be scheduled after inspection, if needed. The reservoirs are also subjected to a detailed inspection once per year, noting any appurtenance deficiencies for later correction.

- An aggressive and comprehensive Cross Connection Control program works toward eliminating possible water contamination through cross-connected piping arrangements.
- Easements are inspected, kept clear and clean of brush and debris.
- Other ongoing maintenance programs include: fire hydrant operation and maintenance program, valve exercising program, monthly steel reservoir cathodic protection check, monthly PRV inspections, yearly PRV adjusting and calibration, five-year PRV rebuilding program, domestic water meter upgrades to Radio Read technology and galvanized water service renewals.

10.4.1 Telemetry

Monitoring and adjusting primary operations of the water system are carried out using the Supervisory Control and Data Acquisition (SCADA) computerized control system located at the Public Works Operations facility. The SCADA system allows the operator to adjust operational parameters to meet specialized needs and requirements that vary with time of day and season. The SCADA system is fully automated and accessible remotely, plus allowing for manual control and collecting operational data for records and analysis. The system includes Programmable Logic Controllers (PLCs), two dedicated computer servers, computer interface screens, a manually-operated panel interface, and remote access to the system.

10.4.2 Standard Operating Procedures

Standard Operating Procedures for virtually all water functions are written and regularly updated to ensure accuracy and consistency in system operations.

10.4.3 Supplies

As part of maintaining the water system, supplies, equipment and services are purchased from distributors and vendors. Many of these purchases require specific handling procedures, installation requirements, or hazards. Employees are trained for these specifics and most technical information or health hazards have been incorporated into Standard Operating Procedures.

10.4.4 Comprehensive Monitoring (Regulatory Compliance) Plan

The City maintains an active and ongoing program of water quality monitoring and compliance reporting to ensure a safe, high-quality water supply. Public Works Operations employees are responsible for water quality monitoring and compliance reporting. Employees are responsible for collecting and coordinating all water quality sampling, coordination with laboratory testing companies, chlorination and fluoridation control, and water quality record maintenance and reporting. The City Water Quality Program is discussed in Chapter 8.

10.4.5 Emergency Response Program

The most likely disasters to impact the water utility include power outages, floods, fire, storms, sustained freezing temperatures, chemical spills, or earthquakes. These and other issues are discussed at length in the City's Comprehensive Emergency Management Plan and Water System Emergency Response Plan. Both emergency response plans have been included as appendices into this document. The City has also been completing tasks to lessen seismic damage, detailed in the 2002 Water/Wastewater Seismic Disaster and Recovery Plan.

10.4.6 Customer Response to Requests or Service

Customers often call with general water system questions, or questions specific to their home or workspace. Some typical topics include: whether there is fluoride in the drinking water, if there is a water leak, or for a water quality issue. A phone number and online reporting form are provided on the City's website.

Requests, questions, or statements regarding the water system are typically answered within that working day. Questions regarding water quality are typically responded to immediately—including a physical response. All work performed is recorded on work orders and entered into the Public Works Operations database.

10.4.7 Record Keeping

Water quality and operational records are maintained according to WAC 246-290-480 and 485. These records are available for inspection by DOH and will be sent to DOH if requested. Records are kept digitally, on paper, or both depending on the data.

Reports are submitted as required by WAC 246-290-480(1)(a). Most records are kept in hard copy, although water quality results are kept in both hard copy and electronic format.

10.5 Water Quality Protection Programs

10.5.1 No Lead Piping in System

In May 2016, the Washington State Governor issued Directive 16-06 which calls for DOH to further prioritize and assist communities in responding to lead in water systems.

However, there is no evidence that the City's water system contains any lead service connections or appurtenances. Record drawings of the system do not detail or describe any lead service connections being used, and there is no record of work being performed where lead service lines have been found in the system. Because of this, the City is not currently implementing and programs for finding lead appurtenances beyond the sampling discussed in Chapter 8.

10.5.2 Cross-connection Control Program

The City has a cross-connection control program which is designed to protect the health of water consumers of the public water system. The cross-connection control program establishes minimum operating policies and backflow prevention assembly installation and testing practices. This program is structured such that it may be supplemented with published documents and materials developed by the City for its specific use. The authority to enforce these practices and policies is established in City of Issaquah Municipal Code Chapter 13.13 or its future revisions.

A copy of the City's cross-connection control program is included in Appendix O.

10.5.3 Sanitary Survey

All Group A public drinking water systems are required to complete routine sanitary surveys of the system every three to five years. The survey evaluates the critical elements of the water system and its operation including:

- Planning and management documents.

- Distribution system and status of cross-connection control program.
- Source and sanitary control area.
- Source pumps and pumping facilities.
- Source treatment procedures and equipment.
- Monitoring, reporting, and data verification.
- Finished water storage.
- Operator certification status.

In the State of Washington, sanitary surveys are administered by DOH. The last sanitary survey for the City was conducted in October 215 with the letter of finding received from DOH in December, 2015. The survey did not find any “significant deficiencies” in the system requiring corrective actions. The next sanitary survey of the system will take place in 2020.

10.6 Design Review Procedures

The City implements a comprehensive design review of both developer-led water system projects and projects initiated by the Public Works department.

Developer-led water system designs are reviewed at multiple stages during the permitting process by a broad group of City stakeholders, including professional engineering staff and system operators. These reviews are intended to make sure that all City and DOH policies and requirements are met by the design. Specific standards as shown in Appendix E must be met before the design is approved for construction. In addition, when necessary, submittals to the DOH (engineering reports, plans and specifications, and documentation of construction completion) are submitted. Approval from DOH must be received before construction begins.

Construction of developer initiated water projects is performed under the watch of City inspectors and, when needed, Public Works staff.

Projects implemented by the City follow a similar approach. The City uses both in-house design staff and consulting engineering firms to design projects. Typically, a preliminary design report is prepared, followed by submission of plans, specifications, and estimates at the 30, 60, 90, and 100 (bid ready) percent design points. Reviews include both engineering and operations staff. These reviews are intended to make sure that all City and DOH policies and requirements are met by the design. All work is performed under the supervision of Washington State registered engineers. When necessary, submittals to the DOH (engineering reports, plans and specifications, and documentation of construction completion) are submitted. Approval from DOH must be received before construction begins.

Chapter 11. Capital Improvement Program

This chapter describes the improvements necessary for meeting Issaquah's future water system needs through the year 2037. The improvements are based upon evaluation of the existing system facilities, reports from the operations staff, and the analyses performed while preparing this Plan and form the capital improvement program (CIP).

Specific needs of the water utility must be evaluated on an ongoing basis. As growth and land-use patterns are likely to vary from neighborhood to neighborhood over the planning period, the size and timing of necessary projects may differ from the recommendations in this Plan.

Additionally, this Plan has not attempted to identify all the capital improvements required to serve potential new developments within the City's Future Retail Water Service Area. Specific on-site or off-site improvements may be required that are outside of the scope of this Plan. Additional facility requirements should be identified as part of ongoing facility planning efforts.

11.1 Capital Improvement Program Projects

The improvements addressed in this chapter constitute the recommended CIP for the City water utility, shown in Table 11-3. The CIP includes components that focus on improving the existing system to meet the City's water system policies and criteria, components that respond to projected growth, and desired improvements to upgrade the current system to meet current requirements.

The recommended improvements are summarized in four categories: Water Supply and Treatment, Storage Reservoirs, Booster Pump Stations, and Distribution System. A summary of the projects included in each of these categories is provided below. A detailed list of these projects with CIP costs are provided in Table 11-3 and a map showing project locations is provided in Figure 11-1. Figure 11-2 shows the hydraulic profile of the system with the CIP projects that impact system hydraulics.

11.1.1 Water Supply and Treatment

Water supply projects relate to well, intertie, and treatment facility upgrades. The following projects are planned:

- **Refurbish Gilman Wells** – The Gilman Wells are over 30 years old. This project would refurbish and the building and selected mechanical, electrical, and control infrastructure, including pumps and valves, to enhance the ability to withstand a seismic event and enhance security. The condition of the casings in each of the wells will be evaluated and a determination will be made of the need for rehabilitation or replacement. Rehabilitation of the wells will enhance the routine operation, as well as increase reliability of the system during non-routine catastrophic events.
- **Refurbish Risdon Wells** – The Risdon Wells are approximately 50 years old. This project would refurbish and the building and selected mechanical, electrical, and control infrastructure, including pumps and valves, to enhance the ability to withstand a seismic event and enhance security. The condition of the casings in each of the wells will be evaluated and a determination will be made of the need for rehabilitation or replacement. Rehabilitation of the wells will enhance the routine operation, as well as increase reliability of the system during non-routine catastrophic events.

- **Water Treatment Plant** – This project addresses a permanent solution to perfluorochemicals (PFCs), Manganese (Mn), Iron (Fe), Arsenic (As), pH, and chlorination regarding the City's groundwater supplies. In addition, this project will address fluoridation of the groundwater supplies, to support blending with regional CWA water to meet future needs in the 297 zone.

  The 297 operating zone provides water from the City's wells to areas of the valley floor and up Squak Mountain. As growth occurs in the 297 zone the well capacities will be out-stripped requiring the blending of regional water with the groundwater to provide adequate water supply. This will require addressing the chemistry of both supplies as they blend. To address ongoing water quality challenges at the wells and the issues surrounding blending, the City needs to plan, study, engineer, and build a treatment facility to continue providing reliable and safe drinking water.

  The project would result in an increase in operating costs due to additional treatment being given to the City's well water; however, maintenance of water quality compliance and the ability to blend well and regional water would optimize the use of groundwater and minimize the need to purchase additional regional water.

- **Gilman Wells PFOS Discharge to Sewer** – This project will create a permanent flushing system connected to the sanitary sewer to reduce operations costs for discharging the monthly backwash necessary for the carbon treatment system at Well 4.

- **Emergency Water Fill Station** – Install an emergency water tank that can be remotely filled and dispense water to the public in the event of an emergency.

- **Emergency Water Filtration Plant** – This project creates an emergency supply from Lake Sammamish, including treatment and transmission to distribution systems, which could be utilized by the Issaquah and Sammamish Plateau Water (SPW) systems. SPW would be involved in the development of an emergency supply to determine whether the supply would be an acceptable alternative for both the City and SPW.

- **Bulk-Purchase Water Filling Stations** – Access to Issaquah-produced bulk water is mostly unregulated. The only bulk water source currently available to the public is through any citywide fire hydrant which poses a significant water quality risk. Project will modify five hydrants to be metered and available for use 24-hours a day as bulk water filling stations for public and private use after obtaining a permit.

- **Well Capacity Optimization** – Optimize Gilman and Risdon Wells to maximize use of instantaneous water rights for wells to fullest extent feasible. This would reduce the amount of CWA water that needs to be purchased and would help delay the need for a central Water Treatment Plan.

11.1.2 Storage Reservoirs

As determined in Chapter 9, the City is able to meet all DOH minimum storage requirements through the 20-year planning horizon except for the Valley Operating Area.

Deficiencies in storage for this operating area is addressed by the following project:

- **South SPAR 297 Reservoir** – This project becomes necessary in the future to provide additional standby storage as growth occurs in the Valley Operating Area. Project will be constructed after SPAR booster pump station and associated water main projects are completed. Reservoir is planned to have a 2.5 MG storage volume, constructed of concrete, and will be located north of I-90 near the Sunset Interchange (I-90 Exit 18). Predesign has been completed for the project.

- **South Cove Reservoir Rehabilitation** – Rehabilitate (or replace) a 1 million gallon reservoir which was originally constructed in 1981. This project will correct deficiencies within the reservoir and potentially increase pressures within the South Cove pressure zones.
- **Reservoir Chlorine Boosting** – Some reservoirs currently have an issue of having low residual chlorine levels due to slow reservoir turnover if utilized to the full operating capacity. This project would add booster chlorination equipment at reservoirs having chlorine residual issues.

11.1.3 Booster Pump Stations

As determined in Chapter 9, all pump stations have sufficient capacity to meet current and future maximum day demands. However, two pump station projects are planned:

- **SPAR Booster Pump Station and Main** – provides redundant pumping to the Holly I and II BPSs which are located in a geologically sensitive hazard area and pump from the Valley 297 Pressure Zone to the Issaquah Highlands Central Park 742 Zone. The SPAR Booster Pump Station will be located on the north of I-90 near the Sunset Interchange (I-90 Exit 18) and is planned to have three, 1,000 gpm pumps with approximately 5,800 ft of piping to connect the pump station site to the Valley 297 and Issaquah Highlands Central Park 742 Zones. Predesign has been completed for the project.
- **Replace Forest Rim Booster Pump Station** – replaces the existing Forest Rim Booster Pump Station which is nearing the end of its design lifespan. The current pump station is also susceptible to seismic damage. The new pump station will consist of a new earthquake resistant concrete building with new more efficient pumps, motors, electronics, and security systems. Predesign has been completed for the project.

11.1.4 Distribution System

Distribution system projects relate to transmission and distribution main replacement, looping and extension, PRV replacement, and tie-ins.

A total of seven projects are included in this category:

- **Upgrade water meters to radio read** – Continued program to upgrade service water meters from Touch Read to radio readings.
- **I-90 Watermain Underboring** - Crossing of I-90 between NW Sammamish Road and NW Poplar Way with approximately 930 ft of 12-inch pipe. Project improves available fire flow to the northwest portions of the Valley 297 Pressure Zone. Looping the system with the crossing will also increase water quality due to the added circulation.
- **Lakemont Triangle Regional Main Tie-in and Meter** – Allows the Lakemont Operating Area to be served from the Bellevue-Issaquah Pipeline instead of through interties with the Bellevue Water System and will include a master meter to track flows.
- **Talus PRV Station** – Adds a PRV Station near the Talus I/II BPS allowing water to drop from the Talus 616 Zone to the Valley 297 Zone to allow fire flows goals to be met along Renton-Issaquah Rd SE without having pressures drop below 20 psi.

- **Redundant Water Feed to Squak Mountain** – Constructs approximately 5,000 ft of 12-inch main providing a redundant connection between the north part of the Mt. Hood Operating Area to the Mt. Hood Reservoir.
- **Redundant Water Feed for South Cove Reservoir** – Constructs a connection between the South Cove Operating Area to the CWA regional supply to provide a redundant water supply for the South Cove Reservoir.
- **Water Main Replacement Program** – See description below.

Water Main Replacement Program

The Water Main Replacement Program is a list of pipe replacement projects developed based on the City's rehabilitation objectives and on the results of the hydraulic modeling analysis. The City has allocated an annual budget toward implementing these projects. However, not all of these projects will be completed during the CIP planning horizon in Table 11-3; thus the total main replacement budget shown in this table is less than the sum of all estimated project costs.

Each of these projects has been prioritized using "High", "Medium", or "Low" categories based on how critical the project is to meeting minimum regulatory requirements and the City's level of service and reliability goals. An overall map of these projects and their locations is shown in Figure 11-1.

Prioritization criteria for the water main replacement program include:

- High Priority
  - Replacement of asbestos cement mains.
  - Improvements to provide required fire flow during maximum day demand while keeping pressures above 20 psi.
- Medium Priority
  - Improvements to provide required fire flow during maximum day demand while keeping velocities below 20 ft/s.
  - Construction of new mains to establish looping to improve system performance and water quality.
  - Removal and replacement of 2-inch service pipes with 4-inch or larger pipes, where needed.
- Low Priority
  - Improvements to provide required fire flow during maximum day demand while keeping velocities below 10 ft/s.

Table 11-1. Basis of Unit Costs

Cost	Row	Calculated As
Materials	A	Cost for materials from construction cost database (pipe, excavation, paving, etc.)
Division 01 Costs	B	8% of A
Contingency	C	30% of (A + B)
Sales Tax	D	10% of (A + B + C)
Engineering and Admin	E	15% of (A + B+ C + D)
Permitting	F	5% of (A + B+ C + D)
Project Cost	G	A + B + C + D + E + F

Note: Construction cost database costs escalated to Seattle area costs and 2017 dollars.

The water main replacement projects have been identified by operating area with a letter followed by a number. Letters correspond to: Valley Operating Area (V), Mt. Hood Operating Area (MH), South Cove Operating Area (SC), Wildwood Operating Area (WW), Cougar Ridge Operating Area (CR), Highwood Operating Area (HW), Montreux Operating Area (M), Issaquah Highlands Operating Areas (IH) and Talus Operating Areas

(T). The numbers identify and separate the projects within each operating area. Projects with a number below 100 are projects previously identified in the 2012 WSP while projects with a number of 100 or higher were identified as part of this WSP's modeling effort.

The list of all identified Water Main Replacement Program projects is found in Table 11-4, Table 11-5, and Table 11-6. The tables also include a planning level cost estimate for each project. The project cost estimates are presented in 2017 dollars and are based on applying a linear foot cost for each pipe size against the planned length of pipe. This includes trenching the roadway to install the water main, installing necessary valves and fittings, connecting service connections and water meters, flushing the lines, backfilling the trench, and asphalt repair work. Costs also include Division 1 costs (contractor mobilization, traffic control, site control and restoration), design, engineering, administration, taxes, and a planning level contingency (a summary of these are in Table 11-1). The costs do not take into account individual variables related to the particular projects, such as the potential need for full roadway restoration or impacts to other utilities. The assumed unit costs used for water main replacement program projects are given in Table 11-2. Costs associated with the various projects should be adjusted to account for inflation rates applicable to the proposed design and construction schedules. As a result, final project costs will vary from the estimates presented herein. Because of these factors, funding needs must be carefully reviewed prior to establishing final budgets.

Table 11-2. Assumed Project Unit Cost

Pipe Size (inch)	Assumed Project Unit Cost ($/LF)	
	Pipe Upsizing / Replacement	New Water Main
4	$331.70	$296.73
8	$406.65	$366.71
10	$458.48	$418.54
12	$494.84	$454.90
14	$626.01	$586.07
16	$655.79	$615.85
18	$735.10	$695.16

11.2 CIP Cost Estimate and Schedule

Table 11-3 provides a summary of planned CIP projects, planning-level cost estimates, and project schedules. The project cost estimates are presented in 2017 dollars.

Table 11-3. Capital Improvement Program Schedule and Budget

Project	No.	Project Costs in 2017 Dollars ($1,000s)											
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028-2037	Total CIP (2018-2037)
Distribution Projects													
Water Main Replacement Program	D-1	787	787	787	787	787	787	787	787	787	787	7,870	15,740
Upgrade Water Meters to Radio Read	D-2	45	45	45	45	45	45	45	45	45	45	450	900
I-90 Watermain Underboring	D-3	34	472										506
Lakemont Triangle Regional Main Tie-in and Meter	D-4			400									400
Talus PRV Station	D-5								275				275
Redundant Water Feed to Squak Mountain	D-6		168	1,101									1,269
Redundant Water Feed for South Cove Reservoir	D-7					600							600
	Total	866	1,472	2,333	832	1,432	832	832	1,107	832	832	8,320	19,690
Pump Station Projects													
SPAR Booster Pump Station and Main	PS-1	392	3,465	1,148									5,005
Replace Forest Rim Booster Pump Station	PS-2	1,170											1,170
	Total	1,562	3,465	1,148	0	0	0	0	0	0	0	0	6,175
Storage Projects													
South SPAR 297 Reservoir	S-1				168	168	5,400						5,736
South Cove Reservoir Rehabilitation	S-2								900				900
Reservoir Chlorine Boosting	S-3		400										400
	Total	0	400	0	168	168	5,400	0	900	0	0	0	7,036
Water Supply And Treatment Projects													
Refurbish Gilman Wells	WS-1							821					821
Refurbish Risdon Wells	WS-2							821					821
Water Treatment Plant	WS-3	1,066	1,492	10,660	10,660								23,878

Table 11-3. Capital Improvement Program Schedule and Budget

Project	No.	Project Costs in 2017 Dollars ($1,000s)											
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028-2037	Total CIP (2018-2037)
Gilman Wells PFOS Discharge to Sewer	WS-4	200											200
Emergency Water Fill Station	WS-5								210				210
Emergency Water Filtration Plant	WS-6								2,100				2,100
Bulk-Purchase Water Fill Station	WS-7								100				100
Well Capacity Optimization	WS-8		200										200
	Total	1,266	1,692	10,660	10,660	0	0	1,642	2,410	0	0	0	28,330
TOTAL BUDGET													
	TOTAL	3,694	7,029	14,141	11,660	1,600	6,232	2,474	4,417	832	832	8,320	61,231

Table 11-4. High Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
MH-1	12	260	118		✓		Upsizing pipes in Cabin Creek Ln SW off of Sunrise Pl SW.
SC-100	8	330	121		✓	✓	Upsizing pipes on SE 51st St from West Lake Sammamish Pkwy SE to hydrant 206001617 to meet velocity constraint and remove AC pipe.
SC-101	12 14	2,350 3,240	2,968		✓		Upsizing pipes: 14-inch in West Lake Sammamish Pkwy SE from 184th Ave SE to 192nd Ave SE. 12-inch pipe within Timberlake Apartments and Sammamish Bluffs Condominiums.
SC-103	8	1,100	403		✓	✓	Upsizing pipes in SE 43rd Pl to resolve fire flows limited by pressure and to remove AC pipe.
SC-104	8	160	59		✓	✓	Upsizing pipes on 189th Pl SE from SE 42nd Pl to hydrant 206001594. Upsizing pipes on SE 43rd St from 189th Ave SE to hydrant 206001592. Project removes AC pipe and allows fire flow to meet velocity constraint.
SC-105	8	50	18		✓	✓	Upsizing pipes on 190th Ave SE from 191st Ave SE to hydrant 206001593 to meet velocity constraint and remove AC pipe.
SC-106	8	1,090	400		✓		Upsizing pipes in 182nd Ave SE.
SC-107	12 14 16	500 930 240	920		✓		Upsizing piping near Sammamish Crown Apartments: 16-inch at intertie, 14-inch between intertie bifurcation and hydrant 206001643 and in 182nd Ave SE, and 12-inch between hydrant 206001643 and 182nd Ave and between hydrant 206001634 and 182nd Ave.
SC-108	8	380	139		✓	✓	Upsizing pipe in 187th Pl SE and SE 44th Pl to meet velocity constraint and remove AC pipe.
SC-109	8 12 14	22,950 110 850	9,333			✓	Removal and replacement of AC pipes within South Cove service area that have not be identified for replacement by other projects resolving hydraulic deficiencies.
T-105	12	30	17		✓		Upsizing of segment of 8-inch pipe on loop between Shangri-La Way NW and hydrant 206001036.
V-1	8	490	199	✓			New pipe from Talus 616 zone to change services in Goode Pl from Valley 297 to Talus 616 zone.
V-2	12	2,560	1,165		✓	✓	Upsizing 6-inch pipes on 19th Ave NW between NW Poplar Way and NW Mall St, and upsizing 6-inch pipes along NW Mall St between 19th Ave NW and hydrant 206000743 to meet velocity constraint and to remove AC pipe.
V-3	12	320	146		✓		Upsizing pipe containing hydrant 206000735 between 19th Ave NW and Hyla Ave NW.
V-5	12	290	132		✓		Upsizing pipe feeding hydrant 206000182.
V-6	12	470	214		✓		Upsizing pipes feeding hydrants 206000187, 206000188, and 206000189.
V-7	12	400	182		✓		Upsizing pipes feeding hydrant 206000142.
V-9	12	390	177		✓	✓	Upsizing pipes feeding hydrant 206000033 to meet velocity constraint and remove AC pipe.

Table 11-4. High Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-12	12	280	139	✓			New pipe between hydrant 206001284 and intersection of NE Creek Way and 3rd Ave NE.
V-15	8	110	45	✓			New pipe creating a loop between hydrants 206000387 and 206000389.
V-38	14 16 18	1,250 2,940 1,090	3,301		✓		Upsizing pipes to increase fire flow and eliminate low pressures at southern end of Valley 297 Zone on Issaquah-Hobart Rd SE. Large diameter pipes required to minimize headloss. Upsize pipes to 14-inch on 2nd Ave SE from southern end of pipe loop serving hydrant 206000038 to Front St S. Upsize to 18-inch on Front St S from tee with 2nd Ave SE pipe to 6th Ave SE. Upsize to 16-inch between intersection of SE Lewis St and 6th Ave SE to hydrant 206001292 at south end of system. Upsize to 14-inch between hydrants 206001292 and 206001473.
V-101	12	650	296		✓		Upsizing of pipes along 6th Ave SE from SE Lewis St to hydrant 206000002.
V-134	12	680	309		✓		Upsizing pipes between hydrant 206000112 and hydrant 206000999.
V-161	12	220	100		✓	✓	Upsizing pipes between hydrant 206000592 and NW Maple St to remove existing AC pipe and to meet velocity constraints.
V-186	12	1,360	619		✓		Upsizing pipes along loop containing hydrants 206000669, 206000668, 206000665, 206000663, and 206000662.
WW-1	8	530	194		✓		Upsizing pipes on Mt Fury Cir SW between hydrant 206000291 and Mountain Park Blvd SW.
Total High Priority Water Main Replacement Cost = $21,710,000							

Table 11-5. Medium Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
CR-1	12	1,300	591		✓		Upsizing of pipes on Pine View Dr NW, NW Pine Cone Pl, and Newport Way NW between transition to 12-inch pipe south of hydrant 206001343 and PRV Station No. 24.
IH-101	12	250	114		✓		Upsizing pipes feeding hydrant 206000866 on 14th Ct NE.
IH-103	12	40	18		✓		Upsize pipe on NE Denny Way between hydrant 206001212 and 4th Ave NE.
IH-109	12	10	5		✓		Upsizing pipe (pipe 203005380) between hydrant 206000937 and 16-inch main.
MH-3	4	100	30		✓		Remove 2-inch pipe and replace with 4-inch pipe in Sunrise Pl SW.
MH-6	12 14	80 560	365		✓		Upsizing pipes on Cabin Creek Ln SW between Sunrise Pl SW and hydrant 206001208.
MH-103	12	130	59		✓		Upsizing pipes feeding hydrant 206000279.

Table 11-5. Medium Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
T-104	12	50	23		✓		Upsizing pipe on NW Pebble Ln between Shangri-La Way NW and hydrant 206001067.
V-11	10 12	3,660 250	1,646		✓		Upsizing pipe loops around Issaquah High School.
V-112	12	470	214		✓		Upsizing pipes on NW Alder Pl and 2nd Pl NW between 1st Ave NW and hydrant 206000395.
V-115	12	330	150		✓		Upsizing pipes between hydrant 206001353 and Newport Way NW.
V-116	12	420	191		✓		Upsizing pipes between hydrant 206000414 and Newport Way NW.
V-117	12	100	45		✓		Upsizing pipes between hydrant 206000429 and Newport Way NW.
V-121	12	330	150		✓		Upsizing pipes between hydrant 206000437 and Newport Way NW.
V-122	12	360	164		✓		Upsizing pipes between hydrants 206001401 and 206001402.
V-125	12	160	73		✓		Upsizing pipes between hydrant 206000146 and Rainier Blvd N.
V-127	12	190	86		✓		Upsizing pipes between hydrant 206000132 and NE Dogwood St.
V-129	12	200	91		✓		Upsizing pipes between hydrant 206001284 and 206001285.
V-133	12	330	150		✓		Upsizing pipes on 1st Ave NE between hydrant 206000109 and NE Juniper St. Upsizing pipes on NE Juniper St between 1st Ave NE and pipe leading to hydrants 206000998 and 206000999.
V-138	12	190	86		✓		Upsizing pipes between hydrant 206000108 and NE Gilman Blvd.
V-139	12	360	164		✓		Upsizing pipes between hydrant 206000538 and 10-inch pipe loop.
V-14	12	1,430	651		✓		Upsizing pipes on 7th Ave NW between NW Locust St and NW Holly St and upsizing pipes on NW Holly St between 7th Ave NW and hydrant 206000454.
V-16	12	610	277		✓		Upsizing pipes on 5th Ave NW between NW Juniper St and NW Holly St.
V-17	12	530	241		✓		Upsizing pipes on NW Holly St between hydrant 206000454 and 5th Ave NW.
V-18	12	660	300		✓		Upsizing pipes on 3rd Ave NW between NW Juniper St and NW Holly St.
V-19	12	1,180	537		✓		Upsizing pipes on NW Holly St between 3rd Ave NW and Front St N.
V-20	12	350	159		✓		Upsizing pipes on 1st Ave NW between hydrant 206000381 and NW Holly St.
V-21	12	130	59		✓		Upsizing pipe 203008539 near hydrant 206000134.
V-25	12	1,600	728		✓		Upsizing pipes on E Sunset Way between 2nd Ave SE and 6th Ave SE.
V-26	12	690	314		✓		Upsizing pipes on SW Clark St between Wildwood Blvd SW and pipe serving hydrant 206001268.

Table 11-5. Medium Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-28	10 12	290 60	149		✓		Upsizing pipes on Rainier Blvd S between SE Andrews St and SE Bush St.
V-29	12	370	168		✓		Upsizing pipes between hydrant 206000404 and Newport Way NW.
V-30	4	850	252		✓		Remove 2-inch pipe and replace with 4-inch pipe in 1st Ave SE from Trailer Park to south end of 1st Ave.
V-31	12	2,180	992		✓		Upsizing pipe loop around Clark Elementary School / Gibson Ek High School.
V-49	12	70	32		✓		Upsizing pipe from Newport Way NW feeding hydrants 206000430, 206000431, and 206000432.
V-147	12	110	50		✓		Upsizing pipes between hydrant 206000490 and 8-inch pipe loop to the south.
V-149	12	140	64		✓		Upsizing pipes between hydrant 206000501 and 7th Ave NW.
V-151	12	220	100		✓		Upsizing pipes between hydrant 206000526 and pipe loop to the west.
V-152	12	370	168		✓		Upsizing pipes between hydrant 206000536 and pipe loop to the northwest.
V-155	12	190	86		✓		Upsizing pipes between hydrant 206000525 and pipe loop to the south.
V-156	12	350	159		✓		Upsizing pipes between hydrant 206000517 and pipe loop to the southwest.
V-157	12	500	227		✓		Upsizing pipes between hydrant 206000562 and 12th Ave NW.
V-158	12	20	9		✓		Upsizing pipes between hydrant 206000558 and 12th Ave NW.
V-164	12	260	118		✓		Upsizing 8-inch pipes between hydrant 206000586 and 17th Ave NW.
V-175	12	680	309		✓		Upsizing pipes between hydrant 206000704 and NW Sammamish Rd.
V-178	12	480	218		✓		Upsizing pipes on 15th Pl NW between hydrant 206000693 and NW Sammamish Rd.
V-184	10	1,290	540		✓		Upsizing pipes along loop containing hydrants 206000664, 206000655, 206000657, 206000658, and 206000660.
V-188	12	180	82		✓		Upsizing pipes on 3rd Pl NW between hydrant 206001428 and NW Dogwood St.
Total Medium Priority Water Main Replacement Cost = $11,405,000							

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
HW-100	10	460	193		✓		Upsizing pipes between Wildwood BPS and hydrant 206000232.
IH-100	10 12	210 10	93		✓		Upsizing pipes between hydrant 206000868 and NE Katsura St to 10-inch. Upsize remaining 8-inch pipe west of hydrant 206000868 to 12-inch.
IH-102	12	20	9		✓		Upsizing segment of 8-inch pipe (pipe 203008513) between 12-inch runs of pipe near the intersection of 5th Pl NE and NE Discovery Dr.
IH-104	12	270	123		✓		Upsizing pipes on NE Denny Way between hydrants 206001212 and 206001211.
IH-105	12	190	86		✓		Upsizing pipes on NE Eagle Way between NE High St and hydrant 206001209.
IH-106	14	30	18		✓		Upsizing pipes on NE Discovery Dr between SPAR Pump Station discharge line and 9th Ave NE.
IH-107	12	40	18		✓		Upsizing pipes on 14th Ave NE between hydrant 206000852 and Huckleberry Cir.
IH-110	10 12	2,030 100	899		✓		Upsizing pipes to 10-inch on Central Park Ln NE from 24th Ave NE to hydrant 206000900. Upsizing pipes to 12-inch on Central Park Ln NE for remainder of existing 8-inch pipe north of hydrant 206000900.
IH-111	12	160	73		✓		Upsizing pipes on NE Jay Ln from24th Ave NE to hydrant 206001129.
IH-112	10 12	630 20	274		✓		Upsizing pipes to 10-inch on 23rd Pl NE from 24th Ave NE to hydrant 206001130. Upsizing pipes to 12-inch on 23rd Pl NE from hydrant 206001130 to Alley Park. Upsizing pipes to 10-inch on Alley Park from 23rd Pl NE until existing pipe transitions to 12-inch.
IH-113	12	190	86		✓		Upsize pipe on NE Jared Ct from 25th Ave NE to 25th Walk NE.
IH-114	14	900	527		✓		Upsizing pipes on 30th Ave NE from 28th Ave NE to NE Harrison St.
IH-115	10	350	146		✓		Upsizing pipes on 29th Ave NE from NE Magnolia St to hydrant 206001152.
IH-116	10 14	230 80	146		✓		Upsizing pipes to 14-inch on NE Natalie Way from NE Magnolia St to 24th Ct NE. Upsizing pipes to 10-inch on 24th Ct NE from NE Natalie Way to NE Marion Ln. Upsizing pipes to 10-inch on NE Marion Ln from 24th Ct NE to hydrant 206001420.
IH-117	10 14	250 390	349		✓		Upsizing pipes to 14-inch on NE Natalie Way from hydrant 206001115 to 23rd Ct NE. Upsizing pipes to 10-inch on 23rd Ct NE from NE Natalie Way to NE Marion Ln. Upsizing pipes to 10-inch on NE Marion Ln from 23rd Ct NE to hydrant 206001114.
M-101	10 12	350 3,120	1,690		✓		Upsizing pipes to 10-inch on NW Village Park Dr from NW Lac Leman Dr to NW Montreux Dr. Upsizing pipes to 12-inch on NW Village Park Dr from NW Lac Leman Dr to Champery Pl NW. Upsizing pipes to 12-inch on Champery Pl NW.
MH-10	8	640	235		✓		Upsizing pipes on SW Gibson Ln.

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
MH-104	14	1,490	873		✓		Upsizing pipes on Sunrise Pl SW from Wildwood Blvd SW to Cabin Creek Ln SW.
MH-14	8	340	125		✓		Upsizing pipes on Almak Ct NW from W Sunset Way to hydrant 206000375.
MH-15	8	320	117		✓		Upsizing pipes on SW Hepler Ln.
MH-7	8	150	55		✓		Upsizing pipes on Mt SI Pl NW from Mt Quay Dr NW to hydrant 206000328.
MH-9	8	540	198		✓		Upsizing pipes on SW Mt Baker Dr from Mountain Park Blvd SW to hydrant 206000280.
SC-102	10	130	54		✓		Upsizing pipes on 189th Pl SE from 190th Ave SE to transition from 6-inch to 8-inch pipe southwest of hydrant 206001578.
T-106	12	10	5		✓		Upsize small segment of 8-inch pipe on NW Boulderway Dr near the intersection with Timber Creek Dr NW.
V-40	12	130	59		✓		Upsizing pipes between hydrant 206000470 and NW Juniper St.
V-41	12	220	100		✓		Upsizing pipes on Rainier Blvd N from hydrant 206000378 south to tee with 12-inch pipe.
V-42	12	1,130	514		✓		Upsizing pipes on NW Poplar Way from proposed I-90 crossing east past hydrant 206000724 to transition from existing 8-inch pipe to 12-inch. Upsizing pipes between hydrant 206000727 and NW Poplar Way.
V-43	8	180	66		✓		Upsizing pipes on 2nd Ave NE between hydrant 206000071 and NE Creek Way.
V-44	8	700	257		✓		Upsizing pipes on SE Andrews St between 4th Pl SE and 2nd Ave SE.
V-45	8	650	238		✓		Upsizing pipes on SE Bush St between 2nd Ave SE and hydrant 206000088.
V-46	10 12	1,420 180	683		✓		Upsizing of pipes on loop with hydrants 206000118, 206000134, and 206000135 with 10-inch except for pipes between hydrant 206000118 and Front St N, and pipes near hydrant 206000134 which are upsized to 12-inch.
V-47	10 12	590 40	267		✓		Upsizing pipes to 10-inch on NE Crescent Dr between Front St N and tee with 8-inch pipe near hydrant 206000124. Upsizing pipes between tee and hydrant 206000124 with 12-inch.
V-48	10	450	188		✓		Upsizing of pipes on loop with hydrant 206000133.
V-50	10	130	54		✓		Upsizing of pipe between southern portion of Gilman Square pipe loop and NW Dogwood St.
V-51	10	620	259		✓		Upsizing of pipe between eastern portion of Gilman Square pipe loop and NW Dogwood St.
V-52	10	770	322		✓		Upsizing of pipes on 1st Pl NW between NW Dogwood St and transition to 12-inch near NW Alder Pl.
V-53	10	1,170	490		✓		Upsizing of pipes on pipe loop through Vista Ridge Apartments.

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-54	10 12	330 340	306		✓		Upsizing of pipes between hydrant 206000445 and NW Juniper St.
V-55	10 12	740 340	478		✓		Upsizing of pipes to 10-inch on 4th Ave NW between NW Juniper St and NW Holly St. Upsizing of pipes to 12-inch on NW Holly St between 4th Ave NW and hydrant 206001266.
V-56	10 12	1,230 190	609		✓		Upsizing of pipes to 10-inch on pipe loop with hydrants 206000399, 206000402, and 206000365 except for segments between hydrant 206000399 and Newport Way NW, and between hydrant 206000365 and W Sunset Way with 12-inch.
V-102	12	620	282		✓		Upsizing piping leading to hydrants 206000003 and 206000001.
V-103	10 12	1,110 60	494		✓		Upsizing pipe to 12-inch between hydrant 206000038 and 2nd Ave SE. Upsize remaining pipe on loop (also serving hydrant 206000037 and 206000024).
V-104	10	830	347		✓		Upsizing pipes on 4th Pl SE from SE Evans St to 12-inch pipe loop to the south.
V-105	12	90	41		✓		Upsizing pipes between Front St S and hydrant 206000166.
V-106	10 12	1,530 160	720		✓		Upsizing pipes in loop serving Windsong Apartments to 10-inch except for pipe segment between hydrant 206000169 and Front St S which is upsized to 12-inch.
V-107	10	60	25		✓		Upsizing pipes on SE Darst St between hydrant 206001427 and 4th Pl SE.
V-108	10	450	188		✓		Upsizing pipes on SE Andrews St from Rainier Blvd S to 1st Ave SE. Upsizing pipes on 1st Ave SE from SE Andrews St to SE Bush St.
V-109	12	60	27		✓		Upsizing pipes on 3rd Ave NE from E Sunset Way to hydrant 206001281.
V-110	10	340	142		✓		Upsizing pipes on 2nd Ave NE from NE Alder St to E Sunset Way.
V-111	10 12	640 320	426		✓		Upsizing pipes to 10-inch on 1st Ave NE from E Sunset Way to NW Alder Pl. Upsizing pipes to 12-inch on NW Alder Pl from Front St N to Rainier Blvd N.
V-113	10 12	890 90	417		✓		Upsizing pipes to 10-inch on Newport Way NW from W Sunset Way to hydrant 206000179. Upsizing pipes to 12-inch on Newport Way NW from hydrant 206000179 to tee with pipe leading to hydrant 206001454.
V-114	10 12	730 90	350		✓		Upsizing pipes to 10-inch on loop serving hydrants 206000409 and 206000411 except for pipes between hydrant 206000407 and Newport Way NW, and hydrant 206000411 and Newport Way NW which are upsized to 12-inch.
V-119	10 12	1,830 60	796		✓		Upsizing pipes to 10-inch in Gilman Square pipe loop except for pipe 203005633 which gets upsized to 12-inch.
V-120	10	590	247		✓		Upsizing pipes for pipe loop with hydrants 206000433, 206000434, and 206000435.
V-123	10	570	239		✓		Upsizing pipes for pipe loop with hydrants 206000438 and 206000451.

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-124	10	1,260	527		✓		Upsizing pipes on 1st Ave NW between NW Dogwood St and Rainier Blvd N. Upsizing pipes between hydrants 206000387 and 206001414, and between hydrant 206000389 and 1st Ave NW.
V-126	12	210	96		✓		Upsizing pipes between hydrant 206000149 and NE Dogwood St.
V-128	10	180	75		✓		Upsizing pipes on 3rd Ave NE between hydrant 206000127 and NE Creek Way.
V-130	10	650	272		✓		Upsizing pipes on NE Gilman Blvd between 3rd Ave NE and hydrant 206001284.
V-131	12	100	45		✓		Upsizing pipes between hydrant 206000099 and tee with 12-inch pipe loop to the south.
V-132	10 12	820 520	601		✓		Upsizing pipes to 12-inch on 1st Ave NE between NE Juniper St and hydrant 206000095. Upsizing pipes on 1st Ave NE between hydrant 206000095 and NE Holly St. Upsizing pipes to 10-inch on NE Holly St from 1st Ave NE to Holly Pump Station Mixing Vault.
V-135	10	50	21		✓		Upsizing pipes between hydrant 206000115 and tee with 8-inch pipe loop to the north.
V-136	10 12	410 20	181		✓		Upsizing pipes to 10-inch between Risdon Wells and tee to 8-inch in pipe going to hydrant 206000114. Upsize to 12-inch between upsized 10-inch and hydrant 206000114.
V-137	10 12	170 40	91		✓		Upsizing pipes to 12-inch on NE Gilman Blvd from hydrant 206000131 to tee with 8-inch pipe northwest from hydrant. Continue pipe upsizing with 10-inch pipe until tee with pipe leading to hydrant 206000133.
V-140	12	40	18		✓		Upsizing pipe between hydrant 206000383 and tee with 10-inch pipe to the southwest.
V-141	10	260	109		✓		Upsizing pipe between hydrant 206000440 to 5th Ave NW.
V-142	10	250	105		✓		Upsizing pipe between hydrant 206000439 to 5th Ave NW.
V-143	12	80	36		✓		Upsizing pipes between hydrant 206000469 and NW Juniper St.
V-144	14	500	293		✓		Upsizing pipes on 12th Ave NW between Newport Way NW and hydrant 206000336.
V-145	10	750	314		✓		Upsizing pipes on loop serving hydrants 206001260, 206001261, and 206001262.
V-146	10	1,140	477		✓		Upsizing pipes on loop serving hydrant 206000488, 206000489, and 206000491.
V-148	10 12	3,220 280	1,486		✓		Upsizing of pipes primarily to 10-inch around the Issaquah Commons commercial development with some upsizing of pipes to 12-inch near hydrants.
V-150	12	70	32		✓		Upsizing of pipes between hydrants 206000487 and 206000484.

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-153	10 12	590 210	351		✓		Upsizing to 10-inch of pipe loop off of NW Gilman Blvd of serving US Post Office except for pipes between hydrant 206000531 and NW Gilman Blvd, and hydrant 206000533 and NW Gilman Blvd which are upsized to 12-inch.
V-154	10 12	670 100	330		✓		Upsizing of pipe loop with hydrants 206000518, 206001259, 206000524, and 206000523 to 12-inch except for portion of loop west of hydrant 206000518 which is upsized to 12-inch.
V-159	10 12	1,480 140	689		✓		Upsizing of pipes with hydrants 206000559, 206000548, 206000547, 206000546, and 206000545 with 10-inch pipe except for segment of loop north of hydrant 206000545 which is upsized to 12-inch.
V-160	10	800	335		✓		Upsizing of pipes between 12th Ave NW and hydrant 206000552. Upsizing continues east of hydrant 206000552 until tee with 12-inch pipe.
V-162	10 12	810 130	403		✓		Upsizing of pipes to 10-inch on loop with hydrants 206001510 and 206001234 except for segment of loop south of hydrant 206001234 which is upsized to 12-inch.
V-163	14	110	64		✓		Upsizing of pipes on Newport Way NW from 206000745 northwest until tee with 16-inch pipe.
V-165	10	460	193		✓		Upsizing of pipes on 17th Ave NW between NW Mall St and NW Maple St.
V-166	10	210	88		✓		Upsizing of pipes between hydrant 206001220 and 18th Ave NW.
V-167	10	310	130		✓		Upsizing of pipes between hydrant 206000721 and 18th Ave NW.
V-168	10	310	130		✓		Upsizing of pipes between hydrant 206000720 and 18th Ave NW.
V-169	10 12	1,410 20	600		✓		Upsizing of pipes on NW Pacific Elm Dr to 10-inch except for segment of pipe between hydrant 206000767 and Newport Way NW which is upsized to 12-inch. Upsizing pipes to 10-inch on NW Pacific Yew Pl between hydrant 206000765 and NW Pacific Elm Dr.
V-170	10 12	2,130 50	916		✓		Upsizing of pipe loops serving Sammamish Pointe development off of Newport Way NW.
V-171	10	260	109		✓		Upsizing of pipe loop serving Bentley House Luxury Apartments off of Newport Way NW.
V-173	12	400	182		✓		Upsizing of pipes between hydrant 206000708 and NW Sammamish Rd.
V-174	10	210	88		✓		New pipe creating a loop between hydrants 206000706 and 206000698.
V-176	10	210	88		✓		Upsizing pipes from hydrant 206000696 to NW Sammamish Rd.
V-177	12	210	96		✓		Upsizing pipes from hydrant 206000695 to NW Sammamish Rd.
V-179	10 12	790 110	385		✓		Upsizing pipes to 10-inch on pipe loop with hydrants 206000679, 206000683, and 206000681 except for segment of loop east of hydrant 206000681 which is upsized to 12-inch.

Table 11-6. Low Priority Water Main Replacement Program Projects

Project No.	Proposed Pipe Size (in) and Length (ft)		Cost In 2017 Dollars ($1,000s)	New Pipe	Upsizing	AC Removal	Project Description
V-180	10	130	54		✓		Upsizing pipes between hydrant 206000652 and 11th Ave NW.
V-181	10 12	1,600 90	714		✓		Upsizing pipes to 10-inch on loop with hydrants 206000642, 206000639, 206000635, and 206000634 except for the segment connecting the loop to Lake Dr and a small segment east of hydrant 206000639 which are upsized to 12-inch.
V-182	10 12	1,840 310	924		✓		Upsizing pipes to 10-inch on loop with hydrants 206001476, 206001474, 206000628, and 206000627 except for segments between hydrants 206001476 and 206000627 and Lake Dr which are upsized to 12-inch.
V-183	10	720	301		✓		Upsizing pipes on loop with hydrants 206001108 and 206001109.
V-185	10	110	46		✓		Upsizing of pipes on loop with hydrant 206000655.
V-187	12	10	5		✓		Upsizing of short segment of pipe on E Sunset Way between hydrant 206001492 and 6th Ave NE.
V-189	12	20	9		✓		Upsizing of short segment of pipe on 17th Ave NE between hydrant 206000884 and NE Killian Ln.
V-190	10	210	88		✓		Upsizing of segment of dead-end pipe within the Gateway Apartments development.
Total Low Priority Water Main Replacement Cost = $28,123,000							

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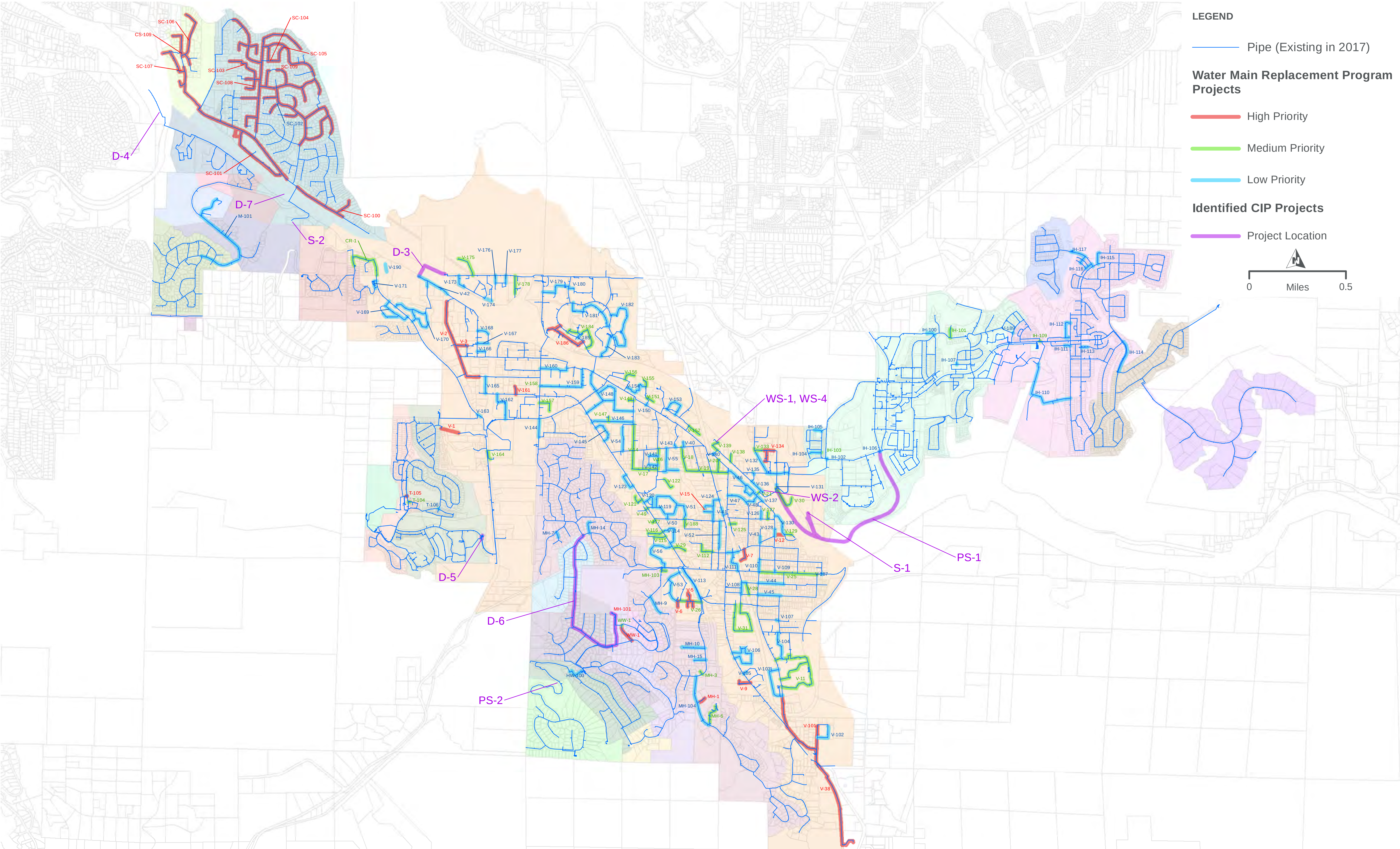

CAPITAL IMPROVEMENT PROGRAM PROJECTS

FIGURE 11-1

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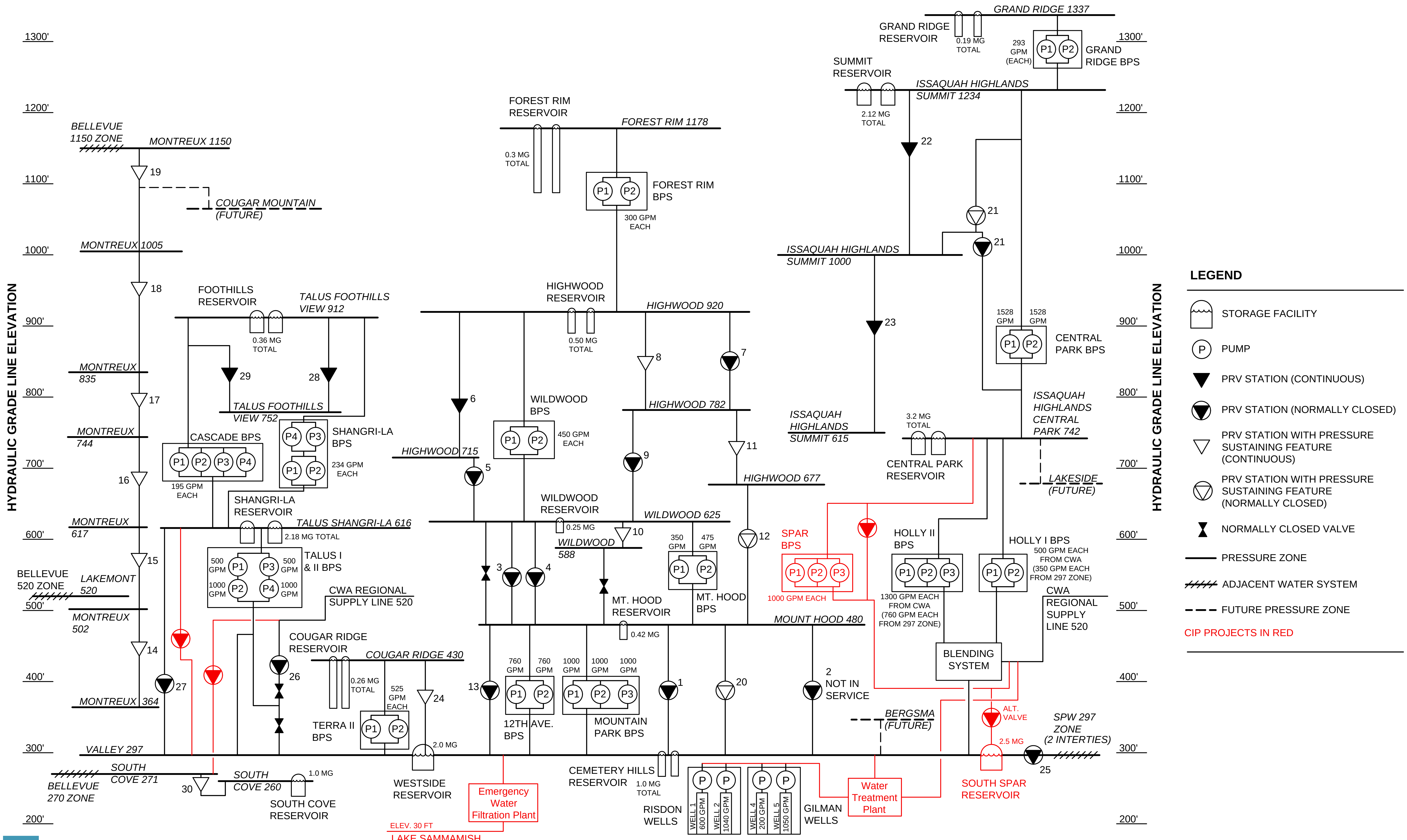

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HYDRAULIC PROFILE WITH CAPITAL IMPROVEMENT PLAN PROJECTS

FIGURE 11-2

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Chapter 12. Financial Program

This chapter presents the financial plan, which is the development of the projected revenues and operating and capital expenses for the City of Issaquah's (City's) water system. The capital costs contained within the financial plan are based on the Capital Improvement Plan (CIP) projects presented in Chapter 11 of this plan.

12.1 Introduction

The effective implementation of a Water System Plan (WSP) is dependent on developing a plan that can be financially supported by the water utility's revenue, by meeting State and local regulatory requirements, and by providing the flexibility to deal with unforeseen changes. The financial plan uses the annual operating expense and identified capital needs of the water system to determine if the current water utility revenues are sufficient to fund operating and capital expenses, and develop, as necessary, a rate transition plan to fully fund the utility.

12.2 Key Assumptions

The City's adopted 2017 and 2018 budgets were utilized as the basis for the operation and maintenance (O&M) cost projection. Escalation factors were then applied to the budgeted O&M to project future expenses. Escalation factors were developed based on historical inflationary factors for the City and local area. The financial plan has also assumed that the recommended rate adjustments from the 2015 rate study will be implemented. The revenues collected are anticipated to reflect the rate increases of 6.0% in 2016 and 5.5% from 2017 – 2018. The results of this analysis are based on those assumptions as a starting point. The financial plan is predicated on the following: projected rate adjustments are implemented, the timing and magnitude of the capital improvements is maintained, assumed debt issuance is executed, and that customer characteristics remain similar for rate revenue generating purposes.

12.3 Historical Review

The first step in reviewing the financial health of the City of Issaquah's water utility is to gain background from prior financial performance. To do this, the analysis starts with the previous five year period of 2011 to 2015, as well as the budget from 2016. Based on this information, one can assess the water utility's financial health as well as gauge any trends that may be occurring. The information from the historical review helped in the development of the assumptions for the financial plan as well as in gaining an understanding of the water utilities' operations. A summary of the historical operating revenues and expenses is show in the Table 12-1.

Table 12-1 Historical Revenue Requirement ($000s)

	Actual 2011	Actual 2012	Actual 2013	Actual 2014	Actual 2015	Actual 2016
Revenues						
Rate Revenue	$5,305	$6,222	$6,489	$6,808	$7,608	$7,238
Misc. Revenue	634	677	713	561	1,036	1,165
Total Revenue	**$5,939**	**$6,899**	**$7,202**	**$7,368**	**$8,644**	**$8,403**
Expenses						
Personnel	$1,421	$1,526	$1,796	$1,833	$1,819	$2,200
Supplies & Equipment	1,332	1,110	1,099	1,295	1,420	1,490
Charges & Service	1,533	1,855	1,603	1,215	1,752	1,938
Interfund Charges	132	150	N/A	N/A	N/A	N/A
Intergov Charges	201	257	206	156	148	137
Capital Outlay / Reserves	N/A	N/A	N/A	150	150	150
Debt Service	N/A	N/A	N/A	639	639	640
Operating Transfers - Out	1,135	1,366	1,553	1,573	1,950	1,706
Total Expenses	**$5,754**	**$6,263**	**$6,257**	**$6,859**	**$7,879**	**$8,262**
Bal. / (Def.) of Funds	***$185***	***$635***	***$945***	***$509***	***$765***	***$142***

As can be seen from the historical data, the City has maintained adequate funding for annual operating and maintenance as well as funding capital improvements during this historical time period. It is important to note that there may be additional expenses and revenues not shown in the available source data. However, this table attempts to make a fair comparison from year to year using all available figures in a similar manner.

12.4 Development of the Financial Plan

A financial projection was developed to determine the City's ability to fund its water system capital improvements, as developed in this WSP, as well as the O&M needs over the review period. The analysis also took into consideration prudent financial management criteria such as adequate funding of capital through rates, debt service coverage ratios, and operating and capital fund balances (or reserve levels). The financial plan developed the projected water utility revenues and expenses for 2019 to 2027. The development of the projection was based on the current 2018 budget provided by the City. The 2018 budget was then escalated through 2027, by applying factors for inflation ranging from 3.0 to 6.5 percent - depending on the expense category - and future customer growth projections. The range in inflationary factors is based on historical trends in various costs such as the difference in increasing general operating supplies at 3.0 percent annually to overall benefits increasing at a higher rate, 6.0 percent for this analysis.

12.4.1 Revenues

The first component in developing the financial analysis is a review of the sources of revenue for the water system. The revised budget for 2017 was the starting point for both rate and other revenues. The revenues received from water system customers and operations are:

- **Rate revenues** – retail to customers
- **Other revenues** – backflow charges, hydrant charges, interest income, rental income, and other miscellaneous sources

Water rate revenues are projected to be approximately $7.5 million in 2018. By 2027, with assumed customer growth of 1.0 percent per year, the rate revenues are projected to total $8.2 million. It is important to note that the rate revenues shown are prior to any additional rate adjustments other than the previously mention adjustments from the 2015 rate study which were effective in 2016 and 2017. Other, or miscellaneous, revenues total approximately $900,000 in 2018. These revenues are projected to increase slightly over the review period to roughly $1.0 million by 2027. In total, the City is projected to receive revenues of $8.5 million in 2018, and that figure is projected to increase by 2027 to approximately $9.3 million. The total revenues are summarized in Table 12-2 below.

Table 12-2 Total Revenues ($000s)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenues										
Rate Revenue	$7,542	$7,618	$7,694	$7,771	$7,849	$7,927	$8,007	$8,087	$8,167	$8,249
Other Revenue	911	931	951	932	942	960	981	986	998	1,013
Total Revenue	**$8,454**	**$8,549**	**$8,645**	**$8,703**	**$8,791**	**$8,887**	**$8,987**	**$9,072**	**$9,165**	**$9,262**

12.4.2 Operations & Maintenance

The next component of the financial plan was to project the O&M expenses incurred to provide water service. The projection of future O&M expenses is based upon the 2018 budget. The budgeted figures were then escalated annually through 2027 using the assumed inflationary factors described previously. The O&M expenses in 2018 are projected to be $7.6 million. O&M expense levels are expected to increase to $10.7 million by the year 2027 based on inflationary factors. This of course assumes that there are no significant additions or changes made to the O&M practices during that period.

An important line item to highlight is the purchased water from Cascade Water Alliance (CWA), of which the City is a member agency. There have been recent increases in the use of CWA water that have led to increased costs as CWA is a more expensive source. In November 2015, there was a landslide in the Talus neighborhood, an area of the City's water system, which compromised the ability to use groundwater as a source in that particular area. As a result, the City switched to CWA as the source for this area and that led to increased purchased water costs. The escalation of purchased water was reviewed and revised to incorporate the following. CWA has signaled that the rate adjustment in 2019 will be approximately 4 percent followed by a 3 percent adjustment in 2020. Then, from 2020 to 2027, it is assumed that there will be an average annual increase of approximately 3.5 percent for CWA costs. In addition to the increase in CWA costs due to rate adjustments, the demand forecast is increasing for the City. The demand growth is projected to range from 6.6 percent to 4.5 percent for the next four years and then average approximately 2.0 percent per year, thereafter. Although this is strong growth in demand, the majority of this additional demand will have to be supplied via CWA purchased water. When taking into account this source of supply, the CWA water demand is expected to grow at around 20 percent for the next few years and then fall off to around 7.0 to 3.5 percent demand growth per year. When evaluating the effects of this demand increase, it is important to note that the CWA purchased water is more expensive as a source. Given this, the City costs to purchase CWA water are dramatically increasing over the next ten-year period as a result of the majority of the demand growth is projected to be supplied via CWA.

The O&M expenses are shown in summary in Table 12-4 below.

12.4.3 Rate Funded Capital

For the City to maintain the existing system and level of service to its customers, it is important to reinvest in the system at a level at least equal to depreciation. It is prudent, therefore, to have a level of annual capital projects funded by rates greater than this target level. This is because the replacement cost of the system will continue to increase due to inflation and the annual depreciation, therefore, may actually be the lower threshold of targeted funding. Depreciation expense for 2015 was estimated at $1.8 million for the water utility. Following prudent financial practices, this would mean that the City should invest at a minimum $1.8 million annually to sustain its capital facilities. The financial plan projects that the rate funded capital will increase over the review period from $600,000 in 2018 to $1.9 million in 2027.

The major factor for the City and a focal point of this financial review is the funding of the City's water system CIP. For purposes of financial planning the CIP, as presented in detail in Chapter 11 which is shown in 2018 dollars, is increased annually by 2.7% to reflect the future escalation of costs due to inflationary pressures. The inflated CIP includes projects totaling $3.7 million for 2018, increasing to a maximum level in 2020 of $14.9 million. The large total for capital projects in 2020 is primarily related to the Water Treatment Plant project which equals $25.4 million over four years (2018 – 2021) and the majority of this project, approximately $22.8 million, is planned for 2020 - 2021. By 2027, the CIP totals $59.3 million and the average capital spending from 2018 – 2027 is $5.9 million annually. Funding for the capital projects comes from several sources:

- The first source is rate-funded capital which starts out at $600,000 in 2018 and increases annually to $1.9 million by 2027. This funding source is very important in showing that the rates have the capacity to fund renewal and replacement of the system which should be targeted as greater than annual depreciation. As mentioned previously, the annual depreciation for 2015 – which is the target minimum funding - was approximately $1.8 million. During the projected time period the level of rate funded capital approaches the target minimum but falls short of the target. The City should continue to increase rate funded capital to reflect annual renewal and replacement needs
- The second source of funding is from reserves; and for purposes of capital funding, the City has two reserves: operating and capital funds. In total, approximately 17.8 percent or $8.0 million comes from reserves over the review period to smooth out rate adjustments as well as limit and reduce debt issuances.
- The final source of funding for capital projects is from long-term debt. This comes in the form of low interest loans and / or revenue bonds. This source allows the City to not only secure funding for large projects but it also serves as a tool to equitably spread the costs of projects to the future beneficiaries, even though they are not connected to the system yet. For this review, it is assumed that the City will issue approximately $37.0 million in long-term debt in order to fund the capital projects. The analysis does not assume or prescribe specific debt service terms. The debt service payments were calculated based on historical City long-term debt terms for planning purposes. Table 12-3 shows a summary of the capital projects and their funding sources.

Table 12-3 Capital Improvement Plan ($000s) [1]

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Total Distribution Projects	$866	$1,512	$2,461	$901	$1,593	$951	$976	$1,334	$1,030	$1,057
Total Pump Station Projects	1,562	3,559	1,211	0	0	0	0	0	0	$0
Total Storage Projects	0	411	0	182	187	6,169	0	1,085	0	0
Total Water Supply & Treatment Projects	1,266	1,738	11,243	11,547	0	0	1,927	2,904	0	0
Future Unidentified Capital Projects	0	0	0	0	0	0	0	0	795	868
Transfer to Cash Reserve	0	0	0	0	0	0	0	0	0	0
Total Capital Improvement Projects	**$3,694**	**$7,219**	**$14,915**	**$12,630**	**$1,780**	**$7,120**	**$2,903**	**$5,323**	**$1,825**	**$1,925**
Less: Outside Funding Sources										
Operating Fund Reserves	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capital Fund Reserves	3,094	1,094	1,690	305	355	95	1,278	98	0	0
Developer Contributions	0	0	0	0	0	0	0	0	0	0
Additional Low Interest Loan	0	0	0	0	0	0	0	0	0	0
Additional Revenue Bonds	0	5,000	12,000	11,000	0	5,500	0	3,500	0	0
Total Funding Sources	**$3,094**	**$6,094**	**$13,690**	**$11,305**	**$355**	**$5,595**	**$1,278**	**$3,598**	**$0**	**$0**
Rate Funded Capital	**$600**	**$1,125**	**$1,225**	**$1,325**	**$1,425**	**$1,525**	**$1,625**	**$1,725**	**$1,825**	**$1,925**

[1] – Costs shown in Table 12-3 are escalated annually by 2.7% to reflect the inflation of future costs.

12.4.4 Taxes

The water utility also has to pay utility and B&O taxes on the revenues that are collected. The first is calculated as 5.029 percent of sales (rate revenues) and the second is calculated as 1.5 percent of total revenues. For 2018, the utility tax is calculated at $379,000 and the B&O tax is estimated at $145,000. By 2027, the utility tax is projected to be approximately $415,000 and $159,000 for the B&O tax. Additionally, with the assumed rate adjustments, there will be proportional increases in taxes from the proposed rate revenues. In 2018, if the projected deficiency was covered entirely by a rate adjustment, there would be an estimated $20,000 in additional taxes on the projected revenues. Over the review period, if the projected deficits were covered by rate adjustments, by 2027, there would be an additional $426,000 in annual taxes.

12.4.5 Debt

The water utility currently has one (1) outstanding debt issuance – the 2011 Water Refunding Bond – with an annual debt service payment of approximately $640,000 for 2018. This issuance is retired in 2021. The City has planned and assumed that it will issue approximately $37.0 million in long-term debt over the next 20 years in order to fund capital projects. This analysis assumes that the City will issue the long-term debt and has incorporated the assumed payment associated with the issuances borrowed at the terms of 4.5 percent for 20 years, as a general assumption. No recommendations are provided on the final timing, total, and terms of each issuance. The borrowing assumptions are simply the identification of funding needs for a given capital plan and only highlights that need not necessarily projecting what the debt service will be. In total, the annual debt service is $635,000 in 2018 and increases over time with additional debt issuances to approximately $2.8 million by 2027.

An important metric used in the analysis of debt is the debt service coverage (DSC) ratio. The DSC is essentially a ratio of revenues available to fund annual debt service payments after deducting O&M expenses from the total available revenues. Generally, a DSC of 1.5 is considered prudent and adequate for a utility. This number is often looked at by rating agencies and can affect the terms of financing for future long-term debt issuances. For the City's water utility, the DSC is calculated at 1.85 for 2018 if the deficiency was funded by rate adjustments. The number increases slightly over the review period and by 2027 it reaches 1.84. As noted previously, the City has done well in the past of funding annual capital projects through rates and limited the use of long-term debt.

12.4.6 Reserve Funds

The City has three separate - operations, capital, and bond reserve- reserve funds. Reserve funds serve a variety of purposes but the two main ones are, first, to provide funds for a catastrophic event resulting in a large capital funds need or loss of revenue. Second, is to act as the name implies as a reserve that can store money from a surplus year and disburse in a deficit year thereby avoiding needed rate increase and decreases and smoothing the rates over time. It is important to note as well, that for the operating reserve, the minimum balance is important as this fund is used to bridge the timing gap between when the water utility bills its customers and when it receives the revenues. This period of time can be up to 90 days and therefore the minimum is set at 90 days of O&M expenses. The beginning balances were taken from the 2017 Budget Verses Actual Report and total $11.9 million. Of this total, $2.5 million was allocated to the operating fund, the capital fund was allocated $8.6 million, and the bond reserve fund was allocated $834,000. Over the review period, reserves are used for various reasons, such as to offset capital costs and lower debt issuances therefore minimizing rate adjustments. In 2027, it is projected that the ending reserve balance will be approximately $10.9 million for the three reserves in total. At this level – after the City has met the 90 days of O&M in the operating reserve and 125% of the annual debt service - the City would have approximately $3.9 million to fund capital and provide a debt reserve.

12.5 Summary of the Financial Plan

The individual components discussed above are used to develop the financial plan. The summation of the annual O&M expenses, taxes and transfers, rate funded capital, and debt service payments is called the revenue requirement. This figure is used in comparison to the City's water rate revenues to assess the sufficiency of the current rates. If there is a deficiency – and depending on the magnitude, timing, etc. – a rate adjustment may be recommended in order to maintain adequate funding for the operational and capital needs of the utility. Shown below in Table 12-4 is a summary of the revenue requirement that was prepared for the City's water utility as part of this WSP.

As noted in Table 12-4 Revenue Requirement Summary ($000s), the City's water utility would be deficient absent any rate adjustments, which are necessary to fully fund the operating and capital needs of the water utility. Key drivers in the financial plan results are the projection of CWA costs and the funding of the proposed CIP. Given this, when comparing the prior rate study to the current financial plan, a number of assumptions have changed. The daily demands on the system have increased substantially with the annexation of the South Cove area as well as additional customer growth. This has resulted in both the additional purchased water and expanding the CIP due to the additional demands on the system. A major component of the CIP that was not in the prior rate study is the water treatment plant which totals $25.4 million. Due to this expense as well as other large capital projects, there are increased needs to issue long-term debt for the City. Any future rate transition plan should aim to provide steady and predictable rate adjustments over time. Those assumed rate adjustments should be designed to fund the deficiency that this financial plan projects and in doing this will help maintain a strong financial position for the City to fully fund the operational and capital needs of the water utility.

The financial plan presented in this section is based upon a number of assumptions: the level of growth in the system, inflation amounts, and the level of debt financing at certain terms. Should these assumptions change (e.g. growth increases, slows down, or does not occur) the level of balance or deficiency and, therefore, rate adjustments required will be affected. Likewise, if costs escalate faster or slower than indicated in this plan, the projected balance or deficiency would also be affected.

Table 12-4 Revenue Requirement Summary ($000s)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Revenues										
Rate Revenue	$7,542	$7,618	$7,694	$7,771	$7,849	$7,927	$8,007	$8,087	$8,167	$8,249
Other Revenue	911	931	951	932	942	960	981	986	998	1,013
Total Revenue	**$8,454**	**$8,549**	**$8,645**	**$8,703**	**$8,791**	**$8,887**	**$8,987**	**$9,072**	**$9,165**	**$9,262**
Expenses										
Total O&M	$7,625	$8,213	$8,925	$8,985	$10,684	$10,859	$11,224	$11,706	$12,190	$13,213
Taxes & Transfers	753	761	770	778	787	796	805	814	824	833
Rate Funded Capital	600	1,125	1,225	1,325	1,425	1,525	1,625	1,725	1,825	1,925
Net Debt Service	40	422	1,342	2,184	1,550	1,972	1,972	2,242	2,242	2,242
Reserve Funding	(169)	(312)	(453)	3	535	676	664	264	151	(484)
Total Expenses	**$8,849**	**$10,210**	**$11,809**	**$13,275**	**$14,981**	**$15,829**	**$16,291**	**$16,751**	**$17,232**	**$17,729**
Bal/(Def) of Funds	($395)	($1,662)	($3,164)	($4,573)	($6,190)	($6,942)	($7,304)	($7,679)	($8,066)	($8,467)
Plus: Add'l Taxes	(20)	(84)	(159)	(230)	(311)	(349)	(367)	(386)	(406)	(426)
Total Bal/(Def) of Funds	**($415)**	**($1,745)**	**($3,323)**	**($4,803)**	**($6,502)**	**($7,291)**	**($7,672)**	**($8,065)**	**($8,472)**	**($8,893)**