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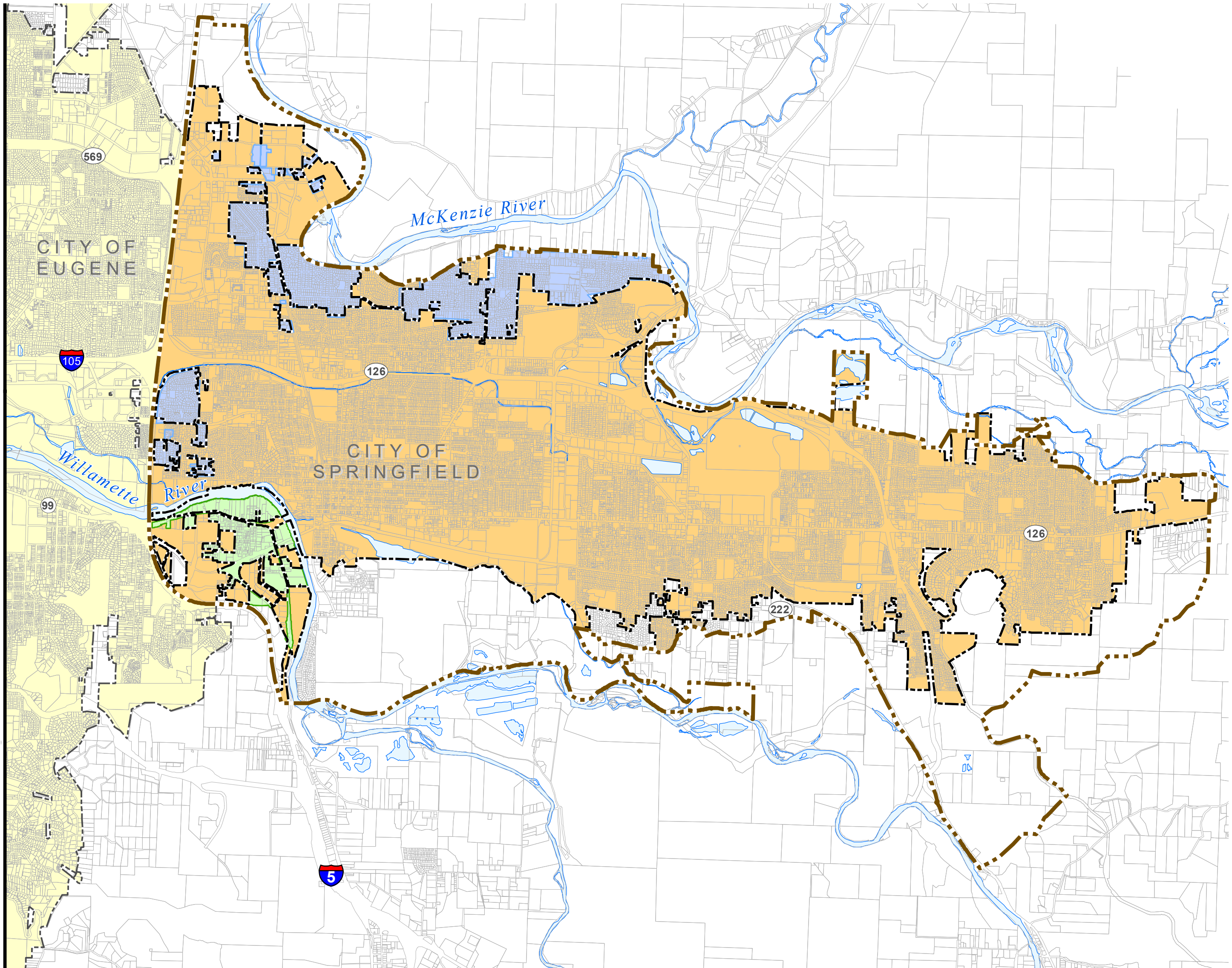

Water System Master Plan

December 2021

SUB

Rainbow Water District

Water System Master Plan

Springfield Utility Board
Rainbow Water District

December 2021

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Plan Requirements Summary

Water System Master Plans (WSMP) are required to comply with the Oregon Administrative Rules (OAR) for Oregon Health Authority (OHA), Public Health Division, Public Water Systems, Master Plan Submission and Review Requirements OAR 333-061-0060(5)(a). The following table identifies the section of this WSMP which addresses the subsection of the OAR.

OAR Subsection	Requirement Description	Report Section
A	Summary of the overall plan	WSMP Summary
B	Existing water system description	1
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	Supply	6.3
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F	Identify engineering solutions and capital costs to correct deficiencies	8
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Acronyms & Abbreviations

A	
AACE	Association for the Advancement of Cost Engineering International
ADD	average daily demand
AL	action level
ALA	American Lifelines Alliance
AWWA	American Water Works Association
C	
CCI	Construction Cost Index
CCL	Contaminant Candidate List
CCR	Consumer Confidence Report
CFE	combined filter effluent
CFR	Code of Federal Regulation
CFS	cubic feet per second
CFU	colony-forming units
CIP	capital improvement program
CSZ	Cascadia Subduction Zone
CT	Contact Time
D	
DBPR	Disinfectants and Disinfection Byproducts Rule
DEQ	Oregon Department of Environmental Quality
DLCD	Department of Land Conservation and Development
DNAPL	Dense Non-Aqueous Phase Liquids
DOGAMI	Department of Geology and Mineral Industries
DWP	Drinking Water Program
DWPLF	Drinking Water Protection Loan Fund
DWS	Drinking Water Services
E	
EDU	Equivalent Dwelling Unit
ENR	Engineering News-Record
EOC	emergency operations center
EPA	Environmental Protection Agency
EPS	extended period simulation
EWEB	Eugene Water and Electric Board
F	
FBRR	Filter Backwash Recycling Rule
FCV	Flow Control Valve
FEMA	Federal Emergency Management Agency
fps	feet per second

G	
GAC	Granular Activated Carbon
GIS	geographic information system
gpm	gallons per minute
GWD	Glenwood Water District
GWR	Groundwater Rule
GWUDI	groundwater under the direct influence
H	
HAA5s	Haloacetic Acids
HDPE	high density polyethylene pipe
HGL	hydraulic grade line
HPC	heterotrophic plate count bacteria
I	
IESWTR	Interim Enhanced Surface Water Treatment Rule
IFA	Infrastructure Finance Authority
IGA	intergovernmental agreement
IOCs	inorganic contaminants
ISDE	Initial System Distribution Evaluation
ISO	Insurance Services Office
L	
LCR	Lead and Copper Rule
LCRMR	Lead and Copper Rule Minor Revisions
LF	linear feet
LOS	level of service
LSL	lead service line
LT1ESWTR	Long-Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
M	
M9	Magnitude 9.0
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDD	maximum day demand
mg	million gallons
mgd	million gallons per day
mg/L	miligrams per liter
MOL	maximum operating level
MPA	Microscopic Particulate Analysis
N	
NaOH	Sodium hydroxide (caustic soda)
NFPA	National Fire Protection Agency
NPDWR	National Primary Drinking Water Regulations
NRCS	National Resource Conservation Service
NSDWR	National Secondary Drinking Water Regulations

NTU	Nephelometric Turbidity Unit
O	
OAR	Oregon Administrative Rule
OFC	Oregon Fire Code
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
OSSC	Oregon Structural Specialty Code
OWERS	Oregon Watershed Emergency Response System
OwrD	Oregon Water Resourced Department
P	
PCBs	polychlorinated biphenyls
pCi/L	picocuries per liter
PFAS	Per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
pH	hydrogen potential
PHD	peak hour demand
PGD	permanent ground deformation
PGV	peak ground velocity
PP&L	Pacific Power and Light Company
ppb	parts per billion
ppt	parts per trillion
PRC	Population Research Center
PRV	pressure reducing valve
PSE	Peterson Structural Engineers
psi	pounds per square inch
R	
RR	rates of repair
RTCR	Revised Total Coliform Rule
RTUs	remote telemetry units
RWD	Rainbow Water District
S	
SCADA	supervisory control and data acquisition
SDCs	system development charges
SDWA	Safe Drinking Water Act
SDWRLF	Safe Drinking Water Revolving Loan Fund
SMCLs	Secondary Maximum Contaminant Levels
SOCs	synthetic organic contaminants
SUB	Springfield Utility Board
SWTR	Surface Water Treatment Rule
T	
TC	total coliform
TCR	Total Coliform Rule

TTHMs	Total Trihalomethanes
U	
UCMR	Unregulated Contaminant Monitoring Rule
µg/L	micrograms per liter
UGB	urban growth boundary
UV	ultraviolet light
V	
VFD	variable frequency drive
VOCs	volatile organic contaminants
W	
Weyco	Weyerhauser (Wellfield)
WMCP	Waer Management and Conservation Plan
WSC	SUB Water Service Center
WSMP	Water System Master Plan Update
WSSFP	Willamette Slow Sand Filtration Plant

Summary

Water System Master Plan Summary

Purpose

The purpose of this plan is to perform a comprehensive analysis of the joint Springfield Utility Board (SUB) and Rainbow Water District (RWD) water system, to identify system deficiencies, to determine future water system requirements, and to recommend water system facility improvements that correct existing deficiencies and that provide for future system expansion. The planning period is for 20 years, through 2040. This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

System Description

The jointly operated SUB and RWD service area includes the City of Springfield and much of the area outside the city limits within the urban growth boundary (UGB). Along with the wholesale customer Glenwood Water District (GWD), the total service area population is approximately 68,000 with approximately 22,912 service connections. SUB alone has approximately 20,260 connections serving approximately 60,000 people.

The SUB/RWD service area is located largely within the City of Springfield city limits, although service is provided to some areas outside the city limits and within the urban growth boundary. In general, the service area is east of the Interstate (I-5), south of the McKenzie River, and north of the Middle Fork Willamette River plus the Glenwood area between I-5 and the Willamette River. The SUB/RWD service area is adjacent to the Eugene Water & Electric Board (EWEB) service area to the west. The combined service area encompasses approximately 13,600 acres, or 21 square miles, and is entirely within Lane County.

Twenty-four wells are owned by SUB, and RWD owns eight wells. In addition, SUB and RWD jointly own three wells for a combined total of 35 developed wells. SUB operates a single surface water treatment plant, the Willamette Slow Sand Filtration Plant (WSSFP), which has a peak capacity of 6.6 mgd.

RWD owns the Kelly Butte Reservoir and co-owns the Moe Reservoir with SUB. Six other above-ground enclosed storage tanks are owned by SUB. These provide a total of 12.65 mg of storage.

Twelve pump stations both manage the transmission of water through the main service level as well as supply water to three upper service levels with gravity storage and five constant pressure upper service levels.

Three locations are identified for providing emergency transfer of water between SUB/RWD and EWEB, although the connections require piping, valving, and sometimes pumping to be put into service.

Water Requirements and Supply Assessment

Historical average day water demand is approximately 10.6 million gallons per day (mgd) with a peak day demand of 19.2 mgd. Based on a review of residential and commercial/industrial growth potential and growth rates, the average daily water demand in 20 years is forecasted to be 13.6 mgd and the peak day is 24.6 mgd.

Water sources include surface and groundwater facilities with a current combined total capacity of 29.02 mgd. However, certain source facilities are subject to several risks to their ongoing reliability without significant investment. These risks include groundwater contamination, well interference, and groundwater water quality issues. The wells also require periodic rehabilitation, such that at any time there are some wells operating at less than their full capacity.

- The WSSFP can be operated at a peak rate of 6.6 mgd for short periods to address peak demands. This rate is limited by the filter plant operations. The plant can sustainably produce 6.0 mgd.
- Thurston and Platt wells and associated treatment facility continue operating at current capacity.
- Weyco facilities become unreliable but will be operated as long as practical.
- SP/Maia have known interference when both operated for a sustained period (30 days). It is anticipated that SP would be turned off to allow the aquifer to recover.
- Sports Way has potential interference issues with the I-5 Wellfield and EWEB wellfields. However, as the senior water right, no reduction from the current capacity is assumed.
- Initial capacity of the planned McKenzie River source facilities is approximately 7.73 mgd. Actual initial incremental capacity will be determined during facility pre-design. For purposes of the 2040 scenarios, 7.73 mgd is assumed.
- The I-5 Wells have known and potential well interference. Running both wells for an extended duration is estimated to reduce the sustainable yield. Capacity may require further reduction to avoid impacting the senior water right at Sports Way. This limits the sustainable capacity to 3.0 mgd.
- The Chase Wellfield has one well confirmed GWUDI. The wellfield discharge is limited by the existing treatment facility capacity.
- Q Street Well has performance issues and is monitored for potential solvent contamination. It can be operated at its current capacity.

For planning purposes, it is assumed that the combined capacity of the existing sources will be reduced to as low as 22.8 mgd over the 20-year planning window. To address this resulting supply deficit, SUB is installing the first increment of the planned surface water treatment plant on the McKenzie River, which will increase the minimum reliable capacity to approximately 30 mgd. The increased capacity will allow less efficient or less reliable wells to be used only for redundant supply.

Water Quality and Service Goals

The distribution system is tested and monitored for water quality goals and contaminants per the State of Oregon Drinking Water Quality Act. SUB/RWD performs water quality treatment to meet the Lead and Copper Rule and the treatment requirements for GWUDI of surface water. SUB/RWD perform over 14,000 water quality tests annually and through monitoring, treatment, and operational measures, SUB/RWD has consistently met, and continues to meet the water quality goals.

Water system analysis criteria are summarized in **Table ES-1**.

Table ES-1:
Water System Performance Criteria Summary

Water System Facility	Evaluation Criterion	Value	Design Standard/Guideline
Water Supply	Reliable Supply Capacity	MDD[2]	Ten States Standards and Washington Water System Design Manual
Service Pressure	Normal Range (ADD[1] Conditions)	40-70 psi	AWWA M32
	Maximum	80 psi	AWWA M32, Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD[2] with Fire Flow	20 psi	AWWA M32, OAR 333-061
Distribution Piping	Velocity during PHD[3] or Fire Flow	Not to exceed 10 fps	AWWA M32
	Minimum Pipe Diameter	8-inch with looping recommended for fire flow,	Recommended
Storage	Total Storage Capacity	Sum of operational, equalization, fire suppression and emergency (standby) storage volumes	
	Operational Storage	25% of ADD[1]	Based on operational review
	Equalization Storage	150 min x (PHD[3]-firm supply rate)	Washington Water System Design Manual
	Fire Storage	Required fire flow x flow duration	2019 Oregon Fire Code
	Emergency (Standby) Storage	50% ADD	Based on historical operations
Pump Stations	Minimum No. of Pumps at Firm Capacity	2	Ten States Standards
	Open Zone Firm Capacity[4]	MDD[2]	Washington Water System Design Manual
	Closed Zone Firm Capacity[5]	PHD[3] + Fire Flow	Washington Water System Design Manual
	Backup Power	At least two independent sources	Ten States Standards
Required Fire Flow and Duration	Single-Family and Duplex Residential	1,500 gpm for 2 hours	2019 Oregon Fire Code, SUB/RWD standards
	Medium and High Density Residential, Mixed Use	2,500 gpm for 2 hours	
	Commercial, Industrial and Institutional	3,500 gpm for 3 hours	

Notes:
1 ADD: Average daily demand, the average volume of water delivered to the system during a 24-hour period = total annual demand/365 days per year.
2 MDD: Maximum day demand, defined as the maximum volume of water delivered to the system during any single day of the calendar year.
3 PHD: Peak hour demand, defined as the maximum volume of water delivered to the system during any single hour of the maximum demand day.
4 Open zone is defined as a pressure zone supplied by gravity from a storage reservoir.
5 Closed zone is defined as a pressure zone supplied constant pressure from a booster pump station without the benefit of storage.

Existing and Future System Deficiencies

The SUB/RWD system has a minor existing storage deficit (0.36 mg) with a 3.2 mg deficit forecasted by 2040. The planned East Second Level zone serving the Natron expansion area will also require 0.36 mg in additional fire suppression storage. To distribute storage across the main service level, new storage is recommended at the Willamette Heights site and in the Natron region which is anticipated to have large industrial fire flow requirements.

Pump stations have adequate pumping capacity to meet current and future requirements. The Steam Plant is an older facility with structural issues. It is intended to be relocated to a nearby location. The Eastside Pump Station may require improvements to better manage cycling of stored water at the Willamette Heights site.

Hydraulic modeling of fire flow conditions tests the distribution system's ability to provide required fire flows at a given location while simultaneously supplying MDD and maintaining a minimum residual service pressure of 20 psi at all services. The fire flow scenarios identified deficiencies, primarily on small, 4-inch and 6-inch diameter pipe or dead-end pipe that is not adequate for current fire flow requirements. For these deficiencies, no immediate improvements are recommended, but should be considered and included with other improvements such as annual water main replacements or new City roadway extensions.

Transmission and distribution piping improvements are identified to improve overall First Level transmission capacity and connectivity, replace aging piping, improve transmission redundancy, and provide service to new growth areas.

Infrastructure Resiliency

Water providers throughout the Pacific Northwest are increasingly aware of the risk to their infrastructure from potential seismic activity. Following recent seismic research which presented persuasive evidence on the imminent threat and extreme risk of a Cascadia Subduction Zone (CSZ) earthquake, the State of Oregon developed the Oregon Resilience Plan (ORP). The ORP established target timelines for water utilities to provide service following a seismic event. The ORP also recognized that, currently, water providers and existing water infrastructure are unable to meet these recovery goals. To improve existing water systems' seismic resilience, one of the ORP's key recommendations was for water utilities to complete a seismic risk assessment and mitigation plan as part of their periodic WSMP update.

As part of this WSMP, SUB, in partnership with RWD, has completed a seismic risk assessment of their existing water systems and has incorporated improvements into the CIP. Key improvements include seismic upgrades to certain storage facilities to include South 67th St, South Hills, and Willamette Heights (#2). Kelly Butte Reservoir also has identified deficiencies and will continue to be operated for as long as feasible due to challenges in making seismic improvements at the constrained site. Operation of Kelly Butte Reservoir will be reviewed at the next update to this master plan if nothing triggers review prior to that time.

A transmission system critical backbone connecting critical water system facilities with public health and safety facilities such as hospitals and emergency response facilities was identified that would be a priority to harden and restore service to after a major seismic event. A pipeline fragility analysis was conducted on the critical backbone and did not suggest susceptibility to water main breaks during an earthquake. Several CIP projects were included to provide additional transmission redundancy as well as to better connect the overall system.

The Glenwood Water District and portions of the SUB system west of the Willamette River are supplied by a single water main crossing the river. It is recommended that a further study be conducted to evaluate redundant supply methods. Redundant supply could entail a second water main crossing of the river and/or a formal agreement with EWEB to provide emergency supply.

This plan provides recommendations for new pipeline construction. Notably, new distribution and transmission piping is recommended to use fully restrained joints. Fully restrained ductile iron pipe reduces the risk of separation at standard push-on joints and allows limited deflection as a result of ground shaking and ground deformation. For pipes larger than 24-inch diameter, SUB should consider weldment ring ductile iron pipe a preferred pipe material. The selection of piping material, lining and coating system, and other design parameters should be made on a case-by-case basis with adequate consideration of specific alignment seismic hazards, hydraulics, performance and life-cycle expectations, soil considerations, etc. Pipes larger than 24-inch diameter are not operated in RWD's system.

Storage facilities are recommended to use flexible expansion joints at the connection points to accommodate the stress that can be placed on the pipe during a seismic event. For service levels with multiple storage facilities, SUB/RWD should consider the use of automatic shutoff valves at some of the facilities to automatically isolate the storage facilities during a seismic event to preserve emergency water in the event of large main breaks.

Critical pump stations and wells should include provisions for standby power generation.

Capital Improvements Plan and Financial Approach

Over the 20-year planning period, the CIP includes $159.9 million and $20.5 million for SUB and RWD, respectively. Key improvements include a new SUB surface water treatment plant in the near term, new and replacement wells to maintain capacity and provide for improved redundancy and operational flexibility, transmission and distribution piping improvements to increase capacity, connectivity and redundancy, and ongoing annual pipeline replacement. Other improvements include water quality monitoring upgrades, facility maintenance, and facility planning and studies. The CIP and associated implementation schedules are shown in Table ES-2 for SUB CIP and in Table ES-3 for RWD CIP. Exact timing of the improvements depends upon actual growth, future condition of facilities, and fiscal considerations.

The Capital Improvement Plans can be funded from a variety of sources. In general, these sources can be summarized as: 1) governmental grant and loan programs; 2) publicly issued debt; and 3) cash resources and revenues. As follow-up work to the adoption of this WSMP, SUB and RWD will each perform a financial water rate and SDC study with their financial consultant, Galardi Group, to update the financial program and allow for budgeting of the respective capital improvement programs.

Section 1

Section 1

Introduction and Existing Water System Description

1.1 Introduction

The purpose of this Water System Master Plan Update (WSMP) is to perform an analysis of the joint Springfield Utility Board (SUB) and Rainbow Water District (RWD) water system and:

- Document water system upgrades completed since the 2010 Water System Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update SUB's and RWD's capital improvement program (CIP)

In order to identify system deficiencies, existing water infrastructure inventoried in this section will be assessed based on estimated existing and future water needs developed in Section 2, water system performance criteria described in Section 3, and regulations described in Section 4. Section 5 presents the current system operation and the direction for operational changes and improvements to transition operation from three interdependent systems to a more consolidated single main service level. The results of the water system distribution and transmission analysis are presented in Section 6. Section 7 identifies the system's seismic resilience and Section 8 outlines improvement projects to mitigate existing and projected future deficiencies and provide for system expansion including a prioritized CIP. The planning and analysis efforts presented in this WSMP are intended to provide SUB and RWD with the information needed to inform long-term water distribution infrastructure decisions. Section 9 presents an overview of available funding sources. A detailed funding review and rate study will be conducted separately from this plan.

This plan complies with water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61.

1.2 Related Plans

This WSMP is consistent with the objectives or information presented in the following related planning and infrastructure documents.

- Springfield Utility Board Water System Master Plan, April 2010, Murray, Smith & Associates
- Seismic Analysis of Various Structures, September 2014, Murray, Smith & Associates
- Springfield Utility Board/ Rainbow Water District Water Management and Conservation Plan, April 2018, Murraysmith

1.3 Water System Background

The jointly operated SUB and RWD service area includes the City of Springfield and much of the area outside the city limits within the urban growth boundary (UGB). Along with the wholesale customer Glenwood Water District (GWD), the total service area population is approximately 68,000 with approximately 22,912 service connections. SUB alone has approximately 20,260 connections serving approximately 60,000 people. **Figure 1-1** illustrates the combined SUB, RWD, and GWD service area.

The SUB/RWD water distribution system is the product of four different water systems that have been acquired or merged over the years into the system as it exists today. These systems include:

- The original Mountain States Power/Pacific Power and Light Systems serving what is now referred to as the West System
- Glenwood Water District serving an area west of the Willamette River
- The original McKenzie Highway Water District system serving East Springfield
- The Rainbow Water District serving customers in the north
- Filbert Grove Water Company serving and area off South 2nd St. adjacent to the Willamette River
- Willamette Water Company serving an area adjacent to Jasper Rd.

Today, the SUB and RWD Systems are divided into the following three separate service system areas.

- West System (downtown Springfield and Glenwood, located south of Interstate 105 and west of the railroad tracks near 28th Street)
- East System (located east of the 28th Street railroad tracks)

- North System (or RWD/SUB North, primarily located north of Interstate 105 and west of Kelly Boulevard)

Customers in the West and East Systems are served only by SUB. The North System is served jointly by SUB and RWD. The three areas are interconnected with existing piping at certain locations and while limited water can be transmitted among them, they currently operate as distinctly controlled systems within the combined service area. Each of the three systems has a main zone or First Level with supply and smaller levels that are served by pump stations or pressure reducing valves (PRVs) from the First Level within the system. The RWD/SUB North System and SUB East System First Levels operate at similar hydraulic grade lines (HGL), as measured in feet of water. Most of the SUB West System operates at the hydraulic grade of the West First Level Low which is lower than the First Levels. SUB maintains a lower pressure in the West First Level Low to minimize leakage from older distribution mains and to reduce pumping costs from the Willamette Slow Sand Filtration Plant (WSSFP).

The study area for this report includes all the developed and developable land within the current City of Springfield UGB. The study period is through the year 2040. **Figure 1-2** illustrates the water service area limits, water system facilities and distribution piping.

1.4 Water Sources

For their source of supply, SUB and RWD rely on a combination of groundwater and filtered surface water. Over half of the total annual water produced comes from the combination of the WSSFP, which uses a mix of wells and river water, and the Thurston Wellfield facilities. The remainder of the supply is provided by the SUB and RWD facilities distributed throughout the North and East Systems.

1.4.1 Water Rights Summary

A tabulation of existing water rights held by SUB and RWD is provided in **Appendix A, Table A-1**, and developed and authorized capacities by source facility are summarized in **Table 1-1**. Existing groundwater has been extensively developed in the area, and the Willamette and McKenzie Rivers would be the most likely sources for any necessary future water right development. Further analysis is presented in **Section 6**. SUB and RWD have adequate combined water rights to meet the forecasted 20-year demand presented in **Section 2**.

Table 1-1
SUB/RWD Water Right and Source Capacity Summary

System (No. developed wells in use)	Authorized Capacity (mgd)	Current Capacity (mgd)	Developed System Capacity (mgd)
North System			**12.69**
Sports Way Well	2.88	2.88	
I-5 Wells (2) (RWD)	4.52	3.93	
Chase Wells (5) (RWD)	5.66	2.64	
Q St Well (RWD)	1.01	0.36	
Weyco Wells (3) (SUB/RWD)	4.71	2.88	
East System			**9.73**
SP/Maia Wells (2)	2.59	2.59	
Platt Wells (2)	1.01	0.75	
Thurston Wells (7)[1]	9.24	5.56	
Thurston Middle School (0)[1]	1.15	0.00	
McKenzie River	25.85	0.83	
West System			**6.60**[2]
Willamette River Intake	7.92	7.20	
Willamette Wells (14) [1]	19.10	6.60	
WSSFP Perimeter Drain	0.65	0.65	
Total System Capacity:	**77.45**		**29.02**

Notes:

1) Authorized capacity includes undeveloped wells in the respective wellfield.
2) The West System capacity is limited by the treatment plant capacity of 6.60 mgd
3) For some sources, the capacity of the physical diversion or appropriation infrastructure exceeds the authorized rate for the source. Throughout this document, the current capacity of each source is calculated based on the actual physical capacity of existing infrastructure or, where existing infrastructure is capable of diverting or withdrawing more than the the authorized rate, the maximum authorized rate.

1.4.2 Groundwater Supply Wells

The supply wells are primarily located to the northwest, northeast, and south of the service area. 24 wells are owned by SUB and RWD owns eight wells. In addition, SUB and RWD jointly own three wells for a combined total of 35 developed wells. The combined developed capacity of the wells is approximately 29.0 mgd (20,200 gpm) after limitations of the WSSFP treatment capacity. The production capacity of the individual wells ranges from approximately 200 gpm (0.29 mgd) to 2,000 gpm (2.88 mgd).

Chlorine is fed to all of the water leaving the wellfields. Following chlorination, detention times from 18 to 50 minutes are provided before the water enters the distribution system.

Table 1-2
SUB Well Capacity Summary

Wellfield	Well	Current Capacity (gpm)	Current Capacity (mgd)
Thurston	1	750	1.08
Thurston	2	960	1.38
Thurston	3	500	0.72
Thurston	4	200	0.29
Thurston	5	600	0.86
Thurston	6	500	0.72
Thurston	7	355	0.51
Platt	1	250	0.36
Platt	2	270	0.39
Weyco[1]	1 (B)	806	1.16
Weyco[1]	2 (C)	600	0.86
Weyco[1]	3 (E)	600	0.86
Maia	1	1,000	1.44
SP	1	800	1.15
Sports Way	1	2,000	2.88
Willamette	1	250	0.36
Willamette	3	450	0.50
Willamette	4	400	0.58
Willamette	6	600	0.86
Willamette	7	400	0.58
Willamette	8	250	0.36
Willamette	9	210	0.30
Willamette	10	500	0.72
Willamette	11	750	1.08
Willamette	12	250	0.36
Willamette	13	325	0.46
Willamette	15	130	0.19
Total		**14,706**	**21.01**

Note:
1) SUB owns 50% of the Weyco wellfield capacity.

Table 1-3
RWD Well Capacity Summary

Wellfield	Well	Current Capacity (gpm)	Current Capacity (mgd)
I-5	1	1,180	1.70
I-5	2	1,550	2.23
Chase	1	325	0.47
Chase	2	550	0.79
Chase	3	220	0.32
Chase	4	550	0.79
Chase	5	190	0.27
Q St	1	250	0.36
Weyco[1]	1 (B)	806	1.16
Weyco[1]	2 (C)	600	0.86
Weyco[1]	3 (E)	600	0.86
Total		**6,821**	**9.82**

Note:
1) RWD owns 50% of the Weyco wellfield capacity.

1.4.2.1 Thurston System (SUB)

The source facilities included at this location are Thurston Wellfield, Platt Wellfield, Thurston Middle School Wellfield, and the McKenzie River.

The Thurston Wellfield consists of seven operating wells and four permitted future wells. The Platt Wellfield has two operating wells. The wells are completed to depths of 50 to 200 feet. The Thurston Middle School Wellfield is permitted for two future wells. All of the raw water from these wells is or is planned to be eventually piped to a common chlorination facility at Thurston Wellfield.

In addition to the wells, SUB has a surface water permit for 40 CFS from the McKenzie River. Up to 4.1 CFS of this permitted diversion must be diverted to Cedar Creek to mitigate the impact of pumping from existing Wells 5, 6, and 7 and potential future Wells 8, 9, 10, and 11 in the Thurston Wellfield and the potential future wells in the Thurston Middle School Wellfield. Cedar Creek runs south of Thurston Wellfield and between the Platt and Thurston Middle School Wellfields.

There are seven active groundwater wells and one GWUDI well (Thurston Well 2) in the Thurston/Platt Wellfield. The combined wellfield capacity is 4,400 gpm (6.31 mgd). Thurston Well 2 water is pumped through two Trojan UV Swift units capable of 2.34 mgd per unit. Turbidity is monitored on the inlet side of UV system. After UV disinfection Thurston Well 2 water combines with other Thurston/Platt Wellfield groundwater before being treated with 25 percent Sodium hydroxide/caustic soda (NaOH). The NaOH system consists of two 4,500-gallon 25 percent NaOH tanks, two diaphragm chemical injection pumps, and two continuously monitoring pH probes.

These pH probes measure raw water pH and treated water pH. A third pH probe is located at the end of detention line.

The water leaving the UV/corrosion control facility flows through the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter. Chlorine levels are continuously monitored at the chlorination station and at the end of detention. The Thurston/Platt well operation is controlled on the level from South 57th Street reservoir tanks.

1.4.2.2 Weyerhaeuser (Weyco) Wellfield (SUB / RWD)

Weyco Wellfield consists of five wells drilled adjacent to the McKenzie River, three of which are currently active. The three active wells are completed to depths of 70 to 87 feet. This wellfield is jointly owned and operated by SUB and RWD. This wellfield is currently operated during peak demand season and when the McKenzie River flows are at or below 3,000 cfs.

The current combined wellfield capacity is 2,000 gpm (2.88 mgd) with an authorized rate of 3.42 mgd for the three wells. The water from the three wells combines before entering the Granular Activated Carbon (GAC) units. The GAC system consists of eight vertical pressure vessels, each capable of holding 20,000 pounds of GAC (total of 160,000 pounds) and a 110,000 gallon backwash holding tank. Turbidity is continuously monitored after filtration. Filtered water is then treated with 25 percent NaOH. The NaOH system consists of two 2,500-gallon 25 percent NaOH tanks, peristaltic chemical injection pumps, and continuous monitoring pH probes. The pH probe measures the treated water pH.

The treated water then flows to a chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter and chlorine levels are continuously monitored at the chlorination station.

1.4.2.3 SP/Maia Wellfield (SUB)

This wellfield consists of two wells drilled into deeper gravels in or near the ancestral McKenzie River channel. The wells are 300 feet and 360 feet in depth.

The SP and Maia Wells are generally operated as peaking wells during the summer season. The combined wellfield capacity is 1,800 gpm (2.59 mgd). Water from the two wells combines before entering the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter and chlorine levels are continuously monitored at the chlorination station.

1.4.2.4 Sports Way Well (SUB)

The Sports Way Well is adjacent to Interstate 5 just north of Springfield. This well is 410 feet in depth and has a capacity of 2,000 gpm (2.88 mgd).

Water from the well is pumped through the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the well flow meter and chlorine levels are continuously monitored at the chlorination station. This water combines into the same detention line as the I-5 Wells.

1.4.2.5 I-5 Wellfield (RWD)

This wellfield consists of two wells located adjacent to Interstate 5, north of the Sports Way Well. Well #1 is 360 feet deep and Well #2 is 380 feet deep. The combined wellfield capacity is 2,730 gpm (3.93 mgd). These wells operate year-round, typically operating one at a time over the winter and running both as necessary during the summer season.

Water from the two wells combines before entering the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter and chlorine levels are continuously monitored at the chlorination station.

1.4.2.6 Chase Wellfield (RWD)

The five Chase Wells are located adjacent to the McKenzie River. They are completed to depths of 60 to 235 feet and screened in sands and gravels with a combined flow rate of approximately 1,835 gpm (2.64 mgd).

There are four active groundwater wells and one GWUDI well (Chase Well 2) in the Chase Wellfield. Chase Well 2 water is pumped through four 500 gpm Harmsco cartridge filtration units. Turbidity is monitored continuously post filtration. After filtration Chase Well 2 water combines with other Chase Wellfield groundwater before being treated with 50 percent NaOH. The NaOH system consists of two 1,800-gallon 50 percent NaOH tanks, peristaltic chemical injection pumps, and two continuously monitoring pH probes. These pH probes measure raw water pH and treated water pH. A third pH probe is located at the end of detention line.

The water leaving the filtration/corrosion control facility flows through the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter. Chlorine levels are continuously monitored at the chlorination station and at the end of detention.

A manual transfer switch allows connection of a portable generator to supply power to various combinations of Chase Wells 1, 2 and 5 along with chlorination and treatment equipment.

1.4.2.7 Q Street Well (RWD)

This well is located adjacent to Highway 126, west of SP and Maia Wells. The well was completed to 280 feet and has a capacity of 230 gpm (0.36 mgd). The Q Street Well is generally operated as a peaking well during the summer season.

Water from the well is pumped through the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the well flow meter and chlorine levels are continuously monitored at the chlorination station.

1.4.3 Willamette Slow Sand Filtration Plant

The intake for the WSSFP is located on the Middle Fork Willamette River. It uses a slow-sand, biological process to filter a blend of river water from the intake pump station and water from GWUDI wells (15 shallow wells, 12 of which are active) that are adjacent to the river. The plant has a peak capacity of 6.6 mgd.

The river intake pump station has three pumps. In normal operation, one of the two 3,500 gpm (5.04 mgd) pumps is used to supply water to the filters when needed to supplement the available GWUDI well water to meet system demand. A 2,300 gpm (3.3 mgd) pump discharges directly to the recharge channel system. A filter bed perimeter underdrain system was constructed to prevent flotation of the beds and the discharge from this system can be directed to the filter beds or to the recharge channel system. To date, all the discharge has been pumped to the recharge system. Overflow from this system or from the clearwell at the plant is directed back to the river through the area lying between the filter plant and the wellfield.

All GWUDI well water is pumped to the aeration tower, which strips carbon dioxide from the well water increasing the pH of the water. The aeration tower system consists of a fiberglass tower with a capacity is 800 – 4600 gpm (14 feet diameter x 21 feet-6 inches height), 40 HP fans (produce 27,500 cfm at 4 feet-5 inches water). Continuously monitoring pH probes measure water at five locations: raw GWUDI well water, raw river water, post-aeration tower, post-UV water and post-chlorinated water. A sixth pH probe is located at the end of detention line.

Once the water flows through the aeration tower the water mixes with raw river water in the basin and then flows to the filters. The filters are 0.85 acres in area, holds 1.3 million gallons (mg) of water and has a maximum capacity of 2.6 mgd. Each filter effluent is monitored for turbidity. If the pH of the filtered water is too low the water is treated with 25 percent NaOH. The NaOH system consists of two 3173-gallon 25 percent NaOH tanks, peristaltic chemical injection pumps, and two continuously monitoring pH probes. These pH probes measure raw water pH and treated water pH. A third pH probe is located at the end of detention line.

Water is then pumped from the clearwell through the UV system and out to the chlorination station. Chlorine gas is fed by a vacuum chlorinator with automatic switchover. The chlorinator is controlled by the wellfield flow meter. Chlorine levels are continuously monitored at the chlorination station and at the end of detention. Turbidity is continuously monitored at the chlorination station. There is a sodium hypochlorite injection system outfitted with two 968-gallon tanks and peristaltic chemical injection pumps. The injection system is not in use at this time.

1.4.4 16th & Q Street & Pierce Wells

Wellhead protection mapping is provided for 38 established and potential future well site locations within the service area. Two potential well site locations are identified on SUB's Springfield Wellhead Protection Areas mapping that are not associated with existing groundwater rights. These are the 16th & Q Street and Pierce Wells.

The 16th & Q Street Well is located on land owned by SUB. The Pierce Well is located on municipal park land. As SUB and RWD currently have adequate water rights to support the projected 20-year demand for the water system, water rights for these potential well sites have not been pursued. However, until the planned surface water plant is operational and its ability to meet North System water needs has been demonstrated, it is recommended that these two potential well sites be maintained as potential well sites for purposes of wellhead protection. Development of these wells would require some evaluation of water rights to identify appropriate next steps.

1.5 Service Levels

The three systems are divided into service levels, or pressure zones, to maintain consistent pressure ranges according to ground elevation and topography. The valley floor is referred to as the "First Level" and upper levels increase up in elevation to serve the surrounding hills. **Table 1-4** summarizes the service levels in each of the systems.

In addition to the major service levels, several sub-levels are supplied by booster pump stations or PRVs. These levels are shown schematically in **Figure 1-3** and approximately delineated in **Figure 1-2**.

Table 1-4
Existing and Planned Service Level Summary

Service Level	Nominal Hydraulic Grade (ft)	Typical Ground Elevations
West First Level Low	603	440 - 490
West First Level	671	460 - 570
West Second Level	820	570 - 670
Glenwood	605	435 - 535
East First Level	675	460 - 570
East Second Level	769	570 - 670
East Third Level	983	670 - 870
East Fourth Level	1148	870 - 1038
North First Level	675	460 - 570
North Second Level	740	570 - 670

Notes:
1) Elevations in NAVD 88 vertical datum
2) Future Natron Area service levels will match existing East System Second and Third Level hydraulic grades.

1.5.1 West System

The West System is supplied predominately by the WSSFP, with additional sources from an intertie with the North System (5th & Moffitt), and an intertie with SUB's East System through a control valve station at the Eastside Pump Station, which can send water from the East First Level to the West First Level Low through a PRV.

The Glenwood Level is supplied by SUB’s West First Level through the Glenwood Intertie. Water produced at the WSSFP is pumped directly to the West First Level Low. Water from the West First Level Low is pumped to the West First Level through the Steam Plant Pump Station controlled by the levels in the Willamette Heights Reservoir. The pumps at this station are controlled by variable frequency drives (VFDs) with a suction sustaining pressure maintained in the West First Level Low. When the Willamette Heights Reservoir reaches a preset low level, the Steam Plant Pump Station pumps water from the West First Level Low to fill the Reservoir. The Steam Plant pump units vary speeds to maintain a suction pressure of 50 psi. When the Willamette Heights Reservoir is full the Steam Plant Pump Station shuts down. The Willamette Heights Reservoir can supply the West First Level Low through a PRV station at the Steam Plant if pressure in the West First Level Low at the Steam Plant site drops below the PRV setting of 50 psi.

1.5.2 East System

The East System is supplied by the Thurston/Platt Wellfield on the McKenzie River, the SP/Maia Wellfield in central Springfield, and SUB's 50 percent capacity share of the Weyco Wellfield through an intertie with the North System at 35th Street. There is also a manually operated intertie with the North System at 28th & Olympic Streets that is not typically operated. The East System is also supplied by the surplus capacity in the West System through the Eastside Pump Station. The West System’s WSSFP operates at a fixed flow determined by the plant operator. When the Steam Plant Pump(s) are off during a Willamette Heights drawdown period, the Eastside Pump Station operate through VFD-controls set to maintain suction pressure in the SUB West First Level Low.

The East System First Level reservoirs are filled directly from the wellfields and Eastside Pump Station through the distribution system. Well pumps are automatically staged on and off in response to the South 57th Reservoir level.

The East Second Level is supplied by the South 72nd Street Pump Station which is controlled by the South 70th Street Reservoir water level. The pressure normally provided by gravity storage in the East Second Level is supplemented by three PRVs from the East Third Level. The Jasper Meadows and Mt. Vernon Pump Stations each supply independent levels at an approximate HGL of 700 and 720 feet respectively.

The South 67th and South 57th Pump Stations supply the East Third Level South Hills Reservoir directly from the East First Level. From the East Third Level, PRVs supply two small sub-levels, the South and North Mountain Gate areas.

1.5.3 North System

The North System is supplied by both RWD and SUB source facilities. The I-5 Wellfield, the Chase Wellfield, and the Q Street Well are owned and operated by RWD. The Weyco Wellfield is jointly (50/50) owned and operated. The Sports Way Well is owned and operated by SUB. The North System has a manually operated option for supplemental supply through an intertie with SUB's East System - the 28th & Olympic Street intertie, which is a normally closed valve.

The North System supply facilities directly fill the Moe and Kelly Butte Reservoirs through the distribution system. Well pumps are staged on and off primarily in response to the Kelly Butte Reservoir level. The Kelly Butte Reservoir drains more rapidly than the Moe Reservoir due to its smaller size and greater distance from the primary supply sources. The Kelly Butte Pump Station and River Heights Pump Station (adjacent to Moe Reservoir) each serve small residential upper levels through VFD controls.

1.6 Storage Facilities

RWD owns the Kelly Butte Reservoir[1] and co-owns the Moe Reservoir with SUB. Six other above-ground enclosed storage tanks are owned by SUB. These provide a total of 12.65 mg of storage. The 2014 reservoir evaluations recommended reducing the maximum operating level (MOL) of several reservoirs to improve their seismic and structural performance. For example, one benefit of lowering the MOL provides more freeboard to allow for water slosh in the event of an earthquake. If operated at these lower levels, the available storage is reduced to 11.61 mg. **Table 1-5** presents a summary of these existing reservoirs and shows location, direct level served, capacity, and floor and overflow elevations. Note that the operating level of the reservoirs is often lower than the physical overflow elevation of the reservoirs. The subsequent seismic evaluation of the S 57th Reservoir in 2017 is reflected in the recommended MOL in **Table 1-5**.

A 2014 seismic evaluation of the reservoirs resulted improvement projects at the S 57th Street, Willamette Heights, Moe, and South Hills Reservoirs. The Moe and S 57th Street Reservoir improvement projects have been completed.

[1] This document uses the term “reservoir” to describe RWD and SUB’s storage facilities; however, neither RWD nor SUB diverts water to open-air natural storage reservoirs. All temporary storage facilities operated by RWD and SUB are above-ground, enclosed concrete or steel storage tanks.

Table 1-5
Storage Facility Summary

Storage Facility Name	Direct Level Served	Nominal Capacity (mg)	Floor Elevation (ft)	Overflow Elevation (ft)	Overflow Depth (ft)	Seismic Rec'd Depth[1] (ft)	Capacity at MOL (mg)	Diameter (ft)	Date Installed
Willamette Heights No. 2	West First Low	2.0	639.54	671.04	31.5	29.0	1.84	104.0	1962
Kelly Butte	North First	1.0	634.20	673.70	39.5	37.5	0.95	65.33	1959
Moe	North First	4.0	625.69	675.19	49.5	47.0	3.80	122.0	1996
S. 57th Street No.1	East First	1.0	643.27	674.77	31.5	27.5	0.84	74.0	1956
S. 57th Street No.2	East First	1.5	644.27	674.77	31.5	27.5	1.31	89.7	1965
S. 67th Street	East First	1.5	644.02	675.52	31.5	27.0	1.29	92.0	1967
S. 70th Street	East Second	0.15	737.20	768.70	31.5	28.7	0.14	28.5	1976
South Hills	East Third	1.5	956.75	983.75	27.0	24.25	1.35	98.0	1982
Total		**12.65**					**11.54**		

Notes:
MOL = Maximum operating level;
mg = million gallons;
Elevations in NAVD 88 vertical datum
1) Recommended depth per *2014 Seismic Analysis of Various Structures*, and 2017 design studies for S. 57th Reservoir improvements.

1.7 Pump Stations

In addition to the Steam Plant and Eastside Pump Stations previously described there are two upper service levels with gravity storage and five sub-levels without storage supplied by booster pump stations.

- A small portion of the West System south of the Springfield Millrace is served directly from the Willamette Heights Pump Station located at the Willamette Heights Reservoir site. These variable speed pumps operate continuously to supply pressure to approximately 40 residences.
- In the North System, the Kelly Butte Pump Station operates to provide service to approximately 70 residential customers. The River Heights Pump Station also serves an independent sub-level.
- In the East System, Jasper Meadows Pump Station serves approximately 80 residential services with VFD controlled pump units. The Mt. Vernon Pump Station also serves an independent sub-level.
- The South 57th Street and South 67th Street Pump Stations serve the East Third pumping from the adjacent reservoirs.
- The East Second Level is supplied by the South 72nd Pump Station, which pumps off the East First Level distribution system.
- Currently in construction, the South Hills Pump Station will supply the East Forth Level from the East Third.

Table 1-6 presents a tabulated summary of these existing pump stations.

Table 1-6
Pump Station Summary

Pump Station	Nominal Capacity (gpm)	Floor Elevation (feet)	Nominal Discharge (psi)	Discharge HGL (feet)	Pumping Service Level (From – to)	VFD	Backup Power
WSSFP Pumps	4,500	465	55	600	WSSFP to West First Low	Yes	Portable Trailer
Steam Plant	4,800	462	85	658	West First Low To West First	Yes	No
Willamette Heights	180	639	90	843	West First to West Second	Yes	Yes
Eastside	5,000	476	82	663	West First Low to East First	Yes	No
Kelly Butte	200	633	50	748	North First to North Second	Yes	Portable Trailer
River Heights	80	623	50	608	North First to North Second	Yes	Portable Trailer
South 72nd Street	500	608	70	768	East First to East Second	No	No
Jasper Meadows	360	563	70	723	East First to East Second	Yes	Portable Trailer
Mt. Vernon	495	588	60	723	East First to East Second	Yes	Portable Trailer
South 67th	550	674	150	983	East First to East Third	Yes	Portable Trailer
South 57th	1,600	643	145	983	East First to East Third	Yes	Yes
South Hills	1,600	955	89	1160	East Third to East Fourth	Yes	Yes

Note:
Elevations in NAVD 88 vertical datum

1.8 Distribution Piping

As previously discussed, the existing distribution system is a combination of older, individual distribution systems. It is unique in both its configuration and operation. The distribution system has historically been designed for supply from multiple sources of water from wells located throughout the system and serving localized areas. This layout results in a water system without large-diameter transmission mains as is typically found in communities with a single source or a centrally located treatment facility. As SUB and RWD have seen the long-term need to develop larger capacity, “single point” sources of water from the WSSFP on the Middle Fork Willamette River and proposed plant on the McKenzie River, larger diameter piping improvements have been made and planned for future implementation to strengthen the transmission capacity.

1.9 SCADA System

The SUB/RWD supervisory control and data acquisition (SCADA) system monitors all storage reservoirs and pump stations within the water distribution system and provides for manual or automatic control of certain facilities and operations. The SCADA system also collects and stores system status and performance data.

All facilities are equipped with remote telemetry units (RTUs) that monitor reservoir water levels, pump station on/off status, discharge pressure, and flow rates. In addition, some sites are equipped with aquifer level monitoring as well as intrusion, overflow warning, chlorine gas leak monitors and fire alarms which alert staff to unauthorized access, flooding or fire.

All signals from the RTUs are collected and transmitted to a server at the SUB Water Service Center (WSC) and/or RWD 42nd Street Office which enables SUB/RWD staff to view the status of the water system. The process alarm systems are part of the SCADA system and dependent on the fiber optic system in order to log alarms. Operators are dispatched in case of equipment breakdowns or emergencies through text message and email notification.

1.10 Interconnections and Control Valves

Several control valves and interties are operated in conjunction with the pump stations to move water amongst the North, West, and East Systems as well as to provide backup supply and redundancy. Table 1-7 summarizes the control valves.

Three locations are identified for providing emergency transfer of water between SUB/RWD and EWEB, although the connections require piping, valving, and sometimes pumping to be put into service. Table 1-8 summarizes the hydraulic grades at the emergency interconnections with EWEB, discussed below:

- At the 31st intertie, a portable trailer is used to bring skid-mounted pumps and a connection spool needed to move water from EWEB to SUB/RWD.
- At the I-5 & Gateway intertie, a portable trailer is used to bring skid-mounted pumps and a connection spool needed to move water from EWEB to SUB/RWD.
- At the 22nd and Henderson intertie, installation of piping is required to complete the connection between the adjacent systems. Due to the adverse hydraulic grade, pumping would be required to supply water to EWEB through this intertie and control valving would be recommended to supply water to SUB.

Quantifying the capacity of any gravity emergency intertie is highly dependent upon the conditions at both sides of the intertie. Through operational changes, an intertie capacity can be increased over normal operating conditions. Additionally, the receiving pressure zone may be operated at a reduced hydraulic grade which will allow for increased intertie capacity. In general, emergency interties are intended to provide for distribution system minimum pressure to protect public safety, as well as to provide emergency water use at minimum demand levels. Fire suppression capacity would be expected to be greatly reduced under an unplanned, emergency intertie use and is dependent on reservoir water volumes available at the time of the emergency event.

Table 1-7
System Interties, PRVs, and Control Valve Summary

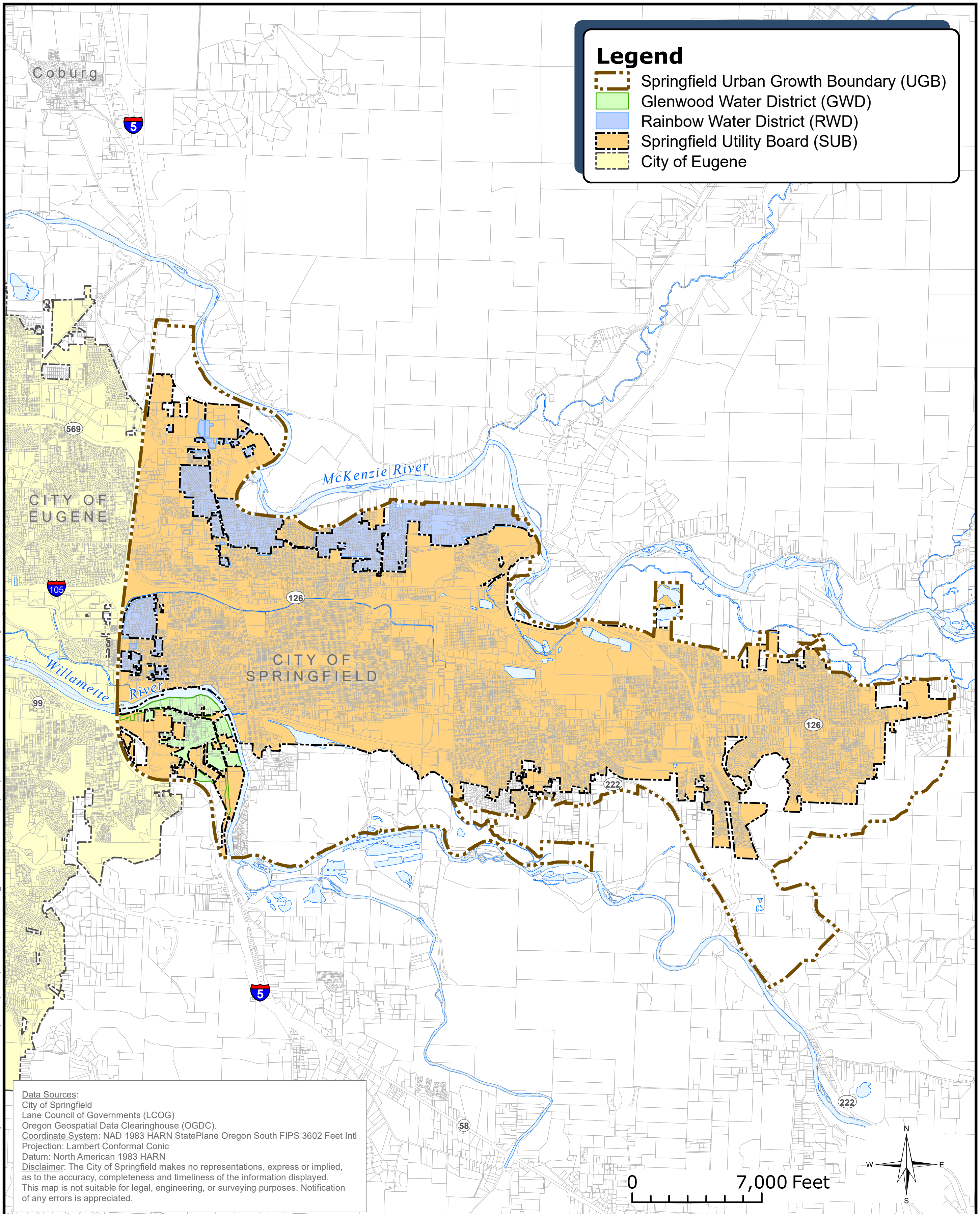
Valve ID	Function	From Level	To Level
Steam Plant PRV	PRV	West First	West First Low
Eastside PRV	PRV & FCV	East First	West First Low
5th & Moffitt	PRV	North First	West First Low
Scott Road	PRV	North First	West First Low
28th St. & Olympic	Valve Valve	North First East First	East First North First
35th & Olympic	FCV	North First	East First
Daisy St	PRV	East Third	East Second
S 67th St	PRV	East Third	East Second
S 72nd St	PRV	East Third	East Second
North Mountaingate	Distribution PRV	East Third	East Second
South Mountaingate	Distribution PRV	East Third	East Second
Glenwood	PRV	West First	Glenwood

Table 1-8
Emergency Connections Summary

Interconnection	EWEB HGL (ft)	SUB/RWD System & HGL (ft)
I-5 & Gateway	607	North, 675
31st Street	607	North, 675
22nd & Henderson	~850	West/Glenwood, 605

1.11 Summary

This section presented a discussion of SUB/RWD existing system and facilities. These systems will be analyzed using the criteria presented in **Section 3**. System improvement recommendations and a comprehensive capital improvement program are presented in **Section 8**.



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murraysmith | SUB SPRINGFIELD UTILITY BOARD | Rainbow Water District

Springfield Utility Board Water System Master Plan

Figure 1-1 Current Service Area Map

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December 2021

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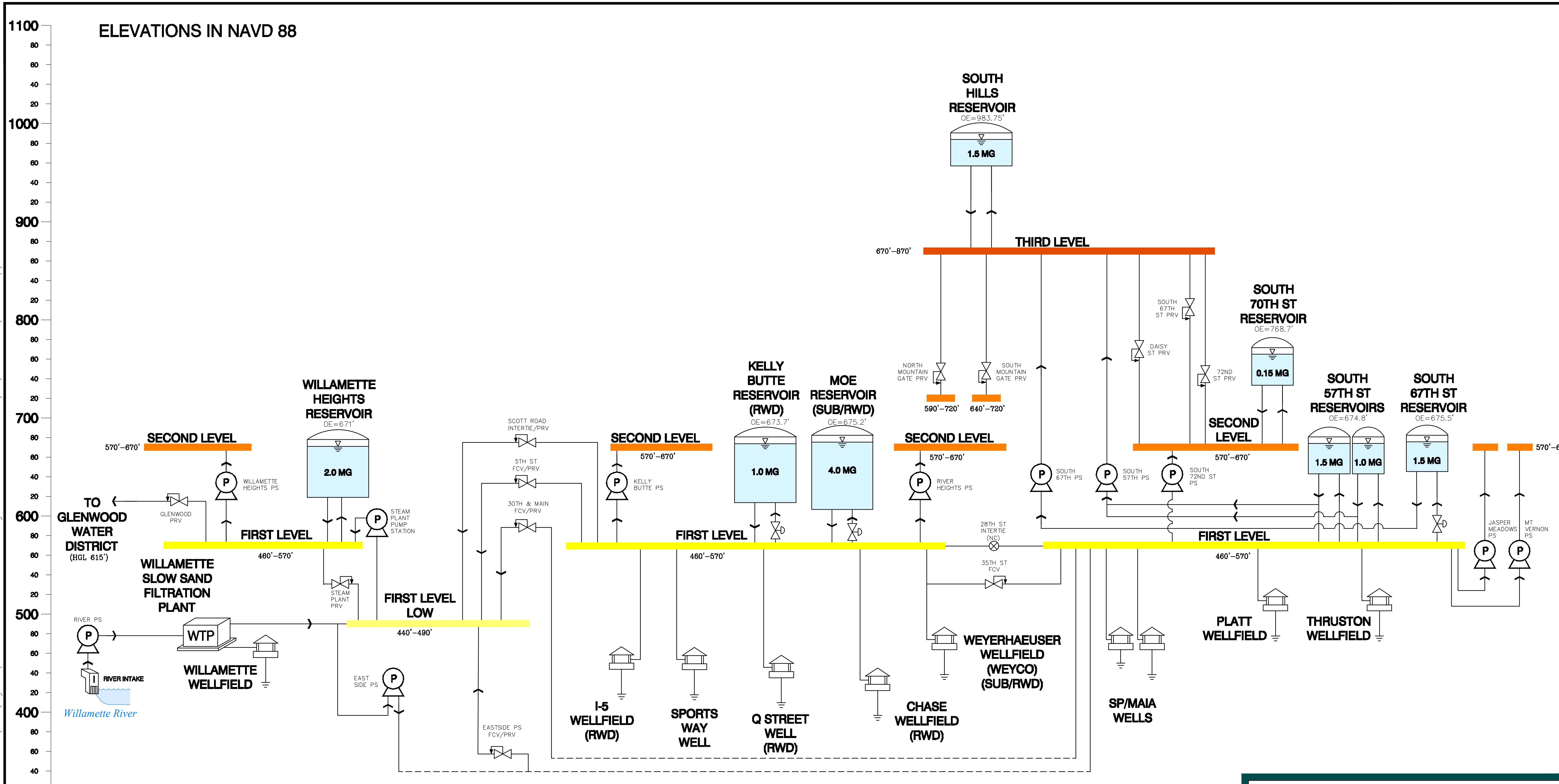

LEGEND

WATER MAIN	
HIGHEST GROUND ELEVATION SERVED BY PRESSURE ZONE OR SUBZONE	
RESERVOIR	1.0 MG (CAPACITY), OE=1240' (OVERFLOW ELEVATION)
ALTITUDE VALVE	
PRESSURE REDUCING VALVE	
PUMP STATION	P

ABBREVIATIONS

EL	ELEVATION
FCV	FLOW CONTROL VALVE
GPM	GALLONS PER MINUTE
HGL	HYDRAULIC GRADE LINE
HP	HORSEPOWER
MG	MILLION GALLONS
NC	NORMALLY CLOSED
OE	OVERFLOW ELEVATION
PRV	PRESSURE REDUCING VALVE
PS	PUMP STATION
PZ	PRESSURE ZONE
RWD	RAINBOW WATER DISTRICT
SUB	SPRINGFIELD UTILITY BOARD

FIGURE 1-3

SPRINGFIELD UTILITY BOARD

Rainbow Water District

Water Distribution System Master Plan

Existing Water System Schematic

December 2021

murraysmith

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Section 2

Section 2

Water Requirements

2.1 Introduction

This section presents existing and projected future water demands for the joint SUB and RWD water service area. Water demands are used to assess the adequacy of facilities and assess supply capacity, as presented in Section 6.

2.2 Service Area

The SUB/RWD service area is located largely within the City of Springfield city limits, although service is provided to some areas outside the city limits and within the urban growth boundary. In general, the service area is east of the Interstate (I-5), south of the McKenzie River, and north of the Middle Fork Willamette River plus the Glenwood area between I-5 and the Willamette River. The SUB/RWD service area is adjacent to the EWEB service area to the west. The combined service area encompasses approximately 13,600 acres, or 21 square miles, and is entirely within Lane County. The service area is illustrated in Figure 1-1.

2.3 Future Service Area

Based on existing development types in the area, limited re-development and densification is expected within the existing water service area. It is anticipated that a few areas in the system will experience growth. One of the primary areas of expansion includes the Natron area east of Highway 222 and along the Bob Straub Parkway area. In addition, the North Gateway and Mill Race areas were approved as part of the UGB expansion in 2019 and are expected to include industrial development. Significant growth is also expected in the Glenwood area of the West system. Lastly, residential development in the South Hills area is also expected. These areas are illustrated in Figure 2-1.

2.4 Planning Period

The planning period for this WSMP is 20 years, through the year 2040, consistent with OAR requirements for WSMP (OAR 333-061). Some planning and facility sizing efforts within this WSMP may consider future water demands beyond the planning period. Typically, if substantial water system improvements are required beyond the 20-year planning period in order to accommodate water demands at saturation development, staging is recommended for facilities where incremental expansion is feasible and practical.

2.5 Current Water Demand

Water demand refers to all water required by the system including residential, commercial, industrial, and institutional uses. Demands are described using three water use metrics: average daily demand (ADD), maximum day demand (MDD) and peak hour demand (PHD), in gallons per unit of time such as gpm or mgd. Average daily demand is the total annual water volume used system-wide divided by 365 days per year. Maximum day demand is the largest 24-hour water volume for a given year. In western Oregon, MDD usually occurs each year between July 1st and September 30th. This timeframe is referred to as the peak season. Peak hour demand is estimated as the largest hour of demand on the maximum water use day.

Water demand can be calculated using either water consumption or water production data. Water demand in this plan was determined from water production, measured as the water supplied to the distribution system from the source facilities plus the water volume supplied from distribution storage. Water production data include water lost through the distribution process and unmetered, non-revenue uses, such as hydrant flushing.

The historical ratios of MDD to ADD and PHD to ADD are used to estimate future maximum day and peak hour demands. Based on historical system-wide demands, the ratio of MDD to ADD is approximately 1.85 and the ratio of PHD to ADD is approximately 2.6. Table 2-1 summarizes SUB/RWD current system-wide water demand based on water production data. Table 2-2 presents the average peaking factors for each system over the previous 5-year period as generated by SUB staff.

As described in Section 1, water systems are divided into pressure zones or levels in order to provide adequate service pressure to customers at different elevations. Each level is served by specific facilities such as reservoirs or pump stations and related piping which supply pressure to customers. In order to assess the adequacy of these facilities, it is necessary to estimate demand in each pressure level. Demand in each level is estimated by multiplying average per capita water usage by the average density of dwelling units per acre and the average number of people per dwelling according to the 2010 census. Level water demand is used to confirm pump station and storage capacity in the analysis in Section 6, and current and future service level demands are presented in Tables 2-4, 2-5, and 2-6 later in this section.

Table 2-1
Historical Water Demand Summary

Year	System	East	West	North	Combined
2015	ADD (mgd)	3.69	2.57	3.83	10.09
	MDD (mgd)	6.74	4.13	7.53	18.40
	PHD/ADD	3.17	1.91	3.57	2.94
	PHD (mgd)	11.69	4.90	13.67	29.68
2016	ADD (mgd)	3.67	2.48	3.77	9.92
	MDD (mgd)	6.86	4.07	7.25	18.18
	PHD/ADD	3.25	1.95	3.49	2.96
	PHD (mgd)	11.90	4.83	13.16	29.33
2017	ADD (mgd)	3.92	2.36	3.68	9.96
	MDD (mgd)	7.41	3.12	7.73	18.26
	PHD/ADD	3.28	2.01	3.81	3.10
	PHD (mgd)	12.85	4.74	14.05	30.87
2018	ADD (mgd)	3.85	2.25	3.62	9.72
	MDD (mgd)	6.96	3.66	6.14	16.76
	PHD/ADD	3.13	1.93	3.09	2.78
	PHD (mgd)	12.06	4.34	11.16	27.03
2019	ADD (mgd)	3.77	2.18	3.72	9.67
	MDD (mgd)	6.34	3.97	6.38	16.68
	PHD/ADD	2.92	2.16	3.11	2.78
	PHD (mgd)	10.99	4.71	11.58	26.92

Notes:
ADD: Average day demand
MDD: Maximum day demand
PHD: Peak hour demand

Table 2-2
Average Peaking Factors by System, 2015 to 2019

Average Peaking Factor	East	West	North	Combined
MDD:ADD	1.82	1.68	1.88	1.81
PHD:ADD	3.15	1.99	3.41	2.91

2.6 Future Water Demand Projections

2.6.1 System-wide Water Demand Forecasts

Estimates of future growth and related water demand are developed using the best available information for the service area including geographic information system (GIS) data, the Population Research Center's (PRC's) most recent projected growth rate for the Springfield UGB and current water demand data presented earlier in this section. Future system-wide water demands are forecast at 10 and 20-years.

Based on a review of recent available historical water demand data by customer class and PRC population forecasts, water demand projections were developed for the 20-year planning horizon. Population growth was observed at an annual rate of 0.125 percent, which was five times lower than the water demand annual growth rate of 0.54 percent, which includes all customer classes. The PRC population forecast predicts an approximate 1 percent annual population growth rate over the next 20 years. Because SUB's industrial customer class water demand has been growing at approximately 3.9 percent annually over the last 5 years and is anticipated to continue to grow, an annual water demand growth rate of 1.25 percent was used in the water demand forecast. This corresponds to a 3 percent growth rate for the industrial class, and a 0.5 percent growth rate for all non-industrial classes. Projected demands are summarized in **Table 2-3**. This analysis was conducted as part of the 2018 Water Management and Conservation Plan update and included with this plan for consistency. The current year forecasted MDD is based on a 2017 MDD of 18.5 mgd growing at the annual rate of 1.25 percent.

System-wide water demand forecasts are used to assess the source capacity adequacy, as discussed in **Section 6**. More localized demand forecasts by service level, presented in the next subsection, are used to support pump station capacity evaluations.

Table 2-3
Water Demand Forecasts

Year	Forecasted MDD (mgd)
Current[1]	19.2
2030	21.7
2040	24.6
Build-out	27.3

Notes:
1. Current forecasted water demand based on historical residential and non-residential demand components use and growth data and trends.

2.6.2 Water Demand Forecasts by Service Level

For the purposes of assessing pumping and storage adequacy in **Section 6** using the criteria developed in **Section 3**, an estimate of water demand for each pressure level is developed. The current water demands in this estimate differ somewhat from the historical current demands based on production records as reported in **Table 2-1** due to the methodology used to forecast water demands by land use.

Developed area and total area by level were determined in order to establish total pressure zone area at the current time and at build-out. Build-out assumes that all vacant land currently within the SUB service area will be developed. Historical water use by customer class (commercial/industrial, open/public, and residential) from 2012 through 2016 was used to develop water use in gallons per acre per customer class. Each level was analyzed by zoning per tax lot in order to develop an ADD based upon customer class acreage. An average combined MDD:ADD peaking factor of 1.81, as shown in **Table 2-2**, was used to determine MDD for each pressure zone. Current demands were developed using only lots not considered to be vacant, while build-out demands included all tax lots.

Three future developments were factored into the buildout demands of existing pressure zones: the Natron area which is included in the East First Level, the Millrace area which is also included in the East First Level, and the North Gateway area which is included in the North First Level .

The demand by service level for the East, West, and North Systems are presented in **Tables 2-4**, **2-5**, and **2-6**, respectively. A further breakdown by sublevel is included in **Appendix C**.

Table 2-4
East System Water Demand by Service Level

Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
First[1]	Current	3,090	2,558	4,630
	Build-Out	4,782	4,131	7,478
Second	Current	201	127	231
	Build-Out	437	293	531
Third	Current	259	161	291
	Build-Out	523	325	587
Fourth	Current	19	12	21
	Build-Out	184	114	207
Total	**Current**	**3,569**	**2,858**	**5,173**
	Build-Out	**5,926**	**4,864**	**8,803**

Note:

1. Includes the Natron – 1st area with a current land use of 18 acres, current ADD of 18 gpm, buildout land use of 368 acres, and buildout ADD of 539 gpm.

Table 2-5
West System Water Demand by Service Level

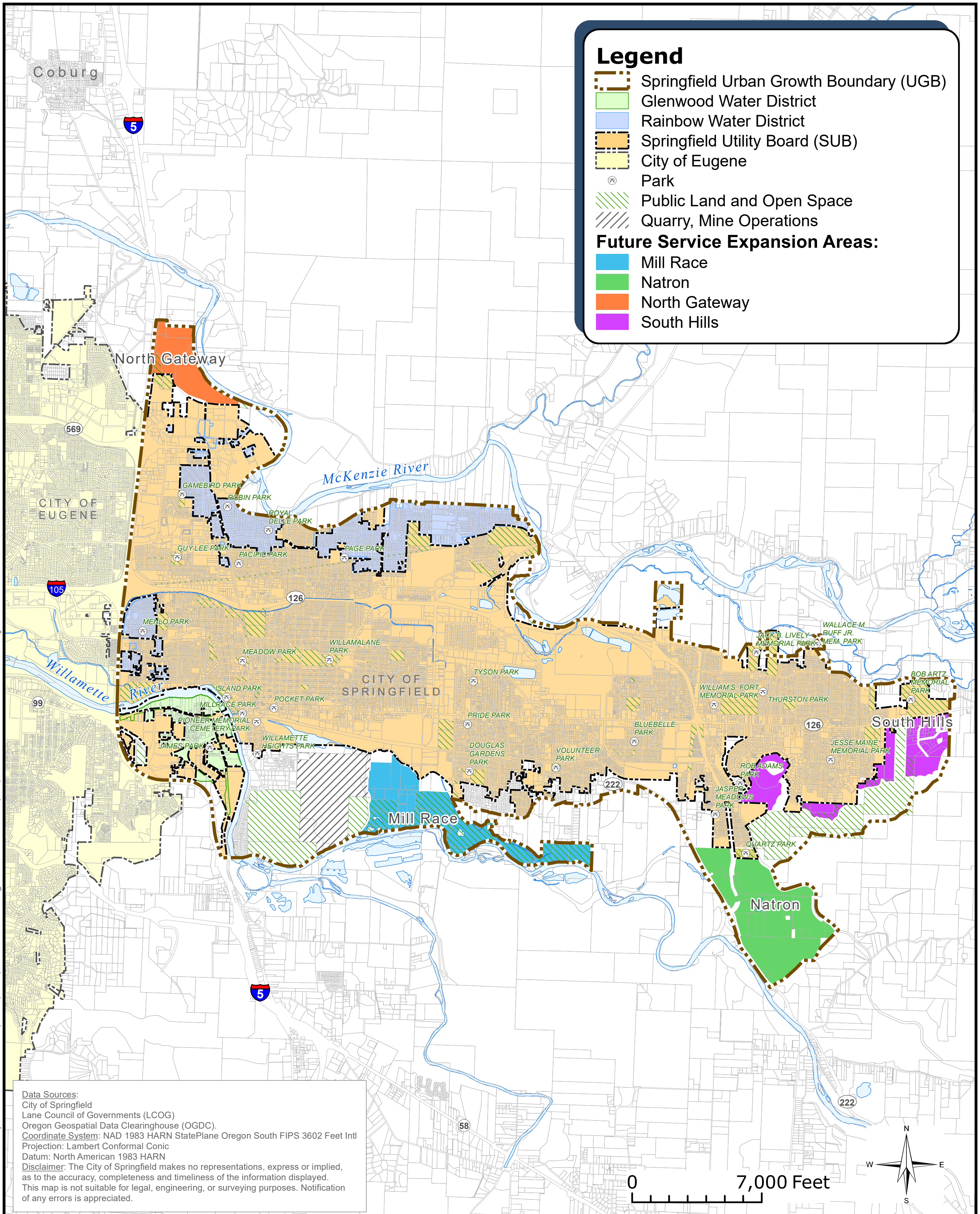
Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
First Low[1]	Current	946	1,071	1,939
	Build-Out	1,527	1,478	2,675
First	Current	104	98	177
	Build-Out	246	228	413
Second	Current	14	8	15
	Build-Out	30	19	34
Glenwood	Current	379	524	949
	Build-Out	536	751	1,359
Total	**Current**	**1,442**	**1,702**	**3,080**
	Build-Out	**2,340**	**2,476**	**4,481**

Notes:
1. Includes the Millrace area with a buildout land use of 506 acres and buildout ADD of 295 gpm.

Table 2-6
North System Water Demand by Service Level

Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
First[1]	Current	2,657	2,280	4,126
	Build-Out	3,399	3,139	5,665
Second	Current	25	16	29
	Build-Out	31	19	35
Total	**Current**	**2,682**	**2,295**	**4,154**
	Build-Out	**3,430**	**3,159**	**5,700**

Notes:
1. Includes the North Gateway area with a buildout land use of 447 acres and buildout ADD of 286 gpm.



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murraysmith | SUB SPRINGFIELD UTILITY BOARD | Rainbow Water District

Springfield Utility Board
Water System Master Plan

Figure 2-1
Future Service Area Map

murraysmith

Section 3

Section 3

Planning and Analysis Criteria

3.1 Introduction

This section documents the performance criteria used for water system analysis presented in Section 6 of this WSMP. Criteria are established for evaluating water supply, distribution system piping, service pressures, storage and pumping capacity, and fire flow availability. These criteria are used in conjunction with the water demand forecasts presented in Section 2 to complete the water system analysis.

3.2 Performance Criteria

The water distribution system should be capable of operating within certain performance limits under varying customer demand and operational conditions. The recommendations of this WSMP are based on the performance criteria summarized in Table 3-4. These criteria have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards,* and the *Washington Water System Design Manual*.

3.2.1 Water Supply

As described in Section 1, the SUB water distribution system operates in conjunction with RWD to supply three interconnected systems known as the North, East, and West Systems. The combined districts obtain the majority of their water from supply wells distributed across the three systems. In addition, surface water from the Middle Fork Willamette River is treated and pumped into the West System. Interties exist between the Systems and three operational emergency interties exist externally to the EWEB water system. Springfield Utility Board supplies the Glenwood Water District (GWD) and operates the GWD system through an intergovernmental agreement.

3.2.2 Service Pressure

Water distribution systems are separated by ground elevation into pressure level to provide service pressures within an acceptable range to all customers. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations to maintain acceptable minimum and maximum water pressures at each individual service connection. When it is not feasible or practical to have a separate reservoir for each pressure level, pump stations or PRVs are used to serve customers in different levels.

The desired service pressure range under normal operating conditions is 40-70 psi and the maximum limit as required by the *Oregon Plumbing Specialty Code* is 80 psi. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system configurations and economic considerations. Where mainline pressures exceed 80 psi, services should be equipped with individual PRVs to maintain their static pressures at no more than 80 psi.

The distribution system should be capable of supplying the PHD while maintaining minimum service pressures of no less than approximately 80 percent of system pressures normally experienced under average day demand conditions. For example, a customer experiencing a pressure of 55 psi under average day conditions must maintain a pressure of at least 44 psi under PHD. The system should meet this criterion with the equalization storage volume in the reservoirs depleted. This criterion ensures that the system does not experience undesirable pressure fluctuations associated with daily demand variations.

The distribution system should also be capable of providing the required fire flow to a given location while, at the same time, supplying MDD and maintaining a minimum residual service pressure at any meter in the system of 20 psi as required by Oregon Health Authority regulations. The system should meet this criterion with all equalization storage in the reservoir depleted, booster pump stations operating at firm capacity, and flow velocity in the distribution system of less than 10 feet per second (fps). Recommended service pressure criteria are summarized in Table 3-1.

Table 3-1
Recommended Service Pressure Criteria

Service Pressure Criterion	Pressure (psi)
Normal Range under ADD conditions	40-70
Desired Maximum Static Service Pressure	80
Minimum under MDD conditions + Fire Flow	20

Note:
ADD= Average Day Demand

3.2.3 Main Size

Typically, new water distribution mains should be at least 8 inches in diameter to supply minimum fire flows. In certain cases, a 6-inch main is acceptable if no fire hydrant connection is required, there are limited services on the main, the main is dead-ended, or further extension of the main is not anticipated. However, larger mains are highly recommended if there is a possibility for future connections or growth.

3.2.3.1 Fire Flow Capacity

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression in most levels. The amount of water required for fire suppression purposes is associated with the local building size and type or land use of a specific location within the distribution system. Fire flow requirements are typically much greater in magnitude than the MDD in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands. Emergency response in the City of Springfield, Glenwood Water District, and the Rainbow Water District is provided by Eugene Springfield Fire Department.

Current and historical planning for the SUB/RWD system has considered fire suppression flow requirements based on development type. Single and Double Family Residential fire flow requirements are 1,500 gpm and industrial/commercial fire flow requirements are 3,500 gpm. Multifamily Residential and Mixed Use area fire flow requirements are 2,500 gpm. This is consistent with the typical upper limit of fire suppression flow requirements for individual developments of these types as established in the current edition of the State of Oregon Fire Code. These fire suppression flow requirements are also consistent with guidelines published by the AWWA, the National Fire Protection Agency (NFPA) and the Insurance Services Office (ISO). Fire flow requirements by land use type based on these guidelines are summarized in **Table 3-2**.

Table 3-2
Required Fire Flow Summary

Land Use Type	Applicable Zoning	Required Fire Flow (gpm)	Required Duration (hours)
Single-Family and Duplex Residential	(LDR) Low Density Residential (SLR) Small Lot Residential	1,500	2
Medium and High Density Residential, Mixed Use	(MDR) Medium Density Residential (HDR) High Density Residential (MUC) Mixed Use Commercial (MUE) Mixed Use Employment (MUR) Mixed Use Residential	2,500	2
Commercial, Industrial and Institutional	(NC) Neighborhood Commercial (CC) Community Commercial (MRC) Major Retail Commercial (GO) General Office (CI) Campus Industrial (LMI) Light-Medium Industrial (HI) Heavy Industrial (SHI) Special Heavy Industrial (MS) Medical Services District	3,500	4

3.2.4 Storage Capacity

Water storage reservoirs in the SUB/RWD system should provide capacity for four purposes: operational storage, equalization storage, fire storage, and standby or emergency storage. A brief discussion of each storage element, as defined in the *Washington Water System Design Manual,* is provided below.

Adequate storage capacity must be provided for each level. Storage volume for levels served through PRVs or by constant pressure pump stations is provided in the upstream level supplying the PRV or pump station. For instance, the Glenwood Level in the West System is served entirely by the Glenwood Intertie PRV which draws water from the West High Level. Thus, the storage criteria for the Willamette Heights Reservoir in the West High Level must also include the combined storage volume requirement of the Glenwood Level.

3.2.4.1 Operational Storage

Operational storage is the volume of water dedicated to supplying customers under normal conditions while the pumps used to fill the reservoir are off. For example, in the East Second Level which is served solely by the S 70th Street Reservoir, operational storage is defined by the S 70th Street Reservoir set points which signal the 72nd Street pumps to turn on and off.

A review of water reservoir levels found operational storage to be approximately 25 percent of the ADD.

3.2.4.2 Equalization Storage

Equalization storage is required to meet water system demands in excess of delivery capacity from the water supply source to reservoirs serving each service level. Equalization storage volume should be sufficient to supply demand fluctuations throughout the day resulting from typical customer water use patterns and is generally considered as the difference between PHD and MDD on a 2.5-hour basis.

For service levels with a single source of supply to the reservoir, equalization storage is calculated as PHD minus the source capacity over a period of 150 minutes. Equalization storage for service levels with multiple sources of supply is calculated as PHD minus the source capacity without the largest pump running over a period of 150 minutes.

3.2.4.3 Fire Storage

Water stored for fire suppression is typically provided to meet the single most severe fire flow demand within each service level. Required fire flow rates and durations based on the 2019 *Oregon Fire Code* (OFC) are discussed previously in this section and summarized in Table 3-2. The recommended fire storage volume is determined by multiplying the fire flow rate by the duration of that flow.

Under the future system configuration described in Section 5, the North, West, and East Systems will be operated as a combined service level. Under this configuration, the single service level fire storage criterion will be modified for the main service level to account for its size. The single, large main service level is recommended to store water to allow for two major fires. This reduces the required fire storage in the collective first levels compared to when the systems are operated in the current separate service levels.

3.2.4.4 Emergency (Standby) Storage

Emergency storage is provided to supply water from storage during emergencies such as pipeline failures, equipment failures, power outages or natural disasters. The amount of emergency storage provided can be highly variable depending upon an assessment of risk and the desired degree of system reliability. The volume of emergency storage recommended for systems with a single supply source may be different than for systems, such as SUB/RWD, which are served by multiple sources. The SUB/RWD system has a high level of source redundancy and reliability due to the numerous groundwater wells and surface water supply which use different water sources. Because of this high reliability, a standby storage capacity of one-half of the system average daily demand is recommended.

3.2.5 Constant Pressure Pump Stations

Although it is desirable to serve water system customers by gravity from storage, constructing and maintaining a reservoir for a small group of customers may be prohibitively expensive and lead to water quality issues associated with slow reservoir turnover. Constant pressure pump stations supply a service level without the benefit of storage. These systems are commonly referred to as a closed zone. Closed zone systems are only recommended for residential developments with a small number of services, preferably in an area that will not be connected to adjacent pressure levels in the future. Constant pressure stations are commonly used to serve customers at the highest elevations in a water service area where only an expensive elevated reservoir would provide the necessary head to achieve adequate service pressures by gravity.

Ideally, pump stations supplying constant pressure service to closed zones should have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the zone. This is recommended for all new closed zones that develop, such as the upper service level in the planned Natron area.

3.2.5.1 Capacity and Number of Pumps

Pumping capacity requirements vary depending on the water demand, volume of available storage and the number of pumping facilities serving a service level. When pumping to storage reservoirs that supply a service level via gravity, also referred to as an open zone, a firm pumping capacity equal to the service level's MDD is recommended. Firm pumping capacity is defined as a station's pumping capacity with the largest pump out of service. A minimum of two pumps at each pump station are recommended for redundancy.

3.2.5.2 Backup Power

It is recommended that pump stations supplying gravity storage reservoirs include manual transfer switches and connections for a portable back-up generator. The emergency storage volume in each reservoir will provide short term water service reliability in case of a power outage at the pump station. Back-up power generators with automatic transfer switches are recommended for all constant pressure pump stations as they lack gravity storage.

3.2.6 Fire Hydrant Spacing

The OFC establishes spacing of fire hydrants based on the fire flow requirements. **Table 3-3** reports the spacing per OFC Table C102.1.

Table 3-3
Required Number and Spacing of Fire Hydrants

Fire Flow Requirement (gpm)	Min. Number of Hydrants	Average Spacing Between Hydrants (feet)	Max Distance from any Point on Street or Road Frontage to a Hydrant (feet)
1,750 or less	1	500	250
1,751–2,250	2	450	225
2,251–2,750	3	450	225
2,751–3,250	3	400	225
3,251–4,000	4	350	210
4,001–5,000	5	300	180
5,001–5,500	6	300	180
5,501–6,000	6	250	150
6,001–7,000	7	250	150
7,001 or more	8 or more	200	120

3.3 Water Quality Goals

In Oregon, drinking water quality standards for 95 primary and 12 secondary contaminants are established under the Oregon Drinking Water Quality Act (OAR 333-061) which includes implementation of national drinking water quality standards. To maintain public health, each contaminant has either an established maximum contaminant level (MCL) or a recommended treatment technique. Accordingly, SUB/RWD meets all these standards. In addition to surface water treatment, a few groundwater sources determined to be GWUDI require treatment to meet the goals. SUB uses ultraviolet disinfection for inactivation of *Giardia lamblia* and *Cryptosporidium* in GWUDI wells. The virus inactivation requirements are met using chlorine disinfection. RWD uses a combination of chlorine disinfection and Harmsco cartridge filtration to address GWUDI at Chase 2. Some of the SUB/RWD facilities also condition the pH to comply with the Lead and Copper Rule and provide for corrosion control through a combination of air stripping and/or the addition of caustic soda.

3.4 Summary

Table 3-4 provides a summary listing of the criteria presented in this section.

Table 3-4:
Water System Performance Criteria Summary

Water System Facility	Evaluation Criterion	Value	Design Standard/Guideline
Water Supply	Reliable Supply Capacity	MDD[2]	Ten States Standards and Washington Water System Design Manual
Service Pressure	Normal Range (ADD[1] Conditions)	40-70 psi	AWWA M32
	Maximum	80 psi	AWWA M32, Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during MDD[2] with Fire Flow	20 psi	AWWA M32, OAR 333-061
Distribution Piping	Velocity during PHD[3] or Fire Flow	Not to exceed 10 fps	AWWA M32
	Minimum Pipe Diameter	8-inch with looping recommended for fire flow,	Recommended
Storage	Total Storage Capacity	Sum of operational, equalization, fire suppression and emergency (standby) storage volumes	
	Operational Storage	25% of ADD[1]	Based on operational review
	Equalization Storage	150 min x (PHD[3]-firm supply rate)	Washington Water System Design Manual
	Fire Storage	Required fire flow x flow duration	2019 Oregon Fire Code
	Emergency (Standby) Storage	50% ADD	Based on historical operations
Pump Stations	Minimum No. of Pumps at Firm Capacity	2	Ten States Standards
	Open Zone Firm Capacity[4]	MDD[2]	Washington Water System Design Manual
	Closed Zone Firm Capacity[5]	PHD[3] + Fire Flow	Washington Water System Design Manual
	Backup Power	At least two independent sources	Ten States Standards
Required Fire Flow and Duration	Single-Family and Duplex Residential	1,500 gpm for 2 hours	2019 Oregon Fire Code, SUB/RWD standards
	Medium and High Density Residential, Mixed Use	2,500 gpm for 2 hours	
	Commercial, Industrial and Institutional	3,500 gpm for 3 hours	

Notes:
1 ADD: Average daily demand, the average volume of water delivered to the system during a 24-hour period = total annual demand/365 days per year.
2 MDD: Maximum day demand, defined as the maximum volume of water delivered to the system during any single day of the calendar year.
3 PHD: Peak hour demand, defined as the maximum volume of water delivered to the system during any single hour of the maximum demand day.
4 Open zone is defined as a pressure zone supplied by gravity from a storage reservoir.
5 Closed zone is defined as a pressure zone supplied constant pressure from a booster pump station without the benefit of storage.

Section **4**

Section 4

Regulatory Requirements

4.1 Introduction

This section contains a summary of the regulatory compliance requirements for the SUB and RWD water systems.

The Safe Drinking Water Act (SDWA), enacted in 1974, authorized the U.S. Environmental Protection Agency (EPA) to establish standards for drinking water quality, monitoring requirements, and enforcement procedures. Both federal and state agencies regulate public drinking water systems. For the federal government, Title 40, Code of Federal Regulation (CFR) 141-143 rules are used. For the state, OAR Chapter 333 Division 61 is reserved for regulations regarding Oregon's public water systems. Oregon has been given the primary authority for implementing EPA's rules within the state as well as rules developed by the state. This status is referred to as "primacy" (40 CFR Part 142, subpart B).

EPA's drinking water rules are administered in Oregon by Drinking Water Services (DWS), which is part of the Center for Health Protection within the Public Health Division of the Oregon Heath Authority (OHA). Prior to the establishment by legislative action in 2009 of the OHA, drinking water rules were administered by the Drinking Water Program (DWP) of the Department of Human Services within the Oregon Health Division. When referencing historical regulatory actions that predate the formation of DWS, the term DWS will be used in this section to also refer to its predecessor, the DWP.

The OHA's rules for water quality standards and monitoring are adopted directly from EPA. The OHA is legally required to adopt rules that are at least as stringent as federal rules. OHA has the option, but has elected not to, implement water quality or monitoring requirements that are more stringent than federal requirements. In some areas not directly related to water quality, OHA rules cover a broader scope than EPA rules. These include general construction standards, cross connection control, backflow installation standards, and other water system operation and maintenance standards.

The activities of SUB and RWD are also governed by the Source Water Protection Program. The Oregon Department of Environmental Quality (DEQ) is responsible for implementing federal Clean Water Act authorities and state water protection laws. An interagency agreement between DEQ and OHA delineates the responsibilities of the two agencies for protecting drinking water sources.

Two types of drinking water standards are implemented under EPA's drinking water standards program. The first type is enforceable National Primary Drinking Water Regulations (NPDWR), which are standards set to control health risks. The second type is non-enforceable National

Secondary Drinking Water Regulations (NSDWR), which address aesthetic aspects of drinking water. A primary regulation can be a numeric "maximum contaminant level" (MCL) or a non-numeric treatment technique. Primary regulations cover microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals and radionuclide contaminants. The microbial contaminants are considered to pose an acute health risk, while chemical contaminants are considered to pose more of a chronic health risk.

Rules under the SDWA can be separated into those controlling microbial contaminants and those controlling chemical contaminants:

Regulations to Control Microbial Contaminants

- Surface Water Treatment Rule (SWTR)
- Interim Enhanced SWTR (IESWTR)
- Long-Term 1 ESWTR (LT1ESWTR)
- Long-Term 2 ESWTR (LT2ESWTR)
- Filter Backwash Recycling Rule (FBRR)
- Revised Total Coliform Rule (RTCR)
- Groundwater Rule (GWR)

Regulations to Control Chemical Contaminants

- Chemical Contamination or Phase II/V Rules
- Arsenic Rule
- Lead and Copper Rule (LCR)
- Disinfectants and Disinfection Byproducts Rules (Stage 1 and Stage 2)
- Radionuclides Rule
- Secondary Standards

In addition, other regulations and agency guidance address other aspects of drinking water quality:

Other Regulations and Agency Guidance

- Unregulated Contaminant Monitoring Rule (UCMR)
- Cyanotoxin Health Advisory
- Variances and Exemptions Rule
- Public Notification Rule
- Consumer Confidence Report Rule
- Standardized Monitoring Framework Rule for Chemical Contaminants
- Per- and polyfluoroalkyl substances (PFAS) Health Advisory
- Chlorine Handling Requirements

4.2 Status of Drinking Water Regulations

The most recent amendments to the SDWA were enacted in 1996. This was essentially a reauthorization of the 1986 SDWA Amendments with relatively minor modifications to the policies, content, and implementation schedule of those regulations. The 1996 SWDA amendments left existing standards and rules unchanged, although the pace of adopting new standards was slowed. The current law contains the following new assignments and programs for EPA and States:

- State revolving loan fund for water system construction
- Public notification reports
- Source water assessment and protection
- Monitoring reductions based on source water protection
- Mandatory certification of operators

All these assignments have been implemented by the EPA and States. Progress on evaluation of potential contaminants continues with the unregulated contaminant sampling requirements and health effect research.

4.3 Drinking Water Protection

DEQ is the lead agency in Oregon responsible for implementing federal and state laws for protecting waters of the state, including drinking water sources. An interagency agreement between DEQ and OHA defines the framework within which the agencies cooperate to protect drinking water sources.

Working jointly with DWS, DEQ prepared proposed legislation and rules in 1994 and 1995 to implement a mandatory wellhead protection program. These laws would have required all public water supplies using groundwater to develop individual wellhead protection programs. The state legislature chose to make the program voluntary for communities serving populations less than 10,000 or with fewer than 3,500 service connections. For communities serving populations greater than 10,000 or with more than 3,500 service connections, who identify their wellhead protection areas, a wellhead protection plan is required to meet state land use planning rules (OAR 660-023-0140).

Under the administrative rules that apply to Oregon's EPA-approved Drinking Water Protection Program, DWS has the responsibility to certify groundwater-derived drinking water protection areas in the state (see OAR 340-040-0180(3)). This certification is granted after technical review assures that the submitted delineations meet minimum requirements for the system as outlined in OAR 333-061-0057, and that the delineation is a reasonable representation of the capture zone of the well, wellfield or spring. The delineations of the capture zones for the Sports Way No 1, Q Street, Maia, and SP Wells, and the I-5, Chase, Weyerhaeuser, Platt, Thurston, and Willamette Wellfields have met the above requirements and have been certified collectively as DWS

Delineation Certificate No. 0002R Version 2. The delineation for the Willamette Wellfield was updated in July 2008 and is included in the Version 2 Certification.

The DEQ is responsible for certifying the delineations for surface water source areas. As part of the rule updates, the terminology was changed from wellhead protection areas to drinking water protection areas to include all drinking water sources. The Middle Fork Willamette surface water intake, owned by SUB, has been delineated by DEQ, and DEQ updated SUB's source water assessment in 2019. As of August 2019, SUB's drinking water protection area includes the entire Middle Fork Willamette Watershed and the entire McKenzie Watershed (resulting from the GWUDI determination at Thurston Well No.2).

The City of Springfield has implemented drinking water protection as part of its municipal development code. Article 17 was adopted in May 2000 and was updated and renumbered in Section 3.3-200 Drinking Water Protection Overlay District on September 3, 2008. The development code requires all new businesses, and businesses that expand or redevelop inside the Overlay District, to meet standards established for protecting drinking water quality in the drinking water protection source areas.

Impact to SUB and RWD: The areas delineated by DWS are significant groundwater resources for the purpose of Statewide Planning Goal No. 5. It is recommended that SUB and RWD continue proactive source protection programs to prevent contamination. The impact of groundwater contamination by synthetic organic contaminants (SOCs) or volatile organic contaminants (VOCs) can be significant, both in terms of cost for treatment and loss of public confidence.

The SP/ Maia wells are located in an area of heavy industry and significant chemical use. They are located immediately next to the freeway and there is the associated risk of high-volume traffic related spills. The Q Street Well draws water from the same aquifer as the SP/Maia wells and is in an area where significant inventories and use of hazardous materials exist. There are nearby underground storage tank clean-up sites with residual fuel products remaining in the soil and shallow groundwater. The well is located immediately next to the freeway and there is the associated risk of high-volume traffic related spills. The I-5/Sports Way wells are in an area that was historically used for agriculture prior to recent development. They are located immediately next to the freeway and there is the associated risk of high-volume traffic related spills. Adjacent to the Sports Way well are new storm water infiltration facilities from nearby businesses and a city storm water outfall.

The WSSFP is fed by an intake on the Middle Fork Willamette River and uses well water that is surface water influenced. Storm water outfalls have been constructed and will continue to be installed along Jasper Road and in the Jasper/Natron area. The Middle Fork Willamette River has Highway 58 along most of its course upstream of SUB's intake, and this highway is the designated east-west hazardous materials transport route in this part of the state. Additionally, this corridor is the east-west rail car transport route and hazardous materials are transported by rail through this area. Thurston Well No. 2 is the most vulnerable of the wells in Thurston wellfield to SOC and VOC chemicals flowing down the McKenzie River. The WSSFP and Thurston Wellfield Facilities are not designed to treat SOCs or VOCs, and it is a critical part of plant operation to avoid bringing chemically contaminated water into the either facility. The primary way to address this risk is to monitor frequently, to support source water protection activities in the watershed, and to continue to participate in the Oregon Watershed Emergency Response System (OWERS). Currently, SUB and RWD are participants in OWERS.

In response to DWS, DEQ, and EPA requirements, and to be proactive in protecting their supply sources, SUB, RWD, and the City of Springfield jointly developed a multi-faceted drinking water protection program. In 1999, SUB, RWD, and the City of Springfield adopted and received DEQ approval for the *Springfield Drinking Water Protection Plan*, developed in accordance with the Oregon Drinking Water Protection Program Guidance Manual. The Department of Land Conservation and Development (DLCD) approved the plan as providing adequate protection of the identified Goal 5 Resource. The approval was conditioned to require Lane County and the City of Eugene to adopt protections that meet the criteria in the Oregon Drinking Water Protection Program Guidance Manual.

In 2013, SUB initiated a two-phase process to advance Lane County's adoption of protections for those portions of the Springfield Wellhead Protection Areas that fall outside the Springfield UGB. With RWD support, SUB filed an application to Lane County for a post-acknowledgement plan amendment to the Lane County Rural Comprehensive Plan. The application requested that Springfield's delineated wellhead protection areas be recognized as a significant groundwater resource. On January 14, 2014, the Lane County Board of Commissioners enacted Ordinance No. PA 1307, which added the Springfield Wellhead Protection Areas to the Goal 5 inventory of significant groundwater resources. In the second phase of this process, which is pending initiation, Lane County will adopt strategies. Continued efforts by SUB and RWD will be needed to (1) help Lane County complete Phase 2, and (2) collaborate with the City of Eugene to adopt protections in the Eugene portion of Springfield's Wellhead Protection Areas.

In 2002, the City of Springfield and SUB prepared a surface water addendum to the drinking water protection plan, which extended the boundaries of the protection program to include the Middle Fork Willamette Watershed. In August 2019, the DEQ completed a new source water assessment for SUB. The updated delineated drinking water protection area includes the Wellhead Protection Areas, the entire Middle Fork Willamette Watershed, and, because of the GWUDI status of Thurston Well No. 2, the entire McKenzie Watershed. Because SUB is committed to developing a McKenzie River source, it is recommended that a second addendum be developed to the drinking water protection plan that addresses the McKenzie Watershed.

In 2013, SUB led a five-year review of and update to the *Springfield Drinking Water Protection Plan*. The update included a new potential contaminant source inventory and Wellhead Protection Areas map. The City of Springfield, SUB, and RWD submitted a recertification request to DEQ. The DEQ approved the recertification in accordance with OARs 340-040-0170 and 340-040-0180 on September 19, 2013. Continued successful implementation of the plan recommendations is required for certification. The next review will occur in conjunction with the addition of a McKenzie Watershed addendum.

A high-priority protection strategy outlined in the *Springfield Drinking Water Protection Plan* is implementation of a drinking water protection overlay. In May of 2000, the City of Springfield adopted the Drinking Water Protection Overlay District (currently Section 3.3-200 of the Springfield Development Code). It requires all new businesses and businesses that expand or redevelop inside the overlay district to meet standards established for protecting drinking water in the drinking water protection source areas.

In March of 2019, the State of Oregon formally acknowledged the City of Springfield's three areas of UGB expansion: (1) North Gateway in northwest Springfield, (2) Mill Race in south Springfield, and (3) Willamalane Park Properties in north Springfield. All three expansion areas lie within the Springfield Wellhead Protection Areas. SUB and RWD will need to work with the City of Springfield to ensure that the expansion areas are subject to the drinking water protection provisions that currently apply within the existing Drinking Water Protection Overlay. It is recommended that SUB and RWD work with City staff to file a Zoning Map Amendment that applies the Drinking Water Protection Overlay District to the UGB expansion areas.

The Drinking Water Source Protection Coordinator at SUB provides technical review of all Drinking Water Protection Overlay permit applications to ensure compliance with the standards, reviews all chemicals being used or stored by permitted businesses for compliance with Dense Non-Aqueous Phase Liquids (DNAPL) restrictions, and provides education and consulting services to the community to protect drinking water quality.

Continued vigilance will be needed from SUB and RWD in the protection of sources. This work will include assisting the City of Springfield with continued implementation of the development code, working toward developing and implementing standards for existing businesses, continuing and expanding public education efforts, expanding protection efforts to protect surface water supplies in both the Middle Fork Willamette and McKenzie watersheds, participating in established watershed emergency response programs, and making incremental improvements in each of the ten areas identified in the *Springfield Drinking Water Protection Plan*.

4.4 Water System Survey

Through a combination of the SWTR and the GWR, public water systems using surface and groundwater sources are subject to water system surveys conducted by the primacy agencies or the EPA. In Oregon, a primacy state, OHA conducts water surveys to identify significant deficiencies which include those which make a system susceptible to microbial contamination. Depending upon the size and type of system, the periodic frequency of inspection varies. For both SUB and RWD, the normal frequency is every 3 years, but this has been extended to every 5 years due to receiving "Outstanding Performer" status.

The Water System Survey of RWD was conducted on November 18, 2015, and of SUB on November 15th and 16th of 2016. OHA staff inspected wells, treatment facilities, and storage tanks and reviewed distribution system practices, water quality monitoring, management/operations, and operator certifications. During both Water System Surveys there were no significant deficiencies or rule violations found.

In addition to not finding any significant deficiencies or rule violations, neither SUB's nor RWD's water system has had any violations in the past five years for MCL, Action Level, or Treatment Technique. The water systems also did not have any monitoring or reporting violations in the last three years, or any waterborne disease outbreaks attributed to the water system. Since all the criteria were met, SUB and RWD were awarded "Outstanding Performer" status. The next OHA Water System surveys for RWD and SUB are anticipated for 2021.

4.5 Surface Water Treatment Rule

The SWTR was promulgated on June 29, 1989. Under the SWTR, all public water systems using surface water or using any GWUDI of surface water are required to disinfect. In addition, the state may require these systems to filter unless certain source water quality requirements and site-specific conditions are met.

The IESWTR, LT1ESWTR, LT2ESWTR, and FBRR are all additions to the SWTR, which have been implemented to reinforce the SWTR. Each regulation increases public health protection by increasing the effectiveness of filtration and disinfection, reducing the risk of *Giardia* and *Cryptosporidium* infection. The Filter Backwash Recycling Rule was enacted to prevent the use of recycled backwash water to clean filters. The rule required that only treated water be used for backwashing filters.

Ingestion of *Giardia, Cryptosporidium* and viruses may cause problems with the digestive systems of humans. *Legionella* is a bacterium that once aerosolized (e.g. in an air-conditioning system or a shower) and inhaled may cause a type of pneumonia. These organisms are very hard to reliably detect, therefore the SWTR establishes treatment techniques to control microbial contaminants. If treatment techniques set out in the SWTR and amendments are met, microbial contaminants will be removed and/or inactivated.

The 1989 SWTR establishes treatment techniques instead of MCLs for the control of *Giardia*, viruses, heterotrophic plate count bacteria (HPC), and *Legionella*. Turbidity limits depend on the filtration method employed in its removal.

Table 4-1
SWTR Requirements – 1989

Topic	Requirement
GWUDI of Surface Water	All groundwater sources must be evaluated to determine if they are GWUDI. Wells that are top priority are ones where water from lakes and rivers in proximity to these wells may travel a relatively short distance in a brief time period through aquifer materials with large pores or fractures. Under these circumstances, pathogenic micro-organisms may be transported in a viable state to a well and filtration may be required.
Treatment Technique	The maximum contaminant level goals (MCLGs) for *Giardia*, viruses, and *Legionella* are zero. There are no MCLGs for HPC bacteria or turbidity. 99.99 percent (4-log) removal and/or inactivation of viruses. 99.9 percent (3-log) removal and/or inactivation of *Giardia* cysts Meet Daily CT Monitoring of turbidity from the combined filter effluent (CFE) Slow sand filtration and natural filtration are required to have turbidity level of representative samples of CFE less than or equal to 1 Nephelometric Turbidity Unit (NTU) in at least 95 percent of the measurements taken each month and the maximum level of turbidity of the CFE must not exceed 5 NTU Conventional and Direct treatment required to have CFE turbidity of less than or equal to 0.5 NTU in at least 95 percent of the measurements taken each month, with a maximum level of 5 NTU. (**Rule changed in 1998**)
Disinfection	Disinfectant levels must be measured at both the entry point to the distribution system and within distribution system Entry point chlorine residual cannot be less than 0.2 milligrams per liter (mg/L) for more than 4 hours. Record lowest entry point chlorine residual of day Disinfectant residual must be monitored at the same frequency and at the same points as where total coliforms are sampled per the RTCR. The residual disinfectant concentration in the distribution system cannot be undetectable, or have HPC of more than 500 colony-forming units (CFU), in more than 5 percent of the samples in one month, for 2 consecutive months.
Training	Operators must be certified to operate Public Water System
Reporting	CT levels Turbidity Chlorine UV Off Spec Water Entry Point Chlorine Residual Distribution Chlorine Residual

The IESWTR provide regulations for public water systems that serve populations over 10,000 and the LT1ESWTR provided the similar requirements for water systems below 10,000. The *Cryptosporidium* outbreak in Milwaukee, WI raised concerns about the adequacy of the SWTR in protecting public health. This rule includes specific treatment requirements for *Cryptosporidium*, which are in addition to the SWTR. See **Table 4-2**.

Table 4-2
IESWTR (1998) and LT1ESWTR (2002) Requirements

Topic	Requirement
GWUDI of Surface Water	These rules apply to GWUDI wells.
Treatment Technique	MCLG for *Cryptosporidium* is zero 99 percent (2-log) removal of *Cryptosporidium* Conventional and Direct treatment were required to have CFE turbidity of less than or equal to 0.3 NTU in at least 95 percent of the measurements collected each month, with a maximum level of 1 NTU) Slow sand filtrations CFE turbidity requirements stayed the same. Requires both conventional and direct filtration treatment plants to monitor individual filters for turbidity and triggers additional reporting if performance limits are exceeded. Requirements of covering new finished water reservoirs
Finished Water Storage	Water Systems planning to build finished water storage must cover the finished water storage
Inspections	Required states to conduct periodic water system survey

The LT2ESWTR also applies to all systems using surface water or GWUDI of surface water. This rule focuses in on water systems that have sources with elevated *Cryptosporidium* risk. The rule requires 2 years of *Cryptosporidium, E. coli* and turbidity sampling to define the requirement for additional treatment. Additional treatment options are identified in EPA's Microbial Toolbox. Additional treatment was required to be in place by 2012 for systems serving 50,000 or more people, and by 2013 or 2014 for smaller systems. See **Table 4-3**.

Table 4-3
LT2ESWTR Requirements - 2006

Topic	Requirement
Source Water Monitoring	Filtered systems must conduct 24 months of source water monitoring for *Cryptosporidium, E. coli*, and turbidity levels. Filtered systems proving at least 5.5-log of treatment for *Cryptosporidium* or intend to install this level of treatment are not required to conduct source water monitoring.
Installation of Additional Treatment	Filtered system may need to provide additional treatment of *Cryptosporidium* based on their bin classification (average source water *Cryptosporidium* concentration).
Uncovered Finished Water Storage Facility	Water Systems with uncovered finished water storage must cover the uncovered finished water storage or fully treat water under SWTR.

Partial removal and/or inactivation credit is given to systems that provide filtration with the remainder achieved through chemical disinfection. The actual amount of reduction credit granted for filtration is based on the specific train of treatment processes provided. Inactivation credit for chemical disinfectants is based on contact time (CT), which equals the free disinfectant residual concentration in milligrams per liter times the disinfectant contact time in minutes.

Impact to SUB and RWD: In 1999, DWS determined all Willamette Wellfield wells and Thurston Well No.2 to be GWUDI. In 2014, RWD's Chase Well No.2 was determined by DWS to be GWUDI. When groundwater wells are determined to be GWUDI, the SWTR requires improved disinfection and/or filtration to achieve 3-log removal or inactivation of *Giardia*, 4-log removal or inactivation of viruses and 2-log removal of *Cryptosporidium*. Improved disinfection may consist of adding sufficient detention time to meet the CT requirements or the addition of UV to achieve necessary inactivation. The treatment must also achieve minimum removal and/or inactivation of *Cryptosporidium,* in line with modifications to the SWTR.

Soon after the Willamette wells were determined to be GWUDI, the WSSFP was constructed to treat GWUDI well water and surface water from the Mid Fork Willamette River. Slow sand filters were constructed and provide 2-log removal of *Giardia* cysts and *Cryptosporidium.* A UV disinfection system was installed, which provides 3-log inactivation of *Giardia* cysts and *Cryptosporidium.* The slow sand filters and UV disinfection provide 5.0-log removal and/or inactivation of *Cryptosporidium* and *Giardia* cysts. The gas chlorination system and detention line provide 0.5-log inactivation of *Giardia* cysts and 4-log inactivation of viruses. In 2013, a corrosion control facility was added to the slow sand filter plant.

From 1999 to 2014 Thurston Well No.2 was not used in the water system because the well was not in compliance with SWTR. Additional geologic studies at Thurston Well No.2 provided data to demonstrate Natural Filtration. Natural Filtration is covered in the rules as an alternative technology and requires state approval of the operating parameters necessary to receive log removal credit. In 2008, DWS approved the application of Natural Filtration Credit for this source and a 2-log credit was granted. For Thurston Well No.2, SUB opted to install UV disinfection as part of the Thurston Corrosion Control facility. In 2014, a new UV facility was operational that provides 3.5-log *Cryptosporidium* and *Giardia* cyst inactivation After applying the 2-log removal credit for *Giardia* cysts and *Cryptosporidium* from natural filtration and 3.5-log *Cryptosporidium* inactivation, Thurston Well No.2 reached the required 5.5-log removal/inactivation for *Cryptosporidium* and *Giardia* cysts*.* The gas chlorination system and detention line provide 0.5-log inactivation of *Giardia* cysts and 4-log inactivation of viruses. Thurston Well No.2 is in compliance with the SWTR. All other Thurston Wells are determined to be groundwater wells. For groundwater wells within 500 feet of surface water and wells for which the presence of source related coliform bacteria is suspected, DWS may consider further investigation.

The RWD considered and rejected applying for Natural Filtration for Chase Well No.2. A replacement well, Chase Well No. 5, was drilled but did not provide the desired yield so design of a filtration system for Chase Well No. 2 was initiated in late 2015. A Chase Wellfield Water Treatment Plant was completed in July 2018 and provides 2.5-log removal of *Giardia* cysts and 2.0-log removal of *Cryptosporidium*, 0.5-log inactivation of *Giardia* cysts and 4-log inactivation of viruses. Chase Well No.2 water is filtered using polyester cartridges and an expanded detention line provides the required CT, with surplus capacity. Corrosion control was also added to treat other wells if needed in the future. All other wells at the Chase Wellfield are determined to be groundwater. The treatment facility also provides corrosion control, adding caustic soda to raise wellfield pH. In November 2020, OHA certified Bin 1 Classification for the Chase Well No. 2 source under LT2ESWTR.

The wells in the SUB/RWD Weyerhaeuser Wellfield have been determine by DWS to be groundwater wells, but DWS reviewed historical data and is concerned that the wells may be influenced by surface water at higher McKenzie River flow rates. Microscopic Particulate Analysis (MPA) verified these as groundwater wells during summer low flows. These wells are currently only operational June through October and are not operated outside these months. These wells were determined to be groundwater wells when the McKenzie River flows are 3,000 cfs or below. If SUB and RWD want to run these wells when the river level is above 3,000 cfs, DWS will require the wells to be sampled for MPA. The SUB/RWD Weyerhaeuser Wellfield GAC Plant was completed in August 1996. This facility was designed primarily for organics removal, but also is adaptable to meet surface water filtration requirements. In the future, if the water must be treated to surface water standards, the primary modifications needed are another pair of filter vessels, a chemical coagulation feed system, rapid mixer, chlorine detention (or UV application), and instrumentation and SCADA modifications.

The I-5 Wells No. 1 and 2, SP Well, Q Street Well, Maia Well and Sports Way Well are all beyond 500 feet from surface water sources and do not have a history of coliform bacteria detections. These wells are not impacted by the SWTR.

Willamette and Thurston entry point daily CTs are calculated using “CT Values for Inactivation of Viruses by Free Chlorine, Hydrogen potential (pH) 6.0 – 9.0,” which is a table from the EPA Guidance Manual Disinfection Profiling and Benchmarking. Turbidity levels from the WSSFP and the Thurston UV Facility are measured at the combined filter effluent. Turbidity data are monitored on SCADA and monthly reports are sent to DWS. Chlorine residual is continuously monitored at the Willamette and Thurston entry point locations. The lowest chlorine residual is recorded each day and used to calculate CT. Entry point chlorine data used to calculate CT is monitored on SCADA and monthly reports are sent to DWS. Distribution chlorine residual is measured each time coliform samples are collected for the RTCR. Water that is UV off spec is monitored and a report is prepared and sent to DWS. Both facilities are meeting all the requirements of this regulation.

SUB’s WSSFP and Thurston Well No.2 are regulated under a section of these rules that allows for alternative treatment technologies. Slow sand filtration and natural filtration are recognized as very effective technologies for the treatment of *Giardia* and *Cryptosporidium* when operated properly. The criteria established in the rule identify compliance criteria for turbidity at less than 1 NTU in 95 percent of samples collected during the month. The maximum turbidity allowed is 5 NTU. The WSSFP and Thurston Well No.2 have met these criteria continuously since startup and are expected to be able to successfully meet the criteria for the foreseeable future.

The Chase Wellfield Water Treatment Plant, owned by RWD is also regulated under the alternative treatment technology rules, using validated 2-micron polyester fibers. An added 82,000-gallon chlorine detention line provides CT. Turbidity levels are measured at the combined filter effluent and monitored on SCADA with monthly reports sent to DWS. Chlorine residual is continuously monitored at the Chase Wellfield entry point. The lowest chlorine residual is recorded each day and used to calculate CT values. Entry point chlorine data used to calculate CT is monitored on SCADA and monthly reports are sent to DWS. Distribution chlorine residual is measured each time coliform samples are collected to meet the RTCR.

Springfield Utility Board has completed the 2007/2009 and 2015/2017 *Cryptosporidium, E. coli* and turbidity sampling requirements identified in LT2ESWTR for the Willamette Slow Sand Filtration Plant source. No *Cryptosporidium* were identified in either 2-year monthly sampling cycle and in both cases a Bin 1 Classification was certified for this source. Based on the Bin 1 Classification, no additional treatment was required at that time. The source for Thurston Well No.2 is the McKenzie River, which was not sampled during the 2015/2017 round, because Thurston Well No.2 meets the 5.5-log removal/inactivation of *Cryptosporidium* requirement.

There are no uncovered finished water reservoirs and therefore SUB/RWD complies with this section of LT2ESWTR.

Studies have been completed by SUB recommending membrane filtration for a future McKenzie River surface water treatment plant. Membrane treatment technology is covered in the SWTRs as an alternative technology that requires a specific study and state approval to establish the log removal credit and operating parameters that the installed technology must operate under. This is in addition to the inactivation needed through UV and/or chlorine CT. As noted above, SUB took the decision to forego *Cryptosporidium* monitoring for installation of UV disinfection at Thurston Well No.2. That decision will need to be revisited for design of a future McKenzie River surface water treatment plant since the bin classification may have a greater impact on cost for a surface water plant with the build out capacity anticipated for that facility. The results of any source water sampling for the future McKenzie River treatment facility may impact the requirements currently imposed for *Cryptosporidium* inactivation of the Thurston Well No.2 water.

Supplementing water supply in the North System with water from the West System by way of a new North-West transmission main will require a review of the sampling requirements in the North System and specifically in the RWD System. The current RWD sampling plan is based on a strictly groundwater source and will need to address the IESWTR and the requirements of the disinfection and disinfection byproduct rules discussed in Subsection 4.11 below before water from the Willamette Wellfield is exported to the North System. It is recommended that revisions to the water quality sampling plan be included in the scope of work for the design for the North-West transmission main.

All reports for the SWTR, IESWTR, LT1ESWTR, and LT2ESWTR are kept on record for a minimum of ten years. All GWUDI reports are kept for a minimum of five years.

4.6 Revised Total Coliform Rule

The EPA published the RTCR in 2013 and DWS began implementing provisions of the rule on April 1, 2016. The RTCR is a revision of the Total Coliform Rule (TCR), which was in effect at the time the previous WSMP was prepared in 2010. This rule applies to all surface water and groundwater systems. Total coliforms (TC) include both fecal coliforms and *E. coli*. Coliform samples are collected at representative sample site in the distribution system.

The most significant change from the TCR to the RTCR is the repeal of an MCL for TC. The RTCR replaced the TC MCL with an MCL for *E. coli*. An *E. coli* MCL occurs when either of the following sampling combinations obtains:

1. A routine sample that is positive for TC is followed by a repeat sample that is either positive for *E. coli* or is positive for TC when analysis for *E coli* has not been conducted on the repeat sample.

2. A routine sample that is positive for *E. coli* is followed by the failure to collect a repeat sample or by analysis of a repeat sample that is found to be positive for either *E. coli* or TC.

Table 4-4
Revised Total Coliform Rule Requirements: How to Respond to Results from Routine Coliform Samples

1st Lab Results	Response	2nd Lab Results	Response
Total Coliform negative (TC-)	Resume routine sampling until a minimum number of samples are collected in the month.	**None**	None
Total Coliform positive (TC+)	Collect repeat and triggered samples within 24 hours. of receiving initial TC+ or EC+ result. <u>Repeat samples:</u> Collect 3 samples, one from the original TC+ or EC+ site, the other 2 from taps within 5 service connections upstream and downstream of the original TC+ or EC+ site. <u>Triggered samples:</u> If original TC+ or EC+ sample site was being supplied by a groundwater source within last 2 weeks,	**Repeat TC-**	Resume routine sampling.
		Triggered TC-	No further groundwater source sampling.
		Repeat TC+	Collect samples within 24 hours of receiving results. Collect 3 repeat samples and continue to do so until a set of 3 samples are all TC-. If 4 or more samples are TC+ in a month a Level 1 Coliform Investigation is required within 30 days.
		Triggered TC+	No further groundwater source sampling.

1st Lab Results	Response	2nd Lab Results	Response
	sample this well(s) or common header. Collect chlorine residual and temperature at groundwater source entry point. Notify upstream/downstream users if needed.	Repeat EC+	This is a Maximum Contaminant Level (MCL) violation and requires a boil water notice within 24 hours of being notified of the results. Notify OHA immediately or no later than the day the results are known. Also, a Level 2 Coliform Investigation (Attachments) is required within 30 days.
		Triggered EC+	Collect 5 additional groundwater source confirmation samples within 24 hours of receiving results. Collect chlorine residual and temperature at groundwater source entry point. If one of these samples is EC+ a GWR public notice is required within 24hours.
E. coli positive (EC+)	Collect repeat and triggered samples within 24 hours. of receiving initial TC+ or EC+ result. Repeat samples: Collect 3 samples, one from the original TC+ or EC+ site, the other 2 from taps within 5 service connections upstream and downstream of the original TC+ or EC+ site. Triggered samples: If original TC+ or EC+ sample site was being supplied by a groundwater source within last 2 weeks, sample this well(s) or common header. Collect chlorine residual and temperature at groundwater source entry point. Notify upstream/downstream users if needed.	Repeat TC+ or EC+	This is a Maximum Contaminant Level (MCL) violation and requires a boil water notice within 24 hours of being notified of the results. Notify OHA immediately or no later than the day the results are known. Also, a Level 2 Coliform Investigation is required within 30 days.
		Triggered EC+	Collect 5 additional confirmation samples within 24hours of receiving results. Collect chlorine residual and temperature at groundwater source entry point. If one of these samples is EC+ a GWR public notice is required within 24 hours.

Monthly monitoring requirements are based on the population served. Every routine sample that is positive for TC must be tested for *E. coli*. If any TC positive routine sample is also found to be positive for *E. coli*, the *E coli* positive result must be reported to the state by the end of the day on which the public water system is informed of the result. A system must collect a set of at least three repeat samples within 24 hours for each positive TC routine sample result and have the repeat samples analyzed for TC. Every repeat sample that is positive for TC must be tested for *E. coli*. If any repeat sample that is positive for TC is also positive for *E coli*, the result must be reported to the state by the end of the day on which the public water system is informed of the result. The water system must collect another set of repeat samples, unless an assessment has been triggered.

Impact to SUB and RWD: SUB updated the RTCR plan in April 2020. SUB and RWD are currently meeting all applicable requirements for the RTCR. Evaluation of distribution system water quality should be reassessed if existing well water treatment processes are modified to meet other current or proposed regulations. It is important to maintain active circulation of water throughout the distribution system, in both pipes and reservoirs, to retain a chlorine-residual and to avoid accumulation of sediment. The absence of a chlorine residual and accumulation of sediments contribute to bacterial growth, which in turn could result in failure to comply with the Rule.

These factors should be considered as new pipelines and reservoirs are being added. Large dead-end pipes should be avoided. Where they are installed, it is important for SUB and RWD to continue their existing program of regular flushing of these lines. Flushing programs must be regular and not just in response to loss of chlorine residuals, because by that time, the system may test positive for coliforms.

Reservoirs should be equipped with separate inlet/outlet pipes unless a high rate of turnover is certain. It is also valuable to include sampling taps drawing from various depths in large tanks to monitor stored water quality.

All RTCR reports are kept on record for a minimum of five years.

4.7 Groundwater Rule (GWR)

The GWR took effect in Oregon in December 2009. It applies to all groundwater systems. The purpose of this rule is to protect against harmful microorganisms in drinking water. Groundwater sources may be susceptible to fecal contamination, which can contain disease causing pathogens.

When the rule took effect water systems were required to notify the state if they will provide compliance monitoring reports that demonstrate 4-log inactivation of viruses or do triggered source monitoring. For groundwater systems that do not demonstrate 4-log viral inactivation with monthly reporting, triggered source water monitoring is required. Source water monitoring is triggered by a TC positive sample results in the distribution system, which requires collection of one triggered coliform sample (within 24 hours of a distribution system TC positive result) at each well (common header can be used for wellfields, with prior DWS approval) that was online at the time the TC positive sample was collected. If a well has an *E. coli* positive result, five more coliform samples from the same well must be collected within 24 hours. If a well has a TC positive result, no further triggered source sampling is needed (refer to **Table 4-4** in Revised TCR Subsection 4.6). Triggered source monitoring is not required for systems that demonstrate 4-log viral inactivation and submit monthly compliance monitoring reports.

The GWR identifies special notification requirement for wholesalers and consecutive systems when there are TC positive results. If the state identifies significant deficiencies in a water system survey, corrective action is required and can consist of correcting deficiencies, providing an alternative source of water, eliminating the source of contamination or providing treatment for the 4-log inactivation of viruses.

Monthly groundwater source assessment monitoring is required for 12 months (or during seasonal operation) to determine whether any fecal contamination exists in the untreated groundwater. Annual groundwater source assessment monitoring requires one untreated groundwater sample to be collected from each well (or common header location approved by DWS) per year from all water systems that disinfect groundwater. If a triggered source sample is collected during the year, this sample can be used as an annual groundwater source assessment sample.

Impact to SUB and RWD: All groundwater sources are already disinfected with chlorine at each source of supply and provide 4-log inactivation of viruses, with the exception of Sports Way/I-5 Wellfield. Willamette and Thurston Well No.2 facilities also use UV inactivation, but do not get credit for virus inactivation.

Thurston and Chase Wellfield entry points are set up to continuously monitor chlorine residual; these wellfields meet the required 4-log inactivation of viruses. For Weyerhaeuser Wellfield, SP/Maia Wellfield, I-5 Wellfield, Q St Well, and Sports Way Well, triggered source monitoring is required. When there is a TC positive sample during SUB/RWD routine monitoring triggered source monitoring may be required at these locations.

Approval was provided by DWS for SUB/RWD to collect coliform samples from Weyerhaeuser, SP/Maia, and Thurston Wellfields' common header, where untreated wellfield water combines before chlorination. A water quality map was created using conductivity, pH, temperature, turbidity and chlorine residual measurements to illustrate where entry point water goes in the distribution system. The use of this map was approved by DWS to determine which wells need triggered source monitoring, if there is a routine TC positive sample. Triggered source samples are only collected from wells supplying the area in which the original TC positive sample was collected. Historically, it is rare to have a TC positive sample in the distribution system.

The distribution system operated by SUB and RWD is combined. The GWR requires that each system notify the other in the event of a TC positive sample. Each utility will be responsible for the distribution system repeat sampling (with a minimum of three samples), groundwater source water sampling (with a minimum of one sample per well or common header; if a sample is *E. coli* positive 5 confirmation samples are required from every well), and any public notification that is required for their respective systems.

A confirmed *E. coli* positive sample at a well will trigger the requirement for 4-log treatment of viruses at the entry point to the distribution system and compliance monitoring. This will also trigger a boil water notice within 24 hours of being aware of confirmed *E. coli* positive results. To achieve 4-log treatment for viruses with chlorine, a CT value of 6.0 or greater (Table E-7 SWTR) is required. A continuously monitoring chlorine residual analyzer would need to be installed at the entry point, which is required to provide the state reports verifying that a CT of 6.0 is always met.

Monthly groundwater source assessment monitoring was conducted by SUB from May 2011 to May 2012 for Thurston, Weyerhaeuser, SP/Maia and Sport Way Wells. There were no confirmed positive *E. coli* samples found at any well. Over the 12-month period four wells in the Thurston Wellfield (3, 5, 6, and 7) had a slightly higher number of coliform detections over the year. Due to the proximity of these wells to the McKenzie River and these elevated coliform results, DWS required SUB/RWD to do additional evaluation to determine if water from these wells is GWUDI of surface water. After four sample events Thurston Well No.3, Thurston Well No.5, Thurston Well No.6, and Thurston Well No.7 were all determined to be groundwater (i.e., not GWUDI).

Monthly groundwater source assessment monitoring was conducted by RWD from February 2014 to January 2015 at I-5 Wellfield with only one TC detection. Over the same time period, Chase groundwater wells were tested with no coliform detections. Assessment of Q Street Well was conducted August 2015 to April 2016 with no detections. Monthly assessment of Chase Well No. 2 is still pending.

All GWR reports are kept on record for a minimum of 5 years.

4.8 Chemical Contaminant Rules or Phase II/V Rules

The Phase II Rule was promulgated in two notices published on January 30, 1991, and July 1, 1991. The Phase V Rule was promulgated on July 17, 1992. The Chemical Contaminant Rule established a list of 65 contaminants that the EPA regulates, which are inorganic contaminants (IOCs), VOCs, and SOCs. This rule provides public health protection through the reduction of chronic risks from cancer, organ damage, reproductive system disorders, circulatory system disorder, or nervous system disorders. One exception is nitrate and nitrite which presents an acute health risk of "blue baby syndrome."

Inorganic contaminants are metals, salts, and other compounds that do not contain carbon. These are elements or compounds that may be natural in the geology or caused by activities of humans through mining, industry, construction, or agriculture. For instance, older fruit orchards may contain high levels of arsenic, which was once used as a pesticide.

Synthetic organic contaminants are man-made chemicals used for a variety of industrial and agricultural purposes. They occur as pesticides, defoliants, fuel additives, and as ingredients for other organic compounds. They are generally toxic, and many are known carcinogens. Some of the more well-known SOCs are atrazine, glyphosate, 2,4-D, dioxin, pentachlorophenol, and polychlorinated biphenyls (PCBs).

Volatile organic contaminants are commonly found in urban and industrial settings. They are used and produced in the manufacture of paints, strippers, solvents, cleaning supplies, electronic equipment, adhesives, petroleum products, pharmaceuticals, and refrigerants. They are often components of fuels, solvents, hydraulic fluids, paint thinners, and dry-cleaning agents. Many of the chemicals on the EPA list of regulated VOCs are DNAPLs, which are particularly harmful to groundwater. Many VOCs are toxic and are known or suspected human carcinogens. A few common VOCs include toluene, methylene chloride, xylenes, benzene, and styrene.

This rule provides Maximum Contaminant Level Goals (MCLGs) for each contaminant. The MCLG is the level of contaminant that can be in the drinking water for which there is no known adverse health effects to a person and which allows an adequate margin of safety. They cannot be enforced. If the contaminant is known to cause cancer, the MCLG is set at zero because exposure to this contaminant could present a cancer risk.

The EPA also used these rules to set MCLs for each contaminant. The MCL is set as close to the MCLG as possible. However, not all MCLs are as low as the MCLG because the MCL weighs the technical and financial barriers along with public health protection.

New surface or groundwater sources are required to be tested for all IOCs, VOCs, and SOCs prior to use. Testing frequency is higher when a new source is brought on-line to the system. See **Table 4-5**. Monitoring reductions may be approved by DWS. See **Table 4-6**.

Table 4-5
Chemical Contaminant Rule Monitoring for New Source

Contaminant	Sampling Frequency- Surface Water	Sampling Frequency- Groundwater
IOC	Yearly	One
VOC	4 Quarters	4 Quarters
SOC	4 Quarters	4 Quarters
Nitrate	4 Quarters	Yearly
Nitrite	One	One

Table 4-6
Chemical Contaminant Rule Monitoring for Existing Source with Monitoring Reductions Granted

Contaminant	Sampling Frequency- Surface Water	Sampling Frequency- Groundwater
IOC	Every 9 years	Every 9 years
VOC	Annually	Every 3 years
SOC	Every 3 years 2 consecutive quarters	Every 3 years
Nitrate	Annually	Annually
Nitrite	Every 9 years	Every 9 years

Chemical Contaminant Rule samples are collected from entry points, with the exception of asbestos. Asbestos samples are collected from the distribution system. Dioxin and acrylamide/epichlorohydrin are only sampled if notified to do so by DWS.

Impact on SUB and RWD: Because of the water system's approved Drinking Water Protection Plan, SUB and RWD were granted a reduction in SOC and VOC monitoring from 3 years to 6 years. Pentachlorophenol (an SOC) testing was not reduced at Weyerhaeuser Wellfield entry point and must be sampled annually during wellfield operation. To ensure vigilant monitoring of SOCs and VOCs, SUB voluntarily samples annually for these organic contaminants for all sources.

It is anticipated that any potential contamination from industrial sources or localized spills of gasoline or other chemicals will be closely monitored and necessary steps taken to eliminate this contamination by treatment of the well water or shutdown of the impacted wells long before any SOC or VOC MCL is reached, or public health is compromised.

Since 2010, there have been no detections of SOCs and VOCs at any of SUB's five entry points. Very low detections of Barium were found at the SP/Maia and Thurston Wellfields. The Weyerhaeuser Wellfield GAC Plant is operated when wells are sending source water to the distribution system. The GAC plant was installed and is operated to remove pentachlorophenol from Weyerhaeuser Wellfield source water. At this time, pentachlorophenol has not been detected in the combined wellfield source water. The GAC plant is operated as a precaution.

It is recommended that SUB and RWD continue to be vigilant in their efforts to monitor for contaminants, monitor chemical uses, require protective measures for chemical storage and use, insist on appropriate cleanup where contaminants are discovered in the aquifer, and support other state and federal agency efforts that help remove contaminant risks in the drinking water supply areas.

All Chemical Contaminant Rule reports are kept on record for a minimum of 10 years.

Table 4-7
Chemical Contaminant Rule Monitoring Schedule for SUB/RWD.

Contaminant	Sampling Frequency- Surface Water Willamette Slow Sand Filtration Plant Thurston Well No. 2 and Wellfield, Chase Well No. 2	Sampling Frequency, Groundwater: Weyerhaeuser, SP/Maia, I-5/Sports Way and Chase Wellfields, and Q St Well
IOC	Every 9 years	Every 9 years
VOC	Annually	Every 6 years[2]
SOC	Every 3 years 2 consecutive quarters[2]	Every 6 years [1,2]
Nitrate	Annually	Annually
Nitrite	Every 9 years	Every 9 years

Notes:
1. Pentachlorophenol samples are collected annually at Weyerhaeuser Wellfield.
2. Annual SOC and VOC sampling is conducted on all SUB's sources

4.9 Arsenic Rule

The EPA was under a court-ordered deadline to propose arsenic regulations by November 1992. The EPA requested an extension of this deadline pending further studies of occurrence and health effects. The 1996 SDWA Amendments required the EPA to develop a comprehensive plan to study the health risks associated with exposure to low levels of arsenic and to consult with other agencies, such as the National Academy of Sciences. The result was the reduction of the MCL from 50 micro grams per liter (µg/L) down to 10 µg/L in 2001, with compliance required by 2006.

Table 4-8
Arsenic Rule Monitoring Schedule

Contaminant	Sampling Frequency- Surface Water	Sampling Frequency- Groundwater
Arsenic	Annually	Every 3 years

Impact on SUB and RWD: All SUB and RWD water sources meet the standard of 10 µg/L. All wellfields except Thurston have had low detection levels of arsenic. Quarterly samples were collected by SUB for one year at each water source and no detections levels were above 5 µg/L.

All Arsenic Rule reports are kept on record for a minimum of 10 years.

4.10 Lead and Copper Rule

In 1991, the EPA published maximum contaminant level goals and regulations for monitoring lead and copper, including action levels that may require installation of corrosion control measures. Lead and copper enter drinking water primarily through leaching of the metals from service lines and plumbing fixtures. Therefore, regulation of these contaminants focuses on monitoring the concentrations at points of use and implementing corrosion control measures when concentrations exceed specified action levels.

The LCR regulation required lead and copper to be monitored at consumers' taps every 6 months. One monitoring period is equivalent to 6 months, and two monitoring periods are required per calendar year (January to June and July to December).

In April 2000 the EPA published the Lead and Copper Rule Minor Revisions (LCRMR). The LCRMR streamlined reporting and allowed for reduction in the number of sample sites monitored and the frequency of sampling for systems that meet specified criteria. The LCRMR did not change the action levels (AL) nor the basic requirements to treat source water if necessary, maintain optimal water quality parameters, deliver public education and replace lead service lines.

Water samples at the customer's tap are required to be taken at high-risk locations, which are defined as homes with the following conditions.

- Copper pipes with lead solder installed from January 1, 1983 through June 30, 1985
- Lead service lines
- Lead interior piping

For a water system to comply with the LCR, the samples at the customer's tap must not exceed the following ALs.

- Lead - 0.015 mg/L detected in the 90th percentile of all samples
- Copper -1.3 mg/L detected in the 90th percentile of all samples

If the ALs are exceeded for either lead or copper, the water system is required to collect source water samples and submit the data with a treatment recommendation to the state. Additionally, if the lead AL is exceeded, the water system is required to present a public education program to their customers within 60 days of learning the results. The public education program must be continued as long as the water system exceeds the lead ALs.

All systems that exceed the lead or copper AL and all systems serving more than 50,000 persons are required to conduct corrosion control studies and optimize corrosion control at the customer tap. Corrosion control studies must compare the effectiveness of pH and alkalinity adjustment, calcium adjustment, and addition of a phosphate or silica-based corrosion inhibitor. In addition to monitoring lead and copper, systems that exceed the lead or copper ALs are required to monitor other water quality parameters.

The EPA is considering Long-Term Revisions to the Lead and Copper Rule. The changes under consideration include substantive changes as well as streamlining the requirements imposed by the rule. Changes under consideration include:

- Proposing full lead service line (LSL) replacement, eliminating the current approach which allows partial LSL replacement when the property owner is unwilling or unable to pay for the portion of the LSL not owned by the utility.
- A range of options for strengthening corrosion control treatment requirements.
- Replacing the current lead AL of 15 parts per billion (ppb) - which was based on a technological assessment that this level was generally representative of effective corrosion control - with a health-based benchmark. Currently the only health-based benchmark in the LCR is the MCLG of zero since there is no safe level of lead exposure.
- Potentially requiring point of use filters where there has been a disturbance of an LSL or where tap sampling indicates an exceedance.
- Clarifying and strengthening sampling requirements.
- Increasing public transparency and information sharing.
- Strengthening public education requirements.
- Potentially revising copper requirements since lead and copper leaching patterns differ. This may include modifying sample site selection to include sites at greater risk of elevated copper and defining water quality parameters that specifically identify waters that are aggressive to copper.
- Required development of a LSL inventory within 3 years of the final rule publication.

Impact to SUB and RWD: Springfield Utility Board serves more than 50,000 people and was required to complete a corrosion control study and optimize corrosion treatment even though lead and copper action levels were not exceeded. In August 2009, DWS approved SUB's process recommendation for packed tower aeration to remove carbon dioxide and increase pH to 7.5 at the Willamette, Thurston, and Weyerhaeuser sources. First, a corrosion control facility using packed tower aeration (with sodium hydroxide as back-up) was built for the Willamette source. This corrosion control facility was commissioned February 2013. The second corrosion control facility using only sodium hydroxide was constructed for the Thurston source and was put into operation in April 2014. Construction of the Weyerhaeuser Wellfield corrosion control facility was postponed to give DWS a chance to evaluate the two lead and copper sampling periods scheduled for 2015.

In 2015, two lead and copper sampling periods were conducted to evaluate the effectiveness of Willamette and Thurston corrosion control facilities to optimize lead and copper levels. The 2015 lead and copper results were reviewed and on February 26, 2016, DWS declared SUB's water system optimized for corrosion control and set the pH minimum at 7.4 for the Willamette Slow Sand Treatment Facility and Thurston Wellfield Facility entry points. Based on these results, DWS also concluded constructing Weyerhaeuser Wellfield corrosion control facility was unnecessary. DWS then required SUB to conduct another two lead and copper sampling periods in 2016. The results from these two sampling periods exhibited that having a pH level of 7.4 or higher at these two entry points effectively optimized SUB's water system for lead and copper.

Subsequent to this determination, DWS modified their position and added a requirement for a minimum pH value of 7.0 at the Weyerhaeuser Wellfield entry point. A pilot study was performed in 2019 to determine an appropriate feed rate for the injection of caustic soda to provide pH adjustment. A joint SUB/RWD facility was constructed adjacent to the Weyco GAC treatment system, to address lead and copper rule compliance. The joint Weyerhaeuser corrosion control facility was commissioned June 2021.

Sixty LCR samples are required, unless monitoring results determine that the number can be reduced to 30 samples. The SUB LCR samples were collected in 2017 and the results were below the optimization levels for lead and copper. The LCR monitoring schedule has been reduced to 30 samples every 3 years. In an effort to update SUB's records, a pipe material survey for LCR samples sites was conducted in 2017.

In addition to implementing corrosion control treatment at the Willamette and Thurston facilities, SUB has been aggressively pursuing and removing potential sources of lead. No LSLs were installed in Springfield's water system. Prior to 1950, leaded goosenecks (also called "pigtails") were used on some homes. These are short, 1 to 2-foot-long pipes connecting the water service line to the main. Service piping is rigid while the lead goosenecks were flexible and could be bent to connect to the service line. SUB has identified water services by age and type of construction that have the potential for lead components and has been systematically inspecting these services and replacing components as needed. SUB has also identified areas where lead service goosenecks may have been installed in the West system prior to SUB owning the facilities. The LCR requires that these lead service connections be removed if there is an actionable level detected, and SUB has removed all lead goosenecks when they are discovered as part of maintenance and repair programs. It is anticipated that the next LCR revisions will require removal of all lead goosenecks, so SUB and RWD should continue to replace any discovered lead gooseneck. SUB has an aggressive schedule for digging up services in the West system that have the potential for a lead gooseneck. If a lead gooseneck is found, crews remove the lead gooseneck and replace the entire service. Lead goosenecks will be removed from all of SUB's water system. As of June 2020, SUB had inspected 254 services with potential for lead and found 13 lead goosenecks that were replaced.

In 1993, RWD had an exceedance of copper in its water system. Through a series of seasonal valve closures, RWD is able to prevent lower pH levels from entering their water system. A corrosion control plan was approved by DWS and the water system's lead and copper levels have been optimized ever since 1993. The District voluntarily installed corrosion control as part of the Chase Wellfield Water Treatment Facility commissioned in 2018, allowing the addition of caustic soda for both Chase Well No. 2 (GWUDI) and other Chase (groundwater) wells, to raise pH at the entry point above 7. They have also investigated potential sources of lead in service lines. They have no known lead services or lead goosenecks, but an inventory of older homes has been compiled and staff investigated these and confirmed no lead exists that would warrant service replacement. There was one hydrant found with a suspected lead joint. Testing determined the material to be leadite, not lead.

All LCR reports are kept on record for a minimum of twelve years. Monthly Lead and Copper Corrosion Control reports are kept on record for a minimum of 10 years.

4.11 Disinfectants and Disinfection Byproducts Rules (DBPRs) (Stage 1 and Stage 2)

The Stage 1 Disinfectants and Disinfection Byproducts rule (Stage 1 DBPR) applies to all community water systems and nontransient noncommunity water systems that treat water with a chemical disinfectant for primary or residual treatment. The Stage 1 DBPR came into effect in December 1998 and regulates Total Trihalomethanes (TTHMs) and Haloacetic Acids (HAA5s).

Calculation of the TTHM value is based on the concentrations of the following individual trihalomethanes.

- Trichloromethane (chloroform)
- Tribromomethane (bromoform)
- Bromodichloromethane
- Dibromochloromethane

Calculation of the HAA5 value is based on the concentrations of the following individual haloacetic acids.

- Monochloroacetic acid
- Dichloroacetic acid
- Trichloroacetic acid
- Monobromoacetic acid
- Dibromoacetic acid

All trihalomethanes have MCLGs established with the exception of chloroform and two of the HAA5s (dichloroacetic acid and trichloroacetic acid). The rule also regulated the maximum residual concentrations permissible for chlorine, chloramines, and chlorine dioxide for systems using those disinfectants. For plants that use ozone it regulated the MCL for bromate, and for plants that use chlorine dioxide it set an MCL for chlorite. The MCLs for TTHMs and HAA5s in the Stage 1 DBPR were calculated as the running annual average of quarterly samples at four distribution system sites per plant or entry point. The MCLs for several constituents relevant to the SUB and RWD systems are listed in **Table 4-9**.

Table 4-9
Selected Constituents Regulated by Stage 1 DBPR

Constituent	MCL / Requirement
Chlorine	4 mg/L
Total Organic Carbon (TOC)	Treatment Technique
TTHMs	80 µg/L
HAA5s	60 µg/L

The Stage 2 DBPR came into effect in January 2006. All systems covered under the rule were required to complete Initial System Distribution Evaluation (ISDE) by July 1, 2010. This rule maintained the MCL levels established in Stage 1 DBPR for TTHMs and HAA5s and the maximum residual levels for chlorine and other disinfectants. It added an MCLG for chloroform and monochloroacetic acid and reduced the MCLG for trichloroacetic acid.

The most significant change in Stage 2 DBPR was the requirement that the MCL be calculated on the locational running annual average of quarterly samples taken at locations determined by the IDSE. The compliance sites for systems in the size range of the SUB/RWD system consist of locations within the distribution system where high TTHMs are found, where high HAA5s are found, and locations with average residence times. The number of sites is based on the type of source water and population served. The rule provides for reduced monitoring for systems with very low disinfection by-products based on two years of existing data.

Impact to SUB and RWD: In preparation for the implementation of Stage 2 DBPR, SUB and RWD collected 2 years of quarterly samples, as required by the Stage 1 DBPR. The samples were collected on a reduced monitoring schedule approved by DWS. One sample per quarter was collected from each source in each utility's distribution system. These sample locations were selected as they were the highest TTHM and HAA5 results from historical sampling data.

Results from this sampling program demonstrated that no single sample exceeded one half the regulated MCL of 80 µg/L for TTHMs or 60 µg/L for HAA5s. In addition, the systems had no TTHM or HAA5 monitoring violations during the two-year period. These results qualified the systems for a 40/30 Certification Waiver, which is one of the four ways to meet the IDSE requirements of the Stage 2 DBPR. SUB and RWD each submitted a 40/30 Certification to EPA for approval, and EPA confirmed the 40/30 Certification in 2007 for each utility. The result is that an IDSE is not required and SUB and RWD can continue monitoring on the reduced monitoring schedule of one sample per plan per quarter. On October 1, 2012, SUB complied with Stage 2 DBP monitoring requirements of dual sample sets at eight locations on a quarterly basis. In October 2013, the number of quarterly sample sites was reduced to four. RWD collects annual samples at two sites. SUB also collects quarterly TOC samples from Willamette and Thurston sources.

Rainbow Water District has implemented voluntary corrosion control at Chase to increase pH above 7. Springfield Utility Board has implemented corrosion optimization measures at the Willamette and Thurston sources, as discussed under Subsection 4.10 Lead and Copper Rule. Packed aeration for carbon dioxide stripping was installed at the Willamette site and sodium hydroxide injection at the Thurston site. Both treatment systems increase the water to 7.8 standard pH units. Any increase in disinfectant application or pH adjustment will need to be monitored to confirm continued compliance with the 40/30 Certification and the Stage 2 DBPR.

All DBPs reports are kept on record for a minimum of ten years.

4.12 Radionuclides Rule

In 2000, EPA Revised the 1977 radionuclide rule. This revision set new monitoring provisions and also issued a standard for uranium. Radionuclides occur naturally and are present in soil and rock; they can also be found in surface water and groundwater. The current standards are shown in **Table 4-10** below.

Table 4-10
Radionuclides Requirements

Constituent	Requirement
Combined Radium 226/228	5 pCi/L[1]
Gross Alpha	15 pCi/L
Beta Emitters	4 mrem/yr[2]
Uranium	30 µg/L

Note:
1. pCi/L= picoCuries per liter
2. mrem/yr= millirem per year

Impact to SUB and RWD: Radionuclides were not detected at any entry point sample during the last round of sampling (RWD in 2012 and SUB in 2017). Samples are collected every nine years. There is little impact to SUB and RWD as a result of the Radionuclide rule, and there is likely to be little impact from any future rule for radon due to the low levels of radionuclides in this geographic area.

All Radionuclides reports are kept on record for a minimum of 10 years.

The EPA proposed a standard of 300 picocuries per liter (pCi/L) in 1991 for Radon. However, promulgation of this regulation was delayed by Congress in order to promote a more comprehensive review of costs and benefits. The 1996 SDWA Amendments require that within 3 years, the EPA promulgate a radon standard based on best available science, risk assessment, and analysis of incremental costs and benefits associated with control. The rule was proposed in 1999. The final rule was scheduled for 2009 and may be re-proposed by EPA.

4.13 Secondary Standards

The EPA established Secondary Maximum Contaminant Levels (SMCLs) in 1979. Secondary standards are aesthetic-based. They are designed to minimize or prevent objectionable appearance, color, odor or taste. These standards are not federally enforceable, and testing is voluntary..

Impact to SUB and RWD: SUB voluntarily samples secondary standards a minimum of every five years. Results are consistently well below the SMCLs. Secondary standards are not expected to have a big impact on SUB or RWD's system because the water in this region has excellent aesthetic qualities.

All secondary standard reports are kept on record for a minimum of 10 years.

Manganese is currently regulated as a secondary standard, although it is anticipated to be come a primary standard by EPA.

4.14 Unregulated Contaminant Monitoring Rule

The SDWA amendments of 1996 required the EPA to establish regulations for an ongoing UCMR. This regulation requires the monitoring of no more than 30 contaminants every five years and storing the test results in a National Contaminant Occurrence Database. The EPA must monitor large systems (who pay for the testing) and monitor a representative sample of small systems serving less than 10,000 (EPA pays for this testing).

The UCMR water quality results are used to prioritize and evaluate contaminants on the Drinking Water Contaminant Candidate List (CCL) and play an important role in supporting regulatory determinations and future rulemakings. When selecting UCMR contaminants, the CCL is typically the source of contaminants for the next monitoring cycle. The CCL is made up of contaminants that are known or anticipated to occur at water systems, are not regulated, and may warrant regulation under the SDWA. The monitoring cycles completed thus far are UCMR 1 (2001-2005), UCMR 2 (2008-2010) and UCMR 3 (2013-2015). UCMR 4(2018-2020) started for RWD and 2019 for SUB.

Impact to SUB and RWD. SUB has participated in all the UCMR monitoring cycles. In the first three UCMR cycles, SUB had no detections. Under the UCMR 4 monitoring cycle, SUB has very low detections for chromium, chromium-6, strontium and vanadium. Springfield does not have large industrial processes using chromium, so the source of chromium and chromium-6 are thought to be naturally occurring from the erosion of natural mineral deposits that contain the element. Strontium and vanadium detections were also attributed to erosion of natural mineral deposits.

In 2019/2020, SUB had detections of bromide, manganese, HAA-5, HAA-6-BR, HAA-9, and Total Organic Carbon. SUB will continue to participate in UCMR monitoring cycles every 5 years.

Participation by RWD in UCMR 4 was as a small system. They had low level detections of bromide at three wellfields, and low levels of DBPs (HAA5, HAA6Br, and HAA9) at one of two distribution system sample locations.

All UCMR records are kept for a minimum of 10 years.

4.15 Cyanotoxin Health Advisory

The cyanotoxin health advisory levels were established in 2015 by the EPA, for *cylindrospermopsin* and *microcystins.* Health advisories for these cyanotoxins were used by EPA, since cyanotoxins are not subject to any national primary drinking water regulation. The cyanotoxin health advisories were set at levels below which adverse health effects are not anticipated to occur over a 10-day period.

Cyanobacteria, also known as blue-green algae, are commonly found naturally occurring in surface waters. Some cyanobacteria species are referred to as toxigenic because they have the potential to produce toxins called cyanotoxins. Cyanotoxins can affect the nervous system and liver function and can act as a skin irritant. Removing cyanobacteria from the water can be done by water filtration plants. The cells of the cyanobacteria generally contain 70 to 100 percent of the total toxins present. When the cells rupture or die, more toxin is released into the water. Removing cyanotoxins that have been released into water is more difficult than removing the cells.

Table 4-11
EPA's Cyanotoxin Health Advisory (10-day) Levels

Cyanotoxin	Children (age 5 and younger)	Adults (age 5 and older)
Clyindrospermopsin	0.7 µg/L	3 µg/L
Microcystins	0.3 µg/L	1.6 µ/L

Table 4-12
Oregon's Cyanotoxin Testing Requirements (effective January 2019)

Topic	Requirement
Applicability	Sample susceptible source or surface water source that has had harmful algal blooms or cyanotoxin detections in the past. Also, if a surface water source is downstream from a water body with past harmful algal blooms or cyanotoxin detections.
Frequency	Sample every 2 weeks, May through Oct. 31.
Monitoring Summary	If cyanotoxins are detected in raw water at or above 0.3 µg/L for microcystin or cylindrospermopsin, sample raw water weekly, and finished water weekly. If detected on finished water, sample finished water daily. Monitoring of finished water can return to weekly following two consecutive non-detects at the entry point and can cease if not

	detected in two consecutive weekly samples and levels are below 0.3 ug/L in raw water. If finished water results are over any advisory level, collect confirmation sample as soon as practical, within 24 hours. Sample daily at entry point. If confirmed over any health advisory level in finished water, a “do-not-drink” advisory must be issued for that system and any purchasing water systems.
Health Advisories	Water suppliers will issue a “do-not-drink” advisory if routine and confirmation samples are over any health advisory level (i.e., vulnerable or general populations). Health advisory levels established by EPA for the two cyanotoxins regulated by these rules are set at a concentration that anticipates no adverse health effects expected if the water is consumed for up to 10 days. Issuing an advisory only when results are confirmed is consistent with other Safe Drinking Water Act contaminants. Given errors in sample collection or analysis, confirming the results prior to action is a standard and reasonable approach. An advisory may be lifted upon approval by OHA if two consecutive samples from finished water and the distribution system are at or below the health advisory level in both the system treating the water, and any downstream purchasing water systems.

Impact to SUB and RWD: SUB has been sampling for cyanotoxins in the Middle Fork Willamette River at the Slow Sand Filtration Plant, since 2013. Dexter Reservoir is about 15 river miles upstream of the Slow Sand Filtration Plant’s intake, where samples are collected. Initially, SUB started sampling at the intake location once cyanotoxins were detected in the reservoir by the City of Lowell, which has a drinking water intake on the reservoir. If cyanotoxins are detected in Dexter Reservoir, SUB is required by DWS to collect samples at the SUB intake and entry point one week after being notified of the City of Lowell cyanotoxin detection. Weekly samples are required until the City of Lowell no longer detects cyanotoxins.

In 2014, Microcystins were detected in the Middle Fork Willamette River and five of the detections were above the children (age 5 and younger) health advisory level. No cyanotoxins were detected in the Willamette Slow Sand Plant finished water in 2014. In 2015, Cylindrospermospin was also detected in the Middle Fork Willamette River. All detections were below the health advisory level and there were no detections of Cylindrospermospin in the Willamette Slow Sand Plant finished water in 2015. Since 2017, SUB is sampling the river intake monthly May – October regardless of whether or not there is an algal bloom in Dexter Reservoir.

Since 2019, SUB has been collecting two cyanotoxin samples every 2 weeks, May 1st through October 31st, from a sample site that has a combination of Middle Fork Willamette water and Willamette GWUDI well water and from the wellhead of Thurston Well 2. There have not been any detections of Microcystins or Cylindrospermopsin.

Studies have shown that slow sand filters can remove 99 percent of algal cells. Cyanotoxins can also be removed by slow sand filters: microcystins can be removed by up to 80 percent and anatoxin-a can be removed by up to 70 percent. Slow sand filtration has proven to provide effective protection from the level of cyanotoxins detected in the Middle Fork Willamette River thus far. If higher levels of cyanotoxins are detected in the river water in the future, other types of treatment may be needed. SUB plans to construct a water treatment plant that will use the McKenzie River as its source. Considerations will need to be made for cyanotoxins when designing this treatment plant.

Sampling for cyanotoxins by RWD at Chase Well No.2 began in July 2018. To date, there have been no detections of either Total Microcystins or Cylindrospermopsin.

All cyanotoxin records are kept for a minimum of 10 years.

4.16 Variance and Exemptions Rule

The Variance and Exemption Rule was established in 1998. There are two types of variances. The first is for water systems that cannot comply with the NPDWR because of their source water quality. The second is for small water systems that cannot afford to comply. Small systems are defined as less than 3,300 people and this number may be extended to 10,000. The first option for a variance requires the water system to comply as soon as possible and requires a compliance schedule determined by the state. The second option require small water systems to comply in three years. For large systems, variances will not be granted for MCL exceedance under the RTCR or treatment technique requirements.

Exemptions still require water systems to comply with the NPDWR, but they allow water systems additional time to comply with NPDWR. Systems must achieve compliance at soon as practicable and in accordance with the State timetable. For large systems, initial exemptions cannot exceed three years. Small systems may be eligible for extension periods. Generally, exemptions from the RTCR MCL are not granted.

Impact to SUB and RWD. SUB and RWD both comply with NPDWR and this rule does not impact either water system at this time.

All Variance and Exemption documents will be kept for a minimum of 3 years.

4.17 Public Notice Rule

Revisions to the Public Notice Rule were made effective in 2000. This rule expanded the number of violations requiring notice, simplified mandatory health effects language, brought all public notice information into one rule and allowed for more state primacy agency flexibility. The timing and distribution requirements changed to those shown in **Table 4-13**.

Table 4-13
Public Notice Rule

Public Notice Tier	Requirement
Tier 1	24 hours
Tier 2	30 days
Tier 3	1 year

Note:
The clock for notification starts when the water system first learns of the violation.

Consumer Confidence Reports can be used for Tier 3 notifications, as long as notice is within one year of first finding out about the violation. If a public notice was issued, the water systems has ten days to send a certification of compliance and a copy of the completed notice to the state. A copy of the public notice must be kept on record for three years.

Impact to SUB and RWD: Although SUB and RWD have not had many violations that triggered issuance of public notices, it is something each water system must always be aware of and be prepared for. SUB and RWD have used public notices for customers that have lost pressure in the water main supplying their home. In preparing for a system-wide boil water event, SUB has created additional public notice language and created a robo-calling system to help get the message out.

All public notice documents are kept on record for a minimum of 3 years.

4.18 Consumer Confidence Report Rule

The Consumer Confidence Report (CCR) Rule was established in 1998. This rule provides public health protection by allowing consumers to make educated decisions regarding any potential health risks pertaining to the quality, treatment and management of their drinking water supply. The CCR is a document that water systems are required to prepare and distribute annually. It summarizes information regarding the water system, the sources of water, definitions, any detected contaminants, compliance and educational information. The water system must deliver the CCR to all billing units or service connections each year and must meet certain deadlines as shown in **Table 4-14**.

Table 4-14
Consumer Confidence Report Rule

Date	Annual Requirements
April 1	Deadline for wholesale providers to deliver water quality information necessary for water purchaser to prepare their CCR.
July 1	Deadline for annual distribution of CCR to customers and State for the report covering January 1 – December 31 of previous calendar year.
October 1	Deadline for annual submission of proof of distribution to state. (If CCR was sent to customers before July 1, then 90 days after distribution date of CCR to customers)

Note:
*The CCR must be made available to customer on request.

In 2012, a CCR Rule Retrospective Review was completed. This review focused on improving the effectiveness of communicating water quality information to the consumer and on reducing the burden of doing so to water systems and States. The results of the CCR Rule Retrospective Review were as follows:

- Water Systems can now use electronic delivery of CCR
- Tier 3 public notices can be reported in CCR
- MCLs should be reported in numbers ≥1.0 in the CCR

- The ease of understanding a CCR was improved
- The process of State certification of CCRs was improved.

Impact to SUB and RWD. Each year by April 1st, RWD sends SUB necessary water quality information from their system, so that SUB can complete the CCR by the deadline. SUB's CCR is available electronically by June 1st and customers' bills are sent with notices throughout the month of June. Customers can find the electronic CCR using a URL, which takes them directly to the CCR. They can also request a hard copy or pick one up at SUB's three office locations. A CCR certification form is sent to the state by October 1st. SUB keeps two CCRs and certification letters on file for 3 years. RWD's electronic CCR is posted to the website and the URL mailed to customers in a bill insert by June 30. Paper copies are made available at RWD's office. Certification to the state is completed by July 15, and copies of the CCR and certification letters are kept on file.

4.19 Per-and Polyfluoroalkyl Substances (PFAS) Health Advisory

Per- and polyfluoroalkyl substances, or PFAS, are persistent human-made compounds used in a wide variety of industrial and consumer products. They are highly resistant to heat, oil, and water, making them valued for products such as food packaging, stain- and water-repellant fabrics, and nonstick cookware. Certain fire-fighting foams designed to suppress fuel fires contain PFAS; and, because they help reduce friction, PFAS are also used in a variety of other industries including aerospace, automotive, building and construction, and electronics.

As a class, PFAS includes thousands of different chemicals, and some are now known to have adverse health effects. Currently there are over 600 PFAS compounds that the EPA has approved for sale or import into the United States. The most commonly detected and studied PFAS chemicals are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Though industry in the United States has voluntarily phased out PFOA and PFOS, they are still persistent in the environment.

In 2016, EPA issued lifetime Health Advisory levels for PFOA and PFOS in drinking water at 70 parts per trillion (ppt) separately or combined.

Impact to SUB and RWD:

In February 2020, EPA released its PFAS Action Plan, which includes, among other elements, a proposal to regulate PFOA and PFOS. Though it will take time before EPA establishes an MCL for PFOA/PFOS, it is recommended that SUB and RWD closely follow regulatory developments.

4.20 Chlorine Handling Requirements

The EPA has developed regulations for systems using gas chlorine and sodium hypochlorite. The regulations require preparation of Risk Management Plans for each chlorine facility and may require installation of emergency chlorine scrubbing for gas chlorine facilities based on quantities stored. Risk Management Plans involve hazard assessments, emergency communication plans, safety reviews, chemical use audits, development of safety procedures and operator training. As part of a safety plan, RWD has installed chlorine gas detection systems at the RWD wellfields and is adding actuators to shut off cylinders should a leak be detected.

The current Uniform Fire Code requires installation of emergency scrubbing, although the application of the rules is dictated by local fire officers.

The Department of Homeland Security is looking at the use and storage of chlorine gas as a potential terrorist target and has implemented restrictions on the use and transport of chlorine gas.

Impact to SUB and RWD: SUB and RWD have modified their storage of gas chlorine to be less than the 2,500-pound threshold quantity that triggers Risk Management Plans for all chlorination facilities and also below the 1,500-pound threshold that triggers the OSHA Process Safety Management, of which SUB has voluntarily implemented some elements. SUB and RWD will need to continue monitoring proposed changes to EPA, OR OSHA, and Department of Homeland Security regulations on the use and storage of gaseous chlorine.

It is recommended that an evaluation be conducted to explore the use of onsite generation or bulk delivery of liquid hypochlorite to reduce the risks of vandalism, terrorist attack, employee exposures, and environmental hazards associated with chlorine gas. It is anticipated that additional regulations will be implemented that will eventually require the change to an alternative method of chlorine disinfection.

4.21 Summary of Recommendations

Key recommendations from Section 4 are listed here.

1. Ensure revisions to the water quality sampling plan are included in the scope of work for the design for the North-West transmission main.
2. Install continuous water quality monitoring stations at the entry points of Weyco Wellfield, SP/Maia Wellfield, and Sports Way/I5 wellfield.
3. Continue to identify and replace any remaining services with lea d goosenecks.
4. Continued vigilance in monitoring for contaminants and chemical uses, in requiring protective measures for chemical storage and use, and insisting on appropriate clean-up where contaminants are discovered in the aquifer. Also, continue to support state and federal agencies in their efforts to reduce contaminant risks in drinking water supply areas.
5. Begin evaluation for conversion from chlorine gas disinfection to onsite generation or bulk delivery of liquid hypochlorite for disinfection.
6. Ensure that the timeline for utilizing the McKenzie River includes source monitoring for *Cryptosporidium* to determine the correct bin classification for that source.

7. Develop a McKenzie Watershed addendum to the source water protection plan.
8. Analyze water quality impact of adding McKenzie River water to distribution system.
9. Continue voluntary source monitoring for PFAS and track developments in regulation of PFAS in drinking water.
10. Plan for LCR revisions requiring development of a lead service line inventory.

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Section **5**

Section 5

Existing and Future System Operation

5.1 Introduction

The water system is currently segmented into three systems, but SUB desires to connect the main service levels (West First, North First, and East First) of the individual systems to create one single first level. This section documents changes to the system operation and configuration needed to combine the segmented systems into a single functioning system. Existing operation of RWD is also discussed. Future operation of the RWD system is anticipated to remain largely unchanged, although some operational adjustments may be made as the supply method to SUB's North System customers is adjusted under the single main service level approach.

5.2 Overview

The current system has three first levels (North, West, East). Each is in approximately the same elevation range (460 feet to 570 feet). The associated pressure range is from 44 psi to 92 psi. The existing system is shown schematically in **Figure 1-2**, in **Section 1**. The future system is shown schematically in **Figure 5-1**.

5.3 System Operation

5.3.1 Hydraulic Grade

The current system has three first levels that are isolated, but largely serve the same ground elevation range (460 feet to 570 feet). Nominally, the levels have an HGL of approximately 671 feet and an associated pressure range from 42 psi to 91 psi. The main level reservoirs have physical overflow elevations ranging from 671.0 to 675.5 feet and MOLs of 668.5 to 672.7 feet. A 2014 structural assessment of the East First Level reservoirs recommended that the MOL of these reservoirs be lowered to reduce the risk of damage to the reservoirs during a seismic event. It may not be practical to reduce the MOL to the recommended 668 feet. Proposed MOLs are presented in **Section 6**. Based on modeling of an interconnected East, West, and North First Level, the existing reservoirs across the three systems will not operate at the same HGLs given their distance from each other, different proximity to supply sources, and differences in base and overflow elevations. Even with all reservoirs set to operate to a MOL at the lowest overflow, 668.5 feet at Willamette Heights Reservoir, the East System reservoirs remained full even when the Kelly Butte and Willamette Heights Reservoirs are draining. As a result, although the three systems can become more interconnected and operate more as a single level with additional piping and connectivity, the supply controls will need to be set to react to different reservoir levels, for example setting some of the East System supplies to operate based on the Kelly Butte (North System) levels to maintain adequate levels in this more distant reservoir. Also, altitude valves may be required to prevent overflow at S 57th Street, S 67th Street Reservoirs and Willamette Heights.

5.3.2 West System

During periods of ADD, the West System relies primarily on production from the WSSFP. During peak demand periods additional supply from the North System can also serve the West System through the 5th and Moffitt Intertie.

The WSSFP operates at a fixed flow that is determined by the plant operator based on system demand in addition to available source and condition of the filter beds. It discharges to the West First Level Low and excess supply can be pumped to serve the West First Level or East First Levels. The WSSFP also operates at less than its max capacity due to low demand and storage limitations at night. Since the filter beds need to operate at a continuous and near constant rate, and there are limitations in being able to provide adequate available storage to receive the supply produced overnight, there are no currently planned expansions of the slow sand filtration process.

The Steam Plant Pump Station serves the West First Level. It operates VFD pumps that are controlled primarily by level controls set to fill the Willamette Heights Reservoir with suction-side settings to maintain pressure in the West First Level Low. There is also a PRV at the facility that can send flow back from the West First Level to West First Level Low if pressure drops in the West First Level Low. The Eastside Pump Station also has VFD pumps controlled by suction settings to maintain pressure in the West First Level Low to move excess water from the WSSFP to the East System.

The Scott Road Intertie from the North System is set to open at 35 psi and provide a limited supply of water to the West First Level Low.

The 5th and Moffit Intertie is used with a flow control valve that operates at three preset rates based on the water level in the Kelly Butte Reservoir. The normal rate of flow is high. As customer demand increases in the North System and Kelly Butte Reservoir level declines, at a preset point, the 5th and Moffitt Intertie flow setting drops to 50 percent and if the reservoir continues to decline the intertie shuts off until the reservoir refills. With the improved transmission and connectivity between the Kelly Butte area and the Willamette Heights reservoir, this condition is required less frequently.

When the 5th and Moffitt Intertie reduces flow or shuts off, customer demand in the West System must be met by production from the WSSFP and the quantity of water available for pumping to the East System at Eastside Pump Station is reduced.

While normally supplied from the West First Level, in an emergency, the Glenwood service area can be supplied from EWEB through manual operation of the 22nd and Henderson Intertie. The quantity of supply is not known.

5.3.3 North System

The North System well sources are managed primarily by the Kelly Butte Reservoir level in operational order to ensure the purchase IGA between RWD and SUB is met, with RWD wells operating first in order and SUB's Sports Way Well set to operate last.

During the peak summer months, the Weyco Wellfield is brought online and up to 50 percent of the production is routed to the East System through the 35th Street Intertie. The Weyco Wellfield is normally operated continuously during peak months but will shut off on high system pressure if demand drops too low. The other wells in the North System operate based on Kelly Butte Reservoir level. As customer demand rises additional wells start and stop as needed. During high demand periods when RWD's source cannot meet peaks, SUB operates the Sports Way Well.

The I-5 Intertie and the 31st Intertie currently have limitations as the I-5 Intertie can only flow water from the SUB/RWD system to the EWEB system due to the pressure being higher in the SUB/RWD system. Currently, there are no pumping facilities to transfer the water from EWEB to SUB/RWD. The pump skid for the 31st Intertie was built in the mid-1990s and does not meet the current OHA requirements for being NSF 61 approved or the current NEC code requirements. Future discussions and modifications will be required for this intertie to be functional again.

Emergency water supply is also available from the East System by manual operation of the 28th and Olympic Intertie or by changing the distribution system valving at the 28th and Olympic Intertie to divert the flow from the SP/Maia Wellfield directly into the North System.

Under the current intergovernmental agreement between SUB and RWD, the North System supply and storage is jointly operated to meet the purchase of water from RWD under the IGA.

5.3.4 East System

The East System relies primarily on production from the Thurston/Platt Wellfields and surplus water pumped from the West System WSSFP through Eastside Pump Station. Additional supply is available from the SP and Maia Wells if needed. The operation of all wells in the East System is controlled by the water level in the S 57th Street Reservoirs.

As customer demand rises in the East System additional wells start and stop as needed. During the peak summer months, the Weyco Wellfield is brought online and up to 50 percent of the production is routed to the East System through the 35th Street Intertie. When the reservoirs fill up in the East System, the downstream pressure at the 35th Street Intertie matches the upstream pressure in the North System and the flow through the intertie will be reduced.

If necessary, the distribution system can be manually controlled to send up to 100 percent of the Weyco Wellfield discharge to the East or North System.

In an emergency the East System can also receive limited water from the North System through manual operation of the 28th and Olympic Street Intertie.

5.3.5 Metering and Water Purchase Requirements

All the source facilities are metered. Groundwater wellfields are master metered. The Sports Way Well, Q St Well, and Chase Wells are individually metered. In addition, the following locations are metered:

- Eastside Pump Station and Pressure Control Valve/PRV (bi-directional magnetic flow metering)
- Steam Plant Pump Station and PRV (bi-directional magnetic flow metering)
- Glenwood PRV
- 5th and Moffitt PRV
- 35th Street Intertie Control Valve (FCV)
- Scott Road PRV

Under the existing IGA, as part of the water purchase monitoring, water is metered at the boundaries of the North System. This allows for accurate water accounting and billing.

Future system operation may reduce the pressure differentials along the North System boundary and will allow two-way flow through the meters. This will result in longer durations of low flow with reduced meter accuracy, as flow meters are typically less accurate at very low flows. Additionally, all the future connections at the First Level across the three systems will require bi-directional metering for the future First Level to operate as a single pressure level.

5.3.6 Planned Improvements and Facility Modifications

To increase the connectivity of the main levels across the three systems and work towards a more interconnected system some improvements are required to allow greater flow to move across the three systems. As previously mentioned, reservoirs throughout the system are unlikely to ever fully operate at the same HGL given their distance from each other, different sizes, and proximity to supply sources. As a result, the MOL should be set primarily with consideration to seismic concerns and not as much towards having all the reservoirs with the exact same HGL since they will fill and drain at different rates. However, differences in the HGL should be mitigated by having supply sources controlled by different reservoirs in the system, particularly Kelly Butte and Willamette Heights Reservoirs since they are the farthest from supply sources so they stagger in operations. To prevent overfilling, altitude valves should also be put on all of the reservoirs that do not currently have them.

Additional pump and control valve modifications and pipe improvements should be made as described below to allow greater connectivity across the three systems, working toward a single interconnected First Level.

5.3.7 West – North System Connections Updates

5.3.7.1 Willamette Heights to Kelly Butte Connection Improvements

The existing Kelly Butte Reservoir serves the western portion of the North System and provides suction supply to the Kelly Butte Pump Station. The reservoir is aging, undersized, and the site is constrained, prohibiting expansion of the storage capacity at the existing location. Seismic performance concerns are being addressed through operation with a reduced water level. Due to these constraints, it is anticipated that the reservoir will be operated for as long as practical. For the purposes of this plan, it is assumed that the reservoir will be in service till the end of the 20-year planning period, but may be replaced with storage at the Willamette Heights Reservoir site and the Kelly Butte area served through increased transmission capacity from the Willamette Heights site. Future discussions will be required to revisit continued operation of the Kelly Butte Reservoir to maximize its beneficial service life.

Planned transmission improvements will connect the West First Level to the North First Level. The flow between systems needs to be metered as part of the SUB/RWD IGA, bi-directional meters will be installed.

5.3.7.2 5th and Moffit FCV/PRV

This connection is currently the primary supply from the North System to the West System and is currently metered. It connects the North First Level to the West First Level Low. The rate of flow is controlled by the water level in Kelly Butte Reservoir and upstream pressure to prevent too much flow from leaving the North First and draining Kelly Butte. Some operational adjustments may be required for transition to a single first level and this connection may become less needed and serve as a backup to send North supply to the West since the North First and West First Levels would be directly connected through new transmission pipe described above.

5.3.8 North – East System Connections Updates

5.3.8.1 28th Street Intertie

This valve is currently normally closed. For a single First Level system, it should be changed to normally open to improve connectivity. A bi-directional flow meter will need to be added here for SUB/RWD water purchase monitoring.

5.3.8.2 35th Street Intertie

This intertie is currently operated to convey supply from the North System, primarily the Weyco facilities, to the East System. This connection is currently metered. Metering should be continued for accounting of water for RWD purchases.

5.3.9 West – East System Connections Updates

5.3.9.1 Eastside Pump Station/Intertie

The Eastside Pump Station is located along the WSSFP discharge main connecting to the West First Level Low and transfers water between the West First Level Low and the East First Level. The pump station is currently operated with a VFD to maintain pressure in the West First Level Low. The pumps can be turned off and a PRV can be used to supply the West First Level Low from the East First Level if needed. This connection is currently metered.

Under a single First Level configuration, the pump station should continue to lift water into the First Level and the 24-inch diameter East Transmission Main connection between the pump station to the West First Level (that is currently closed) should be opened to improve connectivity. This will allow the Eastside Pump Station to serve the East First Level as it currently does and the West First Level, making the Steam Plant Pump Station only needed for backup operations. The Steam Plant PRV should remain active to allow flow back to the West First Level Low from the West First Level if needed.

Hydraulic analysis found that the Willamette Heights Reservoir stays full and does not cycle adequately with an open connection to the East System hydraulic grade due to its lower overflow level than the S 57th and S 67th Street Reservoirs and its distance from supply sources. Consequently, it is recommended that a control valve be installed near the Eastside Pump Station to control flow through the East Transmission Main based on the Willamette Heights Reservoir level (similar to the setting of the Steam Plant Pump Station).

5.3.10 Operations Updates

As system modifications are made, particularly to make the main first levels more interconnected across the three systems, operational approaches will need to be reviewed. Potential changes may need to be made to address several interconnectivity modifications:

- Improved transmission and connection from West First Level to North First Level may allow for increased flow from the WSSFP or East First Level.
- An open connection between North and East Systems through the 28th Street intertie and the 35th Street connection may require adjustment to the movement of water from the Weyerhaeuser wellfield.

- With future increased transmission capacity from the planned Thurston WTP, operation of the Thurston Wellfield may need to be adjusted.
- If at some point in the future when the WSSFP pumps are being replaced, they could be replaced with higher horsepower pumps to directly serve the First Level HGL rather than the West First Level Low HGL. This would remove the need to pump through the Eastside or Steam Plant Pump Stations.
- Well controls should also be reviewed as the levels are more connected and supplies are modified. For example, having East First Level wells such as SP or Maia be controlled by the Kelly Butte Reservoir or new Willamette Heights Reservoirs may be beneficial for operations, particularly if additional surface water supply is brought online in the East First Level or there are changes in the order in which supply sources are called upon to meet demand.

5.3.11 Reservoirs

A reservoir conditions evaluation was completed by Peterson Structural Engineers (PSE) in 2014. This evaluation analyzed reservoir seismic reliability. It was recommended to lower the MOLs of four reservoirs in the First Levels. Hydraulic analysis of the combined First Level system found that the distance amongst the sources and reservoirs was such that the main level reservoirs do not “float” together. As such, there is some flexibility in establishing the MOL for each reservoir.

It is common for altitude valves to be installed when multiple reservoirs are operated in a single pressure level. It is recommended that an altitude valve be installed at the existing and future Willamette Heights Reservoirs as well as the S 57th and future main level Natron Reservoir sites.

The South 70th Street Reservoir is undersized for serving the East Second Level and has deficiencies. In the 2014 Seismic Study, the reservoir is recommended to be taken out of service and the fire suppression storage capacity and flows can be provided by the South Hills Reservoir in the East Third Level.

The Natron Expansion Area will include customers at the first, second, and third service levels. Due to the distance from the existing East System reservoirs, it is recommended that a First Level reservoir be constructed to provide the large fire suppression capacity required by the anticipated industrially zoned development. A Second Level reservoir serving some industrial zoning is also anticipated. The Third Level is relatively small, and due to the steep slopes, is anticipated to be residential in character. A constant pressure booster pump station is recommended to serve the third level of the Natron Expansion Area.

5.3.12 Other Facilities

5.3.12.1 Booster Pump Stations

Several booster pump stations serve the upper levels. Head or pressure settings for the downstream sides of the pump stations should not need adjustment because those level pressures should not be affected by the reconfiguration.

5.3.12.2 Glenwood PRV

Upstream pressures will not change significantly, so no adjustments to the Glenwood PRV are anticipated. No service pressure changes in the Glenwood service area are anticipated.

5.3.12.3 Upper Level PRVs

The upper level PRVs at Mountain Gate North and South are not anticipated to require any adjustments.

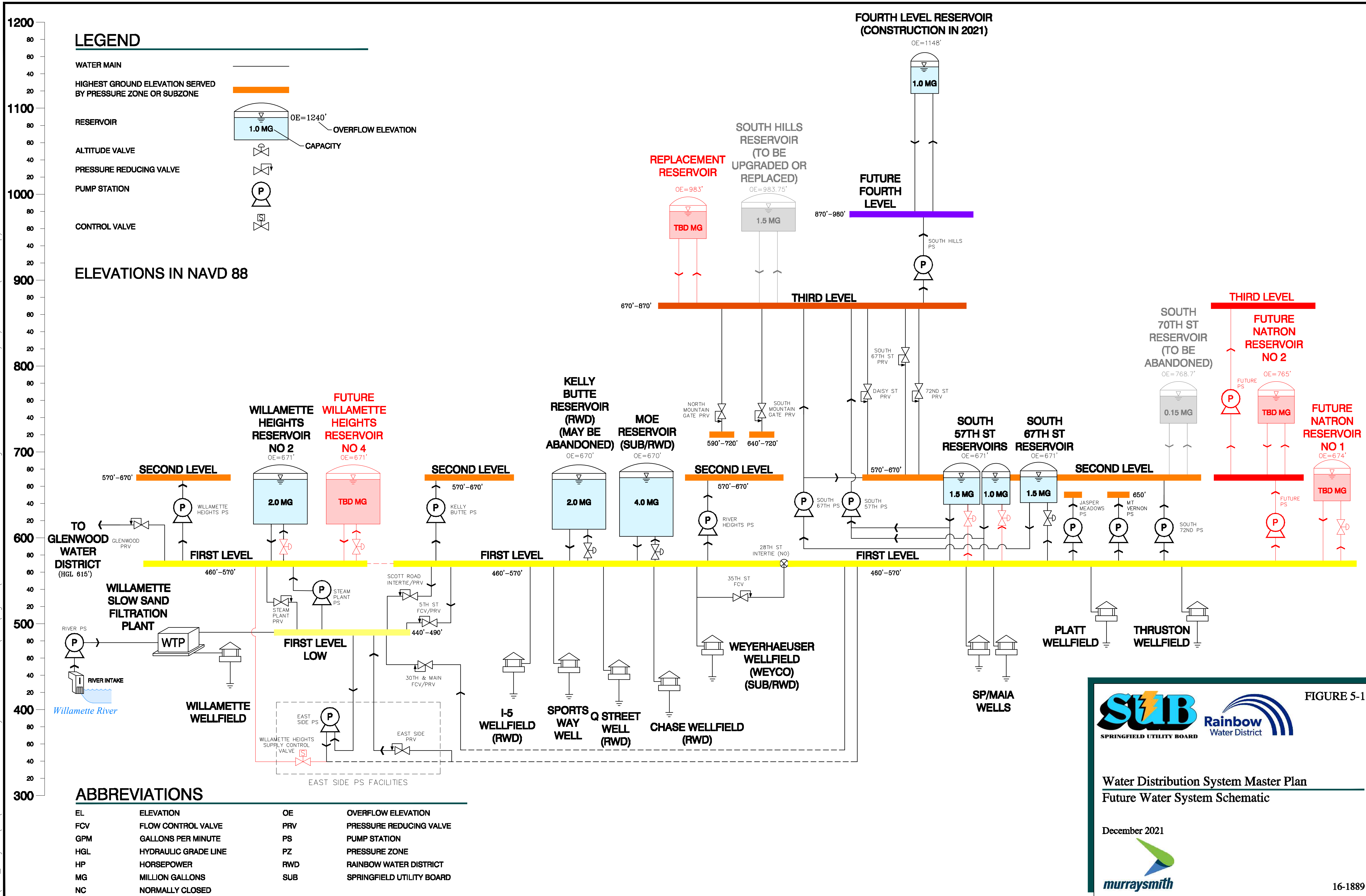

FIGURE 5-1

Water Distribution System Master Plan
Future Water System Schematic

December 2021

16-1889

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Section **6**

Section 6

Distribution System Analysis

6.1 Introduction

This section presents an analysis of the joint SUB and RWD water distribution system based on criteria outlined in **Section 3**. The water demand forecasts summarized in **Section 2** are used in conjunction with analysis criteria to assess water system characteristics including service pressures and level boundaries, storage and pumping capacity, and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in **Section 8**.

6.2 Pressure Level Analysis

Pressure levels are defined by ground topography. Their HGLs are determined by overflow elevations of water storage facilities, discharge pressures of pump stations or outlet settings of PRV facilities serving the level. The SUB/RWD existing distribution system is divided into three primary service levels (1, 2, 3) defined by their HGLs. In the East System, there are hydraulically and geographically isolated pressure levels with similar HGLs. For the purposes of this analysis each hydraulically isolated pressure level is considered independently regardless of service level or HGL. Existing and proposed future water service area boundaries and pressure levels are illustrated on the water system maps in **Figure 1-1**, **Figure 1-3**, and **Figure 2-1**.

6.2.1 Existing Pressure Levels

The existing distribution system has both gravity storage and constant pressure levels. Constant pressure levels are those which supply customers from booster pump stations without the benefit of storage. Constant pressure levels currently serve small residential areas at higher elevations. Constant pressure levels are only recommended for areas with 200 Equivalent Dwelling Units (EDUs) or less, low water demand, and limited potential for expansion or future looping. The existing system also includes the West First Level Low that is a larger zone without gravity storage. It is supplied directly by the WSSFP and through a PRV from the Willamette Heights Reservoir in the West First Level. Existing pressure levels are summarized in **Table 1-2**.

The existing pressure levels provide adequate service pressures between 35 and 80 psi to the current water system customers.

6.2.2 Proposed Future Pressure Levels

As the water service area expands, the water system will need to provide adequate service pressure to more high-elevation customers at the perimeter of the existing distribution system. Where possible, the future service area growth will be supplied by extending piping from existing pressure levels. As existing constant pressure levels expand to include more than 200 EDUs, new storage reservoirs are recommended to supply customers by gravity.

6.3 Source Review

The water demand forecasts presented in **Section 2** include an MDD of 24.6 mgd in 2040 and a build-out demand of 27.3 mgd. Water sources are presented in **Section 1** and include surface and groundwater facilities with a current combined total capacity of 29.02 mgd. However, the source facilities are subject to several risks to their ongoing reliability without significant investment. These risks include groundwater contamination, well interference, and groundwater water quality issues. The wells also require periodic rehabilitation, such that at any time there are some wells operating at less than their full capacity.

The Weyco facilities have several on-going concerns to include operational constraints at the site. However, the Weyco facilities will be operated as long as practical. Within the 20-year planning window, it is anticipated that the reliable source capacity will be reduced to 25.72 mgd. Loss of operation of the Weyco facilities would reduce the reliable source capacity to 22.84 mgd and creates a supply deficit.

While numerous rehabilitation and improvement options are possible, SUB has planned to focus resources on development of a new Thurston surface water treatment facility. This is planned to increase the reliable source capacity to 29.97 mgd as shown in **Table 6-1**. Key source capacity assumptions are summarized below.

- The WSSFP can be operated at a peak rate of 6.6 mgd for short periods to address peak demands. This rate is limited by the filter plant operations. The plant can sustainably produce 6.0 mgd.
- Thurston and Platt wells and associated treatment facility continue operating at current capacity.
- Weyco facilities become unreliable but will be operated as long as practical.
- SP/Maia have known interference when both operated for a sustained period (30 days). It is anticipated that SP would be turned off to allow the aquifer to recover.
- Sports Way has potential interference issues with the I-5 Wellfield and EWEB wellfields. However, as the senior water right, no reduction from the current capacity is assumed.

- Initial capacity of the planned McKenzie River source facilities is approximately 7.73 mgd. Actual initial incremental capacity will be determined during facility pre-design. For purposes of the 2040 scenarios, 7.73 mgd is assumed.

- The I-5 Wells have known and potential well interference. Running both wells for an extended duration is estimated to reduce the sustainable yield. Capacity may require further reduction to avoid impacting the senior water right at Sports Way. This limits the sustainable capacity to 3.0 mgd.

- The Chase Wellfield has wells confirmed GWUDI. The wellfield discharge is limited by the existing treatment facility capacity.

- Q Street Well has performance issues and is monitored for potential solvent contamination. It can be operated at its current capacity.

Table 6-1
Future Reliable Source Capacity

	Current Peak Production Capacity (mgd)	Current Sustained Production Capacity (over 30 days) (mgd)	Future Reliable Source Capacity (mgd)	Reliable Capacity Assumptions
Springfield Utility Board				
Willamette Slow Sand Filtration Plant (WSSFP)	6.60	6.00	6.00	Sustainable operational rate
Thurston Facilities (Thurston & Platt wells)	6.31	5.92	5.92	
Weyco	1.44	1.44	0.00	Anticipate facilities will be operated for as long as practical
S.P./Maia	2.59	1.44	1.44	Limited reliability due to interference.
Sports Way	2.88	2.88	2.88	No interference from junior water rights allowed.
Future McKenzie River (Thurston) WTP	0.83	0.00	7.73	
Rainbow Water District				
I-5	3.93	3.60	3.00	Sustainable rate with some interference.
Chase	2.64	2.64	2.64	
Q St.	0.36	0.36	0.36	
Weyco	1.44	1.44	0.00	Anticipate facilities will be operated for as long as practical
Total Source Capacity	**29.02**	**25.72**	**29.97**	

6.4 Storage Analysis

6.4.1 Maximum Operating Level

The MOL of a storage reservoir is the water level when the reservoir is considered full. It may be set to be less than the depth associated with the physical overflow for a variety of reasons, but typically, the MOL is set to be 6 to 12 inches below the physical overflow elevation for a reservoir when it is nominally full. This additional freeboard is provided to prevent accidental overflows. Several other considerations may further reduce the MOL.

- Seismic design standards require a minimum freeboard to accommodate seismic slosh. This is especially applicable for older reservoirs which were designed under older standards.
- For reservoirs with turnover concerns, the MOL may be lowered, especially in the winter, to promote improved water quality.
- Hydraulically, reservoirs within the same pressure zone that are far apart may not fill at the same rate. For certain systems, reservoirs closer to the supply sources may fill much faster than the reservoir(s) further from the source. When this occurs, the furthest reservoir may need to be operated at a lower MOL to allow the closer reservoir(s) to be able to cycle.

The MOL is typically controlled either by a hydraulically actuated altitude valve or by pump station set points for reservoir water level. Several considerations influence the proposed MOL of the storage reservoirs. Reservoir assessments were completed in 2014 that included recommendations for seismic improvements and reservoir MOLs to reduce the risk of damage to the structure from a seismic event prior to, or without, any improvements being made. During design of the S 57th Street Reservoir improvements, a review of the newer 2019 Oregon Structural Specialty Code (OSSC) resulted in a determination that the new design code required an increase in the recommended freeboard for the S 57th Street Reservoirs.

As discussed in **Section 5**, hydraulic modeling confirmed test operations that when the Willamette Heights Reservoir is allowed to float with the S 57th and S 67th Street Reservoirs, Willamette Heights Reservoir remains full due to its lower HGL. A control valve is proposed to assist in managing the flow of water to Willamette Heights Reservoir and allow it to be operated at the lower recommended seismic MOL without requiring the East System reservoirs to also be lowered.

For the purpose of the storage analysis, the storage reductions in **Table 6-2** were assumed as a conservative, but not worst case, scenario. Refinements to the MOLs and the resulting minor changes to effective, available storage volumes can be addressed by refinement of the sizing of the planned new reservoirs. The proposed MOL scheme considers recommended seismic freeboards, historical operations and set points, and the current operational MOL scheme. The result is a reduction in actual storage volume of approximately 10 percent from the nominal storage volume.

Table 6-2
Reservoir Maximum Operating Level Summary

Reservoir Name	Overflow Elevation (ft)	Current MOL[6] (ft)	Seismic Recommendation		Proposed MOL (ft)	Storage Volume (mg)		
			MOL Reduction (ft)	MOL (ft)		Nominal	At Current MOL[6]	At Proposed MOL
Willamette Heights No. 2	671.04	668.84	1.50 [4]	669.79	668.50	2.00	1.92	1.84
Kelly Butte	673.70	671.73	2.00 [4]	671.70	671.00	1.00	0.95	0.93
Moe	675.19	672.72	1.50 [4]	673.69	672.70	4.00	3.88	3.80
S. 57th St. No. 1	674.77	670.99	5.00 [5]	669.77	669.70	1.00	0.84	0.84
S. 57th St. No. 2	674.77	670.99	5.00 [5]	669.77	669.70	1.50	1.25	1.25
S. 67th Street	675.52	673.79	4.50 [4]	671.02	671.00	1.50	1.29	1.28
S. 70th Street	764.83	760.42	2.50 [4]	762.33	760.42	0.15	0.14	0.13
South Hills	983.75	981.05	1.50 [4]	982.25	981.05	1.50	1.42	1.35
Total						**12.65**	**11.68**	**11.42**

Notes:
1. MOL = Maximum operating level
2. mg = million gallons
3. Elevations in NAVD 88 vertical datum
4. Increase in freeboard recommendation per 2014 Seismic Analysis of Various Structures, Reservoir Evaluations Reports.
5. Increase in freeboard recommendation per 2017 design review for South 57th Street Reservoirs #1 & #2 Seismic Retrofit (SUB projects Nos. 17801 & 17807).
6. Current MOL established by reservoir set points and operational history when set points do not apply.

6.4.2 Capacity

Storage facilities are provided for four purposes: equalization storage, operational storage, emergency or standby storage, and fire suppression storage. As presented in **Section 3**, the total storage required is the sum of these four elements.

Storage reservoirs must have adequate capacity to meet demands within the level being supplied by gravity as well as demands in all PRV and pumped levels out of the gravity zone. For analysis purposes, each system (East, North, West) was treated as a single level for storage analysis purposes. Each gravity sublevel was separately analyzed.

Fire storage is determined by the maximum fire flow requirement of the levels served by the storage facility. Constant pressure zones cannot adequately supply fire flow from a lower level reservoir and must have adequate pumping capacity to meet fire flow requirements.

Operational storage requirements reported in **Table 6-3** were determined from a review of current system operation set points. In each of the system, operational storage was determined by review of reservoir water level data during the summer season.

6.4.3 Storage in Current System Configuration

There are eight distribution system storage reservoirs in the SUB/RWD water system with a combined nominal storage volume of 12.65 mg. Operation of the reservoirs at a lowered MOL reduces the effective current storage to 11.42 mg as shown in **Table 6-2**. Existing storage requirements and current capacity in mg are summarized in **Table 6-3**. Under the existing conditions, the apparent storage deficit in the West System is offset by the storage surplus in the North System, which also supplies water to the West System. The 2014 seismic evaluation recommends that the Kelly Butte Reservoir be ultimately decommissioned. In the event Kelly Butte Reservoir is removed from service, replacement of that storage will be required, which may be accomplished with the construction of a second reservoir at Willamette Heights. This would better rebalance storage in the service area. Another alternative would be to provide additional storage at the Moe Reservoir site which could accommodate approximately 2.0 to 2.5 mg. The Kelly Butte Reservoir issues will require further discussion and evaluation.

As the service area grows, additional storage will be needed to meet increased demand. New reservoirs would address the forecasted long-range storage deficit as well as provide reliable fire suppression capacity for the planned developments.

The service area includes several small, closed service levels that are supplied through constant pressure booster pump stations. The fire suppression storage volume for these zones comes from the associated first (main) service level.

Table 6-3
Storage Analysis Summary – Existing System Configuration

System	Planning Horizon	Storage Requirements (mg)				Total Storage Requirement (mg)	Existing Storage (mg)	Storage Deficit (mg)
		Operational	Fire Suppression	Equalizing	Standby			
West	Current	0.68	0.84	-	1.37	2.89	1.84	1.05
	2030	0.70	0.84	-	1.40	2.94	1.84	1.10
	2040	0.70	0.84	-	1.40	2.94	1.84	1.10
North	Current	1.02	0.84	0.03	2.05	3.94	4.73	-0.79
	2030	1.17	0.84	0.24	2.34	4.59	4.73	-0.14
	2040	1.30	0.84	0.43	2.61	5.18	4.73	0.45
East	Current	1.10	1.20	0.68	2.20	5.18	4.85	0.33
	2030	1.33	1.20	0.99	2.66	6.19	4.85	1.34
	2040	1.61	1.20	1.35	3.21	7.37	4.85	2.52
Total	**Current**	**2.81**	**2.88**	**0.72**	**5.61**	**12.02**	**11.42**	**0.60**
	2030	**3.20**	**2.88**	**1.23**	**6.40**	**13.72**	**11.42**	**2.30**
	2040	**3.61**	**2.88**	**1.78**	**7.22**	**15.49**	**11.42**	**4.07**

6.4.4 Storage in Proposed Single Main Level Configuration

It is anticipated that, in the future, the main levels will be operated hydraulically as a single system. Under this configuration, the main, or First Level, service area is geographically large. Consequently, it is recommended that the fire suppression criteria be used to provide storage capacity to address two large fire suppression events simultaneously in the main level. Upper pressure levels served by gravity storage should provide additional fire suppression storage for those levels when feasible. The analysis presented in **Table 6-4** includes provisions for industrial fire suppression storage in the future development areas. The fire suppression storage assumptions are as follows.

- 1.68 mg for two large industrial fire suppression events simultaneously in the main level.
- 0.36 mg for residential fires in each of the upper pressure levels: joint East 2 & 3, future East 4.
- 0.84 mg for the future Natron industrial area in the main level.

Treating the analysis as a single system simplifies and reduces the fire suppression, equalizing, and standby storage requirements as shown in **Table 6-4**. Note that any existing storage infrastructure that is decommissioned will need to be replaced. Should Kelly Butte and S 70th Reservoirs be decommissioned, the storage deficit would increase from 3.23 mg by a nominal 1.15 mg and by 1.06 mg of effective storage. This results in a 20-year storage deficit of 4.29 mg.

Table 6-4
Storage Analysis Summary – Future, Single-System Configuration

System	Planning Horizon	Storage Requirements (mg)				Total Storage Requirement (mg)	Existing Storage [1] (mg)	Storage Deficit [1] (mg)
		Operational	Fire Suppression	Equalizing	Standby			
Total	Current	2.81	2.88	0.49	5.61	11.79	11.43	0.36
	2030	3.20	2.88	0.45	6.40	12.94	11.43	1.51
	2040	3.61	2.88	0.95	7.22	14.66	11.43	3.23

Notes:

1. Reduce existing storage and increase deficit by 1.06 mg to account for decommissioning of Kelly Butte and S 70th Street Reservoirs pursuant to the 2014 seismic evaluation.

To meet the 4.29 mg future storage deficit after accounting for existing storage reduction, the following improvements are proposed.

- 2.0 mg Willamette Heights Reservoir No. 4 to replace Kelly Butte Reservoir storage and increase storage in the western portion of the system.
- 1.5 mg Natron Reservoir No. 1 to provide storage at the end of the system and allow for industrial fire flow capacity.
- 1.0 mg Natron Reservoir No. 2 to provide for fire flow storage for the Natron second and third level.
- Note that the South Hills Reservoir (1.5 mg) may potentially be replaced with a new third level reservoir (approximately 1.0 mg) and the planned new 0.46 mg reservoir serving the new East 4 service level.

6.5 Pump Station Capacity Analysis

Pumping capacity requirements are estimated based on available storage, the number and size of pumps serving the level, and the level's maximum fire flow requirement. Recommendations are based on firm capacity which is defined as a pump station's capacity with the largest pump out of service.

In pressure levels supplied by gravity, operational and fire storage provided by reservoirs make it unnecessary to plan for fire flow or peak hour capacity from pump stations assuming adequate storage is available. Pump stations supplying levels with storages must have sufficient firm capacity to meet the MDD for all customers in the level and any higher levels supplied from the pump station.

Constant pressure pump stations supply a level without the benefit of storage. These stations are only recommended for areas with 200 EDUs or less and low water demand with limited potential for future looping with adjacent pressure levels. Pump stations supplying constant pressure service must have firm pumping capacity to meet PHD while simultaneously supplying the largest fire flow demand in the level. The pumping capacity analysis is summarized in **Table 6-5** and also shows that the pump stations have adequate capacity.

In the West and North Systems, the upper levels are nearly built out with very little potential for additional development. For these areas, where service is provided to less than 100 residential services, continuing supply from continuous operation pumping stations is recommended.

The East System has the potential for significant expansion as development occurs to the southeast of the existing system within the UGB. The topography in these areas will require the development of pumping and storage facilities to provide water service as they will be upper levels. The following criteria should be used to size pumping and storage facilities to serve these areas regardless of the overall storage needs of the East System.

- Storage facilities should be sized to provide operational, equalizing, fire suppression, and standby storage.
- Pumping facilities supplying upper levels with storage should be sized with firm capacity to meet the MDD and those without storage should be sized to meet the PHD plus the largest fire flow in the level.

A number of existing closed zones within SUB are provided fire suppression through adjacent pressure zones. It is recommended that fire suppression approach in these small service areas be reviewed with the fire department to determine if any improvements are required.

Table 6-5
Pumping Capacity Analysis

Discharge Service Level	Pump Station(s)	Nominal Capacity (gpm)	Capacity Type Required	Capacity Required, MDD or PHD (gpm) Current	Capacity Required, MDD or PHD (gpm) 20-Year	Fire Flow Method	Backup Power
West System							
First	Steam Plant	4,800	MDD	177	413	Storage	No
Second	Willamette Heights	180	PHD	26	59	Adj	Yes
First Level Low	WSSFP	4,500	MDD	1,939	2,675	PRV[1]	No
North System							
Second	Kelly Butte	200	PHD	40	46	Adj	Portable Trailer
Second	River Heights	80	PHD	11	20	Adj	Portable Trailer
East System							
Second	South 72nd St[3]	500	MDD	169	234[3]	Storage	No
Second	Jasper Meadows	360	PHD	21	22	Adj	Portable Trailer
Second	Mt. Vernon	495	PHD	87	94	Adj	Portable Trailer
Third & Fourth	South 67th	1,400	MDD	500	1,660[4]	Storage	Portable Trailer
Third & Fourth	South 57th	1,600	MDD			Storage	Yes

Notes:
1. "Adj" = from adjacent pressure zones – no hydrants in these pressure zones. "PRV" = served from upper levels via pressure reducing valves for high flows.
2. No pump stations provide primary fire suppression capacity. S 57th and S 67th stations provide secondary fire suppression.
3. Assumes S 72nd St Pump Station to be decommissioned. Demands included in third zone.
4. Includes demands for second, third and fourth level zones.

6.6 Fire Hydrant Coverage

As discussed in **Section 3**, the current OFC stipulations require fire hydrants within 250 feet of residential structures or within 500 feet of another hydrant for 1,500 gpm fire suppression capacity requirements, which is the dominant requirement within the service area. When portions of the SUB/RWD system were established, a less stringent spacing requirement was in use. **Figures 6-1**, **6-2** and **6-3** illustrate the current coverage using the new construction 500-foot spacing requirement. New development will meet the current OFC requirements. As opportunities for cost effectively adding hydrants arise, fire hydrant coverage should be improved.

6.7 Distribution System Piping Analysis

A hydraulic network analysis computer program, InfoWater by Innovyze, was developed from the SUB CAD network to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. Existing water demand was allocated in the model based on SUB's billing area groups and peaked to match production records.

The purpose of the model is to determine pressure and flow relationships throughout the distribution system for a variety of critical water demand and hydraulic conditions. System performance and adequacy is then evaluated based on the planning criteria presented in Section 3.

6.7.1 Model Calibration

The model was calibrated for steady state conditions using data from fire hydrant flow tests conducted specifically for model calibration. The model was also calibrated for a summer and a winter period for extended period simulation (EPS) modeling using SCADA information.

For a computer model to provide accurate results under test conditions the model is calibrated with field conditions so that modeled conditions reflect actual system operation. Model calibration was performed using hydrant flow test data gathered by SUB staff. Flow data from the hydrant flow tests were compared to pressure and flow results obtained from modeled flows placed at the same location to determine model accuracy during a steady state, "snapshot" condition. System conditions over a longer four-day period were also simulated and compared to SCADA to evaluate operational settings and tank cycling.

6.7.2 Fire Flow Modeling

The model was used to analyze the distribution system's ability to meet fire flow service criteria throughout the system under existing MDD conditions as described below.

The model was set up to simulate a conservative operating condition during MDD with the largest supply pump off in each system and reservoirs set with the equalizing and fire storage depleted to simulate the last minutes of a fire duration. One fire at a time across the entire system was simulated at each hydrant location to determine the available fire flow at that hydrant during these conditions while maintaining minimum pressure throughout the system.

The required fire flow at each hydrant is based on the land use criteria from Section 3. The results of the fire flow evaluation and deficient areas are in Figures 6-4, 6-5, and 6-6. The deficient hydrants are primarily on small, 4-inch and 6-inch diameter pipe or dead-end pipe that is not adequate for current fire flow requirements. The pipe material is also displayed to help in prioritizing substandard material and diameter areas. For these deficiencies, no immediate improvements are recommended, but should be considered and included with other improvements such as annual water main replacements or new City roadway extensions.

Additionally, there are a few high elevation areas in the East First Level just north of the 72nd Street Pump Station and near the West First Level Low and West First Level boundary that first drop to 20psi based on their elevation and lower baseline pressures. These areas are identified in Figures 6-5 and 6-6 and are the cause of the identified deficiencies. The solution to address the deficiencies caused by these few high elevation locations is based on addressing the pressures at those locations through individual service boosters, zone boundary modifications or other means and not through pipe upsizing or new pipe.

Most of the small constant pressure levels are provided fire flow from adjacent lower service level hydrants and the pump stations are not sized to provide fire suppression flows. No improvements are recommended associated with the constant pressure service areas. The Kelly Butte service level in the North System does have hydrants however the Kelly Butte Pump Station capacity is not designed to provide the 1,500 gpm residential fire flow. The deficiencies in this level can be met in some locations through nearby hydrants in the North First Level. Consequently, no improvements are recommended.

6.7.3 Operation Modeling

The calibrated model was used to evaluate a number of operational conditions including modifications to the separate systems to create greater interconnectivity towards a single main level. The modeling analysis included comparing the existing system operations for tank level cycling and pressure and velocity to determine the impact of the different operational schemes. To improve operations or maintain the existing level of service, some operational changes require improvements to be made, from adding control valves to constructing additional pipes. Others require more minor modifications such as opening isolation valves or allowing bi-directional flow through existing system connections.

Four primary system modifications were modeled relative to greater operational interconnectivity of the system.

A. Serving the West First Level from the Eastside Pump Station

B. Increasing East System Supply options to meet North System Demand

C. Modifying the WSSFP pumps to directly serve the East and West First Level rather than the West First Level Low

D. Adding a Thurston WTP supply in the East System to serve system-wide demands

As described in Section 5, the system is currently operated primarily as three systems, North, East, and West with some controlled interconnectivity. The future plan is to integrate the systems, particularly the First Level in each system that operate at relatively similar HGLs.

To create greater interconnectivity between the West First Level and East First Level, modeling showed a control valve at Eastside Pump Station that controls flow to the West First Level based on Willamette Heights Reservoir levels is required. SUB has already constructed the East Transmission Main that connects the East First Level to the West First Level. Currently this pipeline is closed because based on field testing and confirmed by model simulations, the Willamette Heights Reservoir does not drain when the two levels are openly connected. This is primarily due to the slightly lower HGL of the Willamette Heights Reservoir compared to the S 57th and 67th Street Reservoirs and its greater distance from supply sources. Adding the control valve at Eastside Pump Station to control flows to the West First Level will allow Willamette Heights to fill and drain more in accordance with current operations. This will also allow Steam Plant Pump Station to be used only for backup or emergency operations.

The model indicated that should the WSSFP pumps be replaced to provide greater head and pump to the main level HGL, the Steam Plant and Eastside Pump Stations could become backup with the WSSFP directly serving the East First Level and West First Level through the new Willamette Heights control valve and a new PRV to serve the West First Level Low.

The model indicated a number of supply options to provide greater interconnection between the main levels. The primary results indicate that existing SUB supply is nearly all leveraged within the levels it currently serves. For SUB supply to be more fully leveraged across the main levels additional piping is needed to connect the West First Level and North First Level from the Willamette Heights Reservoir to the Kelly Butte Reservoir respectively. Additionally, as SUB adds supply with the Thurston WTP in the East First Level, additional transmission piping is required to convey that flow to the East System as well as to the North System. For the WTP flow to be fully leveraged across the system existing interties at 5th Street, 28th Street, and 35th Street should all have operational modifications to allow bi-directional flow and metering. Further operational modifications may also be necessary at SUB wells, such as having SP or Maia controlled by distant, small reservoirs, like Kelly Butte to keep that reservoir full and leverage supply sources. Due to the close proximity of the East First Level Reservoirs to supply sources, particularly the Thurston WTP, they should be equipped with altitude valves to prevent overfilling. As should the Willamette Heights Reservoirs, particularly given their slightly lower HGL than the other system reservoirs.

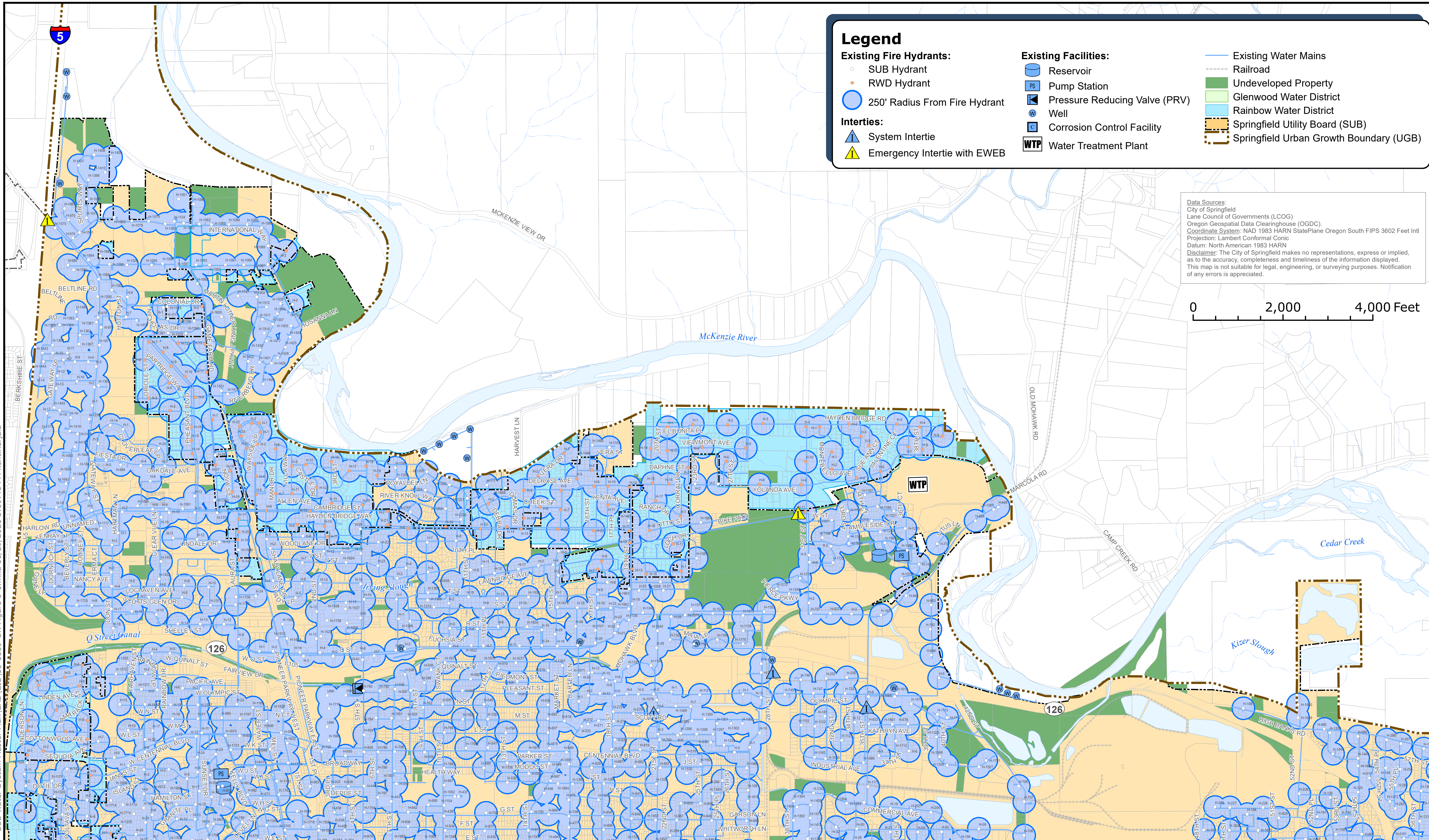
6.8 Glenwood Service Area

The Glenwood Water District is located west of the Willamette River and is served through a master meter and PRV located near the east side of the river along S A Street. The Glenwood Level is operated at a lower HGL (605 feet) than the West First Level (671 feet) and adjacent EWEB system (approximately 850 feet). There is an emergency intertie with EWEB at 22nd and Henderson Avenue, but currently the intertie is one-way due to the hydraulic grade difference.

As seen on **Figure 1-2**, there is a single water main crossing the Willamette River which serves the Glenwood Level. A redundant service approach should be provided to improve service reliability to this geographically isolated area. There are two likely approaches. First, a formal agreement to service the Glenwood area during a service disruption could be made; however, EWEB may not be capable or desire to serve the Glenwood area during a large, area-wide service disruption such as an earthquake and additional transmission line may need to be installed. A second approach would be to install a second, redundant river crossing. The drawback is that the crossing will be expensive and may require extensive permitting.

6.9 Water Quality Assessment

The distribution system is tested and monitored for water quality goals and contaminants per the State of Oregon Drinking Water Quality Act. SUB/RWD performs water quality treatment to meet the LCR and the treatment requirements for GWUDI of surface water. SUB/RWD perform over 14,000 water quality tests annually and through monitoring, treatment, and operational measures, SUB/RWD has consistently met, and continues to meet the water quality goals.



Springfield Utility Board
Water System Master Plan

Figure 6-1
Hydrant Coverage Map - North

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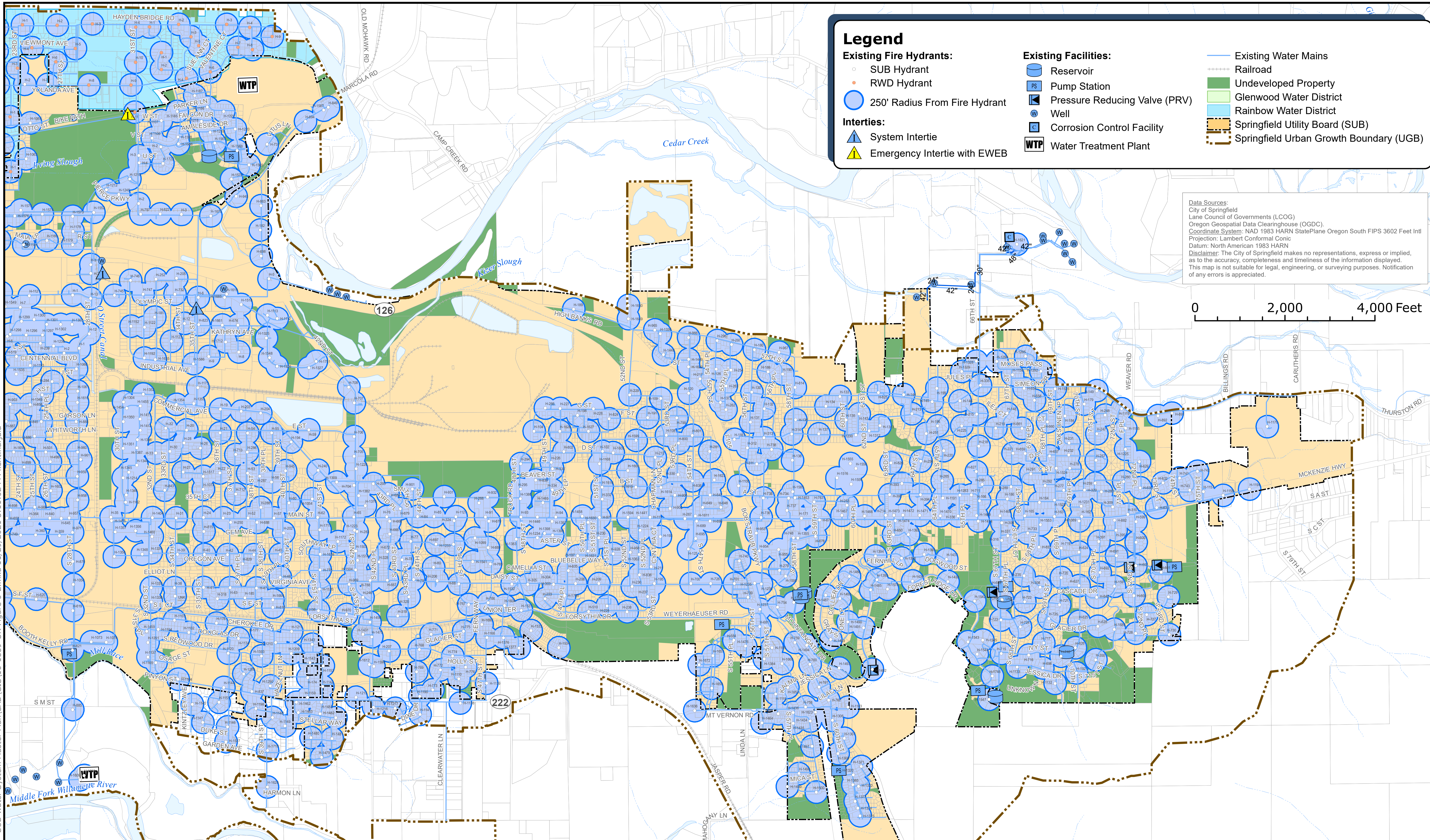

Springfield Utility Board
Water System Master Plan

Figure 6-2
Hydrant Coverage Map - East

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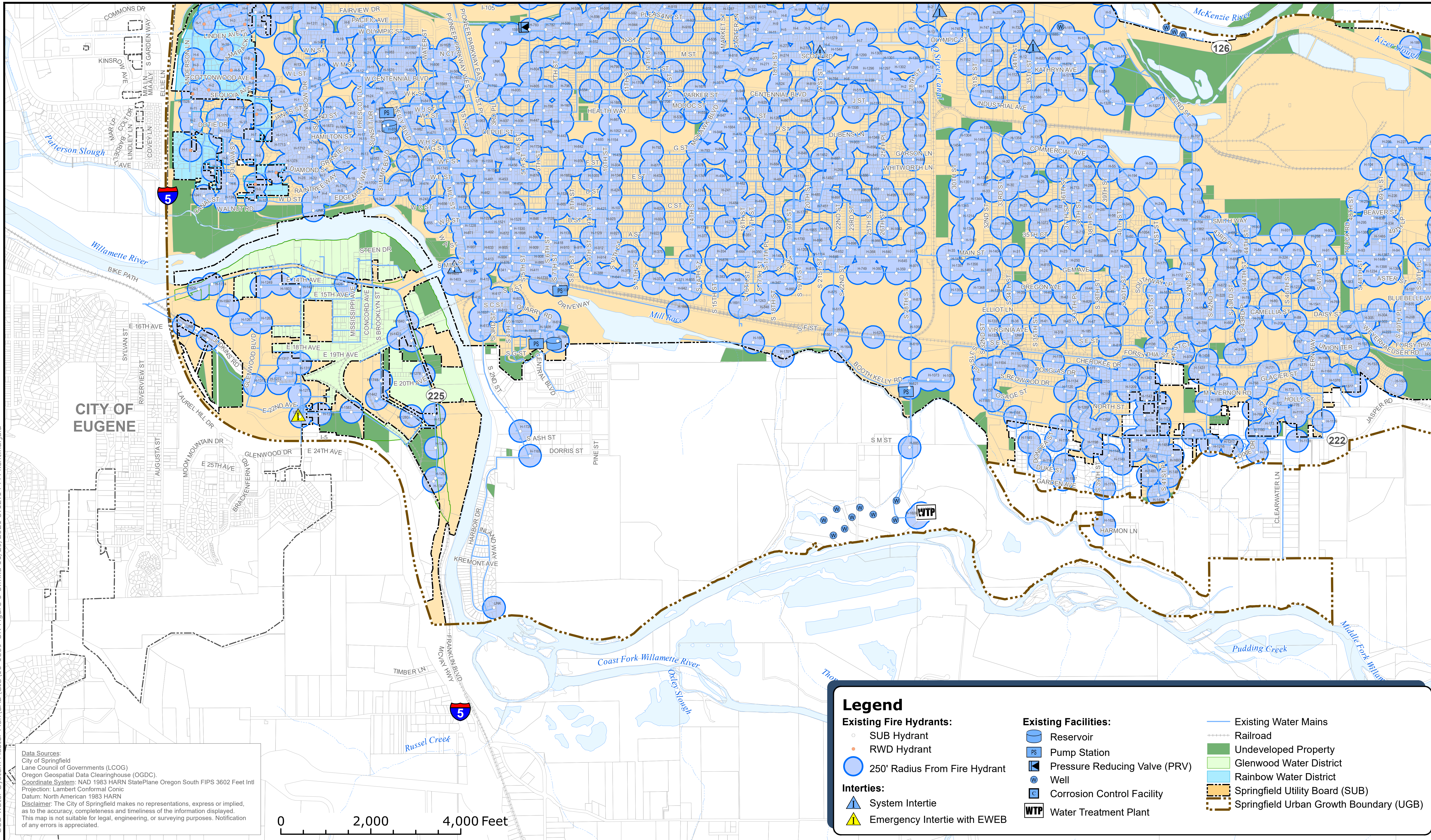

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Water System Master Plan

Figure 6-3
Hydrant Coverage Map - West

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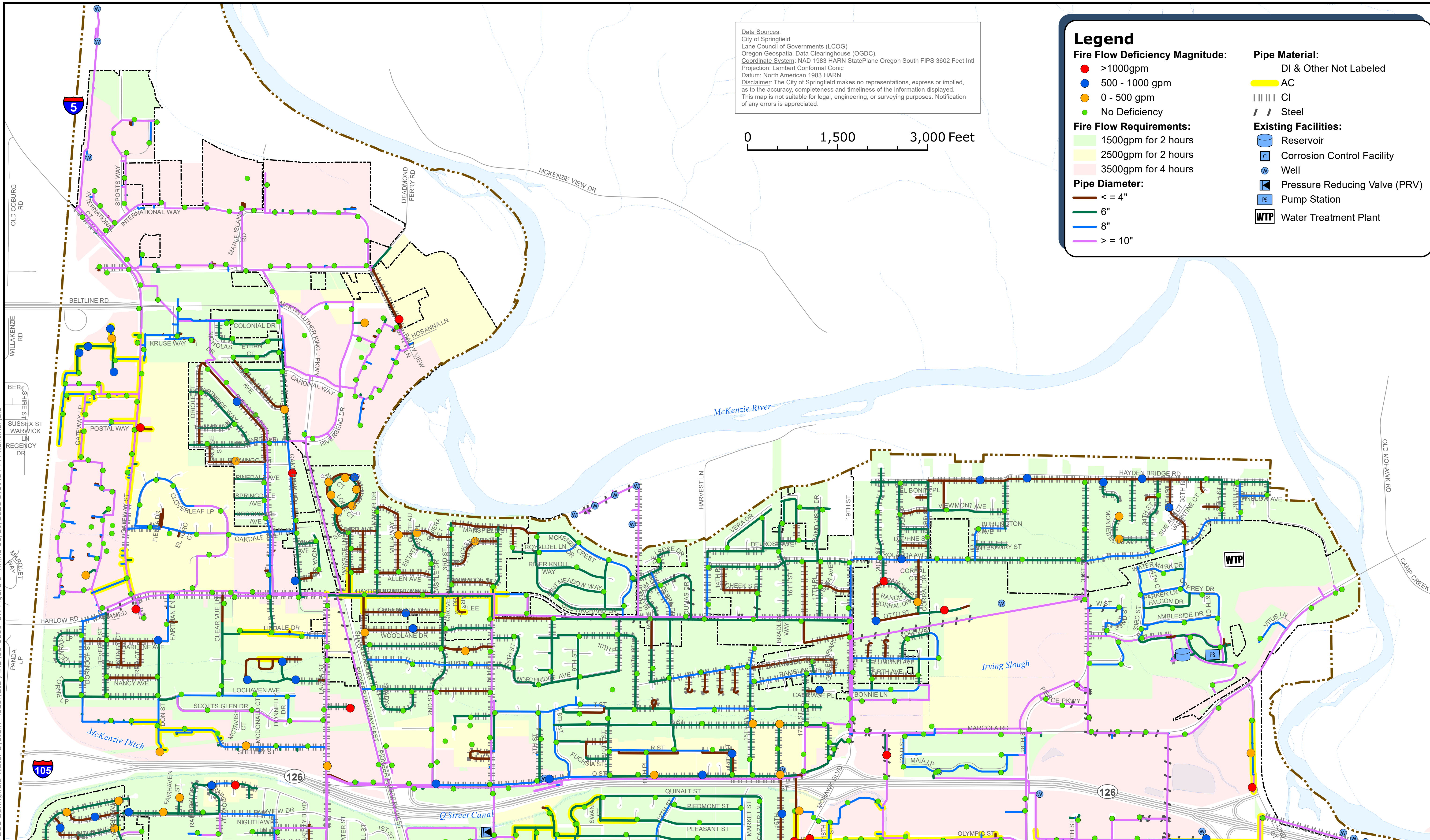

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Rainbow Water District

Springfield Utility Board
Water System Master Plan

Figure 6-4
Fire FLow Deficiencies Map - North

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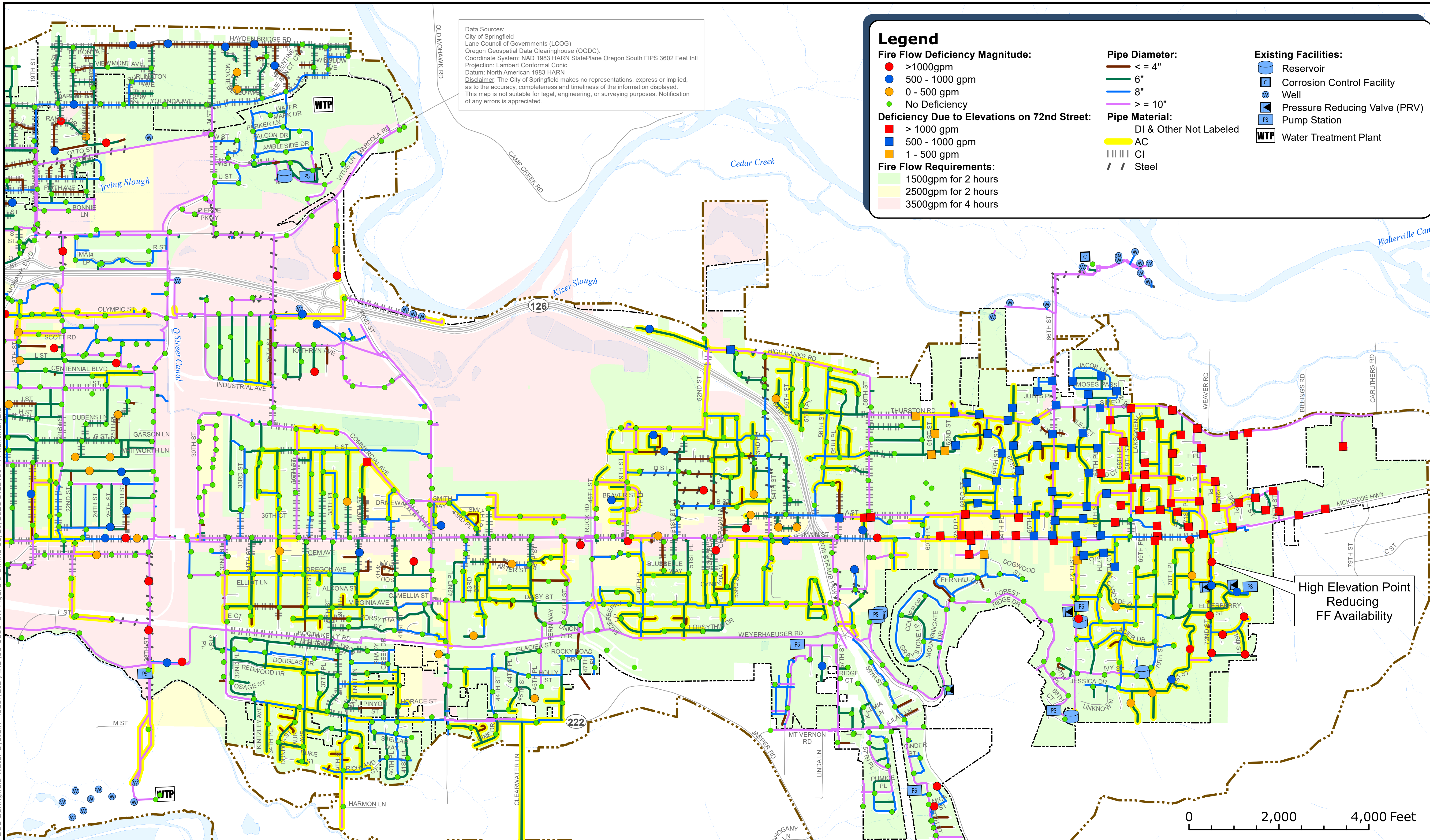

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SUB SPRINGFIELD UTILITY BOARD

Rainbow Water District

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Water System Master Plan

Figure 6-5
Fire FLow Deficiencies Map - East

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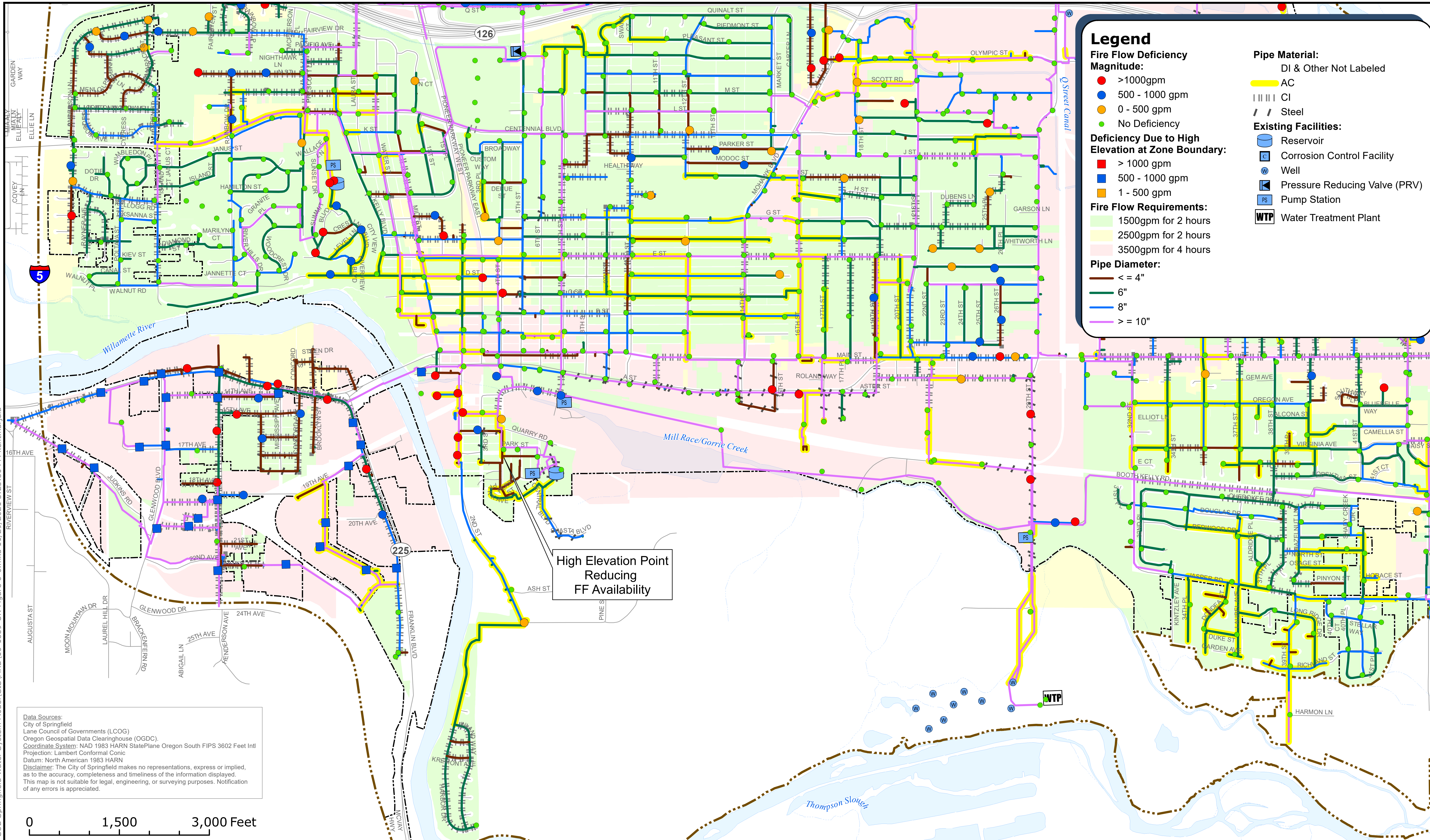

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Springfield Utility Board
Water System Master Plan

Figure 6-6
Fire FLow Deficiencies Map - West

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Section 7

Seismic Resilience Evaluation

7.1 Introduction

Water providers throughout the Pacific Northwest are increasingly aware of the risk to their infrastructure from potential seismic activity. Following recent seismic research which presented persuasive evidence on the imminent threat and extreme risk of a Cascadia Subduction Zone (CSZ) earthquake, the State of Oregon developed the Oregon Resilience Plan (ORP). The ORP established target timelines for water utilities to provide service following a seismic event. The ORP also recognized that, currently, water providers and existing water infrastructure are unable to meet these recovery goals. To improve existing water systems' seismic resilience, one of the ORP's key recommendations was for water utilities to complete a seismic risk assessment and mitigation plan as part of their periodic WSMP update.

As part of this WSMP, SUB, in partnership with RWD, has completed a seismic risk assessment of their existing water system. The scope of this evaluation included risk findings and general recommendations regarding seismic design standards for future water infrastructure. Recommended improvements to mitigate specific facility risks are to be assessed by SUB/RWD and incorporated into this WSMP's CIP list.

7.2 Key Water System Facilities

The performance objectives for facilities were reviewed with SUB in a workshop as part of the study. Please reference SUB's and RWD's Emergency Operations Plans this information is updated yearly, and is consistent with ORP guidelines. Water supply, distribution facility, and other locations were used to develop a water system "backbone" map illustrating key facilities and water mains.

7.2.1 Performance Objectives

The performance requirements were guided by the ORP and the American Lifelines Alliance Seismic Guidelines for Water Pipelines.

The performance objectives are limited to performance of the water system following the seismic event(s). The performance objectives do not include a detailed evaluation of customers to be supplied or varying states of operability following the earthquake.

A workshop was conducted with SUB staff to review the desired level of service (LOS) for the key facilities. The ORP includes a table with recommended LOS for key water system elements. **Figure 7-1**, below, shows SUB's Target States of Recovery, which has been customized based on existing infrastructure and system needs identified in the workshop.

Figure 7-1
Target States of Recovery – Level of Service (LOS) Goals

Target States of Recovery: (Springfield Utility Board)											
	Event Occurs	0-24 Hours	1-3 Days	3-7 Days	1-2 Weeks	2 Weeks - 1 Month	1-3 Months	3-6 Months	6 Months - 1 Year	1-3 Years	3+ Years
Domestic Water Supply											
Potable Water Available at Supply Source (WTP, wells, impoundment)		R	Y		G			X			
Main transmission facilities, pipes, pump stations and reservoirs (backbone) operational		G					X				
Public Works Facility		Y	G				X				
Water supply to critical facilities available		Y	G				X				
Emergency Operations Center		Y	G				X				
Water for fire suppression - at key supply points	???	G		X							
Water for fire suppression - at fire hydrants	???			R	Y	G			X		
Water available at community distribution centers/points				Y	G	X					
SCADA System		G					X				
Distribution system operational					R		Y	G		X	

KEY TO THE TABLE

Target Timeframe for Recovery:

Desired time to restore component to 80-90% operational	G
Desired time to restore component to 50-60% operational	Y
Desired time to restore component to 20-30% operational	R
Current State (90% Operational)	X

Below are descriptions of the modifications to the original Target Recovery Goals Table recommended in the ORP, as well as other discussion items from the workshop.

- "Potable Water Available at Supply Source": The target recovery recommendations of the ORP are anticipated to be achievable with the McKenzie River Surface Water Supply Source coming online by 2027.
- Public Works Facility – This facility was included in the table in addition to the original ORP recommendations. It is noted that this public works facility will be a center for operations including function of the SCADA system.
- Emergency Operations Center – Emergency operations centers (EOCs) are intended to act as local management centers for coordination of emergency responders and supplies following a natural disaster, such as an earthquake.

- "Water for Fire Suppression" – These two target categories were discussed as well. Currently, SUB and RWD are following the recommended recovery guidance as set forth by the ORP. It was noted in the workshop that SUB and RWD representatives will have ongoing conversations with local fire department responder representatives. The following should be continually discussed and agreed upon.
  - Local responders' anticipated plans for emergency response situations to a CSZ earthquake
  - SUB's and RWD's responsibilities in terms of available water supply immediate after an event in support of emergency response plans
- SCADA System – SUB and RWD have SCADA system redundancy built into their systems. The ability to utilize either of the alternate SCADA system locations at Willamette SSF and the Water Service Center allows SUB to be confident in this being operational 0-24 hours after the event. Similarly, RWD has a redundant SCADA server to their 42nd Street office at the Chase Wellfield.
- "Distribution System Operational" – This target category was discussed in detail. The ORP recommends 1-3 days, 3-7 days, 1-2 weeks, and 6 months to 1-year recovery goals for 20-30 percent operational, 50-60 percent operational, 80-90 percent operational, and current state, respectively. Given the complexity of the water distribution system, these goals were relaxed so as to establish a reasonable timeframe for restoring the distribution system.

7.2.2 Facility Analysis

Reference SUB's and RWD's Emergency Operations Plans.

For identified key facilities the target is to have service restored within 1 to 3 days following a seismic event, consistent with the Target States of Recovery table in **Figure 7-1**. Service restoration will be based off source supply damage, severity of distribution piping damage, and priority level of facilities. Key facilities were used to generate the water system backbone for subsequent fragility analysis.

7.2.3 Water System Backbone

A water system backbone of key supply and distribution facilities with connecting transmission and distribution mains was identified based on typical system operations and facility locations. Key water facilities and their supply and distribution functions are summarized in **Table 7-1** and illustrated on **Figure 7-2**, Water System Backbone Map at the end of this section. These key water facilities and their functions should be reviewed and updated every 5 years.

Table 7–1
Key Water System Facilities

Facility Type	Facility Name	Functions
Wells	Chase Wells	▪ Wellfield servicing North System
	I-5 Wells	▪ Wellfield servicing North System
	Q Street Well	▪ Peaking well servicing North System
	Thurston Wells	▪ Wellfield servicing East System
	Maia/SP Wells	▪ Peaking wells servicing East System
	Willamette Wells	▪ Wellfield servicing West System
Water Treatment Facilities	Willamette Slow Sand Filter Plant	▪ Slow sand filtration plant servicing West and East Systems
	Thurston Corrosion Control Facility	▪ Ground water treatment and Corrosion Control for wells servicing East System
	McKenzie Water Treatment Plant*	▪ Water treatment plant servicing the East System with water from the McKenzie River.
	Chase Water Treatment Plant	▪ Cartridge filtration servicing North System
Reservoirs	Moe Reservoir	▪ Reservoir servicing North System
	Kelly Butte Reservoir	▪ Reservoir servicing North System
	Willamette Heights Reservoir	▪ Reservoir servicing West System
	South Hills Reservoir	▪ Reservoir servicing East-Third Level
	S 57th Street Reservoir 1&2	▪ Reservoirs servicing East System
Pump Stations	East Side Pump Station	▪ Pumps water from West First Level Low to East System
	57th Pump Station	▪ Supply to the South Hills Reservoir
Interties	31st St Intertie	▪ Emergency intertie from North System to EWEB
	1-5 & Gateway Intertie	▪ Emergency intertie from North System to EWEB
	22nd & Henderson	▪ Emergency intertie from Glenwood System to EWEB

Note:
*Denotes future facility

Other water facilities shown on the water system backbone map represent service routes to specific facilities or alternate routes through the distribution system to reservoirs and pump stations.

7.3 Seismic Hazards Evaluation

The seismic hazards evaluation for the Springfield water service area was conducted by geotechnical engineers, McMillen Jacobs and Associates, as summarized in the following paragraphs. More detailed information is available in their technical memorandum included as Appendix B.

There are two main sources of seismicity in the Springfield area: the CSZ at the boundary between the oceanic Juan de Fuca Plate and the North American Plate, and crustal faults within the North American Plate. The CSZ is located off the Pacific Coast and stretches from Vancouver Island, British Columbia south to northern California. Subduction zone earthquakes are much larger and longer in duration than crustal earthquakes, but also occur much further away. For the purposes of this evaluation, seismic hazards to the water system are assessed under a CSZ magnitude 9.0 (M9) earthquake as this is regarded as the greatest threat to the region.

Paleoseismic evidence and historic tsunami studies indicate that the most recent CSZ event occurred in the year 1700, probably ruptured the full length of the CSZ, and may have reached a magnitude of 9.0. Recent seismological and geological research (Goldfinger et al., 2012) provides the best understanding of the CSZ mega-thrust earthquake hazard for Oregon and Washington. The magnitude of a CSZ earthquake depends on the rupture length along the subduction zone, full rupture will likely generate mega-M9 and above earthquake events, and partial rupture will likely cause large-magnitude 8.0 to 8.5 earthquakes.

These earthquake events are estimated to recur approximately every 500 years for the mega-magnitude full rupture events and 200 to 300 years for the large-magnitude partial rupture events. Thus, the probability of a future occurrence is high because we are "past due" based on historic earthquakes documented in ocean sediments. The CSZ earthquake with a magnitude greater than 8.5 — similar to recent events in Japan, Chile, and Indonesia — has an estimated 16 to 22 percent probability of occurring off the Oregon Coast in the next 50 years (Goldfinger and others, 2016).

7.3.1 Subsurface Condition Assessment

Seismic hazards were evaluated based on information from existing geotechnical explorations, historical well logs, Department of Geology and Mineral Industries (DOGAMI) hazard maps created for the ORP (Madin and Burns, 2013). Seismic analyses were run assuming a magnitude 9.0 earthquake and a peak ground acceleration of 0.20g to represent the effects of a M9 CSZ seismic event.

7.3.2 Seismic Hazard Findings

The likelihood and magnitude of four sources of seismic hazard were analyzed.

- Liquefaction settlement
- Lateral spreading displacement
- Landslides

- Strong ground shaking

These hazards all have the potential to damage buried water mains and other water facilities. A map of SUB and RWD water facilities was overlaid with mapping of the geohazards in the area and can be seen in **Figures 7-3, 7-4, 7-5, and 7-6** at the end of this section.

The geohazard that causes the largest concern to SUB's water facilities is landslides. Most of the service area is relatively flat but in the areas that contain hills those hills have been utilized to build reservoirs at higher elevations. The facilities that are at risk of landslides are the South 57th Street Reservoirs and Pump Station, the South 72nd Street Pump Station, the Willamette Height Reservoir and Pump Station, and the Kelly Butte Reservoir and Pump Station. Recently, SUB has completed reservoir retrofit and landslide mitigation work at the South 57th Reservoirs and SUB and RWD completed a joint reservoir retrofit mitigation project at Moe Reservoir. Additional details regarding facility and site improvements are discussed in **Table 7-2**.

There is little concern about water facility structures being damaged by liquefaction settlement, ground shaking, or lateral spreading in the event of an M9 earthquake.

7.3.2.1 Liquefaction

Liquefaction occurs when saturated soil experiences enough shaking that it loses its shear strength and transforms from a solid into a nearly liquid state. The results of soil liquefaction include loss of bearing capacity, loss of soil materials through sand boils or flow, flotation of buried chambers and pipes, and post-liquefaction reconsolidation (ground settlement). The assessed liquefaction hazard for the Springfield water service area is quantified as a magnitude of post-liquefaction settlement.

The liquefaction hazard is relatively low in the water service area. The two spots liquefiable soils are present in the water service area are surrounding the South 57th Street Reservoirs and near the 1-5 Intertie. In these areas there is the potential for up to approximately 2 inches of liquefaction induced settlement. Liquefaction hazards for the Springfield water service area are illustrated on **Figure 7-4**.

7.3.2.2 Lateral Spreading

Associated with soil liquefaction settlement, the liquefied soil and non-liquefied soil crust can generate horizontal movement known as lateral spreading. Lateral spreading generally occurs near and along riverbanks, as well as other sloped ground. The potential for lateral spreading depends on the liquefaction potential of the soil, the seismic horizontal loading, the residual shear strength of the soil, and the area's topography.

In general, the lateral spreading hazard is minimal over most the water service area due to its relative flatness. There are three spots in the system that have been identified as having potential for lateral spreading: the area encompassing the Chase Wellfield, the area surrounding the South 57th Street Reservoirs, and south of the Weyco Wellfield. Lateral spreading hazards for the Springfield water service area are illustrated on **Figure 7-4**.

7.3.2.4 Ground Shaking

The rapid and extreme shaking during an earthquake can cause transient stress and strain in pipelines that can be damaging if the pipe material and joints are not strong enough to withstand the shaking. Damage from ground shaking occurs even when there is no permanent ground deformation. The intensity of ground shaking can be quantified with the peak ground velocity (PGV) at a site due to an earthquake.

In general, the ground shaking hazard is 6 to 10 inches/second over most the water service area. Figure 7-5 shows estimated PGV for the water service area.

7.3.2.3 Landslide

Earthquake induced landslides can occur due to the inertial force from an earthquake adding load to a slope. The ground movement due to landslides can be extremely large and damaging to pipelines.

Due to the relative flatness of the water service area most of the water system is not subject to a landslide hazard. However, steeper slopes around the South 57th Street Reservoirs, the Willamette Heights Reservoir, and the far east of the water system near the South 72nd Street Pump Station provide a potential for landslides to occur. Landslide hazards for the water service area are illustrated on Figure 7-6. The estimated landslide deformation in the medium hazard zones is estimated to be between 1 and 4 feet. The estimated landslide deformation in the high hazard zones is greater than 4 feet.

7.3.3 Seismic Hazard Findings Summary

A seismic hazard finding summary is presented for the SUB/RWD water system.

- Backbone Piping
  - In general, the seismic hazards to backbone piping are very low.
  - There are some liquefaction and lateral spreading hazards shown to piping along the Mill Race east of the Steam Plant Pump Station and to piping and pump stations near the intersection of N 42nd Street and Hwy 126. Also, there is lateral spread hazard to piping and wells at the Chase Wellfield. This is further detailed in Figure 7-3 and Figure 7-4.
- Facilities
  - The Kelly Butte, Moe Hill, and Willamette Heights Reservoirs are founded on bedrock or structural fill on bedrock and are not expected to experience seismic liquefaction or lateral spreading hazards.
  - The Willamette Heights Reservoir sits on top of a hill that has a high risk of landslides.

- The South 72nd Street Pump Station and the Willamette Heights Reservoir and Pump Station are in landslide hazard zones. Further study should be conducted at this site to verify the mapped landslide hazard and develop mitigation strategies if needed.

- The S 67th Street, S 70th Street, and South Hills reservoirs, are generally underlain by colluvium in mapped historic landslide areas. Geotechnical explorations suggest that the colluvium is not liquefiable. Slope stability analyses performed by FEI in 2013 suggest that the slopes upon which these reservoirs are founded are stable under both seismic and static conditions. Seismic hazards at these reservoirs are generally low.

- Chase Wellfield shows some low risk due to lateral spreading.

7.4 Water Facility Seismic Vulnerability

7.4.1 Impact of Site Conditions

In addition to the seismic hazard study for the overall service area, reservoirs and pump stations were assessed based on age and mapped geohazards. Also taken into consideration was a seismic analysis for each of the reservoirs that was completed in 2014 and any improvements made since then. Most of the storage and pumping facilities are located on relatively gentle slopes or hills, however the few that are located on the top of hills are at a higher seismic risk.

7.4.2 Seismic Analysis of Reservoirs

In 2014 Murraysmith and PSE conducted a seismic analysis of all the reservoir structures and produced a report. This report includes seismic ratings for each of the reservoirs from 1-10 and recommendations to improve seismic resilience in the event of an earthquake. The condition of each reservoir was determined from observed conditions of the reservoir's components, reports and reservoir drawings supplied from SUB and RWD, and the geotechnical evaluations of each reservoir site. PSE performed structural analysis of each of the reservoir tank structures to determine their analytical structural performance using the 2010 OSSC, AWWA D110-04 standard for concrete pre-stressed tanks, and AWWA D100-11 for welded steel tanks. Each reservoir was analyzed for code level seismic and wind loading. Gravity loads were analyzed to verify allowable foundation bearing pressures and structural integrity of the reservoirs' structural elements. These analyses assumed the reservoirs were full to their overflow levels. The general findings included:

- Maximum Operating Levels are provided for all reservoirs to help mitigate damages from sloshing in the event of an earthquake.

- Addition of flexible expansion joints are recommended at multiple reservoirs. Some retrofit projects have been completed. Addition of flexible expansion joints at reservoir inlet and outlet is still needed for South 67th Street and Willamette Heights Reservoirs.

Table 7-2 further outlines the analytical seismic capacity rating from 1-10 provided by PSE from their structural analysis, the recommended MOL, recommended seismic improvements by PSE, and any improvements that have been made to the reservoirs since the report was developed in 2014. It should be noted that it is anticipated that the Kelly Butte Reservoir and the S 70th Reservoir have seismic and maintenance issues and may be taken out of service within the planning horizon.

7.4.3 Seismic Assessment of Pump Stations and Wells

The review of geologic risks to the pump station and groundwater well facilities shows that the S 67th Street Pump Station has potential landslide risks. The remaining facilities are not identified to have significant geologic risks. Groundwater wells and smaller single-story structures are generally at low risk during seismic events compared to multi-story and larger structures. A facility inspection is recommended to review as-built conditions and identify electrical and mechanical equipment anchorage deficiencies. Based on the condition assessment, facilities can be identified that would require more comprehensive structural analyses.

Table 7-2
Seismic Analysis of Reservoirs (from 2014)

Reservoir	Seismic Structural Rating (2014)	Recommended Seismic Structural Improvements (2014)	Improvements Since 2014
Kelly Butte	4	▪ Strengthening wall connections to roofing and footing ▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ None
Moe Hill	8	▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ Addition of flexible expansion joints at reservoir inlet and outlet and a seismic vault in 2019
South 57th St No. 1	5	▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ Addition of flexible expansion joints at reservoir inlet and outlet and a seismic vault in 2019 ▪ Retaining wall along east slope to mitigate creep
South 57th St No. 2	4	▪ Foundation expansion and anchorage to reduce stresses in third row of steel plates. ▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ Addition of flexible expansion joints at reservoir inlet and outlet and a seismic vault in 2019 ▪ Retaining wall along east slope to mitigate creep ▪ Addition of French Drain with footing expansion to mitigate drainage
South 67th St	5	▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ None
South 70th St	1	▪ Foundation expansion and anchorage ▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ None
South Hills	2	▪ Strengthen wall connections to footing, roof slab, and column support system ▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ None
Willamette Heights	7	▪ Addition of flexible expansion joints at reservoir inlet and outlet	▪ None

The seismic structural rating from the 2014 study is reproduced below.

Rating	Description
9-10	Very good
7-8	Good, shows slights signs of wear
5-6	Shows expected level of aging
3-4	Shows wear and will need rehabilitation or replacement
1-2	Should be replaced or rehabilitated

7.5 Pipe Fragility Analysis

Pipeline fragility describes the likelihood of pipeline damage by estimating the necessary rate of repair per 1,000 feet of main following an earthquake. The estimated rate of repair is based on the pipe material, installation, and surrounding ground conditions. While the actual location of pipeline damage cannot be predicted, pipeline fragility analysis provides a measure of the expected severity of damage to the water system backbone overall and may identify areas of higher relative risk where mitigation efforts should be focused first.

7.5.1 Analysis Method

This analysis focused on estimating rates of repair (RR) for the water system backbone mains illustrated on **Figure 7-2**, which were identified for this analysis with water utility and emergency management staff input. Backbone mains are divided into higher-priority Tier 1 mains which serve water system facilities and lower-priority Tier 2 mains which provide alternate routes through the distribution system or service to lower level facilities and smaller water facilities.

Backbone pipeline fragility was evaluated using data provided by SUB, seismic geohazards described earlier in this section, and the Seismic Fragility Formulations for Water Systems guideline developed by the American Lifelines Alliance (ALA). The ALA is a partnership between the Federal Emergency Management Agency (FEMA) and the ASCE.

The ALA guideline damage algorithms used to calculate RR per 1,000 linear feet (LF) of pipe are based on empirical evidence catalogued after major earthquakes such as the 1989 Loma Prieta Earthquake in the San Francisco bay area and the 1995 Great Hanshin earthquake in Hyogoken-Nanbu (Kobe), Japan. The guideline recommends using two pipe vulnerability functions, each of which address a different seismic hazard.

1. RR = K1 * 0.00187 * PGV

This function estimates a RR per 1,000 LF of pipe due to seismic wave propagation or ground shaking. The magnitude of ground shaking is represented by PGV, described earlier in this section.

2. RR = K2 * 1.06 * PDG0.391

This function estimates a RR per 1,000 LF of pipe due to permanent ground deformation (PGD). PGD can be the result of landslide or lateral spreading due to soil liquefaction, described earlier in this section.

In the pipe vulnerability equations above, K1 and K2 are empirical fragility constants which are used to scale the repair rates for different pipe diameters, pipe materials, and joint types. K1 generally represents the strength and flexibility of the pipe material to withstand ground shaking. K2 generally represents the strength and flexibility of the pipe joint to resist separation during ground deformation. A larger K value correlates with higher material or joint vulnerability.

7.5.2 Pipe Fragility Seismic Hazard Values

Pipe fragility repair rates per 1,000 LF of pipe are calculated for the following seismic hazards.

- Strong ground shaking, expressed as PGV
- Settlement due to liquefaction, expressed as PGD_{LIQ}
- Liquefaction induced lateral spreading, expressed as PGD_{LAT}

Relative potential hazard levels for each of these three hazards are shown as low, medium, and high in **Figures 7-3**, **7-4**, and **7-5**. Note that hazard values are relative to hazards in the surrounding area; they do not quantify danger level during a seismic event. As illustrated in **Figure 7-6**, ground movement due to landslide is unlikely throughout the water service area except for specific transmission main sections discussed I n the seismic hazard findings earlier in this section. Thus, pipe fragility due to landslide is not calculated for the Springfield water system backbone overall. Specific values for PGV and PGD used in the pipe fragility repair rate calculations are summarized in **Table 7-3**. As the reported seismic hazard data are described as low, medium and high, an average value (Pipe Fragility Value) within each range was used for the pipe fragility analysis.

Table 7-3
Pipe Fragility Seismic Hazard Values

Seismic Hazard	Variable (units)	Low		Medium		High	
		Range	Pipe Fragility Value	Range	Pipe Fragility Value	Range	Pipe Fragility Value
Ground Shaking	PGV (inches/second)	6 to 10	8	10 to 14	12	14 to 19	16.5
Liquefaction Settlement	PGD_{LIQ} (inches)	0 to 2	1	2 to 6	4	>6	8
Lateral Spreading	PGD_{LAT} (inches)	0 to 6	3	6 to 12	8	>12	15

7.5.3 Pipe Installation and Materials (K Value Selection)

The ALA seismic fragility guideline provides a range of K values which scale estimated RR for different pipe materials and joint types. K values are estimated based on empirical damage evidence from previous earthquakes. Thus, the influence of some variables, such as pipe diameter, are inconclusive based on the currently available historical water main damage data. Selected K values for the water system backbone are summarized in **Table 7-4** based on the ALA guideline and the current water system asset management data and mapping. A higher K value indicates a pipe that is more likely to break, while a lower K value represents a pipe that is less likely to break due to the variables outlined above.

The value K1 generally represents the pipe material. Repair rates for some material types are also influenced by pipe diameter and soil corrosivity. Large diameter, defined as 16-inch diameter and greater, welded steel or concrete cylinder mains show lower damage rates in previous seismic events than smaller diameter mains of the same material. This may be attributed to higher quality control during construction, fewer bends and lateral connections than smaller mains, or lower soil loads as a function of pipe strength for the same depth of cover.

Soil corrosivity also influences K1 values for cast iron and steel pipes. If these pipes are installed in corrosive soils, anticipated damage rates would be higher. Based on soil survey data from the National Resource Conservation Service (NRCS), soil corrosivity is low throughout the SUB/RWD water service area.

The value K2 generally represents the pipe joint and is selected based on joint type and pipe material. Joint type information was not available for the water system mains. The most conservative assumptions were made for joint types. The only situation where this was not the case was for cast iron pipes. It was assumed that if a cast iron pipe was installed before 1970 it has a cement joint type and if it was installed during or after 1970 it has a rubber gasket joint type.

No empirical data is available in the ALA guideline for high density polyethylene pipe (HDPE) which is expected to perform as well or better than welded steel pipe during a seismic event. HDPE K values are assigned consistent with K values for large diameter welded steel pipe.

Table 7-4
Pipe Fragility K Values

Pipe Material:		Installation Date	Assumed Joint Type	Diameter	K1	K2
Abbreviation	Description					
CI	Cast Iron	<1970	Cement	All	1.4	1.0
CI	Cast Iron	>=1970	Rubber Gasket	All	0.8	0.8
DI	Ductile Iron	All	Rubber Gasket	<12”	0.5	0.5
DI	Ductile Iron	All	Rubber Gasket	12”-24”	0.8	0.7
DI	Ductile Iron	All	Rubber Gasket	>24”	1.0	1.0
AC	Asbestos Cement	All	Cement	All	1.0	1.0
STEEL	Steel	All	Rubber Gasket	All	0.7	0.7
PVC	Polyvinyl Chloride	All	Rubber Gasket	Small	0.5	0.8
HDPE	High Density Polyethylene	All	Welded or fused	Large	0.15	0.15

Notes:
1. Small = 4- to 12-inch diameter
2. Large = 16-inch diameter and greater

7.5.4 Pipe Fragility Findings

Buried pipeline damage caused by ground failure (liquefaction and lateral spreading) will be significantly more severe than damage caused by ground shaking. Empirical data used to develop the ALA’s pipe fragility analysis method reveals repair rates two orders of magnitude higher for damage caused by ground failure. The HAZUS methodology used by FEMA to assess potential earthquake damage to buried pipelines also supports this conclusion. For pipeline repairs caused by ground failure, HAZUS assigns 80 percent of the repairs as “breaks” and 20 percent as “leaks”. For ground shaking, 20 percent are considered breaks and 80 percent leaks.

In the water service area, liquefaction settlement during a seismic event presents the largest risk to transmission and distribution mains. There will be an estimated two potential breaks in the water system due to liquefaction settlement. The number of breaks due to liquefaction settlement, lateral spreading, and ground shaking are shown in **Figures 7-3**, **7-4**, and **7-5** respectively.

The two spots in the system that are vulnerable due to liquefaction settlement during an earthquake are the tier 1 water mains leading to the 57th Street Reservoirs and a section of the tier 2 watermains leading up to the I-5 Intertie and wellfield. There is no identified variability in the system due to lateral spreading or peak ground velocity.

7.6 Design Standards for Seismic Resilience

Oregon Structural Specialty and Mechanical Specialty Codes will dictate that all new water facility construction meet current earthquake standards which are based on an M9 event. Suggestions for water facility design and construction standards include the following.

7.6.1 Pipelines

Based on the seismic vulnerability of the water system, restrained joint ductile iron pipe provides the best balance of cost, performance, and life cycle. **Fully restrained ductile iron pipe reduces the risk of separation at standard push-on joints and allows limited deflection as a result of ground shaking and ground deformation.** Furthermore, ductile iron is a piping material that SUB/RWD crews are familiar with and SUB stocks adequate supplies to respond to leaks and main breaks. This recommendation is based on the following.

- Fully restrained ductile iron pipe can be expected to reduce the number of main breaks due to joint pull-out, which is the most likely cause of failure for unrestrained ductile iron pipe, by an order of magnitude resulting in significantly less repairs following a seismic event.

- Typical restraint systems increase the cost of pipe material by approximately $100 per pipe segment and do not impact pipe installation time. This is a relatively inexpensive method of making distribution piping more resilient and is consistent with the construction standards being implemented by other similar sized utilities.

- Some of the cost of the additional restraint at standard push-on joints will be offset by reduced design costs to calculate thrust restraint lengths since the entire length of pipe will be restrained.

- In the future, connections to existing mains that are fully restrained will reduce the need for thrust restraint design and construction at tie-ins.

For pipes larger than 24-inch diameter, SUB should consider weldment ring ductile iron pipe a preferred pipe material. The selection of piping material, lining and coating system, and other design parameters should be made on a case-by-case basis with adequate consideration of specific alignment seismic hazards, hydraulics, performance and life-cycle expectations, soil considerations, etc. Pipes larger than 24-inch diameter are not operated in RWD's system.

7.6.2 Reservoirs

It is assumed that future reservoir structures will be designed to meet earthquake standards consistent with current Structural and Mechanical Specialty codes. There are two key design considerations associated with reservoir configuration and connections to the distribution system.

- Pipe to reservoir connections
- Automated isolation valves

7.6.2.1 Pipe to Reservoir Connections

At each distribution or transmission piping connection to the reservoir, significant stress can be placed on the pipe as a result of the difference in response to ground motion and deformation by the pipe and reservoir foundation. To minimize the risk of pipe breakage at this location, it is recommended that a flexible expansion joint be installed at this interface. Flexible expansion joints must be capable of allowing axial expansion/contraction and differential movement that results in a vertical or horizontal offset.

7.6.2.2 Automated Isolation Valves

Automated isolation valving with seismic valve actuators should be considered at all reservoir piping connections. There are several considerations to be weighed in determining whether to use an automatic shut-off valve at each reservoir as summarized in **Table 7-5.** SUB and RWD should continue discussions for options of automatic shut off valves that 100 percent close versus partially close. Additional automated isolation valves should be designed and installed in accordance with the cities over all I&C plan.

Table 7-5
Automatic Shut-off Valve Considerations at Reservoirs

If a seismic valve actuator is used for automatic shut-off at reservoirs:	YES	NO
Water Available for Fire Suppression Immediately After Event?		✓
Reservoir Water Volume Preserved for Use During Recovery?	✓	
Requires Maintenance of Batteries for Valve Actuation?	✓	
Vulnerable to Accidental Closure due to False Alarm?	✓	

For each reservoir, SUB/RWD should consider the specific performance objectives associated with a seismic event and the anticipated response and recovery period to determine whether the installation of seismically actuated valves is warranted. For example, if two reservoirs serve a pressure zone, one may be equipped with seismic valves to preserve the water volume for future use during recovery while the other will remain connected to the system to provide fire suppression and emergency water with the risk that this volume may be lost through main breaks.

7.6.3 Pump Stations and Supply Wells

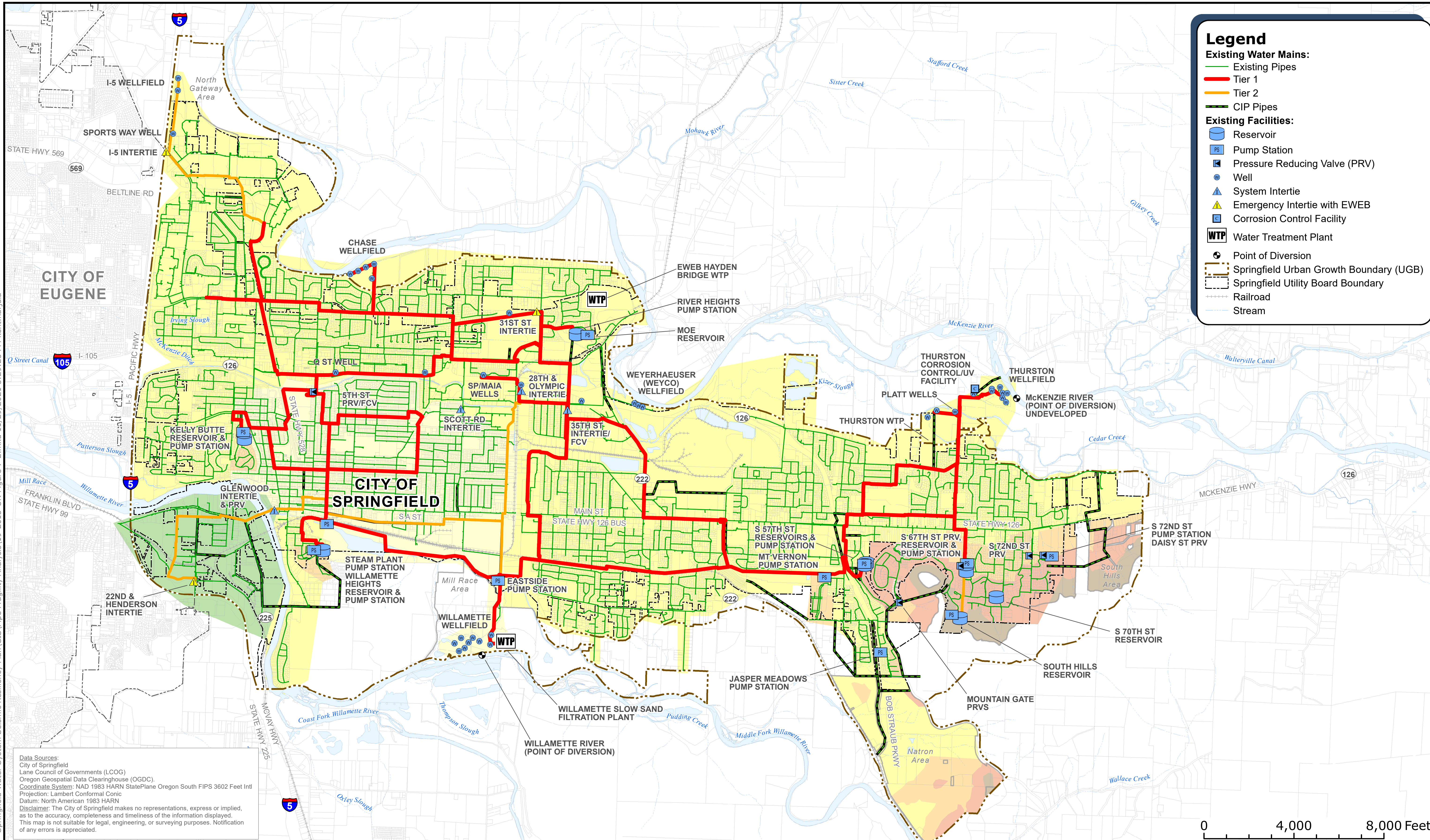
Like reservoir structures, pipe connections at the supply well and pump station buildings present specific vulnerability as a result of differential movement and settlement. To minimize the risk of pipe breakage at this location, it is recommended that a flexible expansion joint be installed at this interface. Flexible expansion joints must be capable of allowing axial expansion/contraction and differential movement that results in a vertical or horizontal offset.

Standby power should also be provided, in the form of a standby generator, at (Tier 1) pump station facilities and at appropriate supply wells to provide adequate emergency supply and reliability. The standby generator should be equipped with on-site fuel storage for at least 24 hours of operation. While a significantly greater volume of fuel will likely be required to sustain operation of the generator through the recovery period following a seismic event, storage of greater volumes of fuel present complications and are likely not economically feasible.

7.7 Next Steps

This initial seismic evaluation demonstrates that there are significant risks to the SUB/RWD water system during a seismic event. The following are recommended.

- Conduct a seismic resiliency study of water facilities in order to identify potential hardening projects. This study should exclude the water system reservoirs as they were recently evaluated in 2014.
- Continue coordination with emergency managers to refine understanding of post-disaster water needs which will inform water facility performance goals and design choices.
- Maintain a list of resiliency improvement projects.
  - Look for opportunities to perform the identified improvements in a cost-effective manner.
  - Periodically review a list of resiliency improvement projects and incorporate specific projects into a formal 10-year CIP.



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Rainbow Water District

Springfield Water System
Seismic Resiliency Plan

Figure 7-2
Backbone Piping

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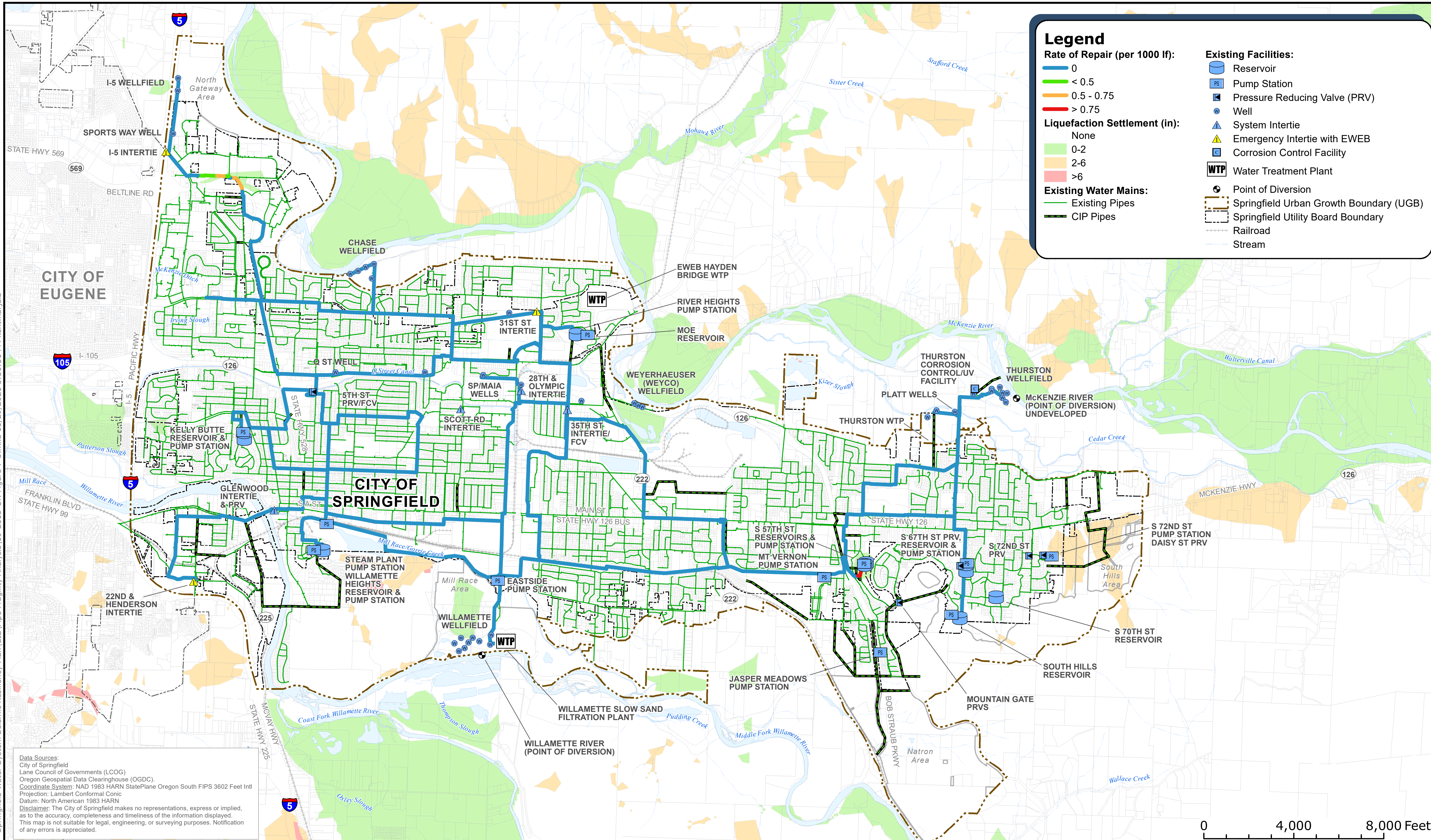

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Springfield Water System Seismic Resiliency Plan

Figure 7-3 Liquefaction Settlement

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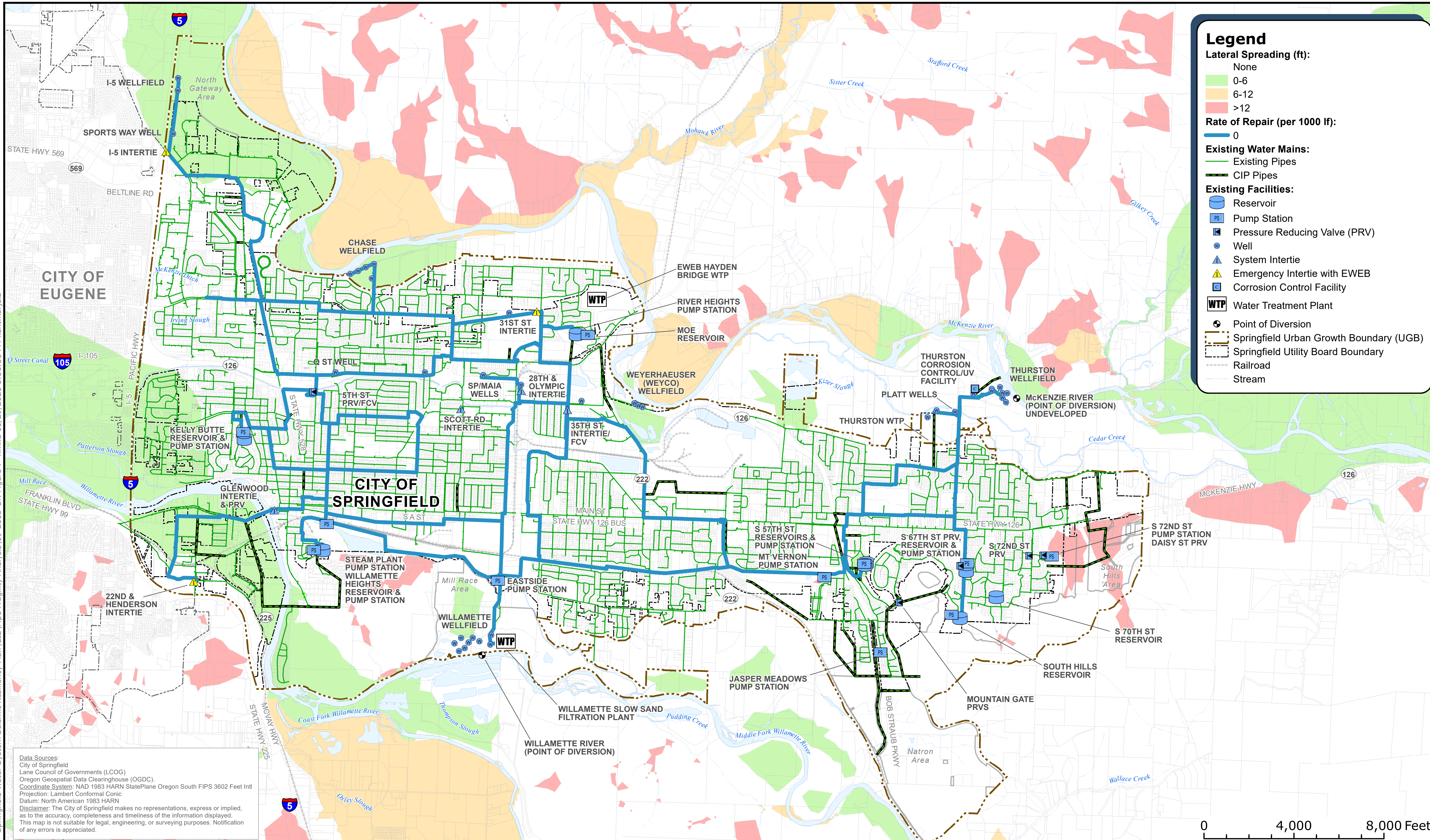

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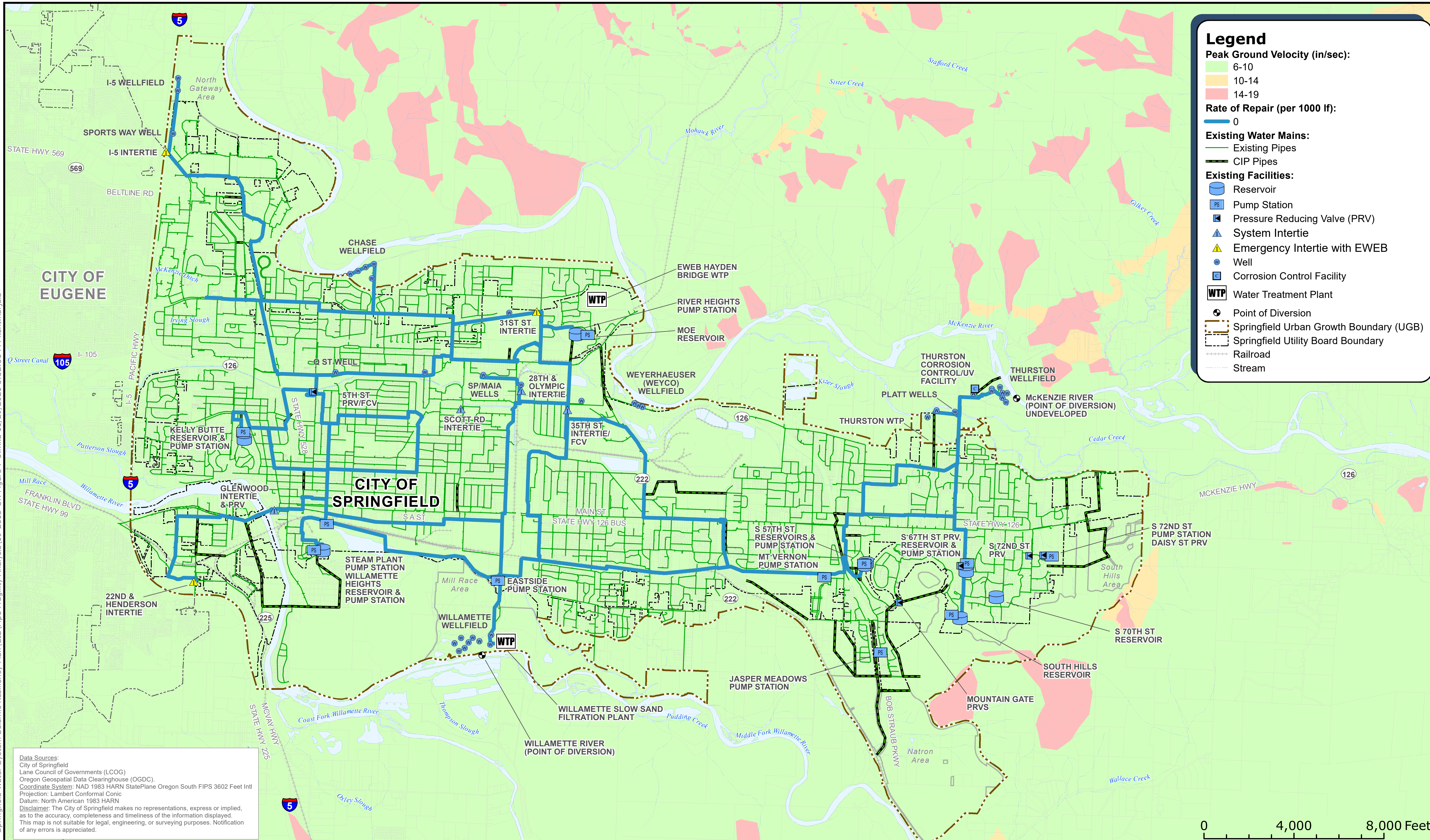
Springfield Water System
Seismic Resiliency Plan

Figure 7-4
Lateral Spreading



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Seismic Resiliency Plan

Figure 7-5
Peak Ground Velocity

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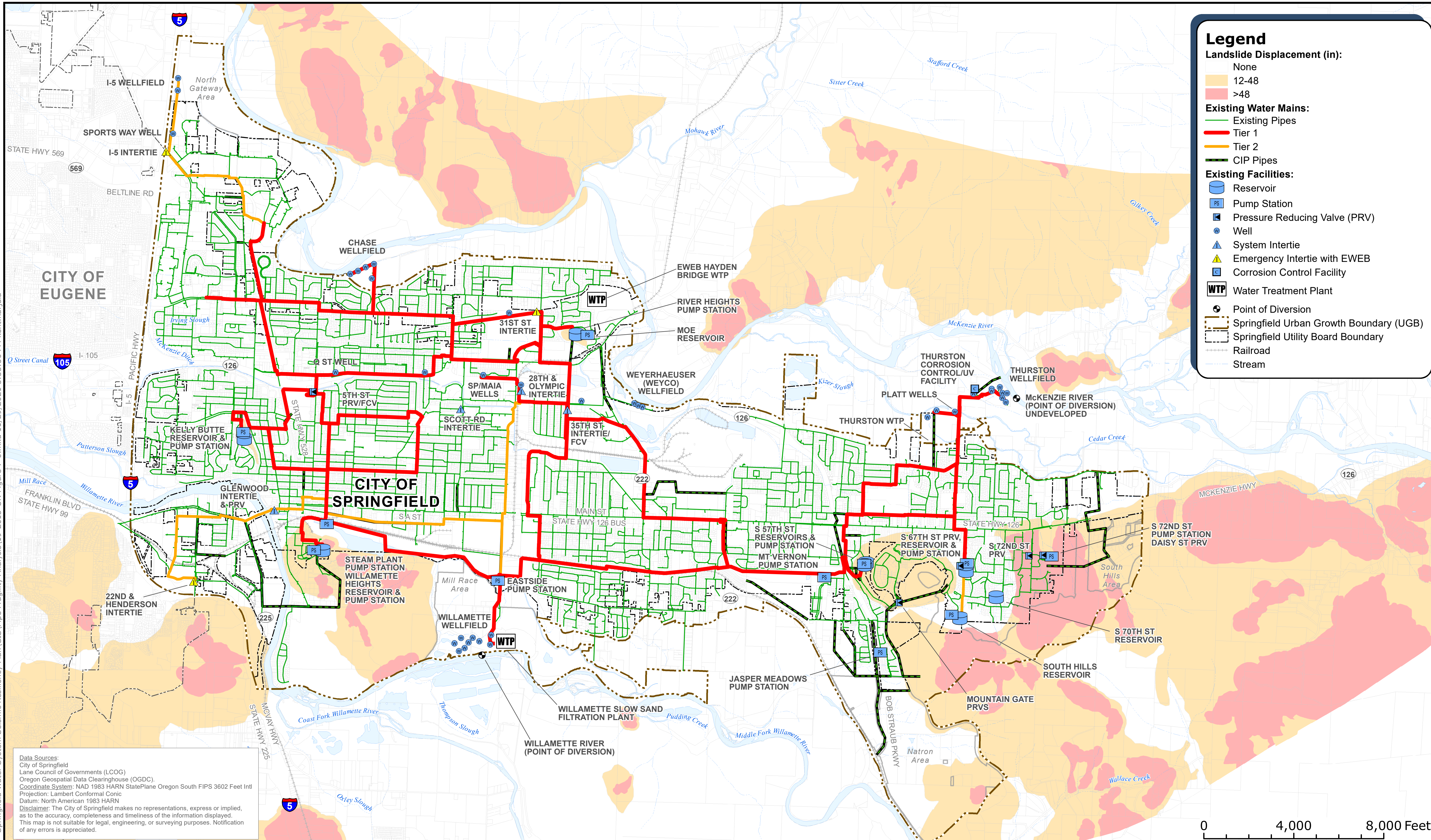

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Springfield Water System Seismic Resiliency Plan

Figure 7-6 Landslide Displacement

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Section 8

Section 8

Recommendations and Capital Improvement Program

8.1 Introduction

This section presents recommended improvements and capital maintenance for the joint SUB and RWD water distribution system based on the analysis and findings presented in **Section 5** and **Section 6**. These improvements include storage reservoir, pump station, PRV, and water main projects. The CIP presented in **Table 8-1** and **Table 8-2** later in this section summarizes recommended improvements and provides an approximate timeframe for project completion.

8.2 Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule, and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage, and other factors. The cost estimates presented here are considered Class 5 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As projects are better defined, the accuracy level of the estimates can be narrowed.

Estimated project costs are based upon recent experience with construction costs for similar work in Oregon and southwest Washington and assume improvements will be accomplished by private contractors. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs. Estimates do not include the cost of property acquisition. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating, the current ENR CCI for Seattle, Washington is 12,771.7 (September 2020).

8.3 Water System Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in **Table 8-1** and **Table 8-2**. This CIP table provides for project sequencing by showing prioritized projects for the 5-year, 10-year, and 20-year timeframes defined as follows.

- 5-year timeframe - recommended completion between 2021 and 2025
- 10-year timeframe - recommended completion between 2026 and 2030
- 20-year timeframe - recommended completion between 2031 and 2040.

Water capital maintenance and improvement programs may be funded from a variety of sources. In general, these sources can be summarized as: 1) governmental grant and loan programs; 2) publicly issued debt; and 3) cash resources and revenues. These sources are described in **Section 9**. It is expected that SUB/RWD will fund all the projects presented in this CIP over the next 20 years from a mix of rates, system development charges, and funding studies as approved by SUB and RWD Boards. Additional financing mechanisms are included below to identify alternatives available to SUB/RWD for future major capital improvements planned beyond the year 2040.

8.4 Supply Source and Treatment Improvements

As presented in **Section 6**, SUB/RWD will need to develop additional supply source capacity within the 20-year planning horizon to meet short-term and long-term water supply needs. Longer-term water supply needs will require major capital investment through the development of new surface water supply facilities. A list of supply improvements and capital maintenance is presented in **Table 8-1** and **Table 8-2**.

8.4.1 Surface Water Plant Design and Construction (SUB)

A new surface water treatment plant using the McKenzie River source will provide additional source capacity to meet projected growth in water demands and anticipated decline in existing source capacity. The new plant will also provide for a seismically resilient source facility. For budgeting purposes, the design and construction components are presented as separate projects.

8.4.2 Willamette Resand Filter Beds (SUB)

The filter beds at the WSSFP require periodic replacement of the filter bed media. Replacement is planned for one bed every other year.

8.4.3 Well Maintenance and Rehabilitation (SUB)

Wells require periodic rehabilitation to recover and maintain the desired production capacity. Anticipated maintenance includes periodic pump and motor testing, testing wells for capacity and efficiency, and well rehabilitation. SUB plans to conduct testing, maintenance and replacement as needed for one well per year.

8.4.4 New Thurston Middle School Wells Nos. 1 and 2 (SUB)

SUB has water rights for two planned wells at the Thurston Middle School property. These projects include drilling and installing pumps capable of supply emergency water.

8.4.5 New Pierce Well (SUB)

Much of SUB's source capacity is located in the East System. Installing new supply in the western portion of the service area allows for redundancy of the critical I-5 Well facilities and improves operational flexibility. Hydraulic modeling has found the I-5 Wells are needed in concert with the RWD facilities to provide adequate North System service pressure under high demands. SUB will conduct a water rights evaluation to determine how to best support the new Pierce Street Well.

8.4.6 New 16th & Q Street Well (SUB)

Much of SUB's source capacity is located in the East System. Installing new supply in the western portion of the service area allows for redundancy of the critical I-5 Well facilities and improves operational flexibility. Hydraulic modeling has found the I-5 Wells are needed in concert with the RWD facilities to provide adequate North System service pressure under high demands. SUB will conduct a water rights evaluation to determine how to best support the new 16th & Q Street Well.

8.4.7 Willamette Filter Bed Curb and Gutters (SUB)

This project, scheduled for 2021, includes WSSFP filter bed improvements to include addition of filter bed curbs and gutters to prevent surface water runoff from reaching the filter beds.

8.4.8 Chase Well No. 6 and/or No. 7 (RWD)

Up to two new wells will be drilled and groundwater supply facilities installed at the Chase Wellfield to offset declining existing well productivity.

8.4.9 I-5 Wellfield Improvements & Backup Generator (RWD)

To allow for operation using a portable generator, install a transfer switch and VFDs at the I-5 Wells. The VFD will allow turn down to a lower horsepower. This project also includes procurement of a portable propane generator sized to power a 200 HP pump and associated equipment.

8.4.10 Well Maintenance and Rehabilitation (RWD)

Wells require periodic rehabilitation to recover and maintain the desired production capacity. Rehabilitation can include both cleaning and disinfection of the wells as well as pump and motor maintenance and replacement as necessary. RWD anticipates rehabilitating one well per year, which is approximately each well every 10 years, depending upon actual conditions. Annual pump and motor maintenance is included in this project cost.

8.5 Storage Reservoirs

Based on existing and projected future storage capacity deficiencies presented in **Section 6**, the seismic improvements identified in the 2014 seismic evaluations study, and anticipated growth areas, and operational considerations, new finished-water storage reservoirs and reservoir improvements are recommended.

8.5.1 57th Street Reservoirs Altitude Valves (SUB)

The S 57th Street Reservoirs were recently improved. Part of that project included provisions for future 16-inch altitude valves. This project includes installing two new altitude valves and integration into the SCADA system. This project should occur prior to any changes in operational controls that could increase the risk of accidental overflows.

8.5.2 South Hills Reservoir Improvements (SUB)

The 2014 seismic evaluations study identified deficiencies with the South Hills Reservoir. A reduction of the operating water level in the structure from 24 feet to 15 feet addresses some of the deficiencies and would reduce the storage from 1.5 mg to 0.83 mg, which is adequate to address the East Third Level storage needs. This project will include engineering evaluation to further investigate improvement options, will consider replacement with a smaller size reservoir, and select the optimal improvements.

8.5.3 S 67th Street Reservoir Seismic Retrofit (SUB)

The 2014 seismic evaluations study identified improvements to the S 67th Street Reservoir. The recommended improvements included adding flexible piping connections, seismic valving, and reservoir maintenance repairs and coating.

8.5.4 Willamette Heights Reservoir No. 2 Seismic Retrofit (SUB)

The 2014 seismic evaluations study identified seismic upgrades to the existing Willamette Heights Reservoir. The recommended improvements included adding flexible piping connections, seismic valving and reservoir maintenance repairs and coating. An altitude valve should also be installed at the reservoir.

8.5.5 Willamette Heights Reservoir No. 4 (SUB)

Hydraulic modeling confirmed that additional storage in the western portion of the service area would be beneficial in maintaining pressures during high demand and more distributed storage benefits fire suppression. SUB has planned for a second reservoir at the Willamette Heights site.

This project includes installation of a second 2.0 million gallon welded-steel reservoir although additional planning will be needed to determine the project timing and sequencing relative to other improvements.

In evaluating the impacts of potentially removing the storage at the Kelly Butte Reservoir site, the North System Transmission improvements were found to be adequate to allow for the removal of reservoir. It is recommended that offsetting storage be constructed prior to removal of the Kelly Butte Reservoir. It is anticipated that the reservoir will remain in operation and further evaluation will occur approximately at the next masterplan update to re-assess the reservoir facilities at that time.

8.5.6 Natron Reservoir, Level 1 (SUB)

As the Natron Service Area develops, a 1.5 mg First Level reservoir is planned to provide adequate fire suppression capacity to the industrial areas. A potential location for the reservoir is located southeast of the Jasper Meadows subdivision on the east side of Weyerhaeuser Road. This project is development driven.

8.5.7 Natron Reservoir, Level 2 (SUB)

As the Natron Service Area develops, a 1.0 mg reservoir is planned to serve the Second Level service area. The location of the reservoir is to be determined but could be located within the Natron service area or east of the service area at an appropriate elevation. This project is development driven.

8.5.8 South Hills Fourth Level Reservoir (SUB)

Supporting development of the South Hills East Fourth Level service area, SUB is currently constructing a 460,000 gallon steel tank as a partial planned replacement of the South Hills Reservoir storage. The construction began in January 2021.

8.5.9 Remove S 70th Street Reservoir (SUB)

Prior studies have recommended that the S 70th Street Reservoir, which is undersized to meet storage requirements for the East Second Level, is not cost effective to maintain and make seismic improvements to and should be decommissioned. It is anticipated that the service area can be served from a new pump station at 67th Street and from the East Third Level via PRV stations. Additional evaluations are needed to further refine the service approach for the East Second Level.

8.5.10 Kelly Butte Reservoir (RWD)

Prior studies have identified current seismic code structural deficiencies for the Kelly Butte Reservoir, although the structure is in good condition. The site is also tight and difficult to access, creating difficulties in major construction work. It is anticipated that the reservoir will be operated for as long as practical. For planning purposes, the reservoir is tentatively scheduled for decommissioning in 2040, but the continued use of the Kelly Butte Reservoir should be reviewed at the next plan update or in approximately 2030.

8.5.11 Emergency Communications Equipment (RWD)

Install an emergency ham radio or other data antenna at Kelly or Moe Reservoir sites in partnership with Springfield Emergency Management.

8.6 Pump Stations

No existing or projected future pumping capacity deficiencies were identified, as presented in Section 6. The pump station improvement projects identified herein address system growth needs, seismic improvements, or are changes to improve system operations.

As noted in **Section 6**, small closed-zone pump stations are not designed to provide fire suppression flows. Fire suppression flows are provided by adjacent pressure zones.

8.6.1 Eastside Pump Station Improvements (SUB)

The Eastside Pump Station currently pumps water from the WSSFP discharge line to the East System and allows flow from the East System to the West First Level Low through a PRV. The hydraulic modeling indicates future uses of Eastside Pump Station may require system improvements or modifications to manage cycling of the Willamette Heights Reservoir.

8.6.2 Natron Pump Station, Level 2 (SUB)

As the Natron Service Area develops, a new pump station will be needed to provide service to the upper elevation service areas. If feasible, the pump station should be located near to the planned main level Natron Reservoir to promote reservoir turnover and good water quality. The timing of this project is driven by development needs.

8.6.3 Natron Pump Station, Level 3 (SUB)

As the Natron Service Area develops, a new pump station will be needed to provide service to the uppermost elevation service area. The Third Level service area is anticipated to be relatively small and residential in character making service from a constant pressure booster station with capacity to serve peak demands and fire flow conditions appropriate. If feasible, the pump station should be located near to the planned Natron Reservoir for Level 2 to promote reservoir turnover and good water quality. The timing of this project is driven by development needs.

8.6.4 Steam Plant Relocation (SUB)

The Steam Plant Pump Station is recommended to be maintained both for typical PRV regulated flow into West First Level Low as well as backup pumping capacity from the West First Level Low to West First Level. Due to structural issues at the current site, the plant is intended to be relocated to a nearby location.

8.6.5 S 67th Pump Station Replacement (SUB)

This project includes pumping improvements to serve the second and third levels. A new structure will be installed to house relocated facilities. This project will require evaluation of the East Second Level service approach to include potential changes in operations associated with the S 70th Street Reservoir, the 72nd St Pump Station and capacity to provide service from the East Third Level via pressure regulators.

8.6.6 S Hills Pump Station Construction Completion (SUB)

The S Hills Pump Station is currently in construction and scheduled to be completed in 2021. This station, located next to the S Hills Reservoir, will supply growth in the new East Fourth Level.

8.7 Transmission and Distribution System Improvements

The water system analysis found that transmission system improvements are needed to provide improved transmission capacity within the system. Table 8-1 and Table 8-2 present recommended water main projects for system interconnectivity and system expansion. This CIP summary table includes estimated project costs.

8.7.1 Water Main Cost Estimates

The cost estimates for transmission and distribution pipelines assumes construction with cement mortar lined ductile iron pipe installed within paved rights-of-way and includes a typical distribution of isolation valves, fittings, and fire hydrants. All joints are assumed to be fully restrained and controlled low-strength material is assumed as trench backfill within existing paved areas per City of Springfield roadway standards. Construction cost estimates also assume installation by SUB crews for SUB piping projects and third-party installers for RWD projects. Project cost estimates are based on SUB and RWD experience with construction of similar sized transmission main improvements within the service area.

8.7.2 Distribution Capital Maintenance - Routine Main Replacement Program (SUB/RWD)

An adequately funded main replacement program is necessary to minimize the risk of failure for critical water system components that will result in significantly greater costs to repair and replace in the future. This project includes replacement of approximately 1 percent of the distribution piping on an average annual basis. Annually, SUB replaces approximately 4,000 to 5,000 feet of 4 to 12-inch diameter distribution mains. RWD annually replaces approximately 500 feet of 4- to 12-inch diameter distribution mains.

The actual timing of the work is subject to several considerations:

- Pipe age and history of breaks which drives the immediacy of replacement
- Coordination with other projects, such as City street reconstruction
- Fire flow deficient areas, presented in **Section 6**
- Replacement of small diameter piping (2-, 4- inch diameters)
- Substandard pipe materials (AC, or corroding steel pipe)
- Financial conditions
- Available staffing

As part of these improvements, opportunities to improve fire hydrant spacing and fire flow capacities should be considered where they can be incorporated.

8.7.3 Transmission Piping Projects

Transmission piping improvements developed by SUB and RWD staff are described below and illustrated in **Figure 8-1**.

8.7.3.1 Henderson Avenue Transmission Pipeline (SUB)

This pipeline completes the 16-inch diameter transmission pipelines constructed in 14th Avenue and across the ODOT maintenance facility at 19th Avenue and Henderson Avenue. The proposed pipeline increases the transmission capacity for future commercial or industrial development in the west half of Glenwood, south of Franklin Boulevard, and includes 1,700 LF of 16-inch diameter pipe.

8.7.3.2 E 19th Avenue Transmission Pipeline (SUB)

This project completes the 16-inch diameter transmission pipeline in 19th Avenue between Nugget Street and Henderson Avenue. The proposed 1,800 LF pipeline provides looped transmission capacity into the area south of the UPPR tracks in Glenwood. This loop is currently provided through a 24-inch diameter transmission pipeline leased from EWEB.

8.7.3.3 Glenwood Service Area Redundant River Crossing (SUB)

The GWD and portions of the SUB service area west of the Willamette River are currently supplied through a single water main crossing the river at the bridge. This project provides two options for a second supply main to provide for redundancy. Further evaluation will be required to select pipe alignment, and style and location of the river crossing. For budgeting purposes only, a horizontally drilled crossing under the river near the railroad bridge, (South of Island Park) and West D Street (West of Island Park); this includes 2,800 feet of 18-inch 24-inch diameter transmission piping.

8.7.3.4 B Street Upsizing (SUB)

When the Willamette Heights reservoirs are filling from the East System supplies, high velocities were found west of the East Side Pump Station. This project includes upsizing 415 LF to 24-inch diameter from 5th Street to 7th Street to improve connectivity and eliminate high velocities.

8.7.3.5 S 28th Street Transmission Pipeline (SUB)

This project includes piping renewal over three sections to replace aging piping. The first is a short section of 36-inch diameter between the millrace crossing and the end of the 60-inch diameter Willamette detention pipeline. The second is extension of the 36-inch diameter pipeline from the millrace to the Eastside Pump Station. The third is a 24-inch diameter pipeline from the Eastside Pump Station to S F Street replacing the existing 16-inch diameter AC and 20-inch diameter OD pipelines. An approximately 1,500 LF of 12-inch diameter main will be installed using the exiting 20-inch diameter piping as casing from the pump station south past the Millrace. Timing of these improvements is driven by coordination with City of Springfield street improvements along S 28th Street and includes 665 LF of 36-inch diameter pipe and 1,100 LF of 24-inch diameter pipe.

The project also includes approximately 6,500 LF of 16-inch diameter transmission piping to provide system looping and redundancy to include a second crossing of the Mill Race waterway.

8.7.3.6 Millrace Transmission (SUB)

Approximately 500 acres were recently brought within the urban growth boundary along the north side of the Middle Fork Willamette River. This project extends piping to the largely residential and open space area. For budgeting purposes, approximately 15,000 LF of 12-inch diameter water main is anticipated to provide for adequate system looping. The alignment of the transmission main and final sizing will be dependent upon the development plans and determined through further design.

8.7.3.7 35th Street Transmission Pipeline (SUB)

This pipeline is a replacement of an existing 10-inch diameter pipeline in 35th Street between Industrial Avenue and Commercial Avenue. The proposed pipeline connects the existing 18-inch diameter 35th Street pipeline to the 16-inch diameter pipeline in Commercial Avenue. The pipeline includes replacement of a railroad crossing in 35th Street using an 18-inch diameter casing. This connection improves reliability of the transmission system between the SP/Maia Wellfield and the 35th Street intertie with the SW portion of the East System. Further evaluation is needed to determine if the existing casing can be reused, or if a larger casing is required to provide adequate redundancy and connectivity. This is a long-range project as it is not addressing any immediate system deficiency.

8.7.3.8 Lively Ranch Transmission Pipeline (SUB)

This project is an extension of the 16-inch diameter transmission pipeline constructed through the Westwinds subdivision. The proposed 3,670 LF pipeline will provide capacity to the westerly end of the Natron area and will connect to the Natron Transmission Pipeline in the future. This pipeline will be constructed when subdivision development occurs on the Lively Ranch property.

8.7.3.9 Mt Vernon Road Transmission Pipeline (SUB)

This project is an extension of the 16-inch diameter pipeline running west from S 57th Street to connect to the south end of the Lively Ranch transmission pipeline. A portion of this pipeline was constructed for the Pinehurst Subdivision. The remainder of the pipeline will be constructed when further subdivision development occurs along Mt Vernon Road or street improvements are made. 1,120 LF of 16-inch diameter and 180 LF of 24-inch diameter piping are anticipated.

8.7.3.10 Natron Transmission Pipeline (SUB)

The Natron Transmission Pipeline is proposed to provide water service to the 850-acre Natron area in southeast Springfield. The proposed 22,000 LF, 24-inch diameter pipeline begins at the Weyerhaeuser Truck Road and will extend south and east in the Bob Straub Parkway to the vicinity of Brand S Road. This project will expand the service area and the project timing is driven by development.

8.7.3.11 Natron Reservoir Fill Pipeline (SUB)

This 350 LF of 16-inch diameter pipeline will extend from the Natron Transmission Pipeline in Bob Straub Parkway to a proposed Natron First Level Reservoir on the east side of the Weyerhaeuser Haul Road south of the Jasper Meadows Subdivision. This project will expand the service area and the project timing is driven by development, but will need to be completed such that the new piping is available when the Natron Reservoir is ready for filling and testing during construction.

8.7.3.12 Thurston Transmission Pipeline (SUB)

The Thurston Transmission Pipeline is proposed to provide additional transmission capacity out of the Thurston Wellfield from North Cedar Creek to S 58th Street and Daisy Street. The-project is being constructed in multiple phases (3 of which are complete) over several years. When the treatment plant is constructed in the Thurston area at the Wellfield or adjacent to the Thurston Middle School, the 42-inch diameter pipeline will carry surface water and surface influenced groundwater to the plant for filtration, pH adjustment, UV, and chlorination. The southerly endpoint is a connection to the existing 24-inch diameter transmission pipeline at S 58th Street and Daisy Street Subsequent phases of the project will be completed prior to the plant being brought online and comprise 5,600 LF of 30-inch diameter pipe as recommended by the hydraulic analyst.

8.7.3.13 Weyerhaeuser Transmission Pipeline (SUB)

This pipeline would complete the 16-inch diameter transmission pipeline across the Weyerhaeuser property between 42nd Street and 48th Street. This 4,250 LF 16-inch diameter pipeline would parallel the existing 12-inch diameter pipeline and increase capacity in this area for east/west transmission and makes provisions for a future 16-inch transmission line into the North System.

8.7.3.14 S 48th Street Transmission Pipeline (SUB)

This project completes the construction of 1,600 LF of 16-inch diameter transmission pipeline in S 48th Street between Aster Street and Daisy Street. This pipeline will be constructed when development happens due to substantial grade changes to the site. The purpose is to complete an alternate 16-inch transmission line to the north system to improve hydraulic capacity and redundancy.

8.7.3.15 42nd Street Transmission Pipeline (SUB)

This project would complete the 3,100 LF, 16-inch diameter transmission pipeline in 42nd Street between Olympic Street and Marcola Road (freeway crossing will need to be addressed). This pipeline may be constructed when street improvements are made.

8.7.3.16 Marcola Road Transmission Pipeline (SUB)

The Marcola Road Transmission Pipeline is a replacement project for an existing failing 16-inch diameter OD steel transmission pipeline constructed in 1956. The proposed 1,800 LF 24-inch diameter pipeline will be installed in Marcola Road from the 24-inch diameter main just east of 22nd Street to 19th Street and in 19th Street from Marcola Road north approximately 300 feet to the 24-inch diameter main at the Albertson's parking lot. Due to the potential for main breaks, this project has a near-term priority. Budgeting reflects reduced cost associated with SUB performing this work internally.

8.7.3.17 Colonial Drive Transmission Pipeline (SUB)

This pipeline would complete the transmission pipeline stubbed out in Colonial Drive between the Pheasant Boulevard transmission pipeline and the Martin Luther King Jr Parkway transmission pipeline. The proposed 16-inch diameter 1,015 LF pipeline would provide an alternate path to the Pheasant Boulevard pipeline between the Sports Way/ I-5 Wellfield and the Martin Luther King Jr transmission pipeline.

8.7.3.18 Mallard Avenue Transmission Pipeline (SUB)

This pipeline would complete the 16-inch diameter transmission pipeline stubbed out in Mallard Avenue between the Pheasant Boulevard transmission pipeline and the Martin Luther King Jr Parkway transmission pipeline. The proposed 330 LF pipeline would provide an alternate path to the Pheasant Boulevard pipeline between the Sports Way/ I-5 Wellfield and the Martin Luther King Jr transmission pipeline.

8.7.3.19 North Gateway Transmission (SUB)

Approximately 450 acres were recently brought within the urban growth boundary in the North Gateway area. For planning purposes, this project will install approximately 7,700 LF of 24-inch diameter main to provide for system expansion to anticipated industrial zoning. Project timing will be driven by development. The alignment of the transmission main and final sizing will be dependent upon the development plans and determined through further design. Note that the looping will include piping parallel to the line from the I-5 Wells which is used for disinfection contact time.

8.7.3.20 North System Transmission Pipeline (SUB)

In the 2014 Source Master Plan, the North System is projected to become source deficient before the 2042 planning horizon. There is little opportunity available to increase groundwater resources in the North System, therefore an alternate supply must be provided to meet future growth. The proposed 24-inch diameter Eastside Pump Station to Steam Plant transmission pipeline will carry 10 MGD at 5 fps velocity. This is more than adequate to supply the West System and Glenwood and provide 3-5 MGD to the North System through the proposed North System transmission pipeline at such time as the source capacity is increased at the Willamette site. Remaining piping includes 850 LF of 24 inch diameter piping along South B Street from the Steam Plant to South 5th Street. On completion of the Eastside Pump Station to Steam Plant transmission pipeline and the North System transmission pipeline, the Eastside Pump Station and/or East System will have the ability, if source is available, to fill all the First Level reservoirs in the SUB/RWD systems.

8.7.3.21 Chase Wellfield Transmission Main Replacement (RWD)

The existing 24-inch diameter transmission main leaving the Chase Wellfield was installed in 1965. The main is aging cast iron with unrestrained joints, and has a portion that is difficult to access for maintenance. An alternative alignment along Harvest Lane would provide for improved maintenance access. This project includes approximately 4,800 LF of 24-inch diameter piping to be performed near the end of 20-year planning window. Approximately 3,300 LF are budgeted and reflect the reduced surface restoration and pipe trench backfill requirements assumed for pipe installation within existing City of Springfield roadways.

8.7.3.22 Hayden Bridge Road Transmission Main Replacement (RWD)

The existing 16-inch diameter Hayden Bridge Road transmission main is a welded steel pipe installed in 1956. The pipe joints were electrically bonded in the 2000s to extend the service life. Due to the pipe age and prior history of corrosion concerns, this 8,800 LF main is recommended for replacement. The project timing is dependent upon pipe conditions. For planning purposes the pipe can be considered to have a 75-year service life with replacement occurring in the 11 to 20-year planning window.

8.7.3.23 Hayden Bridge Road System Looping (RWD)

This project extends upsizing of existing mains on Hayden Bridge Road between approximately N 33rd Street and N 38th Street. This near-term project includes 1,790 LF of 8-inch diameter C900 main.

8.7.3.24 Anderson Ln and 32nd St System Looping (RWD)

This project includes two locations requiring short alignments to complete system looping to eliminate dead ends and improve water quality. Approximately 230 LF of 8-inch diameter piping is required to connect the two existing dead ends of 32nd Street when the road sections are connected. Approximately 540 LF of upsizing from 2- to 8-inch diameter along Anderson Lane from approximately Menlo Loop to W Quinalt Street will provide improved system looping. It is anticipated that this work will be efficiently completed as an element of other projects. The 32nd Street improvements are anticipated to be performed as part of adjacent site development.

8.7.3.25 *South 28th Street / Millrace Service Area*

With future growth of the urban growth boundary along the south side of the Millrace and the north side of the Middle Fork Willamette River. This project utilizes an existing 20-inch OD steel line as casing to bring a 12-inch 1st level piping from Eastside Pump station to service the south side of the Millrace. The alignment of the transmission main and final sizing will be dependent upon the development plans and determined through further design.

8.7.3.26 *31st Street Transmission Pipeline (SUB)*

The 31st Street Transmission Pipeline is a replacement project for an existing failing 18-inch diameter OD steel transmission pipeline constructed in 1951. The proposed 900 LF 24-inch diameter pipeline will be installed in 31st Street from the 24-inch diameter main just west of Short Street to V Street. Due to the potential for main breaks, this project has a near-term priority that is proceeding with the subdivision development along 31st Street.

8.8 Other System Improvements

8.8.1 28th Street Intertie Metering (SUB)

There is an existing North to East System connection that is normally closed, located near the intersection of N. 28th Street and Olympic Street. Ideally, this connection would be opened to allow for additional North to East connectivity, although it is not required under normal system operation. In the event of a major supply disruption in the North System, or other event that would require large transmission from East to North Systems, operation of the intertie improves capacity. To maintain water accounting for billing purposes, metering at the intertie is required. This project includes design and construction of a metering vault for 12-inch diameter piping. The alignment of the transmission main and final sizing will be dependent upon the development plans and determined through further design.

8.8.2 Water Quality Monitoring Stations at Weyco, SP/Maia, and I-5/Sports Way (SUB and SUB/RWD)

Continuously monitoring water quality stations need to be installed at the Weyco, SP/Maia, and I-5/Sports Way wellfield entry points. These stations will be able to continuously monitor chlorine residual, pH, and temperature. The station at the Weyco facilities will be a joint SUB/RWD project.

8.8.3 Develop Small Emergency Water Distribution Sites (SUB/RWD)

As identified in the Eugene and Springfield Natural Hazards Mitigation Plan, three small emergency water distribution sites are to be developed to mitigate water supply disruptions during drought or after an earthquake. Emergency back-up well sites for SUB are Thurston Middle School (6300 Thurston Road), Willamalane Park (1276 G Street), and Page Elementary School (1300 Hayden Bridge Road). Possible sites for RWD include the Northwood Church (2425 Harvest Lane), Centennial Elementary (1351 Aspen) and at Briggs Middle School (2355 Yolanda).

8.8.4 Chase WTP Redundant Control System (RWD)

As identified in the Eugene and Springfield Natural Hazards Mitigation Plan, this project includes installing redundant control system capability at Chase WTP in FY 2020-21 to include a duplicate server at Chase that provides a backup to the control system at RWD's 42nd Street location, synchronizing data and providing off-site backups.

8.8.5 31st Street Intertie Study & Improvements (SUB)

The SUB/EWEB/RWD emergency intertie currently uses a skid-mounted pump station and piping to connect the two systems and allows for limited emergency water supply. The station was designed for 2,500 gpm and has a current test capacity of 1,800 gpm. This pump station is in need of significant upgrades. This project will evaluate options for construction of a permanent emergency supply transfer pump station and PRV to allow for two-way emergency supply. As party to the current intertie agreement, RWD will be included in discussions of the options and any updating of the emergency intertie agreement with EWEB.

8.8.6 Willamette Treatment Expansion Study (SUB)

The WSSFP intake structure is associated with a partially perfected water right. SUB submitted a partial claim of beneficial use for 10.0 CFS in 2020, and the Oregon Water Resources Department issued Water Right Certificate No. 95375. The water right evidenced by Permit S-22200 and Certificate No. 95375 authorizes SUB to divert a total of 20 CFS; however, the water right is subject to a development limitation of 12.28 CFS and the intake is currently limited to that capacity. This study will review potential improvement options to allow for increased surface water intake capacity to allow for further perfection of the water right. Following the study, an expansion of the intake and pump station is anticipated.

8.9 Planning and Studies

8.9.1 Water System Master Plan Update (SUB/RWD)

It is recommended that SUB/RWD update this Water Distribution System Master Plan within the next 10 to 20 years. An update may be needed sooner if there are significant changes to the SUB/RWD water service area, supply or distribution system which are not currently anticipated.

8.9.2 Water Management and Conservation Plan Update (SUB/RWD)

To comply with Oregon Water Resources Department (OWRD) requirements for surface water permit holders SUB/RWD is required to complete an update of their Water Management and Conservation Plan (WMCP) every 10 years. The current plan is in effect until June 28, 2028. The next update of SUB/RWD WMCP is anticipated to begin in 2025 and be completed prior to the end of the 10-year window to allow for coordination with Willamette treatment expansion.

8.9.3 Fire Flow Capacity Improvements (SUB)

Many of the fire flow capacity improvements should be addressed as part of the existing main replacement program, with the deficient, small diameter, substandard materials being considered and prioritized in selecting improvement locations. SUB should also consider how to best address the two identified high elevation customer locations that are reducing overall fire flow availability to some hydrants in the Glenwood and East First Levels, since these locations occur at level boundaries this could include modifying level boundaries through pipe or valve modifications. These specific areas are discussed in Section 6.7.2 and identified on **Figure 6-5** and **Figure 6-6**.

8.9.4 Seismic Resiliency Studies and Follow on Work (SUB/RWD)

As recommended in **Section 7**, a structural evaluation of the critical well and pump station facilities is recommended. At a minimum, these facilities should include the Willamette Heights Pump Station, the Eastside Pump Station, the Chase Wellfield, the Thurston Wellfield, and the I-5 Wellfield. The evaluation should include a review of the equipment anchorage as well as an assessment of the building's seismic risk. Recommended improvements that may arise from the evaluation are included as Follow on Work in **Table 8-1** and **Table 8-2**.

8.10 Summary

This section presented recommendations for improvement, expansion, and capital maintenance projects in the SUB/RWD water distribution system. Recommendations and estimated budgets are presented for supply and treatment system improvements, transmission system piping improvements, future reservoirs, PRVs, pump stations, and water main replacements. As presented in **Table 8-1** and **Table 8-2**, the total estimated cost of these projects through 2040 is approximately $159.9 million associated with SUB and approximately $20.5 million associated with RWD.

Table 8-1
Springfield Utility Board - Capital Improvements Plan Summary

Improvement Category	Location or Project Description	CIP Cost Summary 5-year through 2025	5 to 10-year 2026-2030	10 to 20-year 2031-2040	TOTAL
Supply Source and Treatment	Thurston Pilot Testing	$ 348,300			$ 348,300
	Thurston Intake Structure and Pump Station Design	$ 1,268,600			$ 1,268,600
	Thurston Intake Structure and Pump Station Construction	$ 6,434,500			$ 6,434,500
	Thurston Surface Water Plant Design	$ 5,186,500			$ 5,186,500
	Thurston Surface Water Plant Construction	$ 9,937,300	$ 19,997,300		$ 29,934,600
	Willamette Resand Filter Bed	$ 995,733	$ 357,900	$ 3,600,000	$ 4,953,633
	Willamette Intake/Pump Station & Water Quality	$ 397,000	$ 3,107,300		$ 3,504,300
	Well Maintenance and Rehabilitation	$ 1,680,600	$ 1,802,600	$ 3,783,000	$ 7,266,200
	Drill Thurston Middle School Well #1	$ 421,500	$ -	$ -	$ 421,500
	Drill Thurston Middle School Well #2	$ -	$ 421,500	$ -	$ 421,500
	Drill Pierce Well (31st)	$ -	$ 416,400	$ -	$ 416,400
	Drill 16th & Qst Well	$ -	$ 416,400	$ -	$ 416,400
	Willamette Filter Bed Curb and Gutters	$ 554,000	$ -	$ -	$ 554,000
		$ 27,224,033	*$ 26,519,400*	*$ 7,383,000*	*$ 61,126,433*
Storage Reservoirs	S 57th Altitude Valves			$ 125,000	$ 125,000
	South Hills Reservoir 3rd Level Seismic	$ 950,500			$ 950,500
	S 67th S Reservoir Seismic Retrofit	$ 1,422,600			$ 1,422,600
	Willamette Heights Reservoir #2 Seismic Retrofit	$ 1,417,300			$ 1,417,300
	Willamette Heights Reservoir #4	$ 3,058,500			$ 3,058,500
	Natron Reservoir, Level 1, Study/Design/Construction		$ 491,800	$ 2,500,000	$ 2,991,800
	Natron Reservoir, Level 2, Study/Design/Construction			$ 2,200,000	$ 2,200,000
	South Hills 4th Level Reservoir	$ 3,099,684			$ 3,099,684
		$ 9,948,584	*$ 491,800*	*$ 4,825,000*	*$ 15,265,384*
Pump Stations	Eastside Pump Station Improvements			$ 1,641,000	$ 1,641,000
	Natron Pump Station, Level 2		$ 1,753,200		$ 1,753,200
	Natron Pump Station, Level 3			$ 1,750,000	$ 1,750,000
	Steam Plant Relocation			$ 1,392,000	$ 1,392,000
	S 67th St Pump Station Replacement	$ 2,397,800			$ 2,397,800
	S Hills Pump Station Construction Completion	$ 258,800			$ 258,800
		$ 2,656,600	*$ 1,753,200*	*$ 4,783,000*	*$ 9,192,800*
Distribution Mains	Main Replacement Program	$ 6,218,200	$ 6,936,000	$ 14,616,000	$ 27,770,200
		$ 6,218,200	*$ 6,936,000*	*$ 14,616,000*	*$ 27,770,200*
Transmission Mains	West System Piping Improvements	$ 707,300	$ 1,946,500	$ 6,940,000	$ 9,593,800
	Henderson Ave Transmission				$ -
	E 19th Avenue Transmission				$ -
	Glenwood Redundant River Crossing				$ -
	B Street Upsizing				$ -
					$ -
	31st Street Transmission Pipeline				$ -
	East System Piping Improvements	$ 107,600	$ 6,530,000	$ 11,665,000	$ 18,302,600
	Millrace Transmission				$ -
	35th Street Transmission				$ -
	Lively Ranch Transmission				$ -
	Mt Vernon Road Transmission				$ -
	Natron Transmission				$ -
	Natron Reservoir Fill Pipeline				$ -
	Thurston Transmission	$ 4,653,700			$ 4,653,700
	Weyerhaeuser Transmission				$ -
	S 48th Street Transmission				$ -
	North System Piping Improvements		$ 764,400	$ 4,245,000	$ 5,009,400
	42nd Street Transmission				$ -
	Marcola Road Transmission	$ 658,100			$ 658,100
	Colonial Drive Transmission				$ -
	Mallard Avenue Transmission				$ -
	North Gateway Transmission				$ -
	North System Transmission	$ 513,900			$ 513,900
		$ 6,640,600	*$ 9,240,900*	*$ 22,850,000*	*$ 38,731,500*
Other System Improvements	28th Street Intertie Metering			$ 125,000	$ 125,000
	Water Quality Monitoring Stations	$ 171,900			$ 171,900
	Small Emergency Water Distribution Sites			$ 50,000	$ 50,000
	SUB/EWEB Intertie 31st Study & Improvements		$ 2,868,100		$ 2,868,100
	Willamette Treatment Expansion Study		$ 4,090,300		$ 4,090,300
		$ 171,900	*$ 6,958,400*	*$ 175,000*	*$ 7,305,300*
Planning & Studies	Water System Master Plan Update			$ 25,000	$ 25,000
	Water Management & Conservation Plan Update	$ 155,000	$ 45,000		$ 200,000
	Fire Flow Capacity Improvements Evaluation			$ 50,000	$ 50,000
	Seismic Resiliency Study of Structures			$ 60,000	$ 60,000
	Follow on Work to Study			$ 200,000	$ 200,000
		$ 155,000	*$ 45,000*	*$ 335,000*	*$ 535,000*
	Capital Improvement Program (CIP) Total	$ 53,014,917	$ 51,944,700	$ 54,967,000	$ 159,926,617

Table 8-2
Rainbow Water District - Capital Improvements Plan Summary

Improvement Category	Location or Project Description	CIP Cost Summary 5-year through 2025	5 to 10-year 2026-2030	10 to 20-year 2031-2040	TOTAL
Supply Source and Treatment	New Chase Well No. 6 and/or No. 7			$ 416,000	$ 416,000
	I-5 Wellfield Improvements & Backup Generator	$ 150,000			$ 150,000
	Weyerhaeuser Wellfield Improvements	$ 7,500			$ 7,500
	Well Maintenance and Rehabilitation	$ 1,625,000	$ 1,625,000	$ 3,250,000	$ 6,500,000
		$ 1,782,500	*$ 1,625,000*	*$ 3,666,000*	*$ 7,073,500*
Storage Reservoirs	Kelly Butte Reservoir abandonment			$ 50,000	$ 50,000
	Emergency Communications Equipment		$ 30,000		$ 30,000
		$ -	*$ 30,000*	*$ 50,000*	*$ 80,000*
Pump Stations	(none)				$ -
		$ -	*$ -*	*$ -*	*$ -*
Distribution Mains	Annual Fire Hydrant Coverage Improvement	$ 125,000	$ 125,000	$ 250,000	$ 500,000
	Routine Main Replacement Program (Capital Maint.)	$ 675,000	$ 675,000	$ 1,350,000	$ 2,700,000
		$ 800,000	*$ 800,000*	*$ 1,600,000*	*$ 3,200,000*
Transmission Mains	Chase Wellfield Transmission Main Replacement			$ 2,842,500	$ 2,842,500
	Hayden Bridge Road Transmission Main Replacement			$ 6,732,000	$ 6,732,000
	Hayden Bridge Road System Looping	$ 179,000			$ 179,000
	Andersen Ln and 32nd St System Looping	$ 77,000			$ 77,000
		$ 256,000	*$ -*	*$ 9,574,500*	*$ 9,830,500*
Other System Improvements	Joint Water Quality Monitoring Station at I-5/Sports Way	$ 60,000			$ 60,000
	Small emergeny water distribution sites	$ 25,000			$ 25,000
	Chase WTP Redundant Control System	$ 35,000			$ 35,000
		$ 120,000	*$ -*	*$ -*	*$ 120,000*
Planning & Studies	Water System Master Plan Update			$ 75,000	$ 75,000
	Water Management & Conservation Plan Update		$ 25,000		$ 25,000
	Seismic Resiliency Study of Structures	$ 30,000			$ 30,000
	Follow on Work to Study		$ 100,000		$ 100,000
		$ 30,000	*$ 125,000*	*$ 75,000*	*$ 230,000*
	Capital Improvement Program (CIP) Total	$ 2,988,500	$ 2,580,000	$ 14,965,500	$ 20,534,000

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Section **9**

Section 9

Funding Sources

9.1 Introduction

A variety of sources may contribute to the funding of SUB/RWD's CIP. In general, these sources can be summarized as: 1) governmental grant and loan programs; 2) publicly issued debt; and 3) cash resources and revenues. These sources are described below.

9.2 Government Loan and Grant Programs

9.2.1 Oregon State Safe Drinking Water Financing Program

Annual grants from the U.S. EPA and matching state resources support the Safe Drinking Water Fund. The program is managed jointly by the OHA Drinking Water Services and Business Oregon's Infrastructure Finance Authority (IFA). The Safe Drinking Water Fund program provides low-cost financing for construction and/or improvements of public and private water systems. This is accomplished through two independent programs: the Safe Drinking Water Revolving Loan Fund (SDWRLF) for collection, treatment, distribution and related infrastructure, and the Drinking Water Protection Loan Fund (DWPLF) for sources of drinking water improvements prior to the water system intake.

The SDWRLF lends up to $6 million per project, with a possibility of subsidized interest rate and principal forgiveness for a Disadvantaged Community. The standard loan term is 20 years or the useful life of project assets, whichever is less, with interest rates at 80 percent of the current state/local bond rate. The maximum award for the DWPLF is $100,000 per project.

9.2.2 Special Public Works Fund

The Special Public Works Fund program provides funding for the infrastructure that supports job creation in Oregon. Loans and grants are made to eligible public entities for the purpose of studying, designing, and building public infrastructure that leads to job creation or retention.

Water systems are listed among the eligible infrastructure projects to receive funding. The Special Public Works Fund is comprehensive in terms of the types of project costs that can be financed. As well as actual construction, eligible project costs can include costs incurred in conducting feasibility and other preliminary studies and for the design and construction engineering.

The Fund is primarily a loan program. Grants can be awarded, up to the program limits, based on job creation or on a financial analysis of the applicant's capacity for carrying debt financing. The total loan amount per project cannot exceed $10 million. The IFA is able to offer discounted interest rates that typically reflect low market rates for very good quality creditors. In addition, the IFA absorbs the associated costs of debt issuance thereby saving applicants even more on the overall cost of borrowing. Loans are generally made for 20-year terms but can be stretched to 25 years under special circumstances.

9.2.3 Water/Wastewater Fund

The Water/Wastewater Fund was created by the Oregon State Legislature in 1993. It was initially capitalized with lottery funds appropriated each biennium and with the sale of state revenue bonds since 1999. The purpose of the program is to provide financing for the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act (SDWA) or the Clean Water Act.

Eligible activities include costs for constructing improvements for expansion of drinking water, wastewater, or stormwater systems. To be eligible a system must have received, or be likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency, associated with the SDWA or the Clean Water Act. Projects also must meet other state or federal water quality statutes and standards. Funding criteria include projects that are necessary to ensure that municipal water and wastewater systems comply with the SDWA or the Clean Water Act.

In addition, other limitations apply, including:

- The project must be consistent with the acknowledged local comprehensive plan.
- The municipality will require the installation of meters on all new service connections to any distribution lines that may be included in the project.
- The funding recipient shall certify that a registered professional engineer will be responsible for the design and construction of the project.

The Water/Wastewater Fund provides both loans and grants, but it is primarily a loan program. The loan/grant amounts are determined by a financial analysis of the applicant's ability to afford a loan including the following criteria: debt capacity, repayment sources, and other factors.

The Water/Wastewater Fund financing program's guidelines, project administration, loan terms, and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $10 million per project through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter-approved bond issuance. A limited tax general obligation pledge may also be required. Certain entities may seek project funding within this program through the sale of state revenue bonds, although this can be a significant undertaking.

9.2.4 Water Infrastructure Finance and Innovation Act

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) established the WIFIA program, a federal credit program administered by EPA. The program can provide financing for a broad range of eligible water and wastewater projects or combinations of projects. Up to 49 percent of eligible project costs can be financed through WIFIA, which can be combined with other local funding sources such as revenue bonds.

The WIFIA program offers the potential for substantial savings to municipalities on borrowing costs through a combination of lower interest rates, deferred payments, flexible payment structuring, and longer loan term. Lower borrowing costs can reduce the level of rate increases needed to fund capital improvements.

The savings on borrowing costs begin with lower interest rates. The interest rate on WIFIA loans is fixed and is tied by statute to the 30-year Treasury rate as of closing, which is typically well below the market rate on revenue bond financing. Unlike with revenue bonds, funds from WIFIA loans are disbursed over time on a reimbursement basis as expenses are incurred. Interest accrues on WIFIA loan funds only as they are disbursed.

WIFIA loans are set up for 30-year repayment periods, with the loan term beginning after substantial completion of construction. Payments can be deferred throughout the construction period and for up to 5 years after substantial completion. The result is a potential loan term of up to 35 years after substantial completion. The WIFIA program also allows for flexible payment structuring throughout the loan term to help the borrower manage the impact of loan payments on rate increase requirements.

Projects are selected to apply for WIFIA financing through a competitive annual process administered by the EPA. Appropriate related federal provisions apply under the loans, such as National Environmental Policy Act (NEPA), Davis-Bacon, and American Iron and Steel.

9.3 Public Debt

9.3.1 General Obligation Bonds

General obligation bonds are backed by SUB/RWD full faith and credit, as SUB/RWD must pledge to assess property taxes sufficient to pay the annual debt service. This tax is beyond the State's constitutional limit of $10 per $1,000 of assessed value. A "double-barrel" bond uses a mix of property taxes and user fees and is a mix of the general obligation bond and a revenue bond.

Oregon Revised Statutes limit the maximum bond term to 40 years. The realistic term for which general obligation bonds should be issued is 15 to 20 years, or more. Under the present economic climate, lower interest rates will be associated with the shorter terms.

Financing of water system improvements by general obligation bonds is usually accomplished by the following procedure:

1. Determination of the capital costs required for the improvement.
2. An election by the voters to authorize the sale of bonds.
3. The bonds are offered for sale.
4. The proceeds from the bond sale is used to pay the capital costs associated with the project(s).

General obligation bonds are similar to revenue bonds in matters of simplicity and cost of issuance. Since the bonds are secured by the power to tax, these bonds usually command a lower interest rate than other types of bonds. General obligation bonds lend themselves readily to public sale at a reasonable interest rate because of their high degree of security, tax-exempt status, and public acceptance.

The double-barrel bonds, wherein a portion of the user fee is pledged toward payment of the debt service, can potentially be used to elimate the need for additional property taxes. These revenue-supported general obligation bonds have most of the advantages of straight revenue bonds, plus lower interest rates and ready marketability. However, their use does not eliminate the potential need to recover through taxation should user fees not result in an adequate rate of repayment

General obligation bonds, which impact the community's tax burden through the full faith and credit pledge, are normally associated with the financing of facilities that benefit a large portion of the community and must be approved by a majority vote.

The disadvantage of general obligation bond debt is that it is often added to the debt ratios of the underlying municipality, thereby restricting the flexibility of the municipality to issue debt for other purposes. Furthermore, general obligation bond authorizations must be approved by a majority vote and often necessitate extensive public information programs.

9.3.2 Revenue Bonds

For revenue bonds, SUB/RWD pledge the net operating revenue of the utility to repay the bonds. The primary source of the net revenue is user fees, and the primary security is SUB/RWD's pledge to charge sufficient user fees to pay all operating costs and debt service.

The general shift away from ad valorem property taxes and toward a greater reliance on user fees makes revenue bonds a frequently used option for payment of long-term debt. Many communities prefer revenue bonding because it ensures that no tax will be levied. In addition, debt obligation will be limited to system users since repayment is derived from user fees. An advantage with revenue bonds is that they reserve the tax-based revenues for other services and are not typically restricted by debt limitation statues. Furthermore, the issuing authority can set user rates to fund the debt repayment without needing a public vote.

Successful issuance of revenue bonds depends on the bond market evaluation of the revenue pledged. Revenue bonds are most commonly retired with revenue from user fees. Legislation has eliminated the requirement that the revenues pledged to bond payment have a direct relationship to the services financed by revenue bonds. Revenue bonds may be paid with all or any portion of revenues derived by a public body or any other legally available monies. A public body may provide credit enhancement, typically a surety or letter of credit, to achieve more favorable terms.

Normally there are no legal limitations on the amount of revenue bonds to be issued, but excessive issue amounts are generally unattractive to bond buyers because they represent high investment risks. However, many factors are considered that can offset risk for even highly leveraged entities. In rating revenue bonds, credit rating agencies consider the economic justification for the project, reputation of the borrower, methods and effectiveness for billing and collecting, rate structures, a provision for rate increases as needed to meet debt service requirements, track record in obtaining rate increases historically, adequacy of reserve funds provided in the bond documents, supporting covenants to protect projected revenues, and the degree to which forecasts of net revenues are considered sound and economical.

Municipalities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate (ORS 288.805-288.945). Certain notice and posting requirements must be met and a 60-day waiting period is mandatory. A petition signed by five percent of the municipality's registered voters may cause the issue to be referred to an election.

9.3.3 Improvement Bonds

Improvement (Bancroft) bonds can be issued under an Oregon law called the Bancroft Act. These bonds are an intermediate form of financing that is less than full-fledged general obligation or revenue bonds, but is quite useful, especially for smaller issues or for limited purposes.

An improvement bond is payable only from the receipts of special benefit assessments, not from general tax revenues. Such bonds are issued only where certain properties are recipients of special benefits not occurring to other properties. For a specific improvement, all property within the improvement area is assessed on an equal basis, regardless of whether it is developed or undeveloped. The assessment is designed to apportion the cost of improvements among the benefited property owners approximately in proportion to the afforded direct or indirect benefits. This assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash or applying for improvement bonds. If the improvement bond option is taken, the municipality sells Bancroft improvement bonds to finance the construction, and the assessment is paid over 20 years in 40 semi-annual installments with interest. Cities and special districts are limited to improvement bonds not exceeding three percent of true cash value.

With improvement bond financing, an improvement City or District is formed, the boundaries are established, and the benefited properties and property owners are determined. The City or District usually determines an approximate assessment, either on a square foot or a front foot basis. Property owners are then given an opportunity to object to the project assessments. The assessments against the properties are usually not levied until the actual cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. Commonly, warrants are issued to cover debts, with the warrants to be paid when the project is complete.

The primary disadvantage to this source of revenue is that the property to be assessed must have a true cash value at least equal to 50 percent of the total assessments to be levied. As a result, a substantial cash payment is usually required by owners of undeveloped property. In addition, the development of an assessment City or District is very cumbersome and expensive when facilities for an entire community are contemplated. In comparison, general obligation bonds can be issued in lieu of improvement bonds, and are usually more favorable.

9.4 Water Fund Cash Resources and Revenues

The SUB/RWD financial resources available for capital funding include rates, cash reserves, and system development charges (SDCs). Rates are the backbone of a municipal water system's revenue and are typically established to provide funds to capitalize improvement projects or to repay debt-financed improvement projects.

An SDC is a fee collected on new development. The SDC is used to finance the necessary capital improvements required by the development. The charge is intended to recover an equitable share of the costs of existing and planned facilities that provide capacity to serve new growth.

Oregon Revised Statue 223.297 – 223.314 establish guidelines on the establishment of the SDC methodology and administration. By statute, an SDC amount can be structured to include one or both of the following two components:

- *Reimbursement Fee* – Intended to recover an equitable share of the cost of facilities already constructed or under construction.
- *Improvement Fee* – Intended to recover a fair share of future planned capital improvements needed to increase the capacity of the system.

The reimbursement fee methodology must consider the cost of existing facilities and the value of unused capacity in those facilities. The calculation must also ensure that future system users contribute no more than an equitable share of existing facilities costs. Reimbursement fee proceeds may be spent on any capital improvements or debt service repayment related to the system for which the SDC is applied. For example, water reimbursement SDCs must be spent on water improvements or water debt service.

The improvement fee methodology must include only the cost of projected capital improvements needed to increase system capacity. In other words, the cost of planned projects that correct existing deficiencies or do not otherwise increase capacity may not be included in the improvement fee calculation. Improvement fee proceeds may be spent only on capital improvements (or related debt service), or portions thereof, that increase the capacity of the system for which they were applied.

Appendix

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APPENDIX A
EXISTING WATER RIGHTS SUMMARY

Table A-1: Existing Water Rights Summary								
Facility	Water Use	Application Number	Permit Number	Certificate Vol./Page	Priority Date	Authorized Rate (cfs)	Current Capacity (cfs)	Authorized Date of Completion
Springfield Utility Board Groundwater Sources								
Maia Well	Municipal	G-11217	G-10349	82801	1/20/1984	2.23	2.23	
Platt 1	Municipal	G-10642	G-9984	51/56428	2/4/1982	0.56	0.56	
Platt 2	Municipal	G-10643	G-9985	51/56429	2/4/1982	1.00	0.60	
S.P. Well	Municipal	G-10775	G-9989	51/56430	7/12/1982	1.78	1.78	
Sports Way Well	Municipal	G-14179	G-12845	87007	10/6/1995	4.46	4.46	
Thurston 1	Municipal	G-3463	G-3267	34/42085	4/21/1966	1.67	1.67	
Thurston 2	Municipal	G-4854	G-4570	34/42086	4/28/1969	2.14	2.14	
Thurston 3	Municipal	G-5724	G-4989	34/42088	2/10/1972	1.11	0.11	
Thurston 4	Municipal	G-10641	G-9983	51/56427	2/4/1982	0.45	0.45	
Thurston 5	Municipal	G-15243	G-16148		12/11/2000	1.34	1.34	1/2/2027
Thurston 6	Municipal	G-15243	G-16148		12/11/2000	1.34	1.11	1/2/2027
Thurston 7	Municipal	G-15243	G-16148		12/11/2000	0.89	0.79	1/2/2027
Thurston 8	Municipal	G-15244	G-16149		12/11/2000	1.34		1/2/2027
Thurston 9	Municipal	G-15244	G-16149		12/11/2000	1.34		1/2/2027
Thurston 10	Municipal	G-15243	G-16148		12/11/2000	1.34		1/2/2027
Thurston 11	Municipal	G-15244	G-16149		12/11/2000	1.34		1/2/2027
Thurston Middle School 1	Municipal	G-15241	G-16147		12/11/2000	0.89		1/2/2027
Thurston Middle School 2	Municipal	G-15241	G-16147		12/11/2000	0.89		1/2/2027
Weyco A (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.10		
Weyco B(1) (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.80	1.80	
Weyco C(2) (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.80	1.34	
Weyco D (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	0.90		
Weyco E(3)	Municipal	G-3000	G-2795	45302	12/16/1964	1.70	1.34	
Willamette 1	Municipal	GR-3175			Nov-50 (see Note 6)	2.01 (see Note 7)	0.56	
Willamette 2	Municipal	GR-3181			Nov-50 (see Note 6)	2.79 (see Note 7)		
Willamette 3	Municipal	GR-3178			Nov-50 (see Note 6)	2.79 (see Note 7)	0.77	
Willamette 4	Municipal	GR-3177			Nov-50 (see Note 6)	2.79 (see Note 7)	0.89	
Willamette 5	Municipal	GR-3180			Nov-50 (see Note 6)	1.34 (see Note 7)		
Willamette 6	Municipal	GR-3176			Nov-50 (see Note 6)	2.79 (see Note 7)	1.34	
Willamette 7	Municipal	GR-3179			Apr-53 (see Note 6)	2.79 (see Note 7)	0.89	
Willamette 8	Municipal	G-397	G-266	20/27979	6/18/1956	2.00	0.56	
Willamette 9	Municipal	G-3212	G-3027	27/35650	8/30/1965	0.89	0.46	
Willamette 10	Municipal	G-3298	G-3075	27/35754	11/1/1965	2.40	1.11	
Willamette 11	Municipal	G-3297	G-3074	27/35651	11/1/1965	3.30	1.67	
Willamette 12	Municipal	G-3296	G-3073	47/52375	11/1/1965	2.22	0.56	

Table A-1: Existing Water Rights Summary								
Facility	**Water Use**	**Application Number**	**Permit Number**	**Certificate Vol./Page**	**Priority Date**	**Authorized Rate (cfs)**	**Current Capacity (cfs)**	**Authorized Date of Completion**
Willamette 13	Municipal	G-12555	G-11558	85381	6/4/1991	0.72	0.72	
Willamette 15	Municipal	G-12555	G-11558	85381	6/4/1991	0.72	0.29	
Perimeter Drain	Quasi-Municipal	G-2761	G-2643 / T-9365		6/8/1964	1.00	1.00	10/1/2005
Rainbow Water District Groundwater Sources								
Weyco A (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.10		
Weyco B(1) (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.80	1.80	
Weyco C(2) (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	1.80	1.34	
Weyco D (see Note 2)	Municipal	G-283	G-237	37/45301	3/29/1956	0.90		
Weyco E(3)	Municipal	G-3000	G-2795	45302	12/16/1964	1.70	1.34	
I-5 Well # 1	Municipal	G-15840	G-16477		9/18/2002	3.05	2.62	4/30/2029
I-5 Well # 2	Municipal	G-15840	G-16477		9/18/2002	3.95	3.45	4/30/2029
Chase 1 & 2	Municipal	G-3000	G-2795	37/45302	12/16/1964	2.50	1.95	
Chase 3	Municipal	G-4991	G-4709	37/45303	9/12/1969	0.89	0.49	
Chase 4 & 5	Municipal	G-5301	G-5132	T-12738 (see Note 4)	9/1/1970	2.00	1.64	10/1/2027
Chase 2	Municipal	55855	S-41902	T-12739 (see Note 5)	5/6/1977	0.27		10/1/2027
7th & Q Street	Quasi-Municipal	G-9832	G-9945	65691	7/14/1980	1.56	0.56	
Springfield Utility Board Surface Water Sources								
McKenzie River	Municipal	S-85336	S-54378 / T-10402		11/8/2002	35.90		1/2/2027
McKenzie River	Fish Life and Wildlife	S-85336	S-54378 / T-10402		11/8/2002	4.10	4.10	1/2/2027
Mid Fork Willamette River	Industrial and Municipal	SW-131			1852	3.00 (see Note 1)	3.00 (see Note 1)	
Mid Fork Willamette River	Municipal	S-28213	S-22200	95375 (see Note 3)	3/18/1953	20.00 (see Note 3)	10.21	10/1/2030

Notes:

1. The City of Springfield filed Claim SW-131, which claims a rate of 150 cfs. A portion of the claim is based on historical municipal use. The portion of SW-131 that is allocated to municipal use will be determined through adjudication. However, for planning purposes, SUB cannot rely on this claim because, in adjudication, OWRD could determine that SUB is not entitled to any water under the claim. Given that current system capacity limits the amount of water that can be used by SUB under the claim to 3.0 cfs, SUB has used that amount for purposes of this table.
2. Application G-283/Permit G-237/Certificate 45301 authorizes four wells in the Weyerhaeuser Wellfield, which are jointly owned by SUB and RWD (50%/50%). In 2013, SUB submitted an Ownership Update Form for water right Certificate 45301, notifying the Department that SUB and RWD each hold a 50 percent interest in the water right evidenced by Certificate 45301 and requesting that the Department update its files and online Water Rights Information System (WRIS) accordingly. The Department accepted the form but has not yet updated its WRIS records.
3. Certificate 95375 partially perfected 10.0 cfs of the 20.0 cfs authorized under Permit S-22200. The completion date for the remaining 10.0 cfs is October 1, 2030 under OWRD's final order dated October 17, 2014. The full water right evidenced by Certificate 95375 and Permit S-22200 is subject to a development limit of 12.28 cfs until OWRD approves an updated Water Management and Conservation Plan authorizing a greater rate of diversion. The development limit is further discussed in the October 17, 2014 final order related to SUB's extension application.
4. Transfer Order T-12738 cancelled Certificate 45304 and added Chase 5 as a secondary point of appropriation. The new completion date under the transfer order is 10/1/2027.
5. Transfer Order T-12739 cancelled Certificate 57754. The new completion date under the transfer order is 10/1/2027.
6. The priority dates for Groundwater Registrations GR-3175, GR-3181, GR-3178, GR-3177, GR-3180, and GR-3176 will be finally determined by OWRD through adjudication.
7. The authorized rates for Groundwater Registrations GR-3175, GR-3181, GR-3178, GR-3177, GR-3180, and GR-3176 are expressed in gallons per minute (gpm) in the certificates of registration. For consistency and ease of reading, those rates have been converted into cfs in this document.

APPENDIX B
SEISMIC HAZARDS TECHNICAL MEMO
MCMILLAN-JACOBS (MARCH 2020)

Technical Memorandum

To:	Michael McKillip, PhD, PE, MurraySmith	Project:	SUB Water System Seismic Resiliency Evaluation
From:	Wolfe Lang, PE, GE, McMillen Jacobs Associates	cc:	
Prepared by:	Luke Ferguson, PE McMillen Jacobs Associates	Job No.:	6056.0
Date:	May 21, 2021	Revision:	No. 2
Subject:	Seismic Hazards Evaluation Technical Memorandum		

1.0 Introduction

The Springfield Utility Board (SUB) is currently conducting a Water Master Plan study in conjunction with the Oregon Resilience Plan (ORP). A key required component of the study is understanding both the seismic hazards and resiliency of the water system. SUB has contracted MurraySmith, Inc. (MurraySmith) to provide professional engineering services for the resilience study. McMillen Jacobs Associates (MJ) has been retained by MurraySmith to provide geotechnical engineering services.

This memorandum presents the results of our evaluation. The following tasks were completed in accordance with our scope of work:

1. Review of available geological information;
2. Review of State of Oregon Department of Geology and Mineral Industries (DOGAMI) seismic hazard maps for a magnitude 9.0 Cascadia Subduction Zone (CSZ) event in SUB's service area;
3. Review of available geotechnical boring information provided by MurraySmith to verify DOGAMI seismic hazard maps;
4. Review of available well information from Oregon Department of Water Resources to verify DOGAMI seismic hazard maps;
5. Review of available geotechnical information from the City of Springfield to verify DOGAMI seismic hazard maps;
6. Site reconnaissance to address key geological and geotechnical assumptions and to examine areas that are potentially prone to failures from lateral spreading and seismic landslide hazards;
7. Develop estimates of strong ground shaking, liquefaction induced settlement, lateral spreading permanent ground deformation (PGD), seismic landslide PGD, and develop maps illustrating these hazards in relation to SUB's service area; and
8. Develop this memorandum summarizing the results of our evaluations including seismic hazard maps.

In the following sections, we present the results of the data review, seismic hazards evaluation, and a summary of geotechnical hazards along the backbone system. Seismic hazard maps are provided in Appendix A. Site visit photographs are provided in Appendix B. The Willamette Water Treatment Plant, located off 26th Street, is not included in this study.

2.0 Data Review

We reviewed geotechnical data from MurraySmith and the City of Springfield, and well logs from the Oregon Water Resources Department. A list of reviewed exploration logs is provided in Table 1.

Table 1. Existing Exploration Logs Reviewed

Log Type	Document and Exploration Name	Depth (ft)
Well	LANE 50107, Oregon Water Resources Department	12
Well	LANE 50235, Oregon Water Resources Department	10
Well	LANE 50236, Oregon Water Resources Department	10
Well	LANE 50237, Oregon Water Resources Department	10
Well	LANE 15226, Oregon Water Resources Department	335
Well	LANE 72773, Oregon Water Resources Department	30
Well	LANE 72779, Oregon Water Resources Department	30
Well	LANE 72780, Oregon Water Resources Department	35
Well	LANE 76854, Oregon Water Resources Department	45
Well	LANE 51916, Oregon Water Resources Department	26
Geotech.	2013, Moe Hill Reservoir, SUB Reservoirs Seismic Analysis, FEI	NA
Geotech.	2018, Subgrade Evaluation, Dogwood Street, Branch Engineering	NA
Geotech.	2012, 58th Street Relief Sanitary Sewer Line: BH-1, FEI	30
Geotech.	2012, 58th Street Relief Sanitary Sewer Line: BH-3, FEI	21
Geotech.	2012, 58th Street Relief Sanitary Sewer Line: BH-4, FEI	22
Geotech.	2010, Jasper Trunk Sewer: BH-1, FEI	35
Geotech.	2010, Jasper Trunk Sewer: BH-2P, FEI	30
Geotech.	2010, Jasper Trunk Sewer: BH-3, FEI	25
Geotech.	2010, Jasper Trunk Sewer: BH-4, FEI	21
Geotech.	2010, Jasper Trunk Sewer: BH-7, FEI	25
Geotech.	2010, Jasper Trunk Sewer: BH-9, FEI	31
Geotech.	2010, Jasper Trunk Sewer: BH-10P, FEI	28
Geotech.	2013, Kelly Butte Reservoir, SUB Reservoirs Seismic Analysis, FEI	NA
Geotech.	2013, Willamette Heights Reservoir, SUB Reservoirs Seismic Analysis, FEI	NA
Geotech.	2012, 58th Street Relief Sanitary Sewer Line: BH-2, FEI	20
Geotech.	2010, Jasper Trunk Sewer: BH-5P, FEI	27
Geotech.	2010, Jasper Trunk Sewer: BH-6P, FEI	37
Geotech.	2010, Jasper Trunk Sewer: BH-8P, FEI	37
Geotech.	2010, Jasper Trunk Sewer: BH-13P, FEI	18
Geotech.	2010, Jasper Trunk Sewer: BH-11P, FEI	28
Geotech.	2010, Jasper Trunk Sewer: BH-12P, FEI	24
Geotech.	2017, Proposed CMC Development – 5th Street, EEI	4 – 20
Geotech.	2013, S 57th Street Reservoir: BH-1, FEI	51
Geotech.	2013, S 67th Street Reservoir: BH-1, FEI	30
Geotech.	2013, S 67th Street Reservoir: BH-2, FEI	35
Geotech.	2013, S 70th Street Reservoir: BH-1, FEI	30
Geotech.	2013, S 70th Street Reservoir: BH-2, FEI	30
Geotech.	2013, South Hills Reservoir: BH-1, FEI	30
Geotech.	2013, South Hills Reservoir: BH-2, FEI	30
Geotech.	2013, South Hills Reservoir: BH-3, FEI	30

3.0 Site Reconnaissance

On February 7, 2020 MJ employee Luke Ferguson, PE visited the project area in order to perform a geotechnical reconnaissance of SUB reservoirs and high seismic hazard areas in which SUB pipelines are present. Facilities visited include:

- S 67th Street Reservoir
- S 70th Street Reservoir
- South Hills Reservoir
- South 57th Street Reservoir
- Moe Hill Reservoir
- Kelly Butte Reservoir
- Willamette Heights Reservoir

High seismic hazard areas visited include:

- South bank of McKenzie River (multiple locations)
- South bank of Willamette River (Glenwood)

These locations were selected for a site visit because they are critical facilities in the SUB water system or are within the mapped seismic hazard zones (Figures 3, 4, and 5). During the reconnaissance, MJ noted site conditions, exposed soil conditions, site topography, proximity to bodies of water, and constructed features. Selected photographs from the site visits are provided in Appendix B.

4.0 Geology and Seismic Setting

4.1 Geologic Setting

Springfield, Oregon is located east of Interstate 5 on the eastern border of Eugene, Oregon. The city is about 15 square miles in size, and relatively flat. The city is bordered on the west by Interstate 5, the north by the McKenzie River, the south by the Willamette River, and the east by foothills of the Cascade mountains.

Springfield lies at the southern tip of the Willamette Valley and is bordered by the Cascade Range to the east and Coast Range to the west. The area is underlain by Eocene to Oligocene aged marine sandstones and siltstones. The marine sediments are intermixed with tuff and basalt flows of the Fisher Formation (Yeats et al., 1996; Hladky and McCaslin, 2006; McClaughry et al., 2010). These units are overlain by basalt, tuff, and pyroclastics of younger Miocene to Oligocene volcanic activity (Yeats et al., 1996; Hladky and McCaslin, 2006).

Older bedrock is generally overlain by alluvium associated with meandering and flooding of the Willamette and McKenzie Rivers (Hladky and McCaslin, 2006). The alluvium ranges in composition from silt to boulders but generally consists of dense sands and gravels.

4.2 Seismic Setting

The Pacific Northwest is located near an active tectonic plate boundary. Off the northwest coast the Juan de Fuca oceanic plate is subducting beneath the North American crustal plate. This tectonic regime has resulted in seismicity in the project area occurring from three primary sources:

- Shallow crustal faults within the North American plate;
- CSZ intraplate faults within the subducting Juan de Fuca plate; and
- CSZ megathrust events generated along the boundary between the subducting Juan de Fuca plate and the overriding North American plate.

Among these three sources, CSZ megathrust events are considered as having the most hazard potential due to the anticipated magnitude and duration of associated ground shaking. Recent studies indicate that the CSZ can potentially generate large earthquakes with magnitudes ranging from 8.0 to 9.2 depending on rupture length. The recurrence intervals for CSZ events are estimated at approximately 500 years for the mega-magnitude full rupture events (magnitude 9.0 to 9.2) and 200 to 300 years for the large-magnitude partial rupture events (magnitude 8.0 to 8.5). Additionally, current research indicates a probability of future occurrence because the region is “past due” based on historic and prehistoric recurrence intervals documented in ocean sediments. For example, over the next 50 years, the CSZ earthquake has an estimated probability of occurrence off the Oregon Coast on the order of 16 to 22 percent (Goldfinger et. al., 2016).

In 2013, the State of Oregon developed the Oregon Resilience Plan (ORP, 2013) to prepare the state for the magnitude 9.0 CSZ event. We understand that this earthquake scenario is selected as the seismic source in the City’s seismic hazard study.

5.0 Subsurface Conditions

The subsurface within the project area is dominated by the following geologic units:

- Mixed Grain Sediments: This unit consists of sediments that are highly variable in grain size, ranging from clay to gravel, but are generally hard clay and silt. This material has been deposited by stream action (alluvium) as well as by landslides and mass wasting (colluvium). This unit is not generally susceptible to liquefaction, except in zones where mixed grain sediments consist predominantly of loose sand and nonplastic silt, which is mainly near existing waterways.
- Coarse Grained Sediments: This unit consists of sediments that are highly variable in grain size, ranging from silt to cobbles, but are generally dense sand and gravel. This material has been deposited primarily by stream action (alluvium). This unit is not generally susceptible to liquefaction, except in zones where coarse grained sediments consist predominantly of loose sand and nonplastic silt, which is manly near existing waterways.
- Sedimentary Rocks: This unit consists of Eocene to Oligocene aged marine sedimentary rocks including sandstone and siltstone. This unit is not liquefiable.
- Volcanic Rocks: This unit consists of Oligocene to Miocene basalt, basaltic andesite, and tuff. This unit is not liquefiable.

A geologic map, provided in Figure 1, shows the overall distribution of these geologic units.

6.0 Geotechnical Seismic Hazards

Seismic hazards include strong ground shaking, liquefaction settlement, lateral spreading, and seismic-induced landslides. These hazards have the potential to damage facilities (i.e., pipelines, reservoirs, pump stations, treatment plants) through either permanent ground deformation or intense shaking. Our analysis of these seismic hazards is based on information provided from existing geotechnical explorations, historic well logs, DOGAMI hazard maps created for the ORP (Madin and Burns, 2013), and our knowledge of the geotechnical conditions of the area. In our seismic analyses we assumed a magnitude 9.0 earthquake and a peak ground acceleration (PGA) of 0.20 g to represent the effects of a M9 CSZ seismic event in the project area.

Geotechnical information contained in logs and reports studied for this project was analyzed for potential seismic hazards and compared to seismic hazards mapped by DOGAMI. Where appropriate, DOGAMI mapped hazards were modified and improved to incorporate results of the analysis of local geotechnical information.

6.1 Ground Shaking

To assess the hazard potential of ground shaking in the project area we reviewed the peak ground velocity (PGV) map published by DOGAMI for the ORP in the event of a M9 CSZ earthquake (Madin and Burns, 2013).

The estimated ground shaking intensity (PGV) depends on earthquake magnitude, distance to fault rupture, and the subsurface materials present at the site. Generally, the PGV values are estimated to range between 6 and 10 inches per second in the Springfield area. The PGV hazard map is shown in Figure 2.

6.2 Liquefaction

Liquefaction is a phenomenon affecting saturated, granular soils in which cyclic, rapid shearing from an earthquake results in a drastic loss of shear strength and a transformation from a granular solid mass to a viscous, heavy fluid mass. The results of soil liquefaction include loss of shear strength, loss of soil materials through sand boils, flotation of buried chambers/pipes, and post liquefaction settlement.

To evaluate the hazard potential of soil liquefaction in the project area we reviewed liquefaction hazard maps published by DOGAMI for the ORP, modified as discussed in Section 6.0, in the event of a M9 CSZ earthquake. Where geotechnical data was available, we conducted site specific analyses based on the subsurface conditions shown in previous geotechnical explorations listed in Section 2 using the latest SPT-based liquefaction susceptibility and settlement assessment procedures (Boulanger and Idriss, 2014; Idriss and Boulanger, 2008). Based on our evaluation, liquefaction settlement is generally not a hazard throughout the majority of the SUB service area. However, in some areas along the McKenzie and Willamette Rivers where saturated, unconsolidated alluvium exists liquefaction settlement up to 2 inches may occur. The liquefaction settlement hazard map is shown in Figure 3.

6.3 Lateral Spreading

Liquefaction can result in progressive deformation of the ground known as lateral spreading. The lateral movement of liquefied soil breaks the non-liquefied soil crust into blocks that progressively move downslope or toward a free face in response to earthquake generated ground accelerations. Seismic movement incrementally pushes these blocks downslope as seismic accelerations overcome the strength of the liquefied soil column. The potential for and magnitude of lateral spreading depends on the liquefaction potential of the soil, the magnitude and duration of earthquake ground accelerations, the site topography, and the post-liquefaction strength of the soil.

To assess the hazard potential of lateral spreading in the project area we reviewed a lateral spreading hazard map published by DOGAMI for the ORP, modified as discussed in Section 6.0, in the event of a M9 CSZ earthquake. The primary zones of lateral spreading hazard correspond to slopes around the McKenzie and Willamette Rivers. Lateral spreading PGD up to 6 inches may occur in these areas. The lateral spreading hazard map is shown in Figure 4.

6.4 Seismic Landslides

Earthquake induced landslides can occur on slopes due to the inertial force from an earthquake adding load to a slope. The ground movement due to landslides can be extremely large and damaging to pipelines and other structures. To assess the hazard potential of landslides in the project area we reviewed a landslide hazard map published by DOGAMI for the Eugene-Springfield area, and modified it based on reviewed geotechnical data.

Generally, there is not a seismic landslide hazard in the majority of the SUB service area. However, seismic landslide hazard is present at the South 57th Street Reservoir and Willamette Heights Reservoir. Steep slopes at the Moe Hill and Kelly Butte reservoirs also provide the potential for landslides. Seismic landslide PGD up to 4 feet may occur in these areas. The seismic landslide hazard map is shown in Figure 5.

DOGAMI has mapped several historic landslides in the hills in the southern Thurston area, as well as in the hills in the Willamette Heights/Dorris Ranch area (Calhoun et al., 2018).

7.0 Summary of Seismic Hazards for Backbone Piping

In general, the seismic hazards to backbone piping in the SUB service area are very low. There are some liquefaction and lateral spreading hazards to piping along the Mill Race east of the Steam Plant Pump Station and to piping and pump stations near the intersection of N 42nd Street and Hwy 126. Also, there is liquefaction and lateral spread hazard to piping and pump stations near Harvest Landing. These hazard areas are shown in Figures 3 and 4.

8.0 Summary Seismic Hazards and Recommendations for Critical Facilities

In addition to the seismic hazard study for the overall service area, we conducted site visits to 7 critical facilities. The critical facilities are listed in Table 2 and shown in Figures 1 through 5. Table 2 summarizes the results of the site visit and document review, the geotechnical hazards, and the geotechnical recommendations at these locations. The document review consisted mainly of a review of the "SUB Reservoirs Seismic Analysis" reports completed by FEI in 2013. These reports include geotechnical exploration results conducted during the original design of the reservoirs and some supplemental explorations (performed by FEI) to support their analyses of these reservoirs.

The Kelly Butte, Moe Hill, and Willamette Heights Reservoirs are founded on bedrock or structural fill on bedrock and are not expected to experience seismic liquefaction or lateral spreading hazards. However, due to the close distance of these reservoir foundations to steep slopes at these sites and the unknown bedrock conditions, seismic landslides may be a hazard. Existing geotechnical explorations and FEI's 2013 study did not include analysis of bedrock weathering, joint density and orientation information, or a site-specific stability analysis of the nearby steep slopes. We recommend conducting additional geotechnical boreholes (one upslope and one downslope from reservoir) to assess the bedrock conditions and conducting a kinematic slope analysis or similar to determine the factor of safety of the slope against movement during both static and seismic conditions.

The S 57th Street reservoirs are founded on soil but due to the nature of the soil and the probable lack of groundwater the liquefaction and lateral spreading hazards are low. However, the groundwater levels in this area are poorly known, affecting the confidence of liquefaction conclusions. There is a seismic landslide hazard risk at this location due to the steep slopes in this area and the seismic slope stability of the reservoirs slopes has not been studied. An Ultrablock retaining wall was constructed at the cut slope east of the S 57th reservoirs in 2017. This wall serves to reduce the impact of sloughing and soil creep from the cut slope but does not mitigate the potential for a deep-seated landslide. A seismic retrofit of Tank 2 consisting of widening of the reservoir foundation was completed in 2019. Recommendations at this site include drilling additional boreholes with piezometers (one upslope and one downslope of reservoir) and conducting seismic liquefaction and slope stability analyses to verify the seismic hazards.

The S 67th Street, S 70th Street, and South Hills reservoirs, located in the southeast quadrant of the city, are generally underlain by colluvium in mapped historic landslide areas. Geotechnical explorations suggest that the colluvium is not liquefiable. Slope stability analyses performed by FEI in 2013 suggest that the slopes upon which these reservoirs are founded are stable under both seismic and static conditions. We're generally concur with their conclusion that the seismic hazards at these reservoirs are low.

9.0 Limitations

This Seismic Hazards Technical Memorandum has been prepared for the Springfield Utility Board Water System Seismic Resiliency Study, located in Springfield, Oregon. This report contains a compilation of information from previous studies, projects, and published literature. The professional judgements and characterizations presented herein are based on this information. McMillen Jacobs Associates is not responsible for errors and omissions that might appear in studies reported by others.

The scope of our geotechnical services has not included an environmental evaluation regarding the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below the site.

This report has been completed within the limitations of the MurraySmith approved scope of work, schedule and budget. The services rendered have been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same area. McMillen Jacobs Associates is not responsible for the use of this report for anything other than the SUB Water Master Plan study in Springfield, Oregon.

MCMILLEN JACOBS ASSOCIATES

REGISTERED PROFESSIONAL ENGINEER 78866PE OREGON 12-31-07 YUXIN LANG Exp 12-31-2022

Luke Ferguson, P.E.
Project Engineer

Yuxin "Wolfe" Lang, P.E., G.E.
Principal Engineer

Table 2. Preliminary Seismic Hazard Assessment Summary for Critical Facilities

Structure Name	Available or Nearby Geotechnical Information	Mapped Seismic Hazards and Levels	Anticipated Subsurface Conditions and Site Topography	Primary Geotechnical Seismic Concerns & Issues	Recommendations/Notes
Moe Hill Reservoir	Geotechnical Exploration Moe Hill 4.0 MG Prestressed reservoir, CH2M Hill 1993 (test pit logs only) FEI Project 2131028, FEI (no explorations)	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: 1 – 4 ft.	Located on the west end of the top of a hill (Moe Hill) with moderate to steep slopes sloping down to the north, west, and south. Available test pit logs, geologic map and construction notes indicate site is underlain by a thin (0-5 ft.) layer of fill over basaltic bedrock.	Due to steep slopes and bedrock condition uncertainty, seismic landslides are a concern at this site.	Recommend detailed landslide hazard analyses to assess the stability of the Moe Hill slopes, especially during an earthquake. This includes drilling rock cores to determine strength and fracture orientation of underlying rock, followed by a kinematic slope stability analysis.
Kelly Butte Reservoir	FEI Project 2131028, FEI (no explorations)	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: 1 – 4 ft.	Located on top of a ridge (Kelly Butte) with moderate to steep slopes sloping down to the east and west. Construction notes, geologic map, and surface observations indicate site is underlain by marine sandstone.	Due to steep slopes seismic landslides are a concern at this site.	No recommendations. It is our understanding that this reservoir is planned to be abandoned.
Willamette Heights Reservoir	FEI Project 2131028, FEI (no explorations)	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: 1 – 4 ft.	Located at the north end of bluff with steep slopes sloping down to the north, east, and west. Original geotechnical report is not available. Geologic map and nearby outcrop observation (in FEI report) indicate site is underlain by basaltic bedrock.	Subsurface condition uncertainty. Due to steep slopes seismic landslides are a concern at this site.	Recommend detailed landslide hazard analyses to assess the stability of the bluff on which the reservoir is founded. This includes drilling geotechnical borings and rock cores to determine strength and fracture orientation of underlying rock, followed by a kinematic slope stability analysis.

Structure Name	Available or Nearby Geotechnical Information	Mapped Seismic Hazards and Levels	Anticipated Subsurface Conditions and Site Topography	Primary Geotechnical Seismic Concerns & Issues	Recommendations/Notes
S 57th Street Reservoirs	FEI Project 2131028-101, FEI (including three test pits and one boring)	PGV: 6 – 10 in/sec Liquefaction settlement: < 2 in. Lateral spreading PGD: < 6 in. Landslide PGD: 1 – 4 ft.	Located on a bench approximately mid-slope on the west facing slope of a hill. One geotechnical boring and three test pits indicate the site is underlain by colluvium.	Seismic slope stability analysis was not conducted in previous studies. Due to colluvium soil conditions and steep slopes seismic landslides are a concern at this site. Concern of soil creep from cut slope has been addressed by construction of an Ultrablock retaining wall. Due to likely deep groundwater liquefaction is unlikely. However, groundwater levels are not well known.	Recommend detailed seismic slope stability analyses to assess the stability of the slope on which the reservoir is founded. This includes drilling a borehole upslope of reservoir and a borehole downslope of reservoir followed by a limit equilibrium slope stability analysis. Recommend boreholes include means to measure groundwater level to better quantify liquefaction hazard.
S 67th Street Reservoir	FEI Project 2131028-101, FEI (including two borings)	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: No hazard	Located on a gentle north facing slope. Two geotechnical borings, surface observations, and geologic map indicate the site is underlain by colluvium.	Strong ground shaking. FEI conducted a seismic slope stability analysis, and the result indicates a stable site condition.	No recommendations. Liquefaction hazard is very low, and FEI has concluded slope is stable under both seismic and static conditions.
S 70th Street Reservoir	FEI Project 2131028-101, FEI (including two borings) Well Log 51916, OWRD Well Log 72773, OWRD	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: No hazard	Located on a gentle to moderate north facing slope. Two geotechnical borings, surface observations, and geologic map indicate the site is underlain by colluvium.	Strong ground shaking. FEI conducted a seismic slope stability analysis, and the result indicates a stable site condition.	No recommendations. It is our understanding that this reservoir is planned to be abandoned.

Structure Name	Available or Nearby Geotechnical Information	Mapped Seismic Hazards and Levels	Anticipated Subsurface Conditions and Site Topography	Primary Geotechnical Seismic Concerns & Issues	Recommendations/Notes
South Hills Reservoir	FEI Project 2131028-101, FEI (including three borings) Well Log 72779, OWRD Well Log 72780, OWRD	PGV: 6 – 10 in/sec Liquefaction settlement: No hazard Lateral spreading PGD: No hazard Landslide PGD: No hazard	Located on a gentle to moderate north facing slope. Three geotechnical borings, several test pits, and geologic map indicate the site is underlain by colluvium.	Strong ground shaking. FEI conducted a seismic slope stability analysis, and the result indicates a stable site condition.	No recommendations. Liquefaction hazard is very low, and FEI has concluded slope is stable under both seismic and static conditions.

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Appendix A

Figures

LEGEND

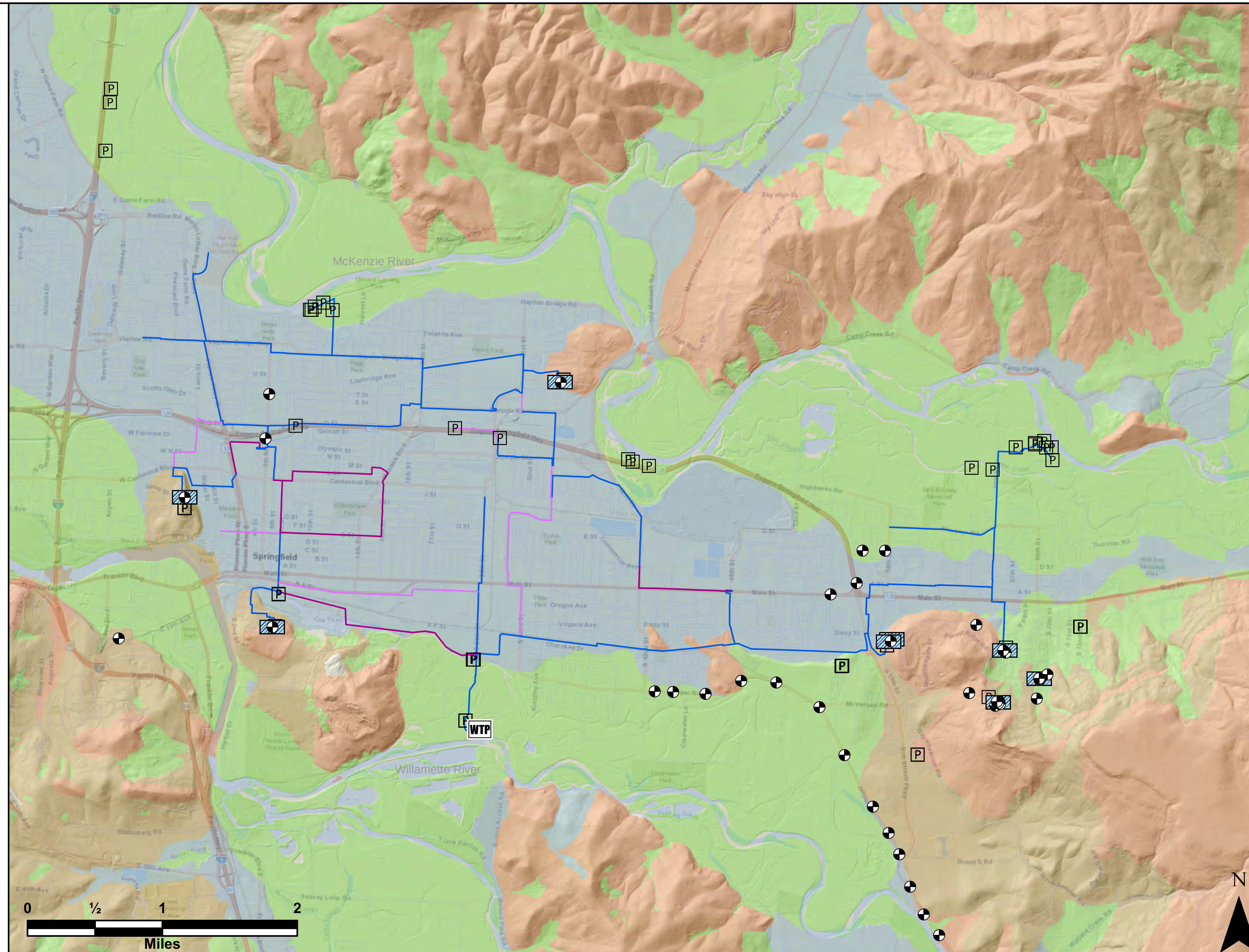
- Geotechnical Exploration
- WTP Willamette Water Treatment Plant
- SUB Reservoir
- P SUB Pump Station

Backbone Piping

- Critical for Access and Modeling
- Critical for Modeling
- Critical for Access

Geology

- Mixed Grain Sediments
- Coarse Grained Sediments
- Sedimentary Rock
- Volcanic Rock



NOTES:
GEOLOGY ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING GEOTECHNICAL INFORMATION AND DOGAMI OGDC-6.

McMILLEN JACOBS ASSOCIATES

SUB SEISMIC RESILIENCY
SPRINGFIELD, OR

SEISMIC HAZARDS TECHNICAL MEMORANDUM
GEOLOGY MAP

MAY
2021

FIGURE
1

PATH: C:\Users\ferguson\Desktop\SUB\SUB_Map.mxd DATE: 3/17/2020 1:40:17 PM

LEGEND

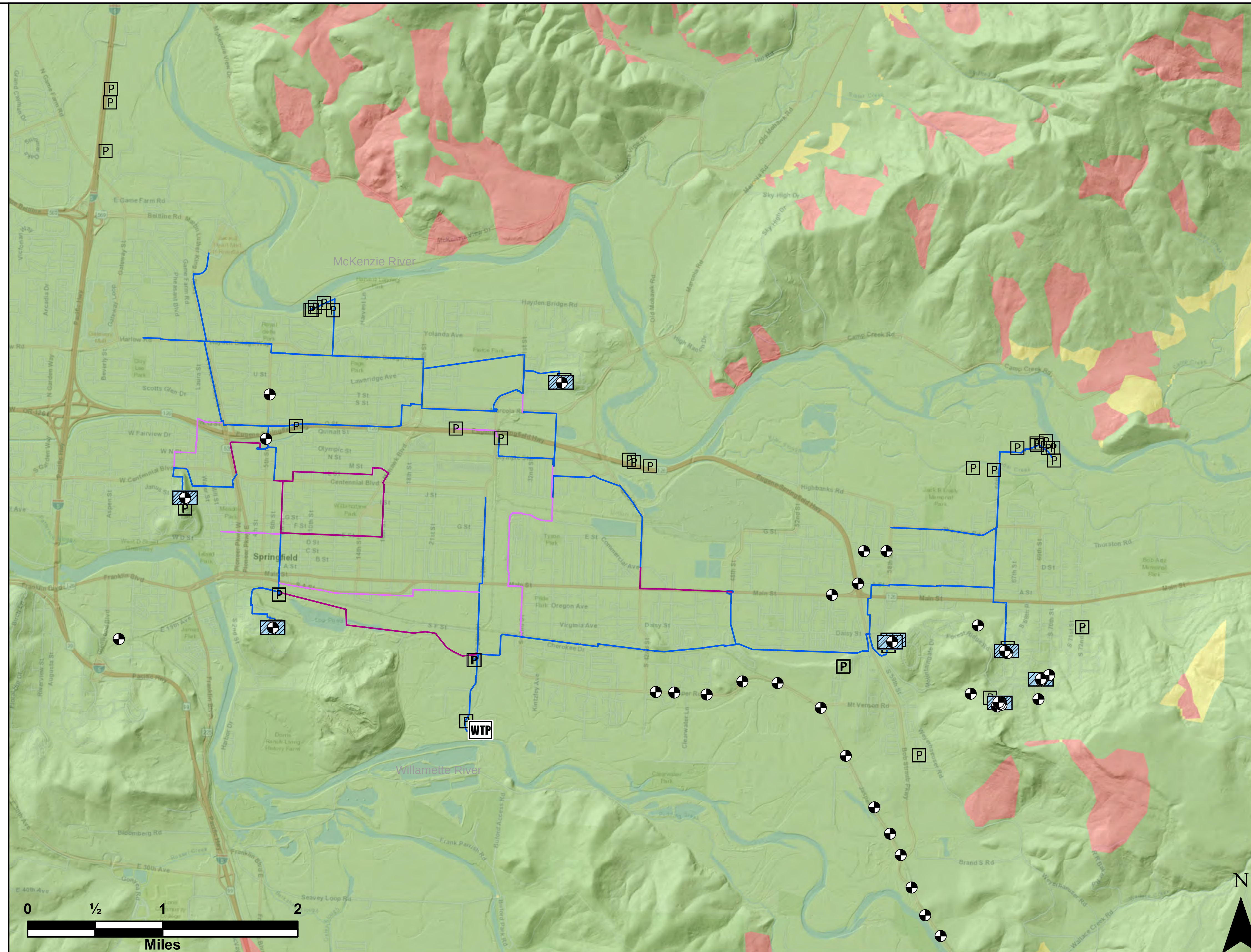
- Geotechnical Exploration
- WTP Willamette Water Treatment Plant
- SUB Reservoir
- P SUB Pump Station

Backbone Piping

- Critical for Access and Modeling
- Critical for Modeling
- Critical for Access

Peak Ground Velocity

- 6 - 10 in/s
- 10 - 14 in/s
- 14 - 18 in/s



NOTES:
PEAK GROUND VELOCITY ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING GEOTECHNICAL INFORMATION AND DOGAMI OPEN FILE REPORT O-13-06.

McMILLEN JACOBS ASSOCIATES

SUB SEISMIC RESILIENCY
SPRINGFIELD, OR

MAY
2021

SEISMIC HAZARDS TECHNICAL MEMORANDUM
PEAK GROUND VELOCITY MAP

FIGURE
2

PATH: C:\Users\ferguson\Desktop\SUB\SUB_Map.mxd DATE: 3/17/2020 1:40:17 PM

LEGEND

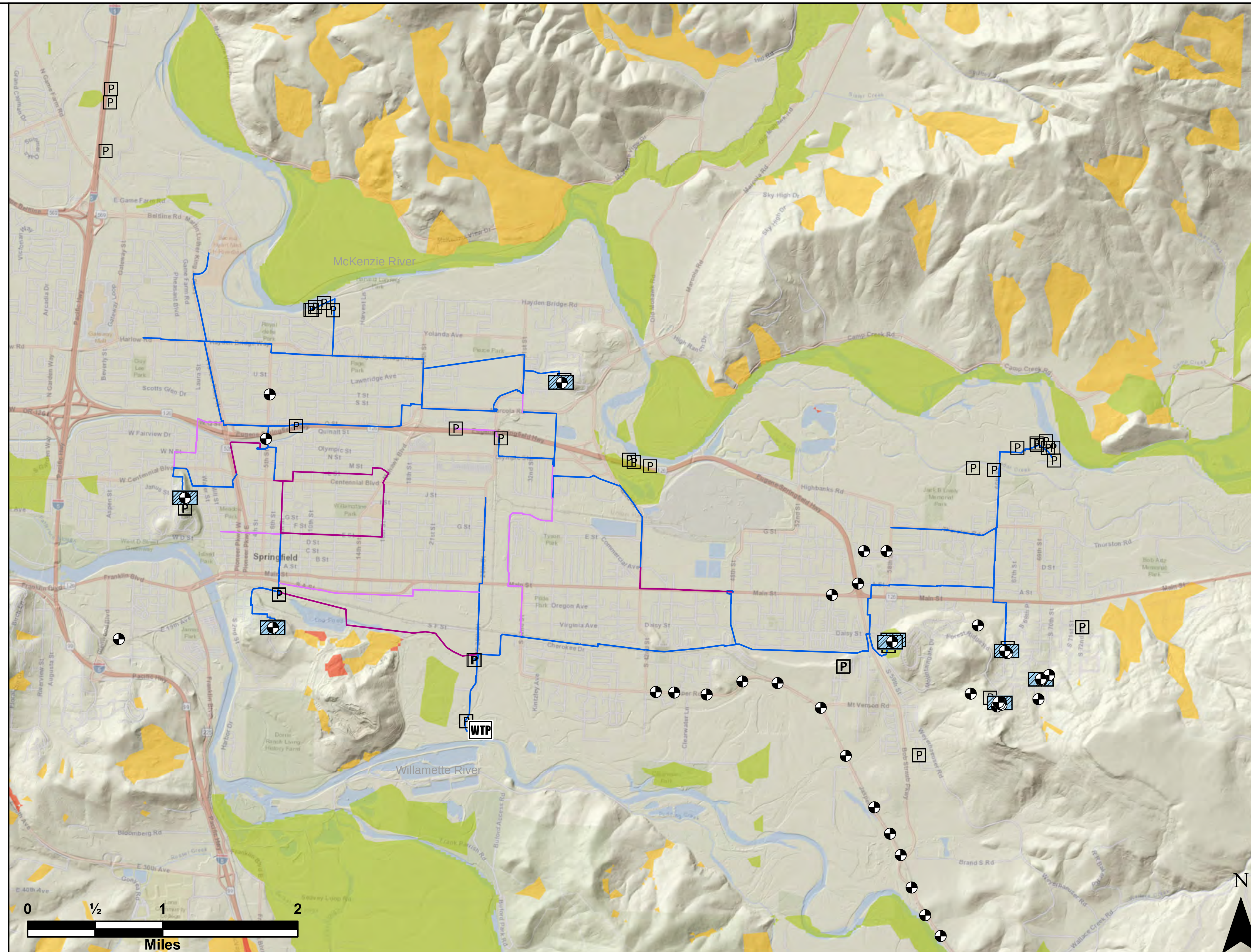
- Geotechnical Exploration
- WTP Willamette Water Treatment Plant
- SUB Reservoir
- P SUB Pump Station

Backbone Piping

- Critical for Access and Modeling
- Critical for Modeling
- Critical for Access

Estimated Liquefaction PGD

- 0 - 2 in
- 2 - 6 in
- > 6 in



NOTES:
LIQUEFACTION SETTLEMENT ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING GEOTECHNICAL INFORMATION AND DOGAMI OPEN FILE REPORT O-13-06.

SOURCES OF GEOTECHNICAL INFORMATION PROVIDED IN TABLE 1 OF MEMO. AREAS OUTSIDE OF EXISTING GEOTECHNICAL INFORMATION HAVE NOT BEEN VERIFIED

McMILLEN JACOBS ASSOCIATES

SUB SEISMIC RESILIENCY SPRINGFIELD, OR	MAY 2021	
SEISMIC HAZARDS TECHNICAL MEMORANDUM LIQUEFACTION SETTLEMENT MAP	FIGURE 3	

LEGEND

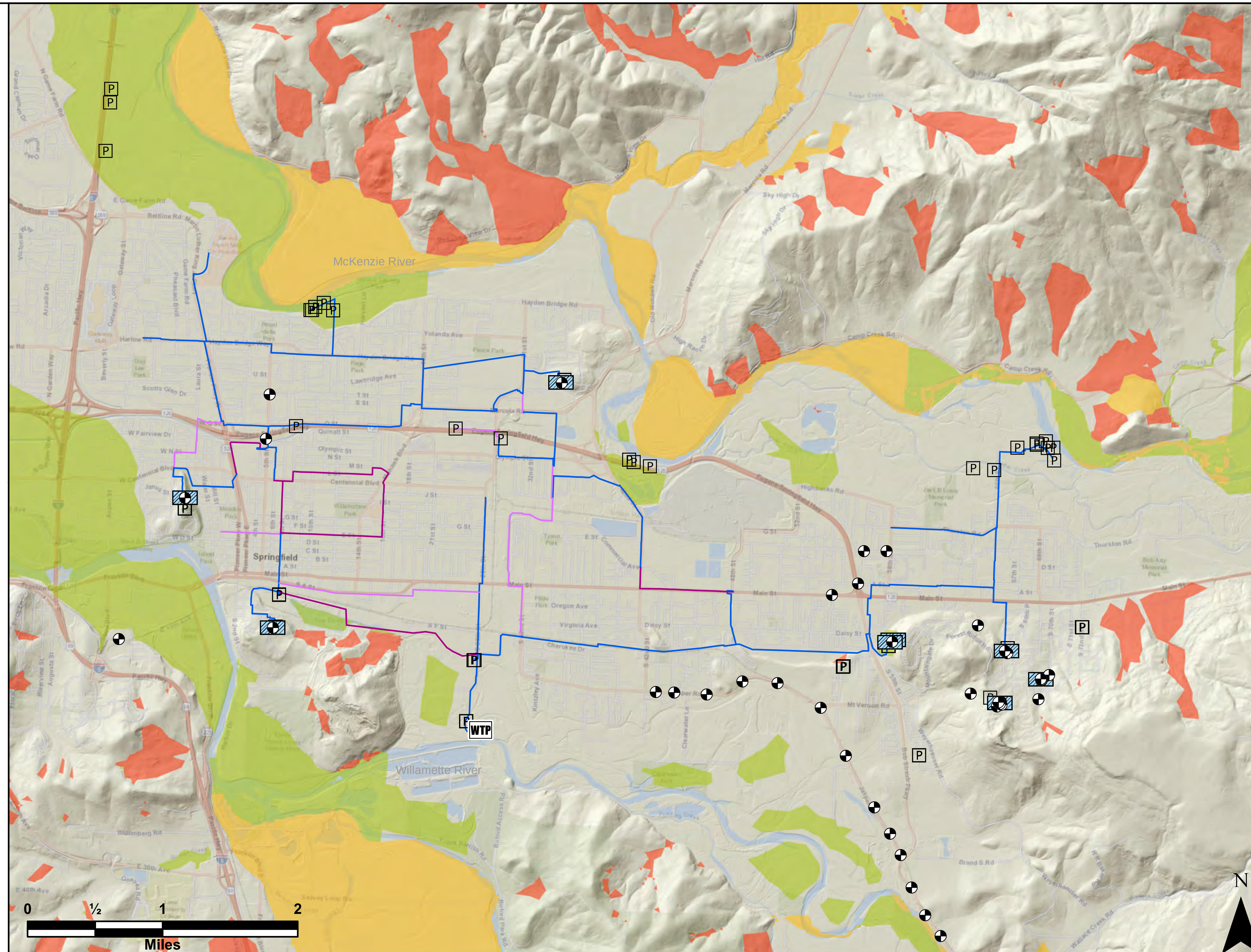
- Geotechnical Exploration
- WTP Willamette Water Treatment Plant
- SUB Reservoir
- P SUB Pump Station

Backbone Piping

- Critical for Access and Modeling
- Critical for Modeling
- Critical for Access

Estimated Lateral Spreading PGD

- 0 - 6 in
- 6 - 12 in
- > 12 in



NOTES:
LIQUEFACTION LATERAL SPREADING ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING GEOTECHNICAL INFORMATION AND DOGAMI OPEN FILE REPORT O-13-06.

SOURCES OF GEOTECHNICAL INFORMATION PROVIDED IN TABLE 1 OF MEMO. AREAS OUTSIDE OF EXISTING GEOTECHNICAL INFORMATION HAVE NOT BEEN VERIFIED

McMILLEN JACOBS ASSOCIATES

SUB SEISMIC RESILIENCY
SPRINGFIELD, OR

SEISMIC HAZARDS TECHNICAL MEMORANDUM
LIQUEFACTION LATERAL SPREADING MAP

MAY
2021

FIGURE
4

PATH: C:\Users\sferguson\Desktop\SUB\SUB_Map.mxd DATE: 3/17/2020 1:40:17 PM

LEGEND

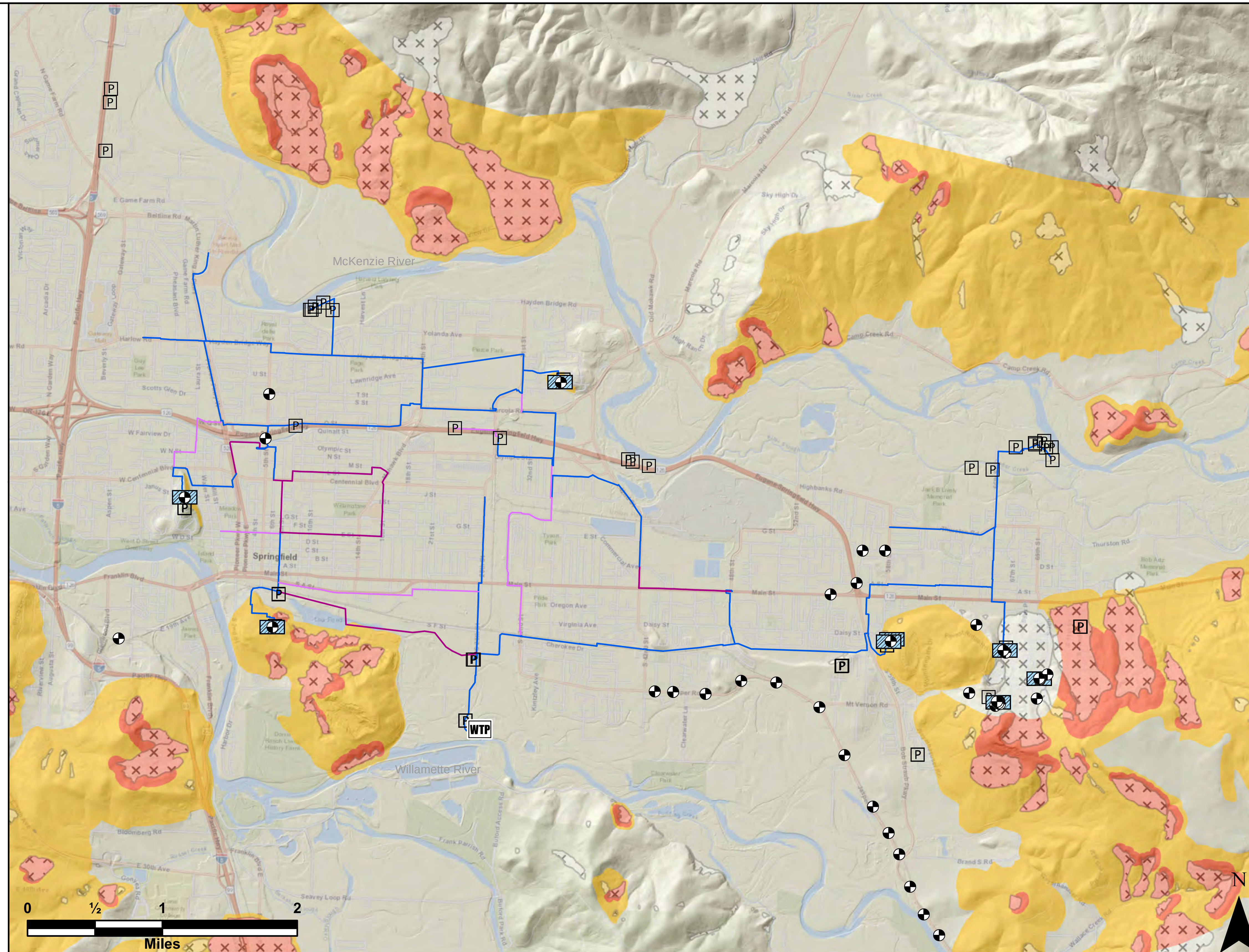
- Geotechnical Exploration
- WTP Willamette Water Treatment Plant
- SUB Reservoir
- P SUB Pump Station

Backbone Piping

- Critical for Access and Modeling
- Critical for Modeling
- Critical for Access

Estimated Seismic Landslide PGD

- 0 - 1 ft
- 1 - 4 ft
- > 4 ft
- Historic Landslide Deposits



NOTES:
SEISMIC LANDSLIDE ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING GEOTECHNICAL INFORMATION AND DOGAMI OPEN FILE REPORT IMS-60.

HISTORIC LANDSLIDE DEPOSITS ARE BASED ON DOGAMI SLIDO 3.4.

McMILLEN JACOBS ASSOCIATES

SUB SEISMIC RESILIENCY SPRINGFIELD, OR	MAY 2021	
SEISMIC HAZARDS TECHNICAL MEMORANDUM SEISMIC LANDSLIDE MAP	FIGURE 5	

PATH: C:\Users\jferguson\Desktop\SUB\SUB_Map.mxd DATE: 3/9/2020 4:40:10 PM

Appendix B

Site Visit Photographs

S 67th Street Reservoir – Looking E

S 67th Street Reservoir – Looking NE

McMILLEN JACOBS ASSOCIATES

SUB Seismic Resiliency Springfield, OR	MAY 2021
Date Photo Taken: February 7, 2020	SLIDE 1

S 67th Street Reservoir – Looking NE

S 67th Street Reservoir – Looking E

McMILLEN JACOBS ASSOCIATES	SUB Seismic Resiliency Springfield, OR	MAY 2021
	Date Photo Taken: February 7, 2020	SLIDE 2

S 67th Street Reservoir – Looking SE

S 67th Street Reservoir – Looking W

S 70th Street Reservoir – Looking E

S 70th Street Reservoir – Looking N

S 70th Street Reservoir – Looking N

S 70th Street Reservoir – Looking W

South Hills Reservoir – Looking NE

South Hills Reservoir – Looking E

South Hills Reservoir – Looking SE

South Hills Reservoir – Looking NW

South Hills Reservoir – Looking E

S 57th Street Reservoir – Looking NE

South Bank McKenzie River – Looking E

South Bank McKenzie River – Looking E

McMILLEN JACOBS ASSOCIATES	**SUB Seismic Resiliency** **Springfield, OR**	**MAY 2021**
	Date Photo Taken: February 7, 2020	**SLIDE 9**

South of McKenzie River – Looking W

South of McKenzie River – Looking E

02/07/2020

02/07/2020

McMILLEN JACOBS ASSOCIATES	SUB Seismic Resiliency Springfield, OR	MAY 2021
	Date Photo Taken: February 7, 2020	SLIDE 11

Willamette Heights Reservoir – Looking NE

Willamette Heights Reservoir – Looking N

McMILLEN JACOBS ASSOCIATES	**SUB Seismic Resiliency** **Springfield, OR**	**MAY** **2021**
	Date Photo Taken: February 7, 2020	**SLIDE 12**

Kelly Butte Reservoir – Looking NW

Kelly Butte Reservoir – Looking SE

Kelly Butte Reservoir – Looking SE

Kelly Butte Reservoir – Looking E

South Bank of Willamette River – Looking E

South Bank of Willamette River – Looking W

McMILLEN JACOBS ASSOCIATES	**SUB Seismic Resiliency** **Springfield, OR**	**MAY** **2021**
	Date Photo Taken: February 7, 2020	**SLIDE 15**

South Bank of McKenzie River – Looking SE

South Bank of McKenzie River – Looking NW

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APPENDIX C
WATER DEMAND BY SUBLEVEL

The demand by service sublevels for the East, West, and North Systems are presented in **Tables C-1**, **C-2**, and **C-3**, respectively.

Table C-1
East System Water Demand by Service Level

Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
1st[1,2]	Current	3,090	2,558	4,630
	Build-Out	4,782	4,131	7,478
2nd	Current	146	93	169
	Build-Out	203	129	234
Jasper Meadows	Current	11	7	12
	Build-Out	11	7	13
Mountain Gate North	Current	16	10	18
	Build-Out	25	16	29
Mountain Gate South	Current	4	3	5
	Build-Out	6	3	6
Mt. Vernon	Current	44	27	50
	Build-Out	48	30	54
3rd	Current	239	148	268
	Build-Out	435	270	488
4th	Current	19	12	21
	Build-Out	176	109	198
Natron - 2nd	Current	0	0	0
	Build-Out	175	127	230
Natron - 3rd	Current	0	0	0
	Build-Out	57	36	64
Natron - 4th	Current	0	0	0
	Build-Out	8	5	9
Total	**Current**	**3,570**	**2,858**	**5,174**
	Build-Out	**5,926**	**4,864**	**8,803**

Notes:

1. Includes the Natron – 1st area with a current land use of 18 acres, current ADD of 18 gpm, buildout land use of 368 acres, and buildout ADD of 539 gpm.
2. Includes the Millrace area with a buildout land use of 506 acres and buildout ADD of 295 gpm.

Table C-2
West System Water Demand by Service Level

Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
West Low[1]	Current	946	1,071	1,939
	Build-Out	1,527	1,478	2,675
West High	Current	104	98	177
	Build-Out	246	228	413
2nd	Current	14	8	15
	Build-Out	30	19	34
Glenwood	Current	379	524	949
	Build-Out	536	751	1,359
Total	**Current**	**1,442**	**1,702**	**3,080**
	Build-Out	**2,340**	**2,476**	**4,481**

Table C-3
North System Water Demand by Service Level

Level	Timeframe	Area (acres)	ADD (gpm)	MDD (gpm)
1st[1]	Current	2,657	2,280	4,126
	Build-Out	3,399	3,139	5,665
Kelly Butte	Current	20	13	23
	Build-Out	21	13	24
River Heights	Current	5	3	6
	Build-Out	10	6	11
Total	**Current**	**2,682**	**2,295**	**4,154**
	Build-Out	**3,430**	**3,159**	**5,700**

Notes:

1. Includes the North Gateway area with a buildout land use of 447 acres and buildout ADD of 286 gpm.

murraysmith

888 SW 5TH AVENUE, SUITE #1170
PORTLAND, OR 97204
www.murraysmith.us

PUBLIC HEALTH DIVISION
Drinking Water Services
Kate Brown, Governor

Oregon Health Authority

444 A Street
Springfield, OR 97477
Ph. (541) 726-2587
Fax (541) 726-2596
http://healthoregon.org/dwp

17 November 2021

Greg Miller, Springfield Utility Board
Jamie Porter, Rainbow Water District
202 S 18th Street
Springfield, OR 97477

RE: Master Plan (PR 2021-143)
Springfield Utility Board and Rainbow Water District
(PWSs OR4100837 & OR4100839)
Concurrence

Dear Mr. Miller and Mr. Porter:

Oregon Health Authority's Drinking Water Services (DWS) received a plan review fee of $4,125 and a copy of the Springfield Utility Board (SUB) and Rainbow Water District (Rainbow) "Water System Master Plan" dated 16 August 2021 via Murraysmith, Inc. on 2 September 2021. The plan projects a 20-year planning horizon out to the year 2040. Upon review, the Master Plan appears to meet the criteria listed in Oregon Administrative Rules (OAR) 333-061-0060(5).

The plan includes system goals and description, future demand estimates, engineering evaluation, evaluations of options to meet future demand, financing, seismic evaluation, and a list of recommended capital improvement projects (CIPs) and cost-estimates.

I have attached a list of comments for consideration. A response on comments to DWS or a change to the Master Plan is not required. Please note that OAR 333-061-0060 contains plan submission and review requirements for all major water system additions or modifications. Construction plans and specifications must be submitted to and approved by DWS before construction begins.

SUB and Rainbow's cooperation is appreciated. If there are any questions or concerns, or want this letter in an alternate format, please contact me at (541) 231-0762 or via email at james.r.macpherson@dhsoha.state.or.us.

Sincerely,

James "Jay" MacPherson, Ph.D., P.E.
Region 2 Plan Review Coordinator
OHA Drinking Water Services

ec: Master File, DWS Portland
Lane County Environmental Health
Michael McKillip Ph.D.., PE., Murraysmith
(Michael.McKillip@murraysmith.us)

PUBLIC HEALTH DIVISION
Drinking Water Services
Kate Brown, Governor

Oregon Health Authority
444 A Street
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17 November 2021

DWS COMMENTS on Master Plan
(PR 2021-143)
Springfield Utility Board and Rainbow Water District
(PWSs OR4100837 & OR4100839)

The following comments are for SUB and Rainbow's consideration, for which a response to DWS or change to the Master Plan is not required:

- The planning period appears to now be effectively through the year 2041 given the plan is not yet final.
- Coverage of environmental impacts of infrastructure improvements could be more descriptive. This includes mention of no environmental impacts where no impacts are anticipated.
- The Lead and Copper Rule (LCR) is in revision. The final rule will assuredly require and "inventory" of "lead" service lines, which is not mentioned in the Master Plan. The latest LCR revision contains requirements to replace all service laterals if they are of lead or unknown composition within a 33-year window. This could be a significant expense should a large number of service laterals of unknown composition exist.
- Section 1.6 refers to reservoir operating levels relative to overflow elevation without context as to why this is important or not.
- Figure 1-2 may benefit by displaying the interties with EWEB.
- Section 4.3, 11th paragraph addresses McKenzie River source water protection. It may be worth referring to Eugene Water and Electric Board's source water protection program in the McKenzie River basin, and the benefit of coordinated activities for efficiency of effort.
- Section 4.5, 11th paragraph, first and second sentences are not how I understand the process of defining Chase well 2 as Ground Water Under the Influence (GWUDI) of surface water.

- Section 4.5, 13th paragraph, last sentence presumes specific treatment technologies for a hypothetical scenario. That seems overly specific for a hypothetical, especially when other treatment possibilities exist.
- Section 4.5, 17th paragraph, first sentence states the filters are sub-micron, which is incorrect given that validation was conducted with 2-micron particles.
- Section 4.10, 13th paragraph, 8th sentence says goosenecks are required to be removed. The current version of the rule only requires removal if the service connection has an Action Level exceedance. The latest LCR revision does not consider lead goosenecks to be a “lead service line,” though DWS recommends they be replaced where known or found.
- Section 4.13 addresses secondary standards of which manganese may be changed to a primary standard by EPA, a point worth mentioning.
- Section 4.17, 3rd paragraph states “do not need to,” inaccurately implying no regulatory requirement to issue public notice.
- Section 4.21 Summary of Recommendations would be more complete with mention of draft Lead and Copper Rule revisions, such as the probable requirement to create Lead Service Line (LSL) inventories.
- Table 6-1 double counts the Weyco water production (once for SUB, once for Rainbow).
- Figure 7-1 shades three “SUB-specific assets” for which the meaning is unclear. One interpretation could be that Rainbow has no public works facility, no EOC, and no SCADA which is inaccurate.
- Page 7-2, first bullet says “This target category was discussed…” though the Master Plan does not appear to address that particular discussion, making the reference vague.
- Section 7.3.3 could benefit by reference to the USGS estimate that if the earthen dams on the Willamette River fail from a CSZ quake, the water level of the Willamette River at Eugene might rise 50 feet, depending on stored water volumes at the time of a CSZ quake. It seems prudent that

Springfield and Rainbow's preparedness include consideration of such extensive flooding.

- Thus, Section 7.7 would be more rigorous should it include recommendation to lobby the USACE to harden those dams as well as the earthen dams at Blue River and Cougar reservoirs off the McKenzie River.
- The eastern production is connected to the rest of the system by a single Tier 1 water main, south of Daisy Street. This seems vulnerable.
- Section 8.2 includes the ENR CCI value of 12,771.7. The utility of that value in the absence of context is unclear. While an engineer may know the context, the wider readership is not likely to understand.
- Section 8.4.2, second sentence implies bed replacement on a continuing rolling basis (i.e., each bed replaced every 8 years). That text is appropriate if that replacement frequency is intended.
- Section 8.4.5 is for a new "Pierce well," of which I find only one street named Pierce, located between two bedrock highs. That seems an unlikely location for relatively high groundwater yield.
- Since Master Plans are intended to be comprehensive and are required for SRF funding on a competitive basis in which problems are given priority, it may be useful to mention perfluoroalkyl substances (PFAS) and volatiles detections at low concentrations in the SP and Q Street wells.

Memorandum

Date: December 2, 2021

Project: 16-1889

To: Mr. Greg Miller
Springfield Utility Board

Mr. Jamie Porter, PE
Rainbow Water District

From: Michael L. McKillip, PE
Murraysmith

Reviewed By: Brian M. Ginter, PE

Re: Water System Master Plan, OHA-DWS plan review comments

REGISTERED PROFESSIONAL ENGINEER 65640 OREGON DEC. 29, 2009 MICHAEL L. McKILLIP RENEWS 12/2022

Introduction

The joint Springfield Utility Board (SUB) and Rainbow Water District (RWD) Water System Master Plan (WSMP) was submitted to the Oregon Health Authority (OHA) for plan review pursuant to OAR 333-061 in August 2021. OHA provided plan review comments on November 17, 2021, but did not request plan revisions or resubmittal. This memorandum addresses OHA's plan review comments.

Comment Responses

The OHA plan review comments and responses are enumerated below.

• *The planning period appears to now be effectively through the year 2041 given the plan is not yet final.*

> Noted. Plan was developed to be through 2040 based on the date used to develop the water demand forecasting.

• *Coverage of environmental impacts of infrastructure improvements could be more descriptive. This includes mention of no environmental impacts where no impacts are anticipated.*

> Noted.

• The Lead and Copper Rule (LCR) is in revision. The final rule will assuredly require and [sic] "inventory" of "lead" service lines, which is not mentioned in the Master Plan. The latest LCR revision contains requirements to replace all service laterals if they are of lead or unknown composition within a 33-year window. This could be a significant expense should a large number of service laterals of unknown composition exist.

SUB and RWD have previously investigated the service line ,materials and no lead service lines are known to have been installed.

The proposed rule, which promulgates December 2021, requires an inventory of the utility-owned and customer-owned portion of the service line to include reporting if it is non-lead, lead, or unknown material composition. See CFR 141.84.

• Section 1.6 refers to reservoir operating levels relative to overflow elevation without context as to why this is important or not.

The section states certain reservoirs were recommended to operate at a lower water level "to improve their seismic and structural performance." A lower maximum operating level reduces the hydrostatic pressure on the reservoir walls and provides greater freeboard to accommodate sloshing resulting from an earthquake.

• Figure 1-2 may benefit by displaying the interties with EWEB.

The interties with EWEB are shown on Figure 1-2.

• Section 4.3, 11th paragraph addresses McKenzie River source water protection. It may be worth referring to Eugene Water and Electric Board's source water protection program in the McKenzie River basin, and the benefit of coordinated activities for efficiency of effort.

Noted.

• Section 4.5, 11th paragraph, first and second sentences are not how I understand the process of defining Chase well 2 as Ground Water Under the Influence (GWUDI) of surface water.

Noted. The first two sentences have been revised as follows:

"The RWD considered and rejected applying for Natural Filtration for Chase Well No.2. A replacement well, Chase Well No. 5, was drilled but did not provide the desired yield so design of a filtration system for Chase Well No. 2 was initiated in late 2015."

• Section 4.5, 13th paragraph, last sentence presumes specific treatment technologies for a hypothetical scenario. That seems overly specific for a hypothetical, especially when other treatment possibilities exist.

Noted. SUB considered the available treatment technologies and opted to identify a specific treatment technology in the plan in order to aid their understanding of future project effort and budgeting.

• *Section 4.5, 17th paragraph, first sentence states the filters are sub-micron, which is incorrect given that validation was conducted with 2-micron particles.*

Noted.

• *Section 4.10, 13th paragraph, 8th sentence says goosenecks are required to be removed. The current version of the rule only requires removal if the service connection has an Action Level exceedance. The latest LCR revision does not consider lead goosenecks to be a "lead service line," though DWS recommends they be replaced where known or found.*

This could be clarified in the text. Under current rules, the utility service connection, or "gooseneck" is only required to be replaced if a service connection has lead levels above the action level. SUB has replaced all lead goosenecks when found. RWD is not aware of any lead gooseneck connections in its system. For homes in the SUB/RWD service areas, with unknown service connection material, no lead levels were detected above the action level threshold.

SUB has previously compiled a list of services with potential lead goosenecks and has investigated those and replaced any that were found. This work is on-going, but not required under the LCR.

RWD has also previously compiled a list of possible lead "goosenecks" and has investigated those.

• *Section 4.13 addresses secondary standards of which manganese may be changed to a primary standard by EPA, a point worth mentioning.*

Noted.

• *Section 4.17, 3rd paragraph states "do not need to," inaccurately implying no regulatory requirement to issue public notice.*

This could be reworded for clarity. SUB and RWD are required to notify OHA and customers of Tier 1, Tier2 and Tier 3 violations. Historically SUB and RWD have not had many of those violations and hence have not issued many public notices.

• *Section 4.21 Summary of Recommendations would be more complete with mention of draft Lead and Copper Rule revisions, such as the probable requirement to create Lead Service Line (LSL) inventories.*

Noted. SUB and RWD have already previously investigated the service line materials and no LSLs are known to have been installed.

• *Table 6-1 double counts the Weyco water production (once for SUB, once for Rainbow).*

The Weyco facilities are not double counted. SUB and RWD each have 1.44 MGD in capacity at the facility.

• *Figure 7-1 shades three "SUB-specific assets" for which the meaning is unclear. One interpretation could be that Rainbow has no public works facility, no EOC, and no SCADA which is inaccurate.*

Figure 7-1 is based on an Oregon Resilience Plan figure for timeline to recovery. The blue shading and specific mention of SUB-Specific Assets or Springfield Utility Board will be removed from the table so that it applies to both water utilities.

• *Page 7-2, first bullet says "This target category was discussed…" though the Master Plan does not appear to address that particular discussion, making the reference vague.*

This could be reworded. These bulleted items are categories laid out in the first column of the ORP Target Recovery Goals Table, Figure 7-1, and include brief take-aways from the workshop discussions.

• *Section 7.3.3 could benefit by reference to the USGS estimate that if the earthen dams on the Willamette River fail from a CSZ quake, the water level of the Willamette River at Eugene might rise 50 feet, depending on stored water volumes at the time of a CSZ quake. It seems prudent that Springfield and Rainbow's preparedness include consideration of such extensive flooding.*

While a significant concern, the planning for upstream dam failure is outside the water utilities' master plan purview. This issue is best addressed at the municipal level.

• *Thus, Section 7.7 would be more rigorous should it include recommendation to lobby the USACE to harden those dams as well as the earthen dams at Blue River and Cougar reservoirs off the McKenzie River.*

While a significant concern, the planning for upstream dam failure is outside the water utilities' master plan purview. This issue is best addressed at the municipal level.

• *The eastern production is connected to the rest of the system by a single Tier 1 water main, south of Daisy Street. This seems vulnerable.*

There is also a 12-inch diameter main in Main Street that connects the two portions of the system. Combined with the West and North System supply sources, the western portion of the service area is not reliant on the single 24-inch diameter main for water supply.

SUB has identified and is continuing to look, long-term, at a potential transmission main connecting the North System with the Thurston site facilities (wells and surface water plant) for improved capacity, connectivity and redundancy

• *Section 8.2 includes the ENR CCI value of 12,771.7. The utility of that value in the absence of context is unclear. While an engineer may know the context, the wider readership is not likely to understand.*

It is unclear what further context is needed. The text reads as follows:

"Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating, the current ENR CCI for Seattle, Washington is 12,771.7 (September 2020)."

• *Section 8.4.2, second sentence implies bed replacement on a continuing rolling basis (i.e., each bed replaced every 8 years). That text is appropriate if that replacement frequency is intended.*

Noted. There are 4 beds with a filter media replacement frequency of every 8 years.

• *Section 8.4.5 is for a new "Pierce well," of which I find only one street named Pierce, located between two bedrock highs. That seems an unlikely location for relatively high groundwater yield.*

The future Pierce well, as shown on the Wellhead Protection Areas map, is located southeast of the Briggs Middle School, east of the end of Otto Street on a parks district property referred to as Pierce Park.

• *Since Master Plans are intended to be comprehensive and are required for SRF funding on a competitive basis in which problems are given priority, it may be useful to mention perfluoroalkyl substances (PFAS) and volatiles detections at low concentrations in the SP and Q Street wells.*

Noted.