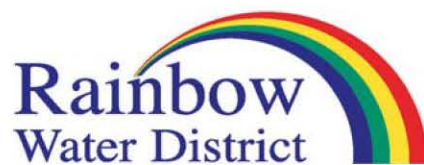
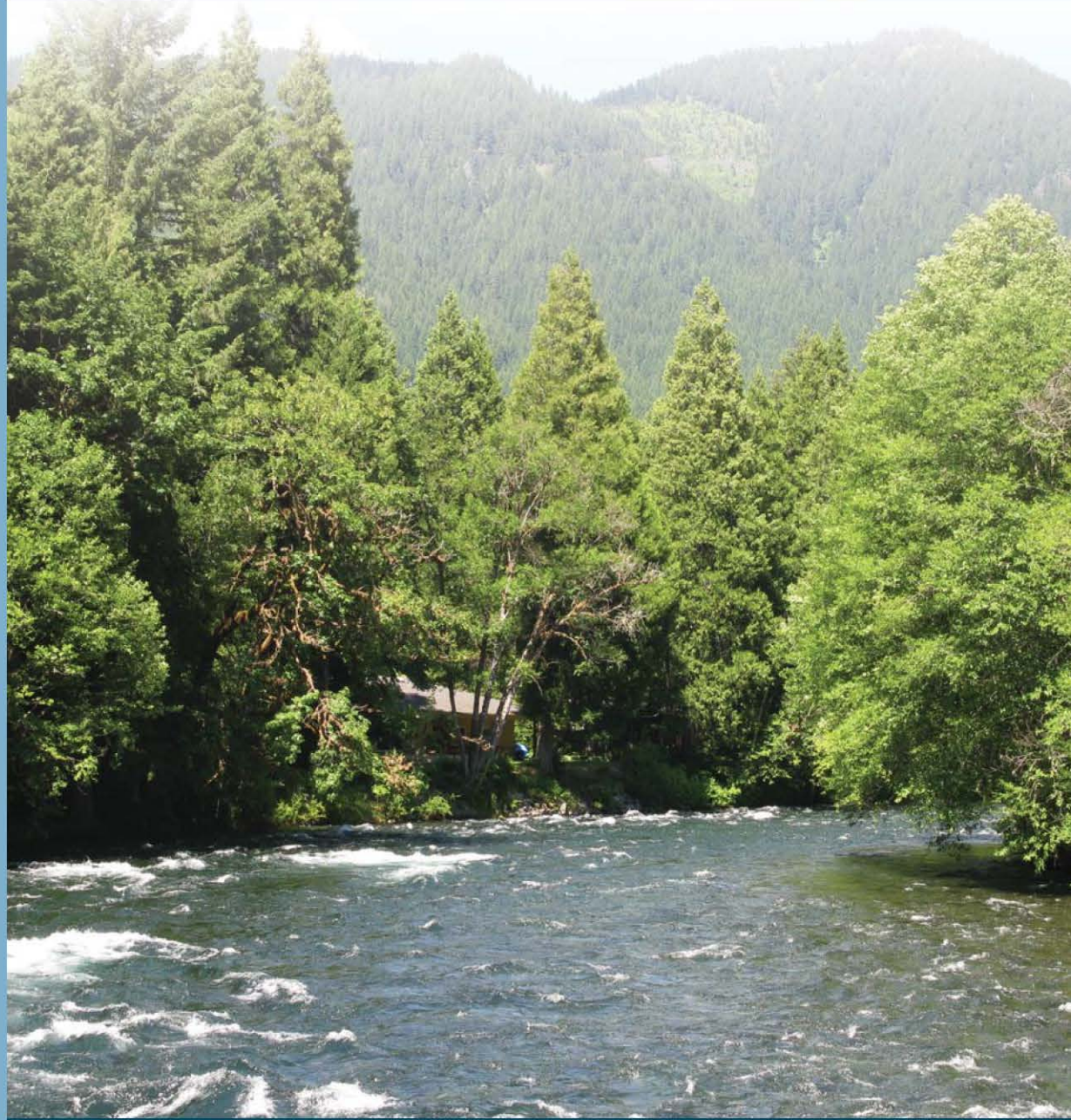


WATER SYSTEM MASTER PLAN



APRIL 2010

WATER SYSTEM MASTER PLAN
FOR
SPRINGFIELD UTILITY BOARD

APRIL 2010



RENEWS 12-31-10



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RENEWS 6-30-11

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EXECUTIVE SUMMARY

Authorization

The consulting firm of Murray, Smith & Associates, Inc. (MSA) was authorized by the Springfield Utility Board (SUB) Board of Directors to assist SUB Water Division staff and Rainbow Water District (RWD) staff in the preparation of an updated Water System Master Plan (WSMP).

Purpose

The purpose of this update is to provide an assessment of SUB's Water System, and to prepare a plan for future water supply, identify deficiencies in the existing system and to recommend improvements needed. This will provide a plan for the future growth within the SUB service area over the next 20 years.

Compliance and Study Period

This WSMP update complies with the water system master planning requirements established under Oregon Administrative Rules (OAR) for Public Water Systems, Chapter 333, Division 61. The study period for this plan is for 20 years, or until the year 2030.

Scope of Work

The scope of work for this master plan includes the following elements:

- Compile and prepare an Existing System Description
- Develop Water Demand Projections
- Review Regulatory Issues
- Prepare a Source Assessment
- Perform a Storage Capacity Evaluation.
- Complete a Transmission System Evaluation
- Prepare a Capital Improvements Plan, Executive Summary and full Water System Master Plan document

Background, Study Area and Study Period

As of July 1, 2008, SUB and RWD served approximately 64,000 people living in Springfield or in the surrounding unincorporated areas. The two utilities currently provide approximately 12.6 million gallons of drinking (mgd) water per day on an average daily basis. During the peak use period in the summer of 2009, the utilities provided approximately 23.5 (mgd), or 16,318 gallons per minute (gpm). The SUB and RWD Systems are divided into the following three service areas:

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

- *North* (or RWD/SUB North, located north of Interstate 105)

Water Sources

SUB and RWD rely on a combination of groundwater and filtered surface water for their source of supply. In 2008, approximately 20 percent of the total supply came from the Willamette Filtration Plant, which has an existing continuous operating production capacity of approximately 6.6 mgd. SUB/RWD also relies on 37 existing groundwater wells located throughout the service area with production capacities ranging from 250 to 2,000 gpm.

Pressure Zones

Each of the three service areas are divided into service levels, or pressure zones, according to ground elevation. The valley floor is referred to as the "First Level" and upper level zones stair-step up in elevation to serve the surrounding hills. Each of the three main services zones are served and supplied through an interconnected system of interties and sources allowing a great deal of operational flexibility.

Storage Reservoirs

RWD owns one reservoir (storage tank), co-owns one with SUB, and SUB owns seven reservoirs. These provide a total of 12.65 million gallons of storage.

Pump Stations and Upper Level Systems

In addition to the supply pumps stations serving the first level system, there are six upper service levels supplied by booster pump stations.

Distribution System

The existing water distribution system is a combination of older, individual distribution systems. The distribution system has historically been designed and operated for supply from multiple sources of water from wells located throughout the system and serving localized areas.

SCADA System

The multiplicity of interconnected systems, sources, and other facilities makes "normal" system operation a complex, dynamic target. The mix of sources changes depending upon time of year, water quality, system demand, routine or emergency operations, etc. A Supervisory Control and Data Acquisition System (SCADA) operating on a SUB-owned fiber optic system monitors and controls all the interconnected systems.

3.2.1 Water Demand

Water Demands

Water demand refers to total water use; that is, the sum of consumption (residential, commercial, public, and industrial) and public uses (for example, fire fighting or hydrant flushing), plus water lost to leakage or evaporation. A given water demand at any one time includes the sum of the production from any operating wells and intakes, plus the outflow from storage reservoirs (or minus the inflow rate into the reservoirs if they are filling). Water demand terms are further quantified and defined as follows:

- *Average Day Demand (ADD)*: total volume of water produced in a year divided by 365 days
- *Maximum Day Demand (MDD)*: maximum volume of water used in any single day of a calendar year
- *Peak Hour Demand (PHD)*: highest hourly use hour during the MDD

Although the MDD and PHD are defined as the highest occurrences throughout a year, values just slightly less, may be recorded a number of times during the months of July and August. The most common units for expressing these demands are million gallons per day (mgd). One mgd is equivalent to 695 gallons per minute (gpm) or 1.55 cubic feet per second (cfs).

Demand Forecasting

The water demand estimates developed as part of this plan were developed through a review and evaluation of historical water use records and are used for several purposes. Maximum Daily Demand (MDD) is used for planning purposes when projecting SUB's water supply and infrastructure needs into the future. Average Daily Demand (ADD) is also evaluated, but planning and operation of the water system centers around the forecasted MDD. Peak Hourly Demand (PHD) is used for analysis of storage needs.

The water demand forecasts used in this study also consider the inclusion of a 10 percent reserve capacity allowance to ensure reliable service in the event of mechanical equipment failure or power outage.

Overall Source Needs

Table ES-1 summarizes maximum day demand projections for the entire SUB system with and without the 10 percent de-rating of source for current and future conditions along with existing source capacity. By the end of the 20 year planning horizon, the overall source deficit will increase to approximately 5.26 mgd with the reserve, or 2.21 mgd without the reserve capacity. Figure ES 1 graphically illustrates anticipated source needs with and without the 10 percent reserve capacity allowance. In the year 2020 the projected MDD equals 90 percent of the available source with the planned addition of 1.4 mgd capacity from Thurston Well No. 2, thus providing a 10 percent reserve.

**Table ES-1
Overall Source Need Summary**

YEAR	MAXIMUM DAY DEMAND w/out Loss Reduction (mgd)	EXISTING SOURCE CAPACITY (mgd)	ADDITIONAL SOURCE NEED, w/ 10% RESERVE (mgd)	ADDITIONAL SOURCE NEED, w/o 10% RESERVE (mgd)
2010	23.54	28.27	--	--
2020	26.96	28.27	--	--
2030	30.48	28.27	5.26	2.21

Conservation

Both SUB and RWD have implemented water conservation measures in recent years. Supply side measures include implementation of a comprehensive leak repair program. Demand side measures include public education programs, incentive rates, and other measures. SUB and RWD are also actively seeking methods to reduce the effects of peak hour demands. An example of this is a public education program advising people to irrigate during the off peak hours. Both utilities plan to continue ongoing conservation programs. These programs and conservation efforts are described in more detail in the recently updated Water Management and Conservation Plan.

Un-Accounted for Water

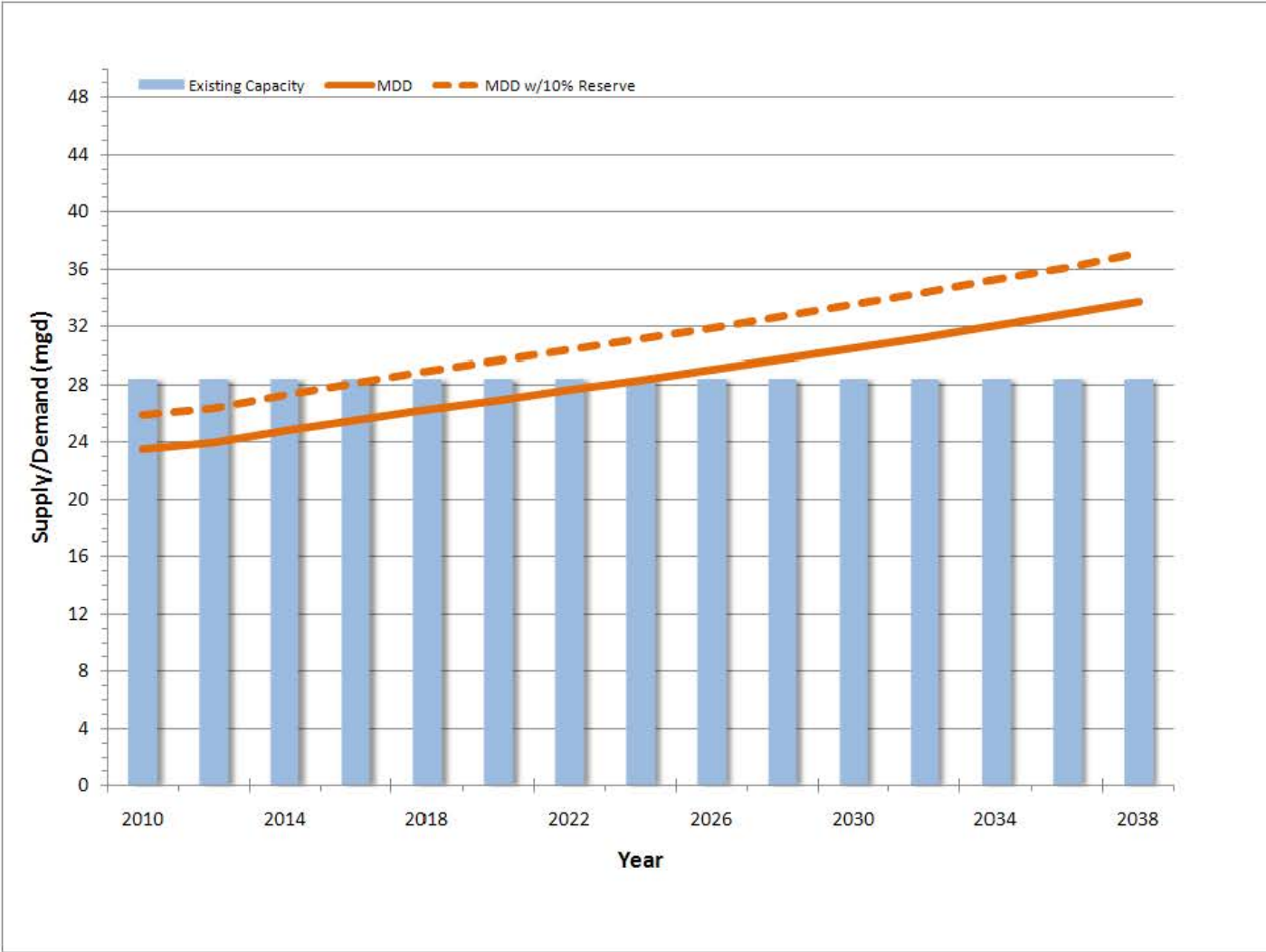
Based on current water production and billing records, SUB/RWD has rates of un-accounted for in the range of 23 to 28 percent. Specifically, the rate was 28 percent in 2003, 23 percent in 2005, and climbed back up to 28 percent in 2008. SUB/RWD maintains the goal of achieving a maximum water loss of rate of 15 percent before the end of the 20-year planning horizon. Recommendations to achieve this goal are presented in the Capital Improvement Program (CIP) presented in Section 8.

Water Quality

Section 4 of the Master Plan includes a comprehensive review and discussion of water quality regulations and how these regulations impact SUB and how SUB consistently meets these regulatory standards. These rules and regulation include the following:

- Oregon Department of Human Services, Drinking Water Program Regulations
- Drinking Water Protection
- Surface Water Treatment Rule
- Interim Enhanced Surface Water Treatment Rule (IESWTR); Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR); and Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

Figure ES-1
Overall Source Need



- Disinfectants/Disinfection By-Products Rule
- Total Coliform Rule
- Groundwater Rule
- Lead and Copper Rule
- Synthetic Organic Chemicals and Inorganic Chemicals
- Volatile Organic Compounds
- Arsenic
- Sulfate
- Fluoride
- Radon/Radionuclides
- Chlorine Handling Requirements

Key water quality recommendations are summarized as follows:

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. As part of the new Groundwater Rule, move each source from triggered source monitoring to compliance monitoring after installing chlorine residual analyzers at the end-of-detention location for each wellfield
3. Develop a schedule for identifying services with lead fittings and their replacement
4. Continue to be vigilant in efforts to monitor for contaminants, monitor chemical uses, require protective measures for chemical storage and use, insist on appropriate clean up where contaminants are discovered in the aquifer. Also support state and federal agencies efforts to reduce contaminant risks in drinking water supply areas
5. Continue periodic monitoring for VOCs in the SP No. 2 monitoring well and work with DEQ to determine the source of this contamination
6. Begin evaluation of conversion from chlorine gas disinfection to liquid hypochlorite disinfection.

Analysis Criteria

The system was analyzed based on detailed water system performance criteria as documented in Section 5. Performance criteria were developed for storage volume need and pumping capacity requirements. Also developed were distribution system analysis criteria, service pressure criteria, fire flow criteria and a discussion of hydraulic modeling conditions.

Storage Criteria Methodology Overview

A general review of local and regional approaches to establishment of water storage requirements was completed to determine the most appropriate methodology to apply to the SUB's water system. Two specific approaches were identified for consideration:

- Method No. 1 – Three-Component Methodology
- Method No. 2 – Washington State Department of Health Methodology

A detailed discussion of these methodologies and their application to the SUB/RWD system is presented and summarized in Section 5. Through this evaluation Method 2 was the recommended approach for the analysis of SUB/RWD's storage needs.

Hydraulic Modeling Analysis

The existing water distribution system was analyzed using a digital hydraulic model specifically developed and calibrated to represent the existing water system. Modeling scenarios were developed to reflect system performance requirements under peak hour conditions and under MMD conditions with a concurrent fire flow event.

Supply Source Analysis

A source analysis was completed to evaluate water needs for the entire system as well as supply requirements for the North, East and West systems. This analysis includes consideration of existing groundwater sources and focuses on the development of additional surface water supplies from the Willamette River and the McKenzie River. Both sources have water rights with varying degrees of development. Alternative No. 1, the McKenzie River Supply source will require construction of a raw water intake and treatment of surface water, including at a minimum filtration and disinfection, as well as new transmission facilities. Development of Alternative No. 2, the Willamette River Supply source up to the total water right quantity will require expanded intake facilities either as a raw water intake on the river or a collector well as well as expanded treatment facilities. Future treatment of a major expansion of the Willamette River source is anticipated to be achieved using technology other than slow sand filtration, such as membrane filtration. This assumption is made given the industry accepted limitations of slow sand filtration and observation of performance and operation of this technology by SUB.

Evaluation Criteria

Eight criteria have been developed to assist with the evaluation of the two major supply source alternatives. Scoring for each criteria are from 1 to 3, with 1 being the lowest, or least favorable score, and 3 being the highest, or most favorable score. These criteria are listed below.

- Project Cost for Transmission System Improvements, Storage Capacity Improvements and Treatment Capacity Improvements
- Broader System Benefit
- Property Acquisition, Siting and Land Use/Permitting
- Source Redundancy.
- Flexibility of Implementation
- Regional Partnership Opportunity
- Protection of Undeveloped Surface Water Rights
- Raw Water Quality

Weighting

Each of the scoring criteria discussed above may have differing degrees of importance, or weight. Criteria are weighted on a scale of 1 to 3, with criteria considered as more important having a weighting of 3 and those of less importance a weighting of 1. Table ES-2 summarizes and initial screening and criteria weighting of the two alternatives.

Based on the scoring analysis presented above Alternative 1, the McKenzie River supply option, earned a slightly higher raw score and weighted score.

Potential Interim Source Expansions

Given the anticipated need for development of expanded source capacity to meet growing system needs and the significant capital cost and timeline associated with development of the two major source options, SUB has identified potential, smaller capacity supply expansions to meet near term supply needs. These options will be considered further in light of demand considerations, cost, and timing in Section 8. These options include:

- The use of Thurston Well No. 2, with the addition of ultraviolet disinfection, for an increase in source capacity of approximately 1.40 mgd.
- The addition of a fifth filter bed at the Willamette Slow Sand Filter to increase overall capacity by approximately 2.2 mgd.
- The addition of a small increment of another treatment technology at the Willamette Wellfield, such as membrane filtration, which was shown to be effective in the study “Water Treatment Evaluation Alternative Technologies Report” by Black & Veatch, December 2008.

Distribution System Piping Analysis

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The computerized model of the City’s water system uses the KYPipe hydraulic network analysis software. 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 on the established planning criteria. The three service areas of the SUB/RWD system were each analyzed and service area specific recommendations developed for each area.

**Table ES-2
Scoring Summary**

CRITERIA	CRITERIA WEIGHTING FACTOR	ALTERNATIVE 1 – MCKENZIE RIVER SUPPLY		ALTERNATIVE 2 – WILLAMETTE RIVER SUPPLY	
		RAW SCORE	WEIGHTED SCORE	RAW SCORE	WEIGHTED SCORE
Project Cost					
▪ <i>Transmission System Improvements</i>	3	1	3	3	9
▪ <i>Storage Capacity Improvements</i>	3	3	9	1	3
▪ <i>Treatment Capacity Improvements</i>	3	2	6	2	6
Broader System Benefit	2	3	6	1	2
Property Acquisition, Siting and Land Use/Permitting	1	2	2	2	2
Source Redundancy	2	3	6	1	2
Flexibility of Implementation	1	1	1	3	3
Regional Partnership Opportunity	3	1	3	3	9
Protection of Undeveloped Surface Water Rights	3	3	9	1	3
Raw Water Quality	1	3	3	3	3
	Total	22	48	20	42

Storage Analysis Summary

Table ES-3 summarizes the recommended additional storage volume need by system for the year 2030 for the two long-term water supply alternatives.

**Table ES-3
Storage Volume Requirement Summary – Year 2030**

SYSTEM	SOURCE ALTERNATIVE 1 MCKENZIE RIVER	SOURCE ALTERNATIVE 2 WILLAMETTE RIVER
West	0	5.5
North	0	0
East	0	0
Total	0	5.5

The results of this analysis should be used to inform the selection of long-term water supply sources and the analysis of transmission needs. Recommended storage needs by system should be based on the selected supply source. Recommendations for siting and configuring new storage facilities are presented later in this report based on the outcome of source and transmission analysis. Upper level storage needs were also analyzed and recommendations developed to meet specific needs.

Recommended Capital Improvement Plan

Recommended water system improvements were developed based on the analysis and findings presented in the full planning document. Recommendations were developed for supply sources, reservoirs, transmission system water lines and other facilities improvements. Recommendations were also developed for ongoing programs. All proposed transmission system improvements are illustrated in this Executive Summary as Figure 8-1. Planning level project cost estimates were prepared for all recommended improvements and programs presented in the master plan. These estimates are developed at a conceptual level and include contingencies. The estimated costs included in this plan are planning level budget estimates presented in 2010 dollars. 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 recent ENR CCI for Seattle, Washington is 8645 (January 2010).

Reservoir Improvements

As previously presented, the need for additional finished water storage capacity is highly dependent on future supply expansion decisions. For the purposes of this plan, it is assumed that SUB will pursue development of the Willamette River supply and that future development of supply from the McKenzie River will be beyond the 20-year planning horizon. Under this approach an additional 5.5 million gallons (mg) of storage is recommended for construction in the West system. The estimated project cost of this improvement is \$8.2 million. It is recommended that preliminary siting of this storage facility be completed in the in 2011 and the construction of a new 5.5 mg reservoir be planned for 2020

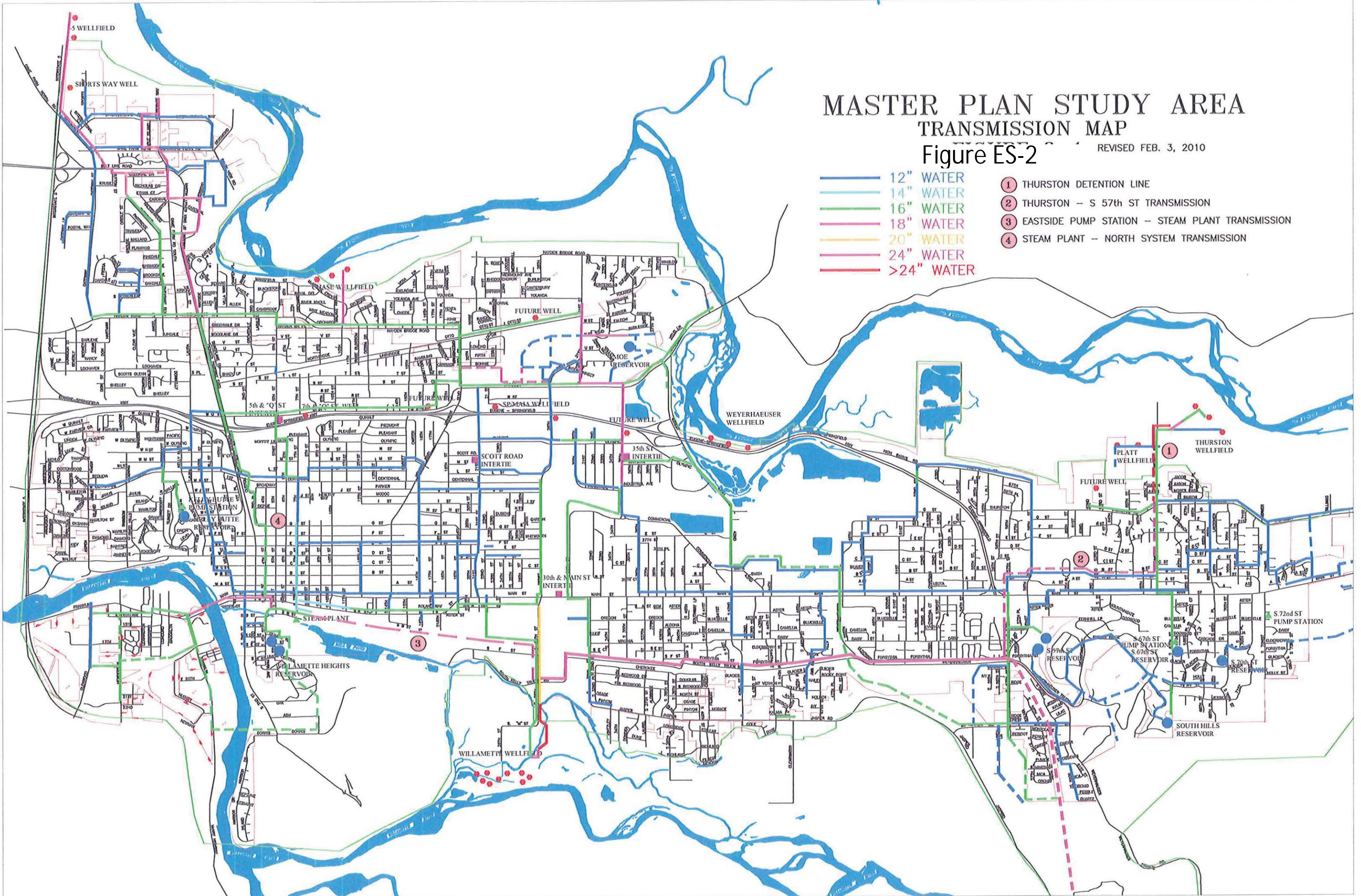
MASTER PLAN STUDY AREA TRANSMISSION MAP

Figure ES-2

REVISED FEB. 3, 2010

- 12" WATER
- 14" WATER
- 16" WATER
- 18" WATER
- 20" WATER
- 24" WATER
- >24" WATER

- ① THURSTON DETENTION LINE
- ② THURSTON - S 57th ST TRANSMISSION
- ③ EASTSIDE PUMP STATION - STEAM PLANT TRANSMISSION
- ④ STEAM PLANT - NORTH SYSTEM TRANSMISSION



Transmission and Distribution System Improvements

The water system analysis found that transmission system improvements are needed to provide improved hydraulic transmission capacity within the distribution system. Table ES-4 lists the recommended improvements in each system.

**Table ES-4
Recommended Transmission System Improvement Summary**

SYSTEM	PROJECT DESCRIPTION	SIZE (IN)	LENGTH (FT)	ESTIMATED COST
West	Willamette Detention-Millrace Crossing	36	350	\$ 210,000
West	Eastside Pump Station-Steam Plant	24	9500	2,700,000
West	Steam Plant-North System	16	5180	1,900,000
East	Thurston Detention	36	2200	1,300,000
East	Thurston Road-S 57 th St	36	9000	3,660,000
North	Mohawk Marketplace	24	2000	600,000
TOTAL				\$10,370,000

Water Main Replacement Program

In addition to the above transmission system improvements, SUB has implemented the following three programs for improvements to the distribution system;

1. Replacement of failing distribution system mains
2. Leak detection and repair
3. Systematic replacement of customer meters

The estimated annual cost of these programs is approximately \$400,000. It is recommended that these programs remain in place and continue.

Supply Source Improvements

As previously presented 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. Opportunities exist to expand the capacity of existing facilities to meet short-term needs. Longer-term water supply needs will require major capital investment through the development of new surface water supply facilities. Recommended short-term improvements included the following:

1. Install ultraviolet disinfection (UV) facilities at Thurston Well No. 2. The estimated project cost for this improvement is \$153,500 and it is recommended that this improvement be completed in FY 2011.

2. Expand the Willamette Slow Sand Filter Plant. It is recommended that this improvement be completed in 2016. SUB has estimated the cost of this improvement to be approximately \$550,000.

SUB is also currently planning, designing and constructing improvements to address Lead and Copper Rule compliance through corrosion control of the source water at the major wellfields. These improvements are planned for implementation over three years, 2010-2012, at Willamette, Thurston and Weyerhaeuser Wellfields. The estimated project cost for these improvements is approximately \$1 million per year, or \$3 million dollars total.

To meet long-term water supply needs, SUB has acquired water rights and completed preliminary planning for construction of new surface water supply and treatment facilities on the Willamette River at the Willamette Wellfield site and on the McKenzie River at the Thurston Wellfield site. As discussed in Section 6, the ultimate decision to develop one of these two sources to meet needs over the 20-year planning horizon depends on a number of factors. The expected capital cost of the two alternatives is anticipated to be similar. This 20-year CIP includes the cost of developing river intake and treatment facilities for one of these two source options with an initial capacity of 6 mgd planned for FY 2019 and a future incremental expansion for an additional 4 mgd planned for FY 2030. The estimated project cost for these two improvements is \$14,500,000 and \$8,000,000, respectively.

Funding Sources

SUB may fund the water capital maintenance and improvement programs from a variety of sources. In general, these sources can be summarized as:

1. Governmental grant and loan programs
2. Publicly issued debt
3. Cash resources and revenues

It is expected that SUB will fund all of the projects presented in this CIP over the next ten years from cash resources and revenues. The other two source funding mechanisms are identified for consideration for major capital improvements planned beyond the year 2020.

Study Recommendations

It is recommended that the SUB and RWD take the following actions:

1. Formally adopt this study as the Springfield Utility Board's and the Rainbow Water District's Water System Master Plan.
2. Adopt the prioritized recommended system improvements described in Section 8 and specifically listed in Table ES-5 as the formal Capital Improvement Program for

the water service area.

3. Review and update this plan within seven (7) to 10 years or sooner, to accommodate changes or new conditions.

Summary

The water system master planning work completed as part of this study provided an inventory of the SUB/RWD existing water supply and distribution system, developed and presented criteria for the system analysis and developed recommendations from these findings to correct existing deficiencies and to provide for system expansion needs. A summary of all the recommended improvements is presented as Table ES-5. The table provides for prioritized project sequencing by illustrating fiscal year (FY) of project need for each facility or improvement category. It is recommended that SUB's CIP be based on the consideration of the principles of the Master Plan and the updated 10-year cash flow plan. The actual CIP will be based on actual need and financial pacing of capital dollars.

Table ES-5
Capital Improvement Program Summary

Category	Project Description / Location	CIP Schedule and Project Cost Summary by Fiscal Year																				Estimated Project Cost ¹			
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029		2030	Long Term	
Source and Treatment	Thurston Well No. 2 UV Disinfection		\$ 153,500																					\$ 153,500	
	Expand Willamette SSF Plant							\$ 550,000																\$ 550,000	
	Long-Term Source Development										\$ 14,500,000											\$ 8,000,000		\$ 22,500,000	
	Corrosion Control Improvements	\$ 987,000	\$ 1,208,600	\$ 963,900																					\$ 3,159,500
	Subtotal	\$ 987,000	\$ 1,362,100	\$ 963,900	\$ -	\$ -	\$ -	\$ 550,000	\$ -	\$ -	\$ 14,500,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,000,000	\$ -	\$ 26,363,000
Storage Reservoirs	West System - 5.5 mgd		\$ 20,000														\$ 8,820,000							\$ 8,840,000	
	Subtotal	\$ -	\$ 20,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,820,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,840,000
Transmission and Distribution System Improvements	Willamette Detention-Millrace Crossing	\$ 210,000																						\$ 210,000	
	Thurston Detention		\$ 1,300,000																					\$ 1,300,000	
	Mohawk Marketplace			\$ 600,000																				\$ 600,000	
	Thurston Rd - S 57th Transmission				\$ 960,000	\$ 1,200,000	\$ 1,500,000																	\$ 3,660,000	
	Eastside P.S. - Steam Plant							\$ 1,350,000	\$ 1,350,000															\$ 2,700,000	
	Steam Plant - North System									\$ 600,000	\$ 750,000	\$ 550,000												\$ 1,900,000	
																								\$ -	
	Subtotal	\$ 210,000	\$ 1,300,000	\$ 600,000	\$ 960,000	\$ 1,200,000	\$ 1,500,000	\$ 1,350,000	\$ 1,350,000	\$ 600,000	\$ 750,000	\$ 550,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 10,370,000
Other	Water Main Replacement	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 6,300,000	
	Leak Detection & Repair	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 2,100,000	
	Supply Source Reliability	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 525,000	
	Water Master Plan Update						\$ 100,000						\$ 100,000												\$ 200,000
	WMCP Update						\$ 40,000						\$ 40,000												\$ 80,000
	Subtotal	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 565,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 565,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 9,205,000
Total	\$ 1,622,000	\$ 3,107,100	\$ 1,988,900	\$ 1,385,000	\$ 1,625,000	\$ 2,065,000	\$ 2,325,000	\$ 1,775,000	\$ 1,025,000	\$ 15,675,000	\$ 1,115,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 9,245,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 8,425,000	\$ -	\$ 54,778,000	

¹ Cost estimates are based on an Engineering (ENR) construction cost index of 8645 for Seattle, Washington (January, 2010).

5 Year Total	\$9,728,000
Annual Average	\$1,945,600

7 Year Total	\$14,118,000
Annual Average	\$2,016,857

10 Year Total	\$32,593,000
Annual Average	\$3,259,300

15 Year Total	\$35,408,000
Annual Average	\$2,360,533

20 Year Total	\$46,353,000
Annual Average	\$2,317,650

SECTION 1

INTRODUCTION

1.1 Authorization

The consulting firm of Murray, Smith & Associates, Inc. (MSA) was authorized by the Springfield Utility Board (SUB) Board of Directors to assist SUB Water Division staff and Rainbow Water District (RWD) in the preparation of an updated Water System Master Plan (WSMP).

1.2 Purpose

The purpose of this update is to provide an assessment of SUB's Water System, and to prepare a plan for future water supply, identify deficiencies in the existing system and to recommend improvements needed. This will provide a plan for the future growth within the Springfield Utility Board service area over the next 20 years.

The 1999 Water System Master Plan was completed by CH2M-Hill Inc. and was used as the basis for this update. New data representing water demand, water production capabilities and the completion of new facilities since 1999 have been analyzed and incorporated into this update. New storage and supply source evaluations and analyses reflect updated planning data and criteria in this plan update.

In accordance with the 1992 Withdrawal and Operations Agreement, and the 1995 Urban Water Service Agreement between Rainbow Water District (RWD) and the Springfield Utility Board, future annexations of land within the Springfield Urban Growth Boundary (UGB) will be served by SUB. For this reason, all lands inside the UGB, including existing RWD customers, are included in the Water Master Plan. The RWD and SUB staff have traditionally cooperated on Master Planning, and have treated the SUB/RWD North System as one planning unit, due to the co-mingling of source, storage and distribution facilities. RWD has provided data for customer demands and source capabilities within the RWD service area.

1.3 Compliance

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

1.4 Scope of Work

The scope of work for this update includes the following tasks:

- **Existing System Description** – Prepare an inventory of existing water system facilities including water rights, source, treatment, storage, pumping and transmission facilities.
- **Demand Projections** – Review water demand projections recently developed for SUB’s Water Management and Conservation Plan and population forecasts developed by the Lane Council of Governments. As part of the review assess water use characteristics and projection criteria. Update long-range water demand forecasts.
- **Regulatory Issues** – Prepare a summary of major drinking water regulations affecting the SUB water system. The summary includes the history and status of each regulation as well as operational, monitoring or capital improvements currently in place or required to meet the regulation. Document current regulatory compliance programs and summarize water system water quality goals.
- **Source Assessment** – Review current source capacity relative to demand projections and assess overall source needs relative to available reserve capacity. Prepare descriptions of current sources and water rights, and identify source alternatives previously analyzed. Develop a recommended source plan. This source plan will include recommended source capacity needs, potential source development options, fatal flaw analysis, and conceptual cost estimates. Potential source treatment facility locations will be identified for assessment of transmission system needs.
- **Storage Capacity Evaluation** – Prepare criteria for analyzing storage needs based on AWWA guidelines and criteria applied by similar sized communities in the region. Of specific interest is the analysis of emergency storage needs based on supply redundancy and risk. Develop recommended storage need criteria for existing and future conditions. Develop project cost estimates for proposed reservoir improvements based on the most appropriate material of construction. Identify recommended reservoir locations.
- **Transmission System Evaluation** – Analyze the SUB transmission system to assess hydraulic capacity for delivery of water supply from treatment facilities and storage reservoirs to meet system demands including fire suppression flow needs.
 - Review the existing KYPIPE hydraulic model, data sets and calibration, to evaluate the suitability of this model for master plan level analysis
 - Develop criteria for assessment of the system based on previous SUB criteria, industry standards and typical criteria used throughout the region
 - Develop hydraulic modeling scenarios to analyze hydraulic capacity under existing and future conditions

- Identify potential system improvements for analysis, which may address system deficiencies
- Perform a computerized hydraulic network analysis using the SUB water system model to determine existing and future deficiencies and analyze potential transmission system improvements.
- **Capital Improvements Plan** – Recommended supply source and distribution system improvements will be organized and developed into a detailed and comprehensive water distribution system Capital Improvements Plan (CIP). The recommended improvements will be categorized as meeting immediate (1 to 5 years), short-term (6 to 10 years), medium-term (10 to 20 years), or long-term (beyond 20 years) needs. Project cost estimates will be developed for all recommended transmission main capital improvements. A water system plan map will be developed showing the existing system as well as the location and size of recommended system improvements and facilities.
- **Executive Summary** – Compile and review all other elements of the document and prepare an Executive Summary for the WSMP.

SECTION 2

EXISTING WATER SYSTEM

2.1 General

As of July 1, 2008, SUB and RWD served approximately 64,000 people living in Springfield or in the surrounding unincorporated areas. The two utilities currently provide approximately 12.6 million gallons of drinking (mgd) water per day on an average daily basis. During the peak use period in the summer of 2009, the utilities provided approximately 23.5 (mgd), or 16,318 gallons per minute (gpm).

Figure 2-1 at the end of this section is a diagrammatic representation of the SUB and RWD water systems.

2.2 Background, Study Area and Study Period

The SUB 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 the 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

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

- *West* (downtown Springfield and Glenwood, located south of Interstate 105 and west of the railroad tracks near 28th Street)
- *East* (located east of the 28th Street railroad tracks)
- *North* (or RWD/SUB North, located north of Interstate 105)

Customers in the West and East Systems are served only by SUB. RWD/SUB North is served jointly by SUB and RWD. The three areas are interconnected with existing piping at certain locations. And while water can be transmitted from one area to another, the areas represent distinct operating systems within the service area. The RWD/SUB North system and SUB East system operate at similar hydraulic grade lines (HGL), as measured in feet of water. Most of the SUB West system operates at a hydraulic grade that is approximately 70 feet, or 30 pounds per square inch (psi) of pressure, lower than the East or North systems. SUB maintains a lower pressure in the West System to minimize leakage from older distribution mains and to reduce pumping costs.

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 2030.

2.3 Water Sources

SUB and RWD rely on a combination of groundwater and filtered surface water for their source of supply. In 2008, approximately 20 percent of the total supply came from the Willamette Filtration Plant, which has an existing continuous operating production capacity of approximately 6.6 mgd.

2.3.1 Water Rights Summary

Table 2-1 is a tabulation of existing water rights held by SUB and RWD. Existing groundwater has been extensively developed in the area and will continue to provide an excellent source of drinking water in the future. A detailed discussion of water supply needs and the likely need for new surface water source development from the Willamette and McKenzie Rivers is presented in Section 6. As shown in Table 2-1, SUB holds water rights for each of these sources.

**Table 2-1
SUB/RWD Water Right Summary**

UTILITY	SOURCE	SERVICE AREA	WATER RIGHT (mgd)	DEVELOPED (mgd / percent)
SUB	Thurston/Platt Wells	East	11.35	4.75 / 42
SUB	Thurston Surface	East	23.16	0.00 / 0
SUB	SP/Maia Wells	East	2.87	2.59 / 90
SUB	Sports Way Well	North	2.88	2.88 / 100
JOINT	Weyerhaeuser Wells	East (50%) North (50%)	4.70	3.46 / 73
SUB	Willamette Wells	West	19.71	6.6 / 33
SUB	Willamette Surface	West	10.08	6.6 / 65
RWD	I-5	North	4.85	3.75 / 77
RWD	Chase	North	5.10	3.38 / 66
RWD	Q Street	North	1.01	0.86 / 85

2.3.2 Supply Wells

The supply wells are primarily located to the northwest, northeast, and south of the service area. SUB owns 27 wells and RWD owns seven (7) wells. In addition, SUB and RWD jointly own three (3) wells. The combined developed capacity of the wells is approximately 28.27 mgd (19,600 gpm). The production capacity of the individual wells ranges from 250 gpm (0.36 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. A carbon filtration plant was constructed at the Weyerhaeuser Wellfield to remove any organic chemicals that may reach the three wells northwest of the International Paper Mill.

2.3.2 Willamette Filtration Plant (SUB West)

The intake for the Willamette Filtration Plant is located on the middle fork of the Willamette River. It uses a slow-sand, biological process to filter a blend of river water from the intake and groundwater from 15 shallow wells that are adjacent to the river.

Chlorine is fed to all of the water leaving the treatment plant. Following chlorination, water travels to the Eastside Pump Station and enters the SUB West system or is boosted in pressure and sent to the East system.

2.4 Pressure Zones

Each of the three service areas are divided into service levels, or pressure zones, according to ground elevation. The valley floor is referred to as the "First Level" and upper level zones stair-step up in elevation to serve the surrounding hills. Table 2-2 summarizes the pressure zones in each of the systems.

**Table 2-2
Pressure Zone Summary**

SYSTEM	SERVICE LEVEL	CONTROLLING STATIC HGL (ft)	CONTROLLING HGL SOURCE	GROUND ELEVATION RANGE SERVED (ft)
West	First Level – Lower	670	Steam Plant PRV	≤ 570
	First Level – Upper	670	Willamette Heights Reservoir	≤ 570
	Glenwood	615	Glenwood Intertie PRV	≤ 570
	Second Level	820	Willamette Heights Pump Station	560 - 680
East	First Level	670	S. 57th Street/S. 67th Street Reservoirs	≤ 570
	Second Level	765	S. 70th Street Reservoir	570 - 670
	Third Level	980	South Hills Reservoir	670 - 870
	Fourth Level	1160	Future	1050
	Fifth Level	1340	Future	1230
North	First Level	670	Moe and Kelly Butte Reservoirs	≤ 570
	Second Level	740	Kelly Butte Pump Station	570 - 650

North System

The North System is supplied by RWD wells along I-5, a well at 7th and "Q" Street, two wellfields along the McKenzie River; Chase and Weyerhaeuser (WEYCO), and a SUB's Sports Way Well. The WEYCO Wellfield is owned 50 percent by SUB and 50 percent by RWD. The WEYCO Wellfield includes granular activated carbon filtration (GAC) treatment facilities. The North System has limited supplemental supply through an intertie with SUB's East System (28th & Olympic).

The North system supply facilities directly supply the reservoirs through the distribution system and well pumps are staged on and off in response to reservoir level.

West System

SUB's West System is supplied predominately by the Willamette Filtration Plant, with additional sources, from two interties with the North System (5th & "Q" and Scott Road), and an intertie with SUB's East System through a control valve station at the Eastside Pump Station.

Glenwood is supplied by SUB's West System through the Glenwood Intertie. Glenwood also has an emergency supply from EWEB through the 22nd & Henderson Intertie.

Water produced at the Willamette Slow Sand Filtration Plant (SSFP) is pumped directly to the West System. Water from the West System is re-pumped at the Steam Plant Pump Station to the Willamette Heights Reservoir. The pumps at this station are controlled by variable frequency drives (VFDs) to maintain constant system pressure during widely varying demands. When the Willamette Heights Reservoir reaches a preset low level, the Steam Plant Pump Station pumps water from the West System to fill the reservoir. The Steam Plant pump units vary speeds to maintain a suction pressure of 50 pounds per square inch (psi). When the Willamette Heights Reservoir is full the Steam Plant Pump Station shuts down and the Willamette Heights Reservoir then feeds the West System through a pressure reducing valve (PRV) station at the Steam Plant. This PRV is set to maintain 50 psi downstream.

East System

SUB's 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 WEYCO Wellfield through an intertie with the North System (35th St). The East System is also supplied by the surplus capacity in the West System through the Eastside Pump Station and a limited supply through an intertie with SUB's North System (28th & Olympic).

In the East the reservoirs are filled directly from the wellfields through the distribution system. Well pumps are automatically staged on and off in response to reservoir level.

The West System's SSFP operates at a fixed flow determined by the plant operator. When the Steam Plant pump(s) are off, the Eastside Pump Station pumps modulate through VFD-control to maintain constant pressure in the SUB West System with excess capacity going to the SUB East System.

2.5 Storage Reservoirs

RWD owns one reservoir (storage tank), co-owns one with SUB, and SUB owns seven reservoirs. These provide a total of 12.65 million gallons of storage. Table 2-3 presents a summary of these existing reservoirs and shows location, system and level served, capacity, and floor and overflow elevations.

**Table 2-3
Storage Facility Summary**

RESERVOIR NAME	SYSTEM SERVED	CAPACITY (mg)	FLOOR ELEVATION (ft)	OVERFLOW ELEVATION (ft)
Willamette Heights	West	2.0	640	668
Kelly Butte	North	1.0	630	670
Moe	North	4.0	620	670
S. 57th Street No.1	East	1.0	640	670
S. 57th Street No.2	East	1.5	640	670
S. 67th Street	East	1.5	640	671
S. 70th Street	East – Second Level	0.15	733	765
South Hills	East - Third Level	1.5	953	980

2.6 Pump Stations and Upper Level Systems

In addition to the pumps stations previously described in the first level system, there are six upper service levels supplied by booster pump stations.

- A small portion of the West System south of the Springfield Millrace is served directly from a booster pump station at the Willamette Heights Reservoir. These constant speed pumps operate continuously to supply pressure to approximately 40 residences.
- In the North System, Kelley Butte Pump Station operates in a similar manner to provide service to approximately 70 residential customers.
- In the East system, Jasper Meadows Pump Station serves approximately 80 residential services with VFD controlled pump units.
- The S. 72nd Street and S. 67th Street Pump Stations serve the second and third service levels in the East system. 67th Street Pump Station pumps from the

adjacent reservoir and 72nd pumps from the distribution system. Both are used to fill upper-level storage facilities.

Table 2-4 presents a tabulated summary of these existing pump stations.

**Table 2-4
Existing Pump Station Summary**

STATION	FLOW (gpm)	FLOOR ELEVATION (ft)	NOMINAL DISCHARGE (psi)
Willamette Heights		636	90
Pump No. 1	150		
Pump No. 2	150		
Kelly Butte		630	50
Pump No. 1	75		
Pump No. 2	75		
Pump No. 3	30		
Jasper Meadows		560	70
Pump No. 1	50		
Pump No. 2	160		
Pump No. 3	160		
South 67th		638	73
Pump No. 1	700		
Pump No. 2	700		
South 72nd		554	70
Pump No. 1	250		
Pump No. 2	250		
Eastside (Transmission Pumping)		473	82
Pump No. 1	3,500		
Pump No. 2	3,500		
Steam Plant (Transmission Pumping)		459	85
Pump No. 1	1,800		
Pump No. 2	3,000		

2.7 Distribution System

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 has seen the long-term need to develop larger capacity, "single point" sources of water from filtration plants on the Willamette and McKenzie Rivers, larger diameter piping

improvements have been made that strengthen the transmission capacity within of the water distribution system. An example of this is the 24 inch diameter transmission main recently constructed between S. 28th Street and S. 57th Street to transmit water from the Willamette Filter Plant in the West System to the East System.

2.8 SCADA System

The multiplicity of interconnected systems, sources, and other facilities makes "normal" system operation a complex, dynamic target. The mix of sources changes depending upon time of year, water quality, system demand, routine or emergency operations, etc. A Supervisory Control and Data Acquisition System (SCADA) operating on a SUB-owned fiber optic system monitors and controls all the interconnected systems.

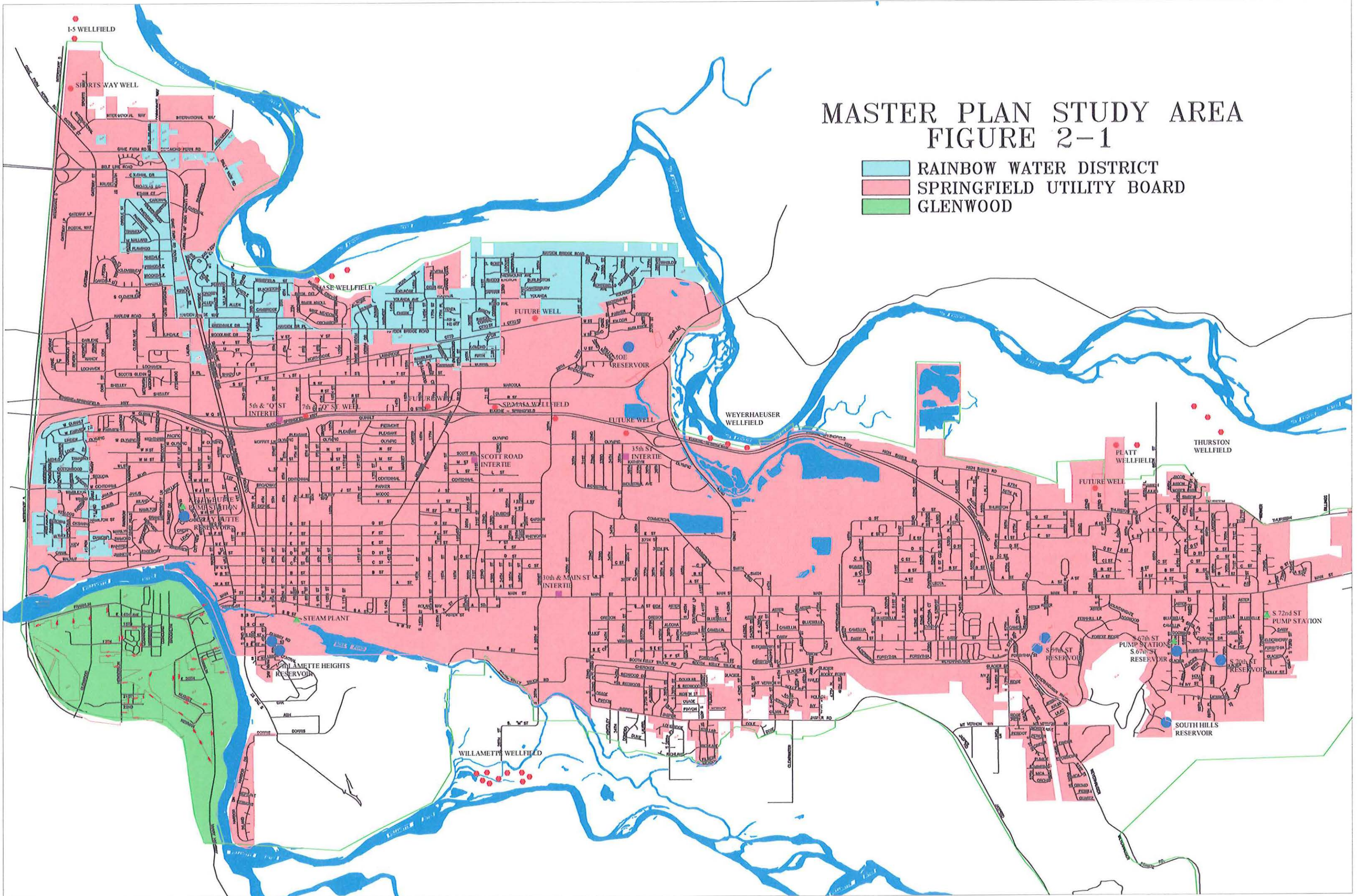
The system is configured in a "distributed control" topology to provide command and control of water supply and booster pumps within each service area. The computer workstation at the Water Service Center (WSC) is networked to computers in the field to provide system monitoring, set-point adjustment and data collection for trending and historical records. The process alarm system is centralized in a dedicated server and dependent on the fiber optic system in order to log alarms and dispatch operators in case of equipment breakdowns or emergencies.

2.9 Summary

This section presented a discussion of SUB's existing system and facilities. These systems will be analyzed using the criteria presented in Section 5. System improvement recommendations are presented in Sections 6 and 7. These recommended improvements are further developed into a comprehensive capital improvement program presented in Section 8.

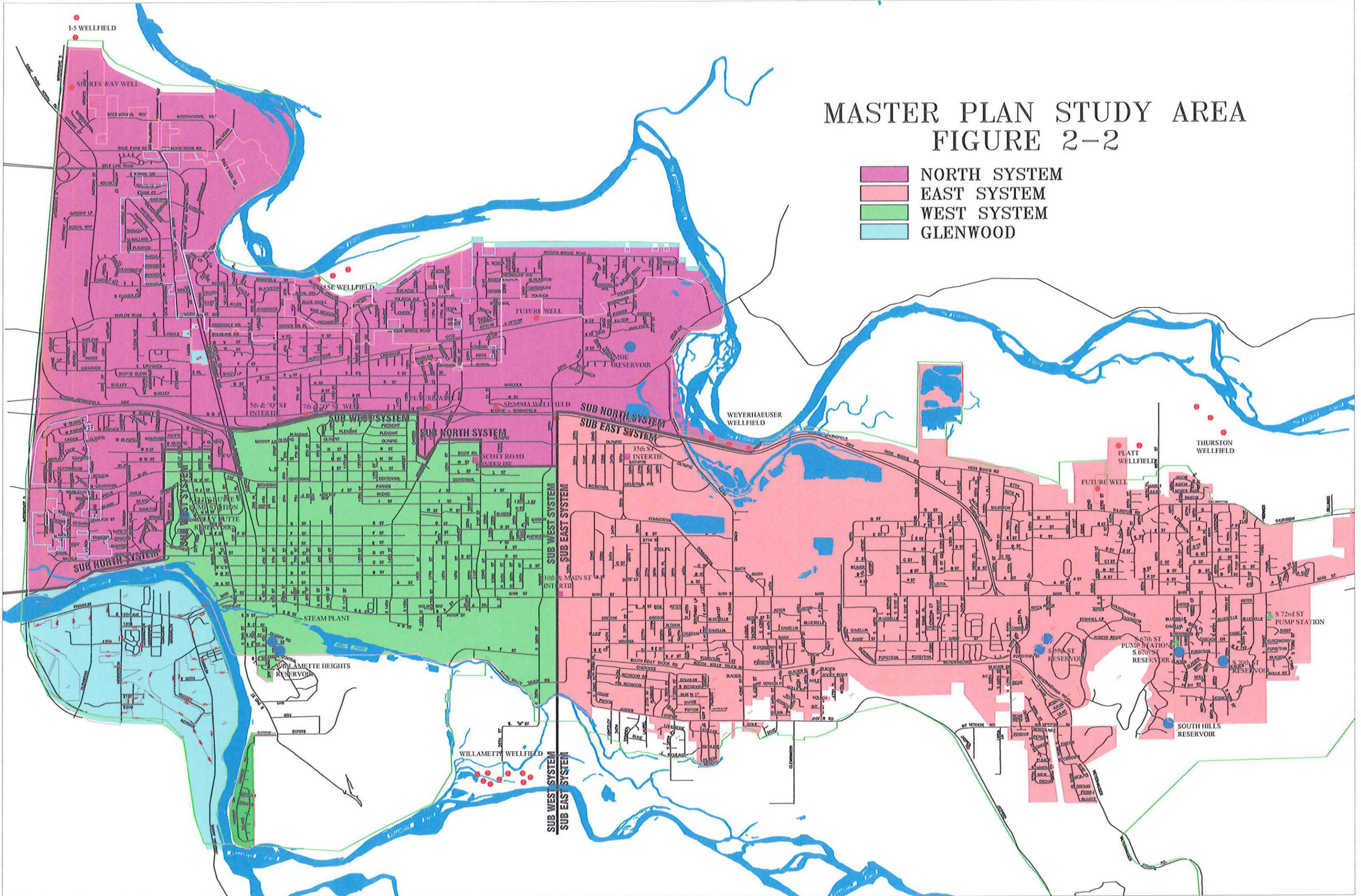
MASTER PLAN STUDY AREA FIGURE 2-1

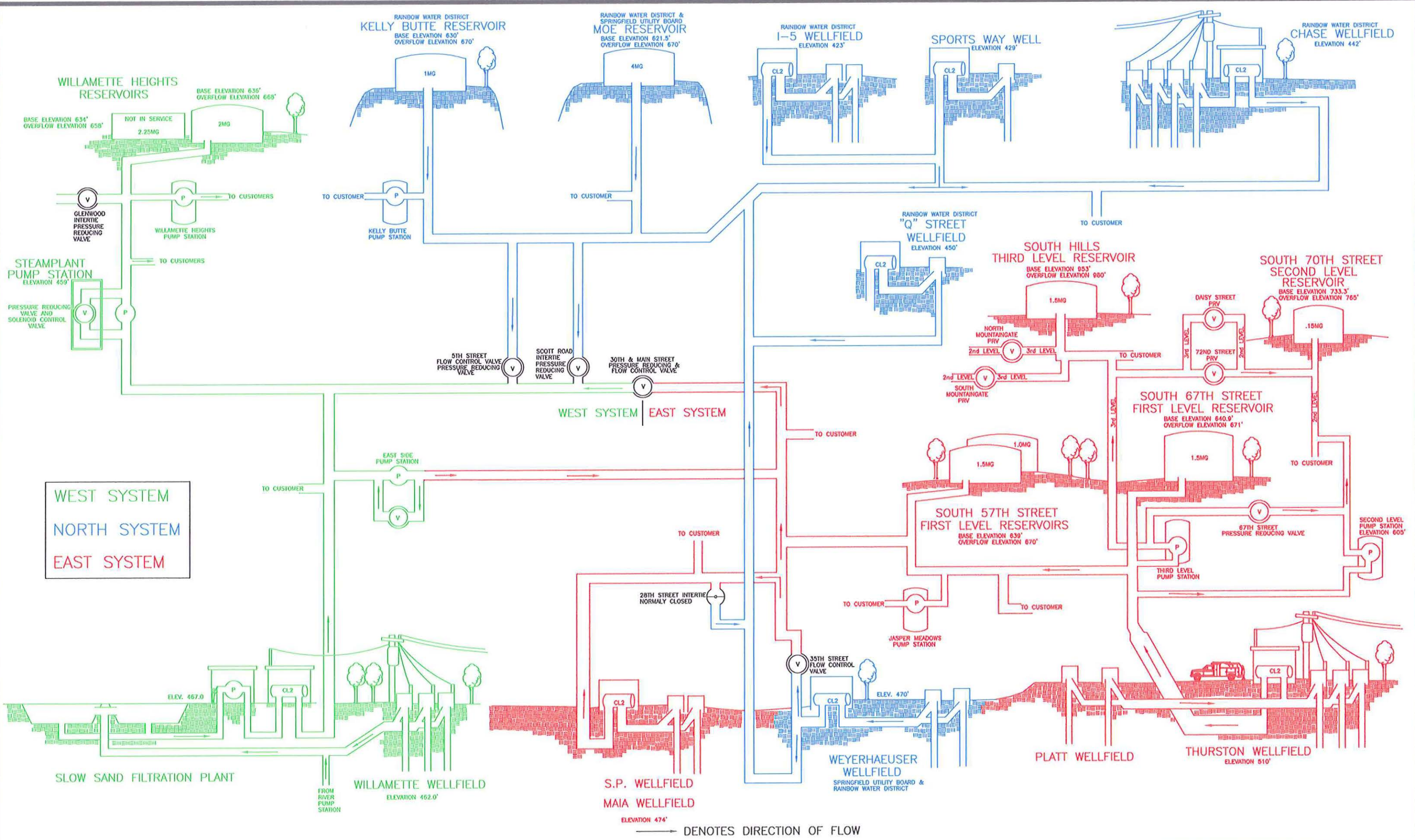
- RAINBOW WATER DISTRICT
- SPRINGFIELD UTILITY BOARD
- GLENWOOD



MASTER PLAN STUDY AREA FIGURE 2-2

- NORTH SYSTEM
- EAST SYSTEM
- WEST SYSTEM
- GLENWOOD





SPRINGFIELD PRESSURE SYSTEMS
FIGURE 2-3

SCALE	NONE	DRAWN	EJN
DATE	03/02/01	ENG	BEM
	LAST REVISION	APPR	
	01/06/10	SHEET	OF



SPRINGFIELD UTILITY BOARD
 WATER ENGINEERING DIVISION
 SPRINGFIELD, OREGON

DRAWING NUMBER
 FF 12 152

SECTION 3 DEMAND PROJECTIONS

3.1 General

This section summarizes water use records and presents projections for future water use for the SUB and RWD systems. Also included is documentation of available water use data and records and the methodology for projecting future demands.

3.2 Definition of Terms

A number of terms are used in the development and presentation of water demands. A brief discussion of these terms is presented below along with definitions that are intended to clarify and illustrate the development of water demand projections.

3.2.1 Water Demand

Water demand refers to total water use; that is, the sum of consumption (residential, commercial, public, and industrial) and public uses (for example, fire fighting or hydrant flushing), plus water lost to leakage or evaporation.

A given water demand at any one time includes the sum of the production from any operating wells and intakes, plus the outflow from storage reservoirs (or minus the inflow rate into the reservoirs if they are filling). Water demand terms are further quantified and defined as follows:

- *Average Day Demand (ADD)*: total volume of water produced in a year divided by 365 days
- *Maximum Day Demand (MDD)*: maximum volume of water used in any single day of a calendar year
- *Peak Hour Demand (PHD)*: highest hourly use hour during the MDD

Although the MDD and PHD are defined as the highest occurrences throughout a year, values just slightly less, may be recorded a number of times during the months of July and August.

The most common units for expressing these demands are million gallons per day (mgd). One mgd is equivalent to 695 gallons per minute (gpm) or 1.55 cubic feet per second (cfs).

3.3.2 Equivalent Meters

Equivalent Meters (EMs) is a normalized value representing the number of customers using different sized water meters. The number of equivalent meters is calculated by assigning each meter size a relative weight. The relative weights are in proportion to the maximum rated flow for a given meter size, compared to the maximum rated flow of a 3/4-in meter at 20 gpm. Table 3-1 lists equivalent meter values.

TABLE 3-1
Equivalent Meter Values

METER SIZE (in)	MAXIMUM RATED FLOW (gpm)	EQUIVALENT METERS
3/4	20	1
1	50	2.5
1-1/2	100	5
2	160	8
3	300	15
4	500	25
6	1,000	50
8	2,000	140
10	4,000	200

3.2.3 Unaccounted-for Water

Unaccounted-for water refers to the difference between metered production values and metered consumption including water used for operational uses such as system flushing. Unaccounted-for water includes unmetered hydrant use, other unmetered uses, and water lost to leakage. Meter inaccuracies also contribute to unaccounted-for water.

3.3 Description of the SUB and RWD Systems

As presented in Section 2, the SUB and RWD systems are divided into three geographical areas: SUB West (West), SUB East (East) and RWD/SUB North (North). The systems are configured with interconnected piping to allow transfers of water from one area to another. These transfers occur routinely on a daily basis at varying flows.

Water demand growth projections differ for the three areas. A brief discussion of the general characteristics of each area is presented below.

3.3.1 West

The West area generally includes downtown Springfield and, based on current development patterns has little vacant land left. Therefore, growth in this area is expected to be considerably less than for East and RWD/SUB North.

3.3.2 East

The East area has the greatest amount of vacant land and will likely experience the highest population growth and highest increase in water use.

3.3.3 North

A significant change to the North system since the 1999 Master Plan was the construction of the 181 acre River Bend Medical Center, including a 366 bed hospital and numerous specialty clinics and medical offices. These new facilities added approximately 200 equivalent meters to the North System when they went into operation in the spring of 2008. The demand estimates presented later in this section reflect this change.

3.4 Demand Records

As of December 31, 2008 the RWD and SUB systems served a total of approximately 21,918 customers. In terms of equivalent $\frac{3}{4}$ inch meters, this equaled approximately 28,104 meters. The ADD of the combined system was 12.18 mgd (8,457 gpm), and was divided nearly equally among the three areas. The records indicate that the RWD/SUB North System had a considerably larger MDD/equivalent meter than did the East or West Systems.

Table 3-2 provides a comparison of MDD and PHD for 1998 and 2008 that highlights the extent of demand growth for the water system since the completion of the 1999 Water Master Plan.

The high peak demands recorded in 1998 illustrate that MDD and PHD can vary significantly depending on heat and weather conditions and customer water use patterns. The 1998 MDD occurred on a Sunday with an air temperature of 102 degrees. The temperature on the Saturday proceeding this maximum day was 91 degrees, followed by a high of 105 degrees on Monday. Historical records have shown that the highest water demand the system typically experiences are on Sundays and Mondays with temperatures above 95 degrees.

In 2008 the highest MDD occurred on a Monday that had a temperature of 98 degrees which was preceded by 95 degrees on Sunday.

Table 3-2
1998 and 2008 High Demand Period Water Use Summary

AREA	MAXIMUM DAY DEMAND		PEAK HOUR DEMAND	
	1998	2008	1998	2008
SUB West	6.70 mgd (4,652 gpm)	6.33 mgd (4,396 gpm)	7,900 gpm	5,217 gpm
SUB East	9.85 mgd (6,839 gpm)	8.11 mgd (5,632 gpm)	12,100 gpm	9,767 gpm
RWD/SUB North	10.10 mgd (7,103 gpm)	8.47 mgd (5,882 gpm)	12,600 gpm	10,683 gpm
Totals	26.65 mgd (18,505 gpm)	22.91 mgd 15,909 gpm	32,600 gpm	25,667 gpm

As indicated in Table 3-2, both the MDD and PHD have declined from 1998 to 2008. This can be attributed to factors such as on-going conservation efforts by SUB, water loss abatement programs including pipe replacement, as well as changes in customers' water use awareness through rate increases and conservation campaigns.

Additionally, metering accuracy and changes to the water accounting system also contribute to a more accurate tabulation of water production and consumption.

3.5 Demand Forecasting

3.5.1 Background

As part of the Water Master Plan work, a determination of the potential build-out of the area inside the existing urban growth boundary (UGB) was completed. This information is important to predict if and when a particular service area may reach saturation development, resulting in reduced or little water demand growth. As an example, the West System's growth in recent years has been minimal due to a combination of minor in-fill development in older neighborhoods, while residential and commercial development occurred in the North and East Systems. It is anticipated that this growth pattern may change as development occurs in the recently annexed Glenwood area.

The data used to develop and support the water demands generated as part of this master planning work has been collected from several sources, including the City of Springfield Planning Department, ECONorthwest and SUB's internal studies and databases. Some of the information, particularly in the upper level areas of the East system, are based on current understanding of development variables including potential development costs and steep slope stability analyses in specific areas to better estimate future development patterns and ultimate densities.

The *Available Lands Survey* currently being prepared by the City of Springfield yielded the following:

- Approximately 5,400 additional dwelling units could be built on vacant land inside the existing UGB. This estimate is subject to variation as it is based on a preliminary assessment of vacant lots and their suitability for development. Of this total, approximately 185 units are in the West System, 1,200 units in the North System and 4,000 units in the East System. Of these 4,000 units in the East, approximately 1,500 would be second level or above. An internal study completed by SUB in 2006 indicated a potential for approximately 3,000 additional dwelling units in the upper level area rather than 1,500 dwelling units in the more current studies. More restrictive slope and stability limitations are now in place than was the case in 2006. The net effect of the smaller number will be to raise the infrastructure development costs, further reducing the potential number of building sites.
- This data should only be used as a general guide to determine potential source of supply requirements and to determine a possible upper population limit.

As stated, the Available Lands Survey is currently under development and is based on certain assumptions concerning the ultimate expansion of the UGB. As this expansion process is a public process the final expansion plan may vary from that assumed as part of this master planning work. Given this variability of the analysis, it is recommended that future water system master planning updates include updated available lands and UGB expansion information.

3.5.2 Use of Demand Estimates

The water demand estimates developed as part of this plan are used for several purposes. Maximum Daily Demand (MDD) for water is used for planning purposes when projecting SUB's water supply and infrastructure needs into the future. Average Daily Demand (ADD) is also evaluated, but planning and operation of the water system centers around the forecasted MDD. Peak Hourly Demand (PHD) is used for storage analysis.

3.6 Historic Forecasting Methodology

In the 1999 Water Master Plan, SUB tracked historical MDD separately for its three water systems from 1984 to 1998. Following is a brief discussion of how MDD was

historically forecasted in the 1999 Water Master Plan and an updated MDD forecasting methodology used in the 2009 Water Master Plan Update.

Historically, SUB forecasted MDD for its three water systems by first forecasting the number of equivalent meters (EM) in each system. From this data, which spanned the years from 1991 to 1997, MDD per equivalent meter (EM) was calculated. The second highest MDD/EM for the period was then multiplied by the number of forecasted equivalent meters for each forecast year to calculate projected annual MDD for each system. For this master planning work the exception is the East system, which used historic MDD from 1986-1997 when forecasting MDD. Water meters for fire protection were excluded from the MDD analysis using this method.

ADD forecasting was completed using the same methodology by using the historical ADD data.

While this method of water demand forecasting served its purpose in previous water system planning work in late 1999, SUB transitioned to a new customer database. This change resulted in account reclassifications that change how meters were counted, which in turn greatly reduced the reliability, consistency and accuracy of the historic MDD/equivalent meters calculation. At the same time SUB expanded its service area by acquiring a number of water districts, there were local planning changes that significantly altered the historical customer profile in the three systems. The net result of these changes is the need to update the water demand forecast methodology to accurately reflect anticipated system growth.

3.7 Water Demand Forecasting Methodology Review

Based on a review of recent available historical water demand data, water demands were developed for the planning horizon using the following methodology:

- 1) The average of MDD per Equivalent Meter from year 2000 to 2009 is determined for the three systems.
- 2) The equivalent meter forecast is multiplied by the MDD per Equivalent Meter in step 1 to forecast MDD by system (North, West, and East).
- 3) Based on estimated growth rates for each system, the number of equivalent meters is determined.

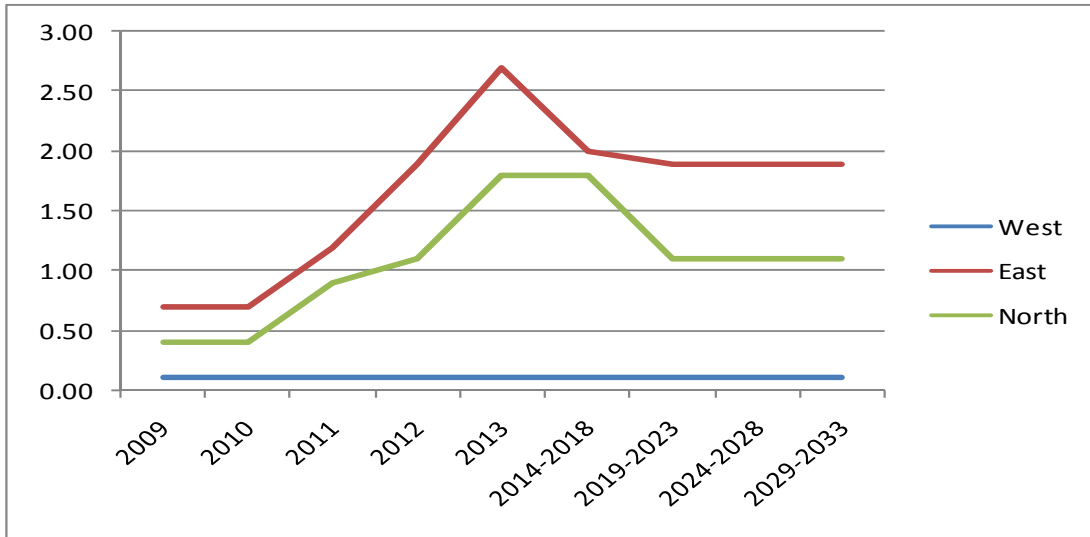
The results of the calculation determines that North, West, and East systems equivalent meters grow at 1.27 percent, 0.34 percent, and 2.12 percent, respectively. ADD calculations use the same methodology (maximum historic ADD per Equivalent Meter from the year 2000 forward).

3.8 Water Demand Projections

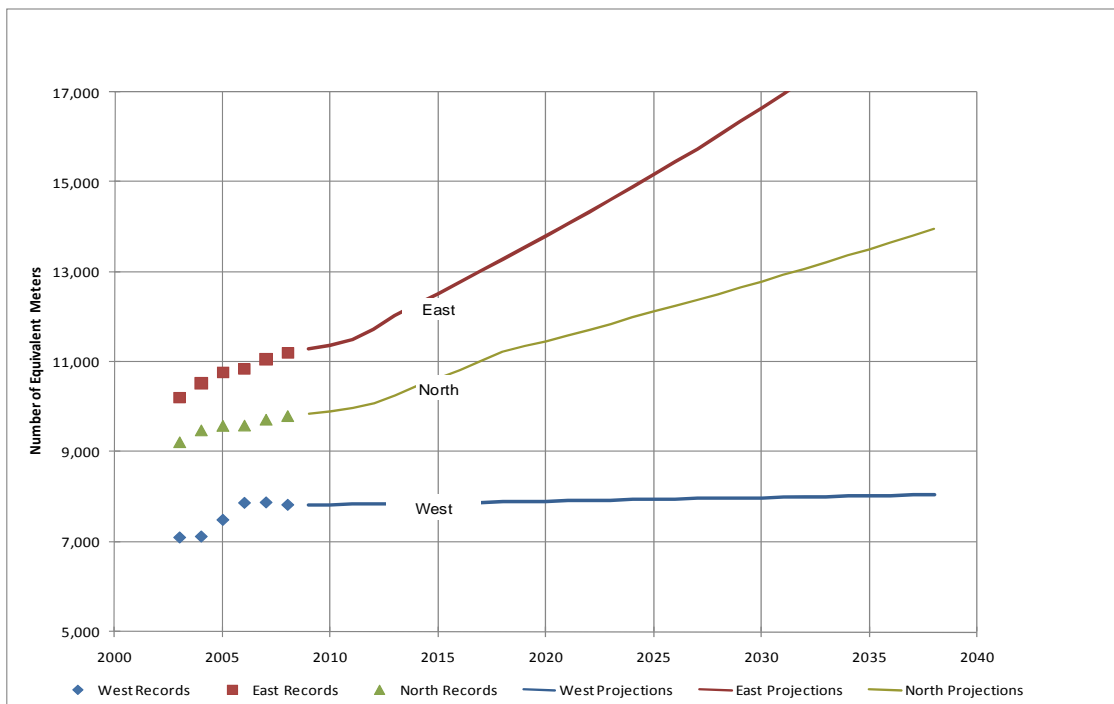
Using the water demand forecasting methodology presented above water demand projections were developed for each of the three service areas. Figure 3-1 illustrates the projected growth rates for each of the three sub-systems within the SUB/RWD water systems. As illustrated, the projected water demand growth of the West System is

assumed at a constant 0.10% growth rate for the 20 year study period, reflecting slow growth expectations. The East and North systems are expected to see higher growth rates for the next 5 years, then level off for the remainder of the study period. Figure 3-2 illustrates the number of meters recorded for each of the three service areas with growth projections for each area based on the projected equivalent meter growth rates shown in Figure 3-1.

**Figure 3-1
Projected Equivalent Meter Growth Rate Summary**



**Figure 3-2
Equivalent Meters Forecast Summary**



Appendix A presents detailed tabulated worksheets that detail how the calculated values are generated for the demand forecasting tables.

3.9 Water Demand Projections by Service Area

3.9.1 West System

As shown in Figure 3-2, the West system's MDD is relatively flat over the last three years and is expected to remain flat until the Glenwood area begins to develop. Density in the downtown and surrounding residential area is expected to preclude any significant increases in water demands.

With the combination of a continued low growth rate plus further achievements in conservation, leak detection and repair, the projections show a net decline in MDD over the 20-year planning period resulting from SUB's target of 15 percent conservation goals applied to the MDD. SUB intends to achieve this goal by implementing supply-side conservation measures while continuing to reduce un-accounted for water.

3.9.2 East System

Figure 3-2 reflects that the East system has the highest annual growth rate for any of the three areas. The projections were based on the East system's MDDs for 2003 through 2008, which ranged from approximately 8.71 mgd to 8.11 mgd. As in the North system, the MDD has actually declined while the equivalent meter count has increased (by 991 units).

With conservation factored in, the MDD is projected to reach approximately 10.68 mgd in year 2015, and 14.20 mgd in 2030. The projected increase in water demand in this area of Springfield with the largest inventory of developable land is about 75 percent. During the same time period, the equivalent meter count is expected to increase by 49 percent. The actual timing of future development, such as in the Natron area, could further increase demand for water in the East System, well past the 20-year planning period.

3.9.3 North System

The North system's recently recorded MDD, as shown in Figure 3-1, indicates a combination of a lower projected growth rate than that experienced in recent years, plus the assumption that conservation, and eventual saturation of the developable lands, will slow the growth in water demands after the 20-year planning period.

3.9.4 Overall SUB and RWD Service Area

As compared to water demand estimates presented in the 1999 Water Master Plan, the 2008 MDD for the combined systems was projected to be 28.1 mgd. Actual MDD in 2008 was recorded at 22.91 mgd, or approximately 18 percent lower than predicted.

This flattening of the load growth curve demonstrates the combined effects of conservation and rate elasticity.

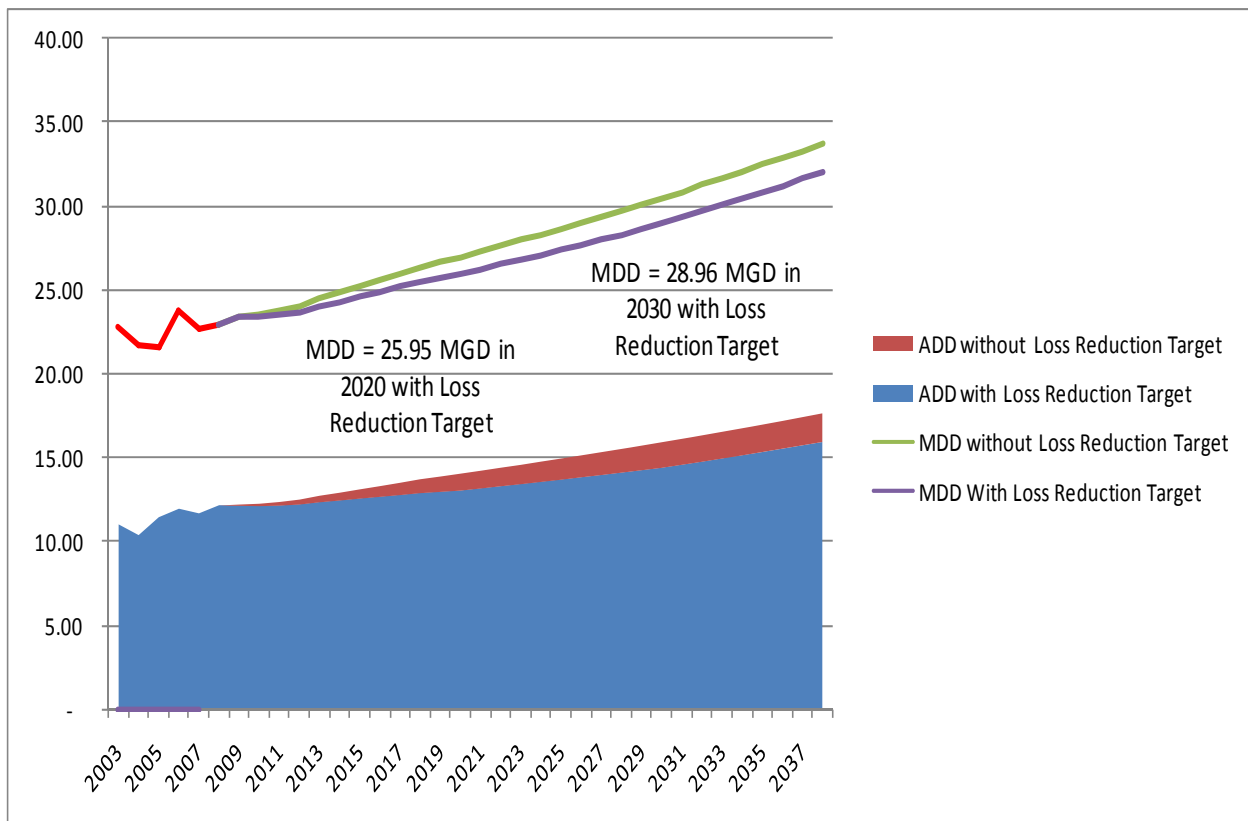
3.10 Conservation

Both SUB and RWD have implemented water conservation measures in recent years. Supply side measures include implementation of a comprehensive leak repair program. Demand side measures include public education programs, incentive rates, and other measures. SUB and RWD are also actively seeking methods to reduce the effects of peak hour demands. An example of this is a public education program advising people to irrigate during the off peak hours. Both utilities plan to continue ongoing conservation programs. These programs and conservation efforts are described in more detail in the recently updated Water Management and Conservation Plan.

As presented and summarized in Figure 3-3, with the conservation targets factored in, the projected MDD is 25.95 mgd in year 2020, including loss reduction target and 28.96 mgd in 2030 with loss reduction target. This represents an increase of 6.05 mgd or 26 percent over 22 years.

Figure 3-3

Water Demand Projection Summary, with and without Loss Reduction Targets



3.11 Unaccounted-for Water

Based on current water production and billing records, SUB has rates of unaccounted-for in the range of 23 to 28 percent. Specifically, the rate was 28 percent in 2003, 23 percent in 2005, and climbed back up to 28 percent in 2008. SUB maintains the goal of achieving a maximum water loss of rate of 15 percent before the end of the 20-year planning horizon. Recommendations to achieve this goal are presented in the Capital Improvement Program (CIP) presented in Section 8.

3.12 Summary

RWD and SUB have historically found that the number of equivalent meters is the best metric for monitoring growth. Therefore, the timing of capital improvements presented in Section 8 will be implemented based on the number of equivalent meters. The water demand estimates presented in this Section 3 are based on historical use records and a comprehensive evaluation of the growth potential in each of the system's three service areas. The water demand projections developed in this section include consideration of water conservation and water loss reductions goals, and will be used in the system analysis to determine existing deficiencies and future system expansion needs. Recommendations related to ongoing water loss reduction programs, demand data record keeping, and future water demand estimating are presented in Section 8.

SECTION 4

REGULATORY ISSUES

4.1 Introduction

This technical memo contains a summary of the regulatory compliance issues facing the SUB and RWD water systems.

Both state and federal agencies regulate public drinking water systems. For the federal government, the U.S. Environmental Protection Agency (EPA) establishes standards for water quality, monitoring requirements, and procedures for enforcement. Oregon, as a primacy state, has been given the primary authority for implementing EPA's rules within the state.

The state agency that administers most of EPA's drinking water rules is the Oregon Department of Human Resources, Drinking Water Program (DHS-DWP). DHS rules for water quality standards and monitoring are adopted directly from EPA. DHS is required to adopt rules at least as stringent as federal rules and DHS has elected not to implement more stringent water quality or monitoring requirements.

In some areas not directly related to water quality, DHS 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.

SUB and RWD's activities are also governed by the Oregon Department of Environmental Quality (DEQ) and DHS Source Water Protection Programs.

4.2 Status of Drinking Water Regulations

The most recent amendments to the Safe Drinking Water Act (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 these regulations. It left existing standards and rules unchanged, although the pace of adopting new standards was slowed. The law does contain the following new assignments and programs for EPA and the 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 of 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 Oregon Department of Human Services, Drinking Water Program Regulations

The DHS, Drinking Water Program, is responsible for regulating public water systems within Oregon. As a primacy state, the DHS is responsible for implementing the national SDWA as well as rules developed by the state. For the most part, Oregon's rules are not more stringent than the SDWA; however, in some areas, including construction standards, plan review, and operator certification, Oregon's rules cover areas not addressed in the SDWA. The complete rules are contained in Oregon Administrative Rules 333-61.

4.4 Drinking Water Protection

The Oregon Department of Environmental Quality (DEQ) is the lead agency in Oregon for implementing the wellhead protection program. Working jointly with DHS, DEQ prepared proposed legislation and rules in 1994 and 1995 to implement a mandatory wellhead protection program. These laws would have made it a requirement for 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 3,500 service connections. For communities serving populations greater than 10,000 or 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 660-23-140).

Under the administrative rules that apply to Oregon's EPA-approved Drinking Water Protection Program, the DHS has the responsibility of certifying groundwater-derived drinking water protection areas in the state (see DEQ's OAR 340-40-180(3)). This certification is granted after technical review assures that the submitted delineations meet minimum requirements for the system as outlined in DHS's OAR 333-61-057, 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 DHS 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 and 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. SUB's Mid Fork Willamette surface water intake has been delineated by DEQ and includes all of the watershed area from the intake up to Dexter Dam near Lowell and each of the

tributaries downstream of the dam up to their headwaters. DEQ has designated the City of Lowell and the City of Oakridge responsible for the portions of the Mid Fork Willamette watershed upstream from their communities.

The City of Springfield has implemented drinking water protection as part of the 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. DEQ and DHS's certification qualifies the delineated areas a significant groundwater resource for the purpose of State-Wide Planning Goal No.5. It is recommended that SUB and RWD continue proactive wellhead protection programs to prevent contamination. The impact of contamination by synthetic or volatile organic chemicals can be significant, both in terms of cost for treatment and loss of public confidence. SUB and RWD are continuing to work with the Springfield City Council, City of Eugene, and Lane County to develop county-wide drinking water protection strategies.

SUB, RWD, and the City of Springfield adopted and received DEQ approval for a drinking water protection plan developed in accordance with the Oregon Drinking Water Protection Program Guidance Manual. The Department of Land Conservation and Development has also approved the plan as providing adequate protection of the identified Goal 5 Resource. However, DLCDC has conditioned the approval in the last Periodic Review Process to require Lane County and the City of Eugene to adopt protections that meet the criteria in the Oregon Drinking Water Protection Guidance Manual prior to the next Periodic Review cycle. SUB and RWD will need to continue efforts to help both public bodies in their adoption processes.

The 5 year update to the Springfield Drinking Water Protection Plan is currently being completed for DEQ approval and recertification. SUB is leading this project with review and approval from RWD. Continued action and accomplishment in implementation of the plan recommendations is required for certification. The next 5-year review will be due in 2015.

SUB's Drinking Water Protection Coordinator provides technical review of all Drinking Water Protection Overlay permit applications to assure 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.

SUB and RWD will need to continue their vigilance in protecting drinking water quality. 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 our public education efforts, expanding our protection efforts to protect our surface water supplies in both the Mid Fork Willamette and McKenzie watersheds, and making incremental improvements in each of the 10 areas identified in the Springfield Drinking Water Protection Plan.

4.5 Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was promulgated on June 29, 1989. Under the SWTR, all public water systems using surface water or using any groundwater under the direct influence 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 rule also addresses the following:

- Criteria under which filtration is required
- Performance criteria for filtration
- Disinfection requirements for filtered and unfiltered systems
- Exemption criteria from the filtration requirements
- Monitoring requirements for all surface water supplies

The SWTR establishes treatment techniques instead of maximum contaminant levels (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. Treatment must achieve at least 99.9 percent (3-log) removal or inactivation of *Giardia* cysts and 99.99 percent (4-log) removal or inactivation of viruses. The maximum contaminant level goals (MCLGs) for *Giardia*, viruses, and *Legionella* are zero. There are no MCLGs for heterotrophic plate count bacteria and turbidity.

Water providers must achieve 3-log removal/inactivation of *Giardia* and 4-log removal/inactivation of viruses. Partial removal/inactivation credit is given to systems that provide filtration with the remainder achieved through chemical disinfection. The actual amount of removal/inactivation credit to be granted for filtration is based on the specific train of treatment processes provided. Removal/inactivation credit for chemical disinfectants is based on "CT," which equals the free disinfectant residual concentration (in milligrams per liter) times the disinfectant contact time (in minutes).

Impact to SUB and RWD. Treatment studies have determined that most of the Willamette Wellfield wells are Groundwater Under the Direct Influence (GUDI) of surface water and the Slow Sand Filtration Plant was constructed to treat well water and surface water from the Mid Fork Willamette River. The plant is meeting all of the requirements of this regulation.

Of the remaining wellfields the Weyerhaeuser and Thurston Wellfields have the most likely vulnerability to the influence of surface waters and, therefore, could possibly be impacted by the SWTR.

Water quality tests from the Weyerhaeuser and Thurston Wellfields have shown a linkage with the McKenzie River. The state has reviewed data collected by SUB and

RWD for the Weyerhaeuser and Thurston Wellfields, and has made a determination on all wells except Thurston No.7. The determination was that Thurston No.2 is GUDI. The evaluation for Thurston Well No.7 will be completed in the summer of 2010. All of the other wells were determined to not be groundwater and not significantly under the influence of surface water.

Additional geologic studies at Thurston No.2 have provided the data to demonstrate Natural Filtration and DHS has approved the application of Natural Filtration Credit for this source. SUB expects that Thurston No.7 will be certified as Groundwater. However, if further studies result in a GUDI designation SUB will request approval of Natural Filtration Credit for this well also. 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.

When groundwater wells are determined to be GWUDI, improved disinfection plus filtration is required. Improved disinfection may consist of adding sufficient detention time to meet the CT requirements or the addition of ultraviolet light (UV) to achieve necessary inactivation.

When additional water is needed from the Thurston Wellfield, Well No.2 can be brought back on line with the addition of UV treatment or chlorination with added detention to meet the requirements of the SWTR. If Thurston Well No.7 is determined to be GWUDI the same requirements would apply.

For the Weyerhaeuser Wellfield, the granular activated carbon (GAC) plant that was completed in August 1996 was designed not only for organic contaminant removal, but also to be adaptable to meet surface water filtration requirements. Currently, all three wells have been designated as Groundwater and surface water treatment has not been needed. In the future event that surface water treatment is needed the primary additions needed for surface water treatment are another pair of filter vessels, a chemical coagulation feed system, rapid mixer, chlorine detention (or UV application), and instrumentation and SCADA modifications.

4.6 Interim Enhanced Surface Water Treatment Rule (IESWTR); Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR); and Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

These three additions to the SWTR have been implemented to reinforce the SWTR and increase public health protections by increasing the effectiveness of disinfection in addition to reducing the risk of *Giardia* and *Cryptosporidium* infection.

The IESWTR and LT1SWTR require that combined filtered water turbidity be less than 0.3 NTU in 95% of all samples collected each month in order to demonstrate compliance with the regulation. This applies to both conventional and direct filtration treatment plants. The maximum turbidity allowed is 1 NTU. The Rule requires individual filters to be monitored for turbidity and triggers additional reporting if performance limits are exceeded. The regulation assumes 2 log removal of *Cryptosporidium* when these standards are met. The IESWTR applies to systems

serving at least 10,000 people. The LT1ESWTR applies to systems serving less than 10,000.

LT2ESWTR also applies to all surface water or ground water under the direct influence of surface water systems. The rule requires 2 yrs of *Cryptosporidium* sampling to define the requirement for additional treatment. Additional treatment options are identified in Microbial Toolbox. Additional treatment is required to be in place by 2012 for systems serving 50,000 or more people, and by 2013 or 2014 for smaller systems.

Impact to SUB and RWD. SUB's Willamette Wellfield Slow Sand Filtration Plant is regulated under a section of these rules that allows for alternative treatment technologies. Slow sand filtration is recognized as one of the most effective technologies for the treatment of *Giardia* and *Cryptosporidium* when it is operated properly. The criteria established in the rule identify compliance criteria for turbidity at less than 1 NTU in 95% of samples collected during the month. The maximum turbidity allowed is 5 NTU. The Willamette Wellfield Slow Sand Filtration Plant has met this criterion continuously since startup and is expected to be able to successfully meet the criteria for the foreseeable future. Additional log removal credit for *Cryptosporidium* is achieved through the use of UV and virus log removal is achieved through the application of chlorine and adequate detention time.

SUB has completed the *Cryptosporidium* sampling requirement identified in LT2ESWTR for the Willamette Wellfield source. No *Cryptosporidium* were identified in the 2 year monthly sampling cycle and a Bin 1 Classification was certified for this source. Based on the Bin 1 Classification, no additional treatment will be required at this time. A second round of sampling is required in 2015 and additional evaluation of those results will be required.

SUB has completed studies recommending membrane filtration to expand capacity at the Willamette Wellfield 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.

When the decision is made to use Thurston Well No.2, SUB will need to confer with EPA and/or DHS to identify where crypto sampling will need to occur. It is anticipated that the sample will be required to be taken at the wellhead (rather than the McKenzie River). EWEB's McKenzie River sample results are available and will help with the regulators evaluation. The sampling plan will need to be approved and initiated as soon as practical.

Should SUB consider a new water treatment plant to use the water rights on the McKenzie River, the treatment plant design will need to take into consideration the requirements of this rule. Water quality studies will need to address the required *Cryptosporidium* sampling and other physical parameters that will impact treatment

selection. If an alternative technology such as membrane filtration is selected, the operating parameters will need DHS approval.

RWD's Chase Wellfield is adjacent to the McKenzie River. Each of the wells in the Chase Wellfield have been evaluated and determined to be Groundwater. The SUB/RWD Weyerhaeuser Wellfield wells have been determined to be Groundwater as noted above. It is not anticipated that any of the other SUB and RWD well sources will be impacted by the SWTR.

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 IESWTR and D/DBP rule requirements 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.

4.7 Disinfectants/Disinfection By-Products Rule

The Disinfectants/Disinfection By-Products (D/DBPs) rule and the Stage 1 D/DBP rule apply to all Community Water Systems and Non Transient Non Community Water Systems that treat water with a chemical disinfectant for primary or residual treatment. This rule is currently in effect and regulates Total Trihalomethanes (TTHMs) and Haloacetic Acids (HAA5s), which include:

TTHMs

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

HAA5s

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

The MCLs for TTHMs and HAA5s in the Stage 1 D/DBP rule are calculated as the running annual average of quarterly samples at four distribution system sites per plant or entry point. The MCLs for several constituents are listed in Table 4-1.

Table 4-1
Constituents Listed by the Disinfectants/Disinfection By-Products Rule

Constituent	MCL / Requirement
Chlorine	4 mg/L
Total Organic Carbon (TOC)	Treatment Technique
TTHMs	0.080 mg/L
HAA5s	0.060 mg/L

The Stage 2 D/DBPs rule is currently being implemented. This rule maintains the MCL levels established in Stage 1 D/DBP rule and adds MCLGs for four TTHMs and three HAA5s. The most significant change in Stage 2D/DBP is the requirement that the MCL be calculated on the locational running annual average of quarterly samples taken at locations to be determined by Initial Distribution System Evaluation (IDSE). The compliance sites consist of locations where high TTHMs are found, locations where high HAA5s are found and average detention time sites within the distribution system. 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 D/DBPs Rule, SUB and RWD collected 2 years of quarterly samples on a reduced monitoring schedule approved by DHS. One sample per quarter was collected from each source in each utilities 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 result exceeded one half the regulated amounts of 80 mg/L for TTHMs or 60 mg/L for HAA5s and qualified for a 40/30 Certification Waiver. Based on two years of results, SUB and RWD each submitted a 40/30 Certification to EPA for approval. EPA confirmed the 40/30 Certification for each utility. The result is that an IDSE is not required and SUB and RWD are allowed to continue monitoring on the reduced monitoring schedule of one sample per plan per quarter.

SUB and RWD are implementing corrosion optimization measures at the Willamette, Thurston and Weyerhaeuser sources. The current plan is to install CO₂ stripping towers to increase pH to 7.5 standard units. Since the applied chlorine may need to be increased in order to maintain the same chlorine residuals in the distribution system, it is possible that TTHMs may increase slightly. It is also possible that additional chlorination may be needed in the towers for biological control. Any increase in

disinfectant application will need to be monitored to confirm continued compliance with the 40/30 Certification and the D/DBP rule.

4.8 Total Coliform Rule

This rule applies to all surface water and groundwater systems. Total coliforms include both fecal coliforms and *E. coli*. The MCLG for total coliforms is zero. Compliance with the MCL is based on the presence or absence of total coliforms in a sample. The MCL for systems analyzing at least 40 samples per month is that no more than 5.0 percent of the monthly samples may have total coliforms present.

Monthly monitoring requirements are based on the population served. A system must collect a set of repeat samples for each positive total coliform result and have it analyzed for total coliforms. The total coliform sampling requirements vary according to population served.

Impact to SUB and RWD. SUB and RWD are currently meeting all applicable requirements for the Total Coliform Rule. Evaluation of distribution system water quality should be reassessed if existing well water treatment processes are modified to meet other current or proposed regulations such as the LCR or D/DBPR. 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.

4.9 Groundwater Rule

The Groundwater Rule takes effect in Oregon in December 2009. The Rule applies to all groundwater systems. Sanitary surveys are required every 3 yrs for community water systems and every 5 years for non-community water systems.

Systems are required to notify the State if they will provide compliance monitoring reports that demonstrate 4-log inactivation of viruses or do triggered source monitoring. Source water monitoring is required for systems that do not treat to 4-log viral inactivation and is triggered by a total coliform (TC) positive sample in the distribution system. Five samples must be taken within 24 hrs of a TC positive result at each source on-line at the time the TC sample was taken. Triggered source monitoring is not

required for systems that demonstrate 4-log viral inactivation and submit monthly compliance monitoring reports.

The Rule identifies special notification requirement for wholesalers and consecutive systems when there are positive TC results. If the State identifies significant deficiencies in a sanitary 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.

Impact to SUB and RWD. SUB and RWD already disinfect with chlorine or UV/chlorine at each source of supply. However, not all sources provide the required 4-log inactivation for viruses.

SUB and RWD have notified DHS that they will be complying with this rule by doing the Triggered Source Monitoring when there is a total coliform (TC) positive sample during routine monitoring.

SUB and RWD have asked for clarification on whether they are required to sample at the entry point from a wellfield prior to chlorination or at each well in the wellfield. Additionally, the utilities have asked if they can identify the source and collect only from the source that provided the water to the TC positive sample location. Alternatively, every source would have to be sampled. As part of corrosion optimization sampling, the utilities are continuing to collect conductivity, pH, and temperature in addition to chlorine residual. Conductivity is a clear indicator of which wellfield is the source of water at each coliform sampling site. Approval of this process would reduce the complexity of the sampling and allow the utilities to focus on the most likely supply source keeping in mind that distribution system problems (backflow, service leaks, and main breaks) may be the cause of a TC positive result.

Historically, it is rare to have a TC positive sample in the distribution system (there were no TC positive samples in 2008 and only one in 2009). SUB collects raw water samples at each operating wellfield once each month. There are occasional TC positive samples at the raw water sources. However, there has never been a positive result for E-coli in the raw wellfield water samples or in the distribution system.

SUB and RWD operate a combined distribution system. The Rule requires that each system notify the other in the event of positive TC sample. Each utility will be responsible for the repeat sampling (with a minimum of three samples), source water sampling (with a minimum of five 5 samples), and any public notification that is required for their respective systems.

The result of positive total coliform samples or e-Coli samples at the sources will trigger the requirement for 4-log treatment of viruses at the entry point to the distribution system and compliance monitoring. In order to achieve 4-log treatment for viruses with chlorine a CT value of 6.0 (Table E-7 SWTR) is required. Evaluations have been

completed for Thurston Wellfield that indicates a CT of 6.0 is not possible at the current flow rates.

In order to avoid the risk of violations, added source sampling, and adverse public notices, it is in SUB's and RWD's best interest to do compliance monitoring instead of triggered source monitoring.

It is recommended that CT evaluations be completed for each wellfield to confirm that a CT of 6.0 can be achieved under all flow, temperature, pH, and chlorine residual conditions. At each wellfield where a CT of 6.0 is not achieved under all operating conditions, it is recommended that modifications be made to meet or exceed these parameters. From a practical standpoint there are only two ways to achieve higher CT values: 1) create longer detention times. 2) create higher chlorine residuals. In SUB's experience, higher chlorine residuals create customer taste and odor complaints, along with less customer confidence and satisfaction with their drinking water. For Thurston Wellfield, an opportunity may exist to install additional detention at the wellfield with the installation of the corrosion control CO₂ stripping towers.

In reviewing the criteria for Compliance Monitoring it is noted that continuous entry point chlorine residual monitoring is required. SUB and RWD do not currently have chlorine residual monitoring at the entry points to the distribution system other than at SUB's Willamette Wellfield Slow Sand Filtration Plant. All sources have continuous monitoring sample locations near the point of chlorination so that immediate adjustments can be made to the rate of application. It is recommended that both utilities work with DHS for approval of locations to install continual monitoring equipment. It may be possible to install a detention line for the sampling equipment that mirrors the system detention. DHS approval will be required prior to design and construction. As soon as chlorine residual analyzers are installed and the SCADA reporting software can be programmed, it is recommended that each source that can meet the criteria be moved to Compliance Monitoring.

4.10 Lead and Copper Rule

On June 7, 1991, the EPA published maximum contaminant level goals and regulations for lead and copper. In April 2000 the EPA Lead and Copper Rule Minor Revisions (LCRMR) took effect. The Lead and Copper Rule (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 (that is, January to June and July to December). The LCRMR did not change the Action Levels (AL) and they did not change the basic requirements to optimize corrosion control and if needed, treat source water, 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:

- Lead solder installed after 1982

- Lead service lines
- Lead interior piping

For a water system to comply with the Lead and Copper Rule (LCR), the samples at the customer's tap must not exceed the following action levels:

- 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 action levels 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 action level 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 action levels.

All systems that exceed the lead or copper action level 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 lead and copper, systems that exceed the lead or copper action levels are required to monitor other water quality parameters.

After performing a corrosion control study, water systems are to develop a corrosion control treatment plan based on study results and monitoring data and submit this plan to DHS for approval. Once the treatment plan is approved by the state, the purveyor will have 24 months to install the optimal corrosion control treatment, and 12 months to collect follow-up samples. Once monitoring has shown that corrosion control is effective, the regulatory agency will assign values for water quality parameters that will be used to ensure that corrosion treatment is effective.

Impact to SUB and RWD. SUB 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. The corrosion study (HDR, December, 2003) recommended that SUB modify wellfield operations to mix water from higher pH sources and operate higher pH wells to a greater extent to reduce corrosion. Follow-up sampling verified that this method was not effective and SUB worked with Confluence Engineering Group to evaluate prior studies and current data to develop recommendations for optimal corrosion control treatment (Confluence, June 2009) and provide a process recommendation for DHS approval. SUB's studies complemented work completed earlier by RWD.

RWD met the lead action level standard, but the copper action level was exceeded in the area served by the Weyerhaeuser Wellfield. Based on this, an LCR compliance study was conducted for RWD (Engineering and Economic Services, Inc., 1996). The study concluded that the most corrosive supply was from the Weyerhaeuser Wellfield, and that treatment of this supply should enable RWD to comply with the rule. In October 1997, DHS approved a revised plan submitted by RWD. Instead of adding

treatment, RWD proposed setting operational valves in the RWD/SUB North System to minimize the Weyerhaeuser Wellfield flow to RWD customers. The plan included follow-up sampling after a period of stabilization to test the effectiveness of this approach. RWD implemented this plan, and results have been below action levels in subsequent sampling and they have remained in compliance.

In August 2009, DHS approved SUB's process recommendation for packed tower aeration to remove CO₂ and increase pH to 7.5 at the Willamette, Thurston, and Weyerhaeuser sources. DHS also approved SUB's request to install the corrosion control systems one at a time over the next three years starting in 2010. SUB plans to install packed tower aeration at the Willamette source first, because it serves the greatest number of customers. Thurston and Weyerhaeuser wellfield are scheduled to have corrosion treatment installed in 2011 and 2012, respectively.

Since treatment will be phased in over three years, DHS agreed to maintain the current three year compliance monitoring schedule. In 2012, the required sampling will be to start the two sampling periods per year as prescribed in the rule. Reduced monitoring may be considered when corrosion optimization is demonstrated. In approving the three year compliance monitoring schedule and the phased installation of corrosion control treatment, DHS required SUB to develop an interim monitoring plan (for DHS approval) to monitor the success of each installation as it is installed. Very few of the LCR sample locations are in the area served by the Willamette or Weyerhaeuser sources. Representative sample locations with copper service pipe will need to be identified and sampled prior to operating the systems.

SUB has 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 and SUB has removed all lead goosenecks when they are discovered as part of maintenance and repair programs. It is recommended that SUB develop a schedule for identifying services with lead fittings and their replacement.

4.11 Synthetic Organic Chemicals and Inorganic Chemicals

The initial list of 83 contaminants that the EPA is required to regulate contains many synthetic organic chemicals (SOCs) and inorganic chemicals (IOCs). EPA identifies the regulation of groups of SOCs and IOCs by phases. 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 rules provide final MCLGs and MCLs for chemicals listed in the Phase II and Phase V Rules, respectively. The final rulemaking also includes monitoring, reporting, and public notification requirements for the SOCs. DHS requires two quarters of monitoring (second and third quarter) once every 3 yrs unless there are detections. In that case, quarterly sampling may be required. Following the initial sampling period and provided there are no detections, a utility may receive a waiver to extend the sampling period to once every 6 yrs or once every 9 yrs if certain conditions are met.

Monitoring is required at each source for two quarters (second and third quarter) once every 3 yrs for each source, unless a monitoring reduction is approved. Dioxin and acrylamide/epichlorohydrin are only sampled if notified to do so by DHS. New sources are required to sample quarterly for one year before qualifying for reduced monitoring.

As part of the Phase II rule, EPA established requirements for monitoring of unregulated contaminants. Monitoring of the 30 contaminants was required unless a vulnerability assessment determined the system is not vulnerable. Unregulated contaminants do not have MCLs or current regulatory requirements. The results from nationwide sampling of these contaminants (chemicals, biologic pathogens, viruses, radionuclides, endocrine disruptors, etc.) will provide occurrence data to assist in the determination of the need to regulate and establish MCLs or treatment techniques.

The Unregulated Contaminant Monitoring Rule 1 (UCMR1) identified 28 contaminants that large water suppliers were required to sample for during the 2001-2005 sampling cycle. UCMR2 identified 26 contaminants that large water suppliers are required to sample for during the 2007-2010 sample cycle. EPA is currently working to develop a broader, more comprehensive approach for selecting contaminants for future the Contaminant Candidate List (CCL).

Impact on SUB and RWD. In response to DHS, DEQ, and EPA requirements, and to be proactive in protecting their supply sources, SUB, RWD, and the City of Springfield jointly developed a Drinking Water Protection Program. In 1992, wellhead protection areas were determined for the Weyerhaeuser Wellfield as a demonstration project funded by SUB and EPA. This project included an inventory of potential contaminant sources near that wellfield. Since that time, SUB and RWD have completed wellhead protection area delineations for all system wellfields. Updates to the delineations for Weyerhaeuser and the Willamette Wellfields have subsequently been completed to address additional information that became available after the initial work was completed. The Willamette Wellfield delineation update was certified by DHS and adopted by SUB, RWD and the City of Springfield. The Drinking Water Protection Plan is currently going through the Lane County process for adoption in those areas outside the city limits but inside the urban growth boundary.

The Drinking Water Protection Plan was adopted in 2000 and a Drinking Water Protection Overlay area was implemented by the utilities and the City of Springfield. It is recommended that SUB and RWD continue to provide oversight and support to the City of Springfield and aggressively work to protect their source water supply areas.

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.

Based on detection of low levels of pentachlorophenol (penta) and trichloroethylene discovered in monitoring wells up gradient of the Weyerhaeuser Wellfield in the early 1990s, there was concern that these contaminants could migrate through the aquifer toward the supply wells. In 2008, International Paper purchased the property with the source of the contamination from Weyerhaeuser and assumed the responsibility for the corrective. IP is currently monitoring this wellfield on a regular basis for these contaminants.

In 1996, Weyerhaeuser Company completed construction of a granular activated carbon adsorption treatment plant as insurance against contamination of this wellfield. In late 2007 trace amounts of penta were detected in the wells and the decision was made by Weyerhaeuser and International Paper to activate the carbon treatment system to protect the public water supply, even though the detected amounts did not trigger agreement concentrations to activate the plant. The plant was commissioned in May 2008 and continues in service today. As discussed earlier, this plant could be modified to fulfill requirements of the SWTR, should the wellfield source be classified by the state as under the influence of surface water.

So far there have been no detections of SOCs in the combined raw water source samples from any SUB or RWD wellfield. This includes sampling completed by SUB for the unregulated contaminants in UCMR1 and UCMR2 at each of SUB's sources, including the Weyerhaeuser Wellfield. The penta detections at the Weyerhaeuser Wellfield were in individual wells at very low concentrations that were not detectable in the combined flow from all the wells.

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 clean up where contaminants are discovered in the aquifer and support other state and federal agencies efforts that help remove contaminant risks in the drinking water supply areas.

SUB and RWD have received monitoring reductions for all SOCs except penta at the Weyerhaeuser source. It is recommended for SUB and RWD to continue voluntary annual monitoring at the SP/Maia, Q Street, I-5/Sports Way and Willamette sources of supply.

The SP/Maia Wellfield has a history of detections and demonstrated aquifer contamination risks. These wells are located in an area of heavy industry and significant chemical use and storage and sampling in 2009 at the SP2 monitoring wells have identified toluene contamination in the deep aquifer. No detections have been observed at the SP/Maia well heads. 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 has been historically 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 are new stormwater infiltration facilities from nearby businesses and a city stormwater outfall.

The Willamette Slow Sand Filtration Plant is fed by both an intake on the Middle Fork Willamette River and uses well water that is surface water influenced. Significant new stormwater outfalls are under construction and are being planned as development occurs along Jasper Road and in the Jasper/Natron area. The Mid 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. The Slow Sand Filter Plant is not designed to treat SOCs or VOCs and it is a critical part of plant operation to avoid bringing chemically contaminated water into the plant. The only way to address this risk is to monitor frequently and to continue to participate in the emergency response and notification system which is coordinated by SUB's Drinking Water Protection Coordinator. The purpose of the notification system is to provide notification when there is a chemical spill so that actions can be taken for clean-up and treatment plant responses to avoid contamination.

SUB is a participant in the McKenzie Emergency Response network that was organized and managed by EWEB as part of their drinking water protection efforts. It is recommended SUB continue to be an active partner in this effort. This work has established a nationally recognized emergency response system that uses a GIS based planning and response that is updated and practiced at least twice a year. The GIS mapping and program elements are on the Water Quality Manager's laptop computer so that it can be used in the field to assist with the implementation of protection measures. These protection measures will continue to be an important part of protecting SUB and RWD's wellfields adjacent to the McKenzie and SUB's future expansion and use of its McKenzie River water rights.

4.12 Volatile Organic Compounds

The final MCLs, MCLGs, and monitoring requirements for several VOCs were promulgated on June 19, 1987. Several VOCs appear on the list of 83 contaminants for which EPA was required to establish MCLs and MCLGs. Systems are still required to monitor for those VOCs that are not otherwise regulated.

EPA has determined that packed tower aeration (PTA) and GAC are Best Available Technologies (BATs) for VOCs. Sampling is required once every three years at all groundwater sources and once a year at Surface Water sources unless monitoring reductions have been granted.

Impact to SUB and RWD. As described in the preceding section, trichloroethylene has been detected in monitoring wells up gradient of the Weyerhaeuser Wellfield. In response to this and the penta detection, a GAC treatment plant has been constructed that will be used should this contaminant or others reach the wellfield.

Low levels of 1,1,1 Trichloroethane (1,1,1 TCA) were detected in 1990 sampling at the SP No.1 well. The highest level detected was 2.6 µg/L, compared to the MCL of 200 µg/L. However, in response, SUB shut down this well for a two-year period. The well was operated on a last-on, first-off basis, because continued monitoring identified that the contamination was dissipating. A sample collected from the same wellfield on August 21, 1996, had a level of 0.0006 µg/L. Since 1998 there have been no detections of 1,1,1 TCA and the well has been operated normally to respond to system demands. Recent low level detections of toluene at the SP No.2 monitoring wells have reaffirmed SUB and RWD's need for continued monitoring and protection efforts. SUB is working with the DEQ to try to determine the source of this contamination.

SUB and RWD have been proactive in developing drinking water protection programs to prevent contamination, but the detection of a VOC at one well and a VOC and SOC near another wellfield indicate that groundwater contamination is an ongoing concern for SUB and RWD. The potential exists for having to use organics removal treatment or abandon wells if contamination occurs. The nature of groundwater movement and the difficulty of tracking its movement, combined with the very low concentrations of compounds present uncertainties to utilities relying on groundwater.

4.13 Arsenic

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 0.050 mg/L down to 0.010 mg/L in 2001, with compliance required in 2006.

Impact to SUB and RWD. It is anticipated that the arsenic regulations will have no impact on SUB and RWD because arsenic levels in local wells and rivers are expected to remain near zero unless influenced by an external source of contamination in the future.

4.14 Sulfate

The Sulfate Rule was originally proposed on December 20, 1994. The Rule includes both an MCL and an MCLG equal to 500 mg/L. Sulfate's health effect (digestive system upset) is acute, relatively short-term, and affects only a small portion of the population. Therefore, the EPA proposed two alternative approaches for regulation. The first option defines a combination of public education, public notification, and provision of

alternative water for targeted populations. The second option is central treatment using BAT (ion exchange, reverse osmosis, and electro dialysis). A final rule was due in May 1996, but was delayed pending the 1996 SDWA Amendments. The 1996 amendments gave the EPA administrator discretion on whether or not to regulate sulfate. The decision to regulate it has not been made yet and is still under consideration. A Secondary MCL has been adopted by Oregon DHS at 250 mg/L. One set of samples were required by 1993 and SUB and other systems in the state that had results lower than the Secondary MCL were provided monitoring reductions.

Impact to SUB and RWD. It is not anticipated that a revised sulfate regulation would have any impact on SUB or RWD, because measured levels have ranged from non-detect to 8 mg/L.

4.15 Fluoride

The current MCL for fluoride (4 mg/L) became effective October 1987. EPA commissioned the National Academy of Sciences to review health effects and risk assessments for fluoride, which was completed in 1993. They determined that the current MCL is adequate for the protection of public health. Therefore, it is not anticipated the EPA will propose changes to the fluoride MCL.

Impact to SUB and RWD. SUB and RWD do not fluoridate their water and this regulation should not affect the supply, because natural fluoride levels are well below this MCL.

4.16 Radon/Radionuclides

EPA proposed a standard of 300 picocuries per liter (pCi/L) in 1991. 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, 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.

Impact to SUB and RWD. It is anticipated that a final radon regulation will not have an impact on SUB and RWD because radon levels are low in this geographic area. Samples from system wells and reservoirs have shown very low or non-detects for currently regulated radionuclides.

4.17 Chlorine Handling Requirements

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.

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 2400 lb limit that triggers Risk Management Plans for all chlorination facilities. 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 hazardous 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.

4.18 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. As part of the new Groundwater Rule, move each source from triggered source monitoring to compliance monitoring after installing chlorine residual analyzers at the end-of-detention location for each wellfield
3. Develop a schedule for identifying services with lead fittings and their replacement
4. Continue to be vigilant in efforts to monitor for contaminants, monitor chemical uses, require protective measures for chemical storage and use, insist on appropriate clean up where contaminants are discovered in the aquifer. Also support state and federal agencies efforts to reduce contaminant risks in drinking water supply areas
5. Continue periodic monitoring for VOCs in the SP No.2 monitoring well and work with DEQ to determine the source of this contamination
6. Begin evaluation of conversion from chlorine gas disinfection to liquid hypochlorite disinfection.

SECTION 5

PLANNING AND ANALYSIS CRITERIA

5.1 Purpose

The purpose of this section is to document criteria for analyzing storage needs based on AWWA guidelines and criteria applied by similarly sized communities in the region. Of specific interest is emergency storage needs based on supply redundancy and acceptable risk. Also included are distribution system analysis criteria, service pressure criteria, fire flow criteria and a discussion of hydraulic modeling conditions. Table 5-1, Existing SUB/RWD Storage Reservoirs, presents information about reservoirs owned and operated by both Springfield Utility Board (SUB) and Rainbow Water District (RWD).

**Table 5-1
Existing SUB/RWD Storage**

Location	System	Height (ft)	Diameter (ft)	Overflow (ft)	Capacity (MG)	Material
Willamette Heights No.3	West	24	103 x 132	658	2.24	Concrete (out of service)
Willamette Heights No.2	West	32	104	670	2.00	Steel
Kelley Butte	North	40	65	670	1.0	Post Tens. Concrete
Moe	North	48	125	670	4.0	Post Tens. Concrete
South 57th No. 1	East	32	74	670	1.0	Steel
South 57th No. 2	East	32	90.5	670	1.5	Steel
South 67th	East	32	92	670	1.5	Steel
Sub-Total 1ST level					11.0	
South 72nd	East	32	28.5	765	0.15	Steel

Location	System	Height (ft)	Diameter (ft)	Overflow (ft)	Capacity (MG)	Material
Sub-Total 2nd Level					0.15	
South Hills	East	27	102	980	1.5	Post Tens. Concrete
Sub-Total 3rd Level					1.5	
TOTAL					12.65 MG	

5.2 Storage Criteria Methodology Overview

A general review of local and regional approaches to establishment of water storage requirements was completed to determine the most appropriate methodology to apply to the SUB’s water system. Two specific approaches were identified for consideration:

- Method No. 1 – Three-Component Methodology
- Method No. 2 – Washington State Department of Health Methodology

A discussion of the key elements, advantages and disadvantages of each method is presented below.

5.2.1 Three-Component Methodology (Method No. 1)

The three-component methodology considers the three primary uses, or components, of distribution system storage and considers the volume of storage necessary for each of those components. The total volume of storage required is the sum of the three component volumes. The three components are:

- *Operational Storage:* Operational storage is required to meet water system demands in excess of delivery capacity from the supply source to system reservoirs. Operational storage volume should be sufficient to meet normal system demands in excess of the maximum day demand (MDD) and is generally considered as the difference between peak hour demand and MDD (on a 24-hour duration basis).
- *Fire Suppression Storage:* Fire suppression storage should be provided to meet the single most severe fire flow demand within each pressure zone. The required fire suppression storage volume is based on the recommended fire flow rate and the expected duration of that flow.

- *Emergency 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. Provisions for emergency storage in other systems vary from none to a volume that would supply a maximum day's flow or higher.

The three-component methodology has historically been used by many water providers in Oregon to establish the water storage requirement. The primary advantage of this methodology is that it is fairly simple to apply and allows policymakers latitude in establishing emergency storage requirements relative to acceptable levels of risk. This simplicity and flexibility are also this methodology's major disadvantage. Emergency storage volume requirements are typically subjective and based on typical industry practice rather than a rigorous, methodical assessment of vulnerability and risk.

5.2.2 Washington State Department of Health Methodology (Method No. 2)

The Washington State Department of Health (DOH) has developed and documented a multiple-component methodology for determining water storage requirements that is used by all water system providers in the State of Washington. This methodology is similar to the approach used in SUB's most recent water system master plan and the three-component methodology described above. This method varies from the recent master planning approach and the three-component methodology in its consistent and objective application of calculated formulas with defined variables, in particular when calculating the standby (emergency) storage component.

This methodology is similar to Method No. 1 in that it considers several storage components and the total water storage volume required is based on the sum of the individual components. This methodology contains five (5) storage components that must be considered and also includes a structured, objective process for determining the storage volume needed for each component. The five (5) components and the method for calculating the storage volume required for each is presented below:

- *Equalizing Storage:* When the source pumping capacity cannot meet the periodic daily (or longer) peak demands placed on the water system, equalizing storage must be provided as a part of the total storage for the system and must be available at 30 pounds per square inch (psi) to all service connections. The volume required depends upon several factors, including peak diurnal variations in system demand and source production capacity. The equation for calculating the required volume of equalization storage is presented below:

$$ES = (PHD - Q_s)(150 \text{ min.}), \text{ but in no case less than zero}$$

Where: **ES** = Equalizing storage component, in gallons

PHD = Peak hourly demand, in gpm

Q_s = Sum of all installed and active source of supply capacities, except emergency sources of supply, in gpm

- **Operational Storage:** Operational storage is the volume of the reservoir devoted to supplying the water system while, under normal operating conditions, the sources of supply are in “off” status. The operational storage volume should be approximately 2.5 times the capacity of the largest pump supplying the system, or the volume of water in the reservoir between the height of the “pump on” and “pump off” set points, whichever is greater.

- **Standby Storage:** The purpose of standby storage, or emergency storage, is to provide a measure of reliability should sources fail or when unusual conditions impose higher demands than anticipated. The volume recommended for systems served by one (1) source may be different than for systems served by multiple sources, as described in the following equations:
 - Water Systems with a Single Source: The recommended volume for systems served by a single source of supply is two (2) times the system’s average day demand (ADD) to be available to all service connections at 20 psi.

$$SB_{TSS} = (2 \text{ days})(ADD)$$

Where: **SB_{TSS}** = Total standby storage component for a single source system, in gallons

ADD = Average day demand

- Water Systems with Multiple Sources:** The recommended volume for systems served by multiple sources should be based upon the following equation:

$$SB_{TMS} = (2 \text{ days})(ADD) - t_m (Q_S - Q_L)$$

Where: **SB_{TMS}** = Total standby storage component for a multiple source system, in gallons

ADD = Average day demand for the system

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

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

t_m = Time that remaining sources are pumped on the day when the largest source is not available, in minutes (Unless restricted otherwise, this is generally assumed to be 1,440 minutes)

- Fire Suppression Storage:** Fire suppression storage should be provided to meet the single most severe fire flow demand within each pressure zone. The required fire suppression storage volume is based on the recommended fire flow rate and the expected duration of that flow. A further discussion of fire flow requirements is presented later in this section.
- Dead Storage:** Dead storage is the volume of stored water not available to all customers at the minimum design pressure. Should dead storage exist in the system, this volume should be subtracted from the effective storage volume of existing facilities. For the purposes of the SUB water system master plan, dead storage should be defined as water at a level in the reservoir that would supply water at a pressure of less than 20 psi to the highest level customer service in the pressure zone supplied by the reservoir.

The five-component methodology mandated by the Washington State DOH is advantageous to use because it is objective, easy to apply and understand, and provides a standardized, industry-accepted approach to determining storage needs.

This methodology does not directly consider variations in system configuration, emergency interties or reduced levels of service under emergency conditions in determining appropriate system storage requirements.

In addition to the methodologies presented above, certain water system master planning approaches have also used a method that uses a multiple of ADD to determine overall storage need. In water system planning work completed in Oregon over the previous decades a multiple of three (3) ADD have been used. While this approach offers a simplified and easy-to-apply methodology, it can tend to be too general and not reflect how systems actually function and perform.

The current SUB master plan evaluated emergency storage needs for each individual system and for each service level with gravity storage facilities. Emergency storage recommendations were based on the identification of the most likely and critical emergency condition that could occur in the service area. The development of reserve supply capacity was also considered as an economical alternative to providing emergency storage in some instances to mitigate for the mechanical failure of the largest groundwater supply well. Consideration of development of standby groundwater supply facilities, if determined to be economical and technically feasible, is a reasonable approach to offsetting standby storage needs and should be considered in coordination with the supply source assessment.

In addition, mandatory water demand curtailment was considered as a further strategy for select higher elevation service levels in lieu of providing the full recommended emergency storage volume. It is MSA's experience that planning for mandatory water curtailment and reduced level of service, if not applied uniformly, could result in customer complaints and concerns over ratepayer inequity.

It is recommended that SUB use Method No. 2 to evaluate system storage needs. This approach is recommended with the understanding that it will be applied individually to SUB's three existing service zones and to each service level.

5.3 Distribution System Analysis Criteria

SUB's water distribution system should be capable of operating within certain system performance limits, or guidelines, under varying demand and operational conditions. The recommended criteria used for this plan are based on the following performance guidelines, which have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines and operational practices of similar water providers. The performance guidelines and assumed conditions for the analysis are as follows:

- The distribution system should be capable of supplying the peak hourly demand while maintaining minimum service pressures of no less than approximately 80 percent of system pressures normally experienced under average day demand conditions. 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 recommended fire flow to a given location while, at the same time, supplying the maximum daily demand (MDD) and maintaining a minimum residual service pressure at any meter in the system of 20 psi. This is the minimum water system pressure required by the State of Oregon Department of Human Services, Drinking Water Program. The system should meet this criterion with the equalization and fire suppression storage volume of reservoirs depleted.

Typically, proposed or new water mains should be at least eight (8) inches in diameter in order to supply minimum fire flows. In special cases, six (6)-inch diameter mains are acceptable if no fire hydrant connection is required, there are limited services on the main, the main is dead-ended and looping or future extension of the main is not anticipated.

5.4 Service Pressure Criteria

Water distribution systems are typically separated into pressure zones or service levels to provide service pressures within an acceptable range to all customers. As previously discussed, the SUB's existing water service area distribution system is divided into three geographic supply zones which include a total of six (6) major service levels, or pressure zones. Pressure zones are usually determined by ground topography and designated by overflow elevations of water storage facilities or outlet settings of pressure reducing facilities serving the zone. Typically, water from a reservoir will serve customers by gravity within a specified range of ground elevations so as to maintain acceptable minimum and maximum water pressures at individual service connections. When it is not feasible or practical to have a separate reservoir serving each pressure zone, pumping facilities or pressure reducing facilities are used to serve customers in different pressure zones from a single reservoir.

Generally, 80 psi is considered the desirable upper static pressure limit and 40 psi the lower limit. Whenever feasible, it is desirable to achieve the 40 psi lower limit at the point of the highest fixture within a given building being served. Conformance to this pressure range may not always be possible or practical due to topographical relief, existing system configurations and economic considerations. Maximum pressures typically should not exceed 100 psi. Table 5-2 summarizes the service pressure criteria used in the analysis of the water system.

**Table 5-2
Recommended Service Pressure Criteria**

Condition	Pressure (psi)
Minimum Service Pressure Under Fire Flow Conditions	20
Minimum Normal Static Service Pressure	40
Desired Maximum Static Service Pressure	80

5.5 Fire Flow Criteria

While the water distribution system provides water for domestic uses, it is also expected to provide water for fire suppression. The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the normal maximum day demand present in any local area. Adequate hydraulic capacity must be provided for these large occasional fire flow demands.

Current and historical planning for the SUB system has considered fire suppression flow requirements based on development type. Residential fire flow requirements have been 1,500 gallons per minute (gpm) and industrial/commercial fire flow requirements are 3,500 gpm. This is consistent with the typical upper limit of fire suppression flow requirements for individual developments of these types as established in the 2007 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).

It is recommended that the utilities continue to apply 1,500 gpm and 3,500 gpm fire suppression requirements for residential and commercial/industrial land uses, respectively.

5.6 Recommended Modeling Conditions

The analysis of the existing and proposed system should assess the distribution system’s ability to perform while maintaining system pressures at acceptable levels for operation of typical customer fixtures and irrigation systems. The modeling conditions should be based on demand scenarios:

- Current and future peak hour demand
- Current and future maximum day demand (MDD) with fire suppression flow

The analysis of the existing system should be performed with current water demands applied to the system and the analysis of the proposed improved system was performed with estimated water demands at saturation development applied to the system.

For peak hour modeling it should be assumed that system reservoirs have reduced water levels reflecting no available operational storage or equalization storage.

All fire flow modeling was performed assuming that the system's primary storage reservoirs are at levels reflecting no available operational, equalization or remaining fire storage. Under these conditions the system must be capable of providing the recommended fire flow to a given location while at the same time supplying the MDD and maintaining a minimum residual service pressure of 20 pounds per square inch (psi) at all services in the system.

Analysis of the existing and proposed system should assume that all supply necessary to meet the maximum daily water demands within each pressure zone is functioning under normal delivery conditions.

5.7 Modeling Scenarios

The development of modeling scenarios related to distribution system performance should primarily be focused on a structured evaluation of the system's ability to meet performance requirements under peak hour conditions and under MMD with a concurrent fire flow event. SUB's hydraulic modeling software can be used to automatically perform a system wide analysis of these two conditions for all nodes. The results of this analysis will indicate where the system cannot meet minimum pressures.

5.8 Summary

This document outlined recommended analysis criteria for system storage needs, distribution system performance, fire flow needs and distribution system modeling conditions.

SECTION 6

SUPPLY SOURCE ANALYSIS

6.1 General

This section documents the evaluation of the Springfield Utility Board (SUB) water system supply source requirements for both the entire system as well as supply requirements for each of the three individual systems: North, East and West. Included in this section is a review of the supply system options available to SUB, criteria for evaluating these alternatives and a qualitative analysis of two supply alternatives.

6.2 Background

Over time, SUB has developed diverse supplies throughout the water system service area to meet existing water demands. The majority of these supply sources are groundwater sources. As water demands continue to increase with population growth it has become apparent that continued expansion of these groundwater supplies is not feasible, requiring a greater reliance on surface water in the future. The long term sustainability of additional groundwater development is uncertain, and the ability to acquire additional water rights to support further development of groundwater is unlikely.

6.3 Supply Source Alternatives

The SUB water service area includes two significant surface water sources, the Willamette River and the McKenzie River. SUB holds water rights for both of these sources and has identified them as the key water resources to meet long term water supply needs. These two options are discussed in further detail below.

Alternative 1 – McKenzie River Supply

SUB holds a permit from the Oregon Water Resources Department (OWRD) dated January 2, 2007 for water rights for 23.16 mgd (35.9 cfs) of supply from the McKenzie River at the Thurston Well field site. The stipulated time allowed by the permit for completing construction necessary to utilize this water is 20 years. To date, no development of this source has been completed. It is SUB's intent to develop this right prior to the 2027 deadline if this source is selected as the most appropriate to develop to meet near term or long term water supply needs. Development of this source will require construction of a raw water intake and treatment of surface water, including at a minimum filtration and disinfection, as well as new transmission facilities.

Alternative 2 – Willamette River Supply

SUB holds water rights for 13.0 mgd (20.0 cfs) of surface water on the Willamette River at a diversion point near the Willamette Wellfield and has developed that right to 10.08 mgd (15.5 cfs). An extension for the undeveloped 2.92 mgd (4.5 cfs) portion of this surface water right is on a voluntary administrative hold with OWRD. SUB will ask for a review of this extension once there is more clarity on the fish persistence issue for the Willamette River.

SUB also holds groundwater rights for 19.85 mgd (30.55 cfs) at the same location.

The developed portion of both the surface and groundwater rights is treated as surface water at SUB's Slow Sand Filter Plant. The existing reliable capacity of the treatment facilities is estimated to be approximately 6.6 mgd. Future development of this source up to the total water right quantity will require expanded intake facilities either as a raw water intake on the river or a collector well as well as expanded treatment facilities. Future treatment of an expanded Willamette River source is anticipated to be achieved using technology other than slow sand filtration, such as membrane filtration. This assumption is made given the industry accepted limitations of slow sand filtration and observation of performance and operation of this technology by SUB.

6.4 Potential Interim Source Expansions

Given the anticipated need for development of expanded source capacity to meet growing system needs and the significant capital cost and timeline associated with development of the two major source options, SUB has identified potential, smaller capacity supply expansions to meet near term supply needs. These options will be considered further in light of demand considerations, cost, and timing in Section 8.

These options include:

- The use of Thurston Well No. 2, with the addition of ultraviolet disinfection, for an increase in source capacity of approximately 1.40 mgd.
- The addition of a fifth filter bed at the Willamette Slow Sand Filter to increase overall capacity by approximately 2.2 mgd.
- The addition of a small increment of another treatment technology at the Willamette Wellfield, such as membrane filtration, which was shown to be effective in the study "Water Treatment Evaluation Alternative Technologies Report" by Black & Veatch, December 2008.

6.5 Source Planning and Reserve Capacity

As part of adopting the 1999 Water Master Plan, SUB has adopted a policy of maintaining a 10 percent reserve supply source capacity. This policy allows for timely development of new supply sources to meet increasing demands associated with

growth and to provide a level of insurance against unexpected increases in water demands. Incurion into the 10 percent reserve is a decision based on acceptable risk balanced with the financial constraints placed on the utility.

Reserve capacity is also provided to ensure reliable service in the event of mechanical equipment failure or power outages. If the total daily demand on a high use day exceeds the source capacity, storage reservoirs are unable to refill completely during the night. A series of high use days could further deplete storage, leaving inadequate water for fire or emergency. Compared to other communities, 10 percent reserve capacity is relatively low, but is justified based on the diversity of the SUB/RWD supply, a history of short duration power outages and the existence of interties, both inter-system and intra-system. Source needs discussed in this section will be presented both with and without a 10 percent reserve capacity.

In the last 20 years, SUB has made numerous improvements to the inter-system transmission mains that facilitate moving water from one system to another. This ability to import or export water from one system to another provides more flexibility to share production capacity between systems.

Based on current concerns regarding the available reliable capacity of the SP/MAIA wellfield with both wells running for extended durations and considering the risks posed by the potential migration of nearby groundwater contamination, it is recommended that source need and water supply planning be based on the existing source capacity with the SP well out of service.

6.6 Overall Source Needs

Table 6-1 summarizes maximum day demand projections for the entire SUB system with and without the 10 percent de-rating of source for current and future conditions along with existing source capacity. By the end of the 20 year planning horizon, the overall source deficit will increase to approximately 5.26 mgd with the reserve, or 2.21 mgd without the reserve capacity.

**Table 6-1
Overall Source Need Summary**

YEAR	MAXIMUM DAY DEMAND w/out Loss Reduction (mgd)	EXISTING SOURCE CAPACITY (mgd)	ADDITIONAL SOURCE NEED, w/ 10% RESERVE (mgd)	ADDITIONAL SOURCE NEED, w/o 10% RESERVE (mgd)
2010	23.54	28.27	--	--
2020	26.96	28.27	--	--
2030	30.48	28.27	5.26	2.21

Figure 6-1, Overall Source Need, illustrates this anticipated need for source, with and without the desired 10 percent supply reserve capacity. In the year 2020 the projected MDD equals 90 percent of the available source with the planned addition of 1.4 mgd capacity from Thurston Well No. 2, thus providing a 10 percent reserve.

6.7 Source Needs by System

6.7.1 East System

The existing total capacity of the East system without the SP well is 7.8 mgd. The MDD for this system is projected to increase from approximately 8.97 mgd in 2010 to 13.14 mgd by the year 2030, the end of the 20-year planning horizon. The East system currently lacks adequate supply to meet existing MDD and lacks reserve capacity. This deficit is currently made up by surplus capacity in the West system that is transmitted to the East system via the Eastside Pump Station and surplus capacity in the North system. Figure 6-2, East System Source Need, illustrates the comparison of supply and demand.

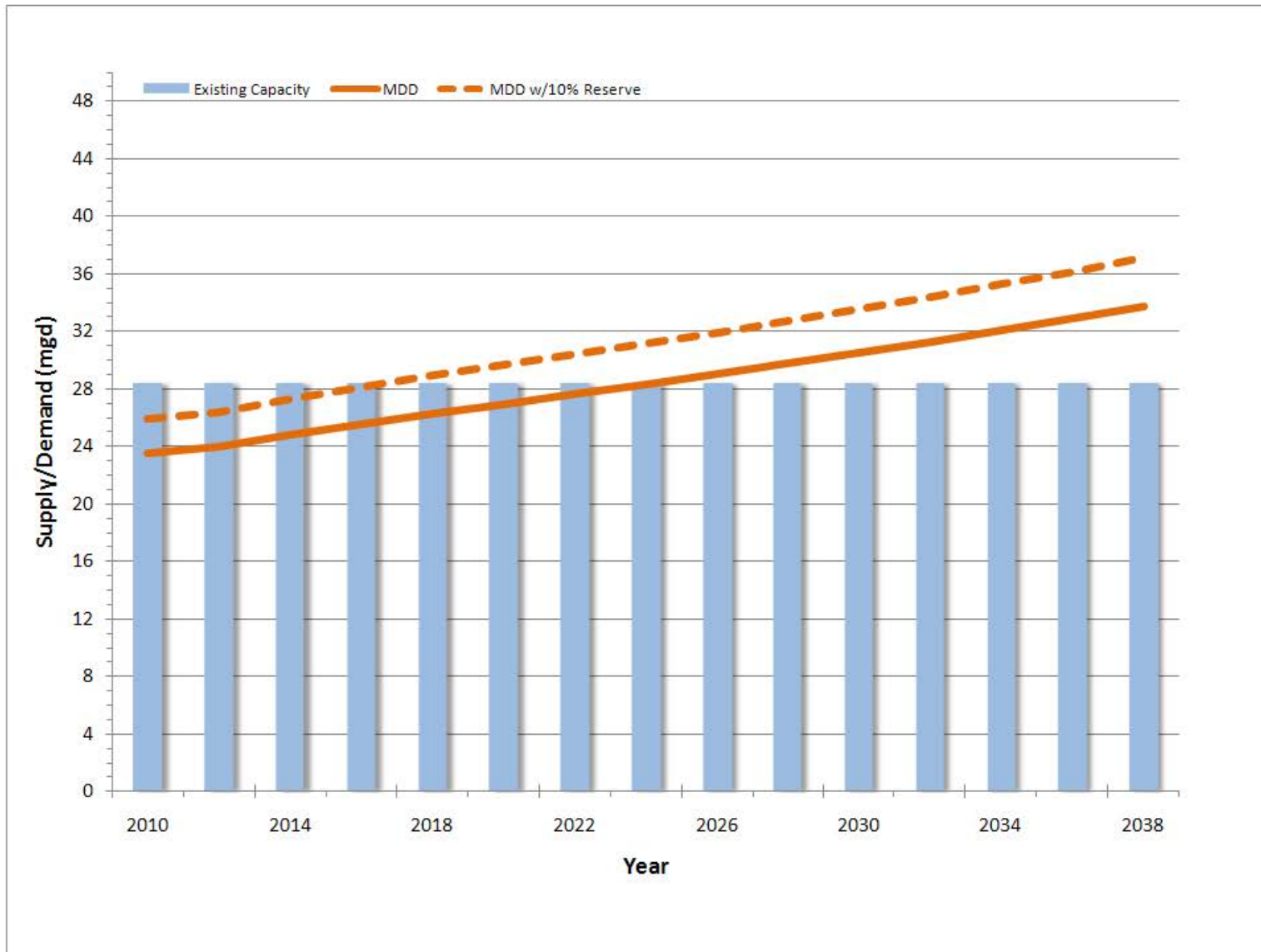
6.7.2 West System

The existing total capacity of the West system is 6.6 mgd. The MDD for this system is projected to increase from approximately 5.56 mgd to 5.67 mgd by the year 2030. The West system has adequate capacity through the planning horizon to meet MDD with the 10 percent reserve capacity. See Figure 6-3, West System Source Need.

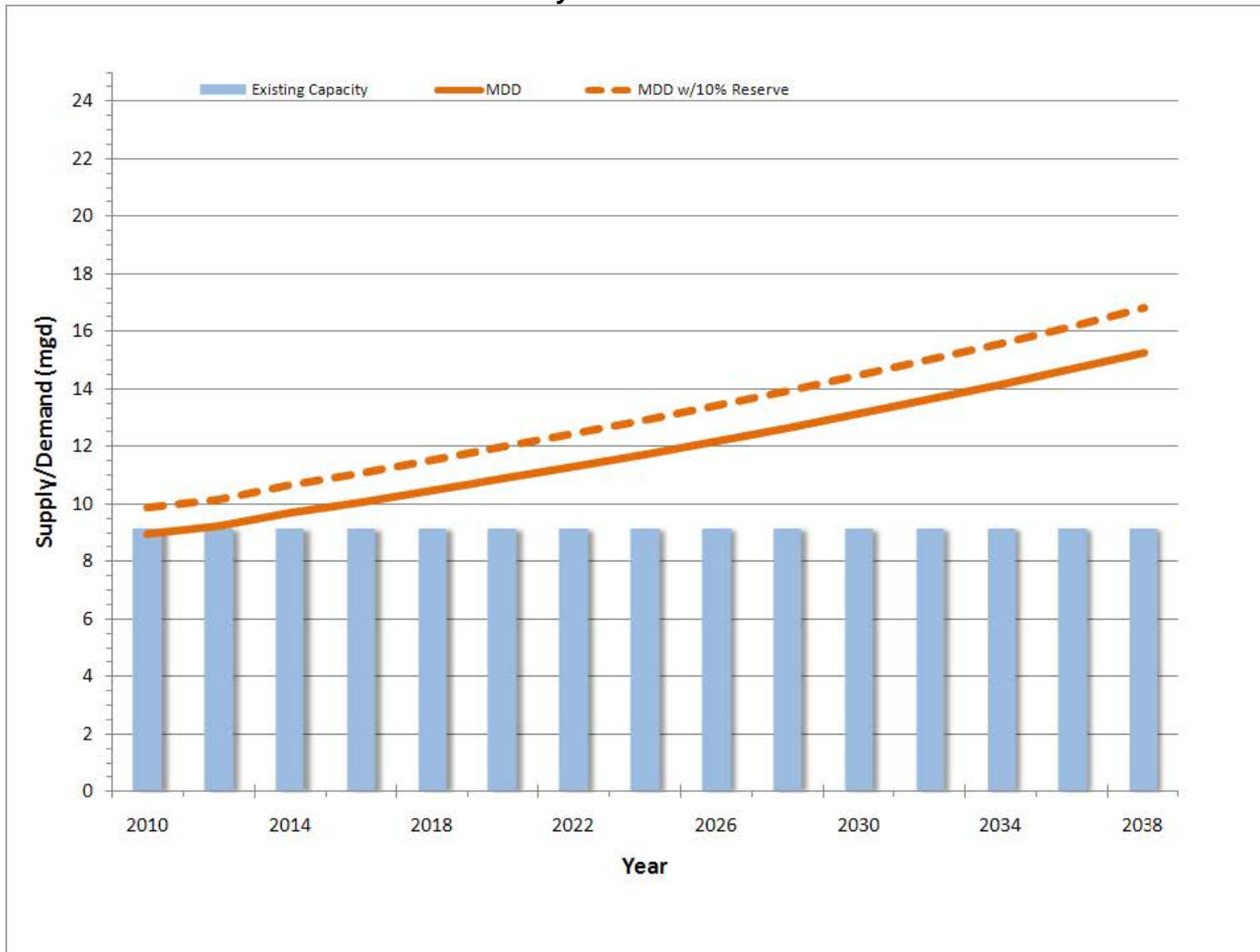
6.7.3 North System

The existing total capacity of the North system is approximately 11.82 mgd. The MDD for this system is projected to increase from approximately 9.01 mgd to 11.67 mgd by the year 2030. The North system has adequate capacity through approximately 2022 to meet MDD with a percent reserve, but will have no reserve capacity beyond 2030. See Figure 6-3, North System Source Need.

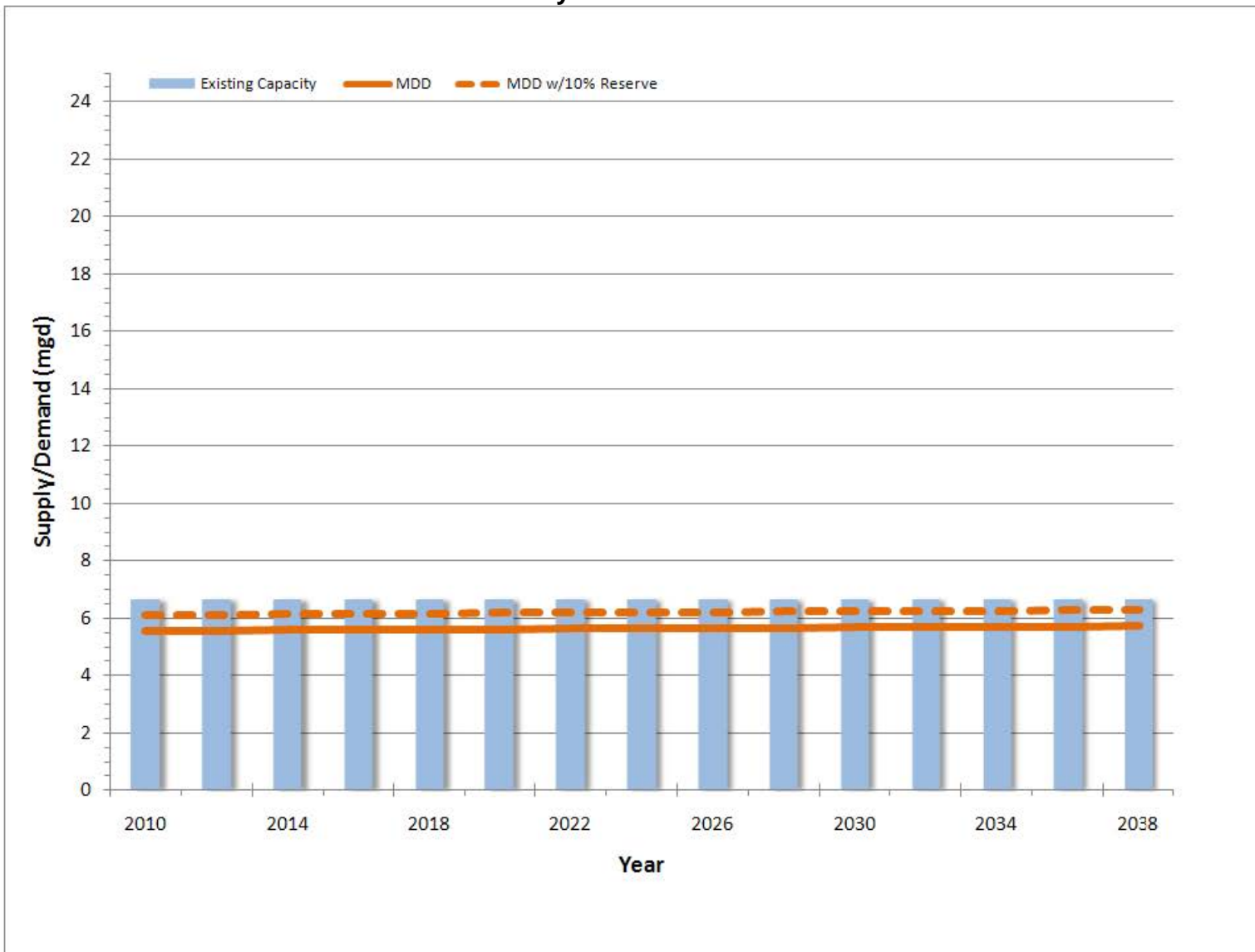
**Figure 6-1
Overall Source Need**



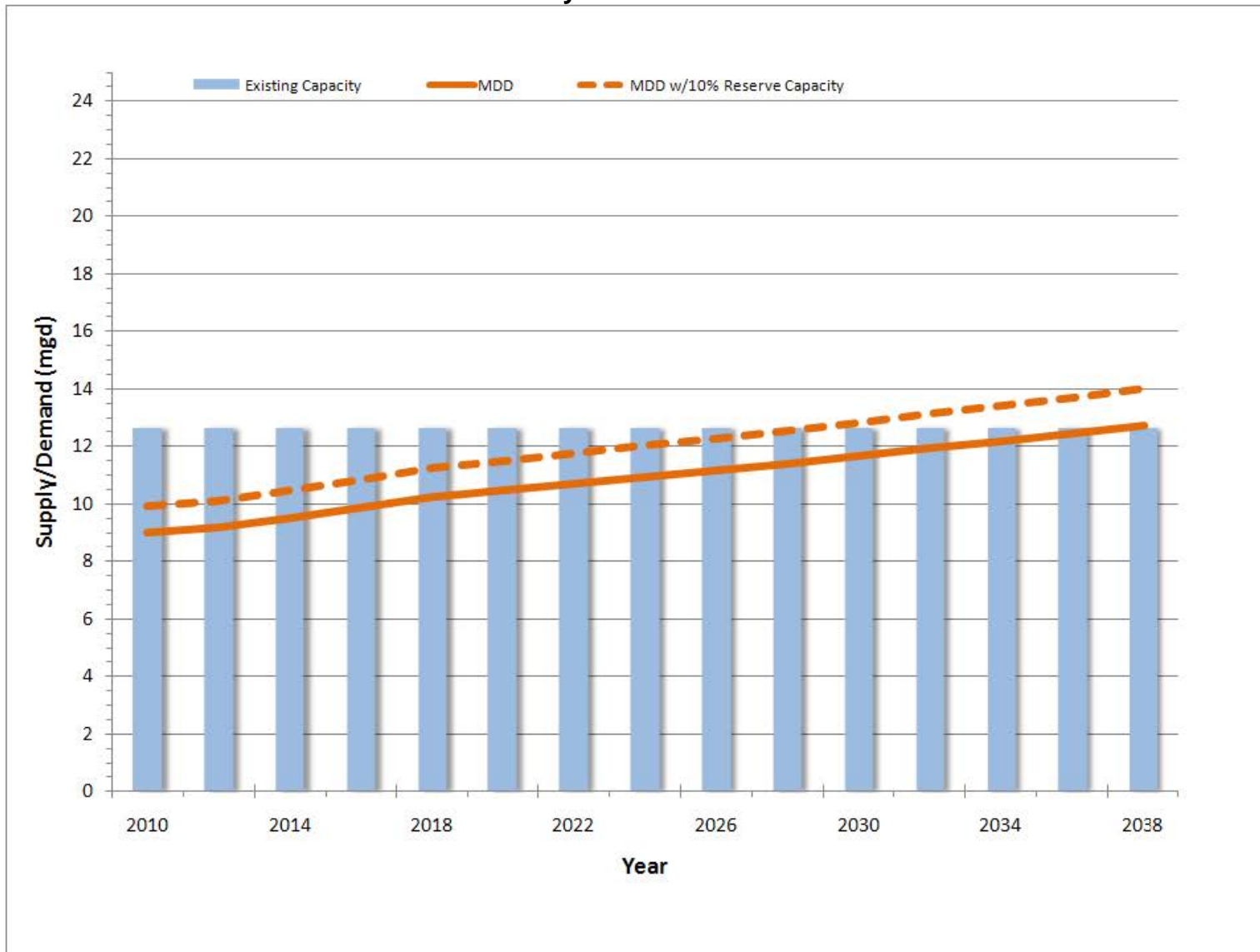
**Figure 6-2
East System Source Need**



**Figure 6-3
West System Source Need**



**Figure 6-4
North System Source Need**



6.8 Evaluation Criteria

Eight criteria have been developed to assist with the evaluation of the two major supply source alternatives. Scoring for each criteria are from 1 to 3, with 1 being the lowest, or least favorable score, and 3 being the highest, or most favorable score. A brief discussion of each criteria and how alternatives will be scored is presented below.

- *Project Cost* – The project cost criterion includes consideration of the capital project costs of an alternative relative to the other alternative. Each of three cost elements is scored for the alternatives. Lower cost alternatives score higher. The cost elements are:
 - Transmission System Improvement Project Cost
 - Storage Capacity Improvement Project Costs
 - Treatment Capacity Improvement Project Costs
- *Broader System Benefit* – For this criterion the potential for broader system wide benefit to system users beyond the individual SUB system service area is assessed.
- *Property Acquisition, Siting and Land Use/Permitting* – This criterion includes consideration of the availability of land for acquisition, the potential need to acquire land to implement the supply alternative. Further consideration is given to the level effort required to comply with land use restrictions, and the effort required to obtain required permits at the proposed new site, or at an existing site, based on the type and extent of improvement.
- *Source Redundancy* – The alternative that increases and improves system reliability through the development of an additional source scores higher under this criteria.
- *Flexibility of Implementation* – The ability to phase proposed improvements over a number of years is rated to reflect if an improvement alternative can be completed over time allowing capital needs to be spread over time, generally creating stable funding needs.
- *Regional Partnership Opportunity* – An alternative that offers the opportunity for regional partnering and cost sharing receives a high score under this criterion.
- *Protection of Undeveloped Surface Water Rights* – This criterion measures the risk of water right loss for a given alternative. A source option that, when developed, protects existing surface water rights, will receive a higher score.
- *Raw Water Quality* – This criterion considers if there are water quality characteristics that make one source more challenging to treat than the other.

6.9 Weighting

Each of the scoring criteria discussed above may have differing degrees of importance, or weight. Criteria are weighted on a scale of 1 to 3, with criteria considered as more important having a weighting of 3 and those of less importance a weighting of 1. Based on an initial screening of the criteria the weighting is summarized in Table 6-2.

**Table 6-2
Criteria Weighting Factor Summary**

CRITERIA	WEIGHT	COMMENT
Project Cost	3	Cost receives highest weighting to reflect the high need for economic efficiency.
Broader System Benefit	2	System benefit is of moderate relative importance
Property Acquisition, Siting and Land Use/Permitting	1	It is anticipated that property acquisition and permitting presents no fatal flaws and is lower relative importance
Source Redundancy	2	Development of a system with a redundant source is of moderate importance
Flexibility of Implementation	1	Considers process compatibility, expandability, timing, and other factors
Regional Partnership Opportunity	3	Developing solutions with regional participation and regional benefit has the highest weighting
Protection of Undeveloped Surface Water Rights	3	Protecting SUB's valuable senior water rights has high importance
Raw Water Quality	1	Raw water quality has a low weighting as the local raw water sources are considered of high quality

6.10 Water Supply Alternatives Evaluation

Each alternative is reviewed and discussed in context of the criteria presented above. Within these discussions both alternatives are scored for each of the criteria. Table 6-2 presents a summary of the scoring.

Alternative 1 – McKenzie River Supply

This alternative is evaluated and summarized as follows by the criteria listed above:

- *Project Cost* – The project cost for the McKenzie River Supply alternative includes is summarized as follows for each of the three project elements:
 - Transmission System Improvement Project Cost: 1
 - Storage Capacity Improvement Project Costs: 3
 - Treatment Capacity Improvement Project Costs: 2
- *Broader System Benefit* – The development of this alternative offers a higher system benefit than the Willamette Supply alternative by reducing storage capacity requirements as determined by the Method 2 storage analysis through this alternative’s addition of a new supply source. The storage analysis showed that overall system storage needs are reduced as the development of this alternative improves system performance under emergency conditions by the addition of alternative source capacity. This alternative receives a score of 3.
- *Property Acquisition, Siting and Land Use/Permitting* – SUB currently owns adequate property to fully develop, this alternative at the Thurston Wellfield site. Siting of this facility and acquiring permits needed for its development similar to Alternative 2. This alternative receives a score of 2.
- *Source Redundancy* – The development of the McKenzie River source increases overall system reliability and redundancy through the addition of a new source. This alternative receives a score of 3.
- *Flexibility of Implementation* – Based on current understanding of the McKenzie River water right permit requirements this alternative must be developed for beneficial use by year 2027. The inability to comply with these requirements may lead to future restriction of developable capacity under this right as part of future requests for Extension of Time. This requirement reduces the flexibility available to develop this supply alternative, resulting in a score of 1. If the water right limitations were not present, the development of this source could be implemented in phases. This water right could be partially perfected if constructed in phases. However, the initial phase would be at a high capital cost for the river intake or infiltration system.
- *Regional Partnership Opportunity* – This alternative offers limited opportunity for regional partnering due to its location in the easterly limits of SUB’s water service area and the fact that this source would not provide an opportunity for the Eugene Water and Electric Board (EWEB) to achieve supply redundancy. EWEB is SUB’s most likely regional partner in supply development. This alternative receives a score of 1.
- *Protection of Undeveloped Surface Water Rights* – As the development of this source option would initiate development of SUB’s existing water rights on the McKenzie River it receives a score of 3.
- *Raw Water Quality* – The water quality of this option is considered high and receives a score of 3.

Alternative 2 – Willamette River Supply

This alternative is evaluated and summarized as follows by the criteria listed above:

- *Project Cost* – The project cost for the Willamette River Supply alternative includes is summarized as follows for each of the three project elements:
 - Transmission System Improvement Project Cost: 3
 - Storage Capacity Improvement Project Costs: 1
 - Treatment Capacity Improvement Project Costs: 2
- *Broader System Benefit* – The development of this alternative offers a lower system benefit than the McKenzie River Supply alternative which is indicated by the increased storage capacity requirements as determined by the Method 2 storage analysis. The analysis revealed that overall system storage needs are greater as the development of this alternative does not provide an equal system performance benefit under emergency conditions with the expansion of an existing source. This alternative receives a score of 1.
- *Property Acquisition, Siting and Land Use/Permitting* – SUB currently owns adequate property to fully develop this alternative at the Willamette Wellfield and Slow Sand Filter Site. Siting of this facility and acquiring permits needed for its development is similar to Alternative 1. This alternative receives a score of 2.
- *Source Redundancy* – Alternative 1 does not increase overall system reliability and redundancy through the addition of a new source. This alternative receives a score of 1.
- *Flexibility of Implementation* – Based on current understanding of the Willamette River water right extension requirements, the time table for the full development of this right is less critical, which increases the flexibility available to develop this supply alternative, resulting in a score of 3.
- *Regional Partnership Opportunity* – This alternative offers opportunity for regional partnering through the sharing of water resources between SUB and the Eugene Water & Electric Board (EWEB) during water supply emergencies. SUB, EWEB, and RWD have an intertie agreement in place which provides for the sharing or purchasing of water for emergencies. The score for this alternative is influenced by the proximity of the Willamette Wellfield to EWEB's service area and the understanding that EWEB has interest in engaging SUB to diversify its supply sources. This alternative receives a score of 3.
- *Protection of Undeveloped Surface Water Rights* – As the development of this source option would not position SUB to better protect undeveloped water rights it receives a score of 1.
- *Raw Water Quality* – With the combination of river and groundwater, the water quality of this option is considered high and receives a score of 3.

6.11 Scoring of Alternatives

Table 6-3 presents a summary of scores based on the discussion presented above.

**Table 6-3
Scoring Summary**

CRITERIA	CRITERIA WEIGHTING FACTOR	ALTERNATIVE 1 – MCKENZIE RIVER SUPPLY		ALTERNATIVE 2 – WILLAMETTE RIVER SUPPLY	
		RAW SCORE	WEIGHTED SCORE	RAW SCORE	WEIGHTED SCORE
Project Cost					
▪ <i>Transmission System Improvements</i>	3	1	3	3	9
▪ <i>Storage Capacity Improvements</i>	3	3	9	1	3
▪ <i>Treatment Capacity Improvements</i>	3	2	6	2	6
Broader System Benefit	2	3	6	1	2
Property Acquisition, Siting and Land Use/Permitting	1	2	2	2	2
Source Redundancy	2	3	6	1	2
Flexibility of Implementation	1	1	1	3	3
Regional Partnership Opportunity	3	1	3	3	9
Protection of Undeveloped Surface Water Rights	3	3	9	1	3
Raw Water Quality	1	3	3	3	3
	Total	22	48	20	42

Based on the scoring analysis presented above Alternative 1, the McKenzie River supply option, earned a slightly higher raw score and weighted score.

6.12 Summary

This section presented a review of SUB's existing supply sources and needs by service area and for the entire service area. Two long term supply source options were presented and evaluated using unweighted and weighted criteria. The rating criteria offered a range of assessment factors ranging from cost to raw water quality. Recommendations related to supply source option implementation are presented in the Capital Improvement Plan in Section 8.

SECTION 7

Distribution System Analysis

7.1 General

This section describes the analysis of Springfield Utility Board's water distribution system. The analysis is based on water demands presented in Section 3 and the planning and analysis criteria outlined in Section 5. This section includes a detailed evaluation of SUB's distribution system and presents findings of a computerized hydraulic network analysis of the system. Included in the analysis is an evaluation of the system's other facilities including storage capacities and pumping station capacities. The findings and recommendations of this water system analysis are developed into a capital improvement program which is summarized in Section 8.

7.2 Distribution System Piping

A hydraulic network analysis computer program was used to evaluate the performance of the existing distribution system and to aid in the development of proposed system improvements. The computerized model of the City's water system uses the KYPipe hydraulic network analysis software. 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 on the basis of planning criteria presented in Section 5.

Computerized Hydraulic Network Analysis Model - The hydraulic model file and its supporting database were used to perform the system analysis and to illustrate recommended improvements. A map of the system model discussed in this section is presented as Figure 7-1.

All pipes are shown as "links" between "nodes" which represent pipeline junctions or pipe size changes. Pipes and nodes are numbered to allow for easy system updating and revision. These numbers have not been shown on Figure 7-1 for drawing clarity but are available within the computer model for future use. Diameter and length are specified for each pipe although only pipe diameters are illustrated for drawing clarity. Pipe lengths are drawn to approximate scale. An approximate ground elevation is specified for each node. Hydraulic elements, such as pressure reducing valves, pump stations and reservoirs, are also illustrated and operating parameters are incorporated into the model database.

Modeling Conditions - The analysis of the existing and proposed system was performed to assess the distribution system's ability to provide recommended fire flows throughout the system under four conditions for existing and future (years 2020 and 2030):

1. Confirm adequate transmission capacity to maintain system pressures through peak hourly demand (PHD) with balanced draw from reservoir(s) and source (pressure \geq 80% average daily demand (ADD) pressure).
2. Confirm adequate transmission capacity to refill reservoirs without excessive distribution system pressures (pressure < 100 psi, if normal pressure > 100 psi, then $< 20\%$ rise).
Demands at ADD represent maximum daily demand (MDD) night demands.
3. Confirm adequate transmission capacity to achieve critical fire flow event (each system) and maintain acceptable residual pressure.
4. Confirm transmission capacity to meet MDD conditions plus fire flow with largest supply out of service and emergency supply conditions in effect.

Existing current water demands as presented in Section 3 were applied to the existing system and allocated throughout the model on the basis of water system customer billing record data. Water usage recorded as customer water billing data was spatially mapped based on user address. The mapped water usage was then associated with the nearest model node. The percentage of total usage at a given node was determined and used to distribute average day, maximum day and peak hour demands.

Fire flow scenarios test system performance in providing the recommended fire flow to a given location while at the same time supplying the MDD and maintaining a minimum residual service pressure of 20 pounds per square inch (psi) at all services in the system.

Model Calibration - 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. Calibration is generally considered successful when pressures measured during hydrant flow tests is within 5 to 10 percent of the hydraulic model. The Hazen-Williams roughness coefficients of the pipes and the distribution of demands from the nodes in the model were adjusted until the modeled flow test results fell within the range described above. Based on the calibration results, a Hazen-Williams roughness coefficient or C-Factor between 110 and 140 was used for all existing pipes throughout the modeling process.

Modeling Results - The calibrated distribution system model is used to evaluate each system's ability to supply various demands while meeting the criteria presented in Section 5 and stated above.

A brief discussion of findings for each system under the four scenarios is presented below.

Descriptions of recommended system improvements to address deficiencies identified through this analysis, project timing and sequencing, and detailed project cost estimates are presented in Section 8. Further detailed discussion of the analysis for each system and the results under each scenario is included in Appendix B.

7.2.1 West System

The results of the West system analysis indicate that improvements are required to meet system performance criteria under two conditions: emergency supply and reservoir refill.

Analysis of emergency supply conditions with a fire flow event and analysis of refill of Willamette Heights Reservoir under low demand conditions, confirmed capacity limitation in transmission facilities in the West system. These deficiencies are observed in the model as low system pressure under emergency conditions and high transmission main velocities. The specific deficiencies observed include:

- 12-inch diameter transmission main under the Union Pacific Railroad (UPRR) tracks at the Steam Plant.
- Transmission mains from the East Side Pump Station to the Steam Plant.

In addition, transmission facilities from the Willamette Slow Sand Filter Plant to the Steam Plant and the East Side Pump Station will require expanded capacity to deliver future supply from an expanded Willamette River supply, if this source option is pursued.

7.2.2 East System

The results of the East system analysis indicate that system capacity is adequate under all conditions except that high transmission main velocities and local areas of high pressure near to the Thurston Wellfield are observed. This is a result of limited transmission capacity from the Wellfield to the distribution system. In order to address this deficiency, additional transmission capacity will be required from the Thurston Wellfield to Thurston Road. Should SUB develop new supply on the McKenzie River at the Thurston site, as discussed in Section 6, then additional transmission capacity from Thurston Road to S 57th Reservoirs will be required.

7.2.3 North System

The results of the North System analysis indicate that the existing transmission and distribution system is adequate under all of the analysis scenarios through the 20-year planning horizon. Further discussion of the potential to more fully integrate the supply, storage and transmission facilities in the East and North systems is presented below.

7.2.4 North and East System Interconnect

The North and East systems currently operate with equal controlling hydraulic grades from the respective storage reservoirs in each system. As part of this water system analysis, an evaluation of opportunities to fully open the interconnections between these two systems was completed. The water system model was used to complete this evaluation and examine any potential benefits or detriments to the systems hydraulically. The interconnected systems were modeled under two sets of conditions. The first was under maximum day demand with all sources operating. The second was winter conditions with SP/Maia and Weyerhaeuser Wellfields inactive.

Both systems generally performed as they do currently. During large fire flow events, 3,500 gpm, in the vicinity of the system boundary under the wintertime operation conditions, flow between systems was observed as described below.

Under current demand conditions with a fire flow in the East System on 42nd Street flow from the North System into the East System was observed. Generally, with fire flow at other locations, or no fire flow, the transfer of water across the boundary of the two systems was limited to less than 300 gpm. Under peak demand conditions, the only change observed from present operation was the split in the flow from Weyerhaeuser Wellfield to each system varied more widely depending on the timing of the demands in each system.

Opening the interconnections between these two systems may provide significant benefit by allowing greater consideration of source rotation and optimization, improve fire flow availability near to the existing boundary and more effective use of the storage volume in Moe Reservoir.

7.3 Storage Reservoirs

7.3.1 General

This section documents the analysis of SUB/RWD water system storage needs and establishes system-wide water storage requirements as well as storage requirements for each of the three individual systems, North, East and West.

There are eight distribution system storage reservoirs in the SUB/RWD water system with a combined storage volume, or capacity, of 12.65 million gallons (mg).

7.3.2 Storage Capacity Analysis

The storage capacity analysis includes an evaluation of existing storage capacities and determination of storage volume needs for each of the SUB/RWD water service areas. Reservoir capacity requirements are developed based on the forecasted water demand requirements presented earlier in this report. For the purposes of this analysis it is

assumed that the existing SUB reservoirs do not contain dead storage and that future facilities will be sited at an elevation that does not include a dead storage volume.

The required emergency storage component can vary considerably depending on the number and capacity of sources available to supply the water system. SUB has two major source expansion alternatives under consideration, as discussed in Section 6: expansion of the Willamette Wellfield/River source or development of the McKenzie River source at the Thurston/Platt Wellfield site. Each of these alternatives results in different firm source/intertie capacities in the three systems. Tables 7-1 and 7-2 summarize estimated storage volume needs for each system under current and future conditions with development of the McKenzie River source and expansion of the Willamette source, respectively.

As illustrated in Table 7-1, assuming that development of the McKenzie River source will be completed within the planning horizon to meet SUB's long-term water supply requirements, there is an adequate existing storage in all three SUB/RWD systems through the planning horizon, to 2030.

As Table 7-2 illustrates, assuming the continued expansion of the Willamette River source and treatment facilities to meet long-term water supply requirements, there is a need for approximately 5.5 mg of additional storage by 2030 in the West system.

**Table 7-1
Storage Analysis Summary – McKenzie River Source Development**

System	Planning Horizon	Storage Requirements (mg)				Total Storage Requirement (mg)	Existing Storage (mg)	Additional Storage Need (mg)
		Equalizing	Operational	Fire Suppression	Emergency			
West	Current	0.38	0.10	0.84	6.0	7.32	2.0	5.32
	2020	0.39	0.10	0.84	0.2	1.53		--
	2030	0.40	0.10	0.84	0.2	1.54		--
North	Current	0.34	0.10	0.84	--	1.28	5.0	--
	2020	0.61	0.10	0.84	--	1.55		--
	2030	0.83	0.10	0.84	--	1.77		--
East	Current	0.86	0.10	0.84	1.78	3.58	5.65	--
	2020	0.47	0.10	0.84	0.9	2.31		--
	2030	0.30	0.10	0.84	2.1	3.34		--

Notes/Assumptions:

- Supply source expansion and timing –
Thurston Well No. 2 – 1.4 mgd (2012)
McKenzie River Source Development – 6 mgd (2016) and an additional 6 mgd (2030)
- Emergency supply assumptions –
West – Willamette Wellfield out of service. No Emergency Supply available until McKenzie River source development. Emergency supply to meet MDD from McKenzie River source in 2020 and 2030.
North – I-5 Wellfield out of service. No Emergency Supply available until McKenzie River source development. Emergency supply to meet MDD from McKenzie River source in 2020 and 2030.
East – Current: Thurston/Platt Wellfield out of service. Emergency supply = Existing MDD surplus capacity in North and West ~ 2.3 mgd
2020 and 2030: McKenzie River source out of service. Emergency supply is equal to the capacity of remaining East sources.
- Operational storage is assumed to be 100,000 gallons for all systems.
- Fire suppression storage based on 3,500 gpm for 4 hours

**Table 7-2
Storage Analysis Summary – Willamette River Source Expansion**

System	Planning Horizon	Storage Requirements (mg)				Total Storage Requirement (mg)	Existing Storage (mg)	Storage Need (mg)
		Equalizing	Operational	Fire Suppression	Emergency			
West	Current	0.38	0.10	0.84	6.00	7.32	2.0	5.32
	2020	0.38	0.10	0.84	6.20	7.52		5.52
	2030	0.38	0.10	0.84	6.20	7.52		5.52
North	Current	0.34	0.10	0.84	--	1.28	5.0	--
	2020	0.61	0.10	0.84	--	1.55		--
	2030	0.83	0.10	0.84	--	1.77		--
East	Current	0.86	0.10	0.84	1.78	3.58	5.65	--
	2020	1.10	0.10	0.84	--	2.04		--
	2030	1.55	0.10	0.84	--	2.49		--

Notes/Assumptions:

- Supply source expansion and timing –
Thurston Well No. 2 – 1.4 mgd (2011)
Willamette River Supply Expansion – 2.2 mgd (2016), 6 mgd (2019) and an additional 6 mgd (2030)
- Emergency supply assumptions –
West – Willamette Wellfield/Willamette River supply out of service. No Emergency Supply available as there is no surplus capacity available in other systems.
North – I-5 Wellfield out of service. No Emergency Supply available until 6 mgd expansion of Willamette River supply (2018). Emergency supply capable of meeting North system MDD for 2020 and 2030.
East – Thurston/Platt Wellfield out of service. Current emergency supply = Existing MDD surplus capacity in North and West ~ 1.4 mgd
2020 and 2030: Surplus supply available from West System.
- Operational storage is assumed to be 100,000 gallons for all systems.
- Fire suppression storage based on 3,500 gpm for 4 hours
- Equalizing storage for the West system is assumed to remain constant in the future. Actual calculation of storage based on surplus supply capacity with Willamette River source expansion would be 0.

7.4 Storage Analysis Summary

Table 7-3 summarizes the recommended additional storage volume need by system for the year 2030 under each of the approaches presented above.

**Table 7-3
Storage Volume Requirement Summary – Year 2030**

System	Source Alternative 1 McKenzie River	Source Alternative 2 Willamette River
West	0	5.5
North	0	0
East	0	0
Total	0	5.5

The results of this analysis should be used to inform the selection of long-term water supply sources and the analysis of transmission needs. Recommended storage needs by system should be based on the selected supply source. Recommendations for siting and configuring new storage facilities are presented later in this report based on the outcome of source and transmission analysis.

7.4.1 Upper Level Storage Needs

In the West and North system, the upper level pressure zones are near to build-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.

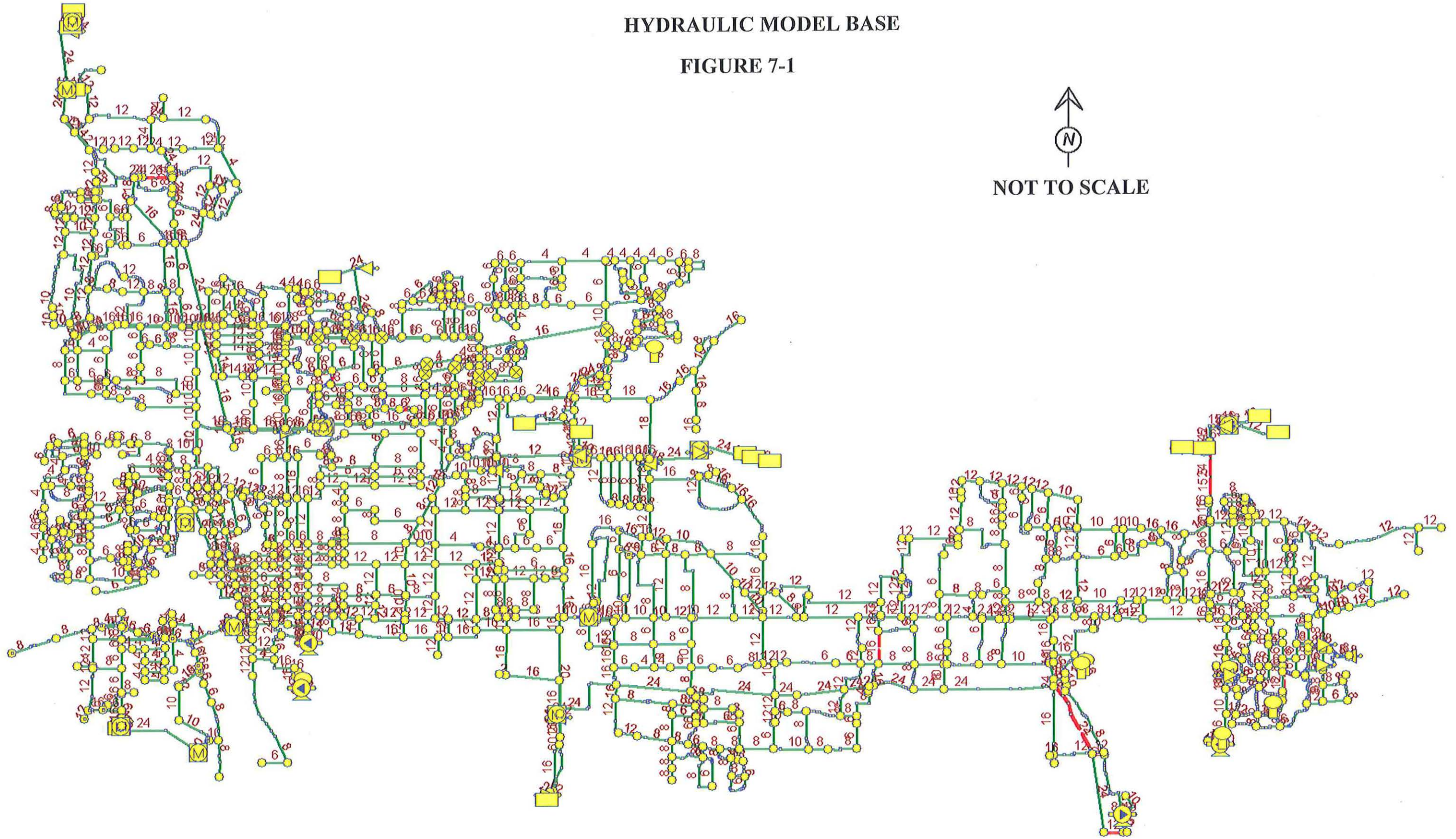
As discussed in Section 3, the East system has the potential for significant expansion as development occurs to the southeast of the existing system within the Urban Growth Boundary (UGB). The topography in these areas will require the development of pumping and storage facilities to provide water service as they will be upper level pressure zones. 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 and standby storage. The standby storage volume should be sized to also accommodate fire suppression storage needs.
- Pumping facilities supplying upper level pressure zones with storage should be sized with firm capacity to meet the maximum day demand of the zone.

2009 WATER MASTER PLAN STUDY AREA

HYDRAULIC MODEL BASE

FIGURE 7-1



SECTION 8

RECOMMEDATIONS AND CAPITAL IMPROVEMENT PLAN

8.1 General

This section presents recommended water system improvements based on the analysis and findings presented in previous report sections. These improvements include proposed reservoir, pump station and water line improvements. Also presented is a capital improvement program schedule for all recommended improvements. All proposed transmission system improvements are illustrated Figure 8-1.

8.2 Cost Estimating Data

Planning level project cost estimates should be prepared for all recommended improvements and programs presented in the master plan. As these estimates are developed at a conceptual level and based on very limited specific project, data high contingencies should be assumed as should a large expected accuracy range. As many of the recommended improvements will be constructed long after the preparation of the original cost estimate all estimates should be indexed to reflect inflationary and other time related affects on anticipated project costs. Project cost estimates presented herein are based on conceptual level project definition and include an allowance for engineering, administration, permitting and contingency.

8.2.1 Project Cost Indexing

The estimated costs included in this plan are planning level budget estimates presented in 2010 dollars. 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 recent ENR CCI for Seattle, Washington is 8645 (January 2010)

8.2.2 Cost Estimating Basis

Pipelines

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. Construction cost estimates also assume installation by Springfield Utility Board (SUB) crews. For transmission piping improvements ranging from 16- to 36-inch diameter, the unit cost per inch diameter per linear foot (\$/in dia-lf) varies from approximately \$11/ in dia-lf to \$23 /in dia – lf depending on anticipated construction conditions, overall project size and complexity, etc. Project cost estimates are based on SUB experience with construction

of similar sized transmission main improvements within the SUB service area.

Reservoirs

Project cost estimates for new reservoir construction assume construction of a ground level circular prestressed concrete reservoir. Cost estimates include site work, excavation, piping, and the reservoir construction. Land acquisition, if necessary, is not included in the project cost estimates.

Source and Treatment

Project cost estimates for development or expansion of supply source and water treatment facilities are based on the analysis and cost estimates presented in the Springfield Utility Board – Willamette Filtration Plant Expansion: Alternative Technologies Report (Black & Veatch, December 2008) and other estimating data prepared outside of this Master Plan.

8.3 Recommended Improvements

8.3.1 General

Presented below are recommended water system improvements for supply sources, reservoirs, transmission system water lines and other facilities. Also presented is a discussion of other recommended improvements and programs. Project cost estimates are presented for all recommended improvements and annual budgets are presented for recommended programs. The recommendations are presented by project type and discussed in order of need.

8.3.2 Reservoirs

As presented in Section 7, the need for additional finished water storage capacity is highly dependent on future supply expansion decisions. For the purposes of this plan, it is assumed that SUB will pursue development of the Willamette River supply and that future development of supply from the McKenzie River will be beyond the 20-year planning horizon. As such, it is recommended that SUB construct additional storage in the West system to meet emergency storage needs. An additional 5.5 million gallons (mg) of storage should be constructed in the West system. It is recommended that preliminary siting of this storage facility be completed in the in 2011, with initial investigations focused on locating the new storage facility adjacent to the existing storage facility at Willamette Heights. Construction of a new 5.5 mg reservoir should be planned for 2020 following confirmation of the ultimate need for this storage resulting from development of major supply expansion at the Willamette Wellfield or Thurston Wellfield sites. Table 8-1 presents a summary of the recommended reservoir improvement projects.

**Table 8-1
Recommended Reservoir Improvement Summary**

Project Start (Fiscal Year)	Project Description	Estimated Project Cost
2011	West System Reservoir Siting	\$ 20,000
2025	5.5 MG West System Reservoir	8,800,000
Total		\$ 8,820,000

8.3.3 Transmission and Distribution System Improvements

The water system analysis found that transmission system improvements are needed to provide improved hydraulic transmission capacity within the distribution system. Table 8-4 lists the recommended improvements in each system.

**Table 8-2
Recommended Transmission System Improvement Summary**

System	Project Description	Size (in)	Length (ft)	Estimated Cost
West	Willamette Detention-Millrace Crossing	36	350	\$ 210,000
West	Eastside Pump Station-Steam Plant	24	9500	2,700,000
West	Steam Plant-North System	16	5180	1,900,000
East	Thurston Detention	36	2200	1,300,000
East	Thurston Road-S 57 th St	36	9000	3,660,000
North	Mohawk Marketplace	24	2000	600,000
TOTAL				\$10,370,000

A brief description and summary of recommended transmission system improvement projects is presented below in order of recommended completion priority.

Willamette Detention-Millrace Crossing

The City of Springfield and US Army Corp of Engineers are reconstructing the Springfield Millrace in 2010 and will have the millrace dewatered at the point SUB's transmission pipelines cross. This is the only opportunity SUB will have to replace the existing 20-inch diameter steel pipeline under these conditions.

Eastside Pump Station-Steam Plant

This project serves multiple goals. With the completion of this project, the Willamette Heights Reservoir can be filled directly from Eastside Pump Station, thereby allowing inactivation of the Steam Plant Pump Station. The transmission line will also provide additional capacity to Glenwood and the Eugene Water and Electric Board (EWEB) intertie located at 22nd & Henderson. In conjunction with the proposed Steam Plant-North System transmission project described below, the Eastside Pump Station will be

able to supply over 5 MGD directly from the Willamette Slow Sand Filter Plant to the North System.

Steam Plant-North System

This project serves two goals. First, it allows transmission of over 5 MGD to the North System from the Willamette Plant as discussed above. This project also allows for the transfer of water between the West system and the North system at the Willamette Heights Reservoir. The reservoir can either supply additional storage capacity for the North System in an emergency or be filled from the North System if there is insufficient source available from the Willamette Plant.

Thurston Detention

This project also serves multiple goals. The immediate goal is to provide additional CT and transmission capacity to allow SUB to restart Thurston Well # 2 and deliver additional supply capacity from the Thurston Wellfield. This project will also provide transmission capacity for future development of a surface water treatment facility at Thurston.

Thurston Road-S 57th Street

This project provides new transmission between the end of the Thurston Detention transmission main and the existing transmission pipeline between S 57th Street and the Eastside Pump Station. This improvement provides approximately 10 MGD of direct transmission capacity between the Thurston Wellfield and the West System. This improvement also provide capacity from Thurston for future development in the Natron area to the south east.

Mohawk Marketplace

This project is a continuation of the replacement of the failing transmission pipeline in Marcola Road in the North System. This transmission main will provide increased capacity to transmit water between Moe Reservoir and the Gateway area of northwest Springfield.

8.3.4 Water Main Replacement Program

In addition to the above transmission system improvements, SUB has implemented three programs for improvements to the distribution system.

The first is replacement of failing distribution mains. SUB plans to replace approximately 2,000 feet of 4- to 12-inch diameter distribution mains each year. These projects are selected by one of two methods. A number of projects result from external sources such as City street reconstruction where opportunities to address main replacement needs in coordination with other work exist. Alternatively, SUB’s database

of waterlines prioritized by repair history over the last 30 years is used to identify waterline replacement projects.

The second program is leak detection and repair. SUB has set a goal for reduction of unaccounted for water. A pilot leak detection study was performed with a consultant in 2009 and resulted in a reduction of unaccounted for water in the East System of about 5%. SUB has purchased leak detection equipment and has dedicated staff to survey the entire water system to locate and repair non-surfacing leaks in the distribution system.

The third program is systematic replacement of customer meters. SUB has set a goal of replacement of residential and commercial meters from ¾-inch to 2-inch diameter on a twenty year cycle. The target is replacement of about 1,000 meters per years. Replacement is based on age of the meters and replacement of difficult to read meters reported by the meter reading staff. The results are increased accuracy in the quantity of water metered and significant labor savings in the meter reading staff time from reduced misreads.

8.3.5 Supply Source Improvements

As presented in Section 6, the SUB will need to develop additional supply source capacity within the 20-year planning horizon to meet short-term and long-term water supply needs. Opportunities exist to expand the capacity of existing facilities to meet short-term needs. Longer-term water supply needs will require major capital investment through the development of new surface water supply facilities. A description of short-term and long-term supply improvements is presented below.

In order to maintain adequate supply to meet maximum day demands for the SUB and RWD systems while maintaining the desired 10 percent reserve capacity, additional supply is required by the year 2016. In addition, the East system currently lacks this reserve capacity without supply from surplus capacity in the North and West systems. In order to address these deficiencies, two improvements are recommended:

Ultraviolet disinfection (UV) at Thurston Well No. 2

Thurston Well No. 2 is classified as a groundwater source under the influence of surface water and requires additional treatment to meet drinking water standards. Implementing UV disinfection of the source water produced from this well along with adequate chlorine disinfectant contact time (CT) will allow SUB to use this source to meet growing water supply needs. The estimated project cost for this improvement is \$153,500 and it is recommended that this improvement be completed in FY 2011.

Expand Willamette Slow Sand Filter Plant

The production capacity of surface water and groundwater supply sources at the Willamette Wellfield site is limited by the capacity of the existing Willamette Slow Sand

Filter Plant. The construction of a fifth filter unit at the plant would increase the capacity of the supply and treatment facilities at this site by approximately 2.2 mgd. This improvement may provide an economical increase in supply capacity but the overall benefit should be weighed against the operational limitations of slow sand filtration and the long-term value of expanded facilities if future surface water treatment facilities utilize different treatment technologies. It is recommended that this improvement be completed in 2016. SUB has estimated the cost of this improvement to be approximately \$550,000.

SUB is currently planning, designing and constructing improvements to address Lead and Copper Rule compliance through corrosion control of the source water at the major wellfields. These improvements are planned for implementation over three years, 2010-2012, at Willamette, Thurston and Weyerhaeuser Wellfields. The estimated project cost for these improvements is approximately \$1 million per year, or \$3 million dollars total.

To meet long-term water supply needs, SUB has acquired water rights and completed preliminary planning for construction of new surface water supply and treatment facilities on the Willamette River at the Willamette Wellfield site and on the McKenzie River at the Thurston Wellfield site. As discussed in Section 6, the ultimate decision to develop one of these two sources to meet needs over the 20-year planning horizon depends on a number of factors. The expected capital cost of the two alternatives is anticipated to be similar. This 20-year CIP includes the cost of developing river intake and treatment facilities for one of these two source options with an initial capacity of 6 mgd planned for FY 2019 and a future incremental expansion for an additional 4 mgd planned for FY 2030. The estimated project cost for these two improvements is \$14,500,000 and \$8,000,000, respectively.

8.3.6 Supply Source Reliability

This program has two components. All pumps and motors in the water system are scheduled for wire to water performance testing annually. This is done to track electrical efficiency and determine wear of pump impellers and other wetted parts. This program also allows for determination of the efficiency and unit cost of water for each pumping system so that system operators can minimize pumping costs by operating efficiently. The second component of the program is testing of the groundwater wells for capacity and efficiency. The initial test cycle is every five years and will be adjusted over time as SUB staff determine the expected rate of decline in capacity for each of the individual wells.

This program will allow scheduling of pump and motor repairs or replacements and groundwater well rehabilitation at the optimal economic point to minimize SUB's unit cost of water produced and to reduce equipment failures due to excessive wear.

Table 8-3
Capital Improvement Program Summary

Category	Project Description / Location	CIP Schedule and Project Cost Summary by Fiscal Year																				Estimated Project Cost ¹		
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029		2030	Long Term
Source and Treatment	Thurston Well No. 2 UV Disinfection		\$ 153,500																				\$ 153,500	
	Expand Willamette SSF Plant							\$ 550,000															\$ 550,000	
	Long-Term Source Development										\$ 14,500,000											\$ 8,000,000	\$ 22,500,000	
	Corrosion Control Improvements	\$ 987,000	\$ 1,208,600	\$ 963,900																				\$ 3,159,500
	Subtotal	\$ 987,000	\$ 1,362,100	\$ 963,900	\$ -	\$ -	\$ -	\$ 550,000	\$ -	\$ -	\$ 14,500,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,000,000	\$ -
Storage Reservoirs	West System - 5.5 mgd		\$ 20,000														\$ 8,820,000						\$ 8,840,000	
	Subtotal	\$ -	\$ 20,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,820,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8,840,000
Transmission and Distribution System Improvements	Willamette Detention-Millrace Crossing	\$ 210,000																						\$ 210,000
	Thurston Detention		\$ 1,300,000																					\$ 1,300,000
	Mohawk Marketplace			\$ 600,000																				\$ 600,000
	Thurston Rd - S 57th Transmission				\$ 960,000	\$ 1,200,000	\$ 1,500,000																	\$ 3,660,000
	Eastside P.S. - Steam Plant							\$ 1,350,000	\$ 1,350,000															\$ 2,700,000
	Steam Plant - North System									\$ 600,000	\$ 750,000	\$ 550,000												\$ 1,900,000
																								\$ -
	Subtotal	\$ 210,000	\$ 1,300,000	\$ 600,000	\$ 960,000	\$ 1,200,000	\$ 1,500,000	\$ 1,350,000	\$ 1,350,000	\$ 600,000	\$ 750,000	\$ 550,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Other	Water Main Replacement	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ 6,300,000
	Leak Detection & Repair	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 2,100,000
	Supply Source Reliability	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 525,000
	Water Master Plan Update						\$ 100,000						\$ 100,000											
	WMCP Update						\$ 40,000						\$ 40,000											\$ 80,000
	Subtotal	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 565,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 565,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000
Total	\$ 1,622,000	\$ 3,107,100	\$ 1,988,900	\$ 1,385,000	\$ 1,625,000	\$ 2,065,000	\$ 2,325,000	\$ 1,775,000	\$ 1,025,000	\$ 15,675,000	\$ 1,115,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 9,245,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 425,000	\$ 8,425,000	\$ -	\$ 54,778,000

¹ Cost estimates are based on an Engineering (ENR) construction cost index of 8645 for Seattle, Washington (January, 2010).

5 Year Total	\$9,728,000
Annual Average	\$1,945,600

7 Year Total	\$14,118,000
Annual Average	\$2,016,857

10 Year Total	\$32,593,000
Annual Average	\$3,259,300

15 Year Total	\$35,408,000
Annual Average	\$2,360,533

20 Year Total	\$46,353,000
Annual Average	\$2,317,650

8.3.7 Capital Improvement Program Schedule Summary

A summary of all the recommended improvements is presented in Table 8-5. The table provides for prioritized project sequencing by illustrating fiscal year (FY) of project need for each facility or improvement category. Those improvements recommended for construction beyond the 20-year planning horizon, after year 2030, are indicated as such. It is recommended that SUB's capital improvement program (CIP) be based on the consideration of the principles of the Master Plan and the up dated 10 year cash flow plan. The CIP will be based on actual need and financial pacing of capital dollars.

8.4 Funding Sources

SUB may fund the water capital maintenance and improvement programs 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 below. It is expected that SUB will fund all of the projects presented in this CIP over the next ten years from cash resources and revenues, however, these additional financing mechanisms are included below to identify alternatives available to SUB for future major capital improvements planned beyond the year 2020.

8.4.1 Government Loan and Grant Programs

Oregon State Safe Drinking Water Financing Program

Annual grants from the U.S. Environmental Protection Agency (EPA) and matching state resources support the Safe Drinking Water Fund. The program is managed jointly by the Department of Human Services (DHS) - Drinking Water Program and the Oregon Economic and Community Development Department (OECDD). 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 (2) separate programs; Safe Drinking Water Revolving Loan Fund (SDWRLF) for collection, treatment, distribution and related infrastructure, and Drinking Water Protection Loan Fund (DWPLF) for sources of drinking water improvements prior to the water system intake.

SDWRLF lends up to \$8 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.

8.4.2 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. There are four (4) major project categories eligible for funding under this program:

- Public infrastructure needed to support job creation
- Community facilities that support the local economy
- Essential Community Facilities Emergency Projects
- Railroads

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 \$15 million. The OECDD is able to offer discounted interest rates that typically reflect low market rates for very good quality creditors. In addition, the Department 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.

8.4.3 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 or the Clean Water Act.

Eligible activities include costs for construction improvement or expansion of drinking water, wastewater or stormwater systems. To be eligible a system must have received, or is likely to soon receive, a Notice of Non-Compliance by the appropriate regulatory agency, associated with the Safe Drinking Water Act 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 Safe Drinking Water Act 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 \$15,000,000 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.

8.4.4 Public Debt

Revenue Bonds

Revenue bonds are commonly used to fund utility capital improvements. The bond debt is secured by the revenues of the issuing utility and the debt obligation does not extend to other SUB resources. With this limited commitment, revenue bonds typically require security conditions related to the maintenance of dedicated reserves referenced as bond reserves and financial performance measures which are added to the bond debt as service coverage. In order to qualify to sell revenue bonds, SUB must show that the net revenue defined as total revenue less operating and maintenance expense, for the water fund is equal to or greater than a standard factor, typically 1.2 to 1.4 times the annual revenue bond debt service. This factor is commonly referred to as the coverage factor, and is applicable to revenue bonds sold on the commercial market. There is no bonding limit, except the practical limit of the utility's ability to generate sufficient revenue to repay the debt and meet other security conditions. In some cases, poor credit may impair a community's ability to acquire and use revenue bonds.

Revenue bonds incur relatively higher interest rates than government programs, but due to the highly competitive nature of the low-interest government loans, revenue bonds are assumed to be a more reliable source of funding as they typically can be obtained by most communities.

8.4.5 Water Fund Cash Resources and Revenues

SUB's financial resources available for capital funding include rate funding, cash reserves, and SDCs.

SDCs are sources of funding generated through development and system growth and are typically used by utilities to support capital funding needs. The charge is intended to recover a fair share of the costs of existing and planned facilities that provide capacity to serve new growth.

Oregon Revised Statute (ORS) 223.297 – 223.314 defines SDCs and specifies how they shall be calculated, applied, and accounted for. 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 such things as 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 their fair 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.

8.5 Summary

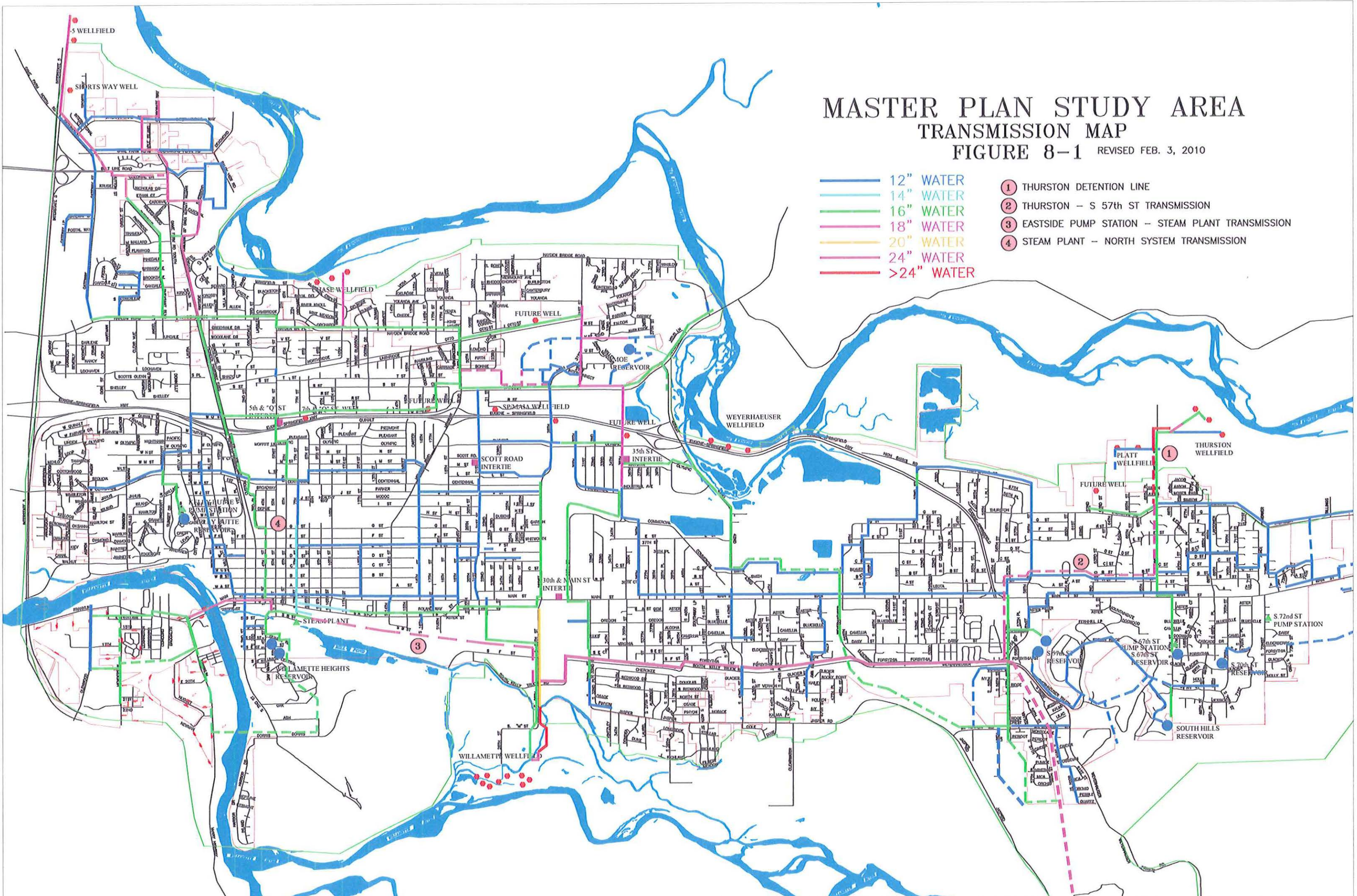
This section presents the recommended capital improvement plan for SUB. Recommendations and estimated budgets are presented for supply and treatment system improvements, transmission system piping improvements, future reservoirs, and water main replacements. The total estimated project cost of these improvements is approximately \$46 million through the 20-year planning horizon.

MASTER PLAN STUDY AREA TRANSMISSION MAP

FIGURE 8-1 REVISED FEB. 3, 2010

- 12" WATER
- 14" WATER
- 16" WATER
- 18" WATER
- 20" WATER
- 24" WATER
- >24" WATER

- ① THURSTON DETENTION LINE
- ② THURSTON - S 57th ST TRANSMISSION
- ③ EASTSIDE PUMP STATION - STEAM PLANT TRANSMISSION
- ④ STEAM PLANT - NORTH SYSTEM TRANSMISSION



2008 HYDRAULIC MODEL RESULTS

2008 WEST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2008 WEST MDD STATIC CONDITIONS

All supply from WWF-SSF @ 4583 gpm (6.6 mgd)

Under static conditions supply from WWF is greater than MDD demand. WWF-SSF Plant would have approximately 3008 gpm of unused capacity. Excess production from the slow sand filters would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant pump is on or system pressure at the Steam Plant is 50 psi or greater, the Steam Plant PRV is closed and all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 428 gpm MDD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

2008 WEST MDD + FIRE 1

2500 gpm @ 5th St & A St/City Hall Node J-885

52.9 psi static pressure

50.8 psi residual pressure

Steam Plant prv is flowing 0 gpm to West System

WWF-SSF Plant would be spilling approximately 508 gpm back to the river to maintain maximum allowed pressure.

2008 WEST MDD + FIRE 2

3500 gpm @ 28th St & C St/chemical plant Node J-923

48.1 psi static pressure

46.8 psi residual pressure

Steam Plant prv is flowing 491 gpm to West System

Willamette Heights Reservoir is dropping @ 919 gpm

2008 WEST MDD + FIRE 3

1500 gpm @ 12th St & N St/ residential Node W0042

52.8 psi static pressure

47.5 psi residual pressure

Steam Plant prv is flowing 0 gpm to West System

WWF-SSF Plant would be spilling approximately 1508 gpm back to the river to maintain maximum allowed pressure.

SCENARIO 4 – EMERGENCY W/MDD + FIRE FLOW

2008 WEST MDD STATIC

All supply from 5th & Q St intertie w/North System @ 481 gpm + storage @ Willamette Heights reservoir.

Unable to sustain desired 50 psi minimum static pressure across West System. Static pressures along 28th St at the eastern edge of the West System are in the low to mid 40's.

2008 WEST EMERGENCY + MDD + FIRE 1

2500 gpm @ 5th St & A St/City Hall Node J-885

49.9 psi static pressure

37.1 psi residual pressure

Pressures along 28th St at the eastern edge of the West System are in the low to mid 30's.

The intertie PRV's at Scott Road, 30th & Main St, and Eastside pump Station all open when downstream pressure is less than 35 psi.

2008 WEST EMERGENCY + MDD + FIRE 2

3500 gpm @ 28th St & C St/chemical plant Node J-923

44.1 psi static pressure

26.2 psi residual pressure

West system pressures are generally in the 30-35 psi range. The intertie PRV's at Scott Road, 30th & Main St, and Eastside pump Station all open when downstream pressure is less than 35 psi.

The 12" Permastran PVC pipeline (P-119) under the Union Pacific Railroad Tracks at the Steam Plant is flowing in excess of 15 feet per second.

2008 WEST EMERGENCY + MDD + FIRE 3

1500 gpm @ 12th St & N St/ residential Node W0042

49.3 psi Static pressure

38.2 psi residual pressure

West system pressures are generally in the 40-45 psi range. Pressures along 28th St at the eastern edge of the West System are in the 35-40 psi range.

SCENARIO 1 – PEAK HOUR FLOW

2008 WEST PHD

All supply from WWF-SSF @ 4583 gpm (6.6 mgd)

2008 WEST PHD 1

Under static conditions supply from WWF is greater than MDD demand. WWF-SSF Plant would have approximately 648 gpm of unused capacity. Excess production from the slow sand filters would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant pump is off, all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 1205 gpm PHD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

SCENARIO 2 – ADD (RESERVOIR REFILL)

2008 WEST ADD

All supply from WWF-SSF @ 4583 gpm (6.6 mgd)

2008 WEST ADD 1

Willamette Heights reservoir is filling @ 2581 gpm. (*2083 gpm required for 8 hr refill*)
Approximately 6 hrs, 27 minutes to fill from ½ full.

HYDRAULIC MODEL RESULTS

2008 EAST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2008 EAST MDD STATIC CONDITIONS

Supply from Thurston WF @ 3305 gpm, Weyco WF @ 1125 gpm, SP/Maia WF @ 1800 gpm,

Total supply @ 6230 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-2 psi of ADD.

S 57th reservoirs are dropping @ 198 gpm

S 67th reservoir is filling @ 148 gpm

2008 EAST MDD + FIRE 1

2500 gpm @ s 48TH & Aster St/Jenna Village Apartments J-923

71.0 psi static pressure

60.2 psi residual pressure

S 57th reservoirs are dropping @ 2159 gpm

S 67th reservoir is dropping @ 392 gpm

2008 EAST MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

76.2 psi static pressure

68.0 psi residual pressure

S 57th reservoirs are dropping @ 2862 gpm

S 67th reservoir is dropping @ 689 gpm

2008 EAST MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

76.5 psi static pressure

67.6 psi residual pressure

S 57th reservoirs are dropping @ 1445 gpm

S 67th reservoir is dropping @ 106 gpm

2008 EAST MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

54.5 psi static pressure

49.4 psi residual pressure

S 57th reservoirs are dropping @ 620 gpm

S 67th reservoir is dropping @ 930 gpm

SCENARIO 4 – EMERGENCY W/MDD + FIRE FLOW

2008 EAST EMERGENCY + MDD STATIC CONDITIONS

Thurston WF off

Supply from Weyco WF @ 1125 gpm, SP/Maia WF @ 1800 gpm

Supply from Eastside PS @ 1430 gpm (available MDD surplus in West from WWF-SSF)

Total supply @ 4355 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-2 psi of ADD.

S 57th reservoirs are dropping @ 293 gpm

S 67th reservoir is dropping @ 1633 gpm

2008 EAST EMERGENCY + MDD + FIRE 1

2500 gpm @ S 48TH & Aster St/Jenna Village Apartments J-923

71.1 psi static pressure

60.8 psi residual pressure

S 57th reservoirs are dropping @ 2114 gpm

S 67th reservoir is dropping @ 2312 gpm

2008 EAST EMERGENCY + MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

76.7 psi static pressure

69.5 psi residual pressure

S 57th reservoirs are dropping @ 2858 gpm

S 67th reservoir is dropping @ 2568 gpm

2008 EAST EMERGENCY + MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

77.1 psi static pressure

68.2 psi residual pressure

S 57th reservoirs are dropping @ 1509 gpm

S 67th reservoir is dropping @ 1917 gpm

2008 EAST EMERGENCY + MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

52.9 psi static pressure

46.8 psi residual pressure

S 57th reservoirs are dropping @ 909 gpm

S 67th reservoir is dropping @ 2517 gpm

SCENARIO 1 – PEAK HOUR FLOW

2008 EAST PHD STATIC CONDITIONS

Supply from Thurston WF @ 3305 gpm, Weyco WF @ 1125 gpm, SP/Maia WF @ 1800 gpm,

Supply from Eastside PS @ 650 gpm (available MDD surplus in West from WWF-SSF)

Total supply @ 6880 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-2 psi of ADD.

S 57th reservoirs are dropping @ 2576 gpm

S 67th reservoir is dropping @ 382 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2008 EAST ADD

Supply from Thurston WF @ 3305 gpm, Weyco WF @ 1125 gpm, SP/Maia WF @ 1800 gpm,

Total supply @ 6230 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-2 psi of ADD.

S 57th reservoirs are filling @ 1440 gpm (*2604 gpm required for 8 hr refill from ½ full*)

S 67th reservoir is filling @ 1367 gpm (*1563 gpm required for 8 hr refill from ½ full*)

2008 NORTH SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2008 NORTH MDD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 5-7 psi lower than ADD.

Kelly Butte reservoir is filling @ 377 gpm

Moe reservoir is filling @ 2279 gpm

2008 NORTH MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

94.3 psi static pressure

38.8 psi residual pressure

Kelly Butte reservoir is dropping @ 173 gpm

Moe reservoir is filling @ 330 gpm

2008 NORTH MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

100.7 psi static pressure

92.2 psi residual pressure

Kelly Butte reservoir is dropping @ 861 gpm

Moe reservoir is filling @ 17 gpm

2008 NORTH MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

88.2 psi static pressure

35.1 psi residual pressure

Kelly Butte reservoir is filling @ 187 gpm

Moe reservoir is filling @ 969 gpm

2008 NORTH MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

97.3 psi static pressure

48.8 psi residual pressure

Kelly Butte reservoir is dropping @ 1037 gpm

Moe reservoir is filling @ 2194 gpm

SCENARIO 4 – EMERGENCY + MDD + FIRE FLOW

2008 NORTH EMERGENCY + MDD STATIC CONDITIONS

Supply from Weyco WF @ 1075 gpm, Chase WF @ 2243

Total supply @ 3318 gpm

North system pressures are generally 5-10 psi below ADD.

Kelly Butte reservoir is dropping @ 1222 gpm

Moe reservoir is dropping @ 461 gpm

2008 NORTH EMERGENCY + MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

90.6 psi static pressure

34.7 psi residual pressure

Kelly Butte reservoir is dropping @ 1856 gpm

Moe reservoir is dropping @ 2327 gpm

2008 NORTH EMERGENCY + MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

94.2 psi static pressure

80.1 psi residual pressure

Kelly Butte reservoir is dropping @ 2472 gpm

Moe reservoir is dropping @ 2712 gpm

2008 NORTH EMERGENCY + MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

86.3 psi static pressure

33.5 psi residual pressure

Kelly Butte reservoir is dropping @ 1430 gpm

Moe reservoir is dropping @ 1753 gpm

2008 NORTH EMERGENCY + MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

96.5 psi static pressure

47.4 psi residual pressure

Kelly Butte reservoir is dropping @ 2338 gpm

Moe reservoir is dropping @ 845 gpm

SCENARIO 1 – PEAK HOUR FLOW

2008 NORTH PHD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally within 1-2 psi of ADD.

Kelly Butte reservoir is dropping @ 1534 gpm

Moe reservoir is dropping @ 865 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2008 NORTH ADD

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 5-10 psi higher than ADD.

Kelly Butte reservoir is filling @ 1451 gpm (*1042 gpm required for 8 hr refill from ½ full*)

Approximately 5 hrs, 45 minutes to fill from ½ full.

Moe reservoir is filling @ 3841 gpm (*4167 gpm required for 8 hr refill from ½ full*)

Approximately 7 hrs, 57 minutes to fill from ½ full. Altitude valve would close on Kelly Butte at 5 hrs 45minutes diverting an additional 1451 gpm to Moe.

2020 HYDRAULIC MODEL RESULTS

2020 WEST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2020 WEST MDD STATIC CONDITIONS

All supply from WWF-SSF @ 5800 gpm (8.4mgd)

Under static conditions supply from WWF is greater than MDD demand. WWF-SSF Plant would have approximately 3388 gpm of unused capacity. Excess production from the slow sand filters would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant pump is on or system pressure at the Steam Plant is 50 psi or greater, the Steam Plant PRV is closed and all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 726 gpm MDD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

2020 WEST MDD + FIRE 1

2500 gpm @ 5th St & A St/City Hall Node J-885

53.3 psi static pressure

51.2 psi residual pressure

WWF-SSF Plant would be spilling approximately 887 gpm back to the river to maintain maximum allowed pressure.

2020 WEST MDD + FIRE 2

3500 gpm @ 28th St & C St/chemical plant Node J-923

56.5 psi static pressure

47.6 psi residual pressure

Willamette Heights Reservoir is dropping @ 112 gpm

2020 WEST MDD + FIRE 3

1500 gpm @ 12th St & N St/ residential Node W0042

53.8 psi static pressure

47.5 psi residual pressure

WWF-SSF Plant would be spilling approximately 1887 gpm back to the river to maintain maximum allowed pressure.

SCENARIO 4 – EMERGENCY + MDD + FIRE FLOW

2020 WEST EMERGENCY + MDD STATIC CONDITIONS

Supply from 5th & Q St intertie w/North System @ 430 gpm + Eastside Pump Station intertie set @ 50 psi (not to exceed 4000 gpm), + storage @ Willamette Heights reservoir through the Steam Plant prv set @ 50 psi No flow through Steam Plant

Willamette Heights Reservoir is dropping @ 726 gpm

Eastside intertie is flowing @ 1982 gpm
2020 WEST EMERGENCY + MDD + FIRE 1
2500 gpm @ 5th St & A St/City Hall Node J-885
56.8 psi static pressure
50.5 psi residual pressure
Steam Plant prv is flowing 693 gpm to West System
Willamette Heights Reservoir is dropping @ 1419 gpm
Eastside intertie is flowing @ 3789 gpm

2020 WEST EMERGENCY + MDD + FIRE 2
3500 gpm @ 28th St & C St/chemical plant Node J-923
52.2 psi static pressure
45.3 psi residual pressure
Steam Plant prv is flowing 1482 gpm to West System
Willamette Heights Reservoir is dropping @ 2208 gpm
Eastside intertie is flowing @ 4000 gpm

2020 WEST EMERGENCY + MDD + FIRE 3
1500 gpm @ 12th St & N St/ residential Node W0042
56.8 psi Static pressure
48.3 psi residual pressure
Steam Plant prv is flowing 0 gpm to West System
Willamette Heights Reservoir is dropping @ 726 gpm
Eastside intertie is flowing @ 3482 gpm

SCENARIO 1 – PEAK HOUR FLOW

2020 WEST PHD
All supply from WWF-SSF @ 5800 gpm (8.4 mgd)

2020 WEST PHD 1
Under static conditions supply from WWF is greater than MDD demand. WWF-SSF Plant would have approximately 2655 gpm of unused capacity. Excess production from the slow sand filters would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant prv is closed, all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 971 gpm PHD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

SCENARIO 2 – ADD (RESERVOIR REFILL)

2020 WEST ADD
All supply from WWF-SSF @ 5800 gpm (8.4 mgd)

2020 WEST ADD 1

Willamette Heights reservoir is filling @ 4226 gpm. (2083 gpm required for 8 hr refill)

Approximately 3 hrs, 57 minutes to fill from ½ full.

The 12" Permastran PVC pipeline under the railroad at the Steam Plant is at 12 fps velocity

Discharge pressure at Steam Plant is 10 psi above normal pressure. The pumps may not be capable of this head in which case some water would spill to the river at the plant to maintain maximum system pressure.

HYDRAULIC MODEL RESULTS

2020 EAST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2020 EAST MDD STATIC CONDITIONS

Supply from Thurston WF @ 6777 gpm, Weyco WF @ 1125 gpm, SP/Maia WF @ 1800 gpm,

Total supply @ 9702 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-5 psi of ADD.

S 57th reservoirs are dropping @ 187 gpm

S 67th reservoir is filling @ 2514 gpm

An additional 5 mgd at Thurston WF would require completion of additional transmission piping to Thurston Rd to avoid excessive pressures in the wellfield.

2020 EAST MDD + FIRE 1

2500 gpm @ s 48TH & Aster St/Jenna Village Apartments J-923

71.6 psi static pressure

60.0 psi residual pressure

S 57th reservoirs are dropping @ 2376 gpm

S 67th reservoir is dropping @ 2208 gpm

2020 EAST MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

75.7 psi static pressure

65.3 psi residual pressure

S 57th reservoirs are dropping @ 3198 gpm

S 67th reservoir is filling @ 2025 gpm

2020 EAST MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

76.1 psi static pressure

66.0 psi residual pressure

S 57th reservoirs are dropping @ 1544 gpm

S 67th reservoir is filling @ 2371 gpm

2020 EAST MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

59.7 psi static pressure

53.6 psi residual pressure

S 57th reservoirs are dropping @ 740 gpm

S 67th reservoir is filling @ 1567 gpm

SCENARIO 4 – EMERGENCY W/MDD + FIRE FLOW

2020 EAST EMERGENCY + MDD STATIC CONDITIONS

Thurston WF off

Supply from Weyco WF @ 1075 gpm, SP/Maia WF @ 1800 gpm

Supply from Eastside PS @ 3388 gpm (available MDD surplus in West from WWF-SSF)

Total supply @ 6263 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm

East system pressures are generally within 1-2 psi of ADD. Pressures east of 69th Street are 5-10 psi lower than normal

S 57th reservoirs are dropping @ 1235 gpm

S 67th reservoir is dropping @ 1400 gpm

2020 EAST EMERGENCY + MDD + FIRE 1

2500 gpm @ S 48TH & Aster St/Jenna Village Apartments J-923

71.1 psi static pressure

60.0 psi residual pressure

S 57th reservoirs are dropping @ 2957gpm

S 67th reservoir is dropping @ 2177 gpm

2020 EAST EMERGENCY + MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

75.5 psi static pressure

65.9 psi residual pressure

S 57th reservoirs are dropping @ 3683 gpm

S 67th reservoir is dropping @ 2451 gpm

2020 EAST EMERGENCY + MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

76.3 psi static pressure

66.6 psi residual pressure

S 57th reservoirs are dropping @ 2316 gpm

S 67th reservoir is dropping @ 1818 gpm

2020 EAST EMERGENCY + MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

52.8 psi static pressure

47.2 psi residual pressure

S 57th reservoirs are dropping @ 1885 gpm

S 67th reservoir is dropping @ 2249 gpm

SCENARIO 1 – PEAK HOUR FLOW

2020 EAST PHD STATIC CONDITIONS

Supply from Thurston WF @ 6777 gpm, Weyco WF @ 1075 gpm, SP/Maia WF @ 1800 gpm,

Total supply @ 9702 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 1-2 psi of ADD.

S 57th reservoirs are dropping @ 4038 gpm

S 67th reservoir is filling @ 1009 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2020 EAST ADD

Supply from Thurston WF @ 6777 gpm, Weyco WF @ 1075 gpm, SP/Maia WF @ 1800 gpm,

Total supply @ 9702 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

S 57th reservoirs are filling @ 2885 gpm (*2604 gpm required for 8 hr refill from ½ full*)

Approximately 7 hrs 30 minutes to refill from ½ full

S 67th reservoir is filling @ 3344 gpm (*1563 gpm required for 8 hr refill from ½ full*)

Approximately 3 hrs 44 minutes to refill from ½ full

When S 67th St reservoir fills and the altitude valve closes, pressures at Thurston Wellfield would caused a shutdown of the wellfield

2020 NORTH SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2020 NORTH MDD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 2-3 psi lower than ADD.

Kelly Butte reservoir is dropping @ 508 gpm

Moe reservoir is filling @ 961 gpm

2020 NORTH MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

91.9 psi static pressure

37.7 psi residual pressure

Kelly Butte reservoir is dropping @ 997.2 gpm

Moe reservoir is dropping @ 1050 gpm

2020 NORTH MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

97.6 psi static pressure

89.7 psi residual pressure

Kelly Butte reservoir is dropping @ 1784 gpm

Moe reservoir is dropping @ 1264 gpm

2020 NORTH MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

86.7 psi static pressure

33.9 psi residual pressure

Kelly Butte reservoir is filling @ 620 gpm

Moe reservoir is filling @ 428 gpm

2020 NORTH MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

96.7 psi static pressure

46.4 psi residual pressure

Kelly Butte reservoir is dropping @ 1811 gpm

Moe reservoir is filling @ 764 gpm

SCENARIO 4 – EMERGENCY + MDD + FIRE FLOW

2020 NORTH EMERGENCY + MDD STATIC CONDITIONS

Supply from Weyco WF @ 1075 gpm, Chase WF @ 2243

Total supply @ 3318 gpm

North system pressures are generally 5-10 psi below ADD.

Kelly Butte reservoir is dropping @ 2097 gpm

Moe reservoir is dropping @ 1790 gpm

2020 NORTH EMERGENCY + MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

88.7 psi static pressure

30.6 psi residual pressure

Kelly Butte reservoir is dropping @ 2769 gpm

Moe reservoir is dropping @ 3619 gpm

2020 NORTH EMERGENCY + MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

90.8 psi static pressure

72.7 psi residual pressure

Kelly Butte reservoir is dropping @ 3351 gpm

Moe reservoir is dropping @ 4037 gpm

2020 NORTH EMERGENCY + MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

85.1 psi static pressure

31.0 psi residual pressure

Kelly Butte reservoir is dropping @ 2336 gpm

Moe reservoir is dropping @ 3051 gpm

2020 NORTH EMERGENCY + MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

95.1 psi static pressure

43.9 psi residual pressure

Kelly Butte reservoir is dropping @ 3276 gpm

Moe reservoir is dropping @ 2112 gpm

SCENARIO 1 – PEAK HOUR FLOW

2020 NORTH PHD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally within 1-5 psi of ADD.

Kelly Butte reservoir is dropping @ 2981 gpm

Moe reservoir is dropping @ 2703 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2020 NORTH ADD

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 5-10 psi higher than ADD.

Kelly Butte reservoir is filling @ 1259 gpm (*1042 gpm required for 8 hr refill from ½ full*)

Approximately 6 hrs, 37 minutes to fill from ½ full.

Moe reservoir is filling @ 3558 gpm (*4167 gpm required for 8 hr refill from ½ full*)

2030 HYDRAULIC MODEL RESULTS

2030 WEST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2030 WEST MDD STATIC CONDITIONS

All supply from WWF-SSF @ 13889 gpm (20 mgd) available (6.6 mgd slow sand filters + 13.4 mgd from ?)

Under static conditions supply from WWF is greater than MDD demand. WWF Plant would have approximately 11415 gpm of unused capacity. Excess production from the slow sand filters would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant pump is on or system pressure at the Steam Plant is 50 psi or greater, the Steam Plant PRV is closed and all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 726 gpm MDD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

2030 WEST MDD + FIRE 1

2500 gpm @ 5th St & A St/City Hall Node J-885

53.0 psi static pressure

50.7 psi residual pressure

WWF-SSF Plant is operating @ 4583 gpm.

Willamette Heights Reservoir is dropping @ 1144 gpm

WWF Plant would have approximately 9306 gpm of unused capacity.

Steam Plant prv is operating at 391 gpm

2030 WEST MDD + FIRE 2

3500 gpm @ 28th St & C St/chemical plant Node J-923

48.8 psi static pressure

45.7 psi residual pressure

WWF-SSF Plant is operating @ 4583 gpm.

Willamette Heights Reservoir is dropping @ 2144 gpm

WWF Plant would have approximately 9306 gpm of unused capacity.

Steam Plant prv is operating at 1391 gpm

2030 WEST MDD + FIRE 3

1500 gpm @ 12th St & N St/ residential Node W0042

52.9 psi static pressure

47.2 psi residual pressure

Excess production from the slow sand filters would be 609 gpm

WWF Plant would have approximately 9915 gpm of unused capacity.

Willamette Heights Reservoir is dropping @ 726 gpm

Steam Plant prv is closed

SCENARIO 4 – EMERGENCY + MDD + FIRE FLOW

2030 WEST EMERGENCY + MDD STATIC CONDITIONS

Supply from Eastside Pump Station prv set @ 50 psi (not to exceed 4000 gpm) + storage @ Willamette Heights reservoir through the Steam Plant prv set @ 50 psi

No flow through Steam Plant

Willamette Heights Reservoir is dropping @ 753 gpm

Eastside intertie is flowing @ 2474 gpm

2020 WEST EMERGENCY + MDD + FIRE 1

2500 gpm @ 5th St & A St/City Hall Node J-885

56.0 psi static pressure

50.1 psi residual pressure

Steam Plant prv is flowing 1040 gpm to West System

Willamette Heights Reservoir is dropping @ 1793 gpm

Eastside intertie is flowing @ 3934 gpm

2030 WEST EMERGENCY + MDD + FIRE 2

3500 gpm @ 28th St & C St/chemical plant Node J-923

51.8 psi static pressure

46.8 psi residual pressure

Steam Plant prv is flowing 1974 gpm to West System

Willamette Heights Reservoir is dropping @ 2726 gpm

Eastside intertie is flowing @ 4000 gpm

2030 WEST EMERGENCY + MDD + FIRE 3

1500 gpm @ 12th St & N St/ residential Node W0042

55.9 psi Static pressure

47.1 psi residual pressure

Steam Plant prv is flowing 163 gpm to West System

Willamette Heights Reservoir is dropping @ 916 gpm

Eastside intertie is flowing @ 3811 gpm

SCENARIO 1 – PEAK HOUR FLOW

2030 WEST PHD

All supply from WWF-SSF @ 13889 gpm (20 mgd) available (6.6 mgd slow sand filters + 13.4 mgd from ?)

2030 WEST PHD STATIC

Under static conditions supply from WWF is greater than MDD demand. WWF Plant would have approximately 10648 gpm of unused capacity. Excess production from the slow sand filters (1342 GPM) would be spilled back to the river or be available for pumping to the East System through Eastside PS.

Note: When the Steam Plant prv is closed, all Willamette Heights and Glenwood demand is met from Willamette Heights Reservoir. This 1012 gpm PHD is not taken from WWF-SSF output leaving a substantial supply surplus in the balance of the West System.

SCENARIO 2 – ADD (RESERVOIR REFILL)

2030 WEST ADD

All supply from WWF-SSF @ 13889 gpm (20 mgd) available (6.6 mgd slow sand filters + 13.4 mgd from ?)

2030 WEST ADD STATIC

Willamette Heights reservoir is filling @ 4700 gpm (current pumping capacity is 4800 gpm/model limits flow to 4700 gpm at rated pump horsepower). (*2083 gpm required for 8 hr refill*) Approximately 3 hrs, 33 minutes to fill from ½ full.

WWF Plant would have approximately 7614 gpm of unused capacity.

Distribution system pressures are 7-10 psi above normal.

The 12" Permastran PVC pipeline under the railroad at the Steam Plant is at 13.3 fps velocity Discharge pressure at Steam Plant is 10 psi above normal pressure. The pumps may not be capable of this head in which case additional source would be available at the WWF Plant.

HYDRAULIC MODEL RESULTS

2030 EAST SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2030 EAST MDD STATIC CONDITIONS

Supply from Thurston WF @ 10249 gpm (WF+10 mgd), SP/Maia WF @ 1800 gpm,
Total supply @ 12049 gpm available (Modeling limited to 75.5 psi at Thurston Rd, 7000 gpm
under 2030 MDD Static Conditions)

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally 5-7 psi less than ADD west of 57th St.

S 57th reservoirs are dropping @ 2138 gpm

S 67th reservoir is filling @ 2218 gpm

An additional 10 mgd at Thurston WF would require completion of additional transmission
piping to avoid excessive pressures in the wellfield.

2030 EAST MDD + FIRE 1

2500 gpm @ s 48TH & Aster St/Jenna Village Apartments J-923

67.6 psi static pressure

53.1 psi residual pressure

S 57th reservoirs are dropping @ 4130 gpm

S 67th reservoir is filling @ 1711 gpm

2030 EAST MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

71.8 psi static pressure

56.3 psi residual pressure

S 57th reservoirs are dropping @ 4893 gpm

S 67th reservoir is filling @ 1474 gpm

2030 EAST MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

72.8 psi static pressure

60.4 psi residual pressure

S 57th reservoirs are dropping @ 3360 gpm

S 67th reservoir is filling @ 1941 gpm

2030 EAST MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

58.8 psi static pressure

52.7 psi residual pressure

S 57th reservoirs are dropping @ 2565 gpm

S 67th reservoir is filling @ 1146 gpm

SCENARIO 4 – EMERGENCY W/MDD + FIRE FLOW

2030 EAST EMERGENCY + MDD STATIC CONDITIONS

Thurston/Platt WF off

Supply from SP/Maia WF @ 1800 gpm

Supply from Eastside PS @ 7000 gpm (available Eastside PS pump capacity 2009)

Total supply @ 8800 gpm

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm

East system pressures are generally within 3-5 psi greater than ADD along the Booth Kelly haul road transmission line.

S 57th reservoirs are filling @ 1208 gpm

S 67th reservoir is dropping @ 1127 gpm

2030 EAST EMERGENCY + MDD + FIRE 1

2500 gpm @ S 48TH & Aster St/Jenna Village Apartments J-923

72.9 psi static pressure

62.3 psi residual pressure

S 57th reservoirs are dropping @ 743 gpm

S 67th reservoir is dropping @ 1676 gpm

2030 EAST EMERGENCY + MDD + FIRE 2

3500 gpm @ 42nd St & E St/pulp plant Node J-24

79.9 psi static pressure

70.7 psi residual pressure

S 57th reservoirs are dropping @ 1604 gpm

S 67th reservoir is dropping @ 1816 gpm

2030 EAST EMERGENCY + MDD + FIRE 3

1500 gpm @ S 38th St & Jasper Rd/residential Node J-54

81.6 psi static pressure

71.0 psi residual pressure

S 57th reservoirs are dropping @ 56.7 gpm

S 67th reservoir is dropping @ 1362 gpm

2030 EAST EMERGENCY + MDD + FIRE 4

1500 gpm @ 73rd St & B St/residential Node E0057

53.1 psi static pressure

47.4 psi residual pressure

S 57th reservoirs are filling @ 676 gpm

S 67th reservoir is dropping @ 2095 gpm

SCENARIO 1 – PEAK HOUR FLOW

2030 EAST PHD STATIC CONDITIONS

Supply from Thurston WF @ 10249 gpm (WF+10 mgd), SP/Maia WF @ 1800 gpm,
Total supply @ 12049 gpm available (Modeling limited to 75.5 psi at Thurston Rd, 10200 gpm
under 2030 PHD Static Conditions)

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

East system pressures are generally within 5-7 psi higher than ADD east of 57th St.

S 57th reservoirs are dropping @ 5703 gpm

S 67th reservoir is filling @ 2267 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2030 EAST ADD

Supply from Thurston WF @ 10249 gpm (WF+10 mgd), Weyco WF @ 1075 gpm, SP/Maia WF @
1800 gpm,

Total supply @ 13124 gpm available (Modeling limited to 75.5 psi at Thurston Rd, 6780 gpm
under 2030 ADD Static Conditions)

S 67th St and S 72nd St booster pump stations are on at 700 gpm and 500 gpm.

S 57th reservoirs are filling @ 2885 gpm (*2604 gpm required for 8 hr refill from ½ full*)

Approximately 7 hrs 30 minutes to refill from ½ full

S 67th reservoir is filling @ 3344 gpm (*1563 gpm required for 8 hr refill from ½ full*)

Approximately 3 hrs 44 minutes to refill from ½ full

When S 67th St reservoir fills and the altitude valve closes, pressures at Thurston Wellfield
would caused a shutdown of the wellfield

2030 NORTH SYSTEM

SCENARIO 3 – MDD + FIRE FLOW

2030 NORTH MDD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 3-5 psi lower than ADD.

Kelly Butte reservoir is dropping @ 746 gpm

Moe reservoir is filling @ 518 gpm

2030 NORTH MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

91.4 psi static pressure

37.3 psi residual pressure

Kelly Butte reservoir is dropping @ 1352 gpm

Moe reservoir is dropping @ 1377 gpm

2030 NORTH MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

97.0 psi static pressure

88.6 psi residual pressure

Kelly Butte reservoir is dropping @ 2057 gpm

Moe reservoir is dropping @ 1672 gpm

2030 NORTH MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

86.5 psi static pressure

33.5 psi residual pressure

Kelly Butte reservoir is dropping @ 853 gpm

Moe reservoir is dropping @ 875 gpm

2030 NORTH MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

96.4 psi static pressure

45.7 psi residual pressure

Kelly Butte reservoir is dropping @ 1990 gpm

Moe reservoir is filling @ 261 gpm

SCENARIO 4 – EMERGENCY + MDD + FIRE FLOW

2030 NORTH EMERGENCY + MDD STATIC CONDITIONS

Supply from Weyco WF @ 1075 gpm, Chase WF @ 2243

Total supply @ 3318 gpm

North system pressures are generally 5-10 psi below ADD.

Kelly Butte reservoir is dropping @ 2368 gpm

Moe reservoir is dropping @ 2201 gpm

2030 NORTH EMERGENCY + MDD + FIRE 1

2500 gpm @ Harvest Ln & Hayden Bridge Rd/Page School Node J-916

87.8 psi static pressure

29.0 psi residual pressure

Kelly Butte reservoir is dropping @ 3048 gpm

Moe reservoir is dropping @ 4021 gpm

2030 NORTH EMERGENCY + MDD + FIRE 2

3500 gpm @ 3333 Riverbend Dr/Sacred Heart Hospital Node J-330

89.4 psi static pressure

70.1 psi residual pressure

Kelly Butte reservoir is dropping @ 3623 gpm

Moe reservoir is dropping @ 4445 gpm

2030 NORTH EMERGENCY + MDD + FIRE 3

1500 gpm @ 31st St & Hayden Bridge Rd/residential Node J-502

84.5 psi static pressure

30.0 psi residual pressure

Kelly Butte reservoir is dropping @ 2612 gpm

Moe reservoir is dropping @ 3457 gpm

2030 NORTH EMERGENCY + MDD + FIRE 4

1500 gpm @ Linden Ave & Juniper Ln/residential Node J-660

94.5 psi static pressure

42.9 psi residual pressure

Kelly Butte reservoir is dropping @ 3560 gpm

Moe reservoir is dropping @ 2509 gpm

SCENARIO 1 – PEAK HOUR FLOW

2030 NORTH PHD STATIC CONDITIONS

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 5-10 psi below ADD.

Kelly Butte reservoir is dropping @ 3655 gpm

Moe reservoir is dropping @ 3661 gpm

SCENARIO 2 – ADD (RESERVOIR REFILL)

2030 NORTH ADD

Supply from I-5 WF @ 2590 gpm, Weyco WF @ 1075 gpm, Sports Way WF @ 1750 gpm, Chase WF @ 2243

Total supply @ 7658 gpm

North system pressures are generally 5-10 psi higher than ADD.

Kelly Butte reservoir is filling @ 1115 gpm (*1042 gpm required for 8 hr refill from ½ full*)

Approximately 7 hrs, 28 minutes to fill from ½ full.

Moe reservoir is filling @ 3345 gpm (*4167 gpm required for 8 hr refill from ½ full*)

