WATER SYSTEM MASTER PLAN

August 2021

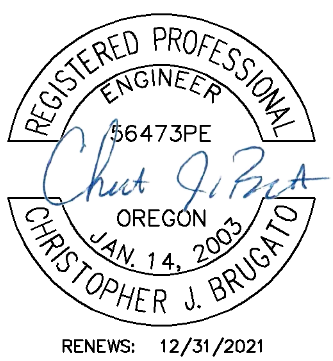
Westech Engineering, Inc.
3841 Fairview Industrial Drive SE, Suite 100
Salem, OR 97302
(503) 585-2474

WATER SYSTEM MASTER PLAN

City of Yachats

August 2021

Prepared for
City of Yachats
441 Hwy 101 N.
PO Box 345
Yachats, OR 97498



Prepared by
Westech Engineering, Inc.
3841 Fairview Industrial Drive SE, Suite 100
Salem, OR 97302
(503) 585-2474

J.O. 3096.4000

PUBLIC HEALTH DIVISION
Drinking Water Services
Kate Brown, Governor

444 A Street
Springfield, OR 97477
Ph. (541) 726-2587
Fax (541) 726-2596
http://healthoregon.org/dwp

3 August 2021

Shannon Beaucaire
City of Yachats
P.O. Box 345
Yachats, OR 97498

RE: Master Plan (PR 2021-99)
Yachats (PWS OR4100966)
Concurrence

Dear Ms. Beaucaire:

Thank you for submitting a copy of Yachats' Water System Master Plan (MP) via Westech Engineering, Inc. (Westech; JO 3096.4000) on 8 June 2021 to Oregon Health Authority's Drinking Water Services (DWS). DWS received the plan review fee of $4,125 on 15 June 2021. DWS concurs with the MP contingent on Oregon Water Resources Department approval of the Water Management and Conservation Plan (WMCP) that is in development.

The Master Plan represents a 20-year planning horizon out to the year 2041. The plan includes a system description, future demand estimates and CIP project lists with cost estimates. Upon review of the Master Plan, it appears the criteria listed in Oregon Administrative Rules (OAR) 333-061-0060(5) have been met.

In addition, I have the following comments:

- The regulatory requirements Section 3 would be more succinct if Yachat's compliance status was addressed in a single leading paragraph. Section 3.7 does not mention the Lead and Copper Rule Revision (LCRR), a probable future regulatory requirement.

- The slosh height of South Reservoir may be an issue in a seismic event (max water level is 4 feet from max height). Slosh height in other reservoirs may also be issues.

Communication with DWS should reference Plan Review 2021-99 and can be emailed to me at james.r.macpherson@dhsoha.state.or.us or mailed to:

Attn: Jay MacPherson
OHA-Oregon Drinking Water Services
444 A Street
Springfield, OR 97477

Your cooperation is appreciated. If you have any questions or concerns, or would like this letter in an alternate format, you are welcome to contact me at (541) 231-0762 or via email.

Sincerely,

James "Jay" MacPherson, Ph.D., P.E.
Region 2 Plan Review Coordinator
OHA Drinking Water Services

ec: Master File, DWS Portland
Amy Bleekman, DWS Springfield
Kaline Chavarria, Lincoln County
Chris Brugato, Westech

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

FOREWORD

Using this Report

This report will be used by many people whose needs for information will differ widely. Accordingly, an Executive Summary appears at the beginning of this report. The summary provides an overview of the report and presents the main conclusions. Readers may gain a good general understanding of the report and its contents by reading the summary. Additional detailed information is presented in the body of the report.

LIST OF ABBREVIATIONS

ADD	Average Day Demand
AWWA	American Water Works Association
bgs	Below Ground Surface
cfs	Cubic Feet Per Second
CIP	Capital Improvement Plan
EDU	Equivalent Dwelling Unit
EPA	US Environmental Protection Agency
FEMA	Federal Emergency Management Agency
fps	feet per second
gpd	gallons per day
gpcd	gallons per active certificate per day
gpm	gallon per minute
GWR	Ground Water Rule
GWUDI	Ground Water Under the Direct Influence (of surface water)
HAA5	five haloacetic acids regulated by the EPA
HP	Horsepower
LCR	Lead and Copper Rule
MDD	Maximum Day Demand
MMD	Maximum Month Demand
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MG	Million Gallons
MGD	Million Gallons Per Day
OAR	Oregon Administrative Rule
ODOT	Oregon Department of Transportation
OHA-DWS	Oregon Department of Human Services, Drinking Water Services
OWRD	Oregon Water Resources Department
PDD	Peak Day Demand
PHD	Peak Hour Demand
PLC	Programmable Logic Controller
psi	pounds per square inch
PWDS	Public Works Design Standards
SCADA	Supervisory Control and Data Acquisition system
SDC	System Development Charge
SMCL	Secondary Maximum Contaminant Level
UGB	Urban Growth Boundary
USGS	United States Geological Survey
VFD	Variable Frequency Drive
WMCP	Water Management & Conservation Plan
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

Summary Outline

EXECUTIVE SUMMARY

INTRODUCTION

The purpose of this study is to provide a comprehensive evaluation of the City's water system with respect to its existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a framework for the provision of water service through the year 2041.

This executive summary has been prepared to provide a concise overview of the evaluations and recommendations from each chapter of the study. A summary of the capital improvement program costs appears at the end of this section, as well as in Chapter 12.

PROJECT OBJECTIVES

This master plan has been developed to provide the City with a guide for short term and long term water system improvements and has been prepared as a reference document to assist the City as it evaluates the impacts of proposed development and land use on the water system.

This master plan accomplishes the following specific objectives:

- Establishes water system design and planning criteria
- Provides an inventory of the existing water system infrastructure
- Identifies and prioritizes current and future water system deficiencies
- Provides specific recommendations to the community and City Council for action
- Provides the City with a water system master plan that addresses the needs of both the City and regulating agencies

BASIS FOR MASTER PLANNING

The City's previous water master plan was completed in 2001; it outlined recommended improvements to the water system components including the distribution, storage, and treatment systems. A number of the major improvements recommended in the previous water master plan have been addressed. The life and planning horizon for a water master planning document is 20 years, with updates typically recommended on 10-year intervals. Accordingly, a new master plan was needed to address water system issues.

STUDY AREA AND PLANNING CONSIDERATIONS - CHAPTER 2

The City's Comprehensive Plan was adopted in 2008 and recently updated in 2019. The Plan established an urban growth boundary (UGB) encompassing approximately 600 acres. The City provides water service to all areas of the City Limits and UGB. The study area for this plan includes all areas within the UGB. The UGB and the City Limits have the same boundaries in Yachats.

The planning period for this study extends through 2041. Based on data provided by the Portland State University Population Research Center, the population in Yachats in 2020 is about 760. The population is expected to increase to approximately to 1,061 in 2040. However, Yachats, like many Oregon Coast communities, experiences seasonal changes in population as a result of hospitality and travelers. Therefore water demand projections were based on an estimated service population, which more accurately describes the number of users of the water system. This methodology is described in more detail in Chapter 5. The population projections presented in Chapter 5 include estimates of permanent and seasonal residents. At maximum occupancy, the existing (i.e., 2021) population is estimated to be about 2,200 people. By 2041, this value is expected to increase to about 2,850 people.

The improvements recommended in this plan are based on the development of land within the UGB in its present location and the current zoning designations for these areas. This report evaluates the anticipated water supply, treatment, pumping, and storage needs for the 20-year planning period. Implementation of the recommended improvements will provide an adequate and dependable water system for the City's existing and future customers. Significant expansions of the service area, or changes to the existing zoning areas could change the recommendations of this plan. An update or reevaluation of key planning assumptions should be performed if such changes occur.

REGULATORY REQUIREMENTS - CHAPTER 3

The US Environmental Protection Agency (EPA) and the State of Oregon Health Authority, Drinking Water Program (ODWP) currently enforce drinking water standards for 83 primary contaminants and 16 secondary contaminants. Primary standards regulate contaminants that pose a serious risk to public health, whereas secondary standards cover aesthetic considerations. Public water systems must sample for primary contaminants routinely to ensure that standards are met and must report the results of such sampling to the regulating agency.

The City's water system operates in compliance with the current regulatory requirements. Regulatory compliance is achieved as a function of the basic water system design, the operational modes selected by the City's licensed operators, as well as the current regulatory structure.

A more detailed discussion of existing and anticipated regulatory requirements is provided in Chapter 3.

EXISTING WATER SYSTEM INVENTORY - CHAPTER 4

The City operates and maintains the existing water system and delivers water to its consumer base. The system utilizes surface water from Reedy and Salmon Creeks. A water treatment plant near the Yachats River produces finished drinking water and conveys it to the distribution system. Six finished water storage reservoirs, six pump stations and a network of distribution pipes deliver water to users. The City also has water rights to the Yachats River and Cape Creek that are currently not in use. The City also has a connection to the Southwest Lincoln County Water People's Utility District distribution grid. This intertie is intended for emergency use only.

The City's water distribution system includes a transmission line from the water treatment plant to the main water storage reservoir, known as the Upper Radar Road Reservoir. This storage tank delivers water to the rest of the areas of town, including other reservoirs and pump stations. The distribution grid is mainly a looped network and is constructed largely in the public road rights-of-way. The distribution system consists of approximately 17.6 miles of pipe of varying materials and sizes.

PRESENT AND FUTURE WATER DEMANDS - CHAPTER 5

At the most fundamental level, future water demands are a product of per capita water use patterns applied over the anticipated population. The per capita use factors utilized in this report are based on typical historical use rates and do not consider the effects of future conservation programs. The development of a conservation program is encouraged and will provide additional operating margins with regard to supply and capacity.

Water demand is defined as the sum of all water produced and delivered to the City's distribution system. It includes water consumed in all use categories and also includes water loss and unaccounted-for water. Water demand varies across seasonal periods, days of the week, and hours of the day. The establishment of an average day demand rate (ADD) serves as the baseline against which other more intensified demands are measured, such as peak day demand (PDD), which is defined as the highest production day within the highest production month and peak hour demand (PHD), which is defined as the greatest flow occurring in any one-hour period.

Population projections of residents within a UGB typically serve as the basis for water demand projections in a municipality. However, Yachats is a community strongly influenced by seasonal occupancy of non-permanent residents that are vacationing. The City provides water to several hotels, second homes, and vacation rentals that greatly increase the number of users on a seasonal basis. For this reason, this plan developed water demand projections instead based upon a projected service population. At maximum occupancy during peak holiday weekends (e.g., Fourth of July), the projected service population was estimated to be about 2,850 people in the year 2041. A detailed description of the population projection methodology is in Chapter 5.

Water demand projections were based on historical water production records and the projected service population. Records from January 2017 through September 2020 were used as a basis to establish historical water demands. Table 5-8 includes a summary of the projected water demands including estimations of short-term peak demands.

WATER SUPPLY EVALUATION - CHAPTER 6

In Oregon, all water is publicly owned. The Oregon Water Resources Department (OWRD) regulates the use of both surface and groundwater throughout the state. Over the years as greater demands have been placed on limited water resources, OWRD has exercised increasing control over water use. Water rights establish a hierarchy utilized by OWRD to adjudicate water in times of water shortages. Accordingly, it is paramount the City secure and maintain suitable water rights to meet long term municipal needs.

The City currently utilizes surface water diverted from Reedy and Salmon Creeks as its sole source of municipal water. The City has water rights to the Yachats River and Cape Creek, but these sources are not currently utilized by the City. The City also has an intertie with the Southwest Lincoln County Peoples Utility District that can be used as a water source on an emergency basis.

The City has active certificated water rights totaling 898 gpm (Reedy Creek) and permitted water rights totaling 1,795 gpm (Salmon Creek and Yachats River). In addition to these active certificated and permitted water rights, the City also has a non-active certificated water right of 220 gpm for Cape Creek. The City's total water right holding (sum of active certificates, permits, and non-active certificates) is 2,893 gpm for all available sources. This is far higher than the City's peak day demand. However, the rates of diversion allowed on paper are different than the rates at which the City can actually divert water. The City appears to have access to sufficient water under its water rights, but stream flows are less than the authorized rate of diversions during the summer months when the City needs to maximize its use of water rights

At the present time, the City currently obtains all drinking water from Reedy Creek and Salmon Creek. During the summer months, the combined flow from these sources can drop to as low as 180 gpm. The projected peak day demand at the end of the planning period is approximately 200 gallons per minute (Table 5-8). In order to replenish fire flow storage in a 72 hour period, an additional 110 gpm is required (Table 5-9). Therefore, the total water production required to meet projected peak day demands while simultaneously replenishing fire flow storage is approximately 310 gpm. During the winter months, the City can produce water at this rate. However, during dry weather conditions at the end of the summer when the combined flow from Reedy and Salmon Creek drop below 200 gpm, the City will be unable to meet production needs with the existing supply sources. For this reason, it is recommended that the City develop the upper Yachats River diversion during the planning period. This would provide an additional 224 gpm of supply for a total reliable water supply of about 400 gpm. This is significantly higher than the 310 gpm that is required to meet peak day demands while simultaneously replenishing fire flow storage. Once the Yachats River Intake is completed, it will increase the City's reliable water supply to not only supply the anticipated growth during the planning period, but future growth well into the next planning period (i.e., beyond 2041).

Overall, the City's water rights are sufficient for the planning period, but additional development work (i.e., infrastructure construction) is needed to ensure a reliable water supply. Chapter 6 includes a detailed analysis of the City's water supplies and recommended improvements.

WATER TREATMENT EVALUATION - CHAPTER 7

The City 's existing water treatment plant was constructed in the early 1990s and has served the City well. The existing treatment plant can reliably produce about 500,000 gallons of water per day. This is significantly more than the estimated peak day demand at the end of the planning period. Therefore, the treatment plant is adequately sized to meet the projected demands and an expansion project to increase the treatment capacity is not needed. However, most of the mechanical and electrical components of the plant are the original equipment that is now about 30 years old and would be about 50 years old at the end of the planning period. This is far beyond the design life for mechanical and electrical equipment such as control panels, pumps, chemical feed equipment, and some of the internal components of the clarifier and filters. Therefore, the City should plan to make significant upgrades to the mechanical and electrical systems during the planning period. In addition to capacity and age issues, the existing treatment plant building does not meet current seismic building codes and improvements to the building structure would be beneficial. The recommended improvements are described in detail in Chapter 7. The recommended improvements are generally needed to address aging infrastructure rathe than to increase the treatment capacity of the plant.

DISTRIBUTION SYSTEM EVALUATION - CHAPTER 8

The primary purpose of a water distribution system is to deliver the full range of consumer demands and fire flows at pressures suited for the particular use. To accomplish this, the distribution system utilizes a combination of large water mains and networks of smaller distribution mains.

The existing distribution system was evaluated and existing or anticipated deficiencies were identified. In general, the distribution system is sufficient to provide domestic flows, but lacks the capacity to convey flows needed for fire suppression. Chapter 8 includes an evaluation of the distribution system as well as improvement recommendations. Some of the improvements are needed to improve fire flows throughout the City and some are needed to replace pump stations and piping that are likely to reach the end of their useful life during the planning period. In addition to the various recommended piping improvements, Chapter 8 also recommends an evaluation of the City's pressure reducing valves. Correcting these problems has the potential to improve the available fire flow throughout the City.

Chapter 8 also includes a recommendation to establish two annual programs (i.e., Program 1 & Program 2). These programs include developing a better tracking system for unaccounted for water and overall water loss and a leak detection and repair program. These programs are critical in order to develop the Yachats River Water Intake as recommended in Chapter 6. The City's Yachats River water rights can only be used if the City's water loss is less than 15%. This is an attainable goal, and there is evidence to suggest that the City is already achieving this. However, the City's water production and consumption data tracking systems should be improved because the water loss data is likely to come under increased scrutiny as the City attempts to develop the Yachats River water right. In addition, as the water distribution system continues to age, new leaks and faults will develop. As such, and active leakage testing and repair program will be needed indefinitely to ensure that water loss is kept below 15%

Table 8-1 is a summary of the recommended distribution improvements. Details of particular projects are discussed in Chapter 8.

WATER STORAGE EVALUATION - CHAPTER 9

In most municipal distribution systems, the water system service pressure is determined by the elevation of the free water surface in the storage reservoirs serving the system. Service pressures in the Yachats distribution system begin with available static pressure created by the City's 1,000,000-gallon reservoir and are reduced en-route to users by friction losses in the pipe network.

The primary function of water storage is to provide a reserve of water to equalize daily variations between supply and consumer demand, to serve fire-fighting needs, and to meet system demands during an emergency interruption of supply. The overall storage within a system can be divided into several storage categories, including operational storage, equalization storage, standby (emergency) storage, fire suppression storage, and dead storage. The analysis in Chapter 9 identifies these volumes that are currently provided by the existing storage tanks and compares them to the storage needs anticipated during the planning period.

The analysis in Chapter 9 shows the City's existing storage tanks are able to meet the storage requirements for the remainder of the planning period. Therefore, the tanks are sufficient from a capacity standpoint. However, improvements are recommended during the planning period to address aging infrastructure and seismic concerns.

The Upper Radar Road Reservoir provides a vast majority of the City's water storage capacity. A seismic evaluation of the tank structure is needed and structural upgrades to improve the seismic resiliency of the structure will likely be required. The construction of the structural improvements will require the reservoir to be taken out of service for a prolonged period of time (i.e., several months). The City's other reservoirs cannot provide enough storage to fight a major fire without this reservoir in service. A new 250,000 gallon reservoir is recommended to be installed adjacent to the existing Lower Radar Reservoir in order to meet this need while seismic upgrades are being completed. This new reservoir is also recommended to eventually replace the existing Lower Radar Road Reservoir. The Lower Radar Road Reservoir was constructed in 1945 and is likely to reach the end of its useful life during the planning period. The new Lower Radar Road Reservoir will be designed to meet current seismic standards. Once the new Lower Radar Road Reservoir and the seismic improvements to the Upper Radar Road Reservoir are completed, the old 1945 tank can be removed from service.

SEISMIC RISK ASSESSMENT & MITIGATION PLAN - CHAPTER 10

OAR 333-061-0060(5)(J) requires communities located in high hazard zones to conduct a seismic risk assessment and mitigation plan as part of a water master planning effort. Chapter 10 includes a description of the analysis and recommended mitigation plan. The critical facilities are identified along with a discussion of the consequences of failure. The recommended capital improvement plan includes structural retrofitting of the critical facilities such as the water treatment plant and storage tanks to improve the overall seismic resiliency of the City's system. Additionally, some critical water distribution pipes are recommended to be replaced. It is recommended that the City consider replacing these pipes with materials resistant that are more resistant to ground motions such as HDPE pipe or restrained joint ductile iron pipe.

OPERATION AND MAINTENANCE - CHAPTER 11

Chapter 11 includes a review of the City's operation and maintenance activities as well as general discussion of operation and maintenance activities that City staff should consider.

RECOMMENDED CAPITAL IMPROVEMENT PLAN - CHAPTER 12

As summarized in the previous sections, the water system has a number of deficiencies, which either do or will limit the City's ability to provide an adequate level of water service for the duration of the planning period. Some of these deficiencies are more critical than others as they present an immediate effect on the ability to provide adequate service. Other deficiencies will manifest as the City expands and the existing system continues to age.

A prioritizing process was developed to rank the improvement projects since the scope of the proposed improvements is large. Factors utilized in the prioritizing process included several measures of criticality (such as public health concerns, end of useful life, inadequate capacity, and City priority), as well as the cost and benefit of each project.

Priority 1 improvements are recommended to be undertaken as soon as practical. These are projects necessary to resolve existing or near-term system deficiencies, especially due to water rights and fire flow capacity. Priority 2 projects are needed to maintain adequate water service based on the condition of aging infrastructure, seismic risk mitigation, and to improve redundancy of water supply to users. Although not critical at this time, they should be considered as improvement projects that will be upgraded to Priority 1 prior to the end of the planning period. Priority 3 projects, while important, are not deemed critical at the present time but will eventually be needed to improve system reliability or to supply future demands.

Presented in the table below is a summary of the priority category totals.

Table ES-1| Cost Summary, Capital Improvement Recommendations

Priority Group	Total Estimated Project Cost
Priority 1	$4,904,000
Priority 2	$8,262,000
Priority 3	$1,313,000
Total	$14,479,000

Table ES-2 is a comprehensive listing of the recommended water system improvement projects. The location of many of the prioritized improvements is shown in Figure 12-1 through Figure 12-3 (in the body of the report). The reader is referred to the body of this report for more detailed descriptions of the individual projects.

Work on the Priority 1 improvements should begin as soon as feasible following approval of this plan by the Oregon Health Authority and formal adoption by the City Council. Priority 2 projects are expected to be needed within the planning period as the City desires to improve reliability and upgrade aging infrastructure. Priority 2 projects can begin as finances become available and as the need arises.

In addition to the recommended capital improvement projects, this plan recommends several ongoing annual programs. These are listed at the end of Table ES-2. The first of these programs includes the non-metered water use tracking work described in Chapter 8. Program 1 and Program 2 are recommended to reduce the amount of unaccounted for water in the system. As described in Chapter 6, these efforts are very important to the City's ongoing effort to demonstrate responsible use of water resources and to ensure long-term water supply. Program 3 is recommended for the periodic updates to the Water Management and Conservation Plan. This effort is also related to administration of the City's water rights. It is envisioned that the recommended annual programs will be funded from the City's operation and maintenance budget for the water system.

The City does not currently have the resources nor is the City's existing user fee structure sufficient to fund all of the recommended improvements; therefore, alternative funding sources must be pursued. Several potential funding sources are identified and discussed in the last portion of Chapter 12. All funding options will likely require an increase of the user rates and SDCs.

Table ES-2| Recommended Capital Improvement Priorities (Yachats Water System)

Project Code[1]	Project	Chapter	Priority	Total Estimated Project Cost[2]
S-1	Permit S-29018 Partial Perfection and Extension Application	6	1	$15,000
S-2	Yachats River Water Rights Planning Work	6	1	$50,000
S-3	Evaluate Using SWLCWPUD as a Long-Term Source	6	1	$75,000
S-4	Yachats River Intake and Raw Water Pipeline	6	1	$2,893,000
S-5	Reedy Creek Raw Water Pipeline Improvements	6	1	$208,000
T-1	WTP Electrical and Control System Improvements	7	1	$814,000
D-1	Water System Design Standards	8	1	$5,000
D-2	Pressure Reducing Valve Maintenance & Coordination	8	1	$50,000
D-3[3]	Windsong Street Service Reconnections	8	1	$11,000
D-4[3]	New PRV at 7th Street & Radar Road	8	1	$101,000
D-5[3]	New PRV on King Street Between 7th and Prospect Ave	8	1	$101,000
D-6[3]	New 8" Water Main on Radar Road at Prospect Ave	8	1	$57,000
D-7[3]	New 8" Water Main on King Street at Prospect Ave	8	1	$86,000
D-10	Retrofit Combs PRV	8	1	$40,000
D-13	Replace 4" AC with 8" from Prospect Ave to Yachats River Road	8	1	$398,000
	Subtotal Priority 1			**$4,904,000**
T-2	WTP Clarifier Rehabilitation	7	2	$641,000
T-3	WTP Mixed Media Filter Rehabilitation	7	2	$350,000
T-4	WTP Pump and Compressor Upgrades	7	2	$402,000
T-5	WTP Instrumentation Upgrades	7	2	$271,000
T-6	WTP Chemical Feed System Improvements	7	2	$205,000
T-7	WTP Building Seismic Retrofit	7	2	$270,000
D-8	New 8" Water Main on Third Street	8	2	$167,000
D-9	New 4" Water Main and PRV on Horizon Hill Road	8	2	$737,000
D-11	Yachats Ocean Road Service Reconnections	8	2	$20,000
D-15	Pontiac Street Waterline - 3rd to 4th	8	2	$88,000
D-16	Shell Street Waterline	8	2	$79,000
D-17	Gender Drive and Windy Way Waterlines	8	2	$254,000
D-18	Pontiac Street Waterline - 2nd to 3rd	8	2	$105,000

Table ES-2| Recommended Capital Improvement Priorities (Yachats Water System)

Project Code(1)	Project	Chapter	Priority	Total Estimated Project Cost(2)
D-19	Hanley Drive Waterline	8	2	$47,000
P-1	New Radar Road Pump Station	8	2	$767,000
P-2	New Horizon Hill Pump Station & Reservoir	8	2	$1,079,000
ST-1	New 250,000-gallon Lower Radar Road Reservoir	9	2	$1,717,000
ST-2	Upper Radar Road Reservoir Structural Inspection & Analysis	9	2	$50,000
ST-3	Upper Radar Road Reservoir Seismic Retrofit Improvements	9	2	$1,013,000
	Subtotal Priority 2			**$8,262,000**
D-12	New 8" Water Main on Green Hill Drive	8	3	$412,000
D-14	8" Water Main Highway 101 from 6th to Marine Dr.	8	3	$583,000
D-20	Automated Water Meter Reading System	8	3	$318,000
	Subtotal Priority 3			**$1,313,000**
Recurring Annual Programs				
Pgm-1	Non-metered Water Use Tracking System (see section 8.4.2)	8	1	$1,000 per year
Pgm-2	Leak Detection and Repair Program (see section 8.4.2)	8	1	$30,000 per year
Pgm-3	Water Management & Conservation Plan Updates (see section 3.10)	3	1	$5,000 per year
	Subtotal Recurring Annual Programs			**$36,000 per year**

[1] Project Code Legend:
S : Water Source/Supply T : Water Treatment ST : Storage
P : Pump Station D : Distribution Pgm : Recurring Annual Program

[2] See Section 12.3.2 for basis of project cost estimates, January 2021 ENR 20 City Construction Cost Index of 11630

[3] As described in Chapter 8, the City may want to consider constructing Projects D-3 through D-7 as a single larger project.

CHAPTER 1

INTRODUCTION

Chapter Outline

INTRODUCTION

1.1 GENERAL OVERVIEW

The City of Yachats is located near the southwest corner of Lincoln County on the Oregon Coast. The City is located at the mouth of the Yachats River. Incorporated in 1967, the City of Yachats has grown to a current population of 760 inside the urban growth boundary (UGB). The UGB and City Limits encompass the same area, which is approximately 600 acres. Being located on the rugged Oregon Coast, Yachats has developed a relatively stable economy with a strong tourism sector. The City is divided into northern and southern areas by the Yachats River.

The City owns and operates the public drinking water system that serves the entire municipal population. The City also has an interconnection with the Southwest Lincoln County Water People's Utility District (SLCWPUD), which can be used to supply the Yachats distribution system. The City currently sources water from two creeks that are close to Yachats: Reedy Creek and Salmon Creek. The City also has a water right to source water from the Yachats River. The City does not have any groundwater sources.

The first community water system serving Yachats was constructed in the 1940's. In 1945 the City constructed a 200,000 gallon storage tank and a raw water impoundment and intake on Reedy Creek. Reedy Creek is still the primary water source for the City. Raw water from Reedy Creek is delivered by gravity to a 500,000 gallon raw water storage tank. The City also has a raw water impoundment and intake structure on Salmon Creek near the treatment plant. Raw water from Salmon Creek is conveyed by gravity in to the plant.

In 1992 the City constructed the existing water treatment plant. The existing treatment plant is capable of supplying 0.5 mgd.

Finished water from the treatment plant is stored in six reservoirs that total approximately 1,590,000 gallons of storage. A majority of the distribution system is served by gravity from these reservoirs. Table 4-3 is a summary of the reservoirs.

There are seven pump stations in the distribution system that either lift water to reservoirs or boost pressure. The main pump station is integrated with the water treatment plant. Table 4-4 is a summary of the pump stations.

1.2 NEED FOR WATER SYSTEM MASTER PLAN

The City adopted their previous water master plan in 2001. The previous water master plan outlined recommended improvements to the water system components including the supply, treatment, storage, and distribution systems. A number of the improvements recommended in the previous water master plan have been completed. Some of the reasons for the preparation of a new master plan at this time include the following:

- The existing Water Master Plan is now about 20 years old. The life and planning horizon for a water master planning document is 20 years, with updates typically recommended on 10 year maximum intervals.
- Construction, operation, and replacement costs for water system components have increased significantly since 2001 when some of the improvements were recommended. There have also been a number of regulatory changes that have occurred since 2001 that influence the planning effort. Therefore, it is appropriate to have a current master planning document that lists recommended improvements together with updated estimates of construction and/or implementation costs. The recommended projects and their associated cost projections can then be included in a capital improvement plan that the City can utilize to help determine if the current water rates and system development charges (SDCs) are appropriate.

1.3 AUTHORIZATION

In the fall of 2018, the City authorized Westech Engineering to begin preparation of an updated Water System Master Plan.

1.4 PURPOSE

The purpose of this plan is to provide a comprehensive evaluation of the City's water system with respect to its existing and future needs, identify improvements and associated costs necessary to meet those needs, and provide the City with a framework for the provision of water service through the year 2041.

This master plan will assist the City in planning and implementing capital improvements. This plan also provides recommendations of how to serve areas within the UGB that are currently undeveloped. The plan will benefit current and future residents of the City by improving water quality, planning for growth, and providing for scheduled improvements with an equitable distribution of improvement costs.

1.5 SCOPE OF WORK

The scope of work for this project is to update the City's previous master plan with respect to existing and future needs, identifying improvements and associated costs necessary to meet those needs, and providing the City with a planning document to guide future water system expansion. This plan accomplishes the following specific objectives:

- Establish water system design and planning criteria
- Describe existing and anticipated federal and state drinking water regulatory requirements
- Provide an inventory of the existing water system infrastructure
- Establish water demand projections based on historic and anticipated population
- Evaluate water supply quality and adequacy
- Evaluate the need for modifications to the water treatment facility
- Develop and calibrate a computerized hydraulic model of the City's water distribution system
- Evaluate the existing distribution system to determine required improvements
- Evaluate existing storage reservoirs and perform a system-wide storage analysis
- Evaluate the existing instrumentation and control system
- Develop recommendations for system-wide improvements to enhance reliability
- Develop recommendations for a prioritized Capital Improvement Plan (based on the above evaluations) to correct existing deficiencies and to serve future growth.
- Provide the City with a water system master plan that addresses the concerns of both the City and regulating agencies.

The updated water master plan can be used to develop specific recommendations to the community and City Council for action. This report does not include a wetland inventory or delineation(s), topographic or aerial surveys, on-site environmental investigations or geotechnical investigations.

1.6 PLANNING REGULATORY COMPLIANCE

1.6.1 Master Plan Requirements

The Oregon Drinking Water Services *(DWS)* requires community water systems with 300 or more service connections to maintain a current water master plan. This plan has been prepared to satisfy the requirements of the DWS as stipulated in OAR 333-061-0060(5).

1.6.2 Future Master Plan Updates

It should be recognized that projections into the future are subject to many variables and assumptions, some of which may prove inaccurate. Accordingly, it is recommended the City review its water system and this master plan at ten-year intervals and update the report as appropriate.

1.7 PREVIOUS STUDIES AND REPORTS

The following reports and studies were referenced in the preparation of this study:

- *Comprehensive Land Use Plan,* City of Yachats, Yachats Oregon, February, 2019
- *Comprehensive Storm Drainage Plan,* Yachats Oregon, HGE Engineers and Planners, May 1993
- *Water Master Plan*. The Dyer Partnership, Engineers and Planners, Inc. June 2001.
- *Construction Drawings, Water System Improvements,* Yachats Oregon, HGE Engineers, December 1990

CHAPTER 2

STUDY AREA AND PLANNING CONSIDERATIONS

Chapter Outline

STUDY AREA AND PLANNING CONSIDERATIONS CHAPTER 2

2.1 STUDY AREA

The City of Yachats is located near the southwest corner of Lincoln County on the Oregon Coast. The City's downtown is at the mouth of the Yachats River. Most of the city is located north of the river. Major road transportation is provided to the City by U.S. Highway 101 which runs north to south. East-west transportation to and from the Willamette Valley is either provided by Highway 126 to Eugene or Highway 34 to Corvallis. Figure 2-2 is a vicinity map that depicts these features.

Incorporated in 1967, the population within the urban growth boundary (UGB) has grown to approximately 760. The City's Comprehensive Plan was adopted in 2008 and was updated in 2019. The UGB encompasses approximately 600 acres. The City Limits and UGB encompass the same area.

Being located on the rugged Oregon Coast, Yachats has developed a relatively stable economy with a strong tourism sector. Yachats is a tourist and vacation destination with shops, restaurants, and several lodging amenities like bed & breakfasts. In the summer months, the City experiences an influx of tourist traffic and seasonal residents.

The improvements recommended in this plan are based on the development of land within the UGB, as well as the existing land use zoning for these areas. It is assumed that no significant development will occur within the study area that will require major changes to the existing zoning, and that there will be no significant expansions of the UGB within the study period. Changes in any of these assumptions could change the recommendations contained in this master plan. Should significant changes in any of the above occur, this plan should be updated accordingly.

2.2 STUDY PERIOD

Choosing a "reasonable" design period for which a utility system should be designed is a somewhat arbitrary decision. If the design period is too short, the public faces the prospect of demands exceeding capacity, requiring the system to be continually upgraded or replaced. On the other hand, choosing a design period that is too long can lead to facilities with excess capacity that may never be needed if population growth does not occur at the projected rates. Such facilities can place an economic burden on the present population and may become obsolete before being fully utilized.

The Oregon Health Authority, Drinking Water Services (DWS) has established 20 years as a proper planning period for water system improvements. This report will evaluate the anticipated water supply, treatment, distribution and storage needs for the 20 year planning period. Most waterline pipes are by their nature unsuited for incremental expansion without extensive capital outlays. For this reason, these facilities will be designed for the ultimate development of land within the UGB based on current land use designations. For other facilities such as treatment and storage facilities, a staged approach to expansion may be acceptable. The planning period used in this report ends in the year 2041.

It should be recognized that projections into the future are subject to many variables and assumptions, some of which may prove inaccurate. Accordingly, it is recommended that the City review its water system at five-year intervals and update this report at 10-year maximum intervals (or more frequently if necessary).

2.3 PHYSICAL ENVIRONMENT

2.3.1 Climate and Rainfall Patterns

Since there is no National Weather Service station in Yachats, rainfall and temperature data were examined from Newport, a coastal city 24 miles north of Yachats. While the data from this weather station is not specifically for Yachats, these values are generally believed to be representative for the immediate area around the City.

The climate in Yachats is similar to much of the Oregon coast with moderate temperatures year-round, little precipitation during summer months, and heavy precipitation between late fall and early spring. Average high temperatures range from the high 40's to mid 50's in the winter months and are in the 60's in the summer. Average low temperatures run in the mid 30's to low 40's in the winter, and are in the high 40's to low 50's in the summer. Days with a maximum temperature above 70°F occur only 20 times per year on average, and days with minimum temperatures below 32°F occur only 20 times per year on average.

The study area receives an average of approximately 68 inches of precipitation annually, with the heaviest rainfall in the winter months. Precipitation extremes are somewhat difficult to verify because rainfall records are not always complete. There are relatively complete records for Newport from 1940 through 2004. Since 1940, the wettest year for the study area was 1968 resulting in an estimated 111 inches of rainfall. The driest year was 1944 when the total rainfall in Newport was approximately 43 inches. Approximately 3/4 of the annual precipitation occurs between November 1 and April 30. July is typically the driest month with an average rainfall for the month of approximately one inch. Snow rarely falls in the area. In the 65 year historical record, snow fell once every 5 years on average Though Yachats usually experiences high annual rainfalls, drought conditions are possible and do occur. Low stream flows resulting from drought conditions can have serious consequences for the City.

2.3.2 Topography

Yachats is located at the Yachats River estuary near the Coast Range foothills. The City's core commercial area is situated on a relatively flat area on the north side of the estuary and west of Highway 101. A similar flat area located on the south side of the estuary and west of Highway 101 includes a number of residential properties. The elevation of these areas varies between about 30 and 60 feet. Moving east from Highway 101, the ground becomes steeper as the study area progresses up the coast range foothills. The highest areas on the east side of the study area are at elevations of 500 to 600 feet. Across the entire study area, the ground generally slopes from the east to the west and several drainages cross the study area from the east to the west. The most significant of these is the Yachats River which divides the study area into areas that can be referred to as North Yachats and South Yachats.

2.3.3 Soils

The soils along the Yachats River are generally alluvial bottomland deposits that are composed of silts, sand, and gravel with some local areas of peat. The soils in the relatively flat areas of the City along Highway 101 are generally marine terrace deposits. These deposits are typically fine to medium grain friable sandstone of beach origin with thin interbeds of siltstone. The thickness of these deposits may be up to 75 feet. In upper elevations along the east side of the study area, the soils are generally rocky basaltic formations.

None of the soil types outright preclude the construction of typical water system infrastructure from a foundation stability point of view. The construction of significant structures (e.g., buildings, pump stations, storage tanks, etc.) recommended in this report will require detailed geotechnical investigations during the design phase of each project.

This discussion of soil types is based on the information included in the Soil Survey of Lincoln County, Oregon prepared by the Natural Resource Conservation Service in July 1997. This document shows the approximate location of the soil types in the study area. The reader is referred to the Lincoln County Soil Survey for more detailed definitions and descriptions of the individual soil designations.

2.3.4 Water Resources

Only surface water resources are analyzed in this study. Due to the area's underlying geology groundwater is generally not available in quantities sufficient to supply a municipal water system. The City does not own or operate any wells at this time and few wells of significant magnitude are located within the study area.

The Oregon Department of Water Resources regulates the use of both surface and groundwater resources. The City holds certificated water rights that total 2.49 cfs from Reedy Creek and Cape Creek. The City holds an additional 4.0 cfs of permitted water rights with various conditions upon their use. More information is provided in Section 4.1.

2.3.5 Geologic Hazards

Known geologic hazards within the study area include localized steep slopes, flooding, seismic, and tsunami concerns.

2.3.5.1 Steep/ Unstable Slopes

Steep and unstable slopes are a concern for areas east of Highway 101. Steep slopes can have the potential for either mass movement or slope erosion. Mass movement results from shifting of rock or soil material in response to gravity, such as landslides and rock slides. These mass movements are often precipitated or aggravated by excessive groundwater. Slope erosion is the removal of soils or rock that occurs as a result of sheet flow, resulting in surface erosion or gully erosion. This is primarily caused by private land use practices (mainly land clearing and road construction) that can exacerbate slope erosion. In 1998, a landslide partially destroyed the City's Reedy Creek impoundment and intake structure. There may be potential for future landslides to affect the City's water intake facilities.

2.3.5.2 Flooding

The Yachats River is the primary stream within the study area. The City is located along the lower reaches of the river. The Yachats River has a streamflow pattern similar to other Coast Range streams. It is typified by high flows during the winter and low flows during the summer months.

The Federal Emergency Management Agency (FEMA) has established a 100-year floodplain designation and insurance ratings for the study area. While sometimes referred to as the "100 year flood", it is more accurate to consider it as the flood having a 1 percent chance of occurrence in any year, or a 10 percent chance of occurrence during any 10 year period.

During a FEMA defined 100-year flood, the Yachats River rises out of its normal channel creating a floodplain. The limits of this floodplain are defined by FEMA. Flood profiles and maps for the streams in and around the study area are included in the Flood Insurance Study prepared for Lincoln County and appear on Flood Insurance Rate Maps (FIRMs). It should be noted that the FEMA flood boundaries are based on flood elevations. Therefore, the actual inundation boundaries may vary due to localized topographical variations. Final determinations of whether a specific property is affected must be determined based on a topographic survey of the property in question.

A review of the existing flood boundary maps show that none of the City's existing treatment, pumping, or storage facilities are located within the 100 year floodplain boundary.

2.3.5.3 Seismic

The 2008 U.S. Geological Survey (USGS) National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States. These factors are applied in the seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. A review of these maps identifies Oregon as having a relatively high seismic risk. The Oregon Structural Specialty Code shares this assessment and has adopted similar ground motion data as the USGS. Seismic risk factors for structures are typically influenced by a combination of factors including the geographical location, specific building and structural configurations, and local soil types. The construction and rehabilitation of significant structures recommended by this report (buildings and storage reservoirs) will require detailed geotechnical reports and seismic evaluations.

In January of 2018, the State of Oregon implemented a new requirement that all water master plans for communities with more than 300 connections must include a seismic risk assessment and mitigation plan. The goal of the assessment is to identify critical infrastructure needed to supply water during an emergency resulting from a strong earthquake. The seismic risk assessment is presented in Chapter 11.

2.3.5.4 Tsunami

Undersea earthquakes can cause destructive tsunamis that strike the coast after the earthquake. The configuration of the Oregon and Washington continental shelf can produce tsunami waves that may appear to rise slowly but can build up to 30 feet or more in height as water surges inland. Tsunamis rarely come as single waves but arrive as multiple crests that may be hours apart. Often the first tsunami is not the largest or most destructive.

Oregon is vulnerable to two types of tsunamis: distant and local. Local tsunamis are generally associated with Cascadia subduction zone earthquakes. Tsunamis from distant undersea earthquakes can take place anywhere in the Pacific Rim and will take several hours to reach the Oregon coast. Because the Cascadia Subduction Zone is so close to the Oregon coast, tsunamis caused by earthquakes along this rift can strike the northern Oregon coast within 20-30 minutes of the earthquake. In many cases, the only tsunami warning will be the earthquake itself.

Since 1995, Oregon has placed restrictions on the construction of certain types of critical and essential facilities within tsunami inundation zones along the coast. In 2013, the Oregon Department of Geology and Mineral Industries (DOGAMI) published a study to define tsunami hazard and inundation zones for Yachats. This study included one inundation map each for distant and local earthquakes. Local source earthquakes (associated with the Cascadian Subduction Zone) generally present a greater threat to Oregon coast cities.

Based on the local source earthquake map and the accompanying report, the maximum tsunami run-up within the Yachats study area is 75 to 100 feet above sea level at the time of the tsunami. Similar to 100 year flood elevations, the tsunami run-up elevations are based on assumed worst case seismic events. The actual wave run-up will depend on the magnitude of the seismic event and any mitigating circumstances, such as concurrent submarine landslides. However, it is not economically feasible to design for higher magnitude events.

Tsunamis are a great concern in Yachats. Virtually all of the areas west of Highway 101 and some of the areas east of Highway 101 are within the Tsunami inundation zone. This includes most of the commercial and residential areas of the City. The City's water treatment plant and the Salmon Creek intake are located entirely within the Medium inundation zone. The storage reservoirs are all located well above the design tsunami inundation zones.

2.3.6 Public Health Hazards

Discussions with City staff have not revealed any known or documented chronic public health hazards within the study area.

2.3.7 Environmentally Sensitive Areas

The Yachats River, the estuary, the tidal areas, and the riparian areas along these waterways are considered to be environmentally sensitive. There are also likely to be other wetland areas located throughout the study area. The City has completed a local wetland inventory that identifies several wetland areas around the study area. Other wetland areas are likely to exist that are not shown on the City's wetland inventory. Most projects recommended in this plan will require some sort of wetland and environmental investigations as part of the early design work.

2.4 FLORA AND FAUNA

The vegetation in the Yachats area is typical of the Oregon coast. Forestlands lie east of the City; the Pacific Ocean lies to the west. Forestlands consist of Douglas Fir, western Hemlock, Sitka Spruce, Red Alder, and Western Red Cedar. Other plants common to the area include Pacific Rhododendron, Vine and Big Leaf Maple, Red Elderberry, Hairy Manzanita, Kinnikinnick, Salal, Salmonberry, and Sword and Bracken Fern.

The tidal zone along the Pacific Coast and the Yachats River estuary are the habitat of marine bass, rockfish, and ocean perch. Other types of marine life include clams, mussels, chitons, limpets, crab, shrimp, starfish, sea anemone, and urchins. Sea mammals living off the coast of Yachats include harbor seal and sea lions. Other mammals that are native to the region include shrew, mole, raccoon, river otter, muskrat, beaver, skunk, squirrel, and blacktail deer.

Of particular environmental interest in the area are the Steelhead, Coho, and Chinook Salmon, and other anadromous fish that can be found at various times of the year in in the Yachats River. As with other coastal streams, impacts due to low water levels, over fishing, and numerous other environmental issues have resulted in dwindling salmon and steelhead populations.

Fieldwork to identify the presence of threatened and endangered species habitat in the study area is beyond the scope of this study. However, several threatened and endangered species may inhabit the study area. Therefore, detailed investigations to determine if a particular project impacts threatened and endangered species should be performed early in the design phase for each project. The one exception to this is for locations of utilities that have previously been developed.

2.5 ENERGY PRODUCTION & CONSUMPTION

Electricity is provided to the community by the Central Lincoln PUD. Natural gas service is not available in the City. There are no known power generation facilities with the City. The major energy demand in a water system is from the electric motors that drive pumps and other equipment. It is recommended that these components be specified as having high efficiency motors and variable speed controls, which will reduce the energy costs over the life of the project. Depending on the current programs in place with the electric utility, there may be rebates available if high efficiency electrical motors and variable speed controls are specified, which will tend to offset the slightly higher capital construction cost.

2.6 SOCIO-ECONOMIC ENVIRONMENT

Growth within the study area will depend on socio-economic conditions within the City. The following section contains a general discussion of economic conditions, trends, population, land use, and public facilities relating to both the study area and the City.

2.6.1 Economic Conditions and Trends

Population growth and the resultant water demands within the study area are linked to the economic conditions and trends of the City.

Yachats does not have large commercial or industrial activities that would support large numbers of employees. Yachats is mainly a residential community with small or medium size commercial/industrial enterprises that mainly serve the local and tourist populations. Some of the attributes that make the City an attractive place to live are location, environmental and air quality, City services, recreational activities, and small-town atmosphere. One of the more active areas of commerce in the City is the recreation industry. By virtue of the coastal location and proximity to popular areas of the central Oregon coast, Yachats offers good recreational opportunities. Many homes in area are vacation rentals or second homes. The City also has a high number of hotel rooms relative to the overall population. The City hosts a large number of part time residents as well as a significant tourist population during the peak tourist season. These economic conditions and trends are expected to continue through the planning period.

2.6.2 Population & Growth Projections

Based on data provided by the Portland State University Population Research Center, the population in Yachats in 2020 is about 760. Based on United States census data, the population was 533 in 1990, 617 in 2000, and 690 in 2010. Therefore, the historic data shows a steady population increase over the last 30 years. This trend is expected to continue during the planning period.

In June of 2017, population projections for Lincoln County were prepared by the Portland State University Population Research Center. These projections estimate the population of Yachats within the UGB to increase from 773 in 2017 to 1,061 in 2040. These projections are based on an average annual growth rate of 1.4% from 2020-2035 and 0.9% from 2035-2067. These projections will be used for planning purposes in order to conform to state-wide planning goals. As noted elsewhere in this document, the study period ends in 2041. Therefore, the 2040 population was extrapolated for one additional year for the preparation of this document. Adding an additional year of growth at a rate of 0.9% to the 2040 population of 1,061 results in a 2041 population of 1,070.

A more in-depth discussion of population projections is presented in Section 5 - Present and Future Water Demands.

2.6.3 Land Use

All of the land within the planning area is within City's UGB. The City's water sources and water treatment plant are outside the UGB. The City's Comprehensive Plan was initially adopted in 2008 and was most recently revised in 2019. The plan is available at the City's website.

A majority of land use zoning in the City is comprised of residential uses. The location of the UGB and city limits are shown in Figure 2-2**.** This figure also shows the land use zoning designations within the City. The total areas contained under each zoning designation are listed in Table 2-1 and illustrated in Figure 2-2.

Table 2-1| Approximate Areas by Land Use Zone

Land Use Zone	Approximate Area (Acres)
Single Family Residential (R-1)	282.9
Single Family & Duplex Residential (R-2)	31.2
Single, Duplex, Multi-family Residential (R-3)	60.5
Single, Duplex, Multi-family, & Motel (R-4)	51.2
Commercial (C-1)	20.6
Public Facilities (P-F)	9.4
State Parks (S-P) & Estuary Natural (E-N)	30.6
Total Area Inside City Limits & UGB	±486 (1)

Notes:
(1) Total does not include road right of ways and other similar non-zoned areas

Figure 2-1 | Ranked Land Uses

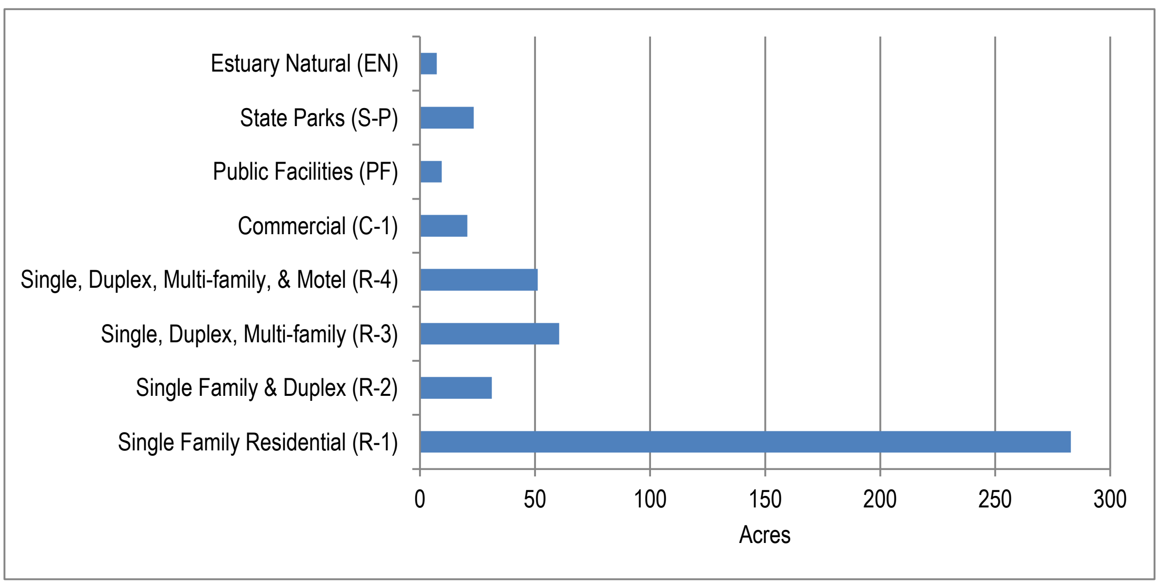


Figure 2-2| Study Area Vicinity Map

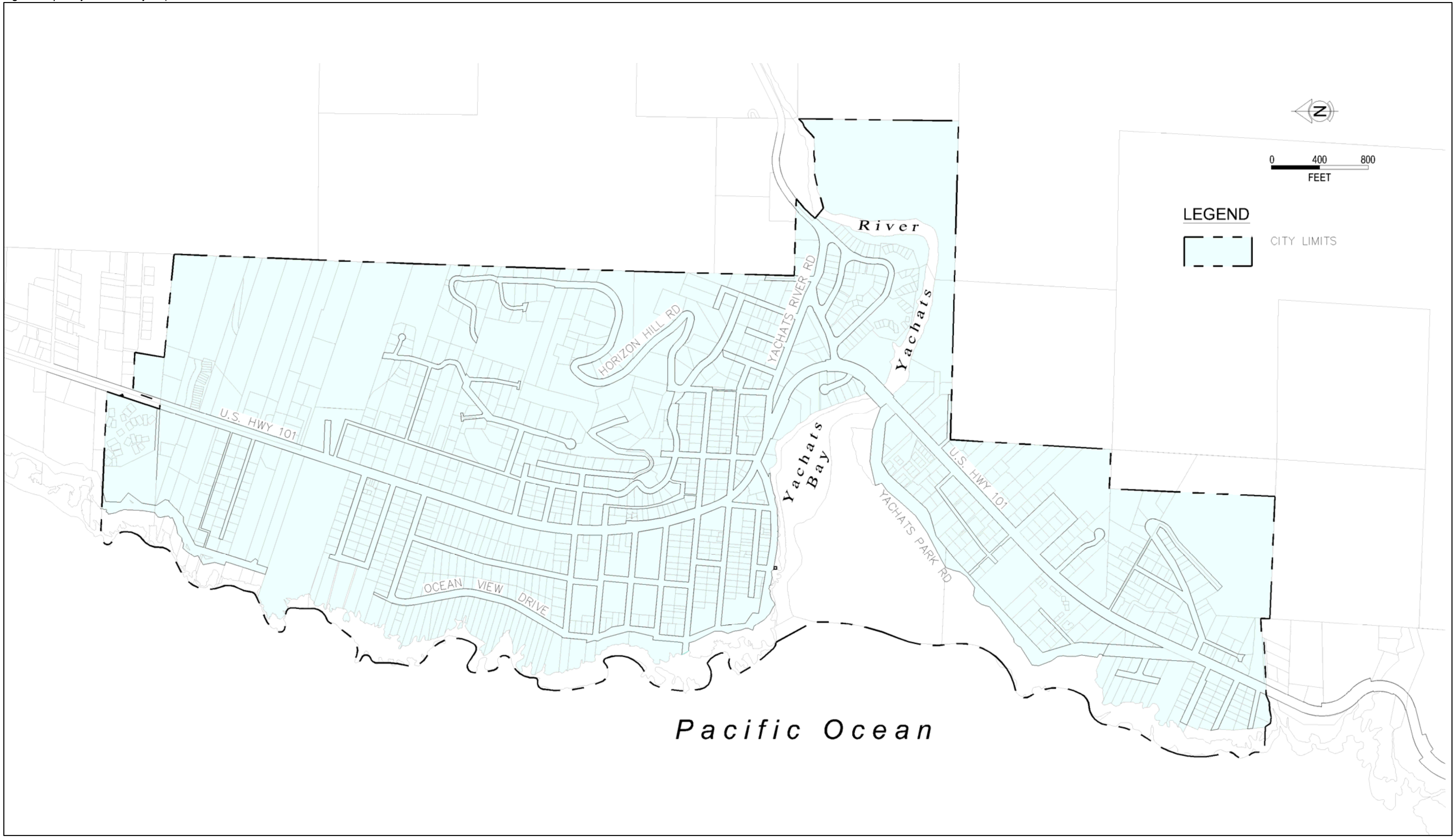
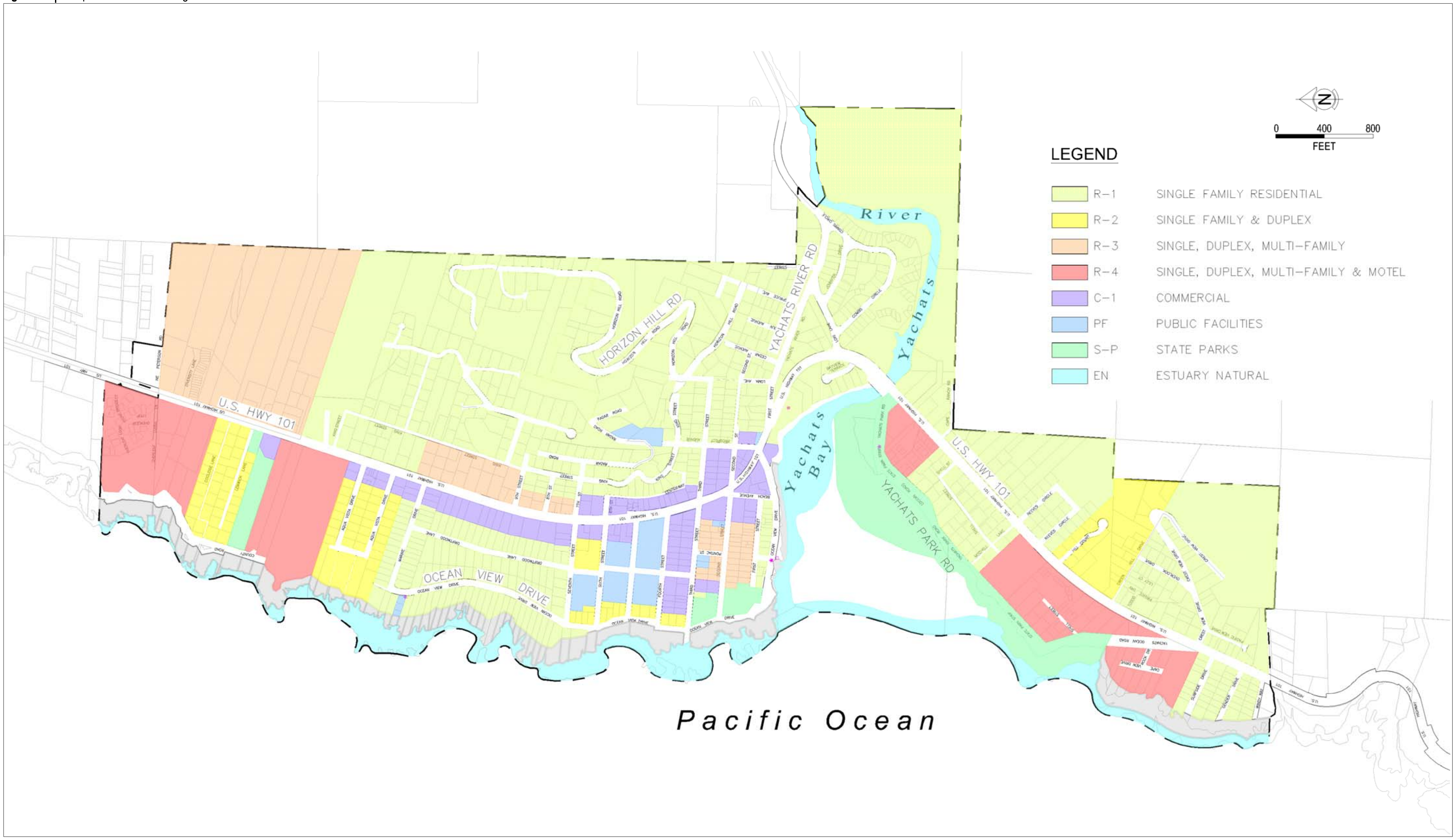


Figure 2-3 | Comprehensive Plan Designations



CHAPTER 3

REGULATORY REQUIREMENTS

Chapter Outline

REGULATORY REQUIREMENTS

3.1 INTRODUCTION

This chapter provides a summary of the key regulatory requirements and standards that govern the operation of the City's water system, and which form the basis of the master planning effort. These regulations include both water quality and water use standards. This overview is for general reference only and may not include all requirements.

3.2 REGULATING AGENCIES

The State of Oregon Health Authority, Drinking Water Program (DWS) is the primary regulating agency for water quality standards related to public drinking water systems. Rules relating to public water systems are contained in the Oregon Administrative Rules (OAR 333-061).

Water rights and water use regulations are administered by the Oregon Water Resources Department (OWRD).

3.3 COMPLIANCE OVERVIEW

As described in greater detail in the following section, the City of Yachats does not currently have any compliance issues that require immediate attention. However, as the system ages, compliance problems may arise. So, the City will need to diligent about making the implementing the improvements recommended in this plan.

3.4 EXISTING WATER QUALITY REGULATIONS

Congress passed the original Title XIV of the Public Health Service Act, commonly known as the Safe Drinking Water Act (SDWA), in 1974. The SDWA and subsequent amendments are federal water quality regulations affecting all public water purveyors. Regulations under the SDWA at the federal level are promulgated by the US Environmental Protection Agency (EPA). The requirements of the SDWA and amendments are implemented by the State of Oregon under the Oregon Drinking Water Quality Act of 1981 (ORS 448 as amended). This legislation allowed the State to gain primacy for enforcing the federal rule requirements and the responsibility of maintaining and enforcing a drinking water program.

The Oregon DWS currently enforces drinking water standards for 83 primary and 16 secondary contaminants (OAR 333-061-0030/0031). Primary standards regulate contaminants that pose a serious risk to public health whereas secondary standards cover aesthetic considerations. Public water systems must sample for primary contaminants routinely to ensure that standards are met, and report results of that sampling to the regulating agency.

Primary contaminants can be grouped into the following general groups. A discussion of each will be presented in this section.

- Microbial contaminants
- Disinfectants and disinfection byproducts
- Inorganic chemicals
- Organic chemicals
- Radiologic contaminants

- Control of each contaminant is administered through a prescribed list of standards or limits that take several forms.
- *Maximum Contaminant Level Goal (MCLG)* — The level of a contaminant in drinking water below which there is no known or expected risk to health, allowing for a margin of safety. All regulated contaminants have an MCLG, although the MCLG is not enforceable.
- *Maximum Contaminant Level (MCL)* — The highest level of a contaminant allowed in drinking water, set as close to the MCLG as feasible using the best available treatment technologies.
- *Treatment Technique (TT)* — A required treatment process intended to reduce the level of a contaminant in drinking water. Contaminants for which testing or monitoring is not economically or technically feasible are regulated by the establishment of a treatment technique. Treatment techniques represent a requirement to install and operate a treatment process that has a proven efficacy for contaminant reduction. Performance standards (PS) are used to determine whether or not a water system is meeting a specific treatment technique requirement and consist of measurements of water quality parameters such as turbidity, disinfectant residual, pH, or alkalinity.
- *Action Level (AL)* — The concentration of a contaminant, which when exceeded, triggers treatment or other requirements that a water supplier must follow.

Water systems that use groundwater sources are governed by a different set of water quality regulations than those that use surface water sources. A third category of source water, regulated under the same standards as surface water, is groundwater under the direct influence of surface water (GWUDI). The DWS defines GWUDI as "any water beneath the surface of the ground with significant occurrences of insects or other macro-organisms, algae or other large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity or pH which closely correlate to climatological or surface water conditions". An evaluation of surface water influence can involve geological assessments or water quality analysis, depending on the determination of the DWS. Such investigations or re-evaluations can be made at any time based on changing conditions. If sources that are determined to be potentially GWUDI cannot be upgraded to preclude surface water influence, those sources will be regulated by GWUDI water quality standards.

3.4.1 Microbial Contaminants

Pathogenic microorganisms in drinking water can be divided into three groups: bacteria, protozoa, and viruses. Pathogenic microorganisms have a number of specific properties which distinguish them from chemical contaminants; they are living organisms and are not dissolved in water, although they will coagulate or attach to colloids and solids in water.

Regulatory inactivation or removal of these three groups of microorganisms is predominantly determined by the nature of the water source. In general, municipalities using surface water or GWUDI sources are required to inactivate or remove all three sources, while those using groundwater are required to provide for inactivation of viruses.

- *Bacteria*

Coliforms are a broad class of bacteria which live in the digestive tracts of humans and many animals. Although many types of coliform bacteria are harmless, some cause gastroenteritis, a general category of health problems that includes diarrhea, cramps, nausea, and vomiting. Gastroenteritis is not usually serious for a healthy person, but can cause serious problems for people with weakened immune systems such as the very young, elderly, or immune-compromised. Outside the colon, coliforms only survive for approximately 48 hours. Common bacteriological pathogens responsible for waterborne disease include *Escherichia coli (E. coli), Legionella, Salmonella typhi, Shigella*, and *Vibro cholerae*.

- *Protozoa*

Protozoa are single-cell organisms. They have a complex metabolism and feed on solid nutrients, algae, and bacteria present in multiple-cell organisms, such as humans and animals. To survive harsh environmental conditions, some species can secrete a protective covering and form a resting stage called a cyst, a condition that can protect some protozoa from conventional chlorine disinfection. Common examples of parasitic protozoa are *Giardia lamblia* and *Cryptosporidium*.

- *Viruses*

Unlike bacteria and parasitic protozoa, viruses can only replicate in living host cells and are inactive for periods outside of the host organism. Due to their small size, viruses can pass through conventional filtration processes and are accordingly typically inactivated with chlorine. Common examples of waterborne viruses include hepatitis A, rotavirus and Norwalk virus.

3.4.1.1 Microbial Contaminant Regulations

Several regulations have been promulgated over the years to prevent microbial contamination of drinking water supplies. These include the Total Coliform Rule (TCR), the surface water treatment rule (SWTR), the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

3.4.2 Total Coliform Rule

Initially published in 1989 the Total Coliform Rule (TCR) applies to all public water systems and establishes health goals—in the form of maximum contaminant level goals (MCLGs), and legal limits—in the form of maximum contaminant levels (MCLs) for total coliform levels in drinking water. The goal of the TCR is to maintain microbial quality in finished and distributed drinking water supplies. Therefore, it primarily applies to the distribution system. It requires systems to sample for coliform bacteria which are used as an indicator of whether a water system is vulnerable to pathogens. Coliforms were also selected because they are easily detected in water.

In promulgating the TCR, the EPA set the maximum contaminant health goal (MCLG) for total coliforms at zero. The ODWP stipulates the total number of water samples a PWS must test each month and limits the number of “coliform-present” samples within this routine collection set. The number of routine samples is dependent on population.

The City is required to collect one (1) monthly sample. Samples must be taken from an approved set of locations throughout the distribution grid, and the number of “coliform-present” results is limited to a single sample.

If a sample tests positive for coliforms, the system must collect a set of repeat samples within 24 hours. A “coliform-present” test result on either a routine or repeat sample constitutes a non-acute violation and requires additional testing for fecal coliforms and *E. coli*. A positive result for either fecal coliform or *E. coli* constitutes an acute MCL violation. Public notification is conducted in accordance with OAR 333-061-0042, which outlines a tiered approach commensurate with the prescribed risk level of a given violation.

Compliance for the TCR is based on a monthly cycle measured on two levels: submitting the prescribed number of samples, as well as successful test results for the absence of total coliforms in a given test cycle.

For this study, the last 10 years of coliform data was reviewed. In that time, one of the samples collected by the City has been “coliform-present.” Four repeat samples were taken and reported that all were negative for coliform.

3.4.3 Revised Total Coliform Rule

The Total Coliform Rule (TCR) was initially published in 1989 and was revised in February, 2013. The Revised Total Coliform Rule (RTCR) applies to all public water systems and establishes health goals- in the form of maximum contaminant level goals (MCLSs), and legal limits- in the form of maximum contaminant levels (MCLs) for *E. coli* in drinking water. The goal of the RTCR is to maintain microbial quality in finished and distributed drinking water supplies. Therefore, it primarily applies to the distribution system. It requires systems to sample for *E. coli* bacteria which are used as an indicator of whether a water system is vulnerable to pathogens.

In promulgating the RTCR, the USEPA set the MCLG and MCL for *E. coli* at zero (0), and eliminated the MCLG and MCL of zero for total coliform, replacing it with a treatment technique for coliform that requires assessment and corrective action. *E. coli* is a more specific indicator of fecal contamination and potential harmful pathogens than total coliform (many of the organisms detected by total coliform methods are not of fecal origin and do not have any direct public health implications).

Under the newly adopted treatment technique for coliform, total coliform serves as an indicator of a potential pathway of contamination into the distribution system. A public water system that exceeds a specified frequency of total coliform occurrence must conduct an assessment to determine if any sanitary defects exist and, if found, correct them. In addition, a water system that incurs an *E. coli* MCL must conduct an assessment and correct any sanitary defects found.

3.4.3.1 Surface Water Treatment Rule

The SWTR was promulgated in 1989. It applies to all public water systems using surface water or GWUDI. Yachats utilizes surface waters. The primary purpose of the SWTR is to provide public health protection from microbial contaminants including bacteria, protozoa, and viruses. Specific provisions of the SWTR include the following.

- All systems that use surface water or GWUDI must disinfect water before discharging into the distribution system.
- All systems that use surface water or GWUDI must filter unless avoidance criteria can be met.
- All systems that use surface water or GWUDI must reliably achieve 3-log (99.9%) removal and/or inactivation of *Giardia lambia.*
- All systems that use surface water or GWUDI must reliably achieve 4-log (99.99%) removal and/or inactivation of viruses.
- Establishes turbidity performance standards for combined filter effluent.
- Establishes a minimum disinfectant residual of 0.2 mg/L at the entry point to the distribution and requires that minimum detectable levels of disinfectant must be maintained at all locations in the distribution system.

Since it is not practical to measure concentrations of *Giardia lambia* and viruses on a regular basis, the SWTR established performance standards to ensure the removal requirements for these contaminates are achieved. Different treatment technologies are assigned a log removal credit for *Giardia lambia*.

For Yachats' treatment plant, a 2.5-log removal credit is granted for the conventional filtration system for removal of *Giardia lambia*. As noted above, the SWTR requires a 3-log removal credit. Therefore, Yachats' disinfection system is operated to provide a 0.5-log removal credit to meet the total 3-log removal credit for *Giardia lambia.*

Pathogen deactivation of a disinfectant is measured based on CT values, which is the disinfectant's concentration multiplied by the time the disinfectant is in contact with the water. The EPA published tables of minimum CT required to achieve various log removal credits. Water treatment systems like Yachats' are required to compare the CT required from the tables to the CT provided on a daily basis to ensure compliance with the SWTR. The EPA also has published tables of CT required to provide 4-log removal of viruses. The CT times for 4-log virus removal are all lower than the CT times for the 1-log removal of *Giardia lambia.* Therefore, as long as the City operates the disinfection system to provide 1-log inactivation of *Giardia lambia,* the 4-log virus removal requirement will also be met.

For systems like Yachats' the SWTR also required that effluent turbidity from the filters did not exceed 0.5 nephelometric turbidity unit (NTU) in 95% of the samples collected with no single result greater than 5 NTU. Stricter limitations for filter performance have been adopted as part of subsequent rules discussed below.

3.4.3.2 Long Term 1 Enhanced Surface Water Treatment Rule

The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) was promulgated in 2002. This rule builds on the SWTR by providing improved public health protection against *Cryptosporidium*, while addressing risk tradeoffs with disinfection by-products. The LT1ESWTR applies to systems like Yachats' that use surface water. Specific provisions of the LT1ESWTR include the following.

- Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*
- 2-log (99%) *Cryptosporidium* removal requirement for systems that use filters.
- Strengthened combined filter effluent turbidity performance standards for systems using conventional and direct filtration.
- Individual filter turbidity monitoring provisions for systems using conventional and direct filtration

Treatment plants such as Yachats' that use conventional filtration (consisting of coagulation, sedimentation, and filtration) are assumed to meet the 99% *Cryptosporidium* removal requirement as long as they comply with the LT1ESWTR turbidity requirements and existing provisions of the Surface Water Treatment Rule. A system's combined filter effluent turbidity is required to be less than 0.3 NTU in at least 95% of the samples collected with no single result greater than 1 NTU in order to provide the required 2-log inactivation of *Cryptosporidium.* The City is currently able to meet the filter effluent turbidity requirement necessary to provide 2-log inactivation of *Cryptosporidium*.

3.4.4 Long Term 2 Enhanced Surface Water Treatment Rule

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) builds on the provisions of the LT1ESWTR for further protection of public health against risks posed by *Cryptosporidium* and other microbial pathogens. The LT2ESWTR applies to all public water systems that use surface water and GWUDI. The goal of the LT2ESWTR is to identify high risk systems and require additional treatment to remove *Cryptosporidium* in those systems. Existing drinking water regulations established in the LT1ESWTR require water systems such as Yachats' to provide at least 2-log removal of *Cryptosporidium*. New data on *Cryptosporidium* infectivity, occurrence, and treatment indicate that the current treatment requirements are adequate for the majority of systems. However, there is a subset of systems with higher vulnerability to *Cryptosporidium* where additional treatment is necessary.

All water systems that utilize surface water or GWUDI are required to monitor the source water for *Cryptosporidium*. These water systems will be classified into one of four risk bins based on the results of the source water monitoring. The LT2ESWTR specifies a range of treatment and management strategies, collectively termed the "microbial toolbox," that systems can select from to meet any additional treatment requirements that are required as a result of their bin classification.

To reduce monitoring costs, small filtered water systems like Yachats' are first required to monitor for *E. coli*–a bacterium that is less expensive to analyze than *Cryptosporidium*. These small water systems are required to monitor for *Cryptosporidium* only if their *E. coli* results exceed specified concentration levels.

The City of Yachats completed the most recent round of *E.coli* testing in 2018. The mean *E.coli* concentration was less than 10 *E.coli*/100mL. This value is less than the trigger level of 100 *E.coli*/100 mL specified for flowing stream sources. Water systems like Yachats' that serve less than 10,000 people and do not exceed the *E.coli* trigger level are assigned a bin 1 classification. This means that Yachats does not need to monitor the source water for *Cryptosporidium* and Yachats' water source is not considered a high risk system for *Cryptosporidium.* As such, no additional treatment or management strategies are required.

3.4.5 Disinfectants and Disinfection Byproducts Rule

Disinfection of drinking water can readily be identified as one of the major public health advances of the 20th century. While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in water to form disinfection byproducts (DBPs) which have been shown to be carcinogenic in laboratory animals. While it is important to strengthen protection against microbial contaminants, it is also important to reduce the potential health risks of DBPs.

The Federal Total Trihalomethane Rule was published in the Federal Register in November 1979 and established an MCL for total trihalomethanes (TTHMs) for community water systems serving 10,000 people or more. The Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DBPR) promulgated in December of 1998 built on the TTHM Rule by lowering the existing MCL and widening the range of affected systems to include all public water systems that add a disinfectant to their drinking water. The rule specifically established:

- a maximum residual disinfectant level goal (MRDLG) for chlorine at 4.0 mg/L
- a maximum residual disinfectant level (MRDL) of 4.0 mg/L for chlorine
- a total trihalomethane MCL of 80 µg/L, regulating the sum of four trihalomethanes
- a haloacetic acid (HAA5) MCL of 40 µg/L, regulating the sum of five haloacetic acids

The rule also established removal limits of total organic carbon (TOC) as a DBP precursor.

The Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) was finalized on January 4, 2006 and applies to water systems that use groundwater, GWUDI, and surface water. The rule retains the MCLs for TTHMs and HAA5s established in the Stage 1 DBPR and augments the rule by providing more consistent protection from DBPs across the entire distribution system and by focusing on the reduction of DBP peaks.

The Stage 2 DBPR requires community water systems to conduct initial distribution system evaluations (IDSEs) to identify and select new compliance monitoring sites that more accurately reflect sites representing high TTHM and HAA5 levels. These new 'worst-case' monitoring sites are selected based on the results of the Stage 1 DBPR compliance monitoring. The rule also redefines the method of calculating MCLs. Compliance with each MCL will be based on a locational running annual average (LRAA) instead of the running annual average (RAA) method used under the Stage 1 DBPR.

3.4.5.1 Regulatory Monitoring

Community water systems can fulfill the IDSE requirements by applying for 40/30 Certification, a process whereby a community water system certifies that all individual TTHM and HAA5 monitoring results for compliance with the Stage 1 DBPR are less than or equal to 40 µg/L for TTHM and 30 µg/L for HAA5 during a prescribed 2-year period. In addition the system must not have had any Stage 1 DBPR monitoring violations for TTHM and HAA5 during the same period. At the state's discretion, a system meeting all of the requirements for 40/30 certification may still be required to conduct standard monitoring. Systems that qualify for reduced monitoring may remain on reduced monitoring as long as their quarterly LRAAs for TTHMS and HAA5 remain no more than 40 µg/L and 30 µg/L, respectively (for systems with quarterly reduced monitoring) or their TTHM and HAA5 samples are no higher than 60 µg/L and 45µg/L, respectively (for systems with annual or less frequent monitoring).

3.4.5.2 Municipal Compliance

The City currently submits samples for DBP testing from one location. TTHM and HAA5 data reported to DWS for 2003 through May 2019 have all been much less than the MCLs. At the present time, the City has been granted the 40/30 certification and is currently on reduced monitoring. There is no indication that the City will have problems complying with the current MCLs and should continue to qualify for reduced monitoring.

3.4.6 Lead and Copper Rule

Lead or copper in Oregon tap water is primarily due to corrosion of plumbing system components within buildings. Consumers commonly describe the presence of copper as metallic, bitter or rusty. The ability to detect copper in tap water is thought to be controlled by individual sensitivity; however, water chemistry also plays a part since the flavor of copper is more noticeable at lower pH levels.

The control of lead and copper concentrations in drinking water began with the Oregon lead solder ban of 1985, which prohibited the use of lead pipe and set lead content limits for plumbing solder and brass fixtures. In 1991 the EPA promulgated the Lead and Copper Rule (LCR) to further regulate lead and copper concentrations in drinking water. The LCR was uniformly adopted by Oregon on December 7, 1992 and applies to community and non-transient, non-community public water systems. The rule is unique in that compliance is measured by water sampled from the consumer's tap instead of from sampling points at the water treatment plant or within the public distribution system. Failure to meet the regulatory limits requires the water utility to implement a corrosion control treatment process designed to reduce the corrosivity of the water.

3.4.6.1 Regulatory Monitoring

The LCR establishes action levels of 15 µg/L for lead and 1.3 mg/L for copper. It also sets a secondary maximum contaminate level (SMCL) for copper at 1 mg/L. The LCR stipulates that sampling be conducted at "high-risk" homes, further defined as homes constructed prior to 1985 that utilize copper piping and lead-based solder. One-liter samples of standing water (first draw after a minimum 6-hours of non-use) are collected from homes identified in the water system sampling plan. In each round of sampling 90% of the samples must have lead levels less than or equal to the action level. The number of samples is determined by the municipal population and equates to 10 initial samples for the City's system.

Water systems that cannot meet the action levels must install corrosion control treatment, and submit water sampling data to DWS at prescribed frequencies. In the event the lead action level cannot be met with these measures in place a public education program, adjustments to the corrosion control program and follow-up sampling is required.

3.4.6.2 Municipal Compliance

Three rounds of initial sampling were required and were collected (1994, 1996 & 1998). Subsequently, seven samples were required with a reduced sample set (10 samples). To date, none of the samples collected since 1996 have shown lead or copper concentrations above the action levels. Based on the City's successful compliance with corrosion control, the sampling frequency required by DWS is every three years.

3.4.7 Inorganic Contaminants

The USEPA regulates most chemical contaminants (inorganic and organic contaminants) through the rules known as Phase I, II, IIb, and V. The agency has issued the four rules over a five-year period after gathering, updating, and analyzing information on each contaminant's presence in drinking water supplies and its health effects.

Inorganic contaminants (IOCs) most commonly originate in the source of water supply, but can also enter the water from contact with materials used for pipes, plumbing fixtures and storage tanks. For most IOCs adverse health effects result after long-term (lifetime) exposure to the compounds. Water systems in Oregon rarely violate maximum levels for inorganic contaminants from source waters, but these contaminants are routinely detected in drinking water systems at levels more than one-half the maximum level. The most commonly detected inorganics in Oregon drinking water systems are nitrate, arsenic, nitrite, cadmium, and mercury.

The Oregon Drinking Water Act currently regulates 16 inorganic compounds (Antimony, Arsenic, Asbestos, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Mercury, Nickel, Nitrate, Nitrite, Selenium, Sodium and Thallium). Oregon law recognizes the acute health effects of nitrate, particularly for young children, and accordingly requires more stringent testing for nitrate.

3.4.7.1 Regulatory Monitoring

Since 2002, the City has regularly tested for IOCs, including Antimony, Arsenic, Asbestos, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Mercury, Nickel, Nitrate, Nitrite, Selenium, Sodium, and Thallium. The Monitoring for IOCs is conventionally required once every three years and yearly for Nitrate. All of these test results were either no constituent detected or were well below the MCL. The City has qualified for a 9-year reduced monitoring cycle for IOCs with the exception of nitrate which is required annually.

3.4.7.2 Municipal Compliance

This City's water sources do periodically test positive for Nitrates, but the concentrations are well below the MCL. The City last tested for all other inorganic contaminates in 2011 and all resulted in "Not Detected". As such, the City is in compliance for IOC testing. Based on the City's compliance history, the sampling frequency required by DWS will likely remain once every nine years and there is no reason to suspect future compliance issues.

3.4.8 Organic Contaminants

Current drinking water standards regulate a total of 56 organic contaminants frequently classified into two sub-groups, Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs). Organic contaminants are man-made chemicals and commonly include industrial and commercial solvents and chemicals as well as herbicides and pesticides used in agriculture and landscaping.

3.4.8.1 Regulatory Monitoring

Public water systems are required to test for each contaminant from each water source during every 3-year compliance period. Public water systems with a population greater than 3,300 must test twice during each three-year compliance period for SOCs (this is not expected to apply to Yachats in the planning period). Public water systems using surface water or GWUDI must test for VOCs at the entry point annually. Quarterly follow up testing is required for any contaminants that are detected. The exceptions are dioxin and acrylamide/epichlorohydrin. Only those systems determined by DWS to be at risk of contamination must monitor for dioxin. Sampling may be reduced to a 6-year cycle if the system has a certified Drinking Water Protection Plan. Systems that cannot meet the MCLs must install or modify treatment systems or develop alternate sources.

3.4.8.2 Municipal Compliance

Yachats currently tests for SOCs and VOCs regularly. SOC and VOC data since January 2003 was reviewed for this study. During this time all results were either "not detected" or below MCLs.

3.4.9 Radiologic Contaminants

The purpose of this rule is to limit exposure to radioactive contaminants in drinking water. Most drinking water sources have very low levels of radioactive contaminants, most of which are naturally occurring as trace elements in rocks and soils. Most radioactive contaminants are at levels that are low enough to not be considered a public health concern. At higher levels, long-term exposure to radionuclides in drinking water may cause cancer. Radon, another decay product of radioactive material, is regulated independently under the Radon Rule later in this chapter.

3.4.9.1 Regulatory Monitoring

Initial testing required by this rule began in 2005 and required all public water systems to test each source quarterly for one year, with test results required for gross alpha, radium-226/228 and uranium.

3.4.9.2 Municipal Compliance

All radiologic test results have been in compliance. Based on this history, there is no reason to suspect that radiologic contaminates will become a problem in the future.

3.4.10 Arsenic Rule

On January 22, 2001 EPA adopted a new standard for arsenic in drinking water at 10 micrograms per liter (µg/L or ppb), replacing the old standard of 50 µg/L. Oregon adopted the rule and the new limit went into effect on October 21, 2004.

Arsenic is a naturally occurring chemical found in the earth's crust, but can be dangerous to humans when released into drinking water supplies as rocks, minerals, and soils erode. Studies have linked long-term exposure to arsenic contamination with cancer and cardiovascular, pulmonary, immunological, neurological, and endocrine effects.

3.4.10.1 Regulatory Monitoring

Systems with surface water sources must sample annually whereas systems with groundwater sources sample every three years. Water systems that exceed the MCL must monitor quarterly and meet the MCL as a running annual average. Public water systems that cannot meet the MCL must either install water treatment systems or develop alternate sources of water.

3.4.10.2 Municipal Compliance

The City has tested for Arsenic regularly since 1986. Only in 1991 did the City detect Arsenic. This result in 1991 was below the MCL. Since 1992, the City has not detected any arsenic in any of the samples collected. Therefore, all arsenic test results have been in compliance. Based on this history, there is no reason to suspect that arsenic will become a problem in the future.

3.4.11 Secondary Contaminants

The EPA has established National Secondary Drinking Water Regulations that set non-mandatory secondary maximum contaminant level (SMCL) water quality standards for 15 contaminants. The EPA does not enforce these SMCLs as they are not considered to present a risk to human health at the listed levels. They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations. Table 3-1 lists these contaminants.

Table 3-1| Secondary Maximum Contaminant Levels

Contaminant	Secondary MCL	Noticeable Effects above the Secondary SMCL
Aluminum	0.05 – 2.0 mg/L	Colored water
Chloride	250 mg/L	Salty taste
Color	15 color units	Visible tint
Copper	1.0 mg/L	Metallic taste, blue-green staining
Corrosivity	Non-corrosive	Metallic taste, corroded pipes/fixture staining
Fluoride	2.0 mg/L	Tooth discoloration
Foaming Agents	0.5 mg/L	Frothy, cloudy, bitter taste, odor
Iron	0.3 mg/L	Rusty color; sediment, metallic taste, reddish or orange staining
Manganese	0.05 mg/L	Black to brown color, black staining, bitter metallic taste
Odor	3 TON (1)	Musty, "rotten-egg" or chemical smell
pH	6.5 – 8.5	Low pH: bitter metallic taste, corrosion High pH: slippery feel, soda taste, deposits
Silver	0.1 mg/L	Skin discoloration, graying of the white part of the eye
Sulfate	250 mg/L	Salty taste
Total Dissolved Solids	500 mg/L	Hardness, deposits, colored water, staining, salty taste
Zinc	5 mg/L	Metallic taste

1 Threshold Odor Number

3.4.11.1 Regulatory Monitoring

Secondary maximum contaminant levels are non-mandatory regulations and therefore do not have a monitoring requirement.

3.4.12 Groundwater Rule

The City of Yachats does not source any of their water from groundwater. The following sections on the Groundwater Rule are included for reference.

On November 8, 2006 the USEPA promulgated the final Ground Water Rule (GWR) to reduce the risk of exposure to fecal contamination that may be present in public water systems that use groundwater sources. The GWR builds upon the Total Coliform Rule (TCR) and addresses bacterial and viral contamination at the source, as a complimentary approach to the distribution monitoring currently required by the TCR.

The GWR establishes a risk-targeted approach to identify groundwater systems that are susceptible to fecal contamination. Indications of risk may come from total coliform monitoring, hydrogeologic sensitivity analyses, or other system-specific data and information. The GWR specifically targets viral pathogens as a category of fecal contaminants.

The rule applies to all public water systems served by groundwater sources that are not treated to Surface Water Treatment Rule (SWTR) standards. Although federal guidance on key aspects of the rule is still in development it is clear that GWR implementation will be state-specific. Oregon has adopted the regulations and received interim primacy for the SWTR until full primacy is approved by EPA.

3.4.12.1 Regulatory Monitoring

For systems that elect to achieve 4-log (99.99%) inactivation of viruses by disinfection for all sources, compliance monitoring is required to ensure the reliability of the treatment process (i.e., compliance monitoring includes continuous monitoring of chlorine residual at the entry point to distribution system). This 4-log virus inactivation disinfection requirement is based on CT values between the water source(s) and the first water user. The concept of "CT" is used to verify the level of treatment or inactivation. CT is achieved by providing enough time for chlorine to inactivate potentially harmful organisms in drinking water before it is consumed. CT represents an abbreviation of chlorine **C**oncentration (measured at the first user of the drinking water) multiplied by the contact **T**ime (the water's time of travel between the point of chlorine addition to the first user). The CT required for 4-log inactivation of viruses depends on the water temperature and the free chlorine residual concentration in the water. In general, the colder the water temperature (or the higher the pH), the less effective chlorine inactivation is, and greater the CT values that are required (i.e., longer contact time for a given chlorine concentration).

For systems that do not achieve 4-log (99.99%) inactivation of viruses by disinfection for all sources, the following requirements of the GWR apply:

- Triggered source water monitoring (effective December 1, 2009)
- Hydrogeologic sensitivity assessments for aquifers
- Assessment monitoring for all sources

The triggered source water monitoring provisions of the GWR are more detailed than any other provision of the final rule and can only be avoided by providing the required 4-log virus inactivation and/or removal prior the first customer.

For a groundwater system without 4-log virus treatment, a single positive routine Total Coliform Rule (TCR) compliance sample will initiate triggered monitoring. A single source water sample must be taken within 24 hours from each groundwater source in production at the time of the positive TCR sample. Testing is performed to detect the presence of *Escherichia coli* (*E.coli*). Systems with an initial positive source water sample must take five more source water samples. The rule anticipates the use of 100-mL samples from wells or springs. The switch from the current requirement of fecal coliform testing after identifying a total coliform sample to *E.coli* testing has been made because *E. coli* is currently understood to be a better indicator of the presence of pathogens.

A hydrogeologic sensitivity assessment (HSA) may be required for all groundwater systems that do not provide 4-log virus inactivation/removal. However, the rule does not require that the HSA provision be used on any system's supply, nor does it specify what approach states should use to identify systems that should be targeted for HSAs. The GWR is not explicit on the consequences of an HSA that finds a source to be sensitive, but draft guidance reads, "*Source water assessment monitoring is recommended as necessary and wells located in sensitive aquifers should be targeted for assessment monitoring using a hydrogeologic sensitivity assessment*".

Assessment monitoring occurs at the state's discretion. The GWR suggests that assessment monitoring should include 12 groundwater source samples that represent each month the system provides groundwater to the public. The consequences of a positive sample from assessment monitoring are not specified in the GWR. There appears to be latitude for the state to determine that any positive sample obtained during assessment monitoring triggers the treatment technique provisions.

Under the existing Total Coliform Rule (TCR) sanitary surveys are to be performed on a 5-year interval. The GWR sanitary survey requirement has been structured to provide more frequent and complete sanitary surveys with more stringent penalties for non-compliance. Surveys are to be performed every 3-years with some discretion granted for water systems that have consistently demonstrated outstanding performance. Failure to correct deficiencies and comply with the required corrective action plan or schedule will result in a treatment technique violation for the water system. States are required to conduct these surveys and identify significant deficiencies requiring corrective action by December 31, 2012 for community water systems with less than 4 log inactivation/removal and by December 31, 2014 for community water systems with 4-log inactivation/removal.

3.4.12.2 Municipal Compliance

As described in greater detail in Chapter 4, the City does not own wells nor are there plans to develop wells in the future. Therefore, as long as the City does not develop and use wells, they are exempt from the GWR.

3.4.13 Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) was published in the Federal Register on April 10, 2000 and was adopted by the State of Oregon in June of 2004. The FBRR complements existing surface water and GWUDI treatment rules by reducing the potential for microbial pathogens, particularly *Cryptosporidium* oocysts, to pass through the filters into the finished water. The FBRR requires all recycled waste streams (e.g., spent filter backwash, thickener supernatant, or liquids from dewatering processes) to be returned to the head of the plant and passed through the entire treatment process, unless properly disposed of otherwise.

3.5 CONSUMER CONFIDENCE REPORT RULE

The EPA published the Consumer Confidence Report Rule in the Federal Register on August 19, 1998. The CCR Rule requires community water systems to provide an annual report to their customers detailing information on water quality delivered by the system and documenting water quality monitoring results.

The report must be distributed by July 1 of each year, must contain an explanation of data collected during or prior to the previous calendar year, and must provide the telephone number of the owner, operator or designee of the community water system as a source of additional information concerning the report. This information is typically sent out with water bills; however, systems must make a good faith effort to reach consumers who do not get water bills (typically renters). Water systems must certify to the DWS that the CCR was sent to customers and that the information it contained was correct and consistent with the compliance monitoring data previously submitted to the DWS. Complete details of the rule requirements can be found in OAR 333-061-0043.

The City provides its users with annual Consumer Confidence Reports.

3.6 CROSS-CONNECTION CONTROL PROGRAM

Plumbing cross-connections, defined as actual or potential connections between a potable and non-potable water supply, constitute a serious health hazard. There are numerous well documented cases where cross-connections have been responsible for the contamination of drinking water and have resulted in poisonings or the spread of disease.

Oregon Administrative Rules 333-061-0070 through 0074 detail the requirements for a cross-connection control program. The City is required to establish a cross-connection ordinance and must submit an annual report to OHA-DWS. Systems with more than 300 service connections are required to provide a certified tester.

The City's cross-connection control standards are contained in Chapter 8.12- Cross-Connections of the Yachats Municipal Code. The City currently employs one certified cross connection control specialist who is responsible for inspecting new devices and installations, monitoring annual inspections, terminating water service in cases of non-compliance and submitting the annual inspection report to DWS.

At the time of this writing, the City is preparing the annual cross connection summary report to be submitted to OHA-DWS. This is explained in more detail in the following section.

3.7 SANITARY SURVEY

The DWS conducts a sanitary survey of each public water system on a regular basis. Sanitary surveys are a critical component of the State's drinking water regulatory program. Under Oregon statute, sanitary survey is "*an on-site review of the source, facilities, equipment, operation and maintenance of a water system, including related land uses, for the purpose of evaluating the capability of that water system to produce and distribute safe drinking water*."

The sanitary survey (conducted by DWS or contract County health department staff) results in a report that includes, as a minimum, "*the following components of a water system: source of supply; treatment; distribution system; finished water storage; pumps, pump facilities and controls; monitoring, reporting and data verification; system management and operations; and operator certification compliance*." The sanitary survey report identifies any significant deficiency prescribed in OAR 333-061-0076, or any violation of drinking water regulations, discovered during the on-site visit.

Public water systems must have completed corrective action of any significant deficiencies within 120 days of receiving written notice, or be in compliance with a DWS approved "corrective action plan" within 120 days of receiving written notice of a significant deficiency.

The most recent sanitary survey for Yachats was completed September 30, 2020. The survey identified three deficiencies. A corrective action plan was submitted to OHA to correct the deficiencies, dated December 21, 2020.

One deficiency related to providing documentation that chlorine used at the water treatment plant is NSF certified. The City provided OHA with this documentation. This deficiency is understood to be resolved at this time.

The two other deficiencies related to the City's backflow prevention and cross-connection control program. The City has responded to these deficiencies by making improvements to the administration of the program and improving record keeping. At this time, the City is completing the required procedures and record keeping for this program within the time frame stated in the corrective action plan.

3.8 FUTURE WATER QUALITY REGULATIONS

The following include both existing regulations which may not apply to the City at present, but which it may become subject to in the future, as well as anticipated future rules that are currently in the regulatory pipeline.

The EPA is required to review existing national primary drinking water regulations every six years in order to identify current health risk assessments, changes in technology, and other factors that provide a health or technological basis to support regulatory revisions to maintain or improve public health protection.

3.8.1 Lead and Copper Rule Revisions (LCRR)

In December of 2020, the EPA finalized and update the Lead and Copper Rule. These new rules are known as the Lead and Copper Rule Revisions (LCRR). The compliance date for the LCRR is currently December of 2024. The LCRR requires better testing protocols to better identify sources of lead in drinking water, establishes a trigger level of 10 parts per billion to address lead service line replacements, clarifies the requirements for lead service line replacements, requires testing in schools and childcare facilities, and requires public disclosure of all lead service lines.

There are no known lead service lines in Yachats and based on the historical data, there is no reason to suspect that lead will become a problem in Yachats. The City will be required to update testing protocols, prepare reports, and make the information public. This work will require additional labor from City staff, but is not anticipated to significantly impact the City.

3.8.2 Vulnerability Assessment

This is an existing regulation that the City may become subject to in the future. The events of Sept. 11, 2001, reinforced the need to enhance the security of the United States. Congress responded by passing the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Bioterrorism Act), which was signed into law June 12, 2002. The Act amends the Safe Drinking Water Act, requires every community water system that serves a population greater than 3,300 persons to conduct a vulnerability assessment, and specifies actions that community water systems and the USEPA must take to improve the security of the nation's drinking water infrastructure.

Complete details of the requirements for Oregon water systems can be found in OAR 333-061-0064.

The City will likely never reach the population threshold that triggers this rule, especially within the planning period.

3.8.3 Unregulated Contaminant Monitoring Rule

This is an existing regulation that the City may become subject to in the future, if the population limits in the rule are modified, or if the DWS decides to include the City in this program. The Unregulated Contaminant Monitoring Rule (UCMR) is used to collect data for contaminants suspected to be present in drinking water, but that do not have health-based standards set under the Safe Drinking Water Act. The UCMR is closely coordinated with EPA's Contaminant Candidate List. The EPA uses both of these programs to identify drinking water contaminants that are not currently regulated in order to identify future health risks and problems with drinking water.

To date, the program has been implemented in three stages, UCM Rounds 1 & 2, UCMR1 and UCMR2 on a 5-year cycle. The first stage was managed by the state primacy agencies and consisted of screening and assessment monitoring tests. The UCMR1 promulgated on September 17, 1999 utilized a tiered monitoring approach that required all large public water systems and a nationally representative sample of small public water systems serving less than 10,000 people to monitor for selected sets of contaminants. The UCMR2 promulgated on January 4, 2007, is being managed by the EPA and requires monitoring for a new set of unregulated contaminants. To date, the City has not been required to collect data for the UCMR, but may be required to in the future.

3.8.4 Radon

This is an anticipated new regulation. Radon is a naturally occurring gas formed from the decay of uranium-238. Radon in drinking water can contribute to indoor air radon levels from washing and showering. Inhalation or ingestion of radon can result in lung or stomach cancer. The USEPA has proposed preliminary guidelines for the regulation of radon; however, the final form of the rule has yet to be promulgated.

We are not aware of radon testing performed to date on any of the City source water. Since the City's primary water source is surface water and radon readily volatilizes from turbulent waters, it is very unlikely that radon exists in the City's water system.

3.9 WATER USE REGULATIONS (WATER RIGHTS)

The Oregon Water Resources Department (OWRD) regulates the use of both surface and groundwater throughout the state of Oregon. On February 24, 1909, the State of Oregon enacted the Water Rights Act, a comprehensive surface water code. This act made "prior appropriation" the sole method of acquiring water rights in Oregon. The system is basically one of first come, first served. Each water right includes a priority date. Prior appropriation utilizes the priority date of a water right to establish the order in which water rights are satisfied in times of shortage. A senior water right is entitled to full delivery of all water under their right before any junior rights are served. Oregon adopted a parallel groundwater code on August 3, 1955. Together, these codes establish a regulatory scheme under which the OWRD exercises jurisdiction over the right to use the State's waters.

In Oregon, all water is publicly owned. Landowners with water flowing past or under their property do not automatically have the right to divert the water without a permit. Over the years as greater demands are placed on limited water resources, OWRD has been exercising greater control over this water use. Water rights have long been used to control the withdrawal of surface or ground water for municipal or agricultural use. Water rights are issued only for beneficial use, without waste. Each water right includes a designated type of "use" and is limited to that purpose. General categories of beneficial use include, but are not limited to irrigation, municipal, industrial, commercial and domestic. Since 1987, the law has specifically included instream flow protection as a beneficial use. A water right holder is entitled to use as much water as is necessary, up to the maximum amount shown on the water right, to accomplish the stated beneficial use. Water rights issued after the adoption of the 1955 groundwater code are issued in two stages: the issuance of an initial water right *permit*, and upon full development, the issuance of a final water right *certificate*.

The first stage is a water right permit, which serves as the initial authorization for a water user to develop the source and begin making beneficial use of the water. The permit typically describes the source, the source location, the priority date, the amount of water that can be used, and documents any water use conditions. Water right permits were typically issued for a five year period. If the water use had not been developed to the full intended extent within the five-year period, an extension could be requested. In evaluating extension requests, the OWRD considers whether or not the applicant has shown diligence in the development of the water right. Failure to develop a permitted source during the permit period could subject the permit to cancellation by the State.

Until several years ago, permit extensions were routinely granted by the OWRD, largely because there was little or no opposition to the extension requests. In the early 1990s, however, in the face of new Endangered Species Listings and growing attention by environmental groups, the State Attorney General advised the OWRD that the past practice of routine permit extensions was not legally sufficient. As a result, the OWRD made substantial changes to the permit extension process. The new rules require a more extensive analysis of the level of diligence shown by the permit holder in developing the water right, as well as consideration of other competing needs for the water. The process also includes a careful review of potential impacts on listed species, or flows necessary for Scenic Waterway purposes. If a permit extension is approved, new conditions may be added to address public interest concerns raised during the review process.

In 2005, House Bill 3038 was passed by the Oregon legislature. The Bill gives municipal water developers 20 years to develop their water rights and validates old extensions. Development of the water rights must proceed with a reasonable level of diligence. However, OWRD may order or allow an extension of time to complete construction or to perfect a water right beyond the time specified in the permit under the following conditions.

- If the holder shows good cause and if other governmental requirements relating to the project have significantly delayed completion of construction or perfection of a water right;
- The extension of time is conditioned to provide that the municipality may divert water beyond the maximum rate diverted for beneficial use before the extension only upon approval by OWRD of a water management and conservation plan; and
- For the first extension issued after the effective date of the Bill but prior to November 2, 1998, undeveloped portions of the permit is required to maintain the fish listed as sensitive, threatened or endangered, within the waterway affected by the permit.

The second stage involves the issuance of a water right certificate, issued after the source is fully developed and put to use. At such time a Certificate of Beneficial Use (COBU), prepared and submitted by the permit holder, is filed with OWRD. Approval of this document results in the issuance of a water right certificate. Once issued, the final certificate serves as evidence of a fully vested water right. At this stage the water right is treated as a property right held by the water user. A certificated right remains valid indefinitely unless it is unused for a period of five or more years, in which case the user may forfeit the water right. The forfeiture process is not automatic. Oregon law has historically protected municipal water supplies by preventing forfeiture for non-use.

3.10 WATER MANAGEMENT AND CONSERVATION PLAN

In addition to regulating water rights, the OWRD has regulatory authority over Water Management and Conservation Plans (WMCP) for public water systems. A WMCP is a plan developed by a water supplier that describes the water system and its needs, identifies its sources of water, and explains how the water supplier will manage and conserve those supplies to meet present and future needs. The requirement for completing such plans is tied to the revised rules surrounding water right permit extensions as described under OAR 690-315. These rules call for all suppliers serving over 1,000 people to complete a WMCP in association with water permit extensions. OAR 690-086 details the requirements of WMCPs.

A current WMCP for the City of Yachats is being produced in conjunction with this Master Plan. Once completed, State statutes require WMCP's be updated at 5-year intervals. To assist the City's planning efforts for this expense, a recurring program is listed in the recommended capital improvement plan presented in Chapter 12 (Pgm-3). The recommended annual budget for this program is $5,000 per year. It is envisioned that the City will save these funds on an annual basis (similar to a reserve) in order to prepare the required WMCP updates at 5-year interval.

CHAPTER 4

EXISTING WATER SYSTEM

Chapter Outline

4.1 INTRODUCTION

The City of Yachats owns and operates the public drinking water system that serves the entire municipal population. The City also has an interconnection with the Southwest Lincoln County Water People's Utility District (SWLCWPUD), which is intended to supply the Yachats distribution system during a water shortage. The City currently sources water from Reedy Creek and Salmon Creek, which are tributaries to the Yachats River. The City also has water rights to the Yachats River and Cape Creek. The City does not have any groundwater sources.

The City operates multiple pressure zones to supply water to users. The City's system is classified as a "community" water system and has been assigned Public Water System (PWS) Identification Number OR41 00966 by DWS and EPA.

This chapter provides an inventory of the existing water system components, including sources of supply, water treatment, distribution system, storage reservoirs, and instrumentation & control. The evaluation of these specific systems and the specific recommendations for improvements are contained in subsequent chapters.

4.2 WATER SYSTEM FLOW SCHEMATIC & MAPS

A schematic representation of the major water system components is presented in Figure 4-2. Detailed maps of the distribution system are included in Appendix A.

4.1 WATER SUPPLY

Yachats has water rights to Reedy Creek, Salmon Creek, Yachats River, and Cape Creek. Reedy Creek is the primary, year-around, source. Salmon Creek is used as a secondary supply only when flows in Reedy Creek are not adequate to supply the City's demands. Cape Creek and the Yachats River are currently held in reserve as future water sources. The following subsections provide additional details on each source.

4.1.1 Current Water Rights

Table 4-1 is a summary of current water rights held by the City of Yachats.

Table 4-1| Water Rights Summary (listed by priority date)

Source Name	Priority Date	Permit Rate cfs (gpm)	Appl #	Pemit #	Cert. #	Authorized Completion Date	Comments
Reedy Creek	7/9/1945	2.0 (898)	S-20951	S-17333	22933	-	City's primary water source
Salmon Creek	8/22/1963 for 1.0 cfs 6/26/1963 for 1.0 cfs	2.0 (898)	S-38383	S-29018	-	10/1/1997	Limited to making up a deficiency in supply from Certificate 22933 (Reedy Creek)
Cape Creek	7/31/1934	0.49 (220)	S-15440	S-11586	14104	-	Currently held in reserve
Yachats River	3/20/1989	2.0[(1)] (898)	S-69856	S-53471	-	10/1/2043	Permit Amendment T-7967 changed the point of diversion of POD 1. Currently held in reserve

[1] 1.0 cfs of the 2.0 cfs is not subject to the instream water right Certificate 59608 or minimum stream flows with a date of priority of March 26, 1974, measured at the point of diversion from the source.

4.1.2 Reedy Creek Water Supply

Figure 4-1| Reedy Creek Intake

Yachats has a certificated water right to divert 2.0 cfs (1.3 mgd) from Reedy Creek. Figure 4-1 shows the Reedy Creek intake, which is approximately one-half mile upstream from the Yachats River. The City originally built an intake and impoundment at this location in the 1940s. The original impoundment and intake was destroyed in a landslide in 1998. The intake was reconstructed, but the impoundment was not. The intake consists of an infiltration gallery with 10" perforated pipe under four feet of gravel within the streambed. This structure acts to pre-filter the raw water. An undesirable effect of this is that the intake accumulates sediment that impedes capacity. Public works has to annually remove sediment as a part of their regular maintenance activities.

Raw water is conveyed by an asbestos concrete (AC) pipe from the header approximately 1,500 feet. Water is then conveyed by a high-density polyethylene (HDPE) pipe approximately 6,900 feet by gravity to the raw water storage tank. Based on discussions with operations staff, the City is maximizing the amount of water that can be removed from Reedy Creek during the dry weather months. Therefore, Reedy Creek is unlikely to be able to provide additional water on a year around basis to meet increased demands due to growth in the City.

Figure 4-2| Existing Water System Flow Schematic

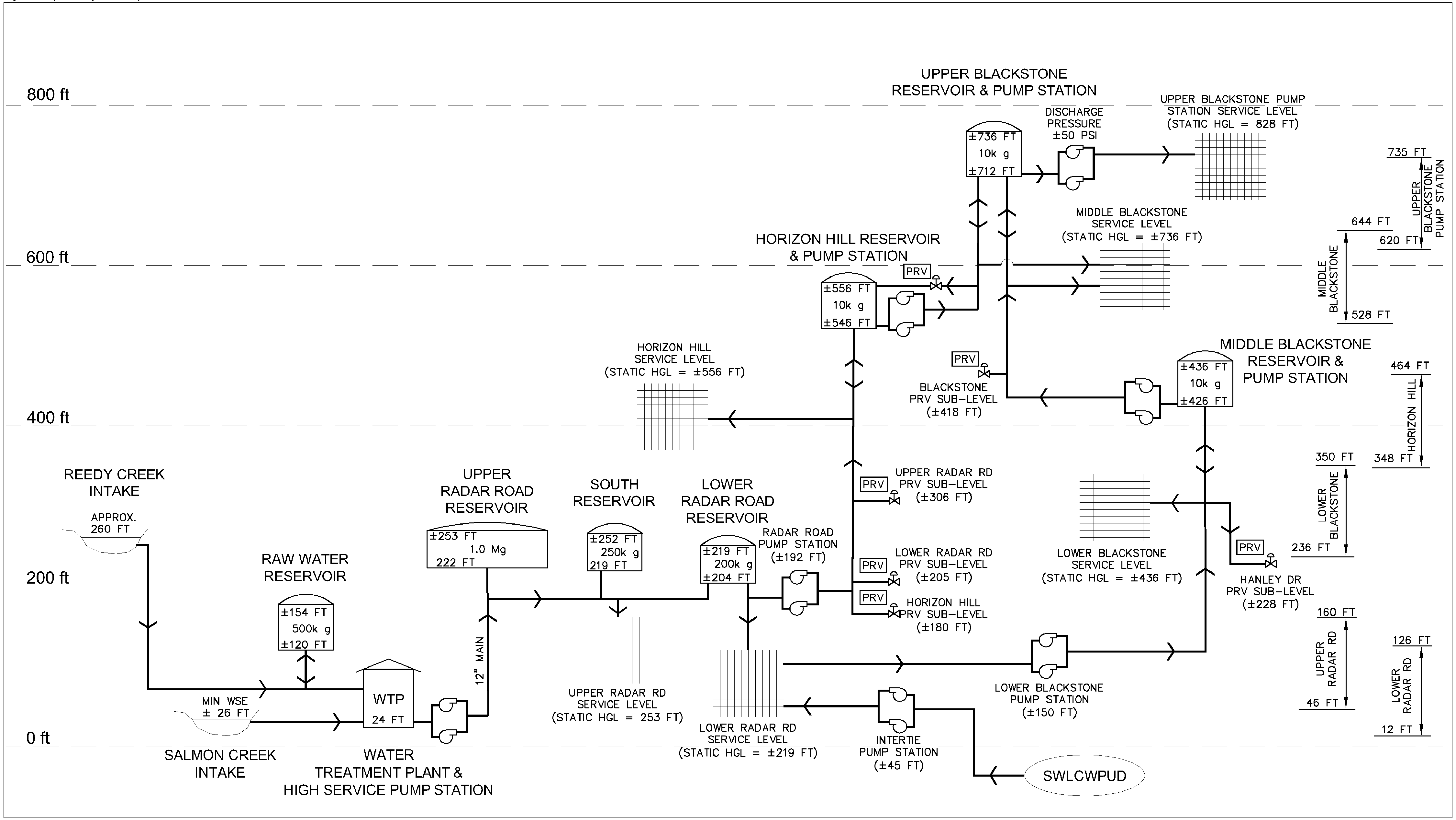
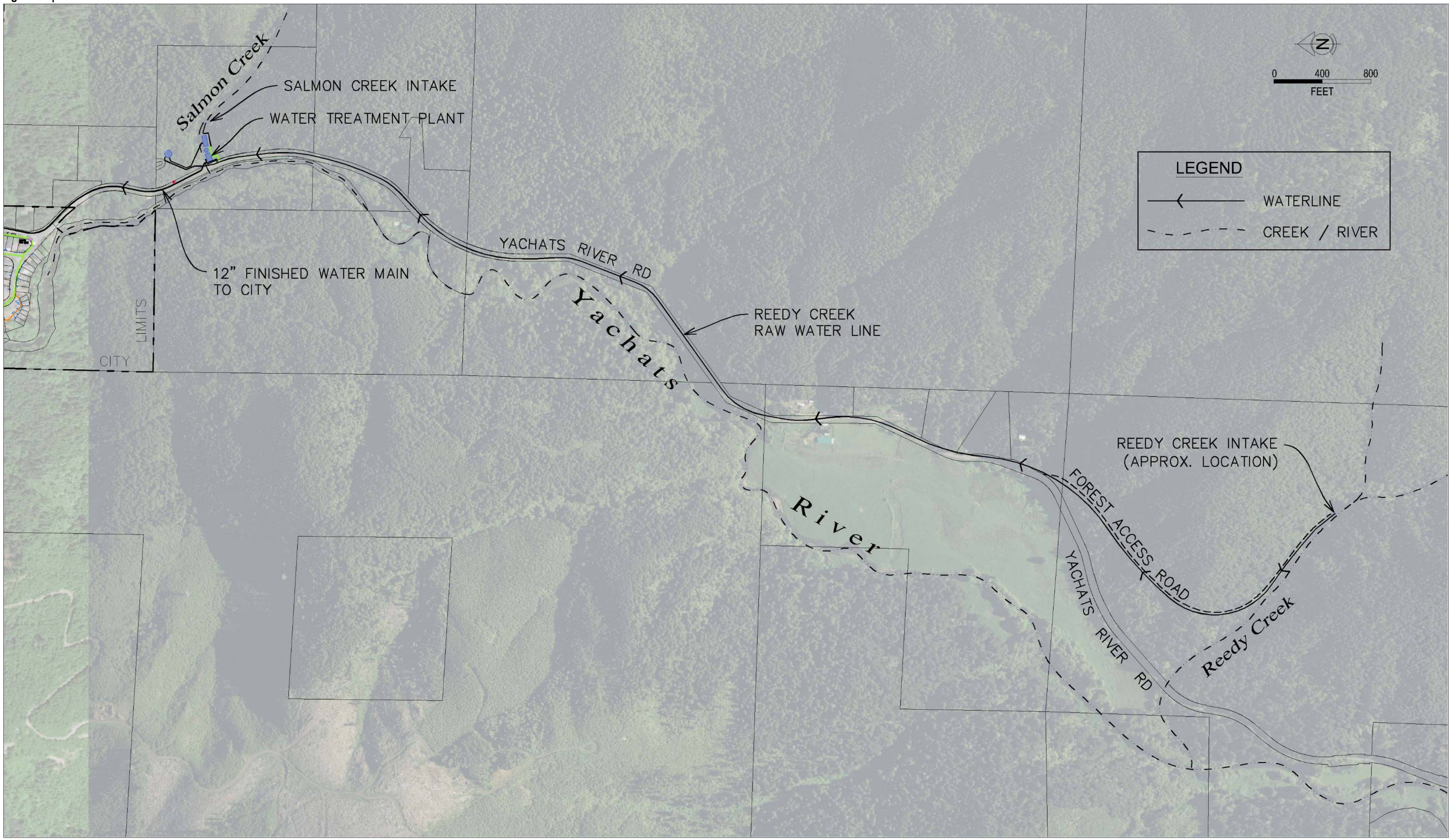


Figure 4-3| Raw Water Sources and Waterlines



4.1.3 Salmon Creek Water Supply

Figure 4-4| Salmon Creek Intake

Yachats has a water right permit to divert 2.0 cfs (1.3 mgd) from Salmon Creek. The permit has not been certificated and work needs to be done to improve the position of this water right. The recommended work is discussed in Chapter 6. The City's intake on Salmon Creek is about 100 yards from the treatment plant, which is shown in Figure 4-4. The intake lies within an impoundment and consists of an 18" slotted stainless steel intake pipe. Water flows by gravity from the intake to the treatment plant through a six-inch diameter PVC pipe. Based on discussions with the operations staff, the City is maximizing the amount of water that can be removed from Salmon Creek during the dry weather months. Therefore, Salmon Creek is unlikely to be able to provide additional water to meet increased demands due to growth in the City.

4.1.4 Cape Creek Water Supply

Cape Creek in the Cape Perpetua area is approximately 2 miles south of the City's UGB. Cape Creek was historically the City's water source, but has not been used for many years. The City has a certificated water right to Cape Creek for 0.49 cfs (219 gpm). No infrastructure exists for this water source. In September 2020, Westech Engineering measured the stream flow rate of Cape Creek at 0.39 cfs (170 gpm). At that time, the area had received a rain storm. It is expected that the minimum stream flow is less than the measured flow rate during the summer months. Cape Creek is a potential long-term source for the City. However, due to the distance from the City, the development costs are likely to be high and amount of water available during dry weather conditions is likely to be low when water demands are highest.

4.1.5 Yachats River Water Supply

The City currently holds 2.0 cfs of water rights from the Yachats River. However, the rights are severely limited by several conditions. The City cannot use 1.0 cfs of these rights during low streamflow conditions because the rights are junior to instream rights owned by the State of Oregon. During dry weather conditions, the flow in the Yachats River routinely decreases below values listed in the in-stream rights. Therefore, the 1.0 cfs that is junior to the in-stream rights is not a reliable source during the dry weather months. The remaining 1.0 cfs of the City's water rights are not subject to the in-stream rights. However, the City is only allowed to access these rights when population growth results in demands that exceed the City's other water sources and only if water losses in the distribution system are below 15%. Finally, the 1.0 cfs of water rights that is not subject to the in-stream rights is divided into two points of diversion. One point of diversion is located near the water treatment plant and the maximum rate of withdrawal from this point is 0.5 cfs. The water at this location is brackish and not suitable for treatment using the City's existing plant. The second point of diversion is located a significant distance upstream where the water is fresh, but the maximum withdrawal rate from this point is limited to 0.5 cfs. Therefore, of the 2 cfs of total water rights, only the 0.5 cfs that can be diverted from the upstream point of diversion is reliably available. The remaining 0.5 cfs of the portion of the water right that is not subject to the instream rights must be diverted from a location with brackish water which would require a very significant change to the treatment plant. The remaining 1.0 cfs that is junior to the instream rights is only available during the winter and higher flow periods in the spring, summer, fall.

4.1.6 Intertie Between City of Yachats and The Southwest Lincoln County Water People's Utility District

Yachats has a water system intertie with the Southwest Lincoln County Water People's Utility District (SWLCWPUD). The City operates the intertie under an agreement with the SWLCWPUD. The City could not provide the agreement for this planning effort, but the authors of this report understand that the intertie can only be used for emergency purposes. The intertie is not intended to be used on a regular basis as supplemental water source. As such, the intertie is not a source that the City can rely on to address increase demands due to growth during the planning period. The intertie has a pump station with control building and underground vaults with piping (Figure 4-5).

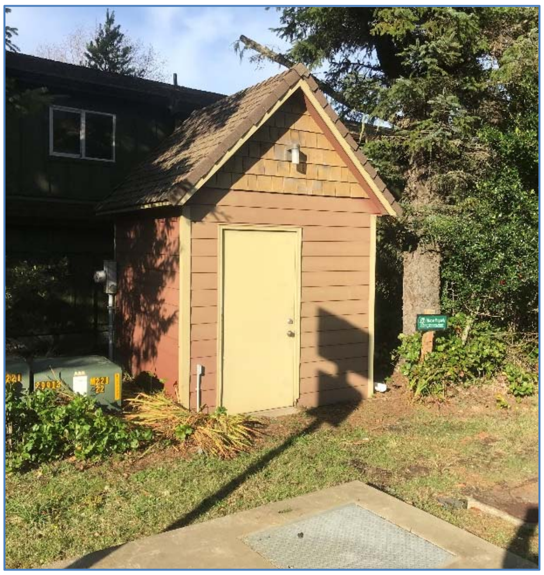


Figure 4-5 | Intertie Pump Station Building on Highway 101

Due to the differences in the hydraulic grade lines, this connection can be used to convey water by gravity from Yachats to the SWLCWPUD. The intertie also includes a pump station that can be used to deliver water south from the District to the City of Yachats.

The pump station and intertie piping are described in more detail in section 4.5.7.

4.2 RAW WATER STORAGE

In 2000, the City constructed a 500,000 gallon raw water storage reservoir. The reservoir is constructed of cor-ten, welded steel. The tank does not have seismic anchors. The tank is 35 feet high and 50 feet in diameter. The high water level is 34-1/2 feet above the base. Figure 4-6 shows the raw water storage tank.

The reservoir was constructed to allow the treatment plant to operate at a more consistent rate during the summer months. Low stream flows previously caused the plant to operate less efficiently. The storage reservoir is drawn down while the plant operates during low flows. When the treatment plant is producing less water than is supplied by Reedy Creek, the reservoir refills.

The City regularly removes sediment that accumulates in the bottom of the tank.

Figure 4-6 | Raw Water Storage Tank

4.3 WATER TREATMENT

In 1992, the existing water treatment plant (WTP) was put in service. The plant's rated capacity is 0.5 mgd (350 gpm). The plant consists of the following components:

- Pre-chlorination
- Chemical Coagulation and Polymer Addition
- Up-flow Contact Clarification
- Multi-media Filtration
- Disinfection (Post-chlorination)
- Serpentine Contact Basin Clearwell

The plant is a custom treatment system with a "conventional" type treatment train. The treatment process includes a single stage flocculation and clarification process followed by mixed media filtration. The original plant was built in 1992 and has been operating consistently in its original configuration ever since.

Raw water is primarily diverted at the Reedy Creek intake, which is then conveyed by gravity to the raw water storage tank near the WTP. Raw water from the storage tank flows by gravity to the clarifier. The WTP also receives raw water by gravity from Salmon Creek. Raw water from Salmon Creek is pumped to the clarifier.

Aluminum sulfate (Alum) as a coagulant and polymer as a filtration aid are added at the clarifier. The clarifier is a single chamber with baffles to separate reaction and clarification, which is shown in Figure 4-7. The clarifier is 35-feet in diameter with walls that are 14-feet, 6 inches tall and 1-foot thick. The clarifier's volume is approximately 104,000 gallons. Coagulants and filtration aids are introduced to the reaction well in the center of the clarifier. A turbine shaft rotates rakes, blades, and a sludge cone scraper. The floor of the clarifier is sloped to collect sludge in a sump. Precipitate is removed from the sump through a 6" desludge line, which drains to the backwash pond. The desludge effluent is controlled by a flow control valve located in a vault. Clarified water is taken off the top of the clarifier water column and is conveyed to the filters by gravity through a 10 inch ductile iron pipe.

Figure 4-7 | Clarifier

The plant is equipped with two mixed media filters. Figure 4-8 shows one of the filters. Each filter includes filter media, backwash supply and waste lines, a rotary surface washer, and 12" stainless steel underdrain header with 3" PVC underdrain laterals. Mixed media in each filter includes layers of anthracite coal, sand, and gravel. The filter units are approximately 12 feet long, 12 feet wide, and 8 feet 7 inches deep. The media filtration area is 12-feet by 12-feet and approximately 144 square feet per unit.

Figure 4-8 | Mixed-media Filters

Chlorine is used to disinfect the filtered water. Sodium hypochlorite is dosed to the clearwell. Sodium hypochlorite is delivered to the plant in 50-gallon drums and a chemical metering pump is used for dosing.

The City previously used on-site generation to produce chlorine, but the system is in need of repairs and is not currently being used.

The sodium hypochlorite solution is added to the filtered water which passes into the clearwell located below the treatment plant floor. The clearwell's working volume between the floor and the high water level is approximately 41,000 gallons. Baffle walls result in a longer flow path and contact time.

Water is pumped from the clearwell into the City's distribution system by two vertical turbine high service pumps, (Figure 4-9). These are described in more detail in the following section on pump stations.

At the present time, the City is able to reliably operate the plant at approximately 475,000 gallons per day or about 330 gpm on average. The treatment plant is rated for a filtering capacity of 350 gpm (500,000 gallons per day).

The clarifier and filters were originally designed for a maximum capacity of 1.0 mgd (700 gpm).

Figure 4-9 | High Service Pumps

The existing filters are backwashed using backwash pumps that pump water from the clearwell to each filter. Backwash water as well as the filter to waste water is discharged to a backwash pond. The plant was originally designed to recycle backwash water from the pond. However, this system has not been used for many years. The City is currently working on a project to restore the backwash recycling system. This system is expected to be operational early in the planning period.

Design criteria for the WTP are presented in Table 4-2.The treatment plant has served the City well over the years and has been well maintained. However, many components of the plant are more than 25 years old and will likely reach the end of their useful life during the planning period. Examples include the electrical control systems and some of the mechanical equipment. A more thorough evaluation of the treatment plant is presented in Chapter 7.

Table 4-2| Water Treatment Design Criteria (Based on Site Visits and City Records)

Reedy Creek Raw Water Intake	
Intake Structure	Infiltration gallery, 10" perforated pipe under gravel
Estimated Minimum Stream Flow Rate	120 gpm
Type of Conveyance	Gravity
Salmon Creek Raw Water Intake & Pumps	
Intake Structure	18" Slotted stainless steel pipe
Estimated Minimum Stream Flow Rate	60 gpm
Type of Conveyance	Pumped
Pump Location	Water Treatment Plant
Type	Centrifugal end-suction
Number	2
Size & Speed	7.5 hp, 480 V, 3 phase
Rated Discharge Rate	±200 gpm
Water Treatment Plant	
Finished Floor Elevation	21 ft
Plant Type	Custom mixed media filtration with chemical coagulation and upflow clarification
Operational Capacity	500,000 gallons per day (347 gpm)
Number of Clarifiers	1
Number of Filter Units	2
Clarifier Area/Filter Area per Unit	±120 ft^2 (10 ft x 12 ft)
Total Clearwell Volume	45,000 gallons
pH adjustment	Dry soda ash feed system with manual soda ash mixing (6% solution strength) and chemical metering pump
Coagulant Feed	Alum (Aluminum sulfate) feed system with chemical metering pump
Polymer Feed	Liquid fed directly with chemical metering pump
Filter Aid	Powder, manual mixed with water, chemical metering pump for solution feed
Disinfection System	
Disinfectant	12.5% Sodium hypochlorite solution delivered in 55 gal drums
Feed Solution Strength	Diluted to 1% for feeding with chemical metering pump
Disinfectant Storage Capacity	Two 160 gallon tanks
Contact Chambers	Clearwell 41,000 gallons

4.4 WATER STORAGE

Water storage reservoirs provide at least four important functions as follows:

- They provide a supply of water to draw upon during short-term peak system consumption.
- They provide a reserve supply of water to meet fire demands.
- They allow water sources to be taken out of service for repairs or maintenance.
- They help in keeping system pressures reasonably constant.

The City presently has six finished water storage reservoirs for a combined storage capacity of 1,590,000 gallons. Table 4-3 provides a summary of the City's storage reservoirs.

4.4.1 Upper Radar Road Reservoir

The Upper Radar Road Reservoir is located on the east side of Radar Road about 400 feet from the road's dead end. It was built in 1992 at the same time as the water treatment plant. This reservoir is the primary water storage structure in the City's water system. All water from the water treatment plant is directed to this reservoir; as a result, it is the source of water for the other reservoirs and pump stations. The water level in the reservoir determines the pressure provided to a large number of users in Yachats.

Figure 4-10 | Upper Radar Road Reservoir

The reservoir is the largest in the City and has a storage volume of 1.0 million gallons. A large portion of the storage volume is underground. The reservoir is primarily a rectangular reinforced-concrete cast-in-place structure. The roof is supported by precast concrete columns with cast-in place concrete beams. It has a metal roof with timber framing. The site has a perimeter chain-link fence and gate.

The reservoir has a maximum water surface elevation of 253.5 feet and a floor elevation of roughly 222 feet. The design overflow elevation is 254 feet. The structure is approximately 124 feet long and 49 feet wide. The maximum interior height is 38 feet. The minimum interior height is 16 feet.

The reservoir's level is monitored by the City's SCADA system and operators. The water treatment plant is controlled by plant operators as needed to maintain the water level in the tank.

Since the tank was constructed several decades ago, it is unlikely that it was designed to withstand seismic forces included in current building codes. As such, the City may want to consider a seismic retrofit project during the planning period. Specific recommendations for the tank are described in Chapter 9.

4.4.2 Lower Radar Road Reservoir

The Lower Radar Road Reservoir is located approximately 120 feet away from the Upper Radar Road Reservoir and about 50 feet lower in elevation. The structure was built in 1945. This reservoir provides water primarily to the northern part of the City.

Water flows by gravity from the Upper Radar Road Reservoir to the Lower Radar Road Reservoir through a 12-inch diameter pipe. A float valve located on the tank inlet line automatically closes when the Lower Radar Road Reservoir is full.

Figure 4-11 | Lower Radar Road Reservoir

A large number of users in the northern part of town are served by this reservoir. The water level in the reservoir controls the overall pressure in this zone of town. The reservoir delivers water directly to the Radar Road Pump Station and to the Lower Blackstone Pump Station. The reservoir's level is monitored by the City's SCADA system and operators.

The tank is a circular concrete cast-in-place structure that lies mostly below grade, as shown in Figure 4-11. The roof is aluminum and timber-framed. The site has a perimeter chain-link fence and gate.

The outer diameter of the reservoir is 50 feet. Assuming the walls are one-foot thick, the reservoir's normal water depth is estimated to be 14.75 feet. The reservoir's maximum water surface elevation is approximately 219 feet, assuming one-half feet of freeboard. The floor elevation is estimated to be 204 feet.

The tank was constructed in the 1940s. Therefore, it is unlikely that it was designed to withstand seismic forces included in current building codes. As such, a seismic retrofit project or complete replacement will likely be needed at some point. Due to the overall age of the tank, the City should consider complete replacement during the planning period. Specific recommendations for the tank are described in Chapter 9.

4.4.3 Horizon Hill Reservoir

The Horizon Hill Reservoir has a storage volume of 10,000 gallons and was built in 1964. The reservoir is located on Horizon Hill Road approximately one-half mile up the hill from Spruce Avenue. The reservoir is a rectangular reinforced-concrete cast-in-place structure. The structure is approximately 14 feet long, 14 feet wide, and 11 feet tall.

A pump station is located adjacent to the reservoir in a concrete masonry unit building. The pump station draws water directly from the concrete reservoir.

Figure 4-12 | 10,000 Gallon Horizon Hill Reservoir & Pump Station

Water is delivered to the reservoir primarily from the Radar Road Pump Station. A float valve maintains a maximum water level in the reservoir at all times. Water can also be delivered to the reservoir from the Upper Blackstone Reservoir; an altitude valve is used on this inlet to maintain a maximum water level in the reservoir without overflowing the reservoir. The reservoir's level is monitored by the City's SCADA system and operators.

Since the tank was constructed several decades ago, it is unlikely that it was designed to withstand seismic forces included in current building codes. Overall, the Horizon Hill Reservoir and Pump Station are old facilities that will likely reach the end of their useful life in the coming years. These facilities are relatively small and could be maintained for the duration of the planning period from the City's existing operation and maintenance budgets. However, at some point, maintenance costs will increase to the point that replacement with modern facilities becomes a better option. The choice to maintain these facilities versus replacing them will ultimately come down to a management decision by the City. The recommended improvements described in Chapter 8 and Chapter 9 describe a complete replacement project. But, the City certainly has the option to continue maintaining the existing facilities and deferring replacement to the next planning period.

4.4.4 South Reservoir

The South Reservoir is located in the southern part of town at the end of Crestview Drive. It was constructed in 2018. The tank primarily serves users that are south of the Yachats River. The structure's storage volume is 250,000 gallons.

The reservoir's level is maintained by the level in the Upper Radar Road Reservoir. The reservoir's base and maximum water surface elevation are roughly 2 feet lower than the Upper Radar Road tank. As such, a valve on the inlet is used to prevent the tank from overflowing. The reservoir's level is monitored by the City's SCADA system and operators.

The tank is a bolted steel construction with a glass-fused coating system. It has a designed maximum water surface elevation of 252 feet and an overflow level of 252.83. The nominal base elevation is 219 feet. The structure is 36 feet in diameter and has walls approximately 37 feet tall. Figure 4-13 shows the reservoir. The site has a perimeter chain-link fence and gate.

Since the tank is relatively new, it was likely designed in accordance with current seismic codes and should serve the City well for the remainder of the planning period. The tank outlet is equipped with a control valve that is designed to close when the water level in the tank drops to about five feet. The City is in the process of installing a seismic monitor and solenoid control system that will close the control valve any time there is a seismic event. The purpose of this system is to prevent the tank from draining completely if a seismic event causes a major waterline rupture in the downstream distribution piping. This system should be installed early in the planning period.

Figure 4-13 | 250,000 Gallon South Reservoir

4.4.5 Middle Blackstone Reservoir

The Middle Blackstone Reservoir was constructed in 2007. It is located adjacent to a utility access road between Gimlet Lane and Horizon Hill Road. Figure 4-14 shows the reservoir and pump station.

The reservoir's levels are maintained by the Lower Blackstone Pump Station based on water level readings. Telemetry allows the two facilities to communicate. The reservoir's level is monitored by the City's SCADA system and operators.

The reservoir has a storage volume of approximately 10,000 gallons. The structure is 10 feet in diameter and has walls that are 18 feet tall. The base elevation is approximately 426 feet. The reservoir has a maximum water surface elevation of approximately 443.

Figure 4-14 | 10,000 Gallon Middle Blackstone Reservoir & Pump Station

The reservoir is a welded stainless-steel construction and is installed on a concrete slab. Anchor bolts secure the reservoir to the concrete slab. Overall the reservoir appears to be in good condition and should serve the City well for the remainder of the planning period.

4.4.6 Upper Blackstone Reservoir

The Upper Blackstone Reservoir was constructed in 2007 as a part of the Blackstone development and is located at the top of Horizon Hill Drive. The reservoir is a cast in place concrete structure.

The structure is 31.5 feet in diameter and is 25 tall from the base to the rim. The reservoir has an estimated storage volume of 120,000 gallons, assuming the walls & roof are one-foot thick and 6 inches of free board inside the structure. The floor elevation is approximately 712 feet. It has an estimated maximum water surface elevation of 736 feet. Figure 4-15 shows the reservoir and adjacent pump station.

Figure 4-15 | 120,000 Gallon Upper Blackstone Reservoir and Pump Station

The Middle Blackstone Pump Station and the Horizon Hill Pump Station are used to maintain the reservoir's water levels. The reservoir control system calls for water automatically from the Middle Blackstone Pump Station based on level readings. The Horizon Hill Pump Station is monitored remotely and operated manually to fill the reservoir. The reservoir's level is monitored by the City's SCADA system and operators. There is no telemetry between the Horizon Hill Pump Station and the Upper Blackstone Reservoir.

The reservoir was constructed relatively recently and appears to be in good overall condition. Therefore, it should serve the City well for the remainder of the planning period.

Table 4-3| Existing Reservoir Inventory[1]

Reservoir Name	*Nearest Street Address*	*Year Constructed*	*Storage Volume (gallons)*	*Approximate Floor Elevation (ft)*	*Approximate Max. Water Surface Elevation (ft)*	*Primary Material*
Upper Radar Road	628 Radar Rd.	1992	1,000,000	222	253.5	Cast-in place concrete
Lower Radar Road	395 Radar Rd.	1945	200,000	204[2]	219[2]	Cast-in place concrete
Horizon Hill	841 Horizon Hill Rd	1964	10,000[4]	546[2]	556[2,4]	Cast-in place concrete
South	125 Crestview Dr.	2018	250,000	219.0	252.8	Bolted-steel
Middle Blackstone	1040 Hanley Dr.	2007[3]	10,000[4]	426[2]	443[2,4]	Welded stainless steel
Upper Blackstone	1000 Horizon Hill Rd.	2007[3]	120,000[4]	712[2]	736[2,4]	Cast-in place concrete
TOTAL	-	-	1,590,000	-	-	-

[1] Reservoir inventory only includes reservoirs used for finished water, ie. raw water storage is not included in the total reservoir volume.
[2] Value based on elevations referenced from OR State DOGAMI LiDAR data.
[3] Estimated year of construction
[4] Estimated from field measurements.

4.5 PUMP STATIONS

The City has several pump stations which serve to move water to the various water service levels in the distribution system. Table 4-4 contains a summary of some of the important characteristics of each of the pump stations. A more detailed description of each of the stations is presented in the following sections.

4.5.1 Water Treatment Plant

Once water is finished being treated at the plant, high service pumps lift the water from the clearwell and deliver it to the Upper Radar Road Reservoir. These two 20 horsepower vertical turbine pumps are located on the floor of the water treatment plant (Figure 4-9). These pumps are fitted with air vents, check valves, and isolation valves. These pumps sit on concrete equipment pads. The pumps discharge from the plant to a 12-inch water main that runs from the plant in to town.

The pumps nominal capacity is approximately 350 gallons per minute at an estimated 250 feet of total dynamic head. The pumps are controlled with the plant's main control panel and operate at a constant speed.

Based on conversations with Public Works staff, the performance of these pumps has substantially diminished since they were installed, even with regular repair and maintenance. As such, they have reached the end of their useful life and will need to be replaced during the planning period in order to provide adequate flow rate and pressure. The recommended improvements are discussed on Chapter 7.

4.5.2 Radar Road Pump Station

The Radar Road Pump Station is located near the Lower Radar Road Reservoir. The pump station consists of a masonry building. The building has a concrete foundation and floor. This building houses the pump station's pumps, piping, and power & control equipment. The pump station does not have a fence. According to operators, the City's water facilities have been tampered with in the past. It is recommended that a fence be installed around the pump station for added security.

Figure 4-16 | Radar Road Pump Station

The pump station pumps water from the Lower Radar Road Reservoir to the Horizon Hill Road Reservoir. Water is delivered to the pump station via an 8-inch pipe and discharges from the pump station via an 8-inch pipe.

The station operates two pumps alternately under normal circumstances. These are Berkeley vertical multistage pumps. The pumps are installed in steel equipment stands anchored to the floor. The pumps are 7.5 and 8 horsepower. The nameplates on the pumps indicate that the pumps nominal capacity is 53 gallons per minute at 450 feet (194 psi) of total dynamic head.

The pumps draw suction from the Lower Radar Road tank with a maximum water surface elevation of about 219 feet. The pumps are used to maintain water levels in the Horizon Hill Reservoir at an elevation of roughly 556 feet. The static head between the pump suction and discharge is about 337 feet which is a relatively high head application.

The pump station piping has isolation gate valves on the inlet and discharge sides of each pump. There is a check valve on the discharge pipe common to both pumps.

The pumps are controlled with a control panel in an on/off fashion at a constant speed. The pump station has equipment for monitoring the reservoir level in the Horizon Hill Reservoir. Pumps are turned on and off in order to maintain water levels in the reservoir. The status of pumps can be monitored with the City's SCADA system.

Overall, the Radar Road Pump Station is an old facility that will likely reach the end of its useful life in the coming years. The station is relatively small and could be maintained for the duration of the planning period from the City's existing operation and maintenance budget. However, at some point, maintenance costs will increase to the point that replacement with modern facilities becomes a better option. The choice to maintain the pump station versus replacing it will ultimately come down to a management decision by the City. The recommended improvements described in Chapter 8 describe a complete replacement project. But, the City certainly has the option to continue maintaining the station and deferring replacement to the next planning period.

4.5.3 Horizon Hill Pump Station

The Horizon Hill Pump Station is located on Horizon Hill Road approximately one-half mile up the hill from Spruce Avenue. The pump station building is adjacent to the reservoir, as shown in Figure 4-17.

Figure 4-17 | Horizon Hill Pump Station

The pump station draws water from the Horizon Hill Reservoir. The pump station boosts water up Horizon Hill Road to the Upper Blackstone Reservoir. The pump station and it pumps were originally designed to be a "dead-end" or booster pump station that only served to increase pressure to users above the pump station. The pressure set point was 100 psi. The pump station is no longer operated in this fashion.

The mainline from the Horizon Hill Pump Station was connected to the Upper Blackstone Reservoir as a part of the Blackstone Development. The pump station is now operated manually to maintain levels in the Upper Blackstone Reservoir. City operators can remotely monitor the levels in the reservoir and run the pumps accordingly. Based on conversations with City operators, the pumps struggle to completely fill the reservoir indicating that they are somewhat undersized

Water is delivered to and discharged from the pump station via 4-inch piping. The pump station has piping that allows the Horizon Hill Reservoir to be filled from the Upper Blackstone Reservoir. A pressure reducing valve is used to lower the pressure coming in to the tank. A float valve in the tank prevents the tank from overflowing.

The pumps, discharge piping, and controls are housed in concrete masonry unit building. The room is accessed from a roll up door. Overall, the building appears to be in fair condition.

The pump station has two 15-horsepower centrifugal pumps. A pressure tank is in the building that is no longer in use. The nominal capacity of the pumps is estimated to be approximately 160 gpm at 240 feet of head.

The pumps are controlled manually in an on/off fashion. They do not have provisions for controlling pump speed. The status of pumps can be monitored with the City's SCADA system.

As described above (Section 4.4.3), the Horizon Hill Reservoir and Pump Station are old facilities that will likely reach the end of their useful life in the coming years. These facilities are relatively small and could be maintained for the duration of the planning period from the City's existing operation and maintenance budgets. However, at some point, maintenance costs will increase to the point that replacement with modern facilities becomes a better option. The choice to maintain these facilities versus replacing them will ultimately come down to a management decision by the City. The recommended improvements described in Chapter 8 and Chapter 9 describe a complete replacement project. But, the City certainly has the option to continue maintaining the existing facilities and deferring replacement to the next planning period.

4.5.4 Lower Blackstone Pump Station

The Lower Blackstone Pump Station is located on the north side of Windsong Street about 275 feet uphill from King Street. The pump station was constructed as a part of the Blackstone development. The pump station pumps water from the Lower Radar Road Zone to the Middle Blackstone Reservoir. The City's Water Service Levels are described in detail in section 4.6.2. The inlet and outlet of the pump station are 8-inch pipes.

The pumps are housed in a prefabricated and insulated shelter with aluminum sheet exterior. The pumps and piping are attached to a steel stand, which is anchored to a concrete equipment pad.

Figure 4-18 | Lower Blackstone Pump Station

The pump station has a metal shelter with a roll up door. The pump station has a dedicated electrical transformer. These structures are shown in Figure 4-18.

The shelter used to house the pumps is not well suited to the Oregon coast environment and the needs of City operators. The station is accessed from removable panels instead of doors. These factors make it difficult for staff to conduct regular checks, maintenance, and repairs. The pumps in the shelter are heavy and are not easily moved in and out of the shelter. Additionally, the shelters do not entirely prevent weather and insects from intruding. The floor inside the shelter is continuously wet during the rainy season, because the slab does not shed water away and is not weather-proof. Despite the effort of operators, insect colonies have occupied and compromised the insulation. Moisture regularly entering the shelter is putting undue wear on electrical equipment, which is shortening its operating life. Additionally the shelter does not have a heater or thermostat. These are necessary during freezing temperatures to prevent failure and undue wear on the equipment.

The City may want to consider replacing the shelter during the planning period. It is recommended that it be replaced with a prefabricated fiberglass or wood framed structure. The pump station does not have a fence. According to operators, the City's water facilities have been tampered with in the past. It is recommended that a fence be installed around the pump station for added security. It is envisioned that the installation of a new shelter and fence will be funded through the City's existing operation and maintenance budget. Therefore, a specific capital improvement project to address these issues is not described in this plan.

The pump station has two 20 horsepower vertical multistage Goulds pumps. Their nominal capacity is estimated to be approximately 210 gallons per minute at 250 feet of head. They are fitted with check valves, isolation valves, a pressure tank and pressure gauges. The piping and steel equipment stand appears to be coated in the field with a thin layer of spray paint. The paint on the stand is peeling, allowing the stand and pipe supports to rust.

The pumps are controlled with variable frequency drives, which allows their speed to be adjusted. They are controlled based on water level readings in the Middle Blackstone Tank and are integrated with the City's SCADA system.

4.5.5 Middle Blackstone Pump Station

The Middle Blackstone Pump Station is located on Gimlet Lane approximately 1,000 feet up the hill from the intersection of Gimlet Lane and Hanley Drive. The pump station site is accessed from a utility access road. The station pumps water from the Middle Blackstone Reservoir and boosts it uphill to the Upper Blackstone Reservoir and Pump Station. Water is delivered to the Middle Blackstone Pump Station via a 6-inch pipe.

Figure 4-19 | Middle Blackstone Pump Station & Reservoir

The shelter is the same type of construction as the Lower and Upper Blackstone Pump Stations. Pumps are housed in a prefabricated and insulated shelter with aluminum sheet exterior. The shelter is anchored to a concrete pad. The station is shown in Figure 4-19.

As previously discussed, these shelters are not well suited to the Oregon coast environment and the needs of City operators. As shown in the Figure, the shelter is not tall enough to walk in to and to stand inside. Also, the station is accessed from removable panels instead of doors. These factors make it difficult for staff to conduct regular checks, maintenance, and repairs. The pumps in the shelter are heavy and are not easily moved in and out of the shelter. Additionally, the shelter does not entirely prevent weather and insects from intruding. The floor inside the shelter is continuously wet during the rainy season, because the slab does not shed water away and the joint is not sealed at the slab. Despite the City's continued effort, ant colonies have occupied and compromised the insulation. Moisture regularly entering the shelter is putting undue wear on mechanical components and electrical equipment, which is shortening their operating life. Additionally, the shelter does not have a heater or thermostat. These are necessary during freezing temperatures to prevent failure and undue wear on the equipment.

The City may want to consider replacing the shelter during the planning period. It is recommended that it be replaced with a fiberglass or wood framed structure. The pump station does not have a fence. Even though the station is behind locked gates it is still susceptible to tampering and vandalism, which has been experienced by City staff. To improve security, the City may want to consider installing a fence around the pump station and reservoir site for added security. It is envisioned that the installation of a new shelter and fence will be funded through the City's existing operation and maintenance budget. Therefore, a specific capital improvement project to address these issues is not described in this plan.

The pump station has two 10 horsepower vertical multistage Goulds pumps with a pressure tank. Their estimated nominal capacity is approximately 80 gallons per minute at 320 feet of head. They are fitted with check valves, isolation valves, and pressure gauges. The piping and steel equipment stand appears to be coated in the field with a thin layer of spray paint. The paint on the stand is peeling, allowing the stand to rust.

The pumps are controlled with variable frequency drives, which allows their speed to be adjusted. They are controlled based on water level readings in the Upper Blackstone Tank and are integrated with the City's SCADA system.

4.5.6 Upper Blackstone Pump Station

The Upper Blackstone Pump Station is located on Horizon Hill Drive approximately 1,500 feet up the hill from the Middle Blackstone Pump Station. The pump station receives water from the Upper Blackstone Reservoir. The purpose of the station it to boost pressure directly to several users in the upper elevations of the Horizon Hill area. Water is delivered to the pump station via a 6-inch pipe and discharges from the pump station via two 6-inch pipes.

Figure 4-20 | Upper Blackstone Pump Station & Reservoir

The shelter for the Upper Blackstone Pump Station is the same type of construction as the Lower and Middle Blackstone Pump Stations. Pumps are housed in a prefabricated and insulated shelter with aluminum sheet exterior. The shelter is anchored to a concrete pad. The station is shown in Figure 4-20.

The shelter is not well suited to the Oregon coast environment and the needs of City staff. As shown in the Figure, the shelter is not tall enough to walk in to and to stand inside. Also, the station is accessed from removable panels instead of doors. These factors make it difficult for staff to conduct regular checks, maintenance, and repairs. The pumps in the shelter are heavy and are not easily moved in and out of the shelter. Additionally, the shelter does not entirely prevent weather and insects from intruding. The floor inside the shelter is continuously wet during the rainy season, because the slab does not shed water away and the walls are not sealed at the floor. Despite the City's continued effort, ant colonies have occupied and compromised the insulation. Moisture regularly in the shelter is putting undue wear on mechanical components and electrical equipment, which is shortening their operating life. Additionally, the shelter does not have a heater or thermostat. These are necessary during freezing temperatures to prevent failure and undue wear on the equipment. The City may want to consider replacing the shelter during the planning period with a wood frame or fiberglass structure.

The pump station does not have a fence. It is susceptible to tampering and vandalism, which has been experienced by City staff at other facilities. It is recommended that a fence be installed around the pump station and reservoir site for added security.

It is envisioned that the installation of a new shelter and fence will be funded through the City's existing operation and maintenance budget. Therefore, a specific capital improvement project to address these issues is not described in this plan.

The pump station has two 1-1/2 horsepower end-suction centrifugal pumps and a pressure tank. Their estimated nominal capacity is approximately 30 gallons per minute at 140 feet of head. They are fitted with check valves, isolation valves, and pressure gauges. The pumps are mounted on a painted steel equipment stand. The piping and steel equipment stand appears to be coated in the field with a thin layer of spray paint. The paint on the stand is peeling, allowing the stand to rust.

The pumps are controlled with variable frequency drives, which allows their speed to be adjusted. Discharge pressure is monitored with a transducer. The pumps are controlled to maintain between 45 and 55 psi and are integrated with the City's SCADA system.

4.5.7 Intertie Pump Station

As previously discussed, Yachats has a water system intertie with the Southwest Lincoln County Water People's Utility District (SWLCWPUD). The purpose of the intertie is to provide an emergency water supply for the City or the SWLCWPUD if needed in response to an event that interrupts normal operation of the primary water sources. The intertie is not intended to be used on a regular basis as supplemental water source. The intertie has a pump station with control building and underground vaults with piping.

The intertie is located at the north edge of the City on the west side of Highway 101 near Ocean Wayside Lane. Due to the differences in the hydraulic grade lines, this connection can be used to convey water by gravity from Yachats to the SWLCWPUD.

Figure 4-21 | Intertie Pump Station on Highway 101

The intertie includes a pump station that can be used to pump water south from the District to the City of Yachats. The control building is a wood-framed, uninsulated, structure (Figure 4-5). It houses two centrifugal booster pumps, piping, isolation & check valves, and pressure gauges. It also houses power and control equipment. The intertie is not monitored remotely by the City's SCADA system. According to operators, the intertie has never been used.

The connection consists of underground piping and will likely require some physical work to use should the need arise. As such, the existing intertie is not operator friendly, and may be somewhat challenging to use.

Table 4-4| Existing Pump Station Inventory

Pump Station Name	*Number of Pumps*	*Pump Type*	*Power (nameplate horsepower)*	*Flow Rate (gpm)* [1]	*Total Dynamic Head (ft)* [1]	*Pump Station Elevation (ft)* [5]	*Approx. Discharge Pressure (psi)*	*Motor Speed Control*	**Reservoir Serviced**	*Operational Scheme*
Water Treatment Plant	2	Vertical Turbine	20	350[3]	250[4]	21.5[3]	110	On/off	Upper Radar Road & South Reservoir	Maintain reservoir level, manual
Radar Road	2	Vertical Multistage	7.5 / 8	53	450	192	200	On/off	Horizon Hill	Maintain reservoir level, automatic
Lower Blackstone	2	Vertical Multistage	20	210[2]	250[4]	150	110	Variable	Middle Blackstone	Maintain reservoir level, automatic
Middle Blackstone	2	Vertical Multistage	10	80[2]	320[4]	426	140	Variable	Upper Blackstone	Maintain reservoir level, automatic
Upper Blackstone	2	Centrifugal	1.5	30[2]	140[4]	712	50	On/off	N/A	Pressure set point
Horizon Hill	2	Centrifugal	15	160[2]	240[4]	546	105	On/off	Upper Blackstone	Maintain reservoir level, manual
Intertie	2	Centrifugal	5	150[3]	Unknown	45	Unknown	On/off	N/A	Manual On/Off

1- Capacity of single pump at nominal duty point.
2- Estimated based on nameplate power, TDH, and assumed efficiency of 65%.
3- Referenced from City records.
4- Estimated based on head conditions and assumed friction losses & service pressures.
5- Referenced from Oregon State DOGAMI Lidar elevation data, except as noted.

4.6 Distribution System

The City's distribution system consists of the pipes, fittings, valves, and hydrants that convey finished water from the water treatment plant and from reservoirs to end users. These components are not of a uniform age, size or material type. The City utilizes typical pipe sizes ranging from 3/4-inch water services up to 12-inch water mains. The system consists of asbestos cement (AC), ductile iron (DI), high density polyethylene (HDPE), and polyvinyl chloride (PVC) pipe. For the last several years the City has standardized around AWWA C-900 PVC water pipe. This subsection presents an inventory and description of the distribution system.

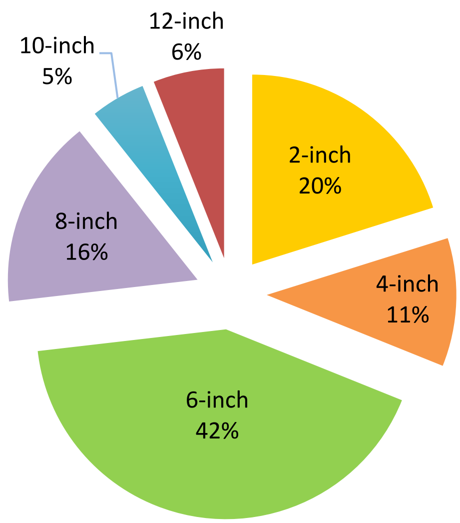
4.6.1 Pipe Network

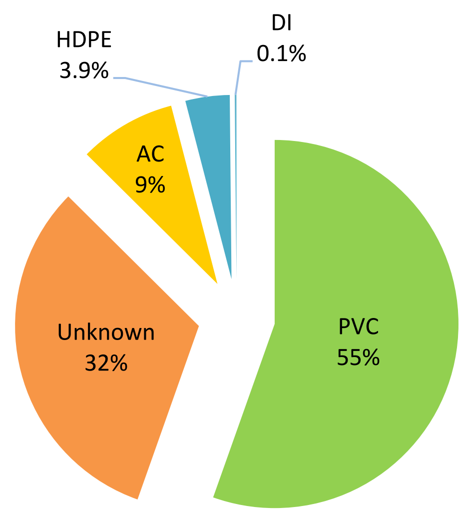
The major components of the water distribution system are shown in the distribution maps included in the appendices. These maps are also available digitally in pdf format.

All public waterlines within the study area are owned by the City. In addition to the City, the Oregon Department of Transportation (ODOT) has jurisdictional oversight for facilities constructed within or along Highway 101.

The existing distribution system is predominantly PVC with some asbestos concrete, ductile iron, and HDPE pipe. Roughly a third of the distribution system's pipe material is unknown. The distribution system is comprised of approximately ±17.6 miles of mainline pipe, inventoried by pipe diameter and pipe material as shown in Figure 4-22.

Figure 4-22| Amount of Distribution Pipe by Diameter and Material





The layout of the existing water system appears to be adequate to deliver the required domestic flow rates to the community. However, some portions of the system do not have the capacity to deliver required fire flows while maintaining the obligatory 20 psi residual pressure at all service connections. This lack of capacity is the result of the configuration of the distribution system and the undersized pipes that lack conveyance capacity.

4.6.2 Water Service Levels

Water must be supplied to the customers at sufficiently high pressures to prevent contamination and to ensure that appliances operate correctly. Excessive pressures must also be avoided to prevent damage to the distribution system and private plumbing fixtures. Common practice is to provide typical water pressures in the range of 40 to 90 psi. The City's infrastructure is setup in order to provide this pressure operating range to an area of the City. These areas are called service levels. Users in the City are in only one service level. Each service level is generally associated with one or more reservoirs that maintain the pressure in the service level. A service level can be separated in to sub-level by a pressure reducing valve (PRV). All of the pipe in the distribution network is within one service level or sub-level.

The City's water system consists of 6 main water service levels with 5 sub-levels (Figure 4-23). Table 4-5 lists the service levels and identifies the source of pressure for each level. A vast majority of the City's users are served by levels 1 & 2, the Upper & Lower Radar Road Service Levels. The other service levels are associated with pump stations that deliver water to users in levels higher than the two main levels. There are three service levels associated with the Blackstone Development. Five sub-levels are associated with PRVs.

Table 4-5| Service Level Inventory

Service Level			*Reservoir Maintaining Pressure in Level(s)*	*Pump Station Maintaining Pressure in Level*	*Sub-level Name*
1		Lower Radar Road	Lower Radar Road Reservoir		
2		Upper Radar Road	Upper Radar Road Reservoir & South Reservoir		
3		Horizon Hill	Horizon Hill Reservoir		
	3.1				Horizon Hill PRV
	3.2				Lower Radar Road PRV
	3.3				Upper Radar Road PRV
4		Lower Blackstone	Middle Blackstone Reservoir		
	4.1				Hanley Drive PRV
5		Middle Blackstone	Upper Blackstone Reservoir		
	5.1				Blackstone PRV
6		Upper Blackstone		Upper Blackstone Pump Station	

Figure 4-23| Water Distribution System Service Level Map

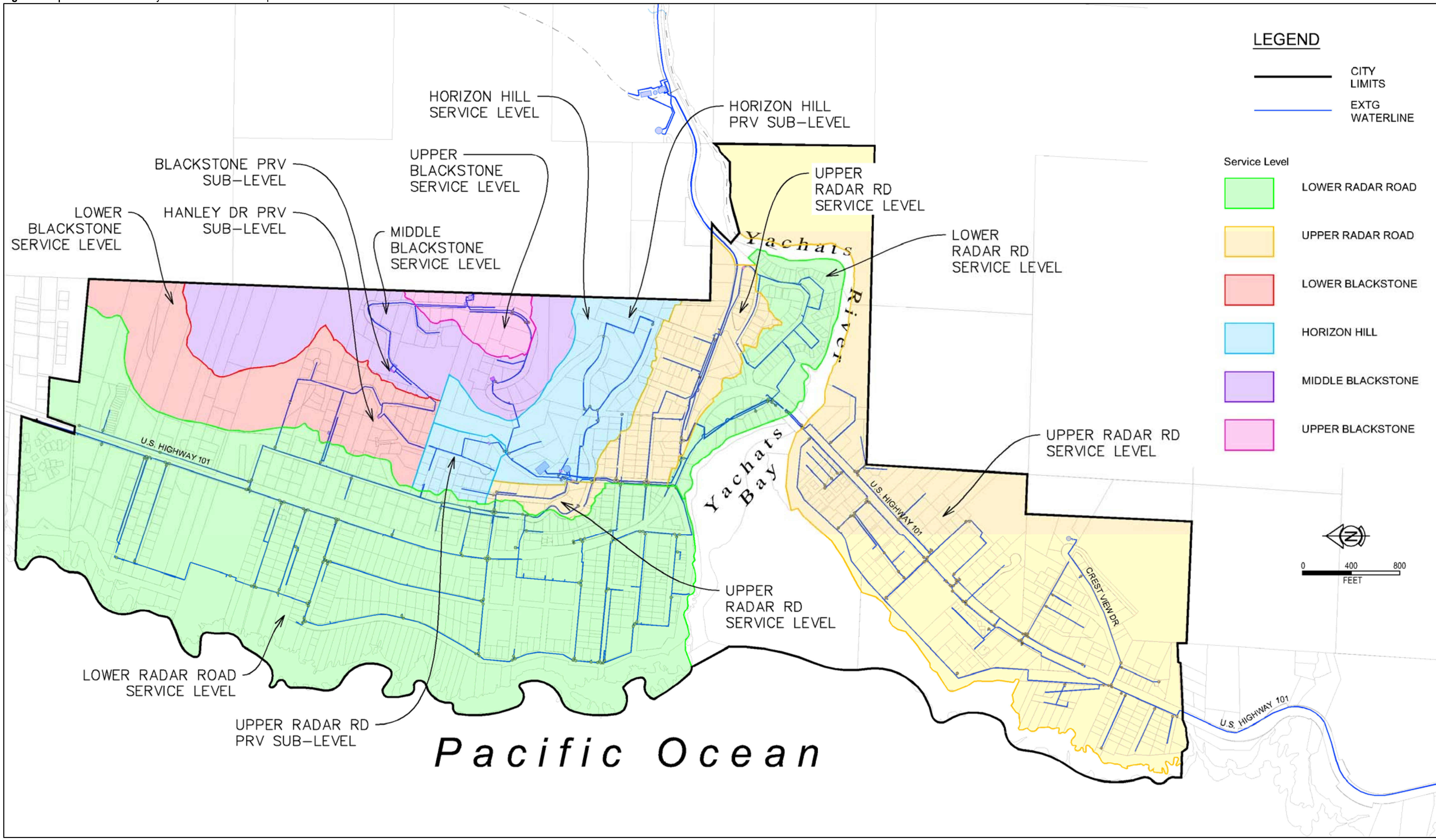


Table 4-6| Service Level Elevations

Service Level		Max. Reservoir Water Surface Elevation (ft)[1]	Elevation at 90 psi Static Pressure (ft)	Elevation at 40 psi Static Pressure (ft)
1	Lower Radar Road	219	12	126
2	Upper Radar Road	253	46	160
3	Horizon Hill	556	348	464
4	Lower Blackstone	443	236	350
5	Middle Blackstone	736	528	644
6	Upper Blackstone	N/A[2]	N/A[2]	N/A[2]

1- Reference Table 4-3 and Table 4-4 for more information.
2- Pressure in service level maintained by booster pump station.

4.6.2.1 Lower Radar Road Service Level

The Lower Radar Road Service Level encompasses a majority of the City's users on the north side of the Yachats River. Users is this level are in the relatively low elevations of town along Highway 101 that are north of the Yachats River. Historically this and the Upper Radar Road service level were the only service levels in the City. However, growth in the higher elevations in the hills above town required creation of separate service levels served by pump stations.

The Lower Radar Road Reservoir maintains pressure in this service level. This service level delivers water directly to the Radar Road Pump Station and the Lower Blackstone Pump Station. The intertie with the SWLCWPUD connects to this service level.

4.6.2.2 Upper Radar Road Service Level

The Upper Radar Road service level serves users in the low elevation parts of the City that are generally south of the Yachats River. Pressure in this level is maintained by the Upper Radar Road Reservoir and the South Reservoir. The water treatment plant high service pump station feeds directly in to this service level.

4.6.2.3 Horizon Hill Service Level

The Horizon Hill service level serves users along Horizon Hill Road by gravity from the Horizon Hill Reservoir. These users are between the Radar Road Pump Station and the Horizon Hill Reservoir. Pressure in this level is maintained by the water level in the Horizon Hill Reservoir. This service level typically sources water from the Lower Radar Road Service Level; however, it can also source water from the Middle Blackstone Level. The Horizon Hill Service Level also serves the Lower & Upper Radar Road PRV sub-levels and the Horizon Hill PRV sub-level.

4.6.2.3.1 Lower Blackstone Service Level

The Lower Blackstone service level serves users along Windsong Street, Elk Mountain Road, and Gimlet Lane by gravity from the Lower Blackstone Reservoir. This level extends from the Lower Blackstone Pump Station up to the Middle Blackstone Pump Station. Pressure in this level is maintained by the water level in the Middle Blackstone Reservoir. This level also serves the Hanley Drive PRV sub-level. This service level was created when the Blackstone Development was built in order to deliver water to users in higher water service levels. The water distribution system in the Blackstone Development was not designed to provide typical residential fire flow rates of 1,000 gallons per minute. In order to provide conventional fire flow rates, most of the distribution piping serving the

Blackstone Development would need to be replaced with larger piping. The costs for this would be high. Considering that the facilities serving the Blackstone Development are relatively new and the costs to replace the piping is relatively high, this plan does not included recommendations to improve the fire suppression capacity of the distribution system in the Blackstone Development.

4.6.2.3.2 Middle Blackstone Service Level

The Middle Blackstone service level serves users along Horizon Hill Road by gravity from the Upper Blackstone Reservoir. This level extends from the Middle Blackstone Pump Station up to the near the Upper Blackstone Reservoir and also downhill to the Horizon Hill Reservoir. Pressure in this level is maintained by the water level in the Upper Blackstone Reservoir. This level also serves the Blackstone PRV sub-level. As described above (Section 0), the distribution system in the Blackstone Development was not designed to provide conventional flow suppression and this plan does not include recommendations to improve the fire suppression capacity in this service level.

4.6.2.3.3 Upper Blackstone Service Level

The Upper Blackstone service level serves users along Horizon Hill Road that cannot be served by the Upper Blackstone Reservoir. Pressure in this level is maintained by the pumps at the Upper Blackstone Pump Station. Water for this level is sourced from the Upper Blackstone Reservoir. As described above (Section 0), the distribution system in the Blackstone Development was not designed to provide conventional flow suppression and this plan does not include recommendations to improve the fire suppression capacity in this service level.

4.6.3 Pressure Reducing Valves

There is a wide range of elevations within the City's distribution network that need to be served by relatively few reservoirs and pump stations. Oftentimes the pressure that a facility delivers is excessively high for household plumbing for certain areas of the network. In this situation, PRVs are used to reduce pressure.

Based on conversations with City operators, the PRV stations have been in service for a relatively long time and are in need of repair and maintenance. These valves are typically mechanical and operate automatically. As a result, these valves tend to need regular repair, maintenance and, eventually, replacement. It is recommended that all of the PRVs within the City's system be replaced during the planning period as a result of their current condition. A summary of the City's PRVs are in Table 4-7.

Table 4-7| Pressure Reducing Valve (PRV) Summary Table

PRV Name	Approximate Location	Pressure Source	Elevation (ft. approx.)	Max. Water Surface Elevation at Source (ft)	Upstream Static Pressure (psi approx.)
Horizon Hill	Adjacent to Radar Road Pump Station	Horizon Hill Reservoir	180	556	163
Lower Radar Road	Adjacent to Radar Road Pump Station	Horizon Hill Reservoir	200	556	154
Upper Radar Road	Between Radar Road and Hanley Drive	Horizon Hill Reservoir	306	556	108
Hanley Drive	Hanley Drive Near Gimlet Lane	Middle Blackstone Reservoir	228	443	93
Blackstone	Adjacent to Middle Blackstone Pump Station	Upper Blackstone Reservoir	418	736	137

4.6.4 Water Meters

Based on City records of the roughly 959 water meters currently in service. 8 connections are hotels. The City has a good water meter management system. About 10 years ago, the City started replacing meters on an annual basis and now replaced all but about 25 of the older meters. Therefore, the vast majority of the meters in the City are less than 10 years old. For planning and management purposes, the typical life of a meter is about 20 years. Therefore, the meters that now 10 years old will eventually need to be replaced. Therefore, the City should plan to continue the existing meter management program indefinitely. As long as funding for this program is maintained, no changes to the program should be needed during the planning period.

The City's meters are mostly Sensus SR2 meters. Some have touch read sensors and some have radio read sensors. The City has recently started to convert the entire system to radio read sensors that can be read from a radio receiver mounted in a service truck that is driven around the City. Based on discussions with City staff, there has been some discussion about installing a radio network around the City to create a real-time meter reading system that can be used by the City for billing purposes and by the customers to view their water usage patterns. These types of systems are referred to as Advanced Meter Infrastructure or AMI systems. These systems are discussed in greater detail in Chapter 8.

4.7 SCADA & TELEMETRY SYSTEM

The Yachats water system has a central supervisory control & data acquisition (SCADA) system at the water treatment plant. Operators can monitor many aspects of the water system from this system. The system allows operators to monitor the status of components, such as reservoir levels, pump status, and water pressures. The system also allows operators to control certain components, such as change reservoir level set points and turn pumps on and off. The pump stations and reservoirs communicate with the SCADA using radio and telephone-based telemetry.

4.8 EXISTING WATER SYSTEM FUNDING MECHANISMS

Funding for the City's existing water system comes from several sources including user fees, property taxes, system development charges (SDCs), and an urban renewal district.

4.8.1 Water User Fees

User fees are monthly charges to all residences, businesses, and other users that are connected to the water system. User fees are established by the city council and are typically the sole source of revenue to finance operation and maintenance. The City's water user fee system is established by Resolution 2015-12-01. For most residential and commercial connections (i.e., ⅝ and ¾ inch meters), the City currently charges a flat fee of $48.24 that includes up to 200 cubic feet of water per month. An additional charge of $6.00 is assessed for each 100 cubic foot above the initial amount that is included in the base charge. The City does have some users with larger meters. These users are charged a special rate that is based on usage.

The anticipated revenue from water billings for the fiscal year 2020/2021 is budgeted to be approximately $585,000. Including other various charges and interest earnings, the total water fund revenues, for the 2020/2021 fiscal year are budgeted to be approximately $588,000. It should be noted that these budget amounts are less than the historic revenue from user rates. In the previous two fiscal years, the revenue from user rates was about $650,000 and $600,000. Due to the Covid 19 pandemic, the City anticipated less revenue for the 2020/2021 fiscal year.

The City's water fund must provide sufficient revenues to properly operate and maintain the water system and provide reserves for normally anticipated replacement of key system components such as pumps, motors, pump station control equipment, chemical feed equipment, fire hydrants and distribution piping repairs. Although the City relies exclusively on user fees for operation and maintenance costs, the water fund is typically not adequate to finance major capital improvements without outside funding sources.

4.8.2 Property Taxes

The City currently uses property tax revenue to service debt on a general obligation bond for the water system. The anticipated revenue from this source for the fiscal year 2020/2021 is budgeted to be approximately $40,000.

4.8.3 System Development Charges

A system development charge (SDC) is a fee collected by the City as each piece of property is developed. SDCs are used to finance necessary capital improvements and municipal services required by the development. SDCs can be used to recover the capital costs of infrastructure required as a result of the development, but cannot be used to finance either operation and maintenance, or replacement costs.

The SDC fee system was most recently revised by Resolution Number 2007-01-01. The City charges different SDC fees based on the size of the water meter installed at each property. The current fee structure is listed in Table 4-8. Over the last three fiscal years, the City has collected and average of about $50,000 in water system development charges.

Table 4-8 | Current Water SDC Fees

Meter Size	SDC Charge
¾ by ⅝ - Inch	$3,133
¾ - Inch	$4,700
1- Inch	$7,833
1 ½ - Inch	$15,665
2 – Inch	$25,064
3- Inch	$50,128
4- Inch	$78,325
6- Inch	$156,650

4.8.4 Urban Renewal District

The City collects revenues from an urban renewal district. Some of these funds are used to retire the debt associated with the construction of the South Tank Improvement Project. For the 2020/2021 fiscal year, the City planned to use approximately $40,000 of urban renewal funds to service this debt.

4.8.5 Annual Water System Costs

Annual operations and maintenance costs are recurring costs typically funded through user rates. The City's budget for 2020/2021 fiscal year includes various expenditures as listed below (Table 4-9). The total expenditures for the fiscal year are approximately $793,240.

Table 4-9 | Water Utility Fund Expenditures 2020/2021 Fiscal Year

Item	Budget
Personnel Services	$ 345,000
Materials and Services	$ 346,340
Capital Outlays	$ 5,000
Debt Service	$ 48,000
TOTAL EXPENDITURES	**$ 744,340**

4.8.6 Debt Service

The City currently has three outstanding loans (Table 4-10). As of June of 2020, the total outstanding principal owed is approximately $1,872,000 and the minimum debt service payments total approximately $126,600 per year.

Table 4-10 | Water Utility Existing Debt

Loan Description	Loan Amount	Term (years)	Payoff Date	Interest Rate	Annual Payment	Outstanding Principal (6/2020)
Water Revenue Bond	$512,000	15	2032	3.07%	±$42,850	$427,416
Water General Obligation Bond	$533,000	15	2032	3.0%	±$43,825	$439,091
South Tank Business Oregon Loan	$1,030,000	30	2049	1.0%	±$39,911	$1,005,500

4.8.7 Water Capital Reserve Fund

The City maintains a capital reserve fund used to make improvements to the water system. In recent years, the City has typically contributed an average of about $90,000 from user fees to this fund. At the end of the 2020/2021 fiscal year, the ending balance in this fund is anticipated to be about $325,000.

CHAPTER 5

PRESENT AND FUTURE WATER DEMANDS

Chapter Outline

PRESENT AND FUTURE WATER DEMANDS

CHAPTER 5

5.1 INTRODUCTION

A primary measure of the size of a municipal water system is the total amount of water that it delivers to consumers. This capacity is the sum of water required for domestic, commercial, and industrial uses, water that is lost out of the system through leakage, in addition to water required for fire protection.

Future water demands have been prepared based on a number of variables including the following:

- Population projections
- Historical water demand
- Seasonal occupancy
- Projected fire flows

The demand characteristics developed in this chapter will serve as the basis for evaluating the City's existing water system infrastructure and for sizing supply, treatment, storage, and distribution infrastructure across the planning period.

5.2 TERMS AND DEFINITIONS

5.2.1 System Demand

The following terms are used to describe system demand:

- *Consumption* – Consumptive demand is finished water delivered to the system's users through service connections. Consumption is generally less than demand, the difference being system loss and unmetered uses. Consumption is measured by the consumer's meter and is accordingly the metered portion of demand.
- *Demand* – The total amount of finished water entering the transmission/distribution system form the water treatment plant to meet various user needs (excludes raw water that has not passed through the WTP). Demand equals consumption plus system loss and is usually measured by system master meters.
- *Fire Flow Demand* – Demand required for firefighting purposes. Fire flow demands vary by structure type and use and are prescribed by the City and/or fire code. Fire flow demand is considered to be met if the system can deliver the required flow rate while maintaining a minimum residual pressure in the distribution system of 20 psi.
- *System Loss* – System loss is water that cannot be accounted for. It is the difference between the total system demand and the total consumption. System loss is not necessarily the same as leakage. Although the majority of system losses are typically the result of leaks, losses can also be attributed to meter error, as well as unmetered uses such as street flushing, hydrant testing, filter backwashing, and similar activities, or from bypasses, overflows, etc.

5.2.2 Demand Variations

Water demands in municipal water systems vary widely across time. Seasonal, monthly, daily and hourly demand rates are utilized to evaluate and size various components of the overall water system. For the purposes of this report, the following demand classifications will be used. The definitions are generally listed in order of increasing magnitude.

- *Average Day Demand (ADD)* – The total volume of water that enters the system over a period of one year, divided by 365 days.
- *Maximum Month Demand (MMD)* – The largest total volume of water that enters the system in a one-month period, divided by 30 days.
- *Peak Day Demand (PDD)* – The largest total volume of water that enters the system in a 24-hour period. PDD is commonly used to size water treatment plants, large diameter transmission mains and factors into the sizing of reservoirs.

5.3 POPULATION

Population projections serve as the basis for future wastewater flow and load projections. Much of the challenge in projecting system growth relates to the difficulty in accurately tracking or projecting actual populations. This is especially challenging in Yachats. As a tourist destination, The population in Yachats fluctuates on a seasonal basis and on a weekly basis. The population generally increases during the summer season with peaks occurring during weekends and holidays. As noted in the following subsection, the current population of Yachats is estimated to be about 760 residents. During peak holidays, the population is believed to greater than 2,000 residents. This fluctuation is significantly greater than a typical City. Therefore, traditional population estimates are of limited use and other means must be developed to track the service population in Yachats.

The population of Yachats consists of permanent residents, part time residents, and tourists. Permanent residents generally own homes in the City and reside in the City on a full-time basis. Part time residents own homes, but the homes are not occupied on a full-time basis. Tourists visit the City for short periods of time and occupy hotel rooms and vacation rentals.

5.3.1 Historical and Future Population

Historical population histories provide a tool for determining the future growth rate of the municipal water system in Yachats and were considered for this report. The population in Yachats's City Limits has steadily increased from approximately 441 people in 1970 to an estimated population of 760 in the year 2020. This trend is expected to continue during the planning period.

In June of 2017, population projections for Lincoln County were prepared by the Portland State University Population Research Center. These projections estimate the population of Yachats within the UGB to increase from 773 in 2017 to 1,061 in 2040. These projections are based on an average annual growth rate of 1.4% from 2020-2035 and 0.9% from 2035-2067. These projections will be used for planning purposes in order to conform to state-wide planning goals. As noted elsewhere in this document, the study period ends in 2041. Therefore, the 2040 population was extrapolated for one additional year for the preparation of this document. Adding an additional year of growth at a rate of 0.9% to the 2040 population of 1,061 results in a 2041 population of 1,070.

Table 5-1 | Historical and Projected Municipal Population

Year	Municipal Population
1970	441
1980	482
1990	533
2000	617
2010	690
2017	773
2020	797
2030	929
2040	1,061
2041	1,070

1- Data for 1970-2010 referenced from US Census data.
2- Underlined values for 2017-2040 referenced from PSU Population Research Center, Coordinated Population Forecast, 2017.

5.3.2 Seasonal Occupancy of Service Population

The City's water system demand is substantially influenced by the seasonal occupancy of the service population. Many connections served by the City are vacation homes or are utilized for tourism, such as hotels and vacation rentals of single or multifamily residences. As such, the service population fluctuates on a seasonal basis with more users during the summer months, weekends and holidays.

As previously described, peak water demand varies on an annual, monthly and daily basis. For Yachats, these demand variations are assumed to directly depend on the amount of occupancy of the service population. It is assumed that average day demand (i.e., ADD) corresponds with 70% occupancy. It is assumed that maximum month demand (i.e., MMD) corresponds with 80% occupancy. It is assumed that peak day demand (i.e., PDD) corresponds with 100% occupancy.

Table 5-2| Occupancy of Service Population by Demand Variation

Demand Variation	Occupancy of Total Service Population
Average Day Demand (ADD)	70%
Maximum Month Demand (MMD)	80%
Peak Day Demand (PDD)	100%

5.3.3 Current and Future Service Population

Water demand projections in this document are based on estimating the service population that is comprised of three different types of users. Users are categorized either as single family units, multifamily units, or hotel rooms. It is assumed that the relative amount of each of these types of users will stay constant throughout the planning period.

Therefore, each user type is assumed to grow at the same rate forecasted by PSU. Table 5-3 indicates the assumptions used to estimate the service population at full occupancy of each user type.

Table 5-3| Full Occupancy Rates by User Type

User Type	People per Connection
Single Family	1.8
Multifamily	1.8
Hotel Room	1.2

The total number of connections to the City's water system were determined from City records. The number of multifamily units was estimated. The number of hotels and their amount of rooms was determined. It is assumed that the number of single-family units is the number of total connections less the total of multifamily and hotel connections.

The current and future total service population is estimated in Table 5-4.

Table 5-4| Estimated Current and Future Users at Full Occupancy

	Units by User Type			Population by User Type			
Year	Single Family Units	Multifamily Units	Hotel Rooms	Single Family Population	Multifamily Population	Hotel Population	Total Service Population
2020	940	70	311	1,692	126	373	2,191
2025	1,008	75	334	1,815	135	400	2,350
2030	1,081	81	358	1,946	145	429	2,520
2035	1,160	86	384	2,087	155	460	2,703
2040	1,213	90	401	2,183	163	482	2,828
2041	1,224	91	405	2,203	164	486	2,853

5.4 HISTORICAL WATER DEMAND

City records of historical water production were evaluated to determine water demand, usage rates and demand fluctuations. Records from January 2017 through September 2020 were used as a basis to establish historical water demands. The information from this section combined with the population data & projections forms the basis for estimating future water demands as presented in Section 5.5.

5.4.1 Water Production Records

The City's water production is tracked using the flow meter at the water treatment plant. Figure 5-1 graphically illustrates the trends and variation in historical water production during different periods of the year. As would be expected, water production increases during the summer to meet increased demand, and decreases during the winter months.

During the peak summer months, the City produces water almost on a daily basis. However, during fall, winter, and spring months, the City will make water every other day or every third day as needed to replenish the water in the main storage tank. This decreases the overall workload for City staff, but the daily water production curve is significantly obscured by this practice, as depicted in Figure 5-1. The water treatment plant is operated manually based on water levels in the main storage reservoir. City staff monitor the water level in the main reservoir and manually start the water plant to fill the tank.

For this study, the average daily demand (ADD), the maximum monthly demand (MMD), and the peak day demand (PDD) were determined for planning purposes. Water demand varies across seasonal periods, days of the week, and hours of the day. The establishment of an average day demand rate serves as the baseline against which other more intensified demands are measured. Maximum monthly demand rates are useful for determining seasonal demand variations. Peak day demand values are conventionally utilized to size treatment plant capacity and factor into the sizing of reservoirs. Peak day demand is typically the most critical water demand scenario and is usually the standard by which system adequacy is measured.

As shown in Figure 5-1, water production is generally intermittent, with days of no water production followed by days of higher water production. The water production data can be analyzed on an annual or monthly basis to estimate demand variations, but the data cannot be used to determine peak day demands, because there are many days where the plant is operated for long periods of time to make water for more than one day. As such, the peak day demands shown below were estimated based on an assumed water use rate of the service population during full occupancy (100 gallons per capita per day). Municipal water consumption typically averages about 100 gallons per person per day. This value is regularly observed in many municipal water systems in the region. This estimate compared well to data and information provided by the City on relatively high-water demand events, including historical peak week water demands during the summer and water plant operator observations. During the years 2017 through 2020, the City consistently produced the most amount of water per week during the 27th week of the year. This is the week of July 4th, which is historically a busy time for seasonal occupancy.

The current average day and maximum month demands are listed in Table 5-6. The last column in Table 5-6 lists the existing demand per connection in the system. These values are slightly lower in Yachats than for most municipal systems. As previously described, municipal water consumption typically averages about 100 gallons per person per day. Typical household sizes or the number of people per connection typically ranges between 2.2 and 2.8. As such, average water demands per connection should be between 200 and 300 gallons per day. In Yachats, this value is 137 gallons per day (Table 5-6). This discrepancy is likely due to the fact that there are many homes in Yachats that are not occupied on a full-time basis. This is common for coastal communities where second homes are common and many residents are older with smaller family sizes. These historical use rates inform water use rates used for projecting demand. For the purposes of projecting demand variations in this report, per capita use rates were assumed as indicated in the following table.

Table 5-5| Per Capita Water Use Rates for Demand Projections

Demand Variation	Water Use Rate (gallons per capita per day)
Average Day Demand (ADD)	90
Maximum Month Demand (MMD)	100
Peak Day Demand (PDD)	100

The authors of this report are currently working on a planning document for the City's wastewater utility. The wastewater data shows that the average occupancy rate in Yachats is about 70%. The average daily demand of 170 gallons per connection per day roughly corresponds to this same occupancy rate.

Figure 5-1| Historical Water Production

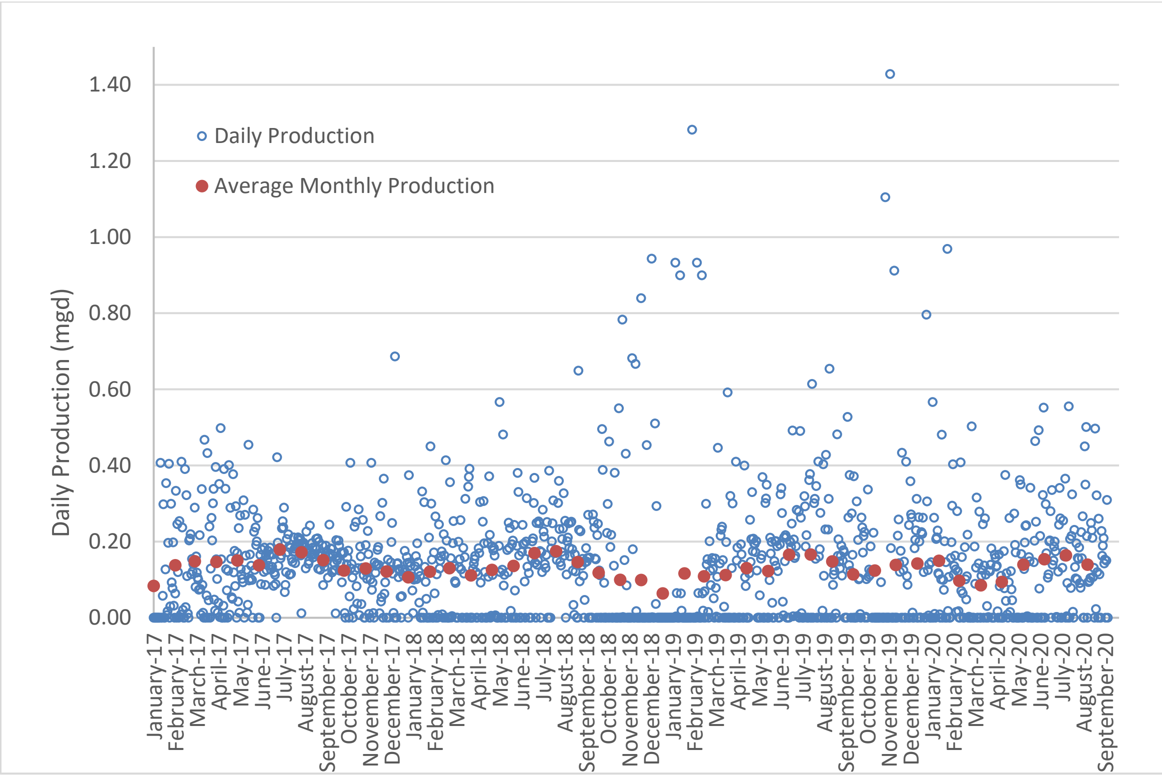


Table 5-6| Existing Water System Demands

Demand	Gallons Per Day	Gallons Per Connection Per Day[1]
Average Day	132,000	137
Maximum Month	169,000	177
Peak Week	192,000	200
Peak Day	220,000[2]	228

1 Based on 959 connections
2 Estimated to be 100 gallons per capita per day for the service population at 100% occupancy, 2,191 people (see Table 5-4).

5.4.2 Water Loss

Water loss or unaccounted-for water is comprised of the difference between the finished water produced at the treatment plant and the water consumed, and consists of all unmetered uses and system leakage. It is important to differentiate these two categories of water loss.

Unmetered use is commonly the result of incomplete or inaccurate metering of consumer demand, including the following typical categories.

- Unmetered or unauthorized connections
- Inaccurate or unrecorded flows for hydrant and main flushing
- Unmetered water for construction activities

- Unmetered water for operations & maintenance uses (street cleaning)
- Unmetered water for fire fighting
- Reservoir overflows
- Data collection errors including faulty meters (non-registering or under-registering)

System leakage, as the name implies, is water lost due to deteriorating pipe, compromised pipe joints, service connections, valves, etc. With proper record keeping and metering of water, the percentage of unaccounted-for water approaches the net volume lost to actual leakage. Conventionally acceptable rates of water loss range between 10% and 15%, although water loss for many small Oregon municipalities can be as high as 20%.

OAR 690-086-0150(4)(a) requires municipalities to conduct annual water loss audits. The City has compiled monthly data for 2018, 2019, and 2020. However, in some months the available data was either incomplete or potentially invalid. For example, in some months, the amount of water sold exceeded the amount of water produced, which would result in a negative amount of water loss. The reason for these errors is unknown and should be investigated early in the planning period. Two annual programs are recommended as a part of this plan to better determine and reduce water loss in Yachats. These programs are described in more detail in 8.4.1.

Based on the available data, the average annual water loss for the Yachats distribution system is estimated to be between 11% and 16% (Table 5-7). Reducing water loss below 15% and maintaining water loss below this amount are important goals for the City. As explained in Chapter 6, this plan recommends the construction of a new intake on the Yachats River. Based on the City's Yachats River water right and another related settlement (see section 4.1.5), the City must have system losses below 15% in order to use water from the Yachats River. Water loss below 15% is a reasonable and attainable goal. Better data management practices may show that water loss in the City is already less than 15%. If the previously mentioned programs are consistently implemented, it is expected that the City should be able to reduce and maintain water loss below 15%.

Table 5-7| Annual Water Loss Data

Year	Total Water Sold (Million Gallons) (1)	Total Water Produced (Million Gallons) (1)	Unaccounted for Water, All Data (%) (2)	Unaccounted for Water, Excluding Invalid Months (%) (3)
2018	43,575,128	47,045,400	8%	16%
2019	32,561,092	40,057,500	18%	21%
2020	39,922,986	42,468,300	6%	13%
Average	-	-	11%	16%

1- Values include all available monthly data.
2- Values calculated based on all available monthly data.
3- Values calculated by omitting months where consumption exceeded water sold or values were incomplete.

5.5 PROJECTED WATER DEMAND

This section builds on the discussions of population projections in Section 5.3 and the discussion of historical water demand as presented in Section 5.4. The basis for projecting future water demands is based in the establishment of a historical demand baseline. The growth projections of Section 5.3 will be combined with historical usage rates to forecast future water demands.

Projected water demands are based on the following assumptions:

- Future occupancy rates will remain approximately equal to the existing occupancy rates. As explained above, average water demands in Yachats are lower than would be expected in a typical municipal system. This is due largely to the high number of second homes and older residents with small family sizes. If future occupancy rates increase, the City may want to consider re-evaluating the demand projections presented in this plan.
- The ratio of residential to non-residential use (commercial, industrial and public uses) will remain constant. In other words, future commercial and industrial developments will track population growth.
- Long-term per capita water demands will not exceed the City's historical averages. Since the efficacy of planned water conservation programs is unknown at this time, the water demand projections of this report exclude conservation. The future success of the City's water conservation policies will serve to further increase the margins of safety used to plan and design the water system infrastructure.
- New commercial and industrial developments will not be large water users; no provision has been made for new industries with heavy water demands such as food processing or beverage production.
- The growth projections of Section 5.3 are reasonable estimates of future municipal populations and the ratio between peak month and peak day demands to average day demands will remain relatively constant during the planning period.
- Future water loss will not exceed the City's historical averages.

5.5.1 Projected Water Demand Summary

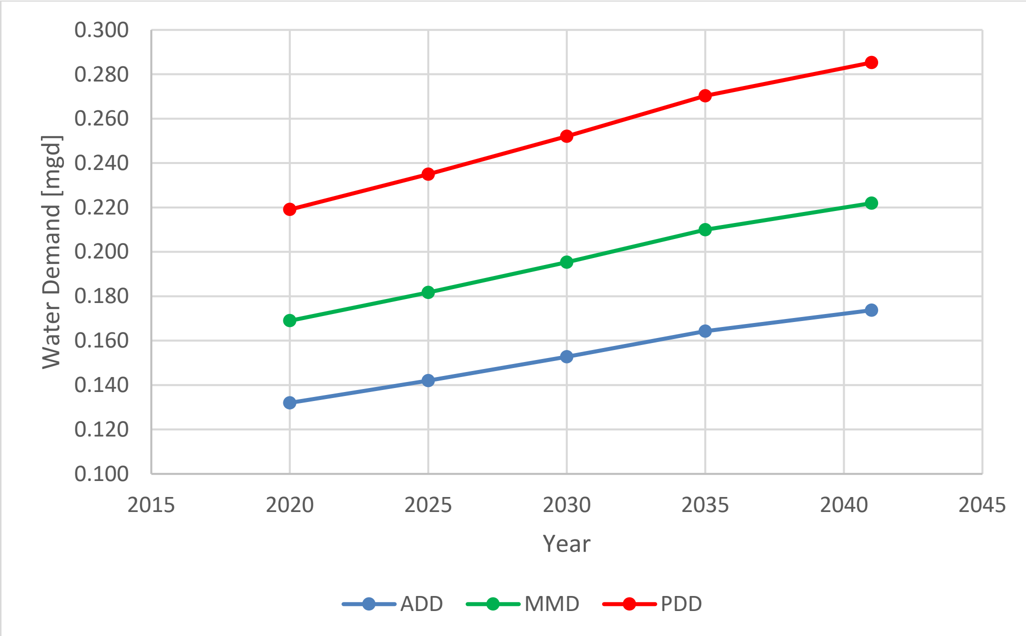
Projected water demand variations for the service population are calculated by multiplying the total service population in a given year (Table 5-4) by the corresponding unit demand per capita (Table 5-5) and the occupancy rate (Table 5-2). These results are summarized in Table 5-8 and illustrated in Figure 5-2 below.

Peak day demands have special significance because they can put stress on the water supply capabilities of the system. The water sources should be able to supply the entire water demand during the peak day of the year in addition to any required fire flows.

Table 5-8| Summary of Projected Water Demands

Year	2020	2025	2030	2035	2041
Total Service Population	2,191	2,350	2,520	2,703	2,853
Average Day Demand (ADD)					
mgd	0.132	0.142	0.153	0.164	0.174
gpm	92	99	106	114	121
Max. Month Demand (MMD)					
mgd	0.169	0.182	0.195	0.210	0.222
gpm	117	126	136	146	154
Peak Day Demand (PDD)					
mgd	0.219	0.235	0.252	0.270	0.285
gpm	152	163	175	188	198

Figure 5-2| Projected Water Demands



5.6 FIRE FLOW

The water distribution system is a community's primary resource for fighting fires. Storage reservoirs and fire hydrants must be suitably sized and configured to reliably deliver the required fire flows to all areas within the city limits. Oregon Fire Code (OFC) provides guidelines to determine fire flows for various structures. Depending on the type of building construction and the size of the building, fire flow requirements can vary between a minimum of 1,000 gallons per minute (gpm) for a duration of one hour to 8,000 gallons per minute for a duration of four hours. The OFC also allows a 50% reduction in the fire flow requirement for buildings that are equipped with an automatic sprinkler system.

Yachats's water distribution system cannot deliver fire flows of 4,000 gpm or more without major upgrades. Even if these upgrades were made, it is unlikely that a developer would choose to site a structure requiring a fire flow of 4,000 gpm in Yachats as local market conditions favor smaller structures. For example, available fire flow of 4,000 gpm would allow construction of an approximately 130,000 square foot building that was constructed of fire-resistant materials. The fire flow requirement could be decreased by 50% if the structure was constructed with an automatic sprinkler system. This is a very large building, similar in size to a large retail facility like a Walmart or Fred Meyer. It is unlikely that a developer would seek to site a building of this nature in Yachats. As such, more modest fire flow goals are appropriate in Yachats. The sizing criteria used for this master plan are summarized below (Table 5-9). These criteria are considered reasonable for a small coastal community like Yachats and will allow the construction of a wide range of possible structures. For larger structures, automatic fire sprinkler systems will be required. However, automatic fire sprinkler systems are fairly common and are not likely to be a significant limiting factor for development of structures requiring them.

Table 5-9| Minimum Fire Flow Requirements

Location	Recommended Fire Flow (gpm)	Duration (hours)	Required Volume (gallons)
Residential Areas	1,000	2	120,000
Commercial/Industrial Areas	2,000	4	480,000

These fire flow values are for planning purposes only, and are not site or building specific. These values do not supersede or take the place of Oregon Fire Code (OFC) or building code fire flow requirements. Higher values may be necessary based on OFC, Fire Marshall or ISO requirements. Reductions may be allowed by the Fire Chief for buildings with fire sprinkler systems.

It should be noted that these minimum recommendations do not supersede fire flows required by the Oregon Fire Code or building codes.

Lastly, in addition to the required flow rates presented above, OAR 333-061-0025 requires that a minimum pressure of 20 psi be maintained in the distribution system at all times, inclusive of fire flow events. Evaluations of the distribution system (existing and future) to deliver the adopted fire flows are presented in Chapter 8 of this report.

CHAPTER 6

WATER SUPPLY EVALUATION

Chapter Outline

WATER SUPPLY EVALUATION

CHAPTER 6

This chapter builds on the inventory of the City's water supply infrastructure as presented in Chapter 4. It discusses the City's water sources, presents the regulatory framework for water rights, and details the water rights secured by the City to-date. It concludes with improvement recommendations to strengthen the City's water rights position and improve the overall water supplies for the City. An evaluation of water treatment facilities is included in Chapter 7.

6.1 EVALUATION CRITERIA

Factors used to evaluate the suitability of existing and planned water supplies include reliability, resiliency, and vulnerability. A short explanation of each of these evaluation criteria is presented below. The parameters presented in this section will be utilized in the analysis and recommendations of this chapter.

6.1.1 Water Rights

As previously noted, in Oregon, all water is publicly owned. The Oregon Water Resources Department (OWRD) regulates the use of both surface and groundwater throughout the state. Over the years as greater demands have been placed on limited water resources, OWRD has exercised increasing control over water use. A water right will not guarantee water for the appropriator. Under the prior appropriation doctrine, a water right authorizes diversions of water only to the extent water is available and does not impact a more senior water right. Water rights establish a hierarchy utilized by OWRD to adjudicate water in times of water shortages. Failure to comply with the requirements and conditions of the City's water rights permits and certificates may result in the restriction or loss of the affected water source. Accordingly, it is paramount that the City secure and maintain suitable water rights to meet long term municipal needs. The recommendations presented in this chapter are based on establishing a strong water rights position for an extended period of time.

6.1.2 Reliability and Resiliency of Water Sources

Interruptions to water production can occur due to problems with raw water quality. Contamination of surface water may be the result of a commercial or industrial accidents, forestry practices, and natural disasters. Changes in water quality can jeopardize water production and in the absence of suitable water treatment may require the WTP to be temporarily shut down.

Interruptions to water production can also occur due to a failure of the equipment used to deliver water from the raw water sources to the WTP.

The following standards are recommended to ensure a high level of reliability for the water system as a whole:

- Two or more sources of water supply should be developed with a total capacity to replenish depleted fire suppression storage within a 72-hour period while concurrently supplying PDD.
- When the largest single source is out of service, the remaining sources should be able to satisfy ADD (capacity with the largest single source out of service is referred to as firm capacity). Outages or maintenance periods caused by equipment failures may last from several days to several weeks. The remaining sources in the system should have the capacity to provide ADD. In the event of an extended outage, it is not uncommon to assume that a public notification process will be utilized to encourage or require water conservation.

6.2 WATER SOURCE EVALUATION

The City currently utilizes surface water diverted from Reedy and Salmon Creeks as its sole source of municipal water. The City has water rights to the Yachats River and Cape Creek, but these sources are not currently utilized by the City. The City also has an intertie with the Southwest Lincoln County Peoples Utility District that can be used as a water source on an emergency basis.

A detailed summary of these sources is presented in Chapter 4.

6.2.1 Water Rights Evaluation

Table 4-1 lists the permitted/certificated flow rates from each of the City's water sources. The City has active certificated water rights totaling 898 gpm (Reedy Creek) and permitted water rights totaling 1,795 gpm (Salmon Creek and Yachats River). In addition to these active certificated and permitted water rights, the City also has a non-active certificated water right of 220 gpm for Cape Creek. The City's total water right holding (sum of active certificates, permits, and non-active certificates) is 2,893 gpm for all available sources. This is far higher than the City's peak day demand. However, the rates of diversion allowed on paper are different than the rates at which the City can actually divert water. The City appears to have access to sufficient water under its water rights, but streamflows are less than the authorized rate of diversions during the summer months when the City needs to maximize its use of water rights

At the present time, the City currently obtains all drinking water from Reedy Creek and Salmon Creek. During the summer months, the combined flow from these sources can drop to as low as 180 gpm. The projected peak day demand at the end of the planning period is approximately 200 gallons per minute (Table 5-8). In order to replenish fire flow storage in a 72 hour period, an additional 110 gpm is required (Table 5-9). Therefore, the total water production required to meet projected peak day demands while simultaneously replenishing fire flow storage is approximately 310 gpm. During the winter months, the City can produce water at this rate. However, during dry weather conditions at the end of the summer when the combined flow from Reedy and Salmon Creek drop below 200 gpm, the City will be unable to meet production needs with the existing supply sources. For this reason, the City should plan to develop the upper Yachats River diversion during the planning period. This would provide an additional 224 gpm of supply for a total reliable water supply of about 400 gpm. This is significantly higher than the 310 gpm that is required to meet peak day demands while simultaneously replenishing fire flow storage.

Overall, the City's water rights are sufficient for the planning period, but additional development work (i.e., infrastructure construction) is needed to ensure a reliable water supply.

6.2.2 Water Supply Reliability

The City currently provides all municipal water from Salmon Creek and Reedy Creek. During wet weather months, the flows in either stream are sufficient to meet the City's needs. Therefore, the City has fairly good redundancy during the wet weather months During dry weather conditions in the late summer and early fall, the City would be unable to meet demands with just one of the two sources. This is somewhat problematic. If a problem with either source was to occur during the dry weather conditions, the City would be unable to meet demands. Fortunately, the City has an intertie with the Southwest Lincoln County Water PUD (SWLCWPUD) that could be used under this scenario. Therefore, the intertie with the SWLCWPUD provides a redundant supply that improves the overall reliability of the system.

Two criteria for evaluating source reliability were introduced in Section 6.1.2, and each are addressed in this subsection.

<u>Source Reliability Criterion #1</u>
Two or more sources of water supply should be developed with a total capacity to replenish depleted fire suppression storage within a 72-hour period while concurrently supplying PDD.

As described above (section 6.1.1), the combined flow from Reedy and Salmon Creeks can drop below 200 gpm during dry weather conditions. The peak day demand at the end of the planning period is estimated to be about 200 gpm and the flow required to replenish fire suppression storage is about 110 gpm. Therefore, the total water supply need is about 310 gpm under this evaluation criteria. The City's existing system is not sufficient to meet this need without relying on the intertie with the SWLCWPUD. For this reason, this plan recommends constructing a new intake and pipeline to convey water from the upper Yachats River point of diversion to the treatment plant. Initially, this facility should be sized to divert 0.5 cfs or 224 gpm. Once completed, the City will have three sources that are capable of reliably producing a minimum of about 400 gpm even during the driest periods of the year.

<u>Source Reliability Criterion 2:</u>
When the largest single source is out of service, the remaining sources should be able to satisfy ADD (capacity with the largest single source out of service is referred to as firm capacity).

The largest single source of water is Reedy Creek. During the driest times of year, flows in Reedy Creek drop to as low as 120 gpm. During similar conditions flows in Salmon Creek can drop to as low as 60 gpm. Therefore, without Reedy Creek, the City would only be able to produce 60 gpm during dry weather conditions. This is significantly less than the average daily demand (ADD) at the end of the planning period which is about 120 gpm (Table 5-8). Therefore, the existing system is not capable of satisfying this criteria. As noted previously, this plan recommends the construction of a new water supply source from the Yachats River. This source should be able to supply a minimum flow of 224 gpm during dry weather conditions. Once constructed, the Yachats River intake will be the largest single source for the purposes of this evaluation criteria. During times when the Yachats River intake is unavailable due to mechanical issues or something similar, the City should still have Reedy Creek and Salmon Creek available with a reliable water supply of at least 180 gpm. Since this flow is greater than the ADD at the end of the planning period (i.e., 120 gpm), this evaluation criteria is satisfied by the construction of the Yachats River Intake.

6.2.3 Potential Future Water Sources

The appropriate planning horizon for water rights acquisition and water supply planning is much longer than the 20 year planning period used for most other elements of this plan. This is due to the fact that most of the surface water resources in the vicinity of Yachats are already maximized and new water rights are not likely to be available. The previous subsection shows that once the Yachats River diversion is constructed, the City's existing water supplies should be sufficient to meet the City's needs for many years. In fact, unless there are significant changes to the City's UGB or occupancy patterns, the additional water provided by the Yachats River diversion may be sufficient for the complete buildout of the UGB. That said, it is always wise for municipalities to be diligent about pursuing additional water supplies. Some available options are discussed below.

6.2.3.1 Ground Water

Groundwater resources on the Oregon Coast are poor due to the local geology. This leaves surface water as the only feasible option.

6.2.3.2 Cape Creek

The City has a certificate for 0.49 cfs of water from Cape Creek. However, as explained in Chapter 4 (subsection 4.1.4), no infrastructure exists to convey water from this source to the City and the flow measured in the summer of 2020 was 0.39 cfs. Based on this measurement, flows are anticipated to be too low in the summer to justify the infrastructure investment needed to develop this source. For these reasons, Cape Creek is not considered a viable long-term source for the City.

6.2.3.3 Raw Water Storage Reservoir

A potential long-term water supply option would be to construct a raw water storage reservoir to store water during the winter months for use during the summer months. Ample surface water is available during the winter months. This water can be used to fill storage reservoirs. During the summer months, the stored water can be released into the stream and removed at a downstream location or the stored water can be used directly as a raw water source. This approach is relatively common. For example, the City of Newport uses two storage reservoirs on Big Creek for this purpose. Similar facilities are used by the cities of Seaside, Carlton, McMinnville, and Portland. To provide the required storage volume a relatively large impoundment would need to be constructed. Impoundments of this nature are typically made by constructing a dam. Though not impossible, dam construction in the current regulatory climate is challenging. A dam construction project must include mitigation for all wetland impacts as well as all impacts to aquatic species habitat. For example, if a dam is constructed without fish passage facilities, the project must also include mitigation to compensate for the stream reach that is made unavailable to aquatic species. The options for mitigation are limited and can be extremely costly. The specific mitigation requirements are determined through a negotiation with the resource agencies. Therefore, a significant amount of work is required to even quantify the costs of the mitigation efforts. That said, the costs for mitigation are likely to exceed the costs for the dam construction itself. Environmental permitting is just one of many challenges associated with a dam construction project. Other issues include finding a site where the topography is suitable, purchasing the land, and determining if the subsurface conditions at the site are suitable for dam construction. Finally, algae and other plant growth in the stagnant water within the impoundment can create taste and odor problems that require additional treatment beyond filtering. For example, the City of Newport utilizes water from impoundments, filters the water using membrane filtration technology, then runs the filtered water through carbon filters that remove objectionable taste and odor chemicals. Carbon filtration adds another unit process to the treatment facilities, increasing treatment cost and complexity.

The City owns a parcel of land on the south side of the Yachats River near the treatment plant. There have been discussions about using this land for a modestly-sized, off-channel, storage pond. The City could fill this pond during the winter months and use the water during low flow conditions. This is a slightly different facility than a storage reservoir of the type described in the previous paragraph. A storage pond at this site would be significantly smaller than a storage reservoir and would only serve as a supplemental source to meet demands during short-duration (i.e., 1-2 week) critical low-flow periods. This is always an option for the City and is something the City should keep in reserve. However, the stored water will likely have taste and odor issues as discussed above. Therefore, improvements to the treatment plant would be needed to use water from this pond.

6.2.3.4 Water Rights Purchases

Another option for obtaining water rights is to purchase them from water rights holders in the vicinity. The City could research surface water rights held on Beamer Creek, the Yachats River, and other nearby tributaries to determine the location of existing diversions and holders of existing water rights. It could then identify appropriate and available water rights, and approach the holders of those rights to discuss the potential purchase.

Once the City reaches an agreement to purchase water rights, the appropriate paperwork can be prepared, such as changing ownership of the water right to the City and submitting a transfer application to change the type of beneficial use to municipal and the point of diversion to the City’s intake. It will be easier to obtain water rights upstream from the City's intake so that downstream-water users cannot claim the additional removal of water "causes damage" to their water right. Also is it important to note that character of the beneficial use (e.g., irrigation, municipal, etc.) can only be changed for certificated water rights.

Some communities have chosen to purchase entire pieces of property for the sole purpose of obtaining a water right allotted to the property. Once the water provider owns the property, they are able to put the water right under their name, change the point of diversion to their intake, and resell the property if desired.

A review of the water rights in the Yachats River basin shows that the opportunity for purchasing water rights is somewhat limited. A cursory review of the existing water rights in the watershed shows that there are two water rights that pre-date the instream water rights. These are for 0.21 cfs and 0.13 cfs. These are relatively small, but would improve the City's water rights position if they could be obtained for a reasonable cost.

This approach will only benefit the City if the City has constructed in the Yachats River intake as recommended later in this plan. None of the upstream water rights in the area can be accessed using the City's existing intakes on Salmon and Reedy Creek. Only an intake on the Yachats River will support this approach.

6.2.3.5 Regional Water System

Another potential long-term water supply strategy is to pool the resources of the various communities in the mid-coast area by creating a regional water supply district. The water distribution systems from Newport in the north to Yachats in the south are almost entirely interconnected. One key missing section is crossing of the Highway 101 Bridge over the Alsea River. If this section were to be installed along with some other pumping and piping improvements, it would become possible to convey water from Newport to Yachats and vice versa. All of the communities in this area (e.g., Newport, Seal Rock, Waldport, Southwest Lincoln County PUD, Yachats, etc.) have individual water supply challenges. However, if these communities were to be combined into a single water district, the various water rights holdings could potentially be leveraged in a way that provides a net benefit to all the communities. The analysis of a regional water district is beyond the scope of this study, but if this concept gains popularity in the coming years, the City should encourage efforts to study the issue and provide funding assistance as appropriate.

In recent years, the City has participated in the Mid-Coast Water Planning Partnership which is a joint effort by the various mid-coast communities to develop a regional approach to addressing water supply issues. The City should continue to take part and contribute to this partnership.

6.2.3.6 Increase Reliance on SWLCWPUD

The City has an emergency intertie with the Southwest Lincoln County Water PUD (SWLCWPUD). The City operates the intertie under an agreement with the SWLCWPUD. The City could not locate the agreement for this planning effort, but the authors of this plan understand the agreement stipulates that the intertie is only for emergency use. Therefore, under the current agreement, the intertie cannot be considered a viable long-term source that the City can use to meet increased demands associated with growth. In the coming years, the City should consider approaching the SWLCPUD about changing the use agreement. The goal would be to engage in discussions with the SWLCPUD about what it would take for the SWLCWPUD to consider the City a "customer" of the SWLCWPUD rather than an "emergency user." This will require the negotiation of a new agreement between the two parties and will likely require a significant financial contribution from the City to the SWLCWPUD in addition to normal water user fees. It is very likely that the SWLCWPUD will require the City to fund major infrastructure improvements in order to increase the water production capacity of the SWLCWPUD's system. The costs for this cannot be estimated at the present time because there are too many unknowns. However, it is possible that the costs will be comparable to the costs for the Yachats River Intake recommended in this plan. Negotiations with SWLCWPU are beyond the scope of this master plan and it is unknown if the SWCLWPUD would even be willing to entertain the idea. However, in the coming years, the City should consider engaging the SWLCWPUD to determine if this option has the potential to be a viable water source. It is possible that once the details of the use agreement are identified, this option may be a better choice for the City than developing the Yachats River. For this reason, this plan recommends that the City enter into discussions with the SWLCWPUD as soon as possible (see Project S-3) below.

6.2.3.7 Desalination

Desalination of seawater or brackish water is used throughout the world to provide municipal drinking water. Desalination minimizes problems with water rights and is a drought-proof water supply strategy. Desalination plants utilize various treatment technologies to remove salt from water. Common examples include distillation and reverse osmosis. The drawback of desalination is the high capital construction costs and high operation and maintenance costs. There are currently no desalination plants in Oregon. There are some small systems in Washington in the Puget Sound area where surface water supplies are limited. There are several larger systems in California. In response to recent drought conditions, the State of California has recently provided financial assistance to various communities to study the feasibility and construct desalination plants. For this master planning effort, desalination was not formally evaluated. Desalination is not considered a cost-effective option for the City during the current planning period. However, beyond the current planning period, this may change. As more desalination plants are constructed, the water supply industry in the United States will gain experience with the process. This combined with future technological advances may one day make desalination an attractive option for the City.

6.2.4 Recommended 20-Year Water Supply Strategy

Based on the previous discussions, Reedy Creek and Salmon Creek should continue to be sufficient to meet demands outside of the summer months, but will be insufficient to meet demands in the summer months as the City's population continues to grow during the 20-year planning period. Therefore, the City will need to develop additional water supplies. The two best options include, developing the upper Yachats River diversion, and increasing reliance on the Southwest Lincoln County Water PUD (SWLCWPUD). The City's current agreement with the SWLCWPUD is only for emergency use. Therefore, a new agreement must be negotiated in order for the City to use the water on a routine basis. Since the conditions of such an agreement are not known, it is not possible to quantify the costs at this time. Therefore, a cost comparison between the SWLCWPUD option and the Yachats River option cannot be made. As such, this plan recommends that the City plan to develop the upper Yachats River diversion during the planning period. But, before proceeding with this work, the City should enter into discussions with the SWLCWPUD to determine the costs and conditions required to purchase water on a routine basis. This information should be used to compare the SWLCWPUD option with the Yachats River option to determine which is the best long-term solution for the City. If this analysis shows that the SWLCWPUD option is the better choice for the City, then this master plan should be amended to reflect that change.

6.3 RECOMMENDED IMPROVEMENTS

6.3.1 Water Loss Reduction

Although a water loss ratio of zero is desirable in theory, it is probably not feasible given the complexity and practical realities associated with municipal distribution systems. A typical and reasonable water loss goal for small municipalities is a 10% to 15% loss rate.

As discussed in Section 5.4.2, the water loss experienced by the City's distribution system is likely to be between 11% and 16%. This is relatively good, but can be improved. In fact, in order to use water from the Yachats River as recommended in this plan, the City must maintain water loss below 15% (see section 4.1.5). This will require a proactive maintenance and monitoring effort as well as improvements to older sections of the distribution system. Recommendations for distribution system improvements that will reduce water loss are included in Chapter 8.

6.3.2 Recommended Water Rights Actions

Recommended actions to strengthen the City's water rights position are described in the following paragraphs. These recommendations are general goals and the City will need to work carefully with a water rights examiner to fine tune these recommendations.

- **Permit number S-29018 Extension Application (Project S-1**)

The permit for Salmon Creek has not been certificated and the development deadline has expired. The City should immediately begin work to apply for an extension of the development deadline for this water right. This task should be given a highest priority of any of the projected listed in this report. The City will need to work with qualified consultants to prepare and submit the applications. A total budget of $15,000 is recommended for this work.

- **Yachats River Development Planning Work (Project S-2)**

Prior to developing water under the City permit for the Yachats River, a significant planning effort will be needed to address regulatory issues and acquire the land or an easement for the new intake. The upper Yachats point of diversion is believed to be located on land owned by the Siuslaw National Forest. The City should anticipate a complex work effort to obtain an easement from the USDA Forest Service that will be needed for the project. In addition to easement acquisition, the City should also anticipate a complex work effort to obtain the required regulatory approvals to develop the water right.

The City entered into an agreement with the Oregon Water Resources Department regarding use of water from the Yachats River. This agreement requires the City to demonstrate compliance with several stipulations prior to accessing water from the Yachats River. These include the following.

- The City must demonstrate that water loses are below 15%.
- The City must prepare demand projections based on the 85% efficiency and upon the best practicable estimate of population and occupancy figures and seasonal average water use.
- The City must provide a schedule for water audits (likely annual).
- The City must demonstrate cooperation in efforts to develop a regional water supply.
- The City must prepare an analysis of the land-use approval process required to develop a Yachats River point of diversion and a discussion of how and when the City intends to comply with those land-use processes.
- The City must prepare an analysis of the feasibility of other water sources and a timeline for when the City will abandon nonviable sources or seek to transfer those sources to instream rights.
- The City must develop a curtailment plan with triggers for curtailment based on stream flows
- The City must maintain a current Water Management and Conservation Plan.

Some of the requirements listed above will be satisfied by the City's water management and conservation plan (WMCP). However, it is likely that the City will need to retain the services of a team of consultants including a water rights consultant to provide the analysis and documentation required to show compliance with the requirements that are not addressed in the WMCP. A total budget of $50,000 is recommended for the easement acquisition and regulatory compliance work that will be required prior to developing the Yachats River water right.

6.3.3 Recommended Water Supply Improvements

Recommended improvements to improve the City's water supply infrastructure follow.

- **Evaluate Using SWLCWPUD as a Long-Term Source (Project S-3)**

A potential alternative to the Yachats River is to purchase water from the Southwest Lincoln County Water PUD (SWLCWPUD or PUD) on a routine basis. The City's current agreement with the SWLCWPUD is for emergency use only. Therefore, the City cannot currently consider the PUD as a viable, long-term, water supply source. However, it may be possible to renegotiate the agreement to allow daily usage as needed by the City. The goal would be for the City to be considered a regular customer of the PUD. As described above (Section 6.2.3.6), it is likely that the PUD will require the City to fund major capital improvements to the PUD's system as a condition of a new agreement. The purpose of this project is to identify these costs and evaluate them against the costs of the Yachats River option to determine which option is the best long-term source for the City. The exact details of the work effort are difficult identify at this time. A negotiation between the two parties will be needed. This will likely be performed by City staff with assistance from a consulting team. Once the details of the new agreement are identified, a formal evaluation can be performed to compare the PUD option against the Yachats River option. If the PUD option is determined to be a better long-term choice for the City, this master plan can be amended accordingly. The amendments will likely include dropping projects S-2 (see above) and S4 (see below) in favor of a new project related to the PUD. The City will likely need the assistance of the City's engineer of record and legal council at a minimum. Other consultants may also be needed. The recommended budget for this work is $75,000. To some degree, this value is a "placeholder" and the actual costs of this effort may be substantially different depending on how the work proceeds.

- **Yachats River Intake and Raw Water Pipeline (Project S-4)**

This project includes the actual design and construction of the intake structure and the pipeline to convey water from the upper Yachats River point of diversion to the City's raw water transmission pipeline. This project will include the construction of a new intake structure in the River which will require in-water work and the associated permitting. The intake should consist of a fish screen in accordance with ODFW requirements and pumping equipment. The project should include a new 8-inch HDPE pipeline along Yachats River Road that will connect to the existing pipeline from Reedy Creek. The total estimated pipeline length is approximately 9,600 feet. The total recommended budget for this project is $2,893,000. A detailed breakdown of this budget is included in Appendix B. Once this project is completed, the City's reliable water supplies will be increased to not only serve the City through the current planning period ending in 2041 but well into, and possibly through, the next planning period ending in 2061. Ultimately, this will depend on future growth rates in the City.

- **Reedy Creek Raw Water Pipeline Improvements (Project S-5)**

This project is proposed to replace an aging pipeline that was constructed in 1945 and will likely reach the end of its useful life during the planning period. This is the section of pipe from the Reedy Creek diversion to Yachats River Road. It is anticipated that the pipeline will be constructed in the existing gravel road that is used to access the Reedy Creek intake. The section pipeline in Yachats River Road to the treatment plant has recently been replaced with HDPE pipe, so this section is in good condition and should serve the City well for the remainder of the planning period and beyond. The total estimated budget for this project is $208,000. A detailed breakdown of this budget is included in Appendix B.

6.3.4 Water Source Recommendations Summary Table

The following table is a brief summary of the various water source improvement recommendations developed in this Chapter. For more details on particular projects, refer to the above discussions. These projects are assigned a priority ranking in Chapter 12.

Table 6-1| Recommended Water Supply Improvements & Projects

Project Code	Project	Recommended Budget
S-1	Permit S-29018 Partial Perfection and Extension Application	$15,000
S-2	Yachats River Water Rights Planning Work	$50,000
S-3	Evaluate Using SWLCWPUD as a Long-Term Source	$75,000
S-4	Yachats River Intake and Raw Water Pipeline	$2,893,000
S-5	Reedy Creek Raw Water Pipeline Improvements	$208,000

CITY OF YACHATS
Water System Master Plan
Yachats, Oregon

CHAPTER 7

WATER TREATMENT EVALUATION

Chapter Outline

WATER TREATMENT EVALUATION

7.1 INTRODUCTION AND GENERAL EVALUATION CRITERIA

This chapter develops and evaluates alternatives to adequately meet the City's water treatment system needs. The alternatives discussed in the following sections were developed by considering the population projections and drinking water demands, the condition and performance of the existing facilities, regulatory requirements, and City of Yachats objectives.

7.2 EXISTING DEFICIENCIES

The City 's existing water treatment plant was constructed in the early 1990s and has served the City well. The existing treatment plant can reliably produce about 500,000 gallons of water per day. This is significantly more than the estimated peak day demand at the end of the planning period (Table 5-8). Therefore, the treatment plant is adequately sized to meet the projected demands and an expansion project to increase the treatment capacity is not needed. However, most of the mechanical and electrical components of the plant are the original equipment that is not about 30 years old and would be about 50 years old at the end of the planning period. This is far beyond the design life for mechanical and electrical equipment such as control panels, pumps, chemical feed equipment, and some of the internal components of the clarifier and filters. Therefore, the City should plan to make significant upgrades to the mechanical and electrical systems during the planning period. In addition to capacity and age issues, the existing treatment plant building does not meet current seismic building codes and improvements to the building structure would be beneficial.

This section includes a discussion of the various alternatives considered to address the existing shortcomings and describes the recommended improvements.

7.3 IMPROVEMENT ALTERNATIVES

The treatment plant building is in good condition and should continue to serve the City for many years. Upgrades are needed to improve the seismic resiliency of the building, but the overall structure is in good condition. The main treatment components (i.e., clarifier, filters, and clear well) are concrete structures that are in good condition and should be sufficient for the remainder of the planning period. Overall, the "backbone" of the treatment plant is sound and no major upgrades are needed. Most of the existing shortcomings are related to mechanical and electrical equipment that can be replaced while retaining the major structural elements of the plant. For this reason, the recommended improvement scheme includes retaining much of the existing treatment infrastructure and continuing to utilize the same treatment technology that is currently in place. As an alternative to this approach, the City could choose to construct an entirely new plant and evaluate other treatment technologies such as membrane filtration. However, this would require abandoning much of the existing infrastructure and would be significantly more costly. The costs for constructing a new treatment plant using different treatment technologies were not evaluated in detail for this study, but are likely to be many times more expensive than the recommended improvements.

7.4 RECOMMENDED TREATMENT PLANT IMPROVEMENTS

The recommended treatment system improvements include several different projects targeted at various elements of the treatment plant. The improvements are listed as separate projects, but some could easily be combined into larger projects which would likely reduce soft costs in some cases. The following bullet points describe each of the recommended project in greater detail. Detailed cost estimates are included in Appendix B.

- **Water Treatment Plant Electrical and Control System Upgrades (Project T-1)**

The main electrical service entrance equipment, the motor control centers, and the main control panel are the original equipment that was installed in early 1990s. There have been some minor upgrades over the years, but most of the components are original. This is far beyond the design life for electrical equipment of this nature. Many of the components are no longer available and failures would cause a major problem for the City. All of these systems should be upgraded early in the planning period. This is probably the most significant need at the treatment plant because there are multiple components for which replacement parts are no longer available. A failure of any of these could lead to an emergency operation scenario for the City. The recommended improvements include a new power service that is larger and can accommodate additional electrical loads in the future, a new backup power generator and automatic transfer switch, a new master control system for the treatment plant and a new motor control center. In order to keep the existing treatment plant operational during the installation of the new electrical and control equipment, it is envisioned that the existing cabinetry on the south wall of the lab room will be removed and the new electrical gear will be installed along the south wall. Once the new electrical gear is operational, the old gear on the north wall of the lab room will be removed and a new laboratory sink and cabinetry will be installed in its place. It is envisioned that the new generator will be installed on the exterior of the building near the building entrance in a sound attenuation enclosure supplied by the generator manufacturer. The total recommended budget for this project is $814,000. A detailed breakdown of this budget is included in Appendix B.

- **Water Treatment Plant Clarifier Rehabilitation (Project T-2)**

The clarifier is used to remove suspended solids prior to filtration. The clarifier is a concrete tank with internal flocculation chamber, launders, and a solids rake arm. The rake arm is powered by a motor located on the walkway over the clarifier. The concrete tank is in good condition and should serve the City well for the remainder of the planning period. The internal components are the original equipment that was installed in early 1990s. Most the internal components are constructed of mild steel and are corroded and are likely to reach the end of their useful life during the planning period. Therefore, the City should plan to replace the equipment at some point during the planning period. The existing clarifier is not equipped with any plate or tube settlers. This is an older approach and replacement of the internal equipment in the clarifier presents an opportunity to install more modern equipment like plate settlers. This will improve the performance of the clarifier and make it easier to operate. The recommended improvements include removing all of the equipment inside the clarifier and replacing with a system of partitions that divide the tank into a flocculation chamber followed by a settling chamber that is augmented with plate or tube settlers. Several equipment manufacturers are capable of providing this type of equipment package. It is envisioned that the designers of the improvements will work with a particular manufacturer to select an equipment package that is suitable for installation in the existing tank. The total recommended budget for this project is $641,000. A detailed breakdown of this budget is included in Appendix B.

- **Water Treatment Plant Mixed Media Filter Rehabilitation (Project T-3)**

The mixed media filters are the primary treatment process in the plant. The filters are located in concrete tanks inside the treatment plant building. The tanks and access walkways are in good condition and will serve the City well for the remainder of the planning period. Most of the filter media, internal piping, and mechanical systems inside the filter tanks are the original equipment that was installed in the early 1990s. It will likely be necessary to reconstruct the internal components of the filters at some point during the planning period. For the purposes of master planning, the proposed improvements are assumed to include removing all of the filter media and the underdrain piping, installing new underdrain piping, new filter media, and a new surface wash system. Obviously one filter will need to be rehabilitated while the other filter provides water treatment. Several equipment manufacturers are capable of providing the materials and equipment needed to rehabilitate the filters. It is envisioned that the designers of the improvements will work with a particular manufacturer to select materials and equipment that is suitable for installation in the existing tanks. The total recommended budget for the rehabilitation of both filters is $350,000. A detailed breakdown of this budget is included in Appendix B.

- **Water Treatment Plant Pump and Compressor Upgrades (T-4)**

Virtually all of the pumps and motors in the plant are the original equipment that was installed in the early 1990s. This includes the Salmon Creek intake pumps, the backwash pump, and the two high service pumps. The treatment plant also includes an air compressor that provides high pressure air for the pneumatic valves that are used to control the filtration process. Rotating machinery like pumps and compressors have a limited useful life due to normal wear and tear. For planning purposes, the City should assume that all of the pumps and the compressor will reach the end of their useful life during the planning period and will need to be replaced. The replacement process provides an opportunity to make some improvements to the plant. For example, the plant includes a single backwash pump. It is more conventional for a plant to have two backwash pumps to provide redundancy. Should the City's backwash pump fail, there would be no way to backwash the filters and the treatment plant would eventually cease to produce water. Therefore, a failure of the backwash pump would be an emergency situation for the City. A better system would be to have two backwash pumps so that there is always a backup if one fails. For this reason, the recommended improvements include the installation of a second backwash pump. This will require coring the building floor over the clearwell and constructing a pump pedestal next to the existing backwash pump. The recommended improvements include the installation of two air compressors rather than one to increase the overall redundancy of the plant. For budgeting purposes, it is assumed that the speed of the backwash pumps will be controlled using variable frequency drives. However, this particular detail will need to be finalized during the design phase of the project. The total recommended budget for the pump and compressor replacement project is $402,000. A detailed breakdown of this budget is included in Appendix B.

- **Water Treatment Plant Instrumentation Upgrades (Project T-5)**

To monitor and control the treatment process, several instruments are used throughout the plant. These include three flow meters, five tubidimeters, a streaming current monitor, a chlorine residual analyzer, and a level transducer in the clearwell. Some, but not all, of these instruments were installed when the plant was constructed in the early 1990s. These types of instruments typically last about 20 years before they become obsolete or wear out. Therefore, the City should plan to upgrade the instrumentation at some point during the planning period. The proposed improvements include installing new modern instrumentation to replace the instruments noted above and electrical and controls work to integrate the instrumentation into the automatic control and monitoring system. The total recommended budget for this project is $271,000. A detailed breakdown of this budget is included in Appendix B.

- **Water Treatment Plant Chemical Feed System Improvements (Project T-6)**

The treatment plant includes several chemical feed systems. These include a polymer feed system, a soda ash feed system, a filter aid feed system, and a chlorine feed system. As a whole, these systems are in fair to poor condition and need to be improved during the planning period. For example, the City has an onsite chlorine generation system that is not currently functional. The electrolizer has failed and the City now uses liquid sodium hypochlorite as a "work around." Similar situations exist for the polymer feed and soda ash feed systems. The chemical room includes a large polymer storage tank that is no longer in use and needlessly consumes floor space. In short, the chemical feed systems need to be cleaned up and modernized. The recommended improvements include installing new polymer and filter aid blending and feed equipment to replace the existing equipment, installing new pump skids for the soda ash and chlorine feed systems, rehabilitating or replacing the onsite chlorine generation equipment, and replacing the chlorine distribution control panel. All of the new equipment should be integrated into the automatic control and monitoring system. The total recommended budget for this project is $205,000. A detailed breakdown of this budget is included in Appendix B.

- **Treatment Plant Building Seismic Retrofit (Project T-7)**

The water treatment plant building was constructed in the early 1990s and was not designed for current seismic codes. In the time since the building was designed, significant changes to building codes have been made with the goal of improving the structural response to large seismic events. In order the improve the overall seismic resilience of the City's water system, the City should consider making seismic upgrade to the treatment plant building. The specific details of these upgrades have not been identified. A detailed structural evaluation of the building is beyond the scope of this master planning effort. However, it is anticipated that some structural improvements will be needed to bring the building in compliance with current structural codes. Since the specific improvements are not known at this time, the budget for this project includes reasonable estimate of the costs for the seismic upgrades. However, this is a "placeholder" value that should be confirmed early in the design process. It is envisioned that the City will retain a structural engineer to inspect and evaluate the building structure prior to designing the needed improvements. At that time, the budget can be updated as needed. For the purposes of this plan, a budget of $200,000 for construction and $70,000 for soft costs are recommended. The total budget for this project is $270,000.

7.5 SUMMARY OF RECOMMENDED TREATMENT SYSTEM IMPROVEMENTS

Several treatment system improvement projects have been identified above. These projects are summarized in the following table. These projects are assigned a priority ranking in Chapter 12.

Table 7-1| Recommended Treatment System Improvements

Project Code	Description	Recommended Budget
T-1	WTP Electrical and Control System Improvements	$841,000
T-2	WTP Clarifier Rehabilitation	$641,000
T-3	WTP Mixed Media Filter Rehabilitation	$350,000
T-4	WTP Pump and Compressor Upgrades	$402,000
T-5	WTP Instrumentation Upgrades	$271,000
T-6	WTP Chemical Feed System Improvements	$205,000
T-7	WTP Building Seismic Retrofit	$270,000

CHAPTER 8

DISTRIBUTION SYSTEM EVALUATION

Chapter Outline

DISTRIBUTION SYSTEM EVALUATION

8.1 INTRODUCTION

The combination of piping, storage, pump stations, and supporting infrastructure is conventionally defined as a water distribution system. For the purposes of this chapter, the discussion of water storage is excluded. Evaluations and recommended improvements to the City's water storage facilities are presented in Chapter 9.

The evaluations of this chapter were derived from the creation and study of a PC-based hydraulic model designed to replicate the City's distribution network. This model was used to simulate various operational modes, fire flow scenarios, and failure states in order to verify improvement recommendations. These recommendations are presented at the end of this chapter. Capital costs and a prioritized ranking of the recommendations appear in Chapter 12.

8.2 SIZING AND CAPACITY

The primary purpose of a water distribution system is to deliver the full range of consumer demands and fire flows at pressures suited for the particular use. To accomplish this, the distribution system utilizes a combination of various sized distribution mains.

Distribution mains must satisfy both normal consumer domestic demands <u>and</u> fire flows, and thus experience a wide range of operating velocities. Distribution mains are evaluated on their ability to provide fire flow during PDD periods. Most Cities now require new waterlines to be a minimum of 8-inches diameter for single-family residential areas, and 10-inches or larger for industrial, commercial, and multi-family areas with fire flows above 1500 gpm.

The American Water Works Association (AWWA) recommends piping velocities below 10 feet per second for distribution mains. Maximum friction loss recommendations for distribution mains should also be less than 10 feet of pressure head per 1,000 feet of pipe length. Exceeding this headloss criteria may result in loss of hydraulic conductivity and increased energy costs.

The following standards are recommended to determine water distribution system adequacy.

- Peak hour demands for the entire system must be met with system pressures remaining above 20 psi.
- The system must be capable of delivering the required fire flows to all portions of the distribution system (in combination with the peak day demand) while maintaining a minimum residual pressure of 20 psi at all service connections.

8.2.1 System Pressure

Pressure is the primary metric for evaluating the ability of a distribution system to deliver water. There are several concepts relating to water system pressure that must be defined for purposes of this discussion.

Pressure and Head. Water pressure (sometimes called head pressure) is directly related to the height to which water will rise in a standpipe at that location. Each psi of water pressure equates to 2.31 feet of water column height in a standpipe (the standpipe can be real or hypothetical). Under conditions of <u>no flow</u> through the pipelines, the water level <u>elevation</u> (in real or imaginary standpipes) will be the same at all points in a pressurized distribution system (to visualize this concept, imagine a lake, where under no-flow conditions the water level elevation is the same at all points). As the elevation of the ground surface changes, the height of water column above that same point will change proportionately, and the pressure will change (conceptually, as the lake bottom elevation goes up or down, the water depth (and water pressure on the bottom) at that point also changes).

- *Pressure Change with Elevation*. Based on the pressure/head concept noted above, water pressure (i.e., head pressure) will increase with decreasing ground elevation, and will decrease as the ground elevation increases.
- *Static Pressure*. As noted above, pressure in a pipeline is constant at all points in that pipeline ONLY when there is no flow through the pipeline, AND when the elevation remains the same at all points. As noted above, in a real distribution system, the static pressure increases or decreases with changing ground elevation.
- *Head Loss.* As water flows through a pipe, pressure decreases along the length of the pipe due to friction loss between the water and the pipe walls. Similar to dry friction, water friction and turbulence along a pipeline walls results in energy loss from the moving object (i.e., flowing water), with the energy loss being manifested as reduced pressure. When the flow stops, the friction loss also stops, and so the system returns to static pressure levels.
- *Dynamic Pressure*. The dynamic pressure (sometimes called residual pressure) is the pressure measured at a point in the distribution system under some defined flow condition. While the *static* pressure in the distribution system remains relatively constant at a given point, the *dynamic* pressure (i.e., the actual observed pressure) can change dramatically. Therefore, pressure at any given point in the distribution system generally decreases as demand for water (and flow velocity) increases.

Periods of heavy fire flow demand depress system pressures significantly. ODWP standards (OAR 333-061-0025) stipulates that water suppliers must maintain a minimum pressure of 20 psi to all service connections at all times, including times of peak fire flow demand. Fire flows are typically modeled concurrent with the peak day demand.

8.2.2 Fire Protection

Table 5-9 in Section 5.6 details the fire flow requirements used for this master plan. These standards will be utilized in the fire flow evaluations of this chapter to ensure that the distribution system is suitably sized and configured to reliably deliver the required fire flows.

8.2.3 Deficiency Categories

In general, distribution system deficiencies fall into several general categories. Many elements of the water system may be experiencing more than one of these problems at the same time. These categories will be used to identify the deficiencies associated with particular elements of the system in the discussions of this chapter.

- *Lack of Capacity*. Undersized pipes cannot deliver peak water demands or fire flows. Although the water system may have capacity to deliver domestic flows, it is often unable to convey larger flows that may be required in an emergency. Pipes in this category have excessive headloss and create flow restrictions. This problem should be addressed either by increasing the size of the existing waterline or constructing new waterlines.
- *Lack of Facility*. Problems in this category are caused by the absence of a waterline, valve or hydrant, or inadequate looping to provide redundancy or reliability. In such cases new components should be constructed in order to increase system reliability or to simplify system operations.
- *End of Useful Life*. This category of problems is the result of old, damaged, or worn out pipes. The most common examples of these problems are leaky pipes and broken valves or hydrants. Corrective measures require the replacement or reconstruction of the failing component(s).

8.3 HYDRAULIC MODEL DEVELOPMENT

8.3.1 Model Methodology

A computer-based numerical model was utilized for this master plan. Modeling of water distribution systems is a proven and effective method for simulating and analyzing the performance of a distribution system under a wide range of operational and hydraulic conditions. A properly constructed and calibrated model permits a robust evaluation of the distribution system and often allows the designer to replicate and evaluate hydraulic scenarios that are too difficult or costly to perform in the real world. Such scenarios are useful to determine the overall strength of a distribution system and to identify weaknesses that require remediation. The evaluation of future pipeline sizes and routing can also be economically performed to ensure that the expansion of the distribution system occurs in an optimized fashion.

The modeling software used for this project was WaterCAD, a commercial modeling software package developed by Bentley Systems Incorporated. This software was utilized to calculate the flow throughout the distribution network and to quantify flow rates, pressures, headlosses, reservoir levels, and pump operating points under various consumer demand patterns and fire flow scenarios.

The general methodology used in the modeling process was to examine the existing distribution grid during various demand and fire flow scenarios. Pressure, flow, or connectivity deficiencies were used to formulate improvement scenarios to remedy the problem. These scenarios were then evaluated to determine their efficacy.

8.3.2 Model Development

At the most basic level the hydraulic model consists of nodes and links. Nodes represent the various elements of the system including water sources, pumps, storage tanks and pipe intersections. Links predominantly represent pipes and define the relationship between each node. The creation of the model utilized information from a variety of sources. The City's existing distribution system maps were used as a base in the early building stage and this information was supplemented with information from record drawings, previous engineering studies, field reconnaissance, and discussions with City staff.

Model pipe elements were constructed based on the diameter, length and material type of each pipe. Hazen-Williams roughness factors were assigned to the pipes based on typical values for pipe materials. Model nodes were placed at pipeline intersections, near fire hydrant locations, and in various locations to simulate clustered water service connections. The model nodes were populated with topographic information to ensure that elevation differences across the planning area were properly accounted for.

Existing pumps were replicated to perform at the currently utilized levels and set points. Reservoirs were constructed with tanks to match the physical geometry and assigned elevations to match the existing facilities.

Due to the simplicity of the City's water system the model was not "skeletonized." Skeletonization is a process which simplifies the system by eliminating or combining short pipe segments, consolidating pipe junctions and eliminating small diameter pipes with insignificant connectivity. This process was not used as the systems simplicity allowed for all pipes to be modeled without the model becoming cumbersome and overly specific.

Once the distribution network was created, the water demands established in Chapter 5 were allocated to specific nodes across the system.

8.3.3 Model Scenarios

The model was used to investigate a number of hydraulic scenarios in the distribution system. These scenarios were evaluated using a combination of steady state and dynamic simulations. The simulations produced a snap-shot of hydraulic conditions at a fixed period in time.

In particular, the hydraulic scenarios investigated include the following under existing conditions.

- Existing peak hour demands.
- Fire flows to each model node in combination with the existing peak day demand (without WTP in operation).

The model was also used to simulate various improvements to the distribution system to identify the most cost-effective solutions to address the system deficiencies. Simulations with several combinations of the proposed improvements were analyzed.

The results from the computer simulations were used to develop a list of long-range improvements required to address system deficiencies and to serve the City through the planning period. Since pipelines are not well suited for incremental expansion, it is most cost effective to size the pipes for fully built-out conditions. Steady state simulations of the future system at buildout were performed to determine the required pipe sizes. The following simulations were performed.

- Peak hour demands at build-out.
- Fire flows to each model node in combination with the existing peak day demand at build-out.

8.4 DISTRIBUTION SYSTEM ANALYSIS

The evaluation of the existing distribution system was performed to identify system deficiencies and possible remedies for the existing distribution grid, as well as improvements to serve future growth-related needs. This section presents improvements for the distribution system broken into several separate projects comprised of distribution and fire flow improvements. Table 8-1 at the end of the chapter summarizes these improvements.

This section evaluates the adequacy of the distribution system to deliver domestic water to all service areas, as well as an evaluation of the adequacy of system looping. Additionally, this section evaluates the adequacy of the distribution system to deliver fire flows to the Upper and Lower Radar Road service levels. Looped distribution systems are desirable when combined with sufficient valves, as it allows flows to be routed around the failure of any single distribution pipe. This provides service redundancy and facilitates repair work while keeping outage areas as small as possible. A looped configuration also provides multiple water paths to any specific point in the system, which reduces velocities along any given flow path and increases the system’s ability to provide high volume fire flows (assuming the looped lines are adequately sized). Also covered in this section is an evaluation of end of useful life. As existing pipes and valves near the end of their useful life, they should be replaced before failure occurs. It can be reasonably assumed that new waterlines (PVC or ductile iron) will have a 75-year service life.

Yachats’s distribution system was found to provide sufficient level of service for domestic flows. There are, however, a number of pipelines that should be upsized to accommodate fire flow requirements (Table 5-9). As noted above, ODWP rules require public water suppliers maintain a minimum pressure of 20 psi at all service connections at all times, including during fire flow events. The current distribution system is incapable of delivering desired fire flows while maintaining 20 psi at all service connections.

The City’s distribution grid in general provides an adequate level of looping. There are however, a few areas in town where looping is not present and should be improved.

8.4.1 Recommended Distribution System Improvements

The recommended distribution system improvements are described in the following paragraphs. Maps graphically showing these improvements are included at the end of this section (Figure 8-1 through Figure 8-3). The reader is encouraged to review these figures along with the following descriptions to aid in the understanding of the recommendations. These improvements described below are generally recommended for one of three reasons: improving fire flows, improving system redundancy, or replacing infrastructure that is likely to reach the end of its useful life during the planning period. A ranked prioritization of these projects into a comprehensive implementation plan is presented in Chapter 12.

- **Water System Design Standards (Project D-1)**

Over the years, the City's distribution grid has been extended using a wide range of piping materials and sizes. The distribution grid has significant amounts of 6-inch diameter water lines. These are typically too small to consistently deliver fire flows in accordance with current building codes and the Oregon Fire Code. For this reason, most cities require minimum pipeline sizes of 8-inch diameter. Many cities document these requirements by publishing design standards that can be provided to developers and other relevant parties. These standards not only clarify pipe sizing requirements, they also document the city's standards with respect to materials, water service installations, fire hydrants, valves, etc. The lack of such standards in Yachats is a shortcoming the City can easily address. We recommend the City budget approximately $5,000 to retain an engineering firm to develop standards for future development of the water system.

- **Pressure Reducing Valve Maintenance and Coordination (Project D-2)**

The City's water distribution system is separated into multiple elevation service levels (Table 4-5). Most of the City is located inside the lowest two service levels, the Upper and Lower Radar Road Levels. Five pressure reducing valves control the flow of water into sub-levels. These valves are a critical component of the City's distribution system. As described above (Section 4.6.3), the existing valves have not been serviced in many years. This is a major shortcoming that should be addressed early in the planning period. The recommended project includes the following sequence: service the valves, survey the elevation of each valve, install connections for accurate pressure gauges, verify the pressure set points for each valve, collect new flow data, and check the hydraulic model. This plan recommends that the City inspect each valve and perform the manufacturer's recommended service work. In addition to mechanical issues, the pressure set points for each valve may not be correct. The valves should be set at the same hydraulic grade line (elevation plus pressure). Since the valves are located at different elevations, they will have different pressure set points. In order to ensure that each valve is properly adjusted, we recommend the City survey the elevation of each valve along with the elevations of three reservoirs, including Horizon Hill, Middle Blackstone, and Upper Blackstone. This data should be kept in the City's records for future reference. We also recommend that the City install connections for new pressure gauges on each side of all valves. The connections should allow the gauges to be removed. Gauges that are permanently mounted and left in service tend to be easily damaged and provide incorrect readings. Instead of permanently-mounted gauges, the City can keep well-maintained gauges on the shelf that can be temporarily installed when service is required. Once the valves have been serviced and accurate pressure readings on each side of each valve are available, the City can use the elevation data to adjust the setpoints on each valve. Once this is completed, fire flow tests should be performed throughout town and this data should be used to check the validity of the hydraulic model used in this report. The total recommended budget for this work is $50,000. The City does not need to perform all of the work at once. The sequence identified above can be performed over a period of time as funds allow.

- **Windsong Street Service Reconnections (Project D-3)**

Over the years, the City has allowed residents to connect to the distribution system at locations with static pressure below 40 psi. This is generally bad practice and should be avoided in the future. Figure 4-23 shows the service level boundaries in the City. This figure is intended to serve as a tool that the City can use to determine the appropriate service level for new homes and developments. The upper limit of each service level is defined as the elevation where the static pressure is equal to 40 psi. This is the practical upper limit where services should be connected. When services are connected at locations where the static pressure is less than 40 psi, they tend to limit the amount of fire flow available in the system because the pressure at the service connections rapidly drops below 20 psi during a fire flow event. Projects D-3 through D-7 are all recommended to correct portions of the system with static pressures below 40 psi. Though these projects are presented separately, it may make sense to construct them as a single project.

Project D-3 is recommended to improve fire flows throughout the central and northern parts of the City. At least two residential meters are serviced from the upper elevations of a 6-inch water line on Windsong Street. These meters are above the nominal 40 psi service level of the Lower Radar Road Service Level. During fire flow modeling, these services limited the amount of fire flow available to the service level because the pressure at these services rapidly drops to 20 psi as fire flows are discharged from the distribution system. These services would be best serviced from the Lower Blackstone Service Level instead of the Lower Radar Road Service Level. Reconnecting these services to the higher level, above the Lower Blackstone Pump Station, would allow the distribution system to deliver larger fire flows while maintaining 20 psi at these services. The recommended budget for this work is $11,000.

- **New PRV at 7th Street & Radar Road (Project D-4)**

This project is recommended to improve the fire flows to the central and northern parts of the City. Projects D-6 and D-7 including switching portions of the distribution system located at higher elevations from the Lower Radar Road Service Level to the Upper Radar Road Service Level. Once projects D-6 and D-7 are completed, the Upper Radar Road Service Level will be physically connected to the Lower Radar Road Service Level and a pressure reducing valve will be needed to regulate flow between the two levels. As described above for Project D-3, the City should consider constructing Projects D-3 through D-7 as a single larger project. The recommended budget for this project is $101,000.

- **New PRV on King Street Between 7th and Prospect Ave (Project D-5)**

This project is similar to Project D-4 and is needed for the same reasons. As described above for Project D-3, the City should consider implementing Projects D-3 through D-7 as a single larger project. Projects D-3 through D-7 are all needed for the same general reason and it makes sense to construct them concurrently. Once projects D-6 and D-7 are completed, the Upper Radar Road Service Level will be physically connected to the Lower Radar Road Service Level and a pressure reducing valve will be needed to regulate flow between the two levels. The recommended budget for this project is $101,000.

- **New 8" Water Main in Radar Road (Project D-6)**

This project is recommended to improve fire flows to the central and northern parts of the City. The pipe along Radar Road west of the Lower Radar Road Reservoir is currently fed from the Lower Radar Road Reservoir. This area of the City is above the service level for the Lower Radar Road Reservoir. As a result, this section of the system limits the amount of fire flow that can be discharged from much of the distribution system. The proposed project includes an 8-inch waterline that will feed this area from 12-inch pipe that is connected to the Upper Radar Road Reservoir. Once this project is completed, the Upper and Lower Radar Road Service Levels will be connected and a PRV (i.e., Project D-4) will be needed to regulate the flow through the service levels. As described above for Project D-3, the City should consider constructing Projects D-3 through D-7 as a single larger project. Projects D-3 through D-7 are all needed for the same general reason and it makes sense to construct them concurrently. As described in Chapter

10, this pipeline segment is a major backbone of the City's distribution grid. Therefore, the City should consider using earthquake resistant piping materials for this installation such as HDPE pipe or restrained joint ductile iron pipe. The estimated length of the pipe is 200 feet. The recommended budget for this project is $57,000. A detailed breakdown of this budget is included in Appendix B.

- **New 8" Water Main in King Street West of Prospect Ave (Project D-7)**

This project is recommended to improve fire flows to the central and northern parts of the City. The pipe along King Street west of the intersection with Prospect Avenue is currently fed from the Lower Radar Road Reservoir. This area of the City is above the service level for the Lower Radar Road Reservoir. As a result, this section of the system limits the amount of fire flow that can be discharged from much of the distribution system. The proposed project includes an 8-inch waterline starting from the 12-inch pipe in Prospect Avenue that is connected to the Upper Radar Road Tank, west along King Street to an existing 6-inch pipe. Once this pipeline is completed it will connect the Upper Radar Road Reservoir to the Lower Radar Road Service Level. Therefore, a pressure reducing valve (i.e., Project D-5) will be needed to regulate the flow between the two service levels. At least four water services will have to be reconnected as a part of the project. The estimated length of the pipe is 250 feet. The recommended budget for this project is $86,000. A detailed breakdown of this budget is included in Appendix B. As described above for Project D-3, the City should consider constructing Projects D-3 through D-7 as a single larger project. Projects D-3 through D-7 are all needed for the same general reason and it makes sense to construct them concurrently.

- **New 8" Water Main in Third Street (Project D-8)**

This project is recommended to improve fire flow to the central & northern parts of the City and to replace infrastructure reaching the end of its useful life during the planning period. The water main between Highway 101 and Prospect Avenue on 3rd Street is 4-inch diameter asbestos concrete (AC) pipe. This pipe is undersized and it is common to replace aging AC pipe to minimize the potential for pipe failures. The approximate length of pipe is 450 feet. Several water services are served by the existing water line. The recommended budget for this project is $167,000. A detailed breakdown of this budget is included in Appendix B.

- **New 4" Water Main and PRV on Horizon Hill Road (Project D-9)**

This project is recommended to improve the reliability and redundancy for an area along Horizon Hill Road. The existing pipe in the "Horizon Hill Loop" is 2-inch thin-walled PVC. This pipe is fragile and susceptible to pipeline failure. It is recommended that this loop be replaced with 4-inch C-900 PVC. This project additionally recommends an additional waterline to connect to this loop from the water main near the Horizon Hill Pump Station. This additional water main will provide a loop to this area to improve redundancy of supply in the event the main supply line fails. A PRV will be required to be installed on this new line in order to reduce pressure to this area. The approximate length of pipe is 3,800 feet of 4-inch. The total recommended budget for the project is $737,000. A detailed breakdown of this budget is included in Appendix B.

- **Retrofit Combs PRV (Project D-10)**

This project is recommended to improve fire flows to the Quiet Water Subdivision. The proposed project is to retrofit the existing PRV on Combs Circle. This PRV separates the Upper and Lower Radar Road Service Levels. It was taken out of service due to abnormal operating behavior. As previously discussed under Project D-2, the PRV elevation should be surveyed and the PRV hydraulically reconfigured to allow water to pass through it in the event of high demand, such as a fire flow. It is expected that the piping and vault can be salvaged, but the valve will need to be replaced and recalibrated. The total recommended budget for this project is $40,000.

- **Yachats Ocean Road Service Reconnections (Project D-11)**

This project is recommended to simplify the distribution system by reconnecting at least two services on Yachats Ocean Road. Two services are served by a 2-inch waterline that is not in the right-of-way and runs along an odd alignment through private property. As such, this line is difficult to maintain. These services would be better served from the 6-inch mainline in Ocean Hills Road. It is recommended that these services be reconnected to the 6-inch water main and to abandon the existing 2-inch water main. This may be a project that can be completed by City staff. The total recommended budget for this project is $20,000.

- **New 8" Water Main in Green Hill Drive (Project D-12)**

This project is recommended to improve fire flows to the southern part of the City and the replace an undersized pipe. The proposed project includes replacing the 2-inch PVC water main in Green Hill Drive with an 8-inch water main. This water main would connect the 10-inch water main on Highway 101 to the relatively new 8-inch water main on Crest View Drive near the South Tank. This pipe is approximately 850 feet. This project will require coordination with ODOT, since the waterline would cross Highway 101. It is envisioned that the highway crossing will be by and auger bore. As described in Chapter 10, this pipeline segment is a major backbone of the City's distribution grid. Therefore, the City should consider using earthquake resistant piping materials for this installation such as HDPE pipe or restrained joint ductile iron pipe. The recommended budget for this project is $412,000. A detailed breakdown of this budget is included in Appendix B.

- **Replace 4" AC with 8" PVC in 2nd Street from Prospect Ave to Yachats River Road (Project D-13)**

This project is recommended to improve fire flows to the central part of the City and to replace infrastructure reaching the end of its useful life during the planning period. The water main between Prospect Avenue and Yachats River Road on 2nd Street and Cedar Avenue is 4-inch diameter asbestos concrete (AC) pipe. This pipe is undersized and it is common to replace aging AC pipe to minimize the potential for pipe failures. The new pipe will connect to the existing 6-inch pipe that is not in use between Loma Avenue and Spruce Avenue. A short section of AC pipe near Spruce Avenue would also be replaced in order to connect the existing 6-inch pipe to the main serving the Quiet Water Subdivision. These improvements are depicted in Figure 8-2. The approximate length of new pipe is 1,300 feet. Approximately 24 water services are served by the existing water lines that would have to be reconnected. The recommended budget for this project is $398,000. A detailed breakdown of this budget is included in Appendix B.

- **8" Water Main Highway 101 from 6th to Marine Dr. (Project D-14)**

This project is recommended to improve fire flows to the central and northern parts of the City, to replace a major portion of the City's aging infrastructure, and to fortify the backbone of the City's water distribution system. The proposed project includes replacing approximately 1,300 feet of 4-inch AC pipe and 300 feet of 2-inch pipe with 8-inch pipe along Highway 101. It is recommended that this new waterline connect to the 6-inch waterline at the intersection of 101 and 6th Street. This project will require substantial coordination work with ODOT. As described in Chapter 10, this pipeline segment is a major backbone of the City's distribution grid. Therefore, the City should consider using earthquake resistant piping materials for this installation such as HDPE pipe or restrained joint ductile iron pipe. The recommended budget for this project is $583,000. A detailed breakdown of this budget is included in Appendix B.

- **Pontiac Street Waterline - 3rd to 4th (Project D-15)**

This project is recommended to improve fire flow and looping in the central part of the City. The proposed project is to connect the 6-inch water main on Fourth Street with the 4-inch water main on Third Street by adding an 8-inch water main on Pontiac Street. The approximate length of the pipe is 225 feet. The recommended budget for this project is $88,000. A detailed breakdown of this budget is included in Appendix B.

- **Shell Street Waterline (Project D-16)**

This project is recommended to improve fire flow and looping in the southern part of the City. The proposed project is to connect the 6-inch water main on Yachats Park Road with the 6-inch water main on Shell Street by adding an 8-inch water main. This water main would replace the existing 2-inch pipe. The approximate length of the pipe is 225 feet. The recommended budget for this project is $79,000. A detailed breakdown of this budget is included in Appendix B.

- **Gender Drive and Windy Way Waterlines (Project D-17)**

This project is recommended to improve the reliability and capacity of water lines on Gender Drive and Windy Way. The proposed project is to replace the existing 2-inch water lines on these streets with 8-inch water lines. The approximate length of pipe is 650 feet. An estimated 19 services would have to be reconnected as a part of the project. The recommended budget for this project is $254,000. A detailed breakdown of this budget is included in Appendix B.

- **Pontiac Street Waterline - 2nd to 3rd (Project D-18)**

This project is recommended to improve fire flow and looping in the central part of the City. The proposed project is to connect the 4-inch water main on 3rd Street with the 6-inch water main on 2nd Street by adding an 8-inch water main on Pontiac Street. The approximate length of the pipe is 300 feet. The recommended budget for this project is $105,000. A detailed breakdown of this budget is included in Appendix B.

- **Hanley Drive Waterline (Project D-19)**

This project is recommended to improve water line redundancy and looping along Hanley Drive. This would provide a looped system instead of a dead-ended system. The proposed project includes approximately 150 feet of 6-inch pipe. Two PRVs currently serve two separate sub-levels in this area, the Hanley Drive PRV and the Upper Radar Road PRV. The project would adjust these PRVs to deliver the same static pressure at their interconnection point and connect both ends of the systems served by the PRVs. As previously discussed under Project D-1, all of the City's PRV head conditions and set points are recommended to be coordinated and updated. This project only addresses the additional cost of the piped connection. The recommended budget for this project is $47,000. A detailed breakdown of this budget is included in Appendix B.

- **Automated Water Meter Reading System (Project D-20)**

In recent years, the City has been replacing old meters with radio-read meters. These meters are currently read by City staff using a drive-by vehicle-based radio reading system. Rather than using a drive-by radio reading system, some municipalities install a radio network throughout the City that can be used to read the meters in real-time without using hand-held or vehicle-mounted equipment. These systems consist of a network of radio receiving stations installed around the City in strategic locations. These stations are typically used to read data from each meter on an hourly basis. The City would contract with a company to encrypt and securely host the data. The City can even set up a customer portal that can be used by residents to view water usage data in real-time. These systems are known as Advance Meter Infrastructure (AMI) systems. The nearby Seal Rock Water District has this type of system as do several other municipalities in Oregon. Later in the planning period when the City has a sufficient number of radio read meters, it may make sense for the City to install the AMI equipment. This will require working with a system manufacturer to perform a radio study of the City. The radio study will identify the number and location of radio-read stations required to cover the City. These same companies can also host the data and the customer portal. As this time, the total number of receiving stations that would be needed for an AMI system in Yachats is not known. But based on the relatively complex topography in the City, a higher-than-average number of receiving stations will likely be needed. Assuming three radio-reading stations are required, the total recommended budget for this project is $327,000. A detailed breakdown of this budget estimate is included in Appendix B. This only includes the radio-receiving stations and associated software infrastructure. It does not include the cost of any additional meters needed by the City. It is also important to note that this is just the initial installation cost. The City will need to also budget for the annual costs associated with the third-party data hosting and customer portal management. These annual fees will likely be $25,000 - $50,000 depending on the hosting company and the desired level of service.

- **New Radar Road Pump Station (Project P-1)**

This project is recommended to replace the existing Radar Road Pump Station. The proposed project includes demolition of the existing station and construction of a new station in the same location. As discussed in more detail in Section 4.5.2, the Radar Road Pump Station has served the City for many decades and is expected to require relatively high repair & maintenance costs during the planning period due to its age. Rather than incur increased O&M costs, it may make for sense for the City to replace the station with more modern facilities. That said, the City can probably continue to maintain the system and delay replacement to the next planning period if desired. The Radar Road Pump Station delivers water to the Horizon Hill Reservoir. The Horizon Hill Reservoir can also receive water from the Upper Blackstone Reservoir. It is expected that this redundancy will allow the Radar Road Pump Station to be taken entirely off line during construction. The pump station does not currently have an auxiliary power generator. It is recommended that the new pump station include a generator in the event of a prolonged loss of line power. This will help ensure that service can be maintained to users higher in the distribution system.
The recommended budget for this project is $767,000. A detailed breakdown of this budget is included in Appendix B.

- **New Horizon Hill Pump Station & Reservoir (Project P-2)**

This project is recommended to replace the existing Horizon Hill Pump Station & Reservoir. The proposed project includes demolition of the existing station & reservoir and construction of a new pump station and reservoir in the same location with a relatively similar footprint. As discussed in more detail in Section 4.5.3, these facilities have served the City for many decades and are expected to require relatively high repair & maintenance costs during the planning period due to their age. Rather than incur increased O&M costs, it may make for sense for the City to replace the pump station and reservoir with more modern facilities. That said, the City can probably continue to maintain the system and delay replacement to the next planning period if desired. The Horizon Hill Pump Station delivers water to the Upper Blackstone Reservoir. The Upper Blackstone Reservoir can also receive water from the Middle Blackstone Pump Station. It is expected that this redundancy will allow the Horizon Hill Pump Station to be taken entirely off line during construction. The Horizon Hill Reservoir serves users in the Horizon Hill Service Level. The water supply to this service level will need to be maintained during construction of the new reservoir. This function can be provided from the Upper Blackstone Reservoir by installing an additional PRV. This would be installed near the Horizon Hill Pump Station to connect the Middle Blackstone Service Level to the Horizon Hill Service Level. This PRV would allow the City to take the Horizon Hill Pump Station off line in the future if need be.
It is envisioned that this PRV would be installed prior to demolishing the pump station and reservoir. An existing PRV in the pump station may be able to be salvaged and installed for this purpose. This is the PRV that is used to fill the Horizon Hill Reservoir from the Upper Blackstone Reservoir. The recommended budget for this project is $1,079,000. A detailed breakdown of this budget is included in Appendix B.

8.4.2 Recommended Water Loss Programs

A detailed evaluation of the amount of water losses from the distribution system is contained in Section 5.4.2. The data shows that approximately between 11% and 16% of the water produced is not currently accounted-for. Some of this water is being lost through leakage in the distribution system and some of the loss is likely attributed to authorized uses that are not being properly measured. The City should consider the reduction of unaccounted-for water as a major priority, as it will result in significant benefits to all four areas of the water system (i.e., source, treatment, distribution and storage). Marinating water loss below 15% is critical for the City as it is required in order for the City to use the Yachats River as a water source. As explained in Chapter 6, this plan recommends the construction of a new Yachats River intake to augment the City's water supply system. The City's water rights for the Yachats River along with a subsequent settlement (see Section 4.1.5) require system losses below 15% before the City is permitted to access water from the Yachts River. Therefore, it is critical that the City implement the following two programs. Over the years, the City may need to increase or may be able to decrease the recommended funding amounts for these programs depending on the effectiveness.

This plan recommends two strategies to reduce the amount of unaccounted-for water. The first is to implement a better data management and tracking system to track and records water production amounts, water consumption amounts, authorized and non-metered water use, such as fire flows, construction water, and water for flushing. The second recommendation is an aggressive leakage testing and repair program. Specific recommendations are discussed in the following paragraphs.

- *Non-Metered Water Use Tracking System (Pgm-1)*
  As described in Section 5.4.2, a comparison of water production versus water sold shows several months where the water sold was greater than the water produced. This is very unlikely to be accurate and is probably the result of inaccurate accounting practices. The City should investigate the cause for this and develop a more accurate data management strategy to accurately track water production versus water sold. In addition to improving the City's data management, some of the unaccounted-for water is likely the result of authorized uses such as filter backwash, filter to waste, fire flow measurements, construction water use, street cleaning, etc.. In order to prepare accurate estimates of water loss, the City should develop strategies for tracking the quantities of water used for all legitimate unmetered uses. Where appropriate (e.g., filter backwash lines, filter to waste lines, etc.), the City should consider the installation of new flow meters. For uses where a meter cannot be installed quantities should be estimated and tracked on an annual basis in order to better estimate the actual amount of water that is lost to system leakage. This program is a relatively straight-forward record keeping exercise that public works staff should be able to implement at minimal cost. An annual budget of $1,000 is recommended for this program. To some extent, the value is a "place-holder" and the City may find that the required tracking system can be folded into the normal day to day operations of the Public Works Department. An example of the type of work required includes coordination with the local fire department to estimate the amounts of water used for fire-fighting and hydrant flow measurements. Staff should also spend time identifying all legitimate non-metered use and develop procedures to estimate the quantities of water used along with implementing a record keeping system.
- *Leak Detection and Repair Program (Pgm-2)*
  The City has been diligent about monitoring the system for leakage and has typically tested the entire system for leakage about every two to three years. Therefore, this program is simply a way to formalize the City's existing practices. Most small cities like Yachats retain an outside vendor to provide a leak detection survey. Several companies offer these services in Oregon. In most cases, they are able to pinpoint the location of a leak relatively accurately. Leak detection of the entire system could be performed in roughly 3-4 days at a total estimated cost of approximately $6,000. We recommend that the City establish a goal for an annual budgetary line item of $3,000 to perform leakage testing of the entire system once every three years. The costs for repairs are difficult to estimate in a planning document, but a reasonable amount to initially start with would be about $27,000 per year. Therefore, the total recommended annual budget for this program is $30,000. Leak detection and repair should be considered a normal part of water system operation and maintenance. As the distribution system continues to age, new leaks will likely develop, so, this program should be continued indefinitely. This program is also important from a water supply perspective. The recommended water supply strategy discussed in Chapter 6 includes the construction of new intake on the Yachats River. The City's water rights for the Yachats River include a condition that water loss must be less than 15%. Therefore, this program and Program-1 are important to achieve and maintain water loss levels low enough to show compliance with the City's water rights for the Yachats River.

8.5 SUMMARY OF RECOMMENDED DISTRIBUTION IMPROVEMENTS

Several improvement projects have been identified based on the hydraulic analyses presented in this chapter. Distribution projects have been suggested to improve a combination of capacity and age deficiencies. Other improvement projects are intended to strengthen fire flows, and system redundancy. These improvement recommendations are summarized in Table 8-1 and graphically depicted on Figure 8-1 through Figure 8-3.

Table 8-1| Recommended Distribution Improvements

Project Code	Description/Location	Existing Size (inch)	Recommended Size (inch)	Length (feet)	Recommended Budget
D-1	Water System Design Standards	-	-	-	$5,000
D-2	Pressure Reducing Valve Maintenance & Coordination	-	-	-	$50,000
D-3	Windsong Street Service Reconnections	-	-	-	$11,000
D-4	New PRV at 7th Street & Radar Road	-	-	-	$101,000
D-5	New PRV on King Street Between 7th and Prospect Ave	-	-	-	$101,000
D-6	New 8" Water Main in Radar Road	-	8	200	$57,000
D-7	New 8" Water Main in King Street West of Prospect Ave	-	8	250	$86,000
D-8	New 8" Water Main in Third Street	4	8	450	$167,000
D-9	New 4" Water Main and PRV on Horizon Hill Road	4	4	3,800	$737,000
D-10	Retrofit Combs PRV	-	-	-	$40,000
D-11	Yachats Ocean Road Service Reconnections	-	-	-	$20,000
D-12	New 8" Water Main in Green Hill Drive	2	8	850	$412,000
D-13	Replace 4" AC with 8" from Prospect Ave to Yachats River Road	4	8	1,300	$398,000
D-14	8" Water Main Highway 101 from 6th to Marine Dr.	4 / 2	8	1,600	$583,000
D-15	Pontiac Street Waterline - 3rd to 4th	-	8	225	$88,000
D-16	Shell Street Waterline	2	8	225	$79,000
D-17	Gender Drive and Windy Way Waterlines	2	8	650	$254,000
D-18	Pontiac Street Waterline - 2nd to 3rd	-	8	300	$105,000
D-19	Hanley Drive Waterline	-	6	150	$47,000
D-20	Automated Water Meter Reading System	-	-	-	$318,000(1)
P-1	New Radar Road Pump Station	-	-	-	$767,000
P-2	New Horizon Hill Pump Station & Reservoir	-	-	-	$1,079,000
Recurring Annual Programs					
Pgm-1	Non-metered Water Use Tracking System				$1,000 / year
Pgm-2	Leak Detection and Repair Program				$30,000 / year

Notes:
(1) Annual costs for data hosting & customer portal management and meters are not included in costs.

Figure 8-1| Map of Recommended Distribution System Improvements

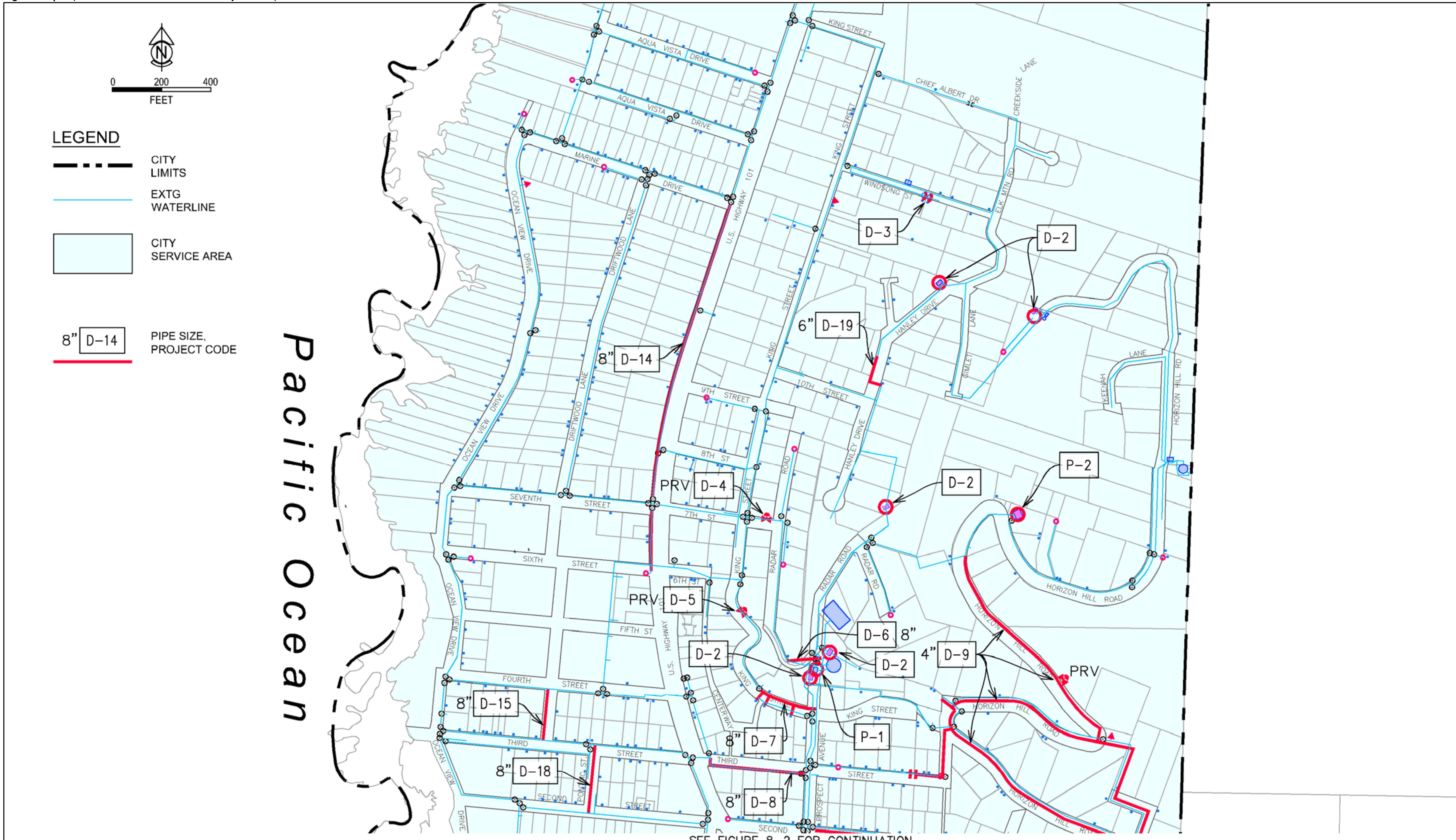


Figure 8-2| Map of Recommended Distribution System Improvements

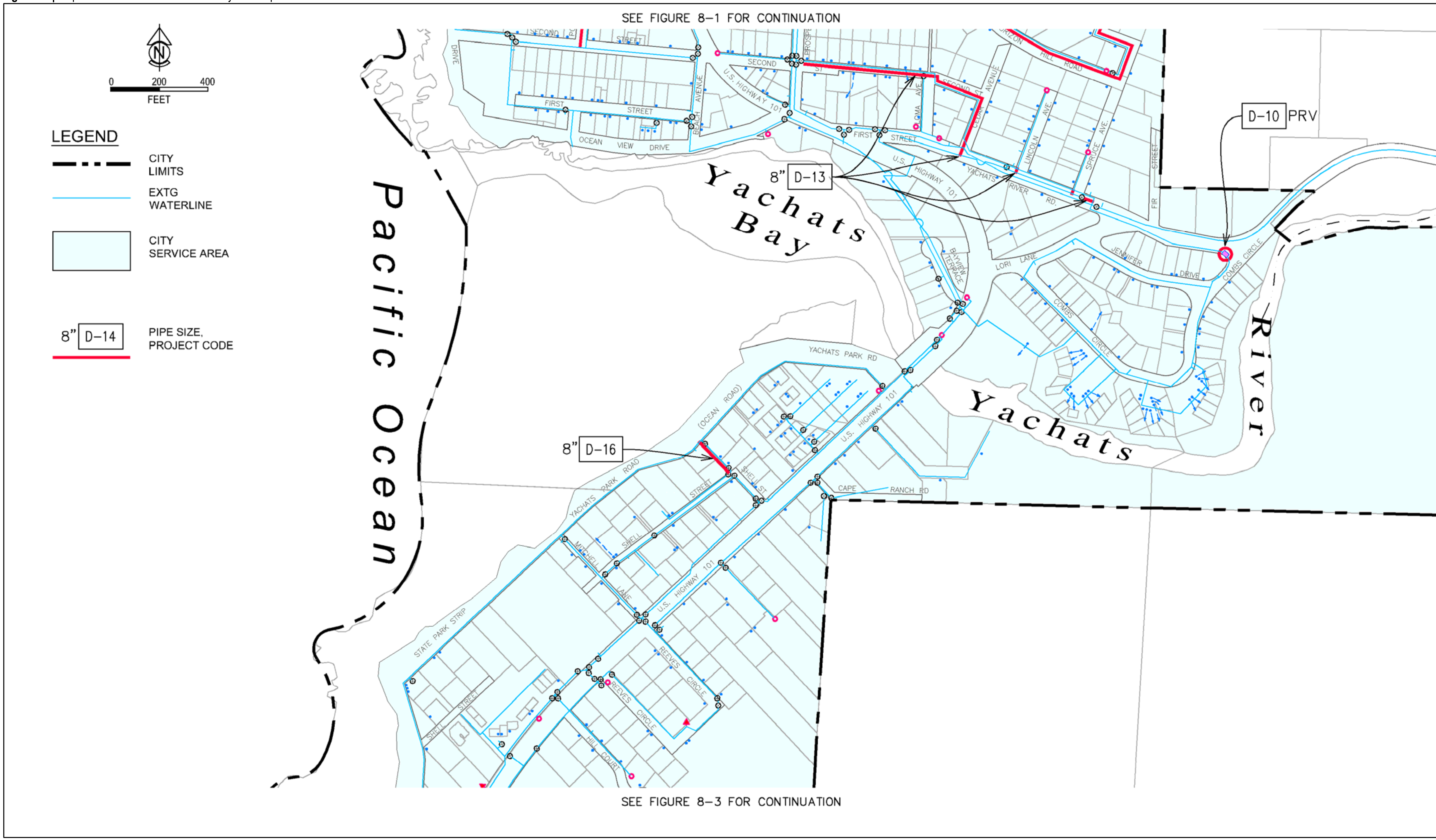
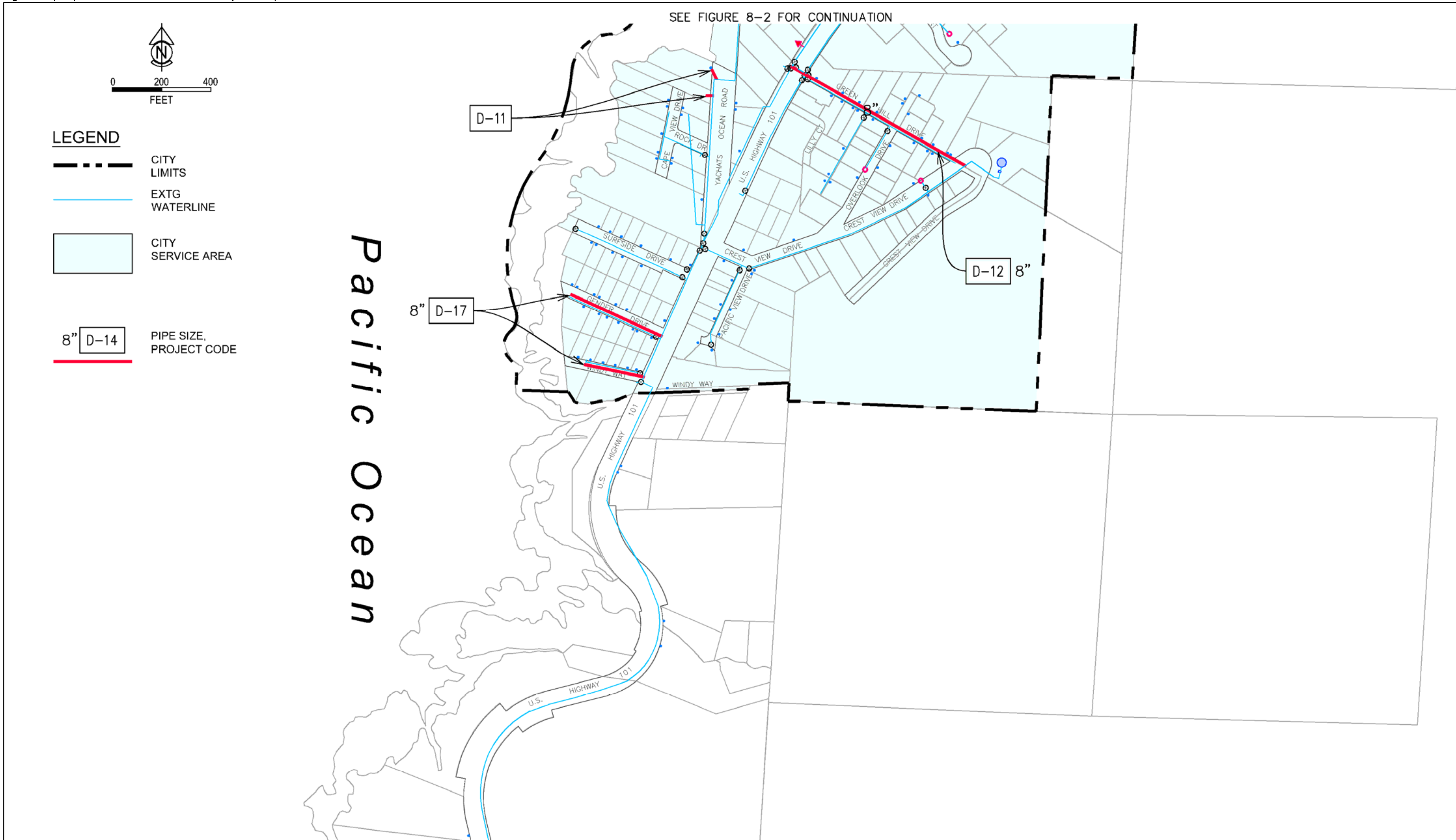


Figure 8-3| Map of Recommended Distribution System Improvements



CHAPTER 9

WATER STORAGE EVALUATION

Chapter Outline

WATER STORAGE EVALUATION

9.1 INTRODUCTION

This chapter presents an analysis and recommendations for the City's water storage facilities. Although closely integrated with the overall water distribution system as discussed in Chapter 8, this report presents water storage as a separate discussion to focus on several key issues unique to this subset of the distribution system.

The City's existing storage reservoirs are described in greater detail in Chapter 4. The City has six finished water storage tanks and one raw water storage tank. For the purposes of this evaluation, the raw water storage tank is not considered in the storage analysis because raw water must be processed by the treatment plant before it is usable to the grid. Throughout this chapter, the terms "reservoir" and "tank" are used interchangeably.

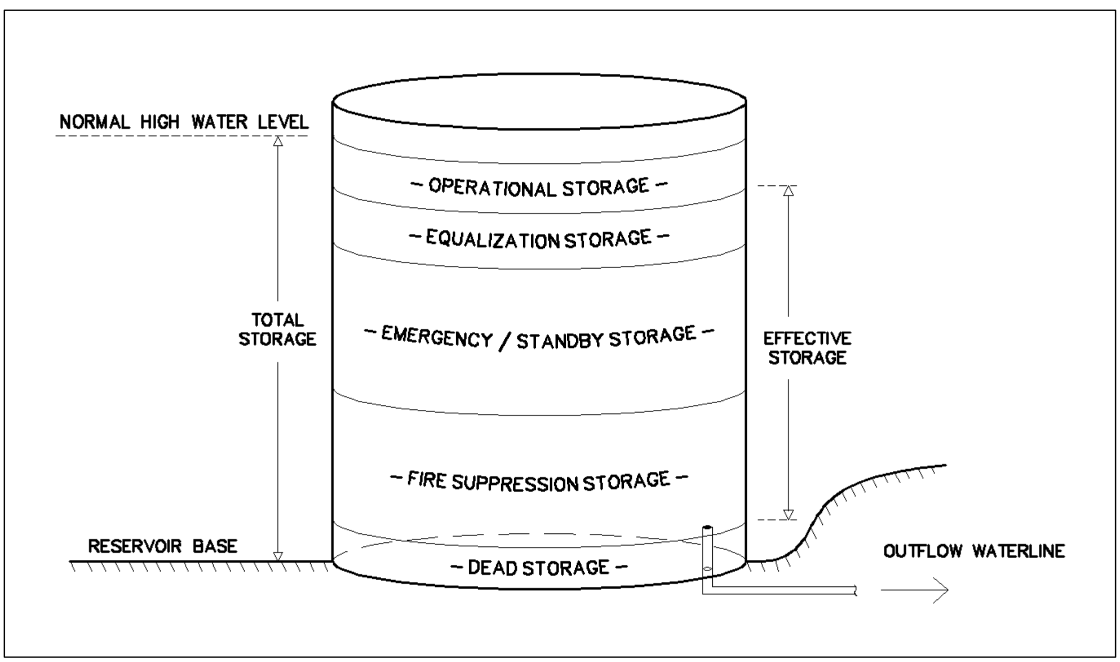
9.2 RESERVOIR EVALUATION & DESIGN CRITERIA

Per OHA-DWS rules, engineers are responsible for planning and designing stable and durable reservoirs that meet demands and protect the quality of stored water. Some of the evaluation criteria utilized in the analysis and recommendations of this chapter are discussed below.

9.2.1 Storage Volume Categories

The primary function of water storage is to provide a reserve of water to equalize daily variations between supply and consumer demand, to serve fire-fighting needs, and to meet system demands during an emergency interruption of supply. The overall storage within a system can be divided into several categories as depicted in Figure 9-1. The following sub-sections define these storage allocation categories. An evaluation of how these categories apply to the City's water system is discussed in Section 9.3.

Figure 9-1| Storage Volume Categories in a Typical Reservoir



9.2.1.1 Operational Storage

Storage volume within the upper elevation of a storage tank is used by the system operators to control the start and stop of the pumps or sources which fill the reservoir. The operational storage volume is not counted as part of the "effective storage" volume (discussed below), since emergency conditions are as likely to begin when the water level is at the bottom of the operational storage range as when it is at the top of the range. The overall elevation difference (storage volume) required by the pump control system is determined by the type of instrumentation, the number of pumps or sources that fill the reservoir, and operator preferences.

9.2.1.2 Equalization Storage

Equalization storage is storage that is utilized to meet short term consumer demands that exceed the production capacity of the supply sources. As previously discussed, water demands vary throughout the day based on the water use patterns of the community in addition to variations in use for multiday durations. Demand fluctuations are influenced by the relative mix of residential, commercial and industrial use, as well as by the weather. Commercial and light industrial use tend to be relatively constant through the normal daytime hours (with light to no use at night), while residential use fluctuates between relatively high flows in the morning, low flows during the day, higher flows in the evening, and minimal flows at night. The equalization storage volume required is typically determined as either a percentage of the peak day demand (PDD), generally 20 to 40%, or by determining the deficit between the peak hour demand (PHD) and the available supply for a determined duration—generally 2 to 4 hours.

9.2.1.3 Standby Storage (Emergency Storage)

Standby storage is storage required to meet demand during emergency situations such as power outages, supply pipeline failures or natural disasters (often termed as emergency storage). The amount of emergency storage provided can be highly variable depending upon *reliability and diversity of supply sources, an assessment of risk, and the desired degree of system reliability.*

Sources that are "continuously available to the system" means sources that comply with <u>all</u> of the following.

(1) Source is <u>either</u> gravity feed to the storage reservoir, <u>or</u> is equipped with adequate and functional pumping equipment, and the source is provided with adequate and functional treatment equipment (if required).

(2) The pumping and/or treatment equipment is regularly used (or is exercised regularly to ensure its integrity, if not regularly used).

(3) Water is available from the source year-round. The capacity of the source is limited to the flow during the lowest flow period (dry-season limited).

(4) The source activates automatically based on pre-set parameters (i.e., reservoir level, water system pressure, or other conditions).

(5) Pumped source provided with on-site auxiliary backup power equipment (with an automatic transfer switch), or there is a separate dedicated mobile generator for each source which is equipped with a manual transfer switch.

Sources which do not comply with these requirements cannot be reasonably considered to be available during a major emergency, including a system wide power outage, particularly if sources are located in rural areas where restoration of power may take some time.

9.2.1.4 Fire Suppression Storage

Fire suppression storage is storage required to satisfy the largest design fire flow demand in the system. Fire storage volume is calculated by multiplying the design fire flow rate by its required duration. For this planning effort the design fire flow volumes are identified in Section 5.6. As described in that section the largest fire flow requirement is for commercial/industrial areas and is 480,000 gallons.

9.2.1.5 Dead Storage

The volume of unusable water stored in a reservoir that either cannot be withdrawn, or which lies below the minimum recommended operating level of the reservoir (i.e., the minimum level required to maintain required suction pressure on pumps, etc). Dead storage that is not available without violating the recommended operating conditions of distribution or fire pumps cannot be counted for the purposes of water storage planning.

For Yachats, effectively all water flows by gravity from the storage tanks into the distribution system. A small amount is held in the tanks to accumulate sediment. Therefore, dead storage in the City's tanks is considered to be negligible.

9.2.1.6 Pumped Storage

Pumped storage is stored water that lies below the normal hydraulic head level of the distribution system (i.e., in ground storage tanks). This is water that must be pumped into the distribution system or into an elevated tank before it is available in the distribution system. If the pumps that move this stored water into the distribution system are not available during an emergency, the pumped storage water is also unavailable.

Yachats does not have any pumped storage and no pumped storage is recommended in this plan. All water flows by gravity from the storage tanks into the distribution system. Therefore, the reliability of pumped storage is not an issue for the City.

9.2.1.7 Effective Storage

As noted above, the total volume in a reservoir often does not equal the effective volume available to the water system. The effective storage volume is defined as the reservoir volume below the bottom of the operational storage level, minus any dead storage. Effective storage in Yachats is estimated in Table 9-1.

9.2.2 System Pressure

In most municipal distribution systems, the service pressure is determined by the elevation of the free water surface in the storage reservoirs serving the system. This is the case for the City's distribution system. Service pressures begin with available static pressure created by the Upper Radar Road Reservoir and are reduced en-route to other tanks or to the consumer by friction losses in the pipe network. In such systems supplied by tanks set above the service level (either elevated tanks or tanks set on a hill), the overflow elevation of the reservoir is a critical design factor, as it directly controls the static pressure of the system.

Service pressures in Yachats at the point of delivery typically range from 40 to 90 psi. Pressures below this range cause inaccuracies in customer meters and flow reductions during periods of high demand whereas pressures above this range can damage domestic plumbing systems. Service pressures above this range must be reduced with a pressure regulating valve. This plan recommends maintaining the existing operating pressure range in the City. Some of the lower elevation areas of the City have static pressures that exceed 90 psi. Services in these areas should be fitted with pressure reducing valves to protect the plumbing systems in the structures that are being served.

9.2.3 Water Quality

There are no specific regulatory requirements for water turnover rates in storage facilities, but industry sources suggest a complete water turnover be accomplished every 3 to 5 days. Experiences with reservoirs with cement-based internal surfaces suggest a slightly higher turnover rate of 5-7 days.

Historically water storage facilities are operated at near full levels to maintain system pressure and maximize storage volumes for emergencies; however, in times of non-emergency the large storage volumes reserved for firefighting can create water quality problems. Degraded water quality in storage facilities is frequently the result of under-utilization and poor mixing during filling cycles. As water ages, there is also a greater potential for disinfection by-product (DBP) formation.

Excessive water age can result in a diverse set of problems ranging from the loss of residual disinfectant, problems with bacterial proliferation or regrowth, increased formation of DBPs, taste and odor issues, as well as temperature and pH instabilities.

The City currently has approximately 1.6 million gallons of total storage. The existing average daily demand is approximately 0.132 mgd. Therefore, the theoretical turnover rate is about once every 12 days. This is somewhat higher than ideal conditions. However, the City does monitor the finish water quality in tanks with grab samples. Historically they have not had problems with finish water quality, including low residual chlorine and disinfection byproducts.

9.2.4 Reliability of Pumped Sources & Pumped Storage

The City has two sources of finished water, the Water Treatment Plant and the Intertie, both of which must be pumped to the City's distribution grid. As discussed in 4.1.6, the Intertie is not considered a reliable long-term source. As such, the analysis below is based on the assumption that the Intertie will not be available.

The other source of pumped drinking water can be from ground storage tanks. The City does not have any pumped ground storage tanks, so reliability of pumped storage is not an issue.

Clearly, the provision of emergency backup power and redundant pumping is critical for systems that rely heavily on pumped sources or pumped storage. The recommended water treatment plant improvements (see Chapter 7) include the installation of a backup power generator to operate the water treatment plant and the finished water pump station. Therefore, the analysis presented below is based on the assumption that the water treatment plant and the finished water pump station will be provide continuously available water by about 2025.

9.2.5 Redundancy

A lack of redundancy with regard to storage facilities is most frequently encountered when a reservoir must be taken off-line for cleaning, inspection or maintenance. While some of these procedures can be accomplished with a facility on-line, others (such as internal recoating) cannot. It is therefore recommended that the planning and construction of reservoir improvements provide the City operators with the flexibility to maintain these important facilities where feasible. For example, a seismic retrofit project is recommended for the Upper Radar Road Reservoir. This reservoir will most likely have to be taken out of service in order to complete these improvements. Redundant storage is needed in order for the City to maintain adequate fire flows during construction. Storage redundancy is also critical in the wake of natural disasters. As discussed in previous chapters, seismic events present the largest natural disaster threat to these structures.

Redundant storage is a problem in Yachats specifically for the Upper Radar Road Reservoir and for the Upper Blackstone Reservoir. As mentioned above, the Upper Radar Road Reservoir will likely need to be taken entirely offline in order to complete seismic improvements. The water system does not have the ability to fight a major fire without this reservoir in operation. Therefore, taking the Upper Radar Road Reservoir out of service without making any other improvements would increase the fire risk to the community. The recommended improvements address this problem.

Based on the storage analysis below, it is estimated that by 2025 there will be at least an excess of 0.695 million gallons of effective storage capacity. If the Upper Radar Road Reservoir is taken off line, there will be a deficit in effective storage of 0.209 million gallons (i.e., 0.695 minus 0.904 million gallons Table 9-2 and Table 9-1). This plan recommends the construction of new a 250,000 gallon reservoir near the existing 200,000 gallon Lower Radar Road Reservoir. These reservoirs could be used in conjunction to provide redundant storage while the seismic retrofits are being completed.

The Upper Blackstone Reservoir is the only water source available to the Middle and Upper Blackstone Service Levels. If this reservoir must be taken off line, temporary storage will need to be put in place to meet the demand in these levels. However, no improvements to the reservoir are identified in this plan that would require the Upper Blackstone Reservoir to be taken out of service.

9.3 WATER STORAGE ANALYSIS

The total recommended storage volume in the system is the sum of the operational, equalization, fire, and emergency storage. For this analysis, dead storage is assumed to be zero, as previously discussed. Any storage tanks built during the planning period are assumed to be designed with zero dead storage. The discussion below summarizes the assumptions under each of the methods used to establish the total recommended storage volume.

9.3.1 Storage Volume Assumptions & Estimates

- Dead Storage Assumptions

As previously discussed, there is a negligible amount of dead storage in the City's system. Therefore, dead storage is assumed to be zero.

- Operational Storage Assumption

For the purposes of this report, the operational storage was estimated as shown in Table 9-1. Operational storage is estimated as the volume of water in the top 3 feet of each reservoir. This equates to approximately 179,000 gallons.

- Effective Storage Estimate

Since Dead Storage is negligible, effective storage is estimated as the Total Storage less the Operational Storage. Effective Storage equates to approximately 1,411,000 gallons as shown in Table 9-1.

- Equalization Storage Assumptions

The equalization storage volume required is typically determined as either a percentage of the peak day demand (typically 20 to 40%), or by determining the deficit between the peak hour demand and the available supply over a given time period. Hourly flow data is not readily available for Yachats. Therefore, it is difficult to determine the deficit between peak hour demands and supply. As such, the former method will be used to estimate the required equalization storage. Since Yachats is a relatively small community, the hourly fluctuations in water usage are likely to be higher than for larger communities. In larger communities, commercial and industrial users tend to dampen hourly variations. Whereas in smaller communities, hourly usage patterns are primarily influenced by residential users. Based on this reasoning, equalization storage in the amount of 40% of the peak day demand is recommended.

Table 9-1| Reservoir Operational and Effective Storage

Reservoir	*Total Storage Volume (gallons)*	*Max. Normal Water Height (ft)*	*Reservoir Draw-down (ft)*	*Operational Storage (gallons)*	*Effective Storage (gallons)*
Upper Radar Road	1,000,000	31.5	3.0	95,239	904,761
Lower Radar Road	200,000	14.75	3.0	40,678	159,322
Horizon Hill	10,000	10.0	3.0	3,000	7,000
South	250,000	32.5	3.0	23,077	226,923
Middle Blackstone	10,000	17.25	3.0	1,740	8,260
Upper Blackstone	120,000	23.5	3.0	15,320	104,680
TOTAL	1,590,000	-	-	179,054	1,410,946

- Standby Storage Assumptions

A common approach for determining the amount of standby storage required is to provide twice the average daily demand minus the production rate from sources that are considered to be “continuously available to the system.” This approach will be used for the storage analysis presented below. As discussed in the other chapters of this plan, the recommended improvements include improvements to the existing water treatment plant and finished water pump station. These improvements include a backup power generator as well as other mechanical improvements that will allow the plant to continue to produce and pump its nominal capacity of 0.5 mgd even during power outages. Therefore, this analysis is based on the assumption that the treatment plant improvements will be constructed early in the planning period and that the water treatment plant and associated pump station will meet all of the criteria identified above (see section 9.2.1.3) to be classified as “continuously available to the system.” In an effort to be conservative, it is assumed that the plant will be continuously producing only the average day demand on a regular basis by 2025.

- Fire Suppression Storage Assumptions

As discussed in Chapter 5, this report utilizes a design fire flow event of 2,000 gpm with a duration of 4 hours, which equates to a total fire flow volume of 480,000 gallons.

9.3.2 Storage Volume Evaluation

The total recommended storage in the system is the sum of operational, equalization, fire, and standby storage (while discounting any dead storage).

Based upon the criteria discussed above, the storage requirements were evaluated to determine the required storage volumes through the end of the planning period. Table 9-2 lists the required water storage that will be necessary for Yachats during the planning period in response to the increased demand associated with the anticipated population growth. The table is based on the assumption that the water treatment plant and finished water pump station improvements will be constructed prior to 2025.

Table 9-2 shows a significant storage excess currently and through the planning period. Therefore, no additional storage is needed from a capacity standpoint. Also, once the water treatment plant improvements are completed, the “continuously available water” supply further decreases the need for storage. As previously discussed, in regards to redundancy, the City could ramp up average daily production of water to meet demands as a way of buffering their needs for excess storage. Additionally, this plan recommends replacing the Lower Radar Road Reservoir while the existing reservoir is in service. It is recommended that both the old and new reservoirs stay in operation temporarily while the Upper Radar Road Reservoir seismic improvements are completed.

It is important to note that the storage requirements shown in Table 9-2 are based on the assumption that at least the average day demand of water production is continuously available to the system by the year 2025. For this assumption to be valid, improvements to the water treatment plant and finished water pump station must be completed prior to 2025. Additionally, the water treatment plant must be equipped with auxiliary power to ensure that water can be produced during a power outage. For simplicity, Table 9-2 does not account for the increased volume of the recommended new Lower Radar Road Reservoir or the new Horizon Hill Reservoir. It is unknown when these projects would be constructed and their construction does not significantly affect the storage volume recommendations in this document.

Table 9-2| Water Storage Evaluation

Year	2020	2025	2030	2035	2041
Total Service Population	2,191	2,350	2,520	2,703	2,853
ADD (mgd)	0.132	0.142	0.153	0.164	0.174
PDD (mgd)	0.219	0.235	0.252	0.270	0.285
Continuously Available Daily Water Production (mgd)	0.000	0.142	0.153	0.164	0.174
Equalization Storage (mg)	0.088	0.094	0.101	0.108	0.114
Fire Suppression Storage (mg)	0.480	0.480	0.480	0.480	0.480
Standby Storage (mg)	0.264	0.142	0.153	0.164	0.174
Effective Storage Required (mg)	0.832	0.716	0.734	0.752	0.768
Existing Effective Storage (mg)	1.411	1.411	1.411	1.411	1.411
Storage Excess (mg)	0.579	0.695	0.677	0.659	0.643
Storage Deficit (mg)	None	None	None	None	None

9.4 EVALUATION OF EXISTING STORAGE TANKS

This section builds on the information presented in Chapter 4 and presents an overview of the existing issues with the City's storage tanks.

9.4.1 Upper Radar Road Reservoir

As described in Section 4.4.1, the existing Upper Radar Road Reservoir was constructed in the 1990's and the structural components of the tank are not likely to be sufficient to withstand seismic loads required by current building codes. The City should, therefore, consider structural upgrades to improve the seismic resiliency of the tank. A seismic evaluation of the tank is recommended. This may require the tank to be drained and taken out of service for a few days. The goal of the seismic evaluation should be to determine the scope and costs of any required structural improvements to bring the tank structure into compliance with current building codes.

9.4.2 Lower Radar Road Reservoir

As described in Section 4.4.2, the existing Lower Radar Road Reservoir was built in 1945 and is roughly 80 years old. Given its age it is very likely that this facility does not meet the requirements of current seismic codes and needs to be seismically retrofitted. The challenge with this is that good records do not exist that identify the critical structural elements of the tank (e.g., thickness of the tank walls, roof support structure, etc.), so, the tank would need to be taken out of service and drained in order to perform a detailed structural inspection. Given its age and the substantial cost associated with seismic improvements, it is recommended that funds would be better allocated to installing a new tank that meets seismic codes. This tank would serve the needs of the City for many years to come. One of the advantages of replacing the tank with a new tank is that the new tank can be constructed next to the existing tank and both tanks can remain in service to provide fire suppression storage to the community while the seismic upgrades to the Upper Radar Road Reservoir are being completed. Once the improvements to the Upper Radar Road Reservoir are completed, the old 1945 tank can be decommissioned.

9.4.3 Horizon Hill Reservoir

The Horizon Hill Reservoir is integral to the Horizon Hill Pump Station. Both share the same structure and are partially embedded in the hill side. Both facilities have been in service for numerous decades and will need substantial improvements to keep them in service through the planning period. It is very likely that the Horizon Hill Reservoir and Pump Station will need seismic retrofits to meet current codes. It is recommended that these facilities be entirely replaced during the planning period with new infrastructure that meets current standards. Entire replacement will ensure that the facilities serve the needs of the City for well beyond the planning period.

9.4.4 Middle Blackstone Reservoir

The Middle Blackstone Reservoir is constructed of welded stainless steel and is anchored to a concrete slab. It was constructed relatively recently as a part of the Blackstone Development. No improvements to this facility are expected to be needed during the planning period.

9.4.5 Upper Blackstone Reservoir

The Upper Blackstone Reservoir is constructed of cast-in place concrete. It was constructed relatively recently as a part of the Blackstone Development. No improvements to this facility are recommended during the planning period.

9.4.6 South Reservoir

The South Reservoir is constructed of bolted steel. It was constructed recently. No improvements to this facility are expected to be needed during the planning period.

The recommended storage system improvements are discussed in greater detail in the following section.

9.5 RECOMMENDED IMPROVEMENTS

The analysis presented in this chapter and in Chapter 4 shows the need for six storage tank improvement projects during the planning period. These are abbreviated with “ST”. These improvements generally include structural improvements to improve the seismic resiliency of the tanks and replacement of tanks that have reached the end of their useful life.

The most critical improvement project is the seismic analysis and retrofit of the Upper Radar Road Reservoir. In order to perform any structural improvements, the tank will most likely need to be removed from service for several months. Draining this reservoir creates an estimated deficit of 309,000 gallons of required storage. This does not allow a sufficient volume to fight a moderate to large size fire. As such, removing the tank from service without providing some other means of storage is not recommended. Therefore, the recommended improvements include the construction of a new tank adjacent to the existing Lower Radar Road tank. This tank will eventually replace the 1945 vintage Lower Radar Road Tank. However, both tanks should remain in service until the seismic retrofit work is completed for the Upper Radar Road Tank. This approach will maintain a reasonable amount of fire storage in the community during the improvement process. Once the seismic retrofit work on the Upper Radar Road Tank has been completed, the old 1945 tank can be decommissioned.

The recommended improvement projects are described in the following paragraphs. The projects are listed sequentially in the order in which they should be performed. The recommended project budgets include construction costs as well as soft costs such as permitting, engineering, legal, and administrative costs. A ranked prioritization of these projects into a comprehensive implementation plan is presented in Chapter 12.

- **New 250,000 gallon Lower Radar Road Reservoir – Project ST-1**

A new 250,000-gallon concrete storage reservoir is recommended next to the existing Lower Radar Road Reservoir. This new reservoir is intended to replace the existing Lower Radar Road Reservoir. Both reservoirs are recommended to temporarily be in service at the same time to provide redundant storage while improvements are made to the Upper Radar Road Reservoir. The existing tank is roughly 80 years old and will likely reach the end of its useful life during the planning period. The old 1945 and the new tank should remain in service for a period of time to allow the construction of the seismic improvements to the Upper Radar Road Tank. Once the seismic improvements are completed, the old 1945 tank can be removed from service. Valves and piping for the new reservoir will need to be able to connect to both the Upper and Lower Radar Road Service Levels. It is recommended that Project ST-1 take place prior to project ST-2 in order to facilitate this redundancy. As a side note, once the existing reservoir is demolished, the current location of the Lower Radar Road Reservoir could provide a site for a second reservoir in the future. The recommended budget for this project is $1,717,000. A detailed breakdown is included in Appendix B. The recommended budget includes funds for the installation of a seismic valve on the tank outlet line.

- **Upper Radar Road Reservoir Seismic Evaluation - Project ST-2**

A seismic evaluation is recommended for the Upper Radar Road Reservoir. It is unlikely that the existing structure meets seismic design criteria identified in current building codes. The goal of the analysis should be to identify the scope and cost of any needed structural improvements. For this master planning effort, we have assumed that it will be most cost effective to retrofit the existing structure rather than replace it. However, the seismic evaluation may show that the opposite is actually true. If so, this plan should be updated accordingly. To perform the seismic evaluation, the City will need to retain the services of a qualified structural engineer. The engineer will need to review the plans and may need to take samples of the concrete. It may also be necessary to drain the tank for a short period (i.e., 1-3 days) of time in order to inspect the interior components. The recommended budget for this project is $50,000. A detailed breakdown is included in Appendix B.

- **Upper Radar Road Reservoir Seismic Retrofit Improvements - Project ST-3**

Structural improvements are expected to be needed to address seismic issues for the Upper Radar Road Reservoir. The extent of these improvements will not be known until Project ST-2 is completed. The budget estimate for this project includes reasonable estimate of the costs for the seismic upgrades (Appendix B). However, this is a “placeholder” value that should be confirmed early in the design process. As noted above, this master planning effort is based on the assumption that it will be more cost effective to retrofit the existing structure rather than replace it. However, the seismic evaluation (i.e., Project ST-2) may show that replaced is the better option. If so, the City will need update the capital improvement plan accordingly. The recommended budget for this project is $1,013,000. A detailed breakdown is included in Appendix B. In addition to structural improvements the recommended project budget includes funds for the installation of seismic valves on the tank outlet line.

- **New 20,000 gallon Horizon Hill Reservoir – See Project P-2**

A new 20,000 gallon reinforced concrete reservoir is recommended to replace the existing Horizon Hill Reservoir. This project is expected to be completed in conjunction with the project to replace the Horizon Hill Pump Station (Project P-2) and is described in greater detail in Chapter 8.

9.6 SUMMARY OF RECOMMENDED STORAGE TANK IMPROVEMENTS

Several water storage improvement projects have been identified above. These projects are summarized in the following table. These projects are assigned a priority ranking in Chapter 12.

Table 9-3| Recommended Treatment System Improvements

Project Code	Description	Recommended Budget
ST-1	New 250,000-gallon Lower Radar Road Reservoir	$1,717,000
ST-2	Upper Radar Road Reservoir Seismic Evaluation	$50,000
ST-3	Upper Radar Road Reservoir Seismic Retrofit Improvements	$1,013,000
ST-4	New 20,000-gallon Horizon Hill Reservoir	See Project P-2

CHAPTER 10

SEISMIC RISK ASSESSMENT & MITIGATION PLAN

Chapter Outline

10.1 INTRODUCTION

OAR 333-061-0060(5)(J) requires every community water system with more than 300 connections to conduct a seismic risk assessment and mitigation plan as part of a water master planning effort. This requirement only applies to communities located within hazard levels VI through X shown in Figure 10-1. The City is located within this hazard level. Therefore a seismic risk assessment and mitigation plan was conducted as part of this master planning effort. The results of this analysis are presented in this chapter.

10.2 REGULATORY REQUIREMENTS

The requirements for the seismic risk assessment and mitigation plan are stipulated in OAR 333-061-0060(5)(J) and include the following.

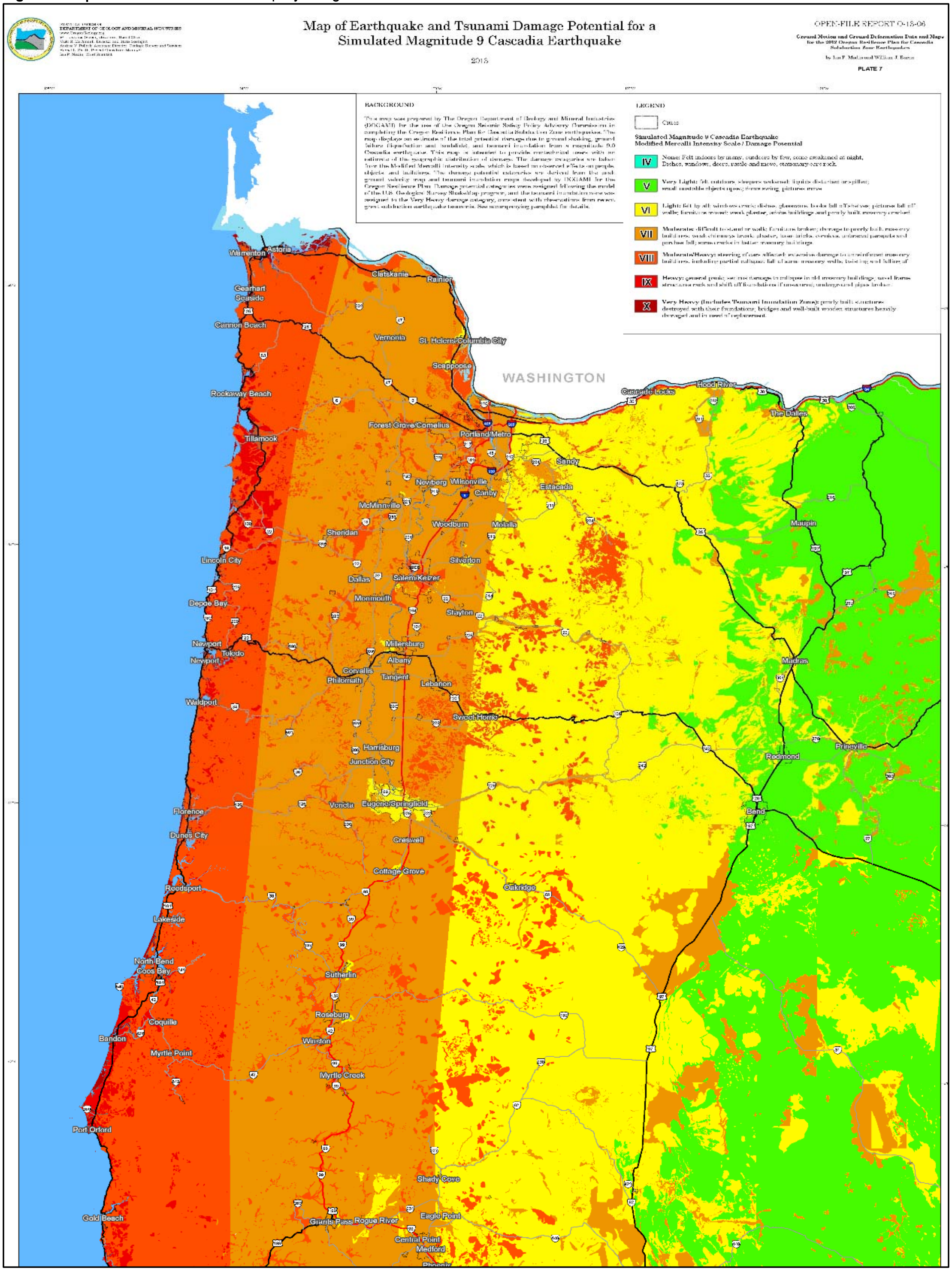
"(J) A seismic risk assessment and mitigation plan for water systems fully or partially located in areas identified as VII to X, inclusive, for moderate to very heavy damage potential using the Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake, Open File Report 0-13-06, Plate 7 published by the State of Oregon, Department of Geology and Mineral Industries.

(i) The seismic risk assessment must identify critical facilities capable of supplying key community needs, including fire suppression, health and emergency response and community drinking water supply points.

(ii) The seismic risk assessment must identify and evaluate the likelihood and consequences of seismic failures for each critical facility.

(iii) The mitigation plan may encompass a 50-year planning horizon and include recommendations to minimize water loss from each critical facility, capital improvements or recommendations for further study or analysis."

Figure 10-1| Seismic Hazard Level Map by Oregon State DOGAMI



10.3 CRITICAL FACILITIES

The critical facilities needed to supply water to the community include the Salmon Creek and Reedy Creek water intakes, the raw water transmission pipe between the intakes and the water treatment plant, the water treatment plant, the 12-inch transmission main from the treatment plant to the Upper Radar Road Storage Reservoir, the Upper and Lower Radar Road Storage Reservoirs, the main distribution system artery extending to the South Reservoir, the South Reservoir, and the main distribution system artery running north along Highway 101. Together these facilities form the backbone of Yachats's water system. These facilities are shown in Figure 10-2.

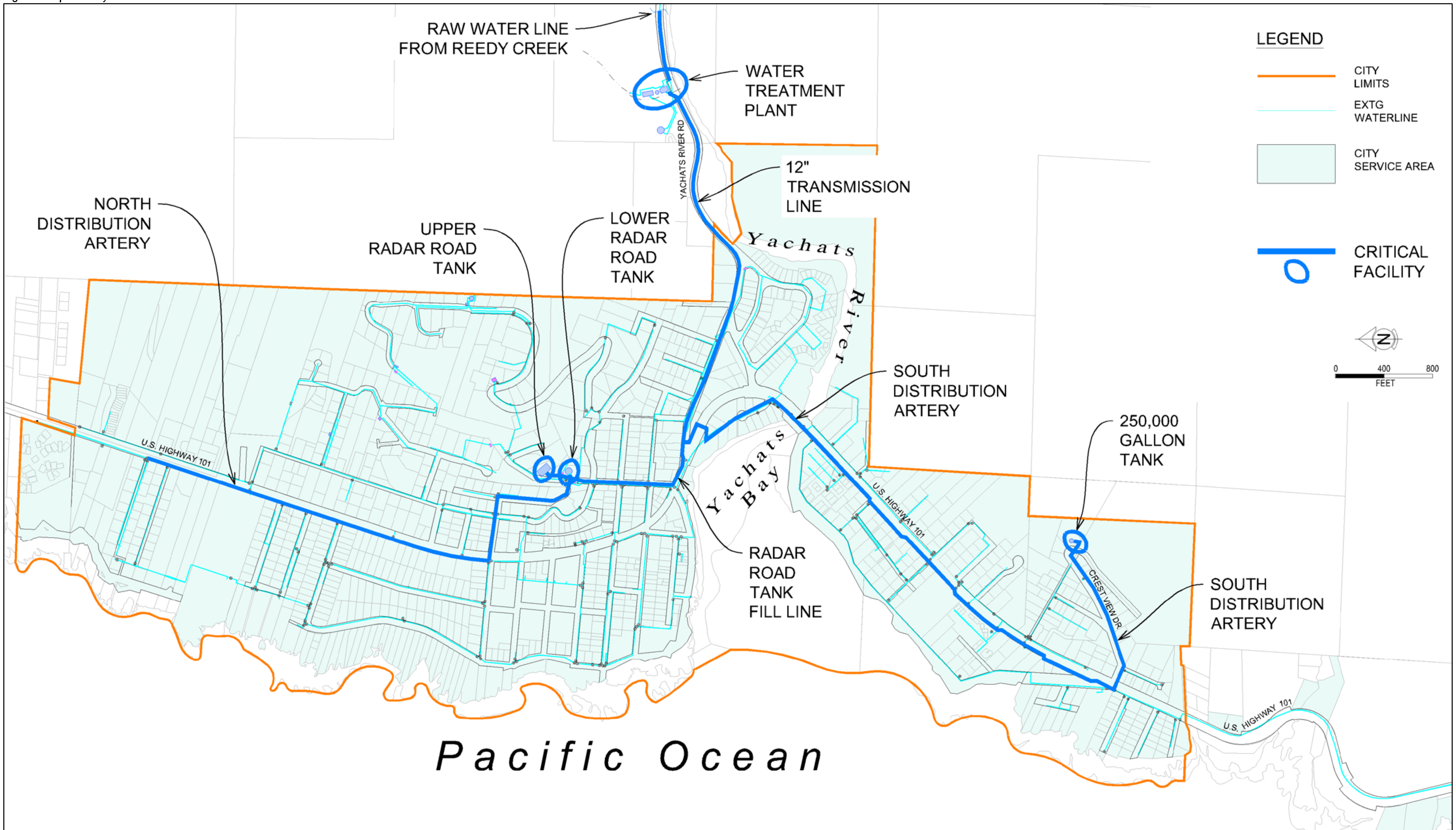
10.4 LIKELIHOOD AND CONSEQUENCES OF FAILURE

This subsection includes an analysis of the likelihood and consequences of failure for each of the critical facilities identified in the previous section. A catastrophic failure of any of these facilities will severely impact the City's ability to produce and deliver drinking water to the system.

- Water Treatment Plant and Upper Radar Road Reservoir

The recommended capital improvement plan includes a seismic retrofit for the water treatment plant building (Project T-7) and a seismic evaluation (Project ST-2) and seismic retrofit (Project ST-3) for the Upper Radar Road Reservoir. It is unclear if these improvements will be completed in current planning period or if they will be deferred to the next planning period. Either way, it is anticipated that these improvements will be completed within a 50-year time frame. The seismic retrofit elements of the project will all be designed in accordance with current building and seismic codes. Current building codes require the structural design to be based on Risk Category IV. The seismic load for design will also be increased by 50% since these will be deemed "essential facilities." Therefore, once the seismic retrofits are completed, the likelihood of catastrophic failure of these facilities in response to a large seismic event should be minimized. The Upper Radar Road Reservoir is located well above the Tsunami Hazzard Zone, so it should not be impacted by a large Tsunami. On the other hand, the Water Treatment Plant is located within the Tsunami Hazzard Zone and may be significantly damaged by a large Tsunami. This is a weakness in the City's system and the only way to correct this problem is to move the treatment plant to higher ground. The treatment plant has a significant amount of design life remaining. As the facility continues to age, it may eventually make sense to abandon it and construct a new treatment plant. At that time, the City should consider moving the plant to a higher elevation.

Figure 10-2| Water System Critical Facilities



- Raw Water Transmission Pipeline

Water is conveyed from the Reedy Creek Intake to the treatment plant through a pipeline that is approximately 8,400 feet long. The first 1,500 feet of this pipeline is old AC pipe, the remaining 6,900 feet is relatively new HDPE pipe. The recommended improvements listed in this plan include replacing the AC section with HDPE pipe (Project S-4). Once this project is completed, the entire pipeline from Reedy Creek to the treatment plant will be HDPE pipe. HDPE pipe is perhaps the most resilient of the piping materials to ground motion. In an HDPE pipeline, all pipe segments are heat fused together, so there are no joints and the piping can withstand large deflections associated with seismic ground motions. Therefore, the risk of a failure of this pipeline during a seismic event will be relatively low after the completion of Project S-4.

- New Lower Radar Road Tank Gallon Tank.

This plan recommends the construction of a new tank to replace the Lower Radar Road Reservoir (Project ST-1). This will be a new facility designed in accordance with current building and seismic codes. As such, the risk of a catastrophic failure after a large earthquake should be minimized.

- South Tank

The South Tank was constructed in 2018. Therefore, the tank is modern and was constructed in accordance with current building and seismic codes. Therefore, the risk of a catastrophic failure after a large earthquake should be minimal.

- Finish Water Transmission Main

Water is conveyed from the water treatment plant to the Upper Radar Road Tank through a 12-inch transmission pipeline. This pipeline was constructed in three segments. The portion from the treatment plant to about Spruce Avenue was constructed in the early 2000s using HDPE pipe. The about Spruce Avenue to Highway 101 was constructed in the early 2000s using PVC pipe. The segment from Highway 101 to the to the Upper Radar Road Tank was constructed in the early 1990s using PVC pipe. Overall, the pipeline is relatively new and in good condition. The HDPE segment has good seismic resiliency. The PVC sections are less seismically resilient since the pipe joints are not restrained. A failure in this pipeline would severely impact the City's ability to supply water to the City's customers. Therefore, it would be ideal if this entire pipeline was HDPE. However, since the PVC sections are relatively new and have a significant amount of design life remaining, the City has no plans to replace them during the planning period. At some point in the future, the PVC segments will reach the end of their useful life due to age. At that time, the City should consider replacing the pipelines with materials that are more seismically resilient.

- Main Water Distribution System Arteries

Yachats's water system includes two main pipeline arteries through the grid (Figure 10-2). Most of the "South Artery" was constructed in the early 1990s using PVC pipe. The section of the "South Artery" between Highway 101 and the South Tank was constructed 2018 when the South Tank was constructed. This segment was also constructed using PVC pipe. The "North Artery" consists of several pipe segments that were constructed at different times with different pipe materials. Some of these segments are relatively new and some are older. For both the "South Artery" and the "North Artery" the individual pipeline segments are typically joined by unrestrained push-on joints. As such, the pipe joints are susceptible to being pulled apart if subject extreme ground motions. Therefore, some pipe failures in the distribution system are likely to occur during a large earthquake event. The distribution grid includes a network of pipes that provide multiple flow paths through the City. Therefore, even if a main pipeline artery is ruptured, there is a good chance that the segment can be isolated and bypassed for repair while still maintaining water flow to the majority of the City. Overall, the distribution piping is probably the one element of the City's system that is most susceptible to failure during a large seismic event. The recommended improvements described in this plan include replacing a small segment of the existing "North Artery" in Radar Road (Project D-6), adding an additional artery in King Street (Project D-7) and a relatively long section of the artery in Highway 101 from Sixth Street to Marine Drive (Project D-14). The City should consider using earthquake resistant piping materials for these projects.

10.5 MITIGATION PLAN

The recommended mitigation plan over the next 50 years consists of various capital improvements and recommended changes to some of the City's design & construction standards. Each element of the plan is discussed in this section.

- Reedy Creek Raw Water Pipeline Improvements (Project S-4)

The capital improvement plan recommended in this document (Chapter 12) lists project S-4 as a priority 1 improvement project. Project S-4 includes replacing the segment of the Reedy Creek raw water pipeline from the Reedy Creek Intake to Yachats River Road. This pipeline should be constructed using HDPE pipe with fused joints. Once this project is completed, the entire pipeline from the Reedy Creek intake to the treatment plant will be HDPE which is very resistant to ground motions caused by seismic events.

- Water Treatment Plant Building Seismic Retrofit (Project T-7)

The capital improvement plan includes a seismic retrofit of the treatment plant building. It is envisioned that this project will include targeted improvements to the treatment plant building structure that will improve overall seismic resiliency. These improvements will reduce the risk of a catastrophic building failure after a large earthquake. It is anticipated that this work will be completed at some point during the next 20-year planning period.

- Upper Radar Road Seismic Retrofit (Project ST-2 & ST-3)

The capital improvement plan recommended in this document (Chapter 12) include projects ST-2 and ST-3. These projects include a seismic evaluation of the reservoir structure and structural modifications to improve the overall seismic resiliency of the structure.

- New Lower Radar Road Reservoir (Project ST-1)

The capital improvement plan recommended in this document (Chapter 12) lists project ST-1 as a priority 2 improvement project. The project includes a new storage tank that will be designed in accordance with current building codes, which take into consideration large seismic events. As such, the risk of a catastrophic failure after a seismic event should be minimized. The new tank will eventually replace the existing Lower Radar Road tank. Thereby improving the overall seismic resiliency of the City's system.

- Raw Water Transmission Pipeline

The segment of the raw water transmission pipeline from the treatment plant to about Spruce Street was constructed using HDPE pipe. This section of the pipeline offers good seismic resiliency. The portion from Spruce Street to the Upper Radar Road Reservoir was constructed using PVC pipe. The PVC segments are relatively new and have a significant amount of design life remaining. Eventually, these segments will reach the end of their useful life due to age. At that time, the City should replace these segments with earthquake resistant materials. This will likely be needed in about 50 years and can be included as part of a future master planning effort.

- Main Water Distribution Arteries

The main water distribution pipelines that supply water to the City (Figure 10-2) primarily consists of PVC pipe with push-on joints. So, the risk of catastrophic failure after a large earthquake is relatively high. The recommended capital improvement plan described in Chapter 12, includes replacing sections of the "North Artery" piping on King Street (Project D-7) and Highway 101 (Project D-14). These segments should be installed using earthquake resistant piping. It is anticipated that the remaining portions of the distribution arteries will reach the end of their useful life during future planning periods (i.e., after 2041). At that time, these pipelines should also be replaced with earthquake resistant piping systems.

- Emergency Fuel Storage Cache

After a large earthquake, the line-power needed to operate the City's water system may not be available for several days or longer. The commercial fuel supply is also likely to be interrupted. The critical components of the City's water system will eventually be equipped with backup power generators. However, the onsite fuel storage capacity of these generators will be somewhat limited. The City may want to consider working with other emergency services agencies in the area to establish a fuel storage cache that can be used for prolonged emergency situations.

- Earthquake Resistant Piping

The previous discussions include several references to earthquake resistant piping systems. This paragraph includes a brief introduction to this topic. Most traditional pipe materials used for buried water distribution systems were not designed to resist extreme ground motions. Most pipelines are constructed of individual pipeline segments that are jointed using bell and spigot joints that are not restrained. Therefore, they can be pulled apart if subjected to extreme ground motions. The concept of earthquake resistant piping is relatively new. Several Japanese companies have developed earthquake resistant ductile iron pipe with flexible joints that are restrained and allow the pipe joints to move in response to ground motions without pulling apart. This pipe is commonly used in Japan and manufactured by several Japanese companies. Earthquake resistant ductile iron pipe is not commonly used in the United States. Some large western cities (e.g., Los Angeles, San Francisco, Portland, Seattle) have begun importing and installing earthquake resistant ductile iron pipe. Therefore, it may become more common in the US in the future. If so, this pipe may eventually be a reasonable option for the City for future pipeline improvement projects. In the meantime, HPDE pipe is also a good option. HDPE pipe is flexible and the individual pipe segments are joined by heat fusing. With heat-fused joints, an entire HDPE pipeline acts a single pipe without joints. Therefore, HDPE pipe is able to respond to ground motion with a low risk of failure. HDPE pipe does present installation challenges in roadways subject to vehicular traffic and is not typically used in areas where water service taps are common. However, for some of the transmission pipelines recommended in this plan, HDPE pipe may prove to be the best option since these projects are not in high-traffic areas and the pipelines will not have any water services or hydrants. As various improvements to the City's distribution system are made in the coming years, the City should consider the use of earthquake resistant piping materials. Over time, as the City is able to replace existing piping with earthquake resistant piping, the overall resiliency of the distribution grid will be improved.

- Storage Tank Seismic Valves

It is recommended that any new reservoirs be constructed to with seismic sensors and actuated valves to shut off the reservoir in the event of an earthquake. It is possible that water mains will rupture downstream of the tank. The actuated valve combined with the seismic sensor will ensure that water storage is not drained in the event of a line break. Once the lines in a reservoir's service level have been verified to be intact, the reservoirs can be re-opened. The budgets for the tank projects listed in this plan are envisioned to include sufficient funds for the installation of seismic sensors and actuated valves.

CHAPTER 11

OPERATION & MAINTENANCE

Chapter Outline

11.1 INTRODUCTION

The maintenance of water systems is necessary to ensure the proper operation of the facilities and to obtain the full useful life of those facilities. Water systems represent a significant investment of public capital. If a water system is allowed to fall into disrepair because of the lack of maintenance, it will not operate efficiently or as designed. Health problems and property damage may result from leaking mains or services, mainline breaks, inoperable valves or fire hydrants. The repair of failed portions of a public water system is costly, quite often equaling or exceeding the original cost of construction. Because of this it is imperative that municipalities consistently provide adequate maintenance funding and staffing to protect their investment.

System maintenance is frequently classified as preventative or corrective. Preventative maintenance involves routinely scheduled inspections of the system and the collection of data to identify problem areas. The proper documentation and analysis of collected data should be performed so that scheduled maintenance can be allocated to specific problems. As a general rule, as preventative maintenance increases, the amount of corrective maintenance required decreases.

Corrective maintenance, often referred to as emergency maintenance, is typically performed when the water system fails, such as leaking mainlines, inoperable pumps, control systems or fire hydrants. Corrective maintenance requires immediate action and the City will typically pay a premium for the completion of this work.

Therefore, it is important to emphasize that preventative maintenance, documentation, and program evaluation ultimately result in a lower cost to the consumer by extending the life of the treatment, distribution or storage system components and reduce costs associated with unscheduled or emergency repairs.

11.2 WATER SYSTEM RECORD KEEPING

Record keeping is an important part of a successful operation and maintenance program.

Unfortunately, record keeping is often neglected because of time and staffing limitations, and the often immediate needs of other maintenance programs. The following categories of record keeping are viewed as central to improving the long term efficiency of the operation and maintenance program.

11.2.1 Water Production

The planning elements of water system expansion and water conservation are strongly rooted in the evaluation of water system demands. The recording of daily water production and billing records provide a basis for projecting future system needs and measuring the efficacy of conservation efforts. The City should continue its good practice of diligently recording water use.

Water use data collection should include:

- Daily water production from all sources and treatment facilities
- Daily amounts of water used for filter backwash
- Historical water use. Track average day, maximum day and monthly total demands.

- Unaccounted-for-water, recorded on a monthly and annual basis to include a breakdown of non-revenue water. The City should track any use of water that is not recorded by a water meter. This includes water for hydrant testing, line flushing, and any other unmetered water sources. The City should estimate quantities of water used and keep a log to document the use of unaccounted for water.
- Daily amounts of waste streams from source and treatment facilities (i.e., filter backwash).

11.2.2 Regulatory Record Keeping

It is the responsibility of the water system operations staff to develop and maintain records relating to the quality of the water produced as well as the condition of the physical components of the system. These requirements are detailed in OAR 333-061-0040. Regulatory records should be maintained at a convenient location within or near the area served by the water system. Table 11-1 provides an overview of record keeping requirements. Operators are encouraged to review the statute for the most current compliance requirements as other rule-specific requirements may apply.

Table 11-1| General Regulatory Record Keeping Requirements

Specific Record or Report	Record Retention
Residual disinfectant measurements	2 years
Copies of public notices issued pursuant to OAR 333-061-0042 and certifications made to the ODWP	3 years
Actions taken to correct violations of primary drinking water regulations	3 years [1]
Bacteriological analysis	5 years
Monitoring plans for disinfection byproducts	5 years
Consumer Confidence Reports	5 years
Records concerning variances or permits	5 years [2]
Chemical analysis, secondary contaminants, turbidity and radioactive substances results	10 years
Reports, summaries or communications on sanitary surveys	10 years
Lead and Copper Rule data	12 years

[1] Retention period begins after the last action taken with respect to the particular violation
[2] Retention period begins after the expiration of the variance or permit

The City is also encouraged to retain organized records of all correspondence with regulators, operator certificates, and the results of any comprehensive performance evaluations.

11.2.3 Operations and Maintenance Records

There are commercially available asset management software programs that allow cities to develop a comprehensive maintenance system to manage operational efforts for the water and wastewater systems (such as those developed by the Hansen Software Corporation). This computer software tracks and schedules work orders, labor expenditures, regularly scheduled maintenance activities, inspection reports, and repairs.

If the City does not currently use software of this type, it is recommended that the City consider acquiring software to maintain a detailed accounting of time spent on various operations and maintenance tasks. This information is helpful to establish the need for additional staff, equipment, training or other resources that may be required to accomplish operations and maintenance programs.

11.2.4 Water System Mapping & System Inventory

The City coordinates through the City Engineer to use AutoCAD to inventory and map their installed infrastructure. A complete inventory of the water system will greatly improve operational efficiency and will enhance future planning efforts.

As is often the case with municipal systems this size, the City relies on the memory and experience of staff members to provide a full account of many system details. As the City continues to grow, it becomes increasingly important that this wealth of information is transferred and organized into a formalized record keeping system.

11.3 Water Use Audit

The definition of unaccounted-for-water is defined as water which is lost through leaks, evaporation, or use that is not recorded and/or accounted-for. Unaccounted-for-water includes distribution pipe leakage, unmetered water use such as fire fighting, hydrant flushing, overflows, street cleaning, and WTP backwash water or instrumentation error.

In recent years, the City has started performing these audits (see section 5.4.2) and this practice should continue. Requirements for annual water audits are set forth in OAR 690-086-150(4a). The City should begin with an inventory of all unmetered uses and install metering devices at these locations to the greatest extent possible. In the event metering is not feasible, estimates should be made to record the unmetered use.

New water meters may need to be installed to properly track waste sources such as backwash and filter-to-waste at the treatment plant. The installation of these meters will allow the City to establish a monthly audit of its raw and treated water systems.

An annual water audit should utilize the sum of all metered sales from each customer class and production records and should be performed in a systematic and well-documented manner to accurately quantify all authorized unmetered and unauthorized uses.

11.4 Leak Detection

The City performs leak detection work about every two to three years. This includes hiring a leak detection firm to inspect the entire distribution system. The City's existing practices are good and should continue indefinitely. Therefore, this plan recommends establishing a formal leak detection program that with an annual budget line item. Specific recommendations are included in Section 8.4.2.

11.5 Distribution System Flushing Program

Maintaining water quality and preserving the hydraulic capacity of a water distribution system is a key concern for water utilities. Mineral precipitation, microbiological activity, and corrosion can all form deposits on the pipe walls and contribute to a reduction in flow and water quality.

Flushing the distribution water mains is an effective way to maintain water quality and system capacity.

A properly conducted flushing program can improve water quality by restoring the disinfectant residual, reducing bacterial regrowth, dislodging biofilms, removing sediments and deposits, controlling corrosion, restoring flows and pressures, eliminating taste and odor problems, and reducing disinfectant demand throughout the system. These benefits prolong the life expectancy of the distribution system and reduce the potential for waterborne disease outbreaks.

11.6 VALVE EXERCISING

Many components of the water system require periodic maintenance to remain functional. Valves and hydrants, in particular, must be exercised on a regular basis to ensure that they remain in operational condition. It is commonly recommended that all valves be exercised annually; however, this is often times not practical due to staffing limitations.

A complete valve exercising program should include the following elements:

- Systematically locating and accessing all distribution system valves. Often valves boxes have been paved over or are partially buried and are difficult to locate. Valve boxes should be cleaned out to fully expose the valve nut, adjusted and realigned as necessary to allow unobstructed access to the valve. Structurally damaged valve boxes should be replaced.
- Each valve should be operated a minimum of two full cycles and an additional cycle if the torque on the valve is high.
- Replacement of the gland packing. In many cases minor leaks in the packing will stop once the gland packing is wetted and is exercised; however, the valve should be repaired if the packing is damaged and the leak does not stop.
- All data collected from the event (valve location, size, initial open/closed status, number of turns, torque (if measured), and any other anomalies should be entered into the City's maintenance database.
- Perform minor street repairs around the valve box as required.

Valve exercising should be coordinated with flushing operations to ensure that any debris in the distribution system dislodged by the valve exercising is flushed from the system.

In cases where staffing levels do not permit the execution of a full exercising program staff should focus on operating each valve greater than 12-inches on an annual basis and other system valves on a 4 year cycle.

11.7 CROSS-CONNECTION CONTROL PROGRAM

Oregon Administrative Rules 333-061-0070 through 0074 detail the requirements for a cross-connection control program. The City is required to establish a cross-connection ordinance and must submit an annual report to ODWP. Systems with more than 300 service connections are required to provide a certified tester.

The City currently has a cross-connection control program. The City currently employs at least one certified cross connection control specialist. This person is responsible for inspecting new devices and installations, monitoring annual inspections, terminating water service in cases of non-compliance, and compiling and submitting the annual inspection report to ODWP.

The City should continue funding this program and work to integrate the location of all backflow devices into the water system mapping. The identification and monitoring of high risk installations is also recommended. In some cases, high hazard assemblies are tested every six months.

11.8 MASTER METER MAINTENANCE

Master meters are installed at the Water Treatment Plant and record the total water pumped though the treatment plant and into the distribution grid. Data from these meters is utilized in conjunction with consumed water from metered connections to establish benchmarks for water loss.

Discussions with staff indicate that some of these meters have not been calibrated for some time, and there is no program designated to accomplish this. It is recommended that these meters be calibrated on an annual basis to ensure that water loss and other operational decisions are being made on a sound basis. Eventually these meters will reach the end of their useful life and will need to be replaced. One of the recommended treatment system projects described in Chapter 7 included replacing these meters.

11.9 CUSTOMER WATER METER MAINTENANCE

The accuracy and performance of water meters is vital to utilities whose billable revenues are derived directly from the collected readings. Loss of revenue from inaccurate or broken meters can be significant and may warrant a meter testing schedule. Meters tend to under-register over time because of wear and deposits and since almost all meters lose accuracy with age, any utility can sooner or later find economic justification for meter maintenance.

11.9.1 Large & Mid-size Meters

An important part of a water utility's operations should be a systematic testing and maintenance program for its larger meters. Large meter installations typically represent a significant portion of a utility's revenue and the cost of a program that focuses on proper installation, maintenance and calibration of these larger meters is often small compared to the potential gain in revenue. Large meters are typically defined as those that are 2-inches or larger.

It is recommended that meters 2-inches and larger be calibrated annually. Large meter installations should be inspected to confirm whether strainers, isolation valves and test ports are present. The length of exposed straight pipe in the meter set should be observed for conformance to the manufacturer's recommendation. Flow-demand recording devices can be utilized to confirm that larger meters are appropriately typed and not oversized for the service they see since significantly oversized meters can result in lost revenue because of inaccurate registration during periods of low flow. Using the correct size and type of meter for each application, combined with routine calibrations, will ensure that customers are charged equitably for water use.

11.9.2 Conventional Meters

The City has been relatively proactive about maintaining and replacing the customer meters. The City only has about 50 meters that are approximately 20 years old. All other meters have been upgraded to touch read meters or radio read meters. This practice should continue indefinitely. Customer meters need to be replaced at approximately 20-year intervals. The City's current practice of replacing a portion of the meters every year or every few years is a good approach to maintaining accurate customer meters. Based on discussions with City staff, the existing meter replacement practices are considered to be adequate and no changes are recommended in this plan.

11.10 HYDRANT MAINTENANCE AND REPLACEMENT

Hydrants are maintained and replaced on an as-needed basis as they are damaged, or as problems are identified in the flushing and hydrant testing programs. Due to budgetary constraints, there is currently no formal hydrant infill program other than the policy of replacing or augmenting hydrants as waterlines are constructed and/or replaced.

Ultimately it is the community, through its economic decisions with respect to taxation and user fees, that determines the standard of fire protection and coverage. To the degree that funding is available the City is encouraged to develop an inventory of existing hydrant coverage and to integrate this in the maintenance program so that future infill efforts can proceed in a logical fashion.

11.11 Reservoir Inspection and Maintenance

Reservoirs should be inspected and potentially cleaned every 5 years. This process typically requires the use of divers. Historically the City has hired divers to clean and inspect the City's reservoir on an as-needed basis. In an effort to formalize this maintenance activity the City should work on establishing an annual reservoir maintenance program (on a rotating basis), with a proposed annual inspection budget of $1,500. Since the City has historically performed reservoir inspection work, we have assumed that the existing operation and maintenance budget can absorb the costs of this work, so, a line item for this recurring program is not included in the recommended capital improvement plan presented in Chapter 12.

11.1 Staffing Levels

The Public Works Department currently employs five full-time employees, with seasonal help hired as needed. The City currently dedicates 1.5 full-time employee to the operation and maintenance of the water system. Overall, the City's current operation and maintenance practices are very good. The recommended changes to the City's operation and maintenance practices identified in this chapter are not likely to require an additional crew member. Therefore, the City should maintain the current level of staffing, and ensure that staff has the required certifications for all aspects of the water system operations, monitoring & maintenance.

CHAPTER 12

CAPITAL IMPROVEMENT PLAN

Chapter Outline

CAPITAL IMPROVEMENT PLAN

12.1 INTRODUCTION

As documented in the previous sections, there is a need for water system improvements within the study area to correct existing and projected deficiencies. Some of these deficiencies are more critical than others. While some deficiencies prevent the City from currently providing the desired level of service, other deficiencies will manifest as the City expands and as the existing systems continue to age.

Recommended improvements for specific components of the City's water system have been described in previous chapters. This chapter builds on that work by assigning a priority and providing background information on the costs of the improvement recommendations. The cost estimates have been developed to a conceptual level, for planning and budgeting purposes (see Section 12.3); more detailed cost estimates will be necessary as the projects are implemented.

12.2 PRIORITIZED IMPROVEMENTS

Since the scope of the proposed improvements is quite large, a prioritizing process is required. Projects that resolve immediate deficiencies or public health concerns should naturally have a higher priority than long-term growth-related improvements. The following approach is designed to provide a basis for evaluating and ranking the improvement projects.

12.2.1 Prioritization Criteria

The assignment of a particular project or capital improvement project to a priority level was made after an evaluation using the following criteria:

- *Public Health Concerns*. Projects targeted to resolve existing or near-term regulatory compliance issues were assigned the highest priority.
- *Consumed Infrastructure (end of useful life)*. Projects to replace damaged or deteriorated infrastructure (particularly those facilities that have reached the end of their useful life and no longer function as designed) were assigned a higher priority.
- *Capacity or Size Deficiencies*. The severity of the deficiency was considered and compared with the service improvements provided by the replacement components. The projected benefit (versus cost) of a project was used to assign a priority.
- *City Priority*. Projects identified by City operations and maintenance personnel to be high priority due to operational or maintenance problems.
- *Demand Development*. The anticipated timeframe for the development of land within the service area of proposed improvements was considered. Projects to serve approved or near-term developments should be given higher priority than improvements targeted to long-term future developments.

12.2.2 Prioritization Levels

In order to assist the City with their planning, scheduling and construction efforts each improvement project was assigned to one of three priority levels. The priority levels are:

12.2.2.1 Priority 1- Near-Term Improvements

These projects are targeted problem areas needing immediate attention. They are projects necessary to resolve existing or near-term system deficiencies, resolve regulatory compliance issues or to serve known near-term demand increases. It is recommended that Priority 1 improvements are undertaken as soon as practical (as quickly as financing can feasibly be arranged and construction/permitting/land or easement acquisition considerations can be addressed).

12.2.2.2 Priority 2- Intermediate Improvements

These are projects that will be needed to maintain adequate water service based on the condition of aging infrastructure, seismic risk mitigation, and to improve redundancy. Although not critical at this time, they should be considered as improvement projects that will be upgraded to Priority 1 prior to the end of the planning period.

12.2.2.3 Priority 3- Long-Term Improvements/Possible Future Need

These projects are projects to improve system reliability and operability, but are not necessary during the planning period. While important, they are not considered to be critical at the present time and can be delayed to the next planning period. Should conditions in the City change, it is always the City's choice to increase the priority ranking of these projects and construct them sooner rather than later.

12.2.3 Prioritized Capital Improvement Projects & Estimated Project Costs

To aid in the development of a water system capital improvement program (CIP), each improvement project was examined and assigned to one of the priority classes described above.

Table 12-1 below summarizes the priority category totals presented in Table 12-2.

Table 12-1| Cost Summary, Capital Improvement Recommendations

Priority Group	Total Estimated Project Cost
Priority 1	$4,904,000
Priority 2	$8,262,000
Priority 3	$1,313,000
Total	$14,479,000

Table 12-2 is a comprehensive listing of the recommended water system improvement projects. The cost estimates are rounded to the nearest $1,000 increment. Maps showing the locations of the prioritized improvements are included in Figure 12-1 through Figure 12-3. The reader is referred to previous chapters of this report for more detailed descriptions of the individual projects.

At a minimum, it is recommended that all of the Priority 1 and Priority 2 improvements be included in the City's Capital Improvement Plan (CIP) for the 20-year planning period ending in 2041. Priority 3 improvements are considered to be optional.

The recurring annual programs, listed in Table 12-2, should be incorporated into the City's operation and maintenance budgets for the water utility. It is envisioned that the City's budget will be increased by these amounts upon the adoption of this plan.

Table 12-2| Recommended Capital Improvement Priorities (Yachats Water System)

Project Code(1)	Project	Chapter	Priority	Total Estimated Project Cost(2)
S-1	Permit S-29018 Partial Perfection and Extension Application	6	1	$15,000
S-2	Yachats River Water Rights Planning Work	6	1	$50,000
S-3	Evaluate Using SWLCWPUD as a Long-Term Source	6	1	$75,000
S-4	Yachats River Intake and Raw Water Pipeline	6	1	$2,893,000
S-5	Reedy Creek Raw Water Pipeline Improvements	6	1	$208,000
T-1	WTP Electrical and Control System Improvements	7	1	$814,000
D-1	Water System Design Standards	8	1	$5,000
D-2	Pressure Reducing Valve Maintenance & Coordination	8	1	$50,000
D-3(3)	Windsong Street Service Reconnections	8	1	$11,000
D-4(3)	New PRV at 7th Street & Radar Road	8	1	$101,000
D-5(3)	New PRV on King Street Between 7th and Prospect Ave	8	1	$101,000
D-6(3)	New 8" Water Main on Radar Road at Prospect Ave	8	1	$57,000
D-7(3)	New 8" Water Main on King Street at Prospect Ave	8	1	$86,000
D-10	Retrofit Combs PRV	8	1	$40,000
D-13	Replace 4" AC with 8" from Prospect Ave to Yachats River Road	8	1	$398,000
	Subtotal Priority 1			**$4,904,000**
T-2	WTP Clarifier Rehabilitation	7	2	$641,000
T-3	WTP Mixed Media Filter Rehabilitation	7	2	$350,000
T-4	WTP Pump and Compressor Upgrades	7	2	$402,000
T-5	WTP Instrumentation Upgrades	7	2	$271,000
T-6	WTP Chemical Feed System Improvements	7	2	$205,000
T-7	WTP Building Seismic Retrofit	7	2	$270,000
D-8	New 8" Water Main on Third Street	8	2	$167,000
D-9	New 4" Water Main and PRV on Horizon Hill Road	8	2	$737,000
D-11	Yachats Ocean Road Service Reconnections	8	2	$20,000
D-15	Pontiac Street Waterline - 3rd to 4th	8	2	$88,000
D-16	Shell Street Waterline	8	2	$79,000
D-17	Gender Drive and Windy Way Waterlines	8	2	$254,000
D-18	Pontiac Street Waterline - 2nd to 3rd	8	2	$105,000
D-19	Hanley Drive Waterline	8	2	$47,000

Table 12-2| Recommended Capital Improvement Priorities (Yachats Water System)

Project Code[(1)]	Project	Chapter	Priority	Total Estimated Project Cost[(2)]
P-1	New Radar Road Pump Station	8	2	$767,000
P-2	New Horizon Hill Pump Station & Reservoir	8	2	$1,079,000
ST-1	New 250,000-gallon Lower Radar Road Reservoir	9	2	$1,717,000
ST-2	Upper Radar Road Reservoir Structural Inspection & Analysis	9	2	$50,000
ST-3	Upper Radar Road Reservoir Seismic Retrofit Improvements	9	2	$1,013,000
	Subtotal Priority 2			**$8,262,000**
D-12	New 8" Water Main on Green Hill Drive	8	3	$412,000
D-14	8" Water Main Highway 101 from 6th to Marine Dr.	8	3	$583,000
D-20	Automated Water Meter Reading System	8	3	$318,000
	Subtotal Priority 3			**$1,313,000**
Recurring Annual Programs				
Pgm-1	Non-metered Water Use Tracking System (see section 8.4.2)	8	1	$1,000 per year
Pgm-2	Leak Detection and Repair Program (see section 8.4.2)	8	1	$30,000 per year
Pgm-3	Water Management & Conservation Plan Updates (see section 3.10)	3	1	$5,000 per year
	Subtotal Recurring Annual Programs			**$36,000 per year**

[1] Project Code Legend:
S : Water Source/Supply T : Water Treatment ST : Storage
P : Pump Station D : Distribution Pgm : Recurring Annual Program

[2] See Section 12.3.2 for basis of project cost estimates, January 2021 ENR 20 City Construction Cost Index of 11630

[3] As described in Chapter 8, the City may want to consider constructing Projects D-3 through D-7 as a single larger project.

Figure 12-1 | Yachats Water System Capital Improvement Priorities

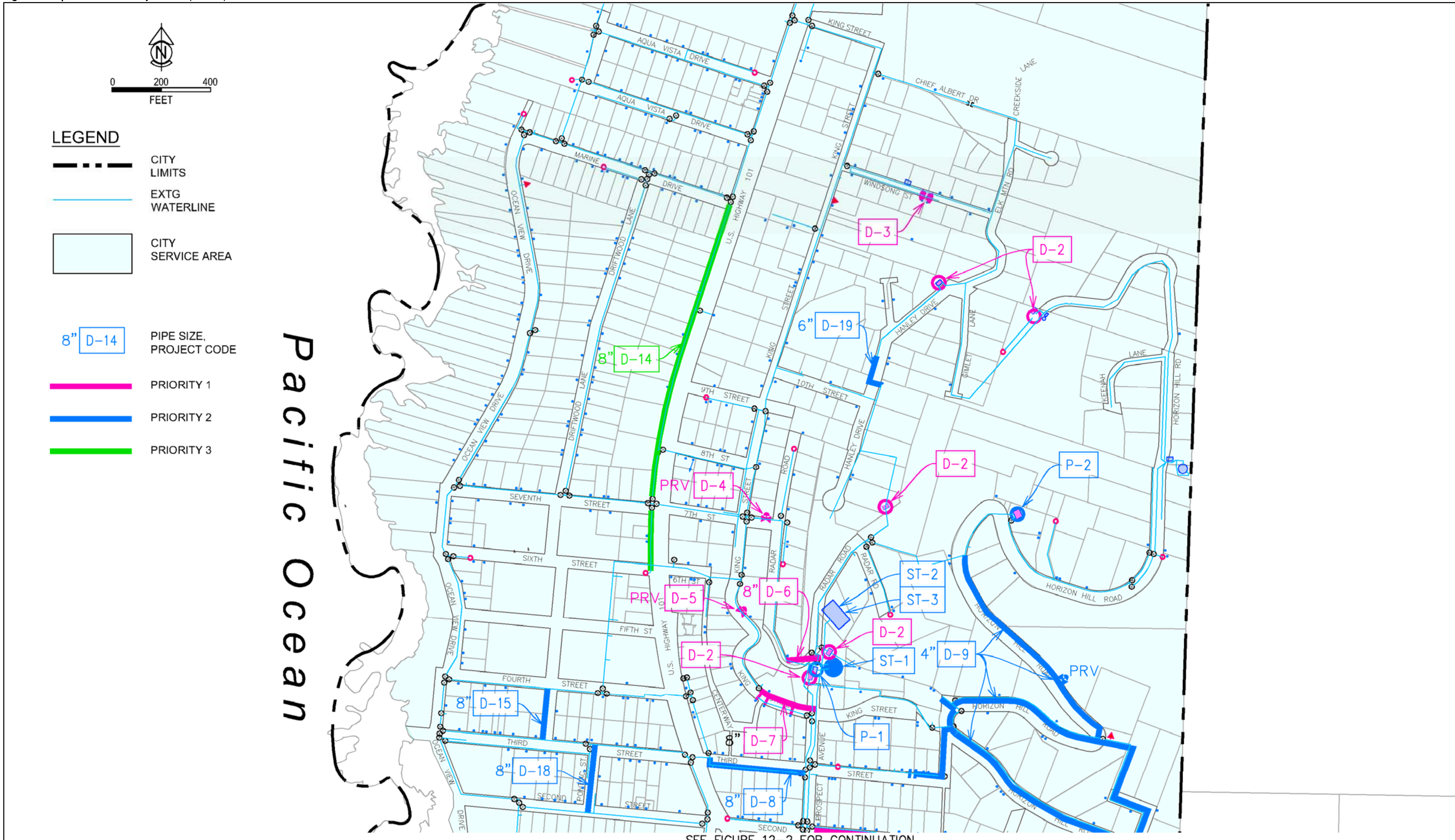


Figure 12-2 | Yachats Water System Capital Improvement Priorities

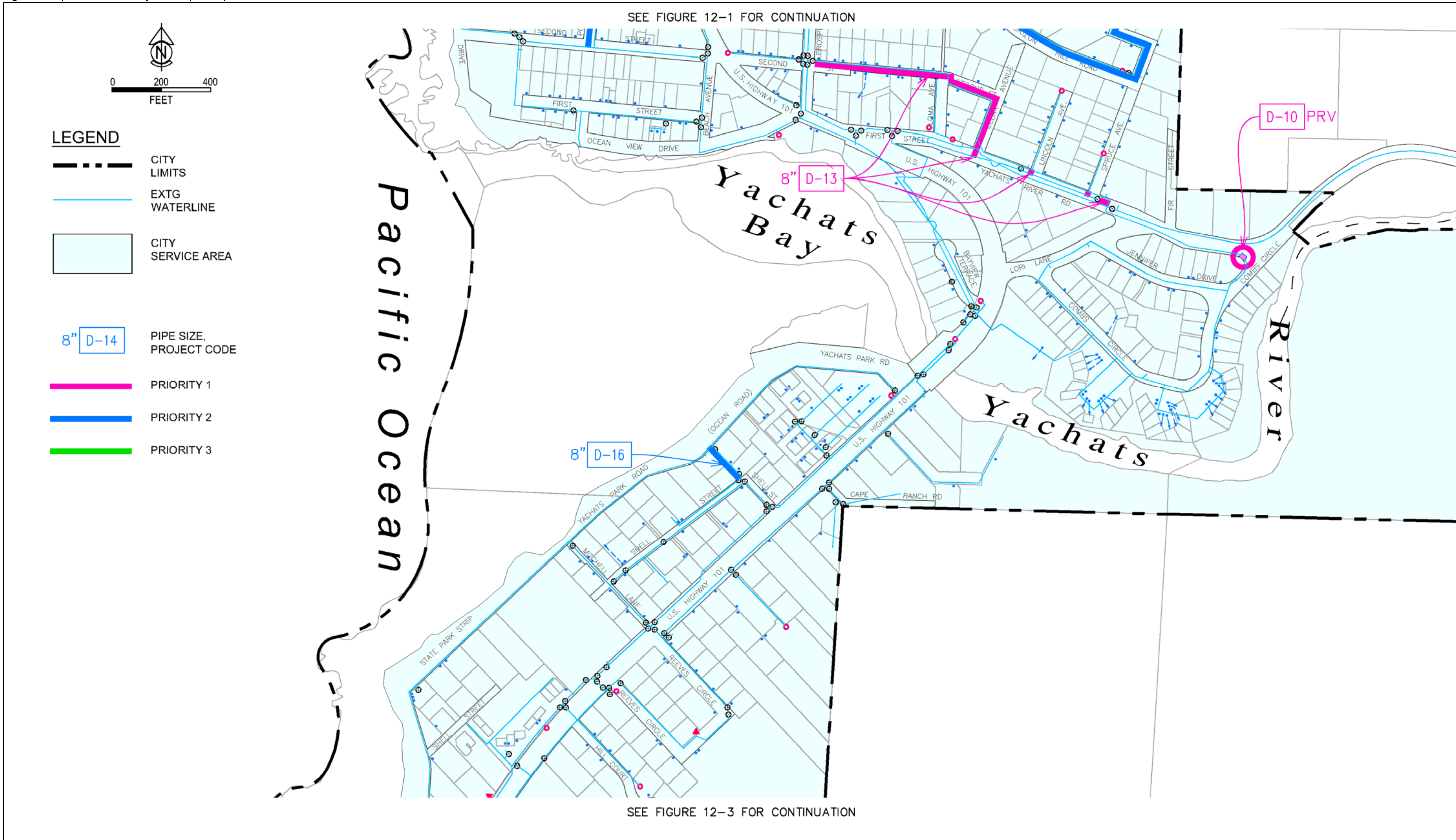
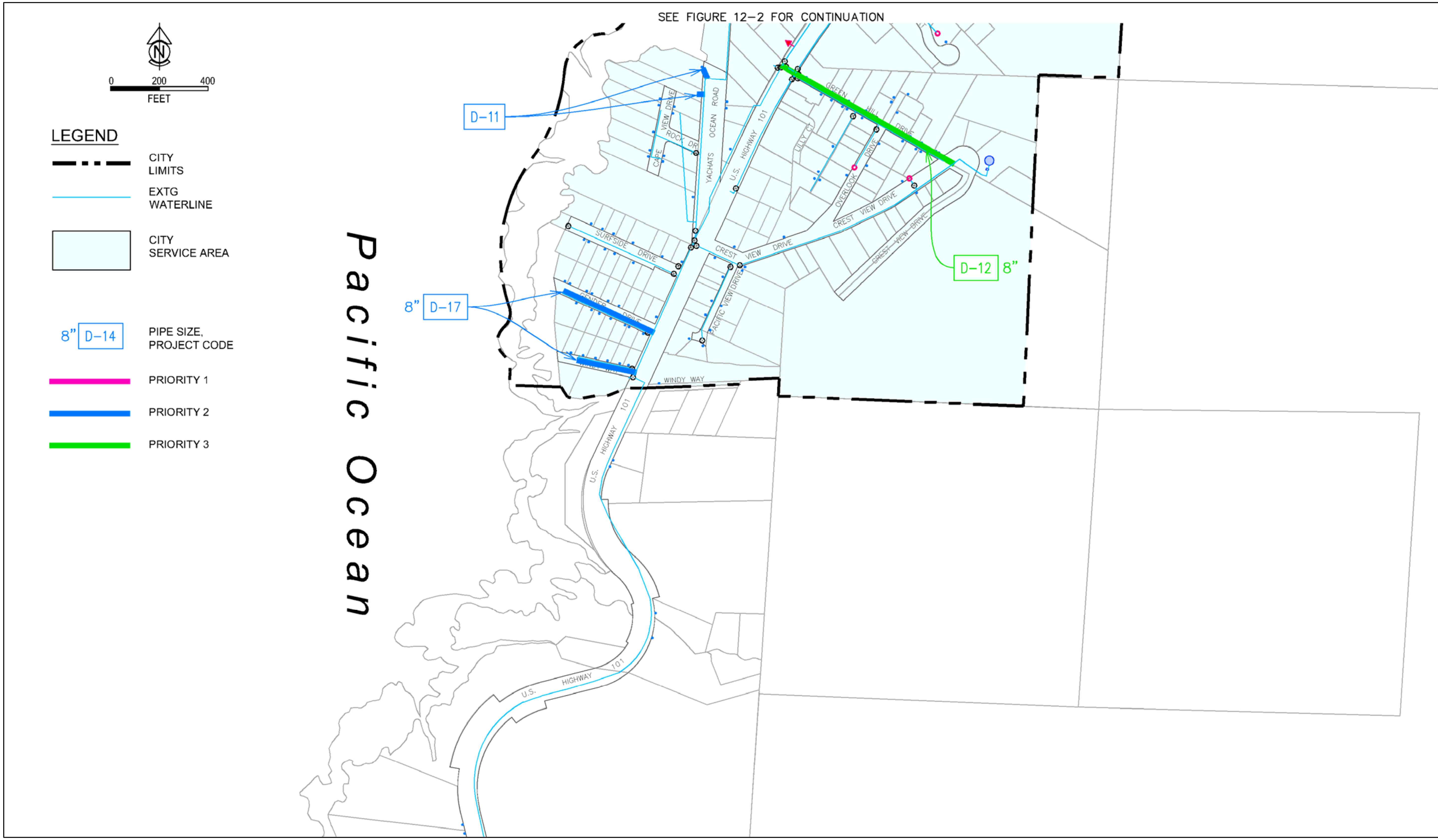


Figure 12-3 | Yachats Water System Capital Improvement Priorities



12.2.4 Environmental Impacts

It should be noted that while the improvements recommended in this report are not anticipated to have significant adverse impacts on the environment, each CIP project may need to undergo project-specific environmental review as part of the preliminary and final design process. In particular, the new Yachats River Water Intake will require work below the ordinary high water level in the river. This type of work requires an extensive permitting process due the presence of threatened and endangered species habitat.

12.3 BASIS OF COST ESTIMATES

In order to forecast municipal capital expenditures, cost estimates have been prepared for each of the improvements. The preparation methodology and intended use of these cost estimates is summarized below. The cost estimates are based on numerous assumptions necessary due to the relative lack of detail available at the master planning stage.

12.3.1 Accuracy of Cost Estimates

The accuracy and precision of cost estimates is a function of the level to which improvement alternatives are developed (i.e., detail and design) and the techniques used in preparing the actual estimate. Estimates are typically divided into three basic categories as follows:

- *Planning Level Estimate*. These are order-of-magnitude estimates made without detailed engineering design data. They are often performed at the zero to 2 percent stage of project completion and typically range from 35 percent over to 25 percent below the final project cost. A relatively large contingency is typically included to reduce the risk of under-estimating. This is particularly important since many times the project financing must be secured before the detailed design can proceed.
- *Budgetary Estimates*. This level of estimate is prepared during the preliminary design phase using process flow sheets, preliminary layouts and equipment details. This type of estimate is typically accurate to (+)30 and (-)15 percent of the final project cost.
- *Engineer's Estimate*. This estimate is prepared on the basis of well-defined engineering data, typically when the construction plans and specifications are completed. The estimating process at this level relies on piping and instrument diagrams, electrical diagrams, equipment data sheets, structural drawings, geotechnical data and a complete set of specifications. This estimate is sometimes called a definite estimate. The engineer's estimate is expected to be accurate within (+)15 to (-)5 percent of the pricing secured during the bidding process.

The project costs prepared as part of this study are planning level estimates. Actual project costs will depend on the final project scope, labor and material costs, market conditions, construction schedule, and other variables at the time the project is built. These variables are typically uncertain at the time planning level estimates are performed.

12.3.2 Adjustment of Cost Estimates Over Time

A commonly used indicator to evaluate the change of construction costs over time is the Engineering News-Record (ENR) construction cost index. The index is computed from the prices for structural steel, Portland cement, lumber, and common labor, and is based on a value of 100 in the year 1913. The construction costs developed in this analysis are based on the January 2021 ENR 20 City Construction Cost Index of 11,630. As the planning period elapses, the costs presented in this study can be updated to the present by applying the ratio of the current cost index to the index used during the preparation of the estimate.

12.3.3 Engineering and Administrative Costs, Contingencies

The cost of engineering services for major projects typically covers special investigations, pre-design reports, topographic surveying, geotechnical investigations, contract drawings and specifications, construction administration, inspection, project start-up, the preparation of O&M manual narratives, and performance certifications. Depending on the size and type of the project, engineering costs may range from 16 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complex mechanical systems. The higher percentage applies to smaller, more complex projects that require the integration of a complex design into an existing facility and where full time inspection is required by the funding agencies or desired by the Owner.

The City will have administrative costs associated with any construction project. These include internal planning and budgeting costs, administration of engineering and construction contracts, legal services, and coordination with regulatory and funding agencies. The specific values used for engineering, administrative, and construction costs for each type of improvement project are described in the following sections.

Since the funding sources for the completion of the recommended improvements have not yet been confirmed, the cost estimates outlined below are based on the assumption that each of the projects will be designed and constructed separately with local funds.

12.4 CONSTRUCTION COST ESTIMATES

The planning level estimates for the water system improvements recommended in this study are based on a number of assumptions as follows. The cost estimates reflect projects bid in late winter or early spring for summer construction. The estimates are based on construction costs of similar historical projects and on current estimates solicited from material and equipment vendors. The estimates are expected to have accuracies of +35 percent and –25 percent of the actual project cost. The following sections describe the cost estimating process for the various categories of projects.

12.4.1 Pipeline Improvement Costs

The proposed pipeline improvement projects range in size from 4-inches to 8-inches in diameter. These costs were developed using the following assumptions:

- Pipe material for buried pipelines is PVC AWWA C900
- Installation of valves and hydrants are included and shall be installed per City standards
- Standard soil cover is 3 feet and trenching costs exclude rock excavation and trench dewatering
- Reconnection of all services are included for waterline replacement projects
- Asphalt trench repair for the full length of the project for the trench width only
- Railway and highway bores must be added to the unit costs at $900 per linear foot
- Construction contingencies are 10% of estimated construction cost
- Engineering is 20% of estimated construction cost
- Legal, permits and administrative costs are 5% of estimated construction cost

Total project costs per foot of installed pipe appear in Table 12-3, along with the percentages listed above for engineering design and administrative costs. Detailed cost estimates for the distribution system improvements are include in Appendix B.

Table 12-3| Estimated Pipeline Improvement Costs

Size & Location	Total Cost per Foot
4-inch Pipe in City Right-of-Way	$100
6-inch Pipe in City Right-of-Way	$110
8-inch Pipe in City Right-of-Way	$120
8-inch Pipe in ODOT Right of Way	$175
Mainline Connections	$9,000 each
Auger Bore Pipe Installation	$900
Water Services	$4,000 each
New Fire Hydrants Including Lateral Piping	$8,000 each

12.4.2 Source Improvement Costs

Construction costs for the new intake structure includes in-water work isolation, site preparation, structures, buildings, pumps, mechanical piping, electrical and instrumentation. Project costs have been based on historical construction cost information for similarly sized projects.

A construction contingency of 10% was assumed for the source improvements. Engineering costs of 20% as well as legal, administration, and permitting costs of 5% were also assumed for these projects.

12.4.3 Water Treatment Improvement Costs

Construction costs for water treatment plant improvements include mobilization, demolition, associated mechanical piping and pumping, as well as electrical and instrumentation modifications.

A construction contingency of 10% was assumed for the water treatment improvements. Engineering costs of 20% as well as legal, administration, and permitting costs of 5% were also assumed for these projects.

12.4.4 Storage Tank Improvement Costs

Construction costs for storage tank improvements include mobilization, erosion control, excavation & earthwork, associated mechanical piping, electrical and instrumentation, as well as civil site improvements.

A construction contingency of 10% was assumed for the storage tank improvements. Engineering costs of 20% as well as legal, administration, and permitting costs of 5% were also assumed for these projects.

12.5 FUNDING SOURCES

As a general rule, small communities are not able to finance major water system improvements without some form of government funding such as low interest loans or grants. It is anticipated that the funding for the recommended capital improvement plan outlined in this report will be secured from multiple sources, including system development charges (SDCs), monthly user fees, as well as state and federal grant and loan programs. The following section outlines the major local and State/Federal funding programs that may be available for these projects.

12.5.1 Local Funding Sources

To a large degree, the type and amount of local funding used for the water system improvements will depend on the amount of grant funding obtained and the requirements of any loan funding. Local revenue sources for capital improvements include ad valorem taxes (property taxes), various types of bonds, water user fees, connection fees and SDCs. Local revenue sources for operating costs are generally limited to water user fees. The following sections discuss local funding sources and financing mechanisms that are most commonly used for the type of capital improvements presented in this study.

12.5.1.1 Existing Debt Service

The City currently has three outstanding loans (Table 12-4). As of June of 2020, the total outstanding principal owed is approximately $1,872,000 and the minimum debt service payments total approximately $126,600 per year.

Table 12-4 | Water Utility Existing Debt

Loan Description	Loan Amount	Term (years)	Payoff Date	Interest Rate	Annual Payment	Outstanding Principal (6/2020)
Water Revenue Bond	$512,000	15	2032	3.07%	±$42,850	$427,416
Water General Obligation Bond	$533,000	15	2032	3.0%	±$43,825	$439,091
South Tank Business Oregon Loan	$1,030,000	30	2049	1.0%	±$39,911	$1,005,500

12.5.1.2 User Fees

User fees are monthly charges to all residences, businesses, and other users that are connected to the water system. User fees are established by the city council and are typically the sole source of revenue to finance operation and maintenance. The City's water user fee system is established by Resolution 2015-12-01. For most residential and commercial connections (i.e., ⅝ and ¾ inch meters), the City currently charges a flat fee of $48.24 that includes up to 200 cubic feet of water per month. An additional charge of $6.00 is assessed for each 100 cubic foot above the initial amount that is included in the base charge. The City does have some users with larger meters. These users are charged a special rate that is based on usage.

The anticipated revenue from water billings for the fiscal year 2020/2021 is budgeted to be approximately $585,000. Including other various charges and interest earnings, the total water fund revenues, for the 2020/2021 fiscal year are budgeted to be approximately $588,000. It should be noted that these budget amounts are less than the historic revenue from user rates. In the previous two fiscal years, the revenue from user rates was about $650,000 and $600,000. Due to the Covid-19 pandemic, the City anticipated less revenue for the 2020/2021 fiscal year.

The City's water fund must provide sufficient revenues to properly operate and maintain the water system and provide reserves for normally anticipated replacement of key system components such as pumps, motors, pump station control equipment, chemical feed equipment, fire hydrants and distribution piping repairs. Although the City relies exclusively on user fees for operation and maintenance costs, the water fund is typically not adequate to finance major capital improvements without outside funding sources.

12.5.1.3 System Development Charge Revenues

A system development charge (SDC) is a fee collected by the City as each piece of property is developed (SDC fees are collected at issuance of building permits). SDCs are used to finance necessary capital improvements and municipal services required by the development. SDCs can be used to recover the capital costs of infrastructure required as a result of the development, but cannot be used to finance either operation and maintenance, or replacement costs.

The SDC fee system was most recently revised by Resolution Number 2007-01-01. The City charges different SDC fees based on the size of the water meter installed at each property. The current fee structure is listed in Table 12-5.

Table 12-5 | Current Water SDC Fees

Meter Size	SDC Charge
¾ by ⅝ - Inch	$3,133
¾ - Inch	$4,700
1- Inch	$7,833
1 ½ - Inch	$15,665
2 – Inch	$25,064
3- Inch	$50,128
4- Inch	$78,325
6- Inch	$156,650

As established in ORS 223, an SDC can have two principal elements, the reimbursement fee and the improvement fee. The reimbursement fee portion of the SDC is the fee for buying into either existing capital facilities or those that are under construction (i.e., it represents a charge for utilizing excess capacity in an existing facility that was paid for by the City or previous developers). The revenue from this fee is typically used to repay existing improvement loans.

The improvement fee portion of the SDC is the fee designed to cover the costs of capital improvements that must be constructed to provide an increase in capacity to support the development.

Over the last three fiscal years, the City has collected and average of about $50,000 in water system development charges.

Based on the infrastructure improvements and cost projections presented in this master plan, the existing SDC fee structure is insufficient to meet the planning period goals. This plan accordingly recommends that the City complete a full review of its SDC rate structure and update these fees accordingly.

12.5.1.4 Connection Fees

Many cities charge connection fees to cover the cost of connecting a new development to the municipal water system. There are two types of connection fees. The first is for newly constructed connections and is designed to cover the cost of City inspections at the time of connection to the distribution system. The second type of fee is designed to defray the City's administrative cost of setting up a new account and is charged against newly constructed connections as well as transfers of an existing service to a new owner.

12.5.1.5 Capital Construction Fund

Capital construction funds or sinking funds are often established as a budget line item to set aside money for a particular construction purpose. A set amount from each annual budget is deposited in a sinking fund until sufficient reserves are available to complete the project. Such funds can also be developed from user fee revenues or from SDCs.

The City maintains a capital reserve fund used to make improvements to the water system. In recent years, the City has typically contributed an average of about $90,000 from user fees to this fund. At the end of the 2020/2021 fiscal year, the ending balance in this fund is anticipated to be about $325,000.

12.5.1.6 General Obligation Bonds

The sale of municipal general obligation bonds is a traditional method of funding municipal water improvement projects. General obligation bonds utilize the City's basic taxing authority and are retired with property taxes based on an equitable distribution of the bonded obligation across the City's assessed valuation. General obligation bonds are normally associated with the financing of facilities that benefit an entire community and must be approved by a majority vote of the City's voters.

General obligation bonds are backed by the City's full faith and credit, as the City must pledge to assess property taxes sufficient to pay the annual debt service. This portion of the property tax is outside the State constitutional limits that restrict property taxes to a fixed percentage of the assessed value. The City may use other sources of revenue, including water user fee revenues, to repay the bonds. If it uses other funding sources to repay the bonds, the amount collected as taxes is reduced commensurately.

The general procedure followed when financing water system improvements with general obligation bonds is typically as follows:

- Determination of the capital costs required for the improvement
- An election by the voters to authorize the sale of bonds
- The bonds are offered for sale
- The revenue from the bond sale is used to pay the capital cost of the project(s)

General obligation bonds can be “revenue supported”, wherein a portion of the user fee is pledged toward repayment of the bond debt. The advantage of this method is that the need to collect additional property taxes to retire the bonds is reduced or eliminated. Such revenue supported general obligation bonds have most of the advantages of revenue bonds in addition to a lower interest rate and ready marketability.

The primary disadvantage of general obligation debt is that it is often added to the debt ratios of the City, thereby restricting the flexibility of the municipality to issue debt for other purposes.

12.5.1.7 Revenue Bonds

Revenue bonds are similar to general obligation bonds, except they rely on revenue from the sales of the utility (i.e., user fees) to retire the bonded indebtedness. The primary security for the bonds is the City's pledge to charge user fees sufficient to pay all operating costs and debt service. Because the reliability of the source of revenue is relatively more speculative than for general obligation bonds, revenue bonds typically have slightly higher interest rates.

The general shift away from ad valorem property taxes makes revenue bonds a frequently used option for payment of long term debt. Many communities prefer revenue bonding, because it ensures that no additional taxes are levied. In addition, repayment of the debt obligation is limited to system users since repayment is based on user fees.

One advantage with revenue bonds is that they do not count against a City's direct debt. This feature can be a crucial advantage for a municipality near its debt limit. Rating agencies closely evaluate the amount of direct debt when assigning credit ratings. There are normally no legal limitations on the amount of revenue bonds that can be issued; however, excessive issue amounts are generally unattractive to bond buyers because they represent high investment risks.

Under ORS 288.805-288.945, cities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate. Certain notice and posting requirements must be met and a sixty (60) day waiting period is mandatory.

The bond lender typically requires the City to provide two additional securities for revenue bonds that are not required for general obligation bonds. First, the City must set user fees such that the net projected cash flow from user fees plus interest will be at least 125% of the annual debt service (a 1.25 debt coverage ratio). Secondly, the City must establish a bond reserve fund equal to maximum annual debt service or 10% of the bond amount, whichever is less.

12.5.1.8 Improvement Bonds

Improvement (Bancroft) bonds are an intermediate form of financing that are less than full-fledged general obligation or revenue bonds. This form of bonding is typically used for Local Improvement Districts.

Improvement bonds are payable from the proceeds of special benefit assessments, not from general tax revenues or user fees. Such bonds are issued only where certain properties are recipients of water system improvements. For a specific improvement, all property within the designated improvement district is assessed on the same basis, regardless of whether the property is developed or undeveloped. The assessment is designed to divide the cost of the improvements among the benefited property owners. The manner in which it is divided is in proportion to the direct or indirect benefits to each property. The assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash, or applying for improvement bonds. If the improvement bond option is taken, the City sells Bancroft Improvement Bonds to finance the construction, and the assessment is paid in accordance with a payment schedule.

The assessments against the properties are usually not levied until the actual cost of the project is determined. Since actual costs cannot normally be determined until the project is completed, funds are not available from assessments for the purpose of paying costs at the time of construction. Therefore, some method of interim financing must be arranged.

The primary disadvantage to this source of revenue is that the development of an assessment district is very cumbersome and expensive when facilities for an entire City are contemplated. Therefore, this method of financing should only be considered for discrete improvements to the system where the benefits are localized and easily quantified.

12.5.1.9 Certificates of Participation

Certificates of Participation are a form of bond financing that is distinct from revenue bonds. While it is more complex, and typically has a higher interest rate than revenue bonds, it is a process controlled by the City Council, and it does not have to be referred to the voters. This can result in significant time savings.

12.5.1.10 Ad Valorem Taxes

Ad valorem property taxes were often used in the past as a revenue source for public utility improvements. These taxes were the traditional means of obtaining revenue to support all local governmental functions. Ad valorem taxation is a financing method that applies to all property owners that benefit, or could potentially benefit from a water system improvement, whether the property is developed or not. The construction costs for the improvement project are shared proportionally among all property owners based on the assessed value of each property. Ad valorem taxation, however, is less likely to result in individual users paying their proportionate share of the costs as compared to their benefits.

12.5.2 State and Federal Grant and Loan Programs

Several state and federal grant and loan programs are available to provide financial assistance for municipal water system improvements. The primary sources of funding available for water system financing are Rural Utilities Service (RUS), Special Public Works Fund (SPWF), the Water/Wastewater (W/W) Financing Program, the Community Development Block Grant (CDBG) program, and the Clean Water State Revolving Fund (CWSRF).

12.5.2.1 Rural Utility Services

Rural Utility Service (RUS) provides federal loans and grants to rural municipalities, counties, special districts, Indian tribes, and not-for-profit organizations to construct, enlarge, or modify water treatment and distribution systems and wastewater collection and treatment systems. Preference is given to projects in low-income communities with populations below 10,000.

Borrowers of RUS loans must be able to demonstrate the following:

- Monthly user rates must be at or above the state-wide average.
- They have the legal authority to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities and services.
- They are financially sound and able to manage the facility effectively.
- They have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay for all facility costs including O&M and to retire indebtedness and maintain a reserve.

The maximum RUS loan term is 40 years, but the finance term may not exceed statutory limitations on the agency borrowing the money or the expected useful life of the improvements. The reserve can typically be funded at 10 percent per year over a ten-year period. Interest rates for RUS loans vary based on median household income, but tend to be lower than those obtained in the open market.

12.5.2.2 Infrastructure Finance Authority

The Oregon Infrastructure Finance Authority (IFA) manages a number of grant and low interest loan programs as describe in the following sections.

- *Special Public Works Fund*

The IFA administers the Special Public Works Fund (SPWF) program. The SPWF is a lottery-funded loan and grant program that provides funding to municipalities, counties, special districts, and public ports for infrastructure improvements to support industrial/manufacturing and eligible commercial economic development. Eligible commercial economic development is defined as commercial activity that is marketed nationally, or internationally, and attracts business from outside Oregon. Funded projects are usually linked to a specific private sector development and the resulting direct job creation (i.e., firm business commitment), of which 30% of the created jobs must be "family wage" jobs. The program also funds projects that build infrastructure capacity to support industrial/manufacturing development where recent interest by eligible business(s) can be documented.

The SPWF is primarily a loan program, although grant funds are available based on economic need of the community. Although the maximum loan term is 25 years, loans are generally made for 20-year terms. The maximum loan amount for projects funded with direct SPWF money is $1 million, while the maximum for projects financed with bond funds is $10 million.

- *Bond Bank Program*

The Bond Bank program, administered by IFA, attempts to lower the cost of issuing debt by pooling small revenue bond issues from many communities into one large revenue bond issue. It uses lottery proceeds to write down financing costs, and to improve the debt/equity ratio on projects. The interest rate for repayment of funds is typically around 6 percent, with up to a 25 year term.

- *Water/Wastewater Financing Program*

IFA also administers the W/W Financing Program, which gives priority to projects that provide system-wide benefits and helps communities meet the Clean Water Act or the Safe Drinking Water Act standards. It is intended to assist local governments that have been hard hit with state and federal mandates for public drinking water systems and wastewater systems. In order to be eligible for this program, the system must be out of compliance with federal or state rules, regulations or permits, as evidenced by issuance of a Notice of Non-Compliance by the appropriate regulatory agency. The funded project must be needed to meet state or federal regulations. Priority is given to communities under economic distress.

Similar to the SPWF, the W/W Financing Program is primarily a loan program, although grant funds are available in certain cases, based on economic need of the community. Although the maximum loan term is 25 years, loans are generally made for 20-year terms. The maximum loan amount for projects funded with direct W/W money is $500,000, while the maximum for projects financed with bond funds is $10 million.

- *Economic and Community Development Block Grant*

The IFA administers the CDBG, but the funds are from the U.S. Department of Housing and Urban Development (HUD), so all federal grant management rules apply to the program. The federal eligibility standards are strict. There are two subcategories of Public Works projects eligible for funding, "Public Water and Wastewater," and "Public Works for New Housing." Only the former is considered in this discussion.

Grants are available for critically needed construction, improvement, or expansion of publicly owned water and wastewater systems for the benefit of current residents. Generally, projects must be necessary to resolve regulatory compliance problems identified by state and/or federal agencies and the project must serve a community that is comprised of more than 51% of low and moderate income persons.

The program separates projects into three parts. Grants are available for:

- *Preliminary Engineering and Planning Projects*. Generally, these grants fund preparation or update of Water System Master Plans and Wastewater Facility Plans, as required by the Oregon Department of Environmental Quality or Oregon Health Division. In addition, funds for grant administration and preparation of a final design funding application can be included in the project budget. All plans produced with grant funds must be approved by the appropriate regulatory agency. Grants of up to $10,000 can also be made for problem identification studies to delineate problems and corrective measures, as required by a regulatory agency.
- *Final Design and Engineering Projects*. Final design and engineering, bid specifications, environmental review, financial feasibility, rate analysis, grant administration, and preparing a construction funding application are all eligible project activities. The final design, plans and specifications must be approved by the appropriate regulatory agency before a grant will be awarded.
- *Construction Projects*. These grants fund construction and related activities, grant administration, and land/permanent easement acquisition. IFA has established an evaluation system that gives priority to projects that provide system-wide benefits. The overall maximum grant amount per water or wastewater project is $2,500,000 (including all planning, final engineering, and construction). The project cannot be divided locally into phases with the expectation of receiving more than one $2,500,000 grant. In order to qualify for grant funding under this program, the water user rates must be at or above statewide averages.

12.5.2.3 Safe Drinking Water Loan Fund & Drinking Water Protection Loan Fund

The Safe Drinking Water Loan Fund is administered by IFA with assistance from ODWP and provides loans to cities, counties, special districts, and Indian tribes to construct, expand, or rehabilitate water treatment, distribution, and storage facilities in order to comply with the federal Safe Drinking Water Act.

Interest rates on loans are about 80% of the general obligation bond rate; however, there are additional financing costs and annual service fees that increase the effective rate. The maximum loan amount per project is $6,000,000.

The maximum loan term is 20 years except for disadvantaged communities that may qualify for loan terms up to 30 years provided the loan term does not exceed the useful life of the facility being constructed.

12.5.2.4 Water Development Loan Fund

The Water Development Loan Fund is administered by the Oregon Water Resources Department. This program provides loans to municipal water suppliers with a population under 30,000. These loans are available with up to 30-year terms.

12.5.3 Funding Recommendations

As available grant funding on public works projects has decreased in the last several years, it will be incumbent upon the City to aggressively pursue funding to finance the cost of the recommended improvements.

Based on the infrastructure improvements and cost projections presented in this master plan, the existing user rates and SDC fee structure is insufficient to fund all the Priority 1 and Priority 2 projects. This plan accordingly recommends that the City complete a full review of its SDC and user fee structure and update these fees accordingly.

For large projects (e.g., the Yachats River Intake) a key step in the funding process is to schedule a "one stop meeting" with Oregon Infrastructure Finance Authority (IFA). These meetings include representatives from the various state and federal funding programs. Each funding program is evaluated for the particular project under consideration. A one-stop meeting is a good way to quickly determine the best funding program for a particular project.

12.6 RECOMMENDED IMPLEMENTATION PLAN

It is recommended that the City plan to construct all Priority 1 and Priority 2 projects during the planning period. It is envisioned that the Priority 3 improvements will be constructed by the City after the current planning period (i.e., after 2041). It is recommended to begin design work on the highest priority projects as soon as possible after final approval of the Master Plan

APPENDIX A

CITY OF YACHATS WATER SYSTEM MAPS


I
LEGEND
1" WATER LINE
2" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
12" WATER LINE
CITY LIMITS
WATER RESERVOIR
PRESSURE REDUCING VALVE (PRV)
FIRE HYDRANT
ISOLATION VALVE
BLOWOFF VALVE (BV)
AIR RELIEF VALVE (ARV)
APPROX. WATER METER LOCATION
I
II
III
IV
V
MAP KEY
0 75 150 300
(feet)
Pacific Ocean
US HWY 101
CITY OF YACHATS – SOUTHWEST LINCOLN COUNTY WATER PEOPLE'S UTILITY DISTRICT INTERTIE & PUMP STATION
VERIFY ARV/BO/ISO VALVE
OCEAN WAYSIDE LN
OVERLEAF LOOP
STONE BRIDGE CT
OVERLEAF LOOP
OVERLEAF LODGE LN
NE PETERSON RD
DIVERSITY LANE
8" PVC
6" PVC
US HIGHWAY 101
20' DUCTILE IRON
30' DUCTILE IRON
100' DUCTILE IRON
COOLIDGE LANE
LEMWICK LANE
COUNTY ROAD
KING STREET
8" AC
1" POLY
AQUA VISTA DRIVE
2" PVC
CHIEF ALBERT DR
CREEKSIDE LANE
STREET
.\Yachats Logo 960.jpg
The City of Yachats, Lincoln County, Oregon


II
LEGEND
1" WATER LINE
2" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
12" WATER LINE
CITY LIMITS
WATER RESERVOIR
PRESSURE REDUCING VALVE (PRV)
FIRE HYDRANT
ISOLATION VALVE
BLOWOFF VALVE (BV)
AIR RELIEF VALVE (ARV)
APPROX. WATER METER LOCATION
I
II
III
IV
V
MAP KEY
0 75 150 300
(feet)
Pacific Ocean
OCEAN VIEW DRIVE
DRIFTWOOD LANE
MARINE DRIVE
AQUA VISTA DRIVE
U.S. HIGHWAY 101
KING STREET
SEVENTH STREET
SIXTH STREET
FIFTH ST
FOURTH STREET
THIRD STREET
SECOND STREET
8TH ST
9TH STREET
10TH STREET
RADAR ROAD
HANLEY DRIVE
WINDSONG ST
CHIEF ALBERT DR
CREEKSIDE
ELK MTN RD
GIMLET LANE
KEENAH LANE
HORIZON HILL ROAD
CENTERWAY
PONTIAC ST.
PROSPECT AVENUE
VERIFY ARV
LOWER BLACKSTONE PUMP STATION
SEE INSET #4 ON MAP V
HANLEY DR PRV
BLACKSTONE PRV
VERIFY
MIDDLE BLACKSTONE RESERVOIR & PUMP STATION
UPPER BLACKSTONE RESERVOIR & PUMP STATION
SEE INSET #2 ON MAP V
6" VERIFY
SEE INSET #3 ON MAP V
HORIZON HILL RESERVOIR & PUMP STATION
2" PRV
UPPER RADAR RD PRV
UPPER RADAR RD RESERVOIR
SEE INSET #1 ON MAP V
LOWER RADAR RD PRV
LOWER RADAR RD RESERVOIR
HORIZON HILL PRV
RADAR ROAD PUMP STATION
THIN WALL PVC LOOP
SEE INSET #7 ON MAP III
.\Yachats Logo 960.jpg
The City of Yachats, Lincoln County, Oregon

III
LEGEND
1" WATER LINE
2" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
12" WATER LINE
CITY LIMITS
WATER RESERVOIR
PRESSURE REDUCING VALVE (PRV)
FIRE HYDRANT
ISOLATION VALVE
BLOWOFF VALVE (BV)
AIR RELIEF VALVE (ARV)
APPROX. WATER METER LOCATION
I
II
III
IV
V
MAP KEY
0 75 150 300
(feet)
Pacific Ocean
Yachats Bay
Yachats River
SEE INSET #7 ON MAP III
SEWER STATION METER VALVE
AS-BUILT LOCATION OF 12" MANIFOLD
MAP LOCATION (VERIFY CORRECT ONE)
6" NOT IN USE
SEE INSET #5
12" MAIN FROM WTP
SEE INSET #6
COMBS PRV (NC)
QUIET WATER SUBDIVISION
VERIFY SIZE
SECOND ST
FIRST STREET
OCEAN VIEW DRIVE
BEACH AVENUE
PROSPECT AVE
U.S. HIGHWAY 101
HORIZON HILL ROAD
SECOND ST.
CEDAR AVENUE
LINCOLN AVE.
SPRUCE AVE.
FIR STREET
YACHATS RIVER RD.
BAYVIEW TERRACE
LORI LANE
JENNIFER DRIVE
COMBS CIRCLE
YACHATS PARK RD
(OCEAN ROAD)
YACHATS PARK ROAD
SHELL STREET
SHELL ST
MITCHELL LANE
CAPE RANCH RD
REEVES CIRCLE
HILL COURT
STATE PARK STRIP
SHELL STREET
VILLAGE 2" MAIN
INSET MAP #7
MAP III
INSET MAP #6
MAP III
2" BO
2" BO VALVE, N.C.
12" GV'S
6" GV'S
N.O.
N.C.
12" MAIN
10" GV
6" BO
6" GV
INSET MAP #5
MAP III
.\Yachats Logo 960.jpg
The City of Yachats, Lincoln County, Oregon


IV
LEGEND
1" WATER LINE
2" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
12" WATER LINE
CITY LIMITS
WATER RESERVOIR
PRESSURE REDUCING VALVE (PRV)
FIRE HYDRANT
ISOLATION VALVE
BLOWOFF VALVE (BV)
AIR RELIEF VALVE (ARV)
APPROX. WATER METER LOCATION
I
II
III
IV
V
MAP KEY
0 75 150 300
(feet)
MATCHLINE — SEE BELOW RIGHT FOR CONTINUATION
U.S. HIGHWAY 101
2" POLY
VERIFY ARV/BO/ISO VALVE
Pacific Ocean
SEE INSET #8
250,000 GAL RESERVOIR
CAPE VIEW DRIVE
ROCK DR
2" PVC
6" PVC
OCEAN ROAD
YACHATS
10" PVC
GREEN HILL DRIVE
HILL COURT
LILLY CT
OVERLOOK DRIVE
CREST VIEW DRIVE
8" PVC
SURFSIDE DRIVE
GENDER DRIVE
PACIFIC VIEW DRIVE
WINDY WAY
MATCHLINE — SEE ABOVE LEFT FOR CONTINUATION
GREEN HILL DRIVE
CREST VIEW DRIVE
250,000 GAL "SOUTH RESERVOIR"
VALVE VAULT
PRV
INSET MAP #8
MAP IV
.\Yachats Logo 960.jpg
The City of Yachats, Lincoln County, Oregon

V
LEGEND
1" WATER LINE
2" WATER LINE
4" WATER LINE
6" WATER LINE
8" WATER LINE
10" WATER LINE
12" WATER LINE
CITY LIMITS
WATER RESERVOIR
PRESSURE REDUCING VALVE (PRV)
FIRE HYDRANT
ISOLATION VALVE
BLOWOFF VALVE (BV)
AIR RELIEF VALVE (ARV)
APPROX. WATER METER LOCATION
I
II
III
IV
V
MAP KEY
0 75 150 300
(feet)
SEE INSET #9 ON MAP V
SALMON CREEK INTAKE
SALMON CREEK RAW W/L
BACKWASH BASIN
WATER TREATMENT PLANT
0.5 MG RAW WATER TANK
REEDY CREEK RAW W/L
YACHATS RIVER RD.
River
REEDY CREEK RAW W/L
4" BO
SALMON CREEK
12" MAIN FROM WTP
COMBS PRV (NC)
COMBS CIRCLE
Yachats
RADAR ROAD
UPPER RADAR ROAD RESERVOIR (1 MG)
VERIFY 8"
LOWER RADAR ROAD RESERVOIR (0.2 MG)
HORIZON HILL PRV
RADAR ROAD PUMP STATION
FLOAT VALVE
TO HORIZON HILL LOOP
INSET MAP #1
MAP II
Salmon Creek
SALMON CREEK INTAKE
SALMON CREEK RAW W/L
BACKWASH BASIN
CLARIFIER
0.5 MG RAW WATER TANK
REEDY CREEK RAW W/L
WATER TREATMENT PLANT
REEDY CREEK RAW W/L
YACHATS RIVER RD.
Yachats River
4" BO
.\Yachats Logo 960.jpg
INSET MAP #9
MAP V
SUPPLY FROM MIDDLE BLACKSTONE
W/L TO KEENAH LN
HORIZON HILL RD
VERIFY SS
UPPER BLACKSTONE PUMP STATION
VERIFY VALVE
VERIFY OVERFLOW TO SS
UPPER BLACKSTONE RESERVOIR (120,000 G)
W/L TO HORIZON HILL RD
SUPPLY FROM HORIZON HILL
INSET MAP #2
MAP II
HORIZON HILL RESERVOIR (10,000 GAL)
HORIZON HILL PUMP STATION
ALTITUDE VALVE
HORIZON HILL RD
INSET MAP #3
MAP II
LOWER BLACKSTONE PUMP STATION
WINDSONG ST
INSET MAP #4
MAP II
The City of Yachats, Lincoln County, Oregon

APPENDIX B

COST ESTIMATES FOR RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

Table C-1

Recommended Budget Level Cost Estimates

Yachats Water System Master Plan

3096.4000.0

5/11/2021

1 = priority 1
2 = priority 2
3 = priority 3

Unit Cost

Priority Code	Project Code	Project & Location(s)	Size (in)	Length (ft)	Mainline Unit Cost ($/foot)	($/ft) $900 Bore Length (ft)	($/each) $9,000 Mainline Connections (#)	($/each) $4,000 Water Services (#)	($/each) $8,000 FHs (each)	(easements, etc) Other Costs	Constr Cost	10% Constr Contingency	Soft Costs 20% Eng Cost	5% Legal, Permits, Admin	Total Project	Rounded Total	Priority 1	Priority 2	Priority 3
		Transmission/Distribution System Improvements																	
1	D-1	Water System Design Standards	Not Used												$5,000	$5,000	$5,000	$0	$0
1	D-2	Pressure Reducing Valve Maintenance & Coordination	Not Used												$50,000	$50,000	$50,000	$0	$0
1	D-3	Windsong Street Service Reconnections	Not Used								$8,000	$800	$1,600	$400	$10,800	$11,000	$11,000	$0	$0
1	D-4	New PRV at 7th Street & Radar Road	Not Used								$75,000	$7,500	$15,000	$3,750	$101,250	$101,000	$101,000	$0	$0
1	D-5	New PRV on King Street Between 7th and Prospect Ave	Not Used								$75,000	$7,500	$15,000	$3,750	$101,250	$101,000	$101,000	$0	$0
1	D-6	New 8" Water Main in Radar Road	8	200	$120	0	2	0	0		$42,000	$4,200	$8,400	$2,100	$56,700	$57,000	$57,000	$0	$0
1	D-7	New 8" Water Main in King Street West of Prospect Ave	8	250	$120	0	2	4	0		$64,000	$6,400	$12,800	$3,200	$86,400	$86,000	$86,000	$0	$0
2	D-8	New 8" Water Main in Third Street	8	450	$120	0	2	11	1		$124,000	$12,400	$24,800	$6,200	$167,400	$167,000	$0	$167,000	$0
2	D-9	New 4" Water Main and PRV on Horizon Hill Road	4	3800	$100	0	4	20	0	$50,000	$546,000	$54,600	$109,200	$27,300	$737,100	$737,000	$0	$737,000	$0
1	D-10	Retrofit Combs PRV	Not Used												$40,000	$40,000	$40,000	$0	$0
2	D-11	Yachats Ocean Road Service Reconnections	Not Used												$20,000	$20,000	$0	$20,000	$0
3	D-12	New 8" Water Main in Green Hill Drive	8	750	$120	100	5	16	2		$305,000	$30,500	$61,000	$15,250	$411,750	$412,000	$0	$0	$412,000
1	D-13	Replace 4" AC with 8" from Prospect Ave to Yachats River Road	8	1300	$120	0	3	24	2		$295,000	$29,500	$59,000	$14,750	$398,250	$398,000	$398,000	$0	$0
3	D-14	8" Water Main Highway 101 from 6th to Marine Dr.	8	1600	$175	0	8	5	5	$20,000	$432,000	$43,200	$86,400	$21,600	$583,200	$583,000	$0	$0	$583,000
2	D-15	Pontiac Street Waterline - 3rd to 4th	8	225	$120	0	2	1	2		$65,000	$6,500	$13,000	$3,250	$87,750	$88,000	$0	$88,000	$0
2	D-16	Shell Street Waterline	8	225	$110	0	2	2	1		$58,750	$5,875	$11,750	$2,938	$79,313	$79,000	$0	$79,000	$0
2	D-17	Gender Drive and Windy Way Waterlines	8	650	$120	0	2	19	2		$188,000	$18,800	$37,600	$9,400	$253,800	$254,000	$0	$254,000	$0
2	D-18	Pontiac Street Waterline - 2nd to 3rd	8	300	$120	0	2	4	1		$78,000	$7,800	$15,600	$3,900	$105,300	$105,000	$0	$105,000	$0
2	D-19	Hanley Drive Waterline	6	150	$110	0	2	0	0		$34,500	$3,450	$6,900	$1,725	$46,575	$47,000	$0	$47,000	$0
3	D-20	Automated Water Meter Reading System	See Table C-12												$318,000	$318,000	$0	$0	$318,000
2	P-1	New Radar Road Pump Station	See Table C-10								$568,000	$56,800	$113,600	$28,400	$766,800	$767,000	$0	$767,000	$0
2	P-2	New Horizon Hill Pump Station & Reservoir	See Table C-11								$799,000	$79,900	$159,800	$39,950	$1,078,650	$1,079,000	$0	$1,079,000	$0
1	S-1	Permit S-29018 Partial Perfection and Extension Application	Not Used												$15,000	$15,000	$15,000	$0	$0
1	S-2	Yachats River Water Rights Planning Work	Not Used												$50,000	$50,000	$50,000	$0	$0
1	S-3	Evaluate Using SWLCWPUD as a Long-Term Source	Not Used												$75,000	$75,000	$75,000	$0	$0
1	S-4	Yachats River Intake and Raw Water Pipeline	See Table C-2								$2,143,000	$214,300	$428,600	$107,150	$2,893,050	$2,893,000	$2,893,000	$0	$0
1	S-5	Reedy Creek Raw Water Pipeline Improvements	8	1000	$120	0	2	0	2		$154,000	$15,400	$30,800	$7,700	$207,900	$208,000	$208,000	$0	$0
1	T-1	WTP Electrical and Control System Improvements	See Table C-3								$603,000	$60,300	$120,600	$30,150	$814,050	$814,000	$814,000	$0	$0
2	T-2	WTP Clarifier Rehabilitation	See Table C-4								$475,000	$47,500	$95,000	$23,750	$641,250	$641,000	$0	$641,000	$0
2	T-3	WTP Mixed Media Filter Rehabilitation	See Table C-5								$259,000	$25,900	$51,800	$12,950	$349,650	$350,000	$0	$350,000	$0
2	T-4	WTP Pump and Compressor Upgrades	See Table C-6								$298,000	$29,800	$59,600	$14,900	$402,300	$402,000	$0	$402,000	$0
2	T-5	WTP Instrumentation Upgrades	See Table C-7								$201,000	$20,100	$40,200	$10,050	$271,350	$271,000	$0	$271,000	$0
2	T-6	WTP Chemical Feed System Improvements	See Table C-8								$152,000	$15,200	$30,400	$7,600	$205,200	$205,000	$0	$205,000	$0
2	T-7	WTP Building Seismic Retrofit	Not Used								$200,000	$20,000	$40,000	$10,000	$270,000	$270,000	$0	$270,000	$0
2	ST-1	New 250,000-gallon Lower Radar Road Reservoir	See Table C-9								$1,272,000	$127,200	$254,400	$63,600	$1,717,200	$1,717,000	$0	$1,717,000	$0
2	ST-2	Upper Radar Road Reservoir Seismic Evaluation	Not Used												$50,000	$50,000	$0	$50,000	$0
2	ST-3	Upper Radar Road Reservoir Seismic Retrofit Improvements	Not Used								$750,000	$75,000	$150,000	$37,500	$1,012,500	$1,013,000	$0	$1,013,000	$0
															Grand Totals	$14,479,000	$4,904,000	$8,262,000	$1,313,000

Notes

(1) Other costs include costs for new pressure reducing station

(2) Other costs include additional surface restoration for work in ODOT right of way/permitting and traffic control

Table C-2

Project S-2: Yachats River Intake and Raw Water Pipeline
Recommended Budget Level Construction Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Miscellanous Permitting Requirements	1	LS	$50,000	$50,000
Mobilization (percentage of total)	8.0%	LS	$155,000	$155,000
In Water Work Area Isolation and Fish Salvage	1	LS	$25,000	$25,000
Concrete Intake Structure	1	LS	$125,000	$125,000
Underground Yard Piping	1	LS	$50,000	$50,000
Water Control Gates	2	Each	$6,500	$13,000
Earthwork	1	LS	$15,000	$15,000
Baserock	100	C.Y.	$50	$5,000
Miscellaneous Site Improvements	1	LS	$50,000	$50,000
Building Structure	300	SF	$225	$67,500
Intake Screen	1	LS	$25,000	$25,000
Intake Air Burst System	1	LS	$30,000	$30,000
Pumps Valves & Piping	1	LS	$100,000	$100,000
Miscellaneous Mechanical Improvements	1	LS	$25,000	$25,000
Power Service	1	LS	$25,000	$25,000
Control Panel and Variable Frequency Drives	1	LS	$90,000	$90,000
Electrical & Controls	1	LS	$65,000	$65,000
Pipeline to Reedy Creek Pipeline	9600	L.F.	$125	$1,200,000
Connection to Existing Pipe	1	LS	$5,000	$5,000
Air Valve Stations	3	Each	$7,500	$22,500
Construction Total				$2,143,000

Table C-3

Project T-1: WTP Electrical and Control System Improvements
Recommended Budget Level Construction Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	8.0%	LS	$44,600	$44,600
Demo Cabinetry and Flooring	1	LS	$5,000	$5,000
New Power Service and Entrance Disconnect	1	LS	$20,000	$25,000
New Control Panel & Programming	1	LS	$50,000	$90,000
New Motor Control Center	1	LS	$60,000	$60,000
New Generator and ATS	1	LS	$50,000	$50,000
New Generator Slab and Misc Sitework Imps	1	LS	$25,000	$25,000
New Laboratory Cabinetry	1	LS	$30,000	$30,000
New Lab Room Floor Covering	1	LS	$5,000	$5,000
Lab Sink and Plumbing	1	LS	$5,000	$5,000
Lab Appliances	1	LS	$3,000	$3,000
Miscellenous Architechtural Improvements	1	LS	$10,000	$10,000
Electrical Labor and Materials	1	LS	$90,000	$210,000
SCADA Programming	1	LS	$40,000	$40,000
Construction Total				$603,000

Table C-4

Project T-2: WTP Clarifier Rehabilitation

Recommended Budget Level Construction Cost Estimate

Yachats Water System Master Plan

3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	8.0%	LS	$35,200	$35,200
Demolish Existing Clarify Equipment	1	LS	$20,000	$20,000
New Clarifier Equipment	1	LS	$275,000	$275,000
Clarifier Equipment Installation	1	LS	$75,000	$75,000
Miscellenaous Mechanical Improvement	1	LS	$35,000	$35,000
Electrical and Controls	1	LS	$35,000	$35,000
Construction Total				$475,000

Table C-5

Project T-3: Mixed Media Filter Rehabiliation
Recommended Budget Level Construction Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	8.0%	LS	$19,200	$19,200
Filter Media and Equipment Removal	2	Each	$5,000	$10,000
New Underdrain, Filter Media and Backwash Equipment	2	Each	$85,000	$170,000
Equipment Installation	2	Each	$20,000	$40,000
Miscellaneous Mechanical Improvements	2	Each	$10,000	$20,000
Construction Total				$259,000

Table C-6

Project T-4: WTP Pump and Compressor Upgrades

Recommended Budget Level Construction Cost Estimate

Yachats Water System Master Plan

3096.4000.0

Construction Costs Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8.0%	LS	$22,000	$22,000
Replace Salmon Creek Intake Pumps	1	Each	$16,500	$16,500
Replace Existing Backwash Pump	1	Each	$32,500	$32,500
Concrete Pedestal for Second Backwash Pump	1	LS	$7,500	$7,500
Redundant Backwash Pump	1	Each	$32,500	$32,500
Backwash Pump Discharge Piping & Valves	1	LS	$17,500	$17,500
Backwash Pump VFDs	2	Each	$10,000	$20,000
Replace High Service Pumps	2	Each	$35,000	$70,000
New Air Compressors	2	Each	$2,000	$4,000
Miscellaneous Mechanical Improvements	1	LS	$25,000	$25,000
Electrical, Controls, SCADA Programming	1	LS	$50,000	$50,000
Construction Total				$298,000

Table C-7

Project T-5: WTP Instrumentation Upgrades
Recommended Budget Level Construction Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	8.0%	LS	$14,500	$14,500
Raw Water Flow Control Valve Control Imps	1	LS	$5,000	$5,000
New Raw Water Flow Meter	1	Each	$10,000	$10,000
New Salmon Creek Flow Meter	1	Each	$7,500	$7,500
New Finish Water Flow Meter	1	Each	$10,000	$10,000
New Streaming Current Monitor	1	Each	$17,500	$17,500
New Turbidimeters	5	Each	$8,000	$40,000
New Particle Counter	2	Each	$10,000	$20,000
New Chlorine Residual Analyzer	1	Each	$3,000	$3,000
New Clearwell Level Transducer	1	Each	$3,000	$3,000
Miscellaneous Mechanical Improvements	1	LS	$20,000	$20,000
Electrical, Controls, SCADA Programming	1	LS	$50,000	$50,000
Construction Total				$201,000

Table C-8

Project T-6: Chemical Feed Improvements
Recommended Budget Level Construction Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization (percentage of total)	8.0%	LS	$11,200	$11,200
Demolish Existing Chemical Storage Tank	1	LS	$10,000	$10,000
New Polymer Feed Equipment	1	LS	$17,500	$17,500
New Filter Aid Feed Equipment	1	LS	$17,500	$17,500
New Soda Ash Feed Equipment	1	LS	$12,000	$12,000
Rehabilitate Onsite Chlorine Generation Sys	1	LS	$35,000	$35,000
New Chlorine Distribution Panel	1	Each	$3,500	$3,500
Miscellaneous Mechanical Improvements	1	LS	$10,000	$10,000
Electrical, Controls, SCADA Programming	1	LS	$35,000	$35,000
Construction Total				$152,000

Table C-9

Project ST-1: New 250,000-gallon Lower Radar Road Storage Reservoir
Recommended Budget Level Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs				
Item	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
General & Civil Sitework				
Mobilization (percentage of total)	8.0%	LS	$94,200	$94,200
Erosion Control	1	LS	$7,500	$7,500
Clearing & Grubbing	1	LS	$5,000	$5,000
General Excavation, Backfill, Spoils Disposal	1	LS	Lump Sum	$40,000
Miscellaneous Civil Improvements	1	LS	$25,000	$25,000
Chainlink Fencing & Gate	520	LF	$125	$65,000
Site Storm Drainage	1	LS	Lump Sum	$35,000
Yard Piping, New & Realignment of Existing	800	LF	$130	$104,000
Sanitary Sewer Realignment	200	LF	$125	$25,000
Sanitary Sewer Manholes	3	EA	$7,000	$21,000
Retaining Wall, Site & Access Road	1000	SF	$45	$45,000
Retaining Wall, Tank, Along Radar Road	800	SF	$45	$36,000
Tank Backfill	500	CY	$60	$30,000
Base Rock & Gravel Surfacing, Site Work	LS	ALL	Lump Sum	$15,000
Base Rock, Tank	260	CY	$35	$9,100
Fine Grading and Seeding	LS	ALL	Lump Sum	$15,000
Radar Road Rehabiliation Work	LS	ALL	Lump Sum	$75,000
Reinforced Concrete Tank Structure				
24-inch mat slab on grade	180	CY	$550	$99,000
Wall base and top joints	380	LF	$50	$19,000
Structural walls	200	CY	$750	$150,000
Structural columns	20	CY	$850	$17,000
Elevated slab and roof curbs	80	CY	$1,000	$80,000
Expansion and construction joints	140	LF	$10	$1,400
Miscellaneous Metalwork				
Overflow cone assembly	1	EA	$850	$850
Silt-stop assembly	2	EA	$500	$1,000
Reservoir exterior access ladder	1	EA	$8,500	$8,500
Reservoir downspouts & roof scuppers	4	EA	$300	$1,200
Roof hatches	1	EA	$8,000	$8,000
Roof vent	1	EA	$6,500	$6,500
Reservoir interior access ladder (SST)	1	EA	$7,500	$7,500
Safety railing at hatches	30	LF	$100	$3,000
Process Instrumentation				
Ultrasonic Level Transmitter	1	EA	$3,500	$3,500
Reservoir sampling cabinet, valves and piping	1	LS	$9,500	$9,500
Chlorine residual analyzer	1	EA	$4,500	$4,500
Valve Vault				
Valve Vault Structure	1	LS	$30,000	$30,000
Piping, and Valves	1	LS	$50,000	$50,000
Seismic Controller and Valve	1	LS	$50,000	$50,000
Miscellanous Mechanical Equipment	1	LS	$25,000	$25,000
Electrical and Controls	1	LS	$50,000	$50,000
Construction Total				$1,272,000

Table C-10

Project P-1: New Radar Road Pump Station
Recommended Budget Level Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs **Item**	**Qty**	**Unit**	**Unit Cost**	**Total Cost**
General & Civil Sitework				
Mobilization (percentage of total)	8.0%	LS	$42,100	$42,100
Demolish Existing Pump Station	1	LS	$5,000	$5,000
Clearing & Grubbing	1	LS	$2,000	$2,000
Earthwork	40	CY	$50	$2,000
Erosion Control	1	LS	$1,500	$1,500
Baserock & Gravel Surfacing	1	LS	$2,500	$2,500
Chain Link Fencing	90	LF	$125	$11,300
Miscellaneous Civil Improvements	1	LS	$20,000	$20,000
Bollards	4	EA	$750	$3,000
Piping				
Underground Suction & Discharge piping	100	LF	$120	$12,000
Storm Drainage Piping	75	LF	$50	$3,800
Sanitary Sewer Service Piping	80	LF	$70	$5,600
Building Structure	400	SF	$200	$80,000
Building Specialties				
Roll Up Door	1	LS	$7,000	$7,000
Concrete Steps & Railing	1	LS	$8,000	$8,000
Misc. Mechanical	1	LS	$12,500	$12,500
Equipment				
Pumps, Piping, and Valves	1	LS	$100,000	$100,000
Instrumentation	1	LS	$20,000	$20,000
Equipment Installation (20% of Equip. Cost)	1	LS	$24,000	$24,000
Auxiliary Power Generator & ATS	1	LS	$60,000	$60,000
Variable Frequency Drives	2	Each	$15,000	$30,000
Control and Telemetry Panels	1	LS	$45,000	$45,000
Power Service	1	LS	$15,000	$15,000
Electrical & Controls (12% of Total Cost)	1	LS	$56,000	$56,000
Construction Total				$568,000

Table C-11

Project P-2: New Horizon Hill Pump Station & Reservoir
Recommended Budget Level Cost Estimate
Yachats Water System Master Plan
3096.4000.0

Construction Costs Item	Qty	Unit	Unit Cost	Total Cost
General & Civil Site Work				
Mobilization (percentage of total)	8.0%	LS	$59,200	$59,200
Erosion Control	1	LS	$1,500	$1,500
Construct New PRV Vault & Piping (Bypass Reservoir)	1	LS	$70,000	$70,000
Demolish Existing Pump Station & Reservoir	1	LS	$10,000	$10,000
Clearing & Grubbing	1	LS	$2,000	$2,000
Earthwork & Excavation	100	CY	$50	$5,000
Civil Site Work	LS	ALL	$10,000	$10,000
Yard Piping	80	LF	$130	$10,400
Base Rock & Gravel Surfacing	LS	ALL	Lump Sum	$3,000
Chain Link Fencing & Gate	100	LF	$125	$12,500
Bollards	4	EA	$750	$3,000
Miscellaneous Civil	1	LS	$20,000	$20,000
Reinforced Concrete Tank Structure, 20,000 g				
24-inch mat slab on grade	20	CY	$525	$10,500
Wall base and top joints	100	LF	$50	$5,000
Structural walls	50	CY	$750	$37,500
Elevated slab and roof curbs	10	CY	$1,000	$10,000
Expansion and construction joints	1	LS	$1,000	$1,000
Miscellaneous Metalwork				
Overflow cone assembly	1	EA	$850	$850
Silt-stop assembly	1	EA	$500	$500
Reservoir exterior access ladder	1	EA	$4,000	$4,000
Reservoir downspouts & roof scuppers	2	EA	$300	$600
Roof hatch	1	EA	$6,000	$6,000
Roof vent	1	EA	$4,500	$4,500
Reservoir interior access ladder (SST)	1	EA	$5,000	$5,000
Safety railing at hatch	15	LF	$50	$750
Valve Vault				
Valve Vault Structure	1	LS	$25,000	$25,000
Piping, and Valves	1	LS	$40,000	$40,000
Piping				
Underground Suction & Discharge piping	100	LF	$120	$12,000
Storm Drainage Piping	50	LF	$50	$2,500
Sanitary Sewer Service Piping	60	LF	$70	$4,200
Washdown Water Piping	20	LF	$40	$800
Washdown Water Station	1	EA	$1,000	$1,000
Building				
Structure	400	SF	$200	$80,000
Roll Up Door	1	LS	$7,000	$7,000
Pump Station Equipment				
Misc. Mechanical	1	LS	$20,000	$20,000
Pumps, Piping, and Valves	1	LS	$100,000	$100,000
Instrumentation	1	LS	$20,000	$20,000
Auxiliary Power Generator & ATS	1	LS	$40,000	$40,000

Variable Frequency Drives	1	LS	$15,000	$15,000
Control and Telemetry Panels	1	LS	$45,000	$45,000
Power Service	1	EA	$15,000	$15,000
Electrical & Controls (12% of Total Cost)	1	LS	$79,000	$79,000
Construction Total				$799,000

Table C-12

Project D-20: Automated Water Meter Reading System
Recommended Budget Level Cost Estimate
Yachats Water System Master Plan
3096.4000.0

I. Capital Costs

Construction Costs

Item	Qty	Unit	Unit Cost	Total Cost
External Antennas	300	Each	$60	$18,000
Radio-Receiving Station Equipment	3	Each	$15,000	$45,000
Radio-Receiving Station Installation	3	Each	$30,000	$90,000
AMI Software & Setup	All	LS	$30,000	$30,000
Customer Portal Setup	All	LS	$25,000	$25,000
Construction Total				$208,000
Soft Costs				
Construction Contingency (10%)				$21,000
Engineering (20%)				$42,000
Administration and Permitting Costs (10%)				$21,000
Billing Software Integration				$35,000
Total Recommended Capital Project Budget				**$327,000**

II. Annual Operation and Maintenance Costs

AMI Data Hosting and Annual Customer Portal Fees	All	LS	$35,000	$35,000
Total Estimated Operation and Maintenance Costs				**$35,000**