City of

# Prineville, Oregon

## Water System Master Plan

2017

Water Solutions, Inc.

DOWL

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Draft

**WATER SYSTEM MASTER PLAN**

**FOR**

**CITY OF PRINEVILLE, OREGON**

**2017**

REGISTERED PROFESSIONAL
ENGINEER
65318PE
DRAFT
OREGON
MAR. 12, 2002
TROY L. BAKER
RENEWS 12-31-17

The City of Prineville, Oregon, has reviewed this Water System Master Plan and adopted it.

DRAFT
Signature and Title ________________ Date ________________


ANDERSON PERRY & ASSOCIATES, INC.

Prineville, Oregon
La Grande, Oregon
Walla Walla, Washington


 Job No. 1260-15

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# Chapter 1 - Introduction

## Purpose of Study

This study presents the results of a Water System Master Plan (WSMP) intended to provide current information on which future operation of the City of Prineville's municipal water system can be based. This WSMP is also intended to satisfy the criteria of the Oregon Health Authority - Drinking Water Services (DWS) and Oregon Administrative Rule 333-061-0060. The City of Prineville's last WSMP was prepared in 2006. This WSMP is intended to fulfill the DWS requirements for a current master plan for the next 20 years. Preparation of this WSMP was authorized by an agreement between the City and Anderson Perry & Associates, Inc., dated September 1, 2016. The primary purposes for developing this WSMP have been to establish water system design criteria for a 20-year planning period; evaluate the adequacy of the existing water supply, treatment, storage, and distribution systems; evaluate alternatives and priorities for improving the City's water system; and identify a financial plan for implementing the recommended improvements. This WSMP will also serve as the basis for developing a capital improvements plan based on the identified improvements and priorities.

## Organization of Study

This WSMP is divided into seven main chapters with an Executive Summary. Specifically, the WSMP includes the following:

A. The Executive Summary of the overall WSMP describes water quality and service goals (design criteria), present and future water system deficiencies, the City's selected and prioritized improvements for achieving the goals and correcting the deficiencies, and the recommended implementation schedule and financing program for constructing improvements.

B. Chapter 1, "Introduction," discusses the objectives of the WSMP, describes the community and environment, and provides a brief history of past development and operation of the City of Prineville's water system.

C. Chapter 2, "Water System Requirements," develops the data on which recommended improvements to the water system are based. Data relating to elements such as service area, population, land use, water use, fire flows, state and federal regulations, and the design criteria developed for this WSMP are presented. A description of the water quality and level of service goals (design criteria) for the water system considering existing and anticipated future regulatory requirements, non-regulatory water quality needs of water users, flow and pressure requirements, capacity needs related to water use, and fire flow needs is also provided.

D. Chapter 3, "Water Supply and Treatment," discusses the operation, capacity, and quality of the existing water supply and treatment systems with respect to existing and future system demands and regulations. Information concerning water rights and permits for the appropriation of water from various sources is presented. An evaluation of the existing water treatment system is also included, as well as alternatives to address current treatment system deficiencies. A comparison of alternatives to obtain additional water supply sources is also provided.

E. Chapter 4, "Water Storage," discusses the existing storage reservoirs, presents the four primary components of water storage relative to the City's design criteria, evaluates alternative storage facilities, and provides recommendations for storage improvements.

F. Chapter 5, "Distribution System," presents information related to the existing distribution system facilities, water quality test results, and fire protection information. Existing deficiencies and deficiencies likely to develop during the planning period are identified. Improvements including specific areas of piping, a water meter replacement program, and water conservation efforts are recommended.

G. Chapter 6, "Selected Water System Improvements and Operational Recommendations," presents information related to water supply, treatment, storage, and distribution system improvements developed through analysis of the system. Cost estimates are provided for each of the recommended water system improvements.

H. Chapter 7, "Project Financing and Implementation," provides a description of alternatives to finance water system improvements including local financing such as user rates, taxes, and financing assistance programs. Operation, maintenance, and replacement costs are projected for both the existing system and future system improvements. The number of residential, commercial, and industrial equivalent dwelling units is provided. Potential water rate needs are developed, and rate implementation procedures are identified. A recommended water system improvement implementation process, including an evaluation of financing alternatives and identification of key implementation steps, is also provided.

I. The "Appendices" contain key materials referenced in this WSMP, which are provided for future reference by City staff. This information includes well log and water rights information, testing results, applicable ordinances, and other applicable water system information.

## Sources of Information

The conclusions and recommendations outlined in this WSMP are based on data, information, and records provided by the City. This information includes, in part, past flow records (supply and usage); financial data (operational cost, revenues, and cost distribution); descriptions of system operation, condition of system components, and identification of problem areas; water quality data; and system layout and sizing. The recommendations and conclusions are, therefore, dependent on the completeness and accuracy of the base information provided.

## Review and Updating of Study

This WSMP should be periodically reviewed and updated to stay current with population growth, water system demands, and changing state and federal regulations. This WSMP is recommended to be reviewed at 5-year intervals and be updated at 10-year intervals, or as growth dictates.

## Objectives of Study

The primary objectives of this WSMP are to provide the following information:

1. Establish planning criteria including service area boundaries; population growth projections; past, present, and future water usage patterns; fire flow requirements; federal and state standards; system pressures; and service goals.

2. Analyze the individual components of the existing water supply system considering capacity, compliance with current water quality standards, water rights, condition of components, operational dependability, and cost of operation. Develop the water supply needs for the planning period and identify cost-effective alternatives for meeting long-term water supply and treatment needs including alternatives for correcting existing system deficiencies. Outline general operation and maintenance (O&M) requirements for the water supply system.

3. Analyze the existing water storage facilities considering capacity, condition of the reservoirs, and distribution system pressures. Assess the City's storage capacity considering emergency storage, operational storage, equalization storage, and fire flow storage. Identify the storage requirements of the water system for the planning period.

4. Develop a Geographic Information System-based map of the distribution system including line sizes, line types, valve and hydrant locations, etc., when known.

5. Utilizing existing distribution system maps and City records, review the condition and adequacy of the distribution system piping. Identify system deficiencies and alternatives for meeting current and future system needs. Provide estimated costs for implementation of recommended improvements. Outline general O&M requirements of the distribution system as well.

6. Analyze the hydraulic capacity and system pressures in the existing water distribution system under average daily and peak daily demand conditions using a computer model. Identify distribution system deficiencies such as low system pressures, low fire flow capacities, dead-end or undersized lines, etc. Identify opportunities for distribution system improvements to address any noted deficiencies.

7. Review the status of the existing Water Department financial condition considering historical water system revenues, O&M costs, and debt service including the adequacy of existing water user fees. Project the future cost of O&M, capital improvement investments, and debt service for the water system. Develop a finance plan for meeting the long-term system needs including general user rate charges and outside financial assistance.

8. Provide information on potential state and federal grant and loan programs that may be available to assist the City in implementing any needed system improvements.

9. Prepare a summary identifying current and future water system needs with their associated estimated cost. Make recommendations for meeting the water system needs for the planning period.

10. Provide an implementation schedule for recommended water system improvements outlining the key steps the City would need to undertake to implement the improvements.

## Regional Setting

The City of Prineville is located in central Oregon along the Crooked River, a major tributary of the Deschutes River that flows north into the Columbia River. The valley through which the river flows is bordered on the north by the slopes of the Ochoco Mountains and on the south by steep escarpments that rise to an extensive lava plateau south of the Prineville area. Location and vicinity maps and aerial photographs for the City of Prineville are shown on Figures 1-1, 1-2A, and 1-2B. The City of Prineville is the County seat and the only incorporated city in Crook County, with a population of 9,253 at the 2010 Census. The 2015 estimated population for Prineville was 9,385, as estimated by the Population Research Center at Portland State University.

The climate in the summer is typically dry with clear days. Winter brings rain, snow, and frozen soils. Temperatures vary from extremes of -30° Fahrenheit (F) in the winter to 120°F in the summer. These extreme temperatures are usually not prolonged. According to the Western Regional Climate Center, the average annual temperature of Prineville is approximately 47°F and the annual average precipitation is approximately 9.9 inches.

Transportation is provided to the City of Prineville by Highways 26 and 126. Prineville is positioned at the intersection of these two highways. It is located approximately 16 miles west of Highway 97, which is a major north-south highway in Oregon.

## Soils

The soils throughout the City of Prineville are generally designated silt loams or sandy loams. The major types are Ochoco-Prineville complex, Powder silt loam, Crooked stearns complex, and Metolius ashy sandy loam. These soils are generally nearly level, well drained to moderately well drained soils with parent materials of volcanic ash over mixed alluvium from volcanic rock.

## Location

The City of Prineville is located in central Oregon at the intersection of Highways 126 and 26, adjacent to the Crooked River in Crook County. The general location of the community is shown on Figure 1-1, Location and Vicinity Maps.

The area of analysis provided in this WSMP encompasses the entire area within the city limits and urban growth boundary (UGB), as shown on Figure 1-1.

## Water System History

### *General*

The majority of the historical information for the water system was obtained from City records; conversations with Eric Klann, Prineville City Engineer; the City's Water Management and Conservation Plan prepared in 2016 by GSI Water Solutions, Inc.; and the 2006 WSMP completed by Ace Consulting.

The City of Prineville owns and operates a municipal water system that obtains water from several wells distributed over the system. The water is then stored in ground-level storage reservoirs and distributed to residential, commercial, industrial, and public customers within the city limits and approximately 120 homes outside the city limits but within the UGB. An estimated 421 houses exist within the city limits that are currently served by private wells and are not connected to the City's water system.

Historically, Prineville's water system was privately owned and operated by the Deschutes Power and Light Company until 1928 when it was acquired by Inland Power and Light Company and then resold to Pacific Power and Light in 1930. The City acquired the water system from Pacific Power and Light in January 1985. Approximately 10 percent of the water mains are 4-inch diameter and smaller, and some are galvanized steel pipe. Over the years, the City has replaced some undersized mains and installed new mains, additional wells, and storage tanks.

### Previous Studies

The primary recommendations in the 2006 WSMP were to increase supply, storage, and distribution. These improvements included replacing existing undersized water mains and wood stave pipes, as well as developing several wells and constructing several tanks and a booster pump station.

### Water Supply Sources

Although the City holds surface water rights to the Crooked River, Prineville Reservoir, and Ochoco Creek, surface water is exclusively used for irrigation and livestock purposes. Municipal water for the City of Prineville is sourced from a total of 11 wells. Seven of the wells are located on the Prineville valley floor and appropriate water from an alluvial aquifer with a total production of 1,370 gallons per minute (gpm). The other four wells are located west of the City and source water from the Airport Area Aquifer System with a production limit of 1,770 gpm. This aquifer is currently being monitored to determine its long-term reliability.

Stearns Well is located off Highway 26 west of the City. In January 1973, the well was drilled to a depth of 246 feet with a water depth at 22.3 feet. A casing with diameters of 24 and 12 inches was installed to a depth of 225 and 226 feet, respectively, with cement grout from 32 to 75 feet. The installed screen is stainless steel with a 12-inch diameter set from 226 to 246 feet. The materials observed during drilling included silty sand, clays, and gravel. During a well test, the well yield was 820 gpm with a 136-foot drawdown for 10 hours.

The 4th Street Deep Well is centrally located in the City approximately 525 feet from the intersection of S.E. Belknap Street and S.E. 4th Street. The well was drilled to a depth of 252 feet with a diameter of 12 inches. The static water level was measured to be 35 feet below the surface when the well was drilled on October 12, 1960. A stainless steel screen was installed with a 12-inch diameter from 222 to 242.5 feet. Casing was installed from the surface to 222 feet with diameters of 24 and 12 inches. Casing was also installed with a diameter of 12 inches from 242.5 feet to 252 feet. The materials observed during drilling included silty clay, silts, water-bearing sand, and gravel. During a well test the yield was 650 gpm with a 74-foot drawdown after 12 hours. The well was rehabilitated in 2005, and the 50 horsepower (Hp) pump has a current capacity of 450 gpm.

The 4th Street Shallow Well is located adjacent to the 4th Street Deep Well. The well was drilled to a depth of 75 feet and cased to a depth of 61 feet. Construction was completed in August 1950. The aquifer was recorded to be gravel from 13 to 28 feet, and the well is perforated from 13 to 22 feet. Materials observed included clay, silt, gravel, and sand. The submersible pump has a rated capacity of 180 to 200 gpm. The well has not been utilized in recent history and is the City's backup source.

The Lamonta Well is located on Lamonta Road north of the City and is manually controlled. Completed on September 4, 1957, the well was drilled to a depth of 256 feet with a diameter of 24 inches. Casing with a diameter of 24 and 12 inches was installed to a depth of 230 and 228 feet, respectively. Additionally, casing with a 12-inch diameter was installed from 253 to 256 feet. A wire-wound screen was installed with a diameter of 12 inches and set from 228 to 253 feet. The static water level is 17 feet below the surface. During a well test, the yield was 800 gpm with a 200-foot drawdown after 1 hour. Materials observed in the well included sand, sandstone, surface water, clay, sandy silt, sticky shale, and gravel. The 50 Hp turbine pump currently produce an average of 250 gpm with a rated capacity of 450 gpm.

Only a well record exists for the Yancey Well, which is located north of Highway 26 on N.W. Fairmont Street. The well was drilled in 1917 to a depth of 228 feet and was later reconstructed in 1975. The casing has a diameter of 8 inches to a depth of 239 feet. The water level was recorded to be 16.2 feet below ground surface on October 26, 1944. The 40 Hp turbine pump has a capacity of 360 gpm. During a well test, the drawdown was 96 feet after 20 hours of pumping at 360 gpm. The current capacity averages 210 gpm. The well is currently controlled by telemetry.

The Stadium Well is located on 5th Street adjacent to the high school track and stadium and is manually controlled. Construction was completed in February 1987, and the well was drilled to a depth of 259 feet. At the time of drilling, the static water level was found to be 31 feet below ground surface. The well is cased with a 12- and 10-inch diameter welded steel liner from 3.5 feet to 228 feet and 218 to 259 feet, respectively. Materials observed during drilling include clay, gravel, and sand. The 40 Hp turbine pump has a limited capacity of 240 gpm with significant drawdown. A filter has been installed in the well due to sand and iron problems. This well is utilized manually as a backup for emergencies and only used for short periods of time.

The Barney Well is located close to the Barnes Butte Reservoir Tank and Stearns Well on the east side of the City. Construction was completed in December 1994, and the well was drilled to a depth of 280 feet. The static water level was found to be 35 feet below ground surface at the time of drilling. A 10-inch diameter welded steel casing was installed from 2 to 280 feet, as well as a perforated casing from 219 to 279 feet. During well tests the yield was 700 gpm for 1 hour with a drawdown of 110 feet. Materials observed during drilling include gravel, clay, and coarse sand. The 75 Hp American Turbine pump, installed in 1999, has a rated capacity of 600 gpm. The well was rehabilitated in 2002. The Barney Well is controlled by telemetry.

The Ochoco Heights Well is located adjacent to the Ochoco Heights Tanks north of the City off Main Street. Only a well record exists for this well. The well is currently inoperable. Presently, no well pump is installed, but there is a possibility of utilizing this well for monitoring if another well is constructed in the vicinity. The well was drilled to a depth of 1,002 feet and was cased to roughly 300 feet. Construction was completed in 1943 and, at that time, the water level was observed to be 52 feet below ground surface.

There are four airport wells, each of which is located southwest of the City neighboring the Prineville Airport. These wells appropriate water from a separate aquifer than the wells located in the

Prineville valley. The aquifer is still being monitored to determine whether the aquifer is a reliable source of water. The wells were drilled between 1980 and 2014. From information available from the well logs, the static water level appears to be deep at roughly 415 feet below ground surface.

## *Water Storage Reservoirs*

The City of Prineville has six aboveground covered water storage reservoirs. The total capacity of the reservoirs is 4.5 million gallons (MG).

The Ochoco Heights reservoirs are identical and are located north of town. Ochoco Heights Reservoir No. 1 was constructed in 1955. The reservoir is an aboveground welded steel tank with a diameter of 41.5 feet and a height of 50 feet. The second tank, Ochoco Heights Reservoir No. 2, was built in 1964 directly adjacent to Reservoir No. 1 with the same material and dimensions. The Ochoco tanks are filled by the wells located on the valley floor. The tanks feed the Ochoco Heights Booster Pump Station, which feeds the Ochoco Heights pressure zone, the Valley pressure zone, and the American Pine Reservoir.

The American Pine Reservoir is located north of the Ochoco Heights reservoirs south of Peters Road. Constructed in 2002, this tank is an aboveground welded steel reservoir. The tank has a diameter of 73 feet and a height of 33 feet. The tank is fed by an altitude valve and provides water to the Northridge pressure zone.

The Barnes Butte Reservoir is located near the Barney and Stearns Wells on the west side of the City, north of Highway 26. The welded steel aboveground reservoir was constructed in 1978. The tank is 40 feet tall with a diameter of 47 feet. Unable to attain the property for a proposed Yellowpine Tank at the north end of Northridge area, the City elected to construct this tank with a booster pump station to provide water to the Northridge area.

The Airport No. 1 Reservoir is an aboveground bolted steel tank with a diameter of 85 feet and an operating range of 22.5 to 23.8 feet. The Airport No. 2 Reservoir is an 80-foot diameter welded steel tank adjacent to the Airport No. 1 Reservoir. The operating range is set to match the Airport No. 1 tank.

The City's water sources are the alluvial aquifer beneath the Prineville valley floor and the Airport Area Aquifer System. The water is pumped from eleven groundwater wells into the system to fill six aboveground reservoirs. Table 1-1 provides a summary of these reservoirs.

**TABLE 1-1**
**SUMMARY OF SYSTEM RESERVOIRS**

| Reservoir | Volume (MG) | Base Elevation (feet)* | Overflow Elevation (feet)* | Height (feet) | Completion Date |
|---|---|---|---|---|---|
| Ochoco Heights Reservoir No. 1 | 0.5 | 2,937 | 2,987 | 50 | 1955 |
| Ochoco Heights Reservoir No. 2 | 0.5 | 2,937 | 2,987 | 50 | 1964 |
| American Pine Reservoir | 1.0 | 2,951 | 2,984 | 33 | 2002 |
| Barnes Butte Reservoir | 0.5 | 3,064 | 3,104 | 40 | 1978 |

| Reservoir | Volume (MG) | Base Elevation (feet)* | Overflow Elevation (feet)* | Height (feet) | Completion Date |
|---|---|---|---|---|---|
| Airport No. 1 Reservoir | 1.0 | 3,380 | 3,404 | 24 | 1996 |
| Airport No. 2 Reservoir | 1.0 | 3,378 | 3,404 | 26 | 2014 |
| **Total** | **4.5** | | | | |

** Elevations are based on the North American Vertical Datum 88 vertical datum.*

Ochoco Heights Reservoirs No. 1 and 2 are aboveground welded steel tanks with diameters of 41.5 feet. The tanks have operating ranges of 40 to 50 feet. These reservoirs provide the water supply for a significant part of the City, primarily north and northwest of the tanks.

## *Distribution System*

The City's water distribution system consists of an assortment of pipe materials including asbestos cement, cast iron, ductile iron, steel, wood stave, and polyvinyl chloride pipe. Pipelines range in size from 1 inch to 18 inches in diameter. Table 1-2 provides a breakdown of the City's pipelines by pipe diameter. The City's distribution system main lines are primarily 6 to 12 inches in diameter, although there are also areas with smaller lines. However, distribution system improvements have been made in recent years to improve flow and pressure in the system. The distribution system is generally laid out with looped piping to assist with water circulation through the system. The City has indicated that water main lines in the distribution system are generally in fair condition.

**TABLE 1-2**
**SUMMARY OF SYSTEM PIPELINES**

| Pipe Diameter (inches) | Total Length (feet) | Total Length (miles) | Percent of Total Pipeline |
|---|---|---|---|
| 2 or Less | 14,677 | 2.8 | 4 |
| 3 | 1,385 | 0.3 | 1 |
| 4 | 19,147 | 3.6 | 5 |
| 6 | 64,067 | 12.1 | 17 |
| 8 | 150,135 | 28.4 | 40 |
| 10 | 15,667 | 3.0 | 4 |
| 12 | 86,160 | 16.3 | 23 |
| 16 | 17,492 | 3.3 | 5 |
| 18 | 3,350 | 0.6 | 1 |
| **Total** | **372,080** | **70.4** | **100** |

The existing distribution network is divided into various pressure zones, as summarized on Table 1-3. Where practical, the distribution system is gravity fed from the reservoirs. Booster pump stations are used to provide adequate system pressures for areas of the system that cannot be served by gravity. The City also uses three pressure reducing valves (PRVs) within the network to regulate system pressures and balance water demands.

The Valley pressure zone is the largest zone and is served by gravity from the Ochoco Heights tanks. The zone also includes the Lamonta, Yancey, Ochoco, 4th Street (Deep and Shallow), and Stadium groundwater wells that fill the tanks. Flows are supplemented to the Valley pressure zone through two PRVs that allow water from higher pressure zones to enter the lower Valley pressure zone.

The Barnes Butte pressure zone is served by gravity from the Barnes Butte Reservoir Tank. The tank is filled by the Barney and Stearns groundwater wells within the zone. Water from Barnes Butte can supplement lower pressure zones of the system through the Williamson and Combs Flat PRVs.

The Williamson pressure zone receives water from the Barnes Butte Reservoir Tank through the Williamson PRV. This PRV is adjusted higher in the summer and lower in the winter.

The Ochoco Heights pressure zone receives its water from the Ochoco Heights tanks. The tanks supply water to the Ochoco Heights booster pump station to serve the pressure zone. A PRV is located on the downstream side of the booster pump station to regulate pressure.

The Northridge pressure zone receives water from the American Pine Reservoir. The tank supplies water to the American Pine Booster Pump Station to serve the pressures zone. A PRV is located on the downstream side of the booster pump station to regulate pressure. The American Pine Reservoir is filled from the Ochoco Heights Booster Pump Station. A pressure sustaining valve exists on the inlet line of the American Pine Reservoir to regulate flow into the tank.

The Airport pressure zone is served by gravity from the airport tanks. The zone includes four groundwater wells that fill the airport tanks. Water from the Airport zone can supplement the Valley zone through the Park Drive PRV. The Airport zone also includes a separate booster pump station and PRV to provide fire flows to industrial properties within the zone.

**TABLE 1-3**
**SUMMARY OF PRESSURE ZONES**

| Pressure Zone | Ground Elevation Currently Served (feet)* | | Hydraulic Control Element | HGL (feet) (Tank Full or PRV Setting) | Static Pressure (psi) | |
|---|---|---|---|---|---|---|
| | Highest | Lowest | | | Low | High |
| Valley | 2,918 | 2,846 | Ochoco Heights Reservoir | 2,987 (Tank Full) | 30 | 61 |
| Barnes Butte | 2,981 | 2,906 | Barnes Butte Reservoir | 3,104 (Tank Full) | 53 | 86 |
| Williamson | 3,029 | 2,884 | Williamson PRV | 3,097 (82 psi) | 30 | 92 |
| | | | | 3,060 (66 psi) | 13 | 76 |
| Ochoco Heights | 2,961 | 2,885 | Ochoco Heights Booster Pump Station with PRV | 3,120 (80 psi) | 69 | 102 |
| Northridge | 3,056 | 2,922 | American Pine Reservoir Booster Pump | 3,136 (80 psi) | 35 | 93 |

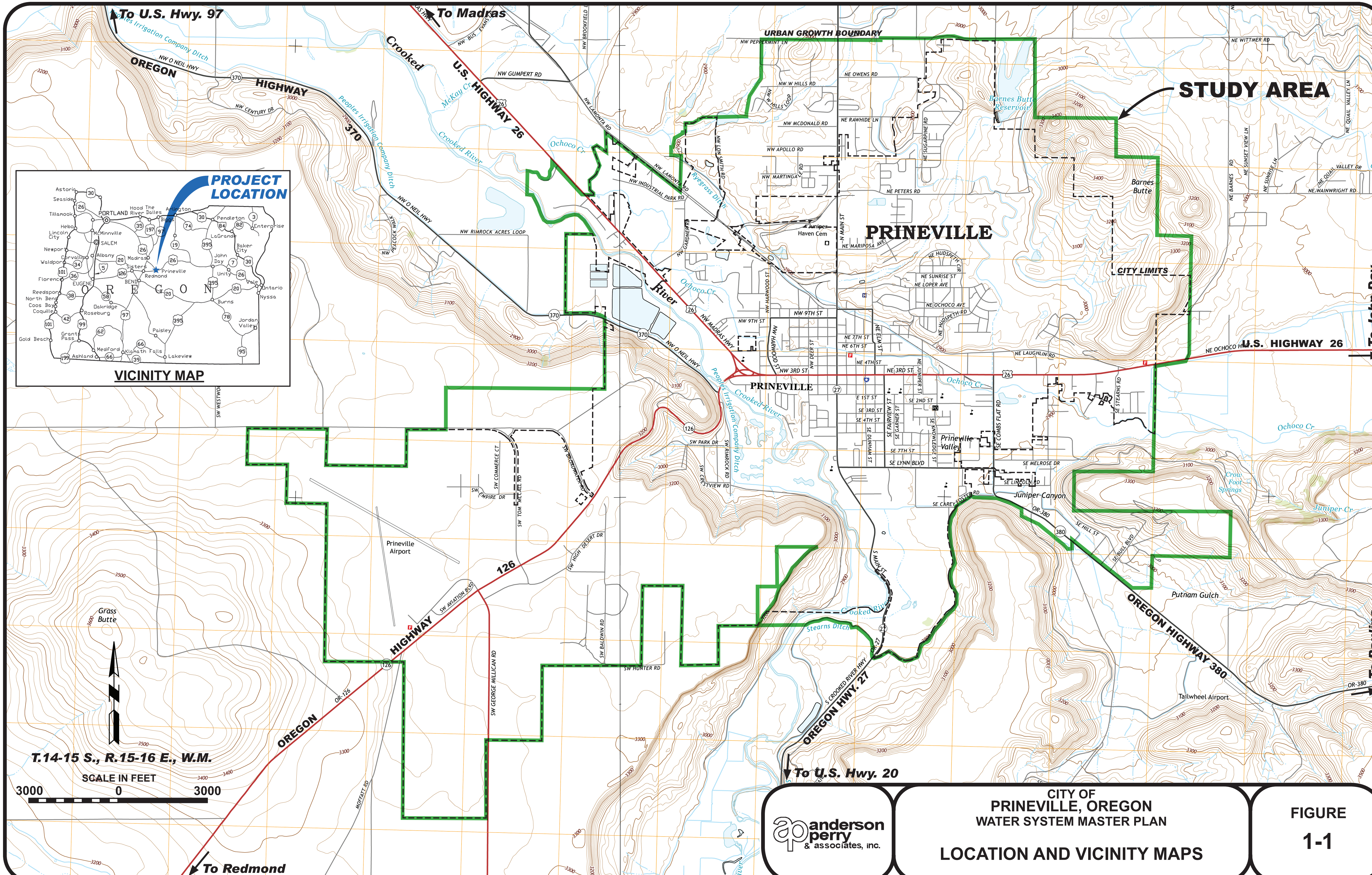
| Pressure Zone | Ground Elevation Currently Served (feet)* | | Hydraulic Control Element | HGL (feet) (Tank Full or PRV Setting) | Static Pressure (psi) | |
|---|---|---|---|---|---|---|
| | Highest | Lowest | | | Low | High |
| | | | Station with PRV | | | |
| Airport | 3,288 | 3,025 | Airport Reservoir | 3,404 (Tank Full) | 50 | 164 |

**Service elevations do not include locations in the immediate vicinity of tanks, PRVs, or booster pump stations.*

*HGL = hydraulic grade line*

*psi = pounds per square inch*

A layout of the distribution system is shown on the Existing Water System Map at the end of this WSMP. The distribution system is discussed in more detail in Chapter 5.

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CITY OF
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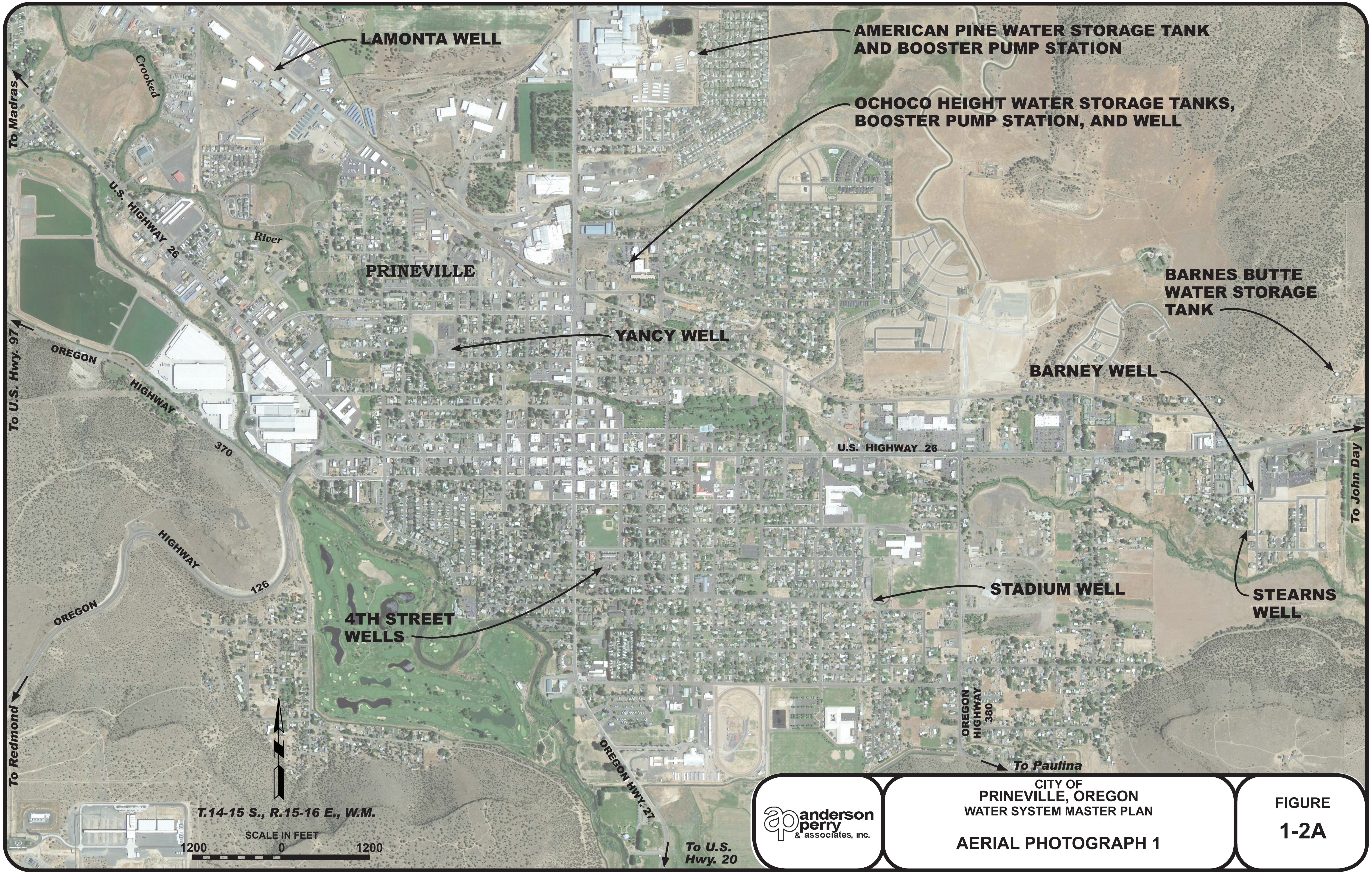
LOCATION AND VICINITY MAPS

FIGURE
1-1

Job# 1260-15-020 Nov. 11, 2016 lbauer

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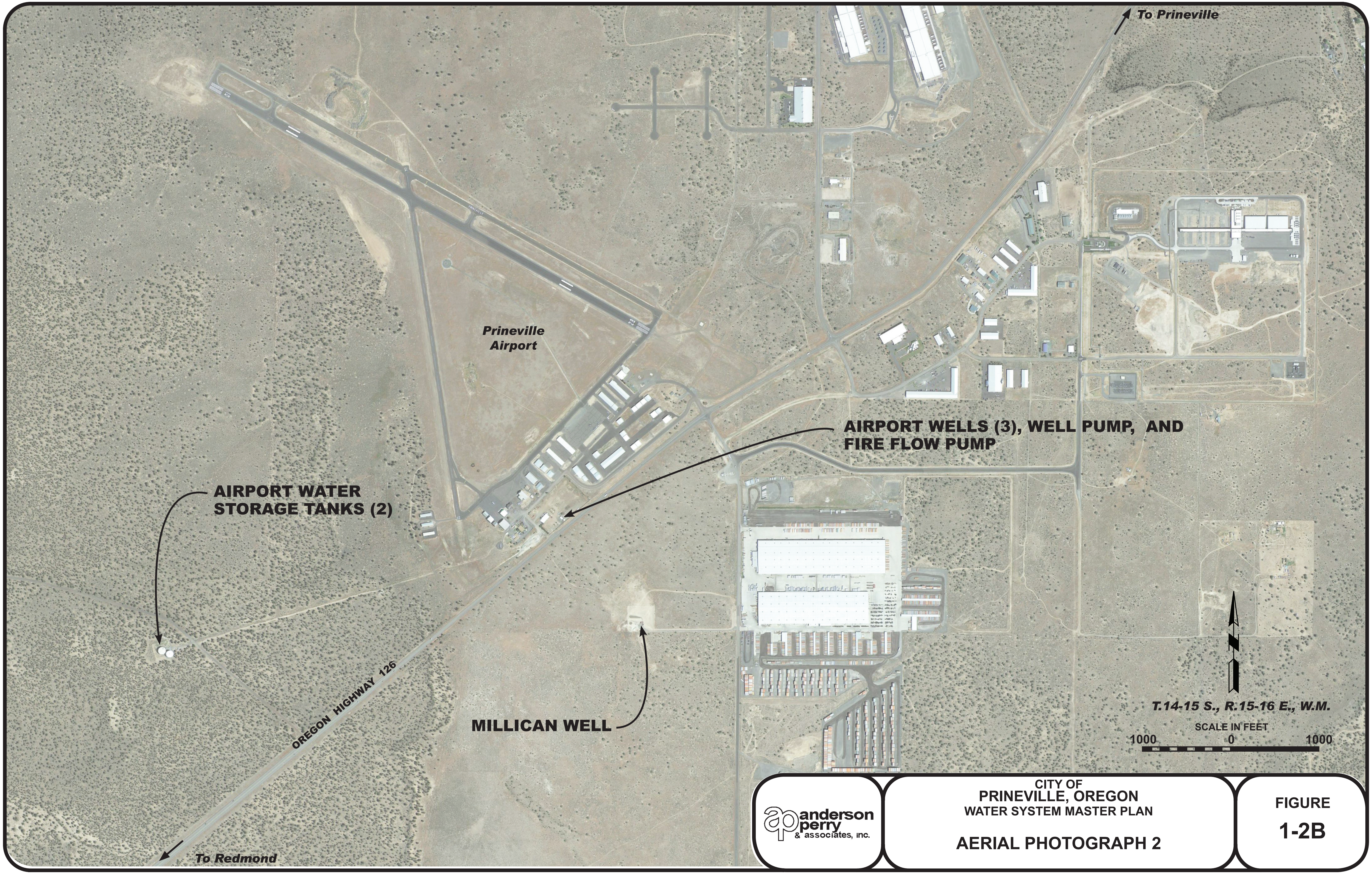
CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

AERIAL PHOTOGRAPH 1

FIGURE
1-2A

Job# 1260-15-020 Nov. 22, 2016 lbauer

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# Chapter 2 - Water System Requirements

## Introduction

This chapter presents basic information from which criteria have been developed for evaluating the City's existing water system and for defining and sizing the required components of the system for the 20-year planning period. Information concerning the service area, population projections, water use, and state and federal requirements is presented.

## Service Area

The term "service area" refers to the area being served with water from the City's water system. Both the present and future service areas are considered in this Water System Master Plan (WSMP). The present service area primarily consists of the developed lands within the boundaries of the city limits; however, there is one small area serviced outside of the city limits. The area is on S.W. Saddle Ridge Loop, which is outside city limits yet inside the urban growth boundary (UGB). For the purpose of this WSMP, the future service area will consist of the present service area plus all areas within the current UGB. The City's zoning map is shown on Figure 2-1.

The service area is located in a valley known as the Crooked River-Ochoco Creek Valley. Dominant geographic features include rimrock formations in the southern part of the service area and Barnes Butte located in the northeastern portion of the area. Surface elevations range from 2,800 to 3,600 above mean sea level. Many areas with large tracts of undeveloped land currently exist within the UGB (see Figure 1-1). With a significant area of open, undeveloped land available, the City of Prineville has the potential for residential, commercial, and industrial growth. Issues related to the service area and service limits of the existing water system are discussed in more detail in Chapter 4.

## Service Population and Planning Period

To estimate the demands that may be placed on a municipal water system, a determination of the population to be served must be made. Population estimates must be made with reference to time. Projections are usually made on the basis of an annual percentage increase estimated from past growth rates, tempered by future expectations. It is difficult to accurately predict the population of a small community over an extended period of time.

The period of time over which the population is to be projected usually depends on the type of improvements to be considered. Improvements that will require long-term financing should be designed for no less than the term of the financing. Facilities that are readily expanded or modified are normally designed for a period of 10 to 20 years. Facilities that are not easily modified or expanded, such as buried pipelines and storage reservoirs, may be designed for their expected life, which is usually 40 to 50 years or more.

The City's water system serves all residential, commercial, industrial, and public customers within the city limits, with the exception of an estimated 421 residences currently served by private wells that are not connected to the City's water system. In addition to the customers within the city limits, the city currently serves an estimated 120 residences outside the city limits but within the UGB.

The certified 2016 population of the City of Prineville was 9,645, according to Portland State University's (PSU) Population Research Center (PRC). This agency is the official source of population data available in Oregon between the official Census data generated at the beginning of each decade. The historical population data shown on Chart 2-1 were provided by the PRC.

For planning purposes, this certified population was utilized for the 2017 population. Assuming an average number of persons per household of 2.51 per PRC data, an estimated 1,057 people within the city limits do not receive City-supplied water, and an estimated 301 people outside the city limits but within the UGB do receive City-supplied water. Therefore, the net 2017 population served by City-supplied water is estimated to be 8,889.

Projections are usually made on the basis of an annual percentage increase estimated from past growth rates combined with future expectations. The historical population data shown hereafter on Table 2-1 was provided by the PSU Oregon Population Forecast Program. In 2013, the Oregon House of Representatives and Senate approved legislation assigning coordinated population forecasting to the PRC. Utilizing average annual growth rates (AAGR) provided by the PRC, historical population trends for the City are shown on Table 2-1 and Chart 2-1.

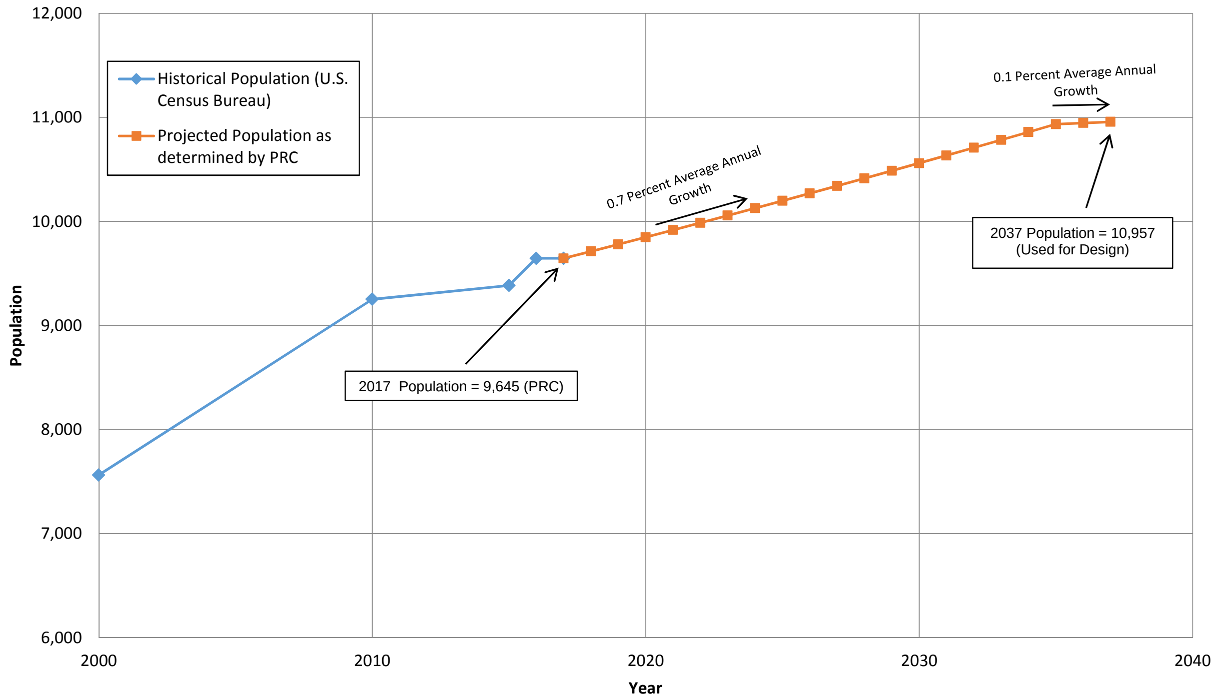
**TABLE 2-1**
**HISTORICAL AND FORECASTED POPULATIONS[1]**

| **Historical** | | | **Forecast** | | | |
|---|---|---|---|---|---|---|
| **2000** | **2010** | **AAGR (2000 to 2010)** | **2017[2]** | **2037** | **AAGR (2016 to 2035)** | **AAGR (2035 to 2066)** |
| 7,358 | 9,253 | *0.6 percent* | 9,645 | 10,958 | *0.7 percent* | *0.1 percent* |

*[1]As provided by the PRC.*
*[2]For planning purposes, the PRC's 2016 certified population was used for 2017.*

The assumed 0.7 percent AAGR between the years 2017 and 2035 and 0.1 percent AAGR between the years 2035 and 2065 results in a 2037 design population of 10,958. However, over the planning period of this WSMP, actual growth could exceed or fall well below the figures presented on Chart 2-1.

**CHART 2-1**
**HISTORICAL AND PROJECTED POPULATION**




## Land Use

The current zoning in the City of Prineville is shown on Figure 2-1. Four Comprehensive Plan land use designations have been identified within the city limits: residential, commercial, industrial, and public. The majority of the City is designated for residential use. Areas along Highway 126 are primarily designated as multipurpose and airport.

## Regulatory Requirements

The City of Prineville's water system is under the jurisdiction of the Oregon Health Authority - Drinking Water Services (DWS). The DWS assumed primacy (responsibility) from the U.S. Environmental Protection Agency (EPA) in February 1986 for enforcement of the federal Safe Drinking Water Act (SDWA). Therefore, the City of Prineville is currently, and will principally be, working with the DWS as the regulating agency with regard to their water system. The City is required to publish annual Consumer Confidence Reports; a copy of the 2013 Report is located in Appendix A.

### *Regulatory Background*

The SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources (rivers, lakes, reservoirs, springs, and groundwater wells). The primary regulations associated with the SDWA address requirements concerning trace minerals, compounds, and microorganisms that may affect the health of water consumers. The

SDWA provides for monitoring, testing requirements, reporting, recordkeeping, and public notification procedures in the event of non-compliance.

The 1986 amendments to the SDWA included provisions for wellhead protection, new monitoring for certain substances, filtration for certain surface water systems, disinfection for certain groundwater systems, and restrictions on lead content in pipe solder and plumbing.

The 1996 amendments to the SDWA included provisions for consumer confidence reporting, stronger protection for microbial contaminants and disinfection byproducts, operator certification, lowering maximum contaminant levels (MCL), and source water assessments.

Enacted in 1981, the Oregon Drinking Water Quality Act established periodically amended statutes and subsequent administrative rules to enforce, at a minimum, the federal SDWA requirements. The DWS administers and enforces drinking water quality standards for public water systems in Oregon. The agency focuses resources in the areas of highest public health benefit and promotes voluntary compliance with state and federal drinking water standards. The DWS also emphasizes prevention of contamination through source water protection, provides technical assistance to water system owners, and provides water system operator training. They also work closely with public water systems to ensure public notification is made in accordance with regulatory guidelines, when required. If the City is unaware of their compliance status or in need of regulatory guidance, it is recommended that the regional DWS office be contacted.

The Arsenic Rule, which became effective in February 2002, lowered the MCL for arsenic allowed in a community water system from 50 parts per billion (ppb) to 10 ppb.

### *Recent Regulatory History (Last Five Years)*

Following is a list of regulations that have been enacted in the past five years:

1. **Reduction of Lead in Drinking Water Act**, which requires any new installation or purchase of materials used in potable locations to be “lead-free.” Lead-free has been redefined as “(A) not containing more than 0.2 percent lead when used with respect to solder and flux; and (B) not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.” This law was enacted on January 4, 2014. Oregon requires drinking water components to be National Sanitation Foundation/American National Standards Institute Standard 61 compliant to meet the intent of this law.

2. **Stage 2 Disinfectants and Disinfection Byproduct Rule (D/DBPR)**, which focuses on public health protection by limiting exposure to disinfection byproducts. The D/DBPR specifically targets total trihalomethanes and five haloacetic acids, which can form in water through disinfectants used to control microbial pathogens. This rule applies to all community water systems (CWS) and non-transient non-community (NTNC) water systems that add a primary or residual disinfectant other than ultraviolet light. Stage 2 of the D/DBPR was enacted in 2012 for large CWS and NTNC water systems and in October 2013 for all CWS and NTNC water systems.

3. **Unregulated Contaminant Monitoring Rule (UCMR) 3.** The EPA uses the UCMR program to collect data for contaminants suspected to be present in drinking water but that do not have health-based standards set under the SDWA. Every five years, the EPA develops a new list of UCMR contaminants, largely based on the Contaminant Candidate List. Oregon Administrative Rule 333-061-0043 requires CWS to report detection of unregulated contaminants in their annual Consumer Confidence Report.

4. **Revised Total Coliform Rule**. This rule requires that total coliform samples be collected by public water systems at sites representative of water quality throughout the distribution system according to a written sample site identification plan.

## *Potential Regulatory Changes*

Following is a list of regulations that may be enacted in the future:

1. **Radon in Drinking Water Rule**, which would attempt to reduce airborne and waterborne radon concentrations to limit exposure levels. This rule would apply to CWS that use groundwater or mixed groundwater and surface water. The proposal is currently on hold, and the EPA has no timeline for publishing this rule.

2. **Fourth Contaminant Candidate List (CCL4) Regulatory Determinations.** The CCL4 is currently in draft form. The EPA has made a preliminary determination to regulate strontium, which is currently still pending. Two new nominated contaminates, manganese and nonylphenol, have been added for the final publication.

3. **Carcinogenic Volatile Organic Chemicals (cVOC) Rule.** The EPA is developing a proposed national primary drinking water regulation for a group of 16 known cancer-causing compounds, including eight currently regulated cVOC and up to eight from the Third Contaminant Candidate List.

4. **Perchlorate Rule.** The EPA is developing a proposed national primary drinking water regulation for perchlorate. Perchlorate may cause adverse health effects. Scientific research indicates that this contaminant can disrupt the thyroid's ability to produce hormones needed for normal growth and development.

5. **Hexavalent Chromium.** The EPA currently regulates hexavalent chromium as part of the total chromium drinking water standard. New information on health effects has become available since the original standard was set, and the EPA is reviewing this information to determine whether new health risks need to be addressed. California has already implemented a hexavalent chromium specific MCL.

6. **Fluoridation.** Fluoride MCLs may be lowered in the future as the health impacts of fluoride are fully realized. The current MCL of 4 parts per million could be reduced to 1 or less. This lower MCL could require systems with naturally occurring fluoride above the MCL to treat to reduce levels.

7. **Cybersecurity.** Executive Order 13636: Improving Critical Infrastructure Cybersecurity, was established in February 2013. The order calls for the development of a voluntary, risk-based

cybersecurity framework. The EPA will make an evaluation as to whether any additional authority and/or regulations to address cybersecurity in the water sector are needed.

8. **Lead and Copper Rule (LCR) Long-Term Revisions.** The LCR is a treatment technique rule. The rule requires public water systems to take certain actions to minimize lead and copper in drinking water in lieu of setting MCL. The goals for the revisions are to improve the effectiveness of the corrosion control treatment and prompt additional actions that may help reduce public exposure to lead and copper.

### *Regulatory Violations*

The City of Prineville has no reported violations in the last 5 years, according to the DWS.

### *Regulatory Requirements Summary*

In summary, many regulations affect operation of the City of Prineville's water system. The information presented herein is intended to provide the City with a brief summary of the regulations and possible future regulations that will likely affect operation of the City's water system. These regulations continue to expand and will require careful attention to maintain compliance. It is recommended that the City of Prineville consult periodically with the DWS in Pendleton to ensure compliance with current regulatory requirements and to address any regulatory questions or issues.

## Water System Sanitary Survey

The DWS conducts sanitary surveys of water systems for communities to assist in identifying potential contamination sources that may impact water quality. These surveys are generally scheduled to occur every five years.

The City of Prineville's latest water system survey was conducted on June 4, 2014. The water system sanitary survey found the following significant deficiencies to be addressed:

- The sanitary seal and casing are not watertight. The seal is deficient in the Barney, Stearns, 4th Street Deep, Ochoco Heights, Yancey, and Lamonta Wells.
- The unused well within the 100-foot setback of the Stadium Well is not allowed, because its construction is unknown. Remove paint stored in Airport Well 2, Lamonta Well, and Ochoco Heights Well buildings.
- Chlorine has not been measured and recorded as required. Although free chlorine residual is measured most days, it must be recorded in a log book.

These deficiencies were corrected by November 18, 2014, or are on an approved corrective action schedule. A copy of the full 2014 Water System Sanitary Survey is included in Appendix B. Included in the survey is a checklist of sanitary survey items during the inspection of the water system. City staff should periodically review the checklist; this will help the City take a proactive approach to these surveys and also help to avoid potential future violations.

## Water Demand

Future water demands, for the purpose of identifying needed future water system improvements, can be estimated from past water use data and population projections. Water use data are usually expressed in terms of various rates of water used for various periods of time. This allows components of the water system to be sized for the maximum demands that will be placed on them. The rates of water use that are important in evaluation of a water supply system are the average daily demand (ADD), which is the total amount of water used during a one-year period divided by 365 days; the peak daily demand (PDD), which is the maximum total amount of water used during any 24-hour period; and the peak hour or peak instantaneous demand, which is a measure of the maximum flow of water at any given time.

Water supply facilities are normally designed for PDD. As a rule, a well would be sized for supplying the needed water during the PDD without continuous 24-hour operation. For example, if the water usage during high demand summer months required a well pump to operate 18 hours or more per day to keep up with the PDD, the situation may warrant the addition of another well or other water supply source to provide some backup capability and to not over-stress the well pumping equipment. Booster pumps and distribution pipelines are generally sized to deliver peak instantaneous demands, because they must be capable of meeting the highest demand. Storage reservoirs are sized to make up the difference between water supply capacity and peak water use rates, at a minimum. Additional capacity (reserve) is usually provided in water storage reservoirs for both emergencies and fire suppression.

### *Per Capita Water Use*

To be utilized for projecting future water demands, past water use data must be converted to a per capita (per person) rate of use. This is done by dividing the average day, peak day, and peak instantaneous water use rates by the number of people served by the water system. These water demand rates would then be expressed as gallons per capita day (gpcd). These values multiplied by a population projected for some future year would then give estimated total demand rates for that year.

The Oregon Water Resources Department maintains a database of water use amounts as reported by the individual water user or entity. Per this database, the total water use reported by the City for the 2016 water year, defined as the period of October 1, 2015, through September 30, 2016, was 569.3 million gallons. For planning purposes, the per capita water use was calculated by dividing this 2016 water year use by the net 2017 population served estimate. Therefore, a per capita water use of 176 gpcd was used to project future demand needs.

### *Historical Average Water Use*

To determine current water demands, customer billing and production records for the City's water supply system were reviewed from water years 2005 through 2015. Monthly well production for the City of Prineville for 2005 through 2015 is shown on Charts 2-2 through 2-13. A comparison chart for all 12 wells is shown on Figure 2-2.

**CHART 2-2**
**AIRPORT WELL NO. 2 MONTHLY PRODUCTION**

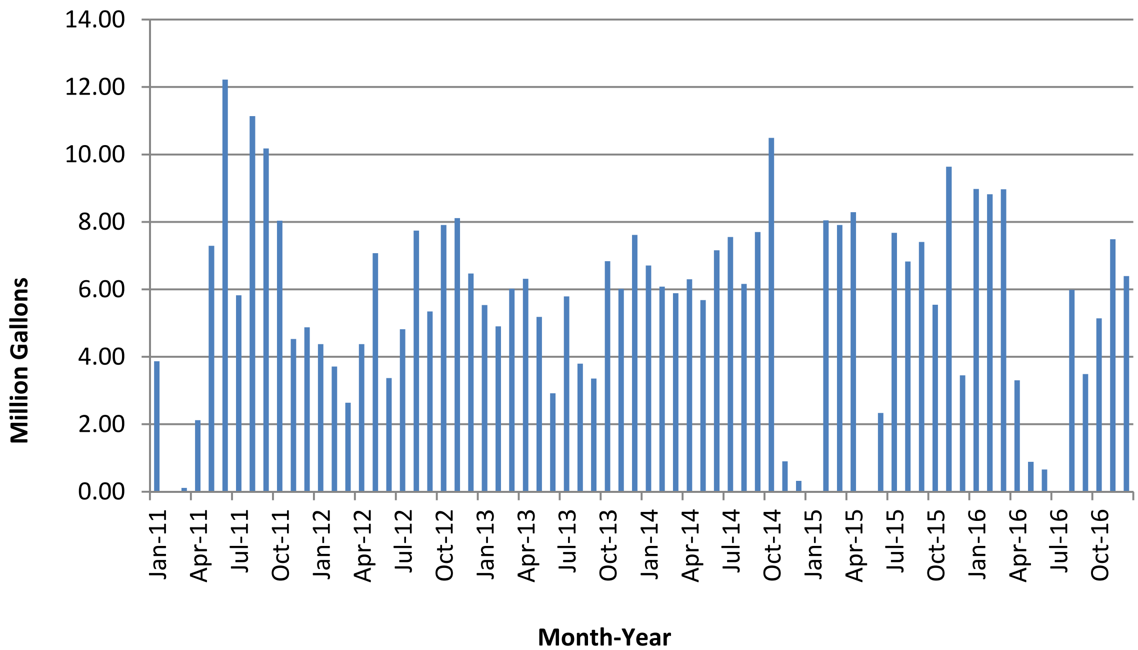



**CHART 2-3**
**AIRPORT WELL NO. 2 MONTHLY PRODUCTION**

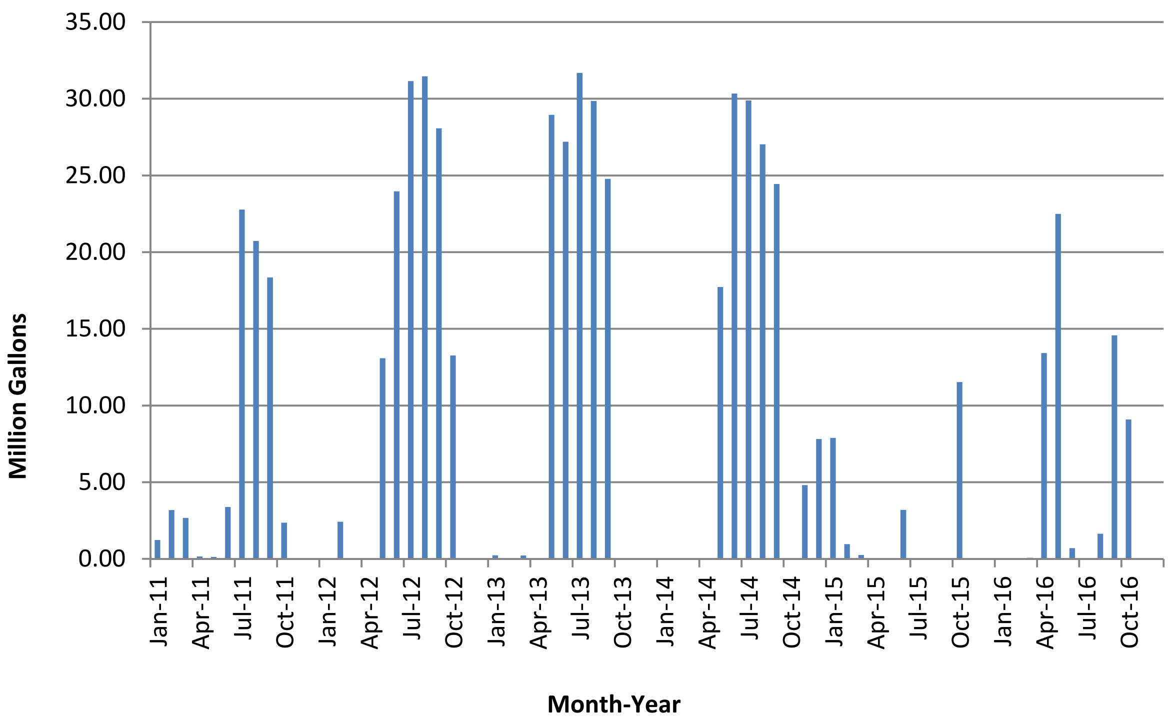


**CHART 2-4**
**AIRPORT WELL NO. 3 MONTHLY PRODUCTION**

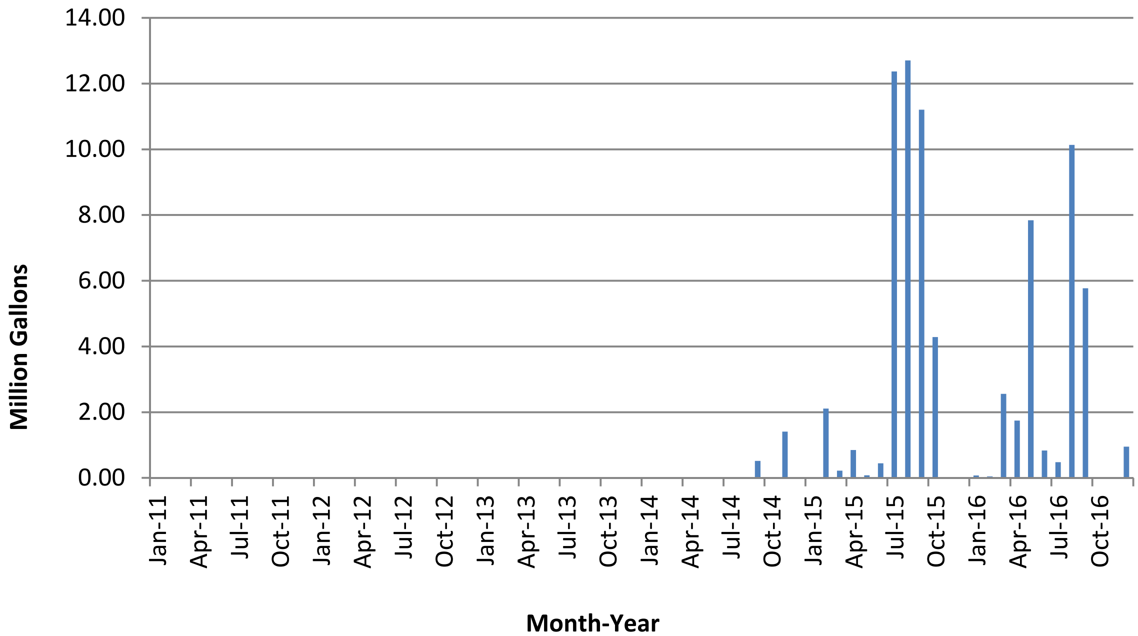



**CHART 2-5**
**AIRPORT WELL NO. 4 MONTHLY PRODUCTION**

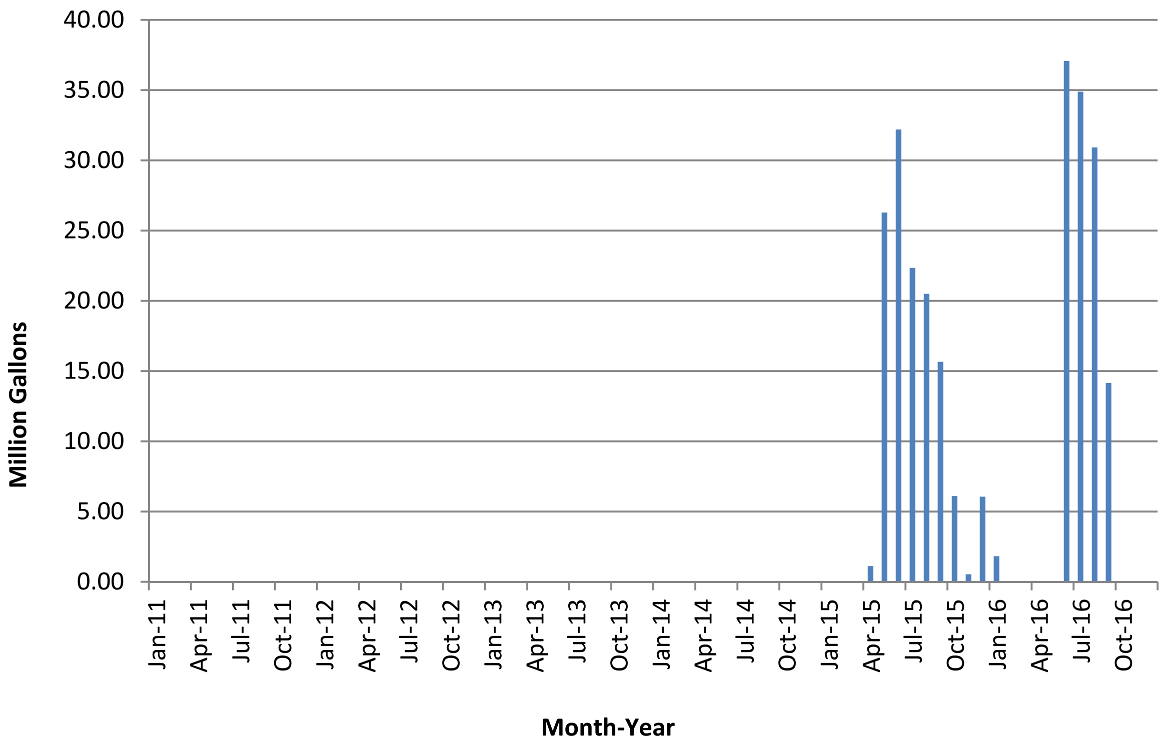


**CHART 2-6**
**4TH STREET DEEP WELL MONTHLY PRODUCTION**

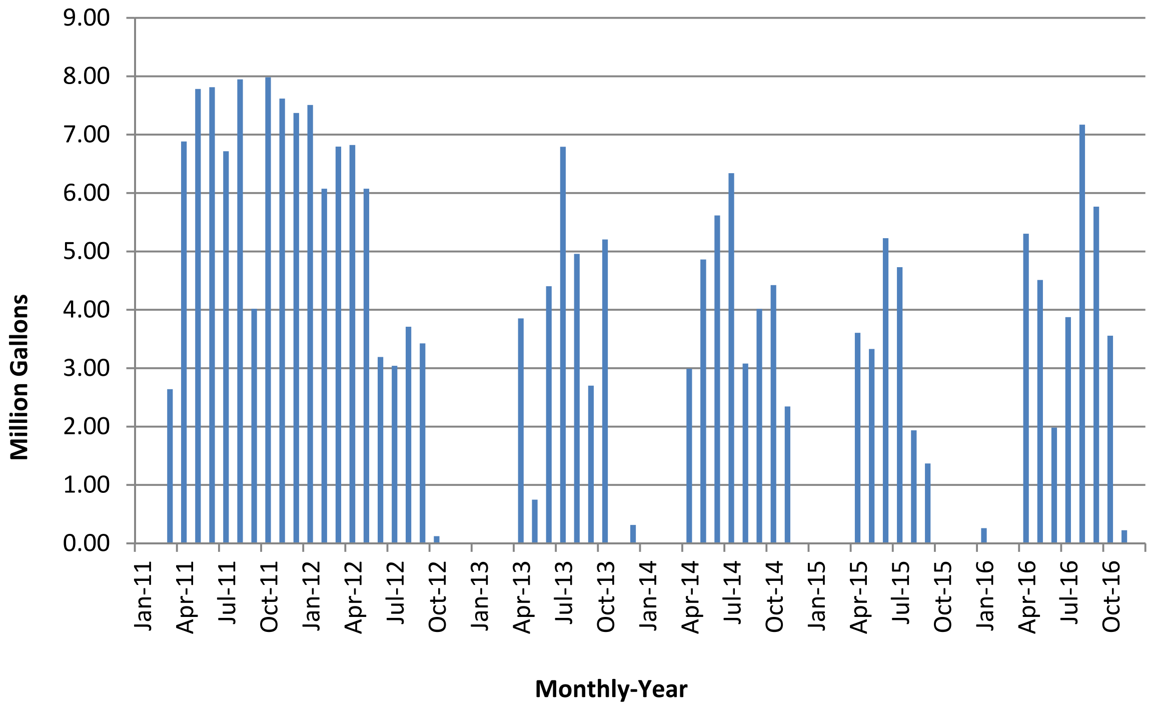



**CHART 2-7**
**4TH STREET SHALLOW WELL MONTHLY PRODUCTION**

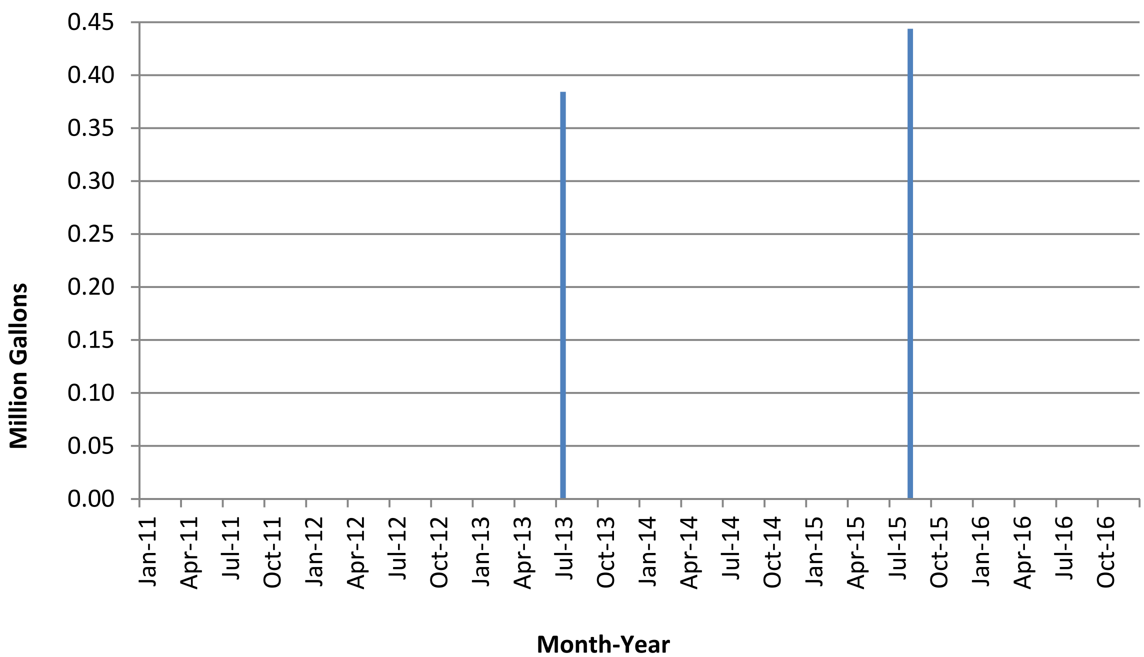


**CHART 2-8**
**LAMONTA WELL MONTHLY PRODUCTION**

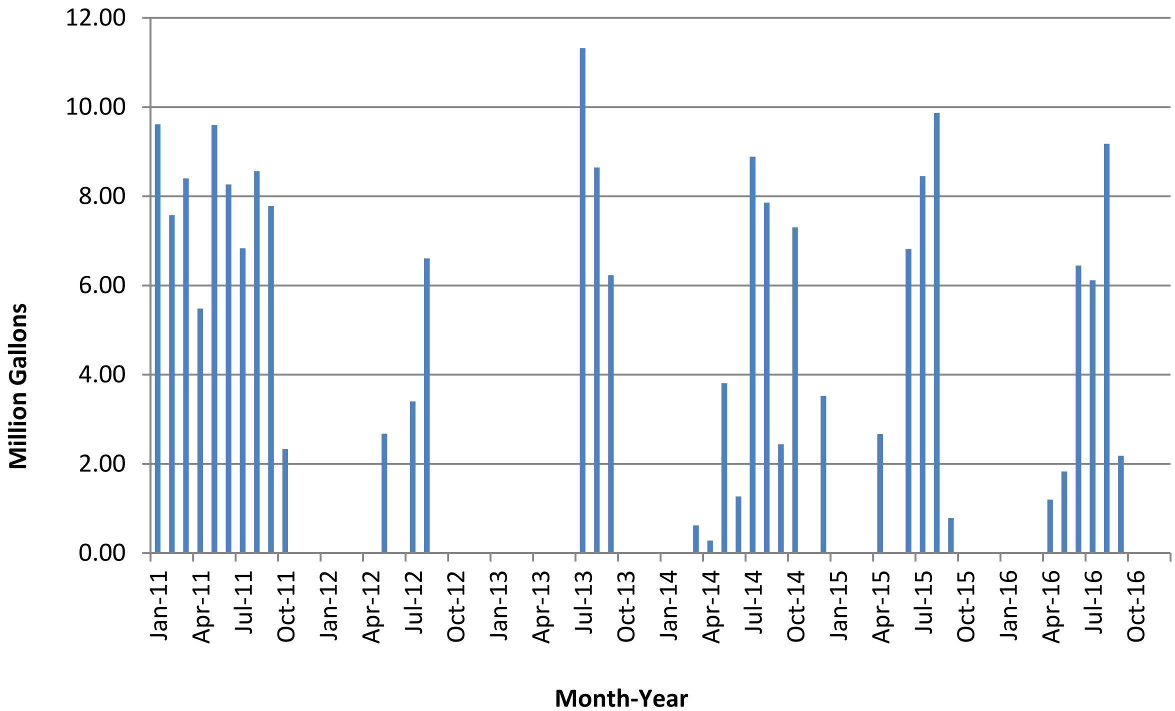



**CHART 2-9**
**OCHOCO WELL MONTHLY PRODUCTION**

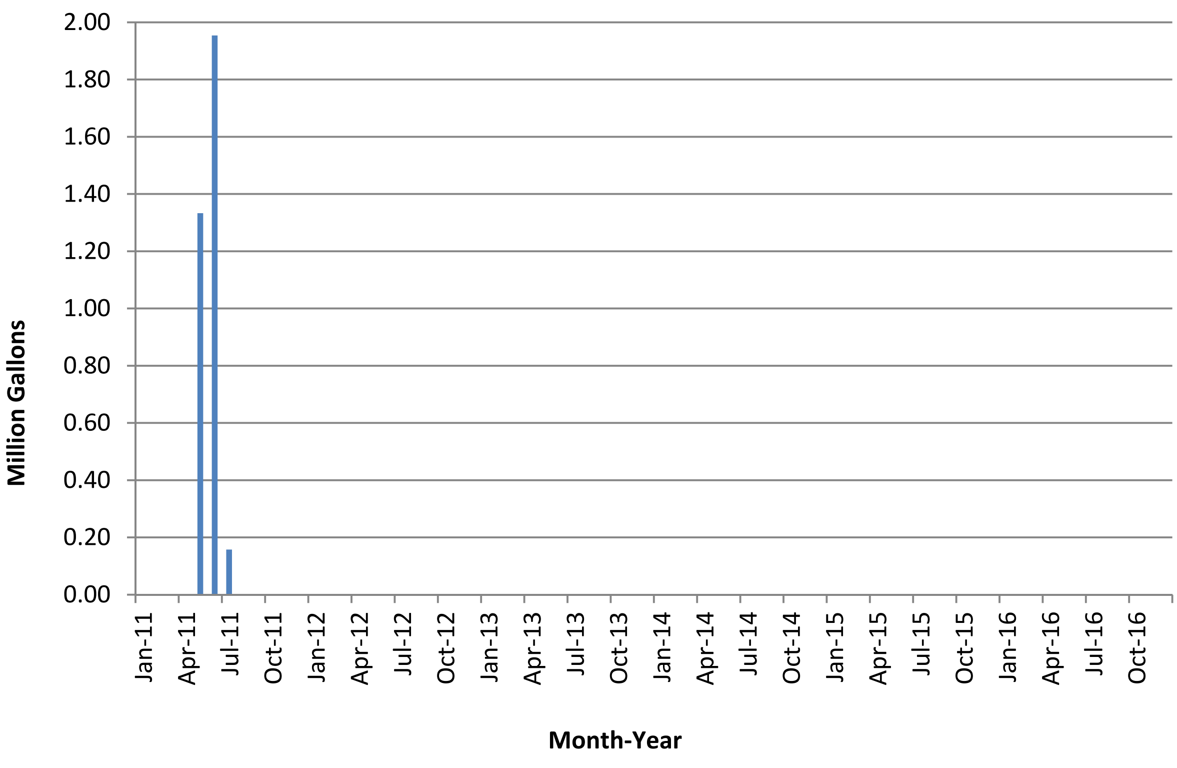


**CHART 2-10**
**STADIUM WELL MONTHLY PRODUCTION**

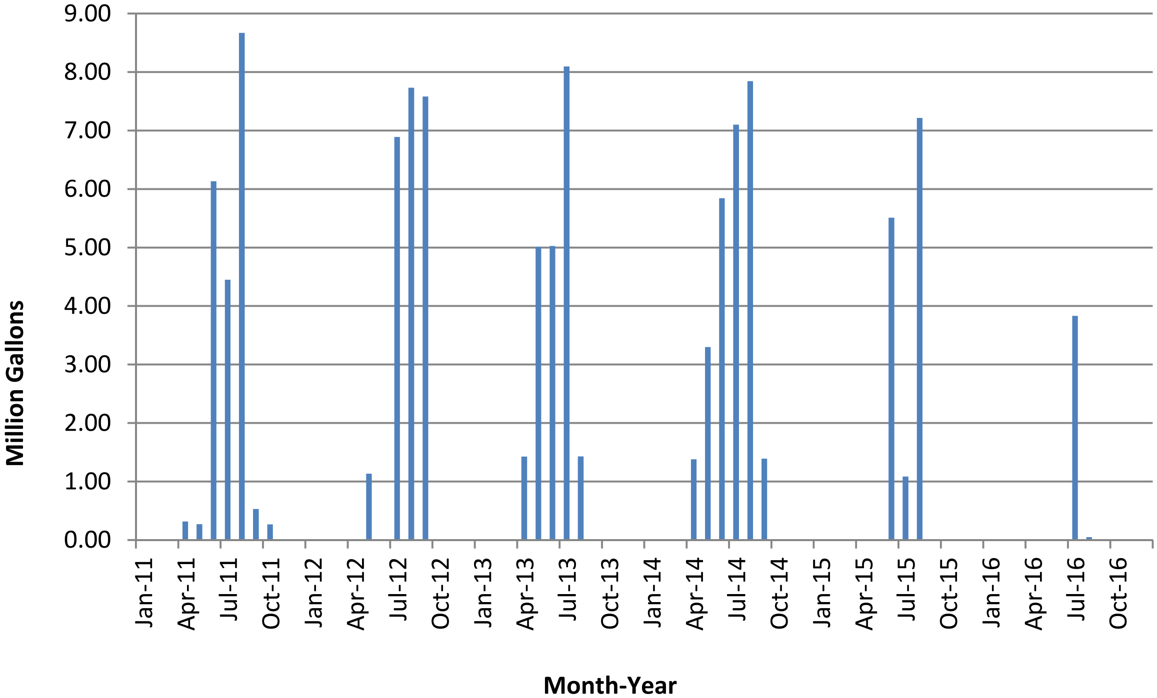



**CHART 2-11**
**STEARNS WELL MONTHLY PRODUCTION**

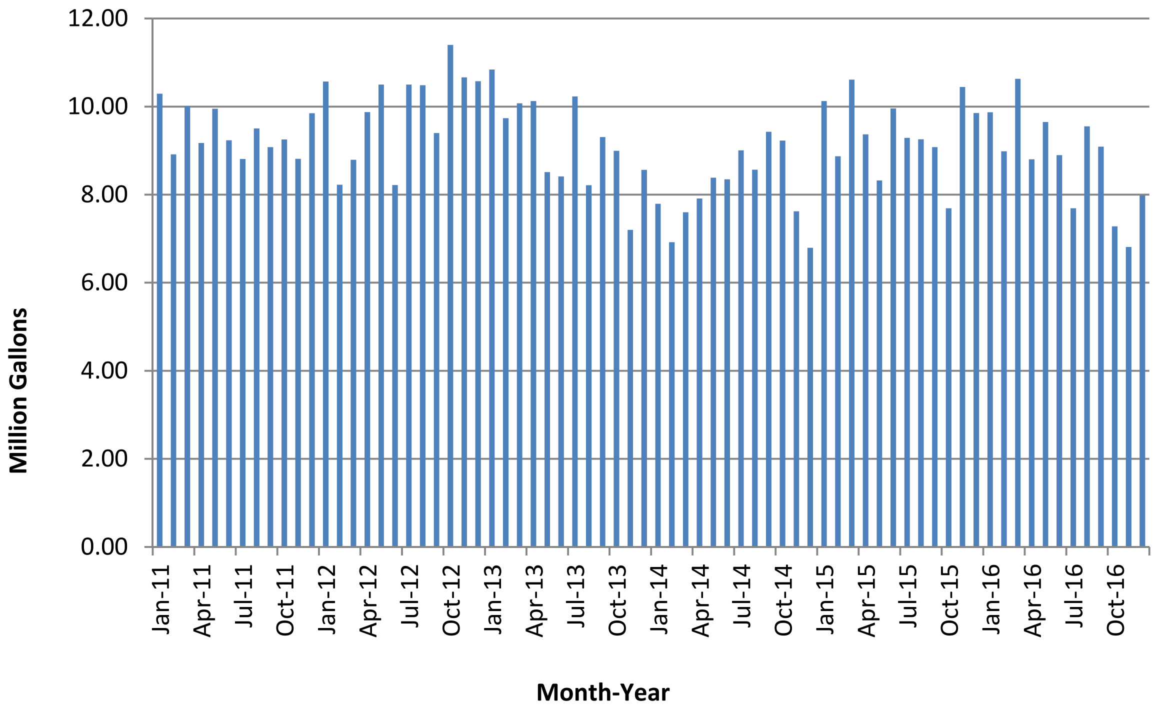


**CHART 2-12**
**BARNEY WELL MONTHLY PRODUCTION**

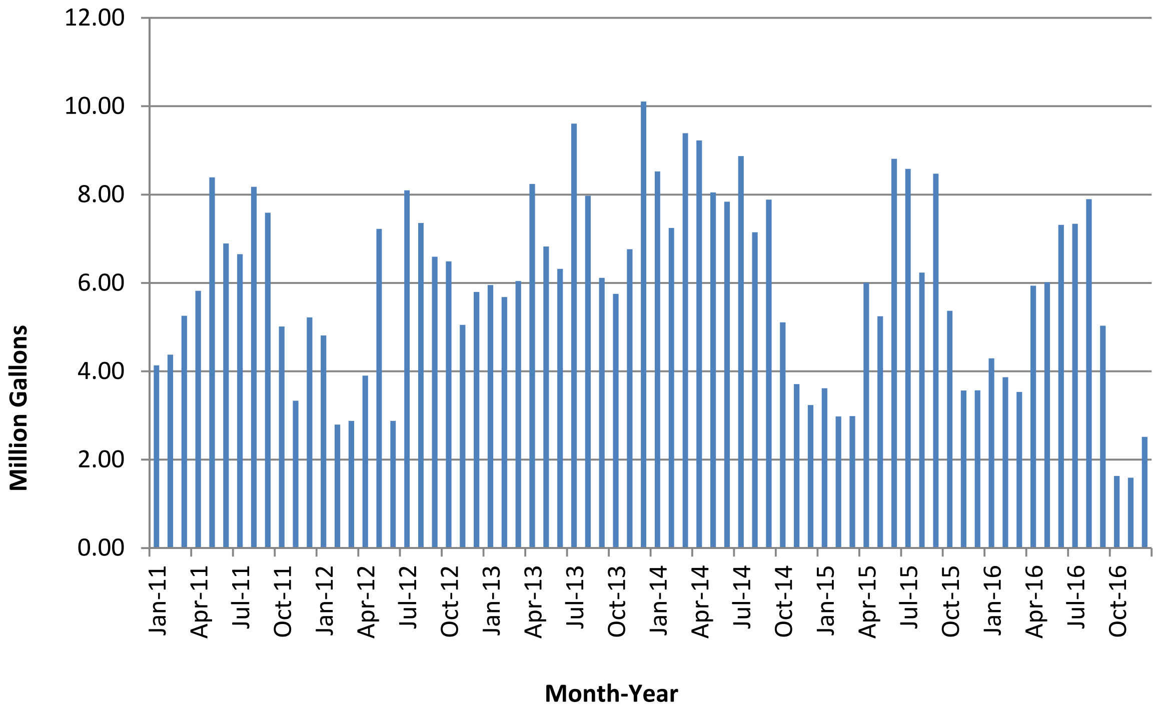
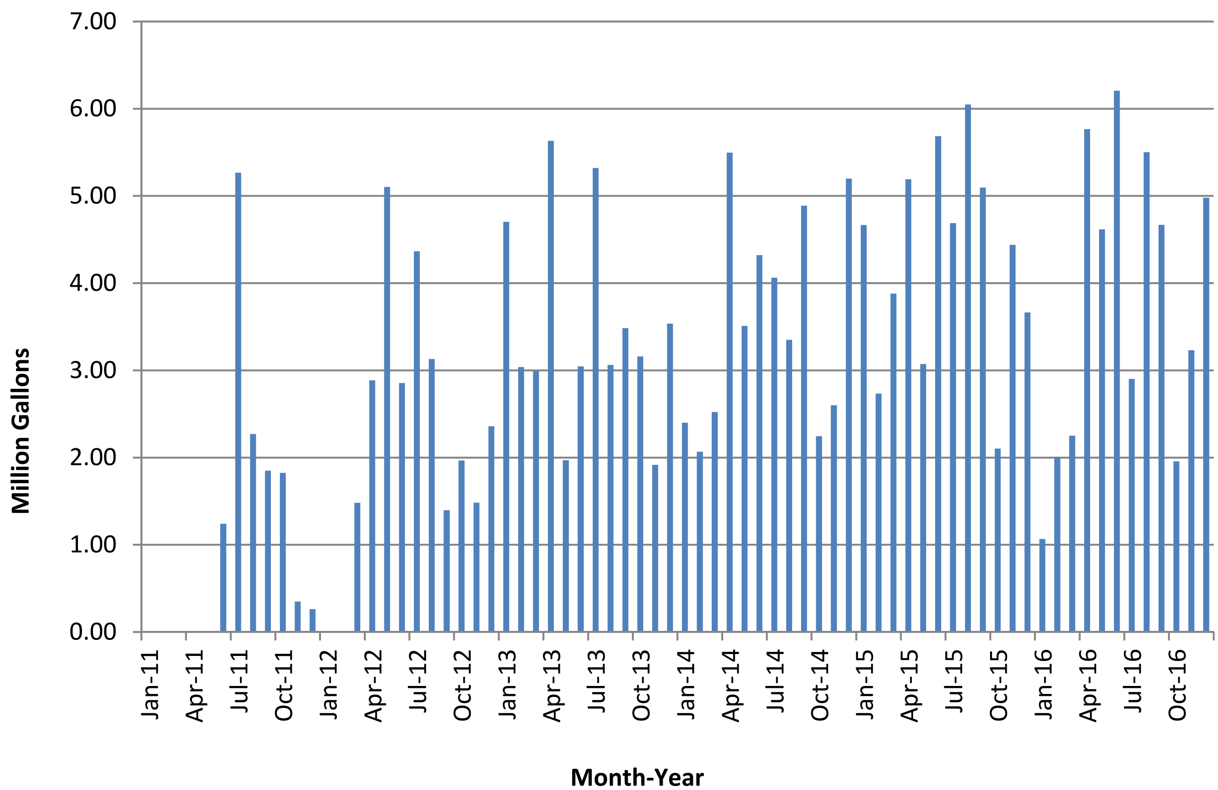



**CHART 2-13**
**YANCEY WELL MONTHLY PRODUCTION**



### Average Daily Demands

For this WSMP, the per capita water use of 176 gpcd was selected as the ADD to project future demand needs. The City's 176 gpcd average water demand is in the low range of typical demands when compared to other cities with water meters in eastern Oregon, as shown on Table 2-2.

**TABLE 2-2**
**COMPARATIVE WATER USAGE**
**TYPICAL FOR SMALL CITIES IN EASTERN OREGON METERED SYSTEMS**

| City | Average Daily Demand (gpcd) | Peak Daily Demand (gpcd) | Peak Factor (peak daily) | Population |
|---|---|---|---|---|
| Lostine, Oregon | 170 | 545 | 3.2 | 250 |
| **Prineville, Oregon** | **176** | **405** | **2.3** | **8,889** |
| Adams, Oregon | 195 | 625 | 3.2 | 265 |
| Cove, Oregon | 215 | 628 | 2.9 | 594 |
| Prairie City, Oregon | 234 | 549 | 2.3 | 1,195 |
| Mt. Vernon, Oregon | 240 | 585 | 2.4 | 617 |
| Umatilla, Oregon | 210 | 483 | 2.3 | 4,686 |
| Athena, Oregon | 250 | 710 | 2.8 | 1,142 |
| Vale, Oregon | 250 | 625 | 2.5 | 1,890 |
| Island City, Oregon | 270 | 810 | 3.0 | 989 |
| John Day, Oregon | 270 | 865 | 3.2 | 2,010 |
| Stanfield, Oregon | 240 | 600 | 2.5 | 1,770 |
| Irrigon, Oregon | 290 | 800 | 2.8 | 1,790 |
| Echo, Oregon | 175 | 525 | 3.0 | 700 |
| Boardman, Oregon | 320 | 960 | 3.0 | 3,445 |
| Helix, Oregon | 323 | 1,130 | 3.5 | 155 |
| Hines, Oregon | 350 | 1,600 | 2.5 | 1,700 |
| Joseph, Oregon | 375 | 1,100 | 2.9 | 1,060 |
| Ione, Oregon | 461 | 1,865 | 4.0 | 250 |

### Peak Daily Demands

PDD usually occur during a particular day between June through September, which is when water use is normally at its greatest due to irrigation and other summer uses. PDD can occur in other months, but normally occur during the hottest period of the year. During PDD, the City's wells operate continuously, and equalization storage is required to meet demands. A peaking factor was determined by dividing the maximum daily demand by the ADD for a given water year. For water years 2007 through 2015, the average peaking factor for the City of Prineville was 2.30 (per the August 2016 Water Management and Conservation Plan, prepared by GSI Water Solutions, Inc.). For the purpose of this WSMP, this 2.30 peaking factor was used to estimate the ADD.

The ADD and PDD assumed for planning purposes are summarized on Table 2-3. These demands have also been summarized as a flow rate to provide the basis for comparison to water supply capacity. The assumed service population for determining the actual daily demand rates is 8,889, as discussed earlier in this chapter.

**TABLE 2-3**
**YEAR 2016 TOTAL AVERAGE AND PEAK DAY DEMAND DATA**

| Parameter | System Demand (gpcd) | Total Demand (gpm) | Percentage of System Capacity (Assumed Total Capacity of 3,140 gpm) |
|---|---|---|---|
| Average Daily Demand | 176 | 1,083 | 34 |
| Peak Daily Demand | 405 | 2,500 | 80 |

*gpm = gallons per minute*

Water supply facilities (well pumps) are normally designed to meet PDD without providing 24-hour service. It is preferable that well pumps operate a maximum of 18 hours per day, if possible. The current total production capability of the valley floor and airport area is approximately 1,370 gpm and 1,770 gpm, respectively. The combined capacity is 3,140 gpm. This capacity can meet the current ADD but does not meet the PDD assuming an 18-hour max operation.

### *Description of Customers Served*

The City of Prineville's water service accounts, as of 2016, are summarized on Table 2-4. The percentage breakdown is also provided on Table 2-4.

**TABLE 2-4**
**WATER ACCOUNT INFORMATION**

| Account Type | Number of Accounts | Percent of Total Accounts | Percent of Water Use in 2016 |
|---|---|---|---|
| Residential | 3,003 | 85 | 60.1 |
| Commercial | 499 | 14 | 30.1 |
| Large Commercial | 16 | <1 | 9.8 |
| **TOTAL** | **3,518** | **100** | **100** |

On Table 2-4, the commercial users consist of schools, churches, City property, and businesses. As shown on the table, residential water users account for approximately 85 percent of the total water users in the City of Prineville, while commercial and large commercial users account for approximately 15 percent. However, residential water use only accounts for approximately 60 percent of water use, while commercial and large commercial account for the remaining 40 percent.

## Fire Demand

### *Fire Protection Ratings*

Flow rates for fire suppression in residential, commercial, and large commercial areas within developed communities are usually determined from the size, density, and occupancy of buildings, type of construction materials, and desired fire insurance rating. Incorporated cities and some rural areas are given a fire suppression rating by Insurance Services Office, Inc. (ISO). The rating is used by insurance companies to determine the cost for providing fire insurance to home and business owners. ISO's fire suppression rating schedule is used to review those features of available public fire protection that have a significant influence on minimizing damage once a fire has begun. These features include receiving and handling fire alarms; the fire district's manpower, equipment and training; and the capability of the water system to provide the needed fire flows.

ISO periodically evaluates fire suppression capabilities of incorporated cities and rural fire districts. The numerical ratings range from Class 1 to Class 10, with Class 1 indicating the highest fire suppression capability and Class 10 the lowest. A Class 10 rating is reserved for unprotected areas that have no fire department and no water supply system. Most protected areas outside of cities have a Class 9 rating, and most small rural cities with municipal water systems are rated Class 8, 7, or 6, depending on the strength of their water system and fire department. The ISO rating for Prineville, based on the YEAR evaluation, is Class 4/8b. The ISO rating information is presented in Appendix C.

ISO's fire suppression rating schedule evaluates the City's fire department capabilities and the domestic water supply capacity on an approximately equal basis (50 percent and 40 percent of the rating schedule, respectively). To reduce the cost of fire insurance in a community, improvements usually must be made to the fire department, the water system, or both, depending on their present condition. It is difficult to determine possible fire insurance savings on commercial buildings, because the insurance costs are determined by many other factors related to the type of occupancy and the type of building construction.

### *Recommended Fire Flows*

ISO also recommends fire flows for various conditions in both residential and commercial settings. Recommended fire flows for residential areas are set forth in the 2012 ISO Schedule as shown below.

| Distance Between Buildings | Required Fire Flows |
|---|---|
| Over 30 feet | 500 gpm |
| 21 to 30 feet | 750 gpm |
| 11 to 20 feet | 1,000 gpm |
| 10 feet or less | 1,500 gpm |

Recommended fire flows for commercial buildings are based on many factors including building size, construction materials used, and what is housed in the building.

The International Fire Code (IFC) requires a minimum flow of 1,000 gpm in residential areas and a minimum of 1,500 gpm for a minimum of two hours in all other occupancies. These requirements increase with square footage of the building and can be quite large for commercial and institutional buildings (schools). These fire flows must be maintained with a system-wide minimum of 20 pounds per square inch (psi) residual pressure. Attaining the required fire flows for commercial areas may not be realistically achievable. The IFC has an allowance for decreases in fire flows for small communities (if approved by the local fire chief), where development of full fire flows is impractical.

The 2004 ISO Hydrant Flow Data Summary recommends needed fire flow protection rates for both residential and commercial districts to receive full credit ratings. ISO does not consider needed fire flows over 3,500 gpm in determining the Public Protection classification for cities. The fire flow design criterion for this WSMP is based on the typical maximum fire flow recommended by ISO, which is 3,500 gpm for a three-hour duration. This maximum fire flow is typically recommended for school areas and other high-density development.

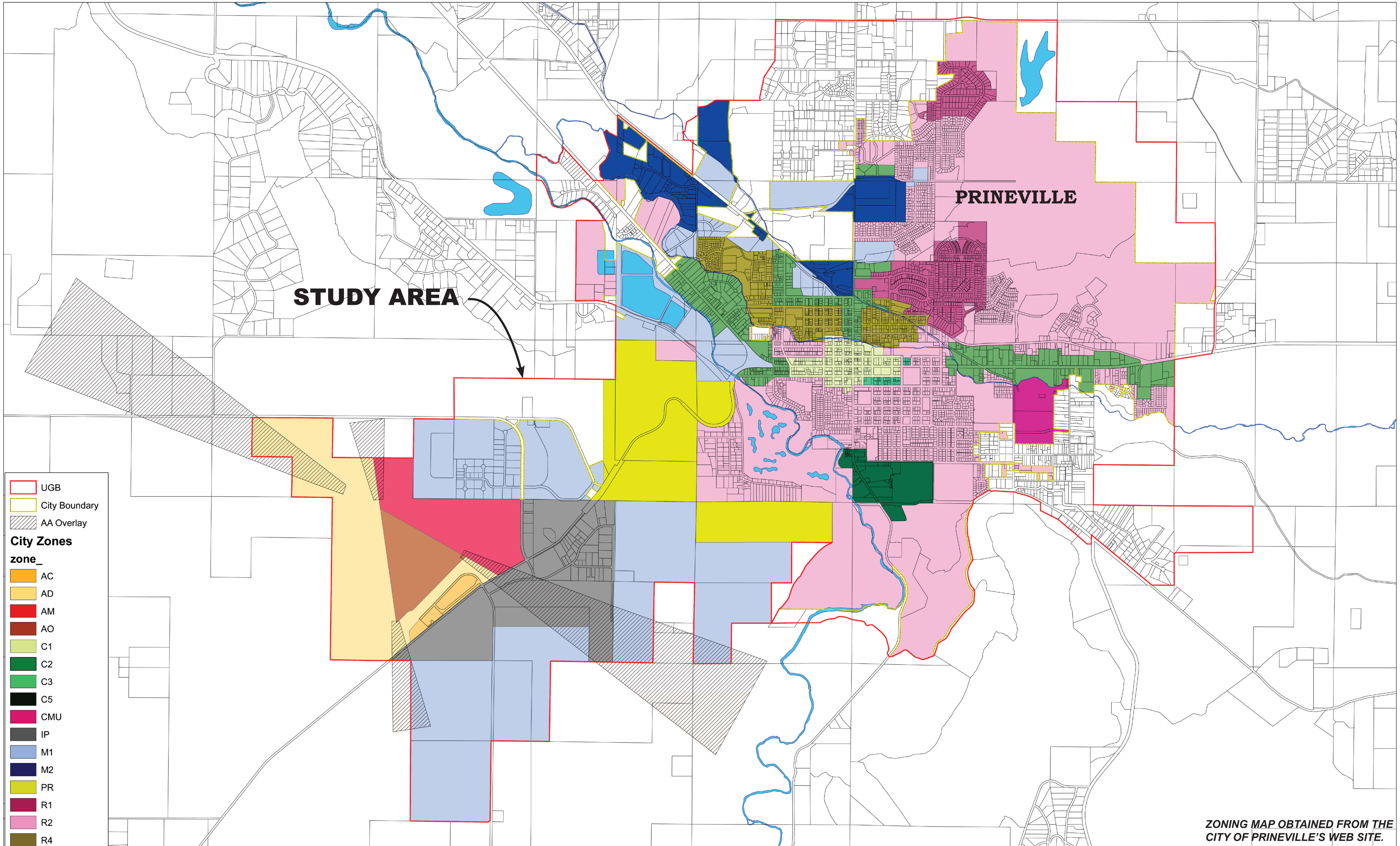
### *Available Fire Flow*

The City routinely tests fire hydrants to help ensure the hydrants remain operable and to estimate available fire flows. Fire hydrant flushing and flow testing data were provided by the City for this WSMP. Based on the test results, the City of Prineville's water system is generally able to deliver water flows ranging from approximately 95 to 3,500 gpm at individual fire hydrants while maintaining working distribution system pressures from 50 to 65 psi. A copy of the fire hydrant flow test results is included in Appendix D. Refer to Chapter 5 for a more detailed discussion of fire flow capacity.

## Design Criteria

In establishing design standards for a water system, primary consideration must be given to state and federal rules and regulations governing water quality and construction standards for water systems. These regulations, as previously stated, are set by both the EPA and DWS. In addition to these public health and safety requirements, many other factors control the design parameters for municipal water systems. The City must evaluate factors such as financial feasibility, philosophy and policies of the City Council, past system performance and service, and expectations of the water users. All of these factors are important and can influence the standards by which water system improvements are made.

Figure 2-3 presents a summary of the water system design criteria for evaluating the existing water system and developing improvements to satisfy present and future needs. Application of these criteria is discussed further in the specific chapters that address the water supply and treatment, storage, and distribution system facilities. Figure 2-3 presents design criteria based on the estimated present service population of 10,958 and present estimated ADD and PDD. Design criteria are shown for the year 2037 based on a 0.7 (2015 through 2035) and 0.1 (2035 through 2065) AAGR in the City. Storage volumes are derived from calculations summarized in Chapter 4. The design criteria presented on Figure 2-3 are used as base information in later chapters for evaluating existing and future system needs and capability.






# Zoning - City of Prineville ending 2015

N W E S

0 0.25 0.5 1 Miles

Date: 12/28/2015

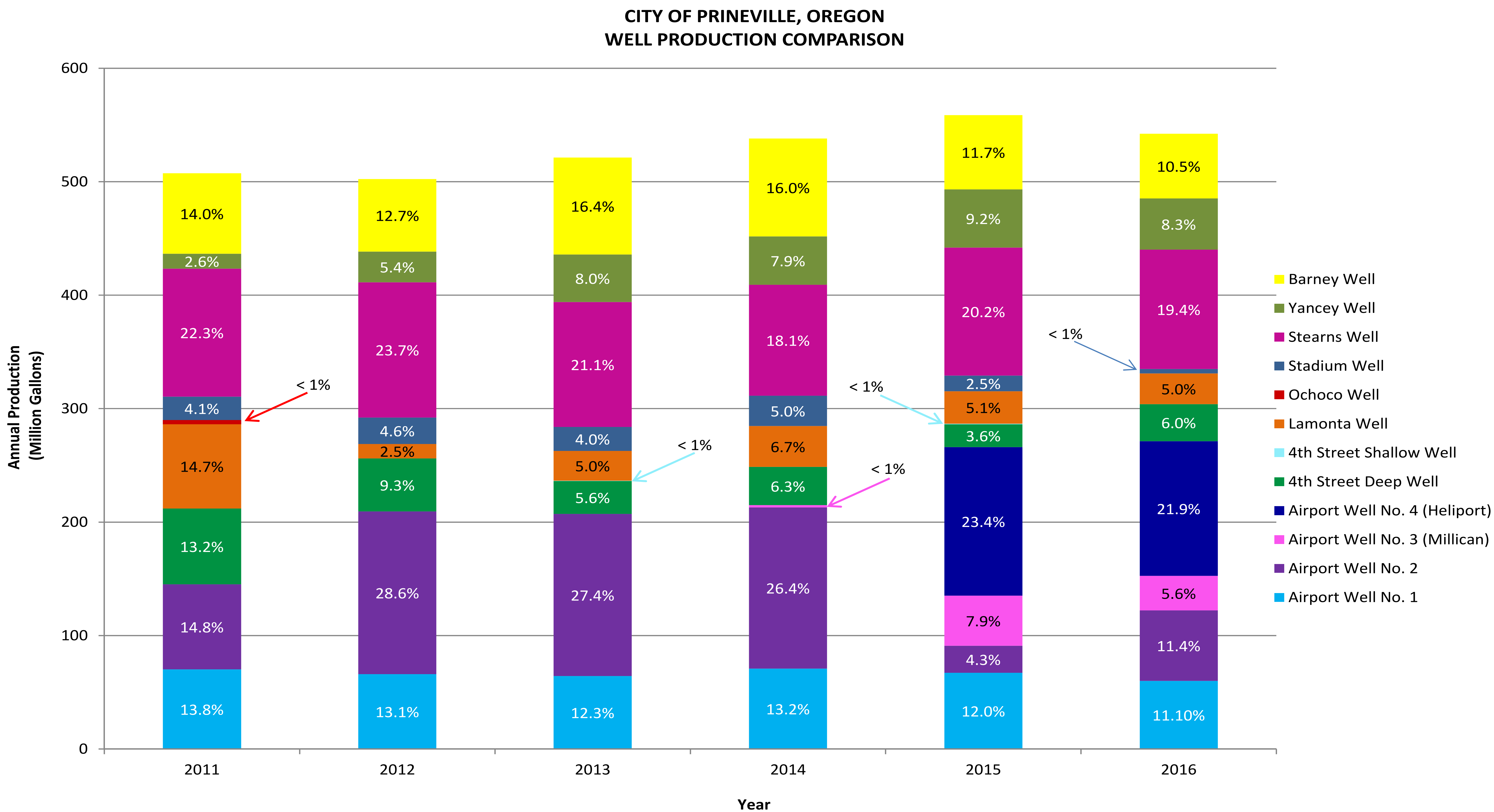
anderson perry & associates, inc.

CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

## ZONING MAP

FIGURE
2-1

Job# 1260-15-020 Nov. 11, 2016 lbauer




anderson perry & associates, inc.

CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

WELL USAGE COMPARISON

FIGURE
2-2

**SUMMARY OF DESIGN CRITERIA**

| | Existing Connected Population 2017[1] | Existing Connected Population with Improvements 2017[2] | Existing Connected Population with Improvements and Anticipated Connections within Urban Growth Boundary 2017[3] | Future Connected Population with Improvements and Anticipated Connections within Urban Growth Boundary 2037[4] |
|---|---|---|---|---|
| Design Population | 8,889 | 9,946 | 10,440 | 11,752 |
| **Supply** | | | | |
| Total Water Production 2016 (MG)[5] | 569.3 | - | - | - |
| Percent Annual Water Use - Residential[6] | 60.1% | | | |
| Percent Annual Water Use - Commercial[6] | 30.1% | | | |
| Percent Annual Water Use - Large Commercial[6] | 9.8% | | | |
| Average Total Daily Demand (gpcd) | 176 | | | |
| Average Residential Daily Demand (gpcd) | 106 | 106 | 106 | 106 |
| Average Residential Daily Flow (gpd) | 937,395 | 1,054,297 | 1,106,605 | 1,245,701 |
| Average Commerical Flow (gpd) | 469,478 | 469,478 | 469,478 | 767,794 |
| Average Large Commercial Flow (gpd) | 152,853 | 152,853 | 152,853 | 475,632 |
| Average Total Daily Flow (gpm) | 1,083 | 1,164 | 1,201 | 1,729 |
| Peak Residential Daily Demand[7] (gpcd) | 244 | 244 | 244 | 244 |
| Peak Residential Daily Flow (gpd) | 2,169,036 | 2,426,873 | 2,547,279 | 2,867,463 |
| Peak Commercial Daily Flow (gpd) | 1,079,798 | 1,079,798 | 1,079,798 | 1,765,926 |
| Peak Large Commercial Daily Flow (gpd) | 351,562 | 351,562 | 351,562 | 1,093,953 |
| Peak Daily Flow (gpm) | 2,500 | 2,679 | 2,763 | 3,977 |
| Peak Hourly Flow[8] (gpm) | 4,626 | 4,957 | 5,111 | 7,358 |
| Estimated Supply Flow Available[9] (gpm) | 3,765 | 3,765 | 3,765 | 3,765 |
| Estimated Supply Flow Required[10] (gpm) | 3,334 | 3,572 | 3,684 | 5,303 |
| Fire Demand | | | | |
| Residential (gpm) | 1,000 | 1,000 | 1,000 | 1,000 |
| Commercial/Public (gpm) | 3,500 | 3,500 | 3,500 | 3,500 |
| Duration (hour) | 3 | 3 | 3 | 3 |
| Minimum Residual Line Pressure Under Peak Demands Plus Fire Flow (psi) | 20 | 20 | 20 | 20 |

anderson perry & associates, inc.

DOWL

CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

SUMMARY OF DESIGN CRITERIA

FIGURE
2-3

| | | | | |
|---|---|---|---|---|
| **Storage** | | | | |
| Equalization Storage[11] (gal) | 129,076 | 178,764 | 201,967 | 538,957 |
| Operating Storage[12] (gal) | 500,000 | 500,000 | 500,000 | 500,000 |
| Fire Reserve[13] (gal) | 630,000 | 630,000 | 630,000 | 630,000 |
| Dead Storage[14] (gal) | 225,000 | 225,000 | 225,000 | 225,000 |
| Emergency Reserve[15] (gal) | 1,559,726 | 1,676,628 | 1,728,935 | 2,489,127 |
| **Total Recommended Storage[16] (gal)** | 3,043,802 | 3,210,392 | 3,285,902 | 4,383,084 |

MG = million gallons
gal = gallons
gpcd = gallons per capita day
gpd = gallons per day
gpm = gallons per minute

[1]Existing Connected Population 2017 was found by utilizing City billing reports to find the number of residences within the city limits not connected to water (421) and the number of residences located outside the city limits connected to water (120). According to the Population Research Center (PRC) the average person per household within the City is 2.51. The certified population for 2016 was 9,645. For planning purposes, this population is utilized as the 2017 population.

[2]Existing Connected Population with Improvements 2017 includes all residences within the city limits that could be served plus the number of residences located outside the city limits currently connected to water (120).

[3]Existing Connected Population with Improvements and Anticipated Connections within Urban Growth Boundary 2017 includes all residences within the city limits that could be served, plus the number of residences located outside the city limits currently connected to water (120), plus residences directly outside the city limits that could be served in the future (assumed to be 20 percent of total residences in the urban growth boundary, which equates to 197 residences).

[4]The Future Connected Population with Improvements and Anticipated Connections within Urban Growth Boundary 2037 was found by utilizing the average annual growth rate values declared by the PRC.

[5]Oregon Water Resources Department entity water use report from October 2015 through September 2016.

[6]City of Prineville 2016 water year metered flow records.

[7]August 2016 Water Management and Conservation Plan, prepared for the City of Prineville by GSI Water Solutions, Inc.

[8]1.85 times peak daily flow.

[9]Alluvial aquifer underlying the Prineville valley floor (1,440 gpm) and the Airport Area Aquifer System (2,325 gpm).

[10]Total capacity required to operate well pumps a maximum of 18 hours per day and meet peak demands.

[11]Difference between peak hourly flow and available supply for a 2-1/2-hour period.

[12]Breakdown of operating storage per tank per the March 2006 Water System Master Plan Update.

[13]3,500 gpm flow for 3-hour duration, assuming only storage is used.

[14]Assumes 5 percent of overall system storage volume.

[15]One-day supply at average daily demand, assuming only storage is used.

[16]Equalization volume plus operational storage plus emergency reserve plus fire reserve plus dead storage

# Chapter 3 - Water Supply and Treatment

## Introduction

This chapter includes a description of the City's present water supply sources, water rights, treatment systems, and a discussion of the water system's capacity to meet present and future needs. The City's current water supply system consists of production from water wells located in the City. The only treatment currently required for the well water is chlorination for distribution system residual maintenance and disinfection purposes.

## Present Water Supply System and Treatment

### *General*

The City of Prineville's water supply currently comes from two groundwater sources supplied by 11 production wells. Seven wells pump water from the alluvial aquifer underlying the Prineville valley floor. Four additional wells pump water from the Airport Area Aquifer System, located on the plateau west of the City adjacent to the Prineville Airport. The locations of the City's production wells are shown on Figure 1-1. The City does not have any interconnections with other municipal water supply systems.

Although the City also holds surface water rights for the use of water from the Crooked River, Prineville Reservoir, and Ochoco Creek, surface water is not currently used as a source for its municipal water supply system (surface water rights are primarily used for irrigation and livestock purposes).

### *Prineville Valley Floor Aquifer*

The Prineville valley floor groundwater system is located within the alluvial deposits that have filled the Crooked River valley. The alluvial system contains a shallow, unconfined aquifer and a deeper, confined aquifer. The majority of water production in the valley is from the deeper confined aquifer, including six of the seven City's valley floor municipal production wells and one additional well currently under construction. The City also has one municipal production well (the 4th Street Shallow Well) completed in the shallow aquifer system. The unconfined aquifer system's water levels are influenced by the numerous creeks and river systems present in the valley. The confined aquifer system has a seasonal water level fluctuation pattern. Water levels are near ground surface during late winter and spring and then decline during the summer. The valley water levels typically recover fully each year. Although this valley aquifer appears to be able to support the current level of production, the City continues to monitor the long-term resiliency of the alluvial aquifer system.

### *Airport Area Aquifer System*

The Airport Area Aquifer System is a sequence of permeable materials deposited at the base of a narrow ancestral paleochannel that existed beneath the plateau in the vicinity of the Prineville Airport. The deposits within the ancestral canyon are part of the eastern edge of the older Deschutes Formation. The groundwater flow system within the ancestral canyon is present in the more permeable deposits found at the base of the paleochannel. The City's Airport Area production wells are located in two distinct waterbearing units: the fractured basalt flow located at the bottom of the ancestral canyon (lower aquifer) and the coarse sand and gravel deposit that represents the ancestral river's alluvial channel deposits (upper aquifer).

### Critical Groundwater Areas

The City's wells are not located in an area designated by the Oregon Water Resources Department (OWRD) as a critical groundwater area or groundwater limited area. However, the wells are located within the Upper Deschutes River Basin, which is regulated under the OWRD's Deschutes Basin Groundwater Mitigation Program.

### Deschutes Basin Groundwater Mitigation Program

A joint OWRD and U.S. Geological Survey study of the Upper Deschutes Basin (Deschutes Groundwater Study Area) determined that the high permeability of the Deschutes Formation also results in a hydraulic connection between groundwater and surface water. Specifically, the OWRD concluded that groundwater uses within the groundwater study area have the potential for substantial interference with surface water rights and will reduce scenic waterway flows unless mitigation is provided, as defined in Oregon Administrative Rules (OAR) Chapter 690, Division 505. As a consequence, new groundwater permits are conditioned to require mitigation that meets the OWRD's requirements.

The City of Prineville and surrounding lands are located within the Upper Deschutes Basin Study Area. The City provides mitigation in the Crooked River zone of impact for water pumped from its Airport Area Aquifer System wells and will need to provide mitigation for groundwater withdrawals under any new groundwater permit.

Currently, the City is in the process of obtaining a water right for the release of up to 5,100 acre-feet (AF) of stored water from Prineville Reservoir for groundwater pumping (downstream fish and wildlife use) mitigation. The City anticipates that the application will result in 5,100 AF of mitigation credits. These mitigation credits are part of the federal Crooked River Collaborative Water Security and Jobs Act of 2014, and required a change in use of the storage right for Prineville Reservoir through a transfer and a new secondary water right to establish mitigation credits. Currently, the secondary water right application (Application S-88402) is pending.

### Valley Floor Wells

The City's seven valley floor wells currently provide approximately half of the City's water supply, with each well capable of providing between 90 and 340 gallons per minute (gpm). Only two of the City's valley floor wells were drilled within the last 30 years, as the City has developed new supply from the Airport Area Aquifer System in recent years. The valley floor wells range in depth from 228 to 280 feet, with the exception of the 4th Street Shallow Well, which is used sparingly. Well logs for all of the City's municipal water supply wells are included in Appendix G.

Figure 3-1 provides estimated production capacity for the wells that are connected to the municipal water system. The City considers its most reliable valley floor wells to be the Barney and Stearns, Stadium, 4th Street Deep, Yancey, and Lamonta wells. Additionally, the City can utilize the 4th Street Shallow Well if needed, although water quality concerns limit the use of the well to peak demand periods. The current combined capacity of the City's valley floor wells is approximately 3.21 cubic feet per second (cfs).

### *Airport Wells*

The City's four Airport Area Aquifer System wells (Airport Wells No. 1 through No. 4) currently provide the other half of the City's water supply, although the share of supply provided by the Airport wells has been increasing over the past 10 years as the City has developed its groundwater rights for the Airport Area Aquifer System. The Airport wells range in depth from 546 to 703 feet deep, and draw water from the upper and lower waterbearing units within the ancestral Crooked River channel, as described above. The well in the fractured basalt unit (Airport Well No. 3) produces 285 gpm, and the wells in the course sand and gravel deposits produce up to 1,100 gpm.

Airport Wells No. 1 through 4 have a combined instantaneous capacity of 5.18 cfs. However, all four wells are not operated simultaneously due to water right constraints. The City's current water rights for its Airport wells limit the production capacity to a total of up to 3.945 cfs.

Therefore, the City's current municipal water supply wells have a combined production capacity of 8.49 cfs; however, the water rights limitations at the airport currently cap production capacity to 7.05 cfs.

### *Disinfection and Treatment*

Treatment of the well supply sources has been designated as residual maintenance chlorination by the Oregon Health Authority - Drinking Water Services (DWS). This means that the source water does not require treatment and, therefore, chlorine contact time is not required. Chlorination is completed at each well source through injection of a sodium hypochlorite solution for the purpose of preventing the potential development of algae and pathogens in the distribution system. Chlorine residuals are measured and recorded regularly to help ensure chlorine levels are maintained appropriately.

## Well Maintenance

### *Well Capacity*

Wells require periodic maintenance to keep them functioning properly and working efficiently. Many wells, particularly wells that source their water from an alluvial aquifer, have a tendency to lose efficiency over time. The result of lost efficiency is either decreased yield (gpm) or greater pumping drawdown. This results in higher pumping costs and loss of production.

Specific capacity (production in gpm per foot of drawdown) is a measure of the well's ability to yield water. Wells can lose efficiency and capacity for a variety of reasons, including mechanical clogging, bacterial clogging, and loss of pump efficiency. Observing changes in a well's specific capacity over time will alert a well owner of developing well efficiency problems.

It is recommended that the City perform simple specific capacity pumping tests either annually or biannually on each well. The results should be recorded and plotted on a graph over time. A specific capacity test is easily performed by pumping the well using the existing well pump and documenting the static water levels, drawdown, and pumping rate of the well. This is best done during a period when the well has been sitting idle for a reasonable period of time (e.g., one week). The idle time is needed to normalize the well's static water level. Noting a reduction in specific capacity will indicate problems with the well or pumping system and the need to take corrective action before the problem becomes irreversible and to minimize operating costs.

Rehabilitation work may include a variety of approaches, depending on the nature of lost efficiency. Rehabilitation work may be accomplished using mechanical cleaning or non-mechanical methods such as shocking with percussion apparatuses, chemical addition, or chlorination. In some cases, it may be necessary to use a combination of mechanical and non-mechanical methods. Generally, the longer rehabilitation work is delayed, the greater the risk that the lost capacity cannot be recovered. Tracking well production over time by performing this relatively easy specific capacity test provides good information to project forward and budget for a maintenance activity that may be required on the well. If specific capacity has not decreased but pumping rates have, this may indicate a problem with the pump rather than the well.

## Static Water Level Trends

### *Prineville Valley Floor Aquifer*

The Prineville valley floor aquifer has a seasonal water level fluctuation pattern. Water levels are near ground surface during late winter and spring and then decline during the summer. The valley floor aquifer water levels typically recover fully each year. Although this valley floor aquifer appears to be able to support the current level of production, the City needs to continue to monitor the long-term resiliency of the alluvial aquifer system.

### *Airport Area Aquifer System*

Water levels in the Airport Area Aquifer System fluctuate seasonally, with the water tables dropping during the summer period, and then recovering during the winter period. In addition to the seasonal fluctuations, the water levels in both of the Airport Area aquifers have shown a long-term decline over the past three years of monitoring. Water levels have declined at average rates of more than 3.5 feet per year in the Upper Aquifer and slightly less than 1 foot per year in the Lower Aquifer during the three-year groundwater mitigation plan data collection effort. Factors that are likely contributing to the measured declines include climate fluctuations (short and decadal cycles) and an increase in annual production from these aquifers. The precipitation record from the Prineville Valley indicates the Prineville area has been in a drying trend between 1998 and 2016, which may be one reason for the observed long-term water level decline. However, the recent increases in annual production from these aquifers may also be a contributing factor to the observed declining water level trend. A longer term water level dataset that includes a wet climate cycle will assist in further assessment of these relationships. The City needs to continue to monitor long-term water levels in the Airport Area Aquifer System to further understand and evaluate the current trend.

## Water Rights

The City of Prineville holds a total of 30 water rights for the use of both groundwater and surface water for municipal, irrigation, group domestic, and industrial supply. Of these 30 water rights, a majority are for either municipal or irrigation. The City’s water rights are summarized on Figures 3-1 and 3-2 and are described in more detail in the following sections. Copies of the water rights certificates are included in Appendix E.

### *Municipal Water Rights*

The City currently holds a total of 12 groundwater rights for municipal use, which include 9 certificates and 3 groundwater permits. The City's municipal water supply currently comes from groundwater supplied by 11 wells, appropriating water under 9 of the City's municipal use water rights with a total authorized rate of appropriation of 19.32 cfs. Although the City has municipal use water rights authorizing 19.32 cfs, current production capacity of the associated wells is approximately 8.39 cfs.

### *Prineville Valley Floor Aquifer Groundwater Rights*

The City holds six water right certificates and one permit (Permit G-11993) for the use of water for municipal supply from the Prineville Valley floor alluvial aquifer. These valley water rights total 5.13 cfs. The current combined production capacity of the City's valley floor wells is 3.21 cfs; therefore, there is 1.92 cfs in excess water rights capacity available for use in the valley's alluvial aquifer. With the exception of Permit G-11993, all of the City's alluvial aquifer water rights are certificated. Permit G-11993 was partially perfected, with Certificate 87714 issued in 2012. An application for extension of time is currently pending for the remaining, unperfected portion of Permit G-11993.

### *Airport Area Aquifer System Groundwater Rights*

The City also holds two groundwater permits in the Airport Area Aquifer System: Permit G-17577 (commonly referred to as Permit A) and Permit G-17236 (commonly referred to as Permit B). Permit G-17577 is for the use of up to 1.715 cfs up to a maximum total annual volume of 1,242 AF from four wells (Airport Wells No. 1 through No. 4) in the Airport Area Aquifer System. Both Permits G-17577 and Permit G-17236 require mitigation under the Deschutes Basin Groundwater Mitigation Program (OAR Chapter 690, Division 505) and, therefore, the permits contain a maximum annual volume limit.

Permit G-17236 is for the use of up to 12.48 cfs for up to 9 wells, with the following limitations: use of no more than 5.57 cfs from Airport Wells No. 1 through No. 4 and Wells No. 5 through No. 7, being no more than 2.23 cfs (1,000 gpm) in total from Airport Wells No. 1 through No. 4, no more than 1.11 cfs in total from Wells No. 5 and No. 6, and no more than 2.23 cfs from Well No. 7. There are no well-specific rate limitations on Wells 8 and 9. The maximum annual volume under Permit G-17236 is 3,682.7 AF. Currently, only Airport Wells No. 1 through 4 (the same wells authorized under Permit G-17577) are constructed and utilized, with a combined capacity of approximately 5.18 cfs (2,325 gpm). Proposed Wells No. 5 through No. 9 would appropriate water from the Deschutes Regional Aquifer, located west of the Airport Area Aquifer System. A map showing the current authorized location of Wells No. 1 through No. 9 is provided on Figure 3-3.

Although the physical pumping capacity of the Airport wells is 2,325 gpm, the City's water rights for the Airport Area Aquifer System are limited by both the maximum rate and volume authorized by water right. Permits G-17236 and G-17577 have a combined rate limitation of 1,770 gpm. The City's Airport Wells No. 1 through No. 4 do not pump simultaneously. During periods of peak demand, the

City is able to operate Well No. 4 in combination with Well No. 2, or in combination with Wells No. 1 and 3 to maximize the rate of production under Permits G-17236 and G-17577.

Additionally, under the Deschutes Basin Groundwater Mitigation Program, the City must provide mitigation pursuant to the rules in OAR Chapter 690, Division 505. To date, the City has provided 263.6 mitigation credits under Permit G-17577 and 340.3 credits under Permit G-17236. The City must provide mitigation for the OWRD's estimate of consumptive use. The OWRD has generally determined that the use of water for year-round municipal supply is 40 percent consumptive, so with the mitigation currently provided the City can appropriate a maximum of 1,509.8 AF from the Airport Area Aquifer wells. In 2015, the City appropriated 816.5 AF from this source.

### *Municipal Water Rights for Wells Not Connected to the City Municipal Water Supply System*

The City also holds four additional municipal use groundwater certificates that are not currently being used to supply water to the City's municipal system. These rights are used to supply water for industrial use or are not used due to water quality, production, or other issues. One of these rights is a surface water right from Ochoco Creek. Figure 3-3 provides further details regarding these water rights. Because these water rights are not used to supply water to the City's municipal system, they are not discussed further in this Water System Master Plan (WSMP). Although the wells associated with these groundwater rights are not connected to the City's municipal system, the water rights associated with the wells may be utilized at other points of appropriation in the Prineville valley floor aquifer through a water right transfer, should the City develop additional wells from that source of supply over the long term.

### *Other City Water Rights*

The City holds one certificate and two groundwater permits that are for uses that include group domestic, industrial, fire protection, and sewerage (see Figure 3-2). Because these water rights are not used to supply water to the City's municipal system, they are not discussed further in this WSMP.

### *Irrigation Water Rights*

There are 16 water right certificates for primary irrigation of 864.6 acres and supplemental irrigation of 257.8 acres on City-owned lands. These rights are all surface water rights, with the exception of one supplemental irrigation right associated with a groundwater well. These irrigation water rights are presented on Figure 3-2. The City uses these rights, in combination with reclaimed water, to irrigate City-owned lands. Both the City golf course and pasture lands near the wastewater treatment plant are irrigated with surface water in this manner. The City leases the majority of acres to which the surface water rights are appurtenant for farming purposes. Because these water rights are not used to supply water to the City's municipal system, they are not discussed further in this WSMP.

## Water Supply Analytical Testing

### General Supply Well Testing Data

Summaries of analytical data related to the City's water quality testing were obtained from the DWS website. The City's well sources have been sampled for the constituents required by the DWS, including total and fecal coliform, volatile organic compounds) synthetic organic compounds, inorganic compounds, radiological agents, pesticides, fluoride, nitrates, nitrites, arsenic, asbestos, and several metals.

As shown in the City's testing data, most of the constituents were not detected in samples obtained from springs or the wells. Of those detected, the concentrations were significantly less than their corresponding U.S. Environmental Protection Agency (EPA) primary drinking water maximum contaminant levels (MCL). Based on the latest chemical results, groundwater from the City's supply wells does not contain bacteriological or chemical constituents at concentrations greater than the corresponding EPA primary drinking water MCL. The DWS water quality testing summaries are presented in Appendix F.

### Distribution System Water Quality Testing

Although the distribution system is discussed in greater detail in Chapter 5, a brief discussion of water distribution system sample analytical testing is presented herein for completeness. The City routinely obtains samples from the water distribution system for analysis of total coliform and fecal coliform. In general, coliform are not present in routine water distribution system samples, although the water has tested positive for total coliforms in the past, but not recently. These past positive test results were reported to the DWS, and the DWS recorded the positive test as an alert, although it was not considered a violation. Total coliform bacteria are commonly found in the environment (e.g., soil or vegetation) and are generally harmless. When only total coliform bacteria are detected in drinking water, the likely source is environmental, and fecal contamination is not likely. However, if environmental contamination can enter the system, that may indicate there is a way for pathogens to enter the system and, therefore, it is important to find the source and resolve the issue.

The City also obtains samples from the distribution system for chemical analysis of disinfection byproducts (DBP), asbestos, lead, and copper. From 1993 through 2015, all detected concentrations of DBP, asbestos, lead, and copper were less than their corresponding EPA action levels. Results from the City's coliform, lead, and copper tests are summarized in the DWS water quality testing summaries in Appendix F.

## Source Water Assessment Interim Report

The 1996 amendments to the Safe Drinking Water Act required states to provide the information needed by public water systems to develop source water assessments if they chose to do so. The information provided in the source water assessment includes identification of the area most critical to maintaining safe drinking water (i.e., the Drinking Water Protection Area [DWPA]), an inventory of potential sources of contamination within the DWPA, and an assessment of the relative threat that these potential sources pose to the water system. The DWS is the principal agency involved with source water assessments in Oregon. As part of the source water assessment, the DWS developed time of travel delineations for the City of Prineville's water supply wells. In 2014, the DWS certified the City's updated DWPA designated time of travel delineations. The City also completed an Inventory of Potential Contaminant Sources associated with the updated DWPA time of travel delineations in 2014. A copy of the Source Water Assessment Interim Report (Report) is included in Appendix H.

The Report includes information related to the City's water sources, including delineation of the source water protection area, a sensitivity analysis, an inventory of potential contamination sources, and the susceptibility of the drinking water sources. Refer to Appendix H for information relative to the City's water supply well source aquifers present beneath the Prineville area. The DWPA delineations are intended to identify the area that supplies the system's drinking water. The DWPA is designated for projected 1-, 2-, 5-, and 10-year time of travel periods for water from the aquifer to enter Prineville's water supply sources. Figures showing the DWPA, the times of travel for groundwater to the wells, and potential contamination sources are included in the Report in Appendix H.

The City's only water source for public supply is from the local groundwater system. Because groundwater sources are susceptible and sensitive to contamination, it is important to understand and protect the groundwater systems that the local population relies on for their drinking water. Potential contaminant sources for each City well were identified and labeled on figures in the Inventory of Potential Contaminant Sources included in the Report located in Appendix H. Potential contaminant sources identified by the Report include leaking underground storage tank sites, commercial and industrial properties, and agricultural facilities. The full list of potential contaminant sources can be found on tables associated with this Report.

The updated documents conclude that the City of Prineville's water system obtains water from several local aquifers that can be impacted by release of contaminates on the ground or into the subsurface. Several high to moderate risk potential contaminant sources were identified within the protection area of several of the City's water wells.

## Water Supply Reliability

The reliability of the water supply is one of the most important components of any water system. Because the health and safety of the community depends on a reliable water source, high priority should be given to help ensure a municipal water system always has the ability to meet the water needs of its customers. A number of factors, such as mechanical failures, water quality concerns, power outages, primary water transmission line failures, etc., can affect the reliability of a water supply. It is nearly impossible to ensure 100 percent reliability of any system. However, having proper system components can reduce the risk of a water supply failure.

The City of Prineville uses shallow wells for their water supply. In general, a groundwater well source is less susceptible to seasonal fluctuations in weather patterns, drought, or contamination than a surface water source. The water levels in the City's wells do have some seasonal fluctuations; however, over time, the static water levels have remained fairly constant (with the exception of the Airport Area Aquifer System). Although the City's water sources have been reliable, certain events could affect the City's water supply. When evaluating the system's performance, potential weaknesses were identified as follows:

1. Transmission line failure
2. Source contamination

3. Equipment failure at the Airport Area Aquifer System wells and valley floor wells
4. Booster pump station equipment failure
5. Contamination in reservoirs and distribution system
6. High demand and low storage volume

The supply has been able to meet system demands, but there is no available capacity to accommodate growth and additional demands. Currently, the existing water system components provide the City with a good degree of redundancy, but there is limited ability to deliver the water supply from the Airport Area Aquifer System wells to the other zones within the City. In the event of a power outage, the City currently has a backup power system at the Airport Area Aquifer System wells and the valley floor wells.

Reservoir storage is further discussed in Chapter 4, and the distribution system and delivery of water supply from the Airport Area Aquifer System wells to other zones within the City are discussed in detail in Chapter 5.

## Water Supply Alternatives

At this time, the City does not have enough source capacity to meet current demands. As discussed earlier, it is desirable to design a system with enough source capacity to provide for peak daily demands without requiring the well pumps to operate 24 hours per day. As shown on Figure 2-3, the peak daily flow requirements, assuming the wells operate 18 hours per day, is estimated to be approximately 3,330 gpm and 5,300 gpm for current and projected future (2037), respectively. As discussed previously, the current combined available capacity from all well sources is 3,210 gpm. Therefore, the City exceeding the available permitted supply capacity, assuming the recommended daily operating time limit of 18 hours is implemented. It appears the City will need to develop an additional 2,090 gpm of source capacity to meet the 20-year projected demands. The City should immediately begin the process of increasing its supply capacity to meet the current and projected demands. The following alternatives were evaluated to meet this objective:

### *Develop Additional Well Sources Alternative*

An alternative potential available to the City is to develop additional well source(s) to increase capacity. The City has recently drilled exploratory wells in the valley floor aquifer to determine the viability of developing additional wells from this source with limited success. The exploratory wells have not yielded adequate water to justify the cost of developing producing wells. Due to the relatively small amounts of water produced from the existing wells and the limited success of the exploratory wells drilled, the City has concluded that developing additional wells to utilize water from the valley floor aquifer is likely not cost-effective and probably not a viable, long-term solution to solve the City's need for more source capacity.

Drilling and developing additional wells to appropriate water from the Deschutes Regional Aquifer is an option the City could consider. As discussed above, Wells No. 1 through 4 have a physical pumping capacity of 2,325 gpm, but are limited by the water right permit to an instantaneous withdrawal rate of 1,770 gpm. Water rights from future Wells No. 5 through 7 (see Figure 3-3), allow no more than 500 gpm in total from Wells No. 5 and 6, and no more than 1,000 gpm from Well No. 7, or 1,500 gpm total. There are no well-specific rate limitations on proposed Wells No. 8 and 9. Well No. 7 would be the most feasible well to drill and develop as it has the closest proximity to the City and would require the shortest pipeline to get it connected to the City's water system and it also has double the available water right when compared to Wells No. 5 and 6. As shown of Figure 3-3, all of the proposed wells would require miles of pipeline to be constructed to connect them to the City's system. These pipelines would have a very high capital cost to construct and, unless Well No. 8 or 9 was connected, would not provide the City with the long-term capacity needed to meet the projected demands. For these reasons, the development of these proposed wells does not appear to be the most viable option potentially available to the City.

### *Shallow Groundwater Source(s) Adjacent to the Crooked River Alternative*

As discussed earlier, the City is currently in the process of obtaining a water right for the release of up to 5,100 AF of stored water from Prineville Reservoir for mitigation for groundwater pumping (downstream fish and wildlife use). The City anticipates the application will result in 5,100 AF of mitigation credits.

These anticipated mitigation credits will provide the opportunity for the City to permit and develop additional groundwater source(s). These future groundwater supply source(s) will likely include shallow well(s) (or a similar collection system) in the valley and near the Crooked River.

A study to evaluate the potential to develop shallow groundwater supply source(s) coupled with aquifer storage and recovery (ASR) is being completed outside of this WSMP. That study will provide detailed analysis of the feasibility of developing the shallow groundwater supply source(s), the best method(s) for developing the source(s) [i.e., wells, infiltration gallery, treatment requirements, etc.], the estimated costs of developing the source(s) and whether ASR is a viable solution for providing more available groundwater during peak pumping times.

Until this pending study is completed, it will not be known for certain, but at this point, it appears the most feasible potential additional source(s) of supply available to the City will be from shallow groundwater hydraulically connected to the Crooked River. Because these potential shallow groundwater sources will be hydraulically connected to the Crooked River, as part of the water rights application process, the City will need to provide mitigation credits associated with the Crooked River zone of impact.

## Recommendations

To obtain the needed additional water supply capacity, the City should develop more sources. This could be done by developing the proposed wells in the Deschutes Regional Aquifer or through shallow groundwater sources located near the Crooked River that are hydraulically connected to the river. The most feasible option available to the City appears to be from the shallow groundwater sources but will not be know for certain until the pending study is completed. Once the study is completed, the information needed to compare alternatives will be available and the City will have the required data and documentation to make the best long-term decision to solve the additional supply capacity needs.

## City-Held Municipal Water Rights

| Well | Application | Permit | Certificate, Claim, or Transfer | Entity Name on Water Right | Type of Beneficial Use | Priority Date | Source of Water | Water Right's Authorized Rate | | | | Current Capacity | | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | gpm | cfs | MGD | Maximum AF per year | gpm | cfs | |
| **Water Sources Currently Connected to Municipal Water Supply System** | | | | | | | | | | | | | | |
| Barney | G-6313 | G-9154 | ~~T-9762~~ | City of Prineville | MU | October 5, 1973 | Prineville Valley Aquifer | 700 | 1.56 | 1.01 | | 340 | 0.76 | |
| Stearns | | | 83993 | | | | | | | | | 210 | 0.47 | |
| Stadium | G-12344 | G-11993 | 87714 (PP) | City of Prineville | MU | December 14, 1990 | Prineville Valley Aquifer | 271 | 0.604 | 0.39 | | 205 | 0.46 | |
| | G-12344 | G-11993 | | | | | | 154 | 0.343 | 0.22 | | | | Permit completion date October 1, 1998. Extension application pending. |
| 4th Deep | U-402 | U-372 | 86889 | City of Prineville | MU | December 8, 1950 | Prineville Valley Aquifer | 337 | 0.75 | 0.48 | | 175 | 0.39 | |
| 4th Shallow | U-396 | U-370 | 88146 | City of Prineville | MU | October 11, 1950 | Prineville Valley Aquifer | 135 | 0.301 | 0.19 | | 90 | 0.20 | Currently used only as backup supply due to water quality and/or production issues. |
| Yancey | U-241 | U-215 | 22839 | Pacific Power and Light Company | MU | June 17, 1947 | Prineville Valley Aquifer | 359 | 0.8 | 0.52 | | 210 | 0.47 | |
| Lamonta | G-605 | G-506 | 86337 | City of Prineville | MU | April 5, 1957 | Prineville Valley Aquifer | 346 | 0.77 | 0.5 | | 210 | 0.47 | |
| Airport No. 1,2, 3, and 4 | G-15974 | ~~G-16146~~<br>~~G-17089~~<br>G-17577 | T-10378,<br>T-11647,<br>T-12192 | City of Prineville | MU | March 31, 2003 | Airport Area Aquifer System | 770 | 1.715 | 1.11 | 1,242.00 | 2325 | 5.18 | Permit completion date October 29, 2026. |
| Airport No. 1, 2, 3, and 4 | G-16900 | G-17236 | T-11685 | City of Prineville | MU | June 27, 2007 | Airport Area Aquifer System | 1,000 | 2.23 | 1.44 | 3,682.70 | | | Permit completion date November 30, 2031.<br>Only Airport area wells developed to date.<br>Permit condition limits Airport area wells to 2.23 cfs (1,000 gpm). |
| Wells 5 through 9 | | | | | | | Deschutes Regional Aquifer | 4,601 | 10.25 | 6.62 | | 0 | 0 | Wells not yet developed. |
| | | | | | | **Valley Floor Aquifer Subtotal:** | | **2,302** | **5.13** | **3.31** | | **1,440** | **3.21** | |
| | | | | | | **Airport Area Aquifer Subtotal:** | | **1,770** | **3.95** | **2.55** | | **2,325** | **5.18** | |
| | | | | | | **Municipal Production Wells Total:** | | **8,673** | **19.32** | **12.49** | | **3,765** | **8.39** | |
| **Water Sources Not Connected to Municipal Water Supply System** | | | | | | | | | | | | | | |
| Freight Depot | G-605 | G-506 | ~~T-11026~~<br>89853 | City of Prineville | MU | April 5, 1957 | Prineville Valley Aquifer | 148 | 0.33 | 0.21 | | | | Not connected to the City's municipal water supply system. Used at the railroad depot for industrial purposes. |
| 10th Street | U-140 | U-133 | 15539 | City of Prineville | MU | May 16, 1941 | Prineville Valley Aquifer | 45 | 0.1 | 0.06 | | | | Currently not in use due to water quality and/or production issues. |
| Ochoco Heights | U-147 | U-140 | 86558 | City of Prineville | MU | May 20, 1942 | Prineville Valley Aquifer | 359 | 0.8 | 0.52 | | | | Currently not in use due to water quality and/or production issues. |
| | Crooked River Decree | -- | 531 | City of Prineville | MU, FP, Sewerage | December 31, 1879 | Ochoco Creek | Reasonable Amount | Reasonable Amount | Reasonable Amount | | | | Not currently in use. |

AF = acre-feet
cfs = cubic feet per second
FP = Fire Protection
gpm = gallons per minute
MGD = million gallons per day
MU = Municipal

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CITY-HELD MUNICIPAL WATER RIGHTS

FIGURE
3-1

## City-Held Irrigation and Other Water Rights

| Well | Application /Decree | Permit | Certificate, Claim, or Transfer | Entity Name on Water Right | Type of Beneficial Use | Priority Date | Source of Water | Authorized Rate | | | Primary Acres | Supplemental Acres | Status/Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | gpm | cfs | MGD | | | |
| **Other Water Rights Held by the City** | | | | | | | | | | | | | |
| Northridge | G-13280 | G-13280 | | City of Prineville | GD | February 5, 1993 | Prineville Valley Floor Aquifer | 67.0 | 0.15 | 0.10 | | | Completion date October 1, 2017. Not connected to City's municipal water supply system. |
| Stearns | G-3139 | G-2919 | 57438 | Pacific Power and Light Company | GD | June 17, 1965 | Prineville Valley Floor Aquifer | 112 | 0.25 | 0.16 | | | Currently not in use due to water quality and/or production issues. |
| Clear Pine | G-13238 | G-12541 | | City of Prineville | Fire Protection, Pollution Abatement, I/M | January 6, 1993 | Prineville Valley Floor Aquifer | 1,791 | 3.99 | 2.58 | | | Completion Date October 1, 2019. Not connected to City's municipal water supply system. |
| **Irrigation Rights on City-Owned Lands** | | | | | | | | | | | | | |
| **Surface Water Irrigation Rights** | | | | | | | | | | | | | |
| | S-25184 | S-19956 | 33012 | Claude Williams | SUP IR | August 25, 1950 | Crooked River | 480 | 1.07 | 0.69 | 85.4 | | |
| | S-15522 | S-11411 | 75485 | Peoples Irrigation Co. | Primary IR | September 11, 1934 | Crooked River | 449 | 1 | 0.65 | 78.4 | | |
| | S-15629 | S-11494 | 75487 | Peoples Irrigation Co. | IR | November 21, 1934 | Crooked River | 72 | 0.16 | 0.10 | 12.4 | | |
| | S-4788 | S-5426 | 82246 | Ochoco Irrigation District | IR | March 13, 1916 (from McKay)<br>August 10, 1917 (from Other Sources) | Ochoco Creek, McKay Creek, Dry Creek, Lytle Creek, Johnson Creek, Ochoco Reservoir, Waste and Return Water Flowing in All Unnamed Waterways | | | | 300 | | Acquired from Ironhorse Development in 2017. Acreage to be finalized by March 31, 2017. |
| | S-32641 | S-25991 | ~~68395~~<br>~~T-8648~~<br>82247 | U.S. Bureau of Reclamation (BOR) | SUP IR | April 8, 1914 | Crooked River and Prineville Reservoir | 13 | 0.03 | 0.02 | 2.5 | | |
| | | | 82247 | BOR | IR | April 8, 1914 | Crooked River and Prineville Reservoir | 31 | 0.07 | 0.05 | 2.8 | 300 | Supplemental portion acquired from Ironhorse Development in 2017. Acreage to be finalized by March 31, 2017. |
| | S-15766 | S-11619 | 87546 | Peoples Irrigation Co. | IR | March 23, 1935 | Crooked River | 85 | 0.19 | 0.12 | 15 | | |
| | Crooked River Decree | | 87547 | Peoples Irrigation Co. | IR, LV | 1893 | Crooked River | 304 | 0.6775 | 0.44 | 54.2 | | |
| | S-32641 | S-25991 | 87548 | BOR and Peoples Irrigation Co. | IR, SUP IR | April 8, 1914 | Crooked River and Prineville Reservoir | 395 gpm primary; 1,522 gpm supplemen | 0.88 cfs primary; 3.39 cfs suppleme | | 32.5 | 129.3 | |
| | S-32641 | S-25991 | ~~T-11103~~<br>83850 | BOR | SUP IR | April 8, 1914 | Crooked River and Prineville Reservoir | 415 | 0.925 | 0.60 | 37 | | |
| | | | ~~T-11134~~<br>83850 | BOR | IR, SUP IR | April 8, 1914 | Crooked River and Prineville Reservoir | 471 | 1.05 | 0.68 | 21.8 | 20 | |
| | S-15766 | S-11619 | ~~T-11134~~<br>90380 | Peoples Irrigation Co. | IR | March 28, 1935 | Crooked River | 139 | 0.31 | 0.20 | 25 | | |
| | Crooked River Decree | | ~~T-11134~~<br>90381 | Peoples Irrigation Co. | IR, LV | December 31, 1893<br>December 31, 1895 | Crooked River | 166 | 0.37 | 0.24 | 29.3 | | |
| | S-32641 | S-25991 | ~~T-11134~~<br>90382 | BOR and Peoples Irrigation Co. | IR, SUP IR | April 8, 1914 | Crooked River and Prineville Reservoir | 705 | 1.57 | 1.01 | 8.3 | 54.3 | |
| | Crooked River Decree | | ~~T-11134~~<br>90383 | Peoples Irrigation Co. | IR, DOM, LV | 1895 | Crooked River | 112 | 0.25 | 0.16 | 20 | | |
| | Crooked River Decree | | 90397 | Peoples Irrigation Co. | IR, DOM, LV | 1895 | Crooked River | 224 | 0.5 | 0.32 | 40 | | |
| | Crooked River Decree | -- | 531 | City of Prineville | IR | December 31, 1879 | | 2,244 | 5.00 | 3.23 | 400 | | |
| **Groundwater Irrigation Rights** | | | | | | | | | | | | | |
| Simmons Well | G-13068 | G-12511 | 87724 | City of Prineville | SUP IR | August 7, 1992 | Prineville Valley Floor Aquifer | 301 | 0.67 | 0.43 | | 54.2 | Not connected to City's municipal water supply system. |
| | | | | | | | | | | Total: | 1,164.6 | 557.8 | |

cfs = cubic feet per second
DOM = domestic
GD = group domestic
gpm = gallons per minute
I/M = irrigation/municipal
IR = irrigation
LV = livestock
MGD = million gallons per day
SUP = supplemental irrigation

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WATER SYSTEM MASTER PLAN
CITY-HELD IRRIGATION AND OTHER WATER RIGHTS

FIGURE
3-2

## APOA LOCATION DESCRIPTIONS

**Airport Well 1**
1,210 feet North and 1,950 feet East from SW corner of Section 11, Township 15 South, Range 15 East (W.M.)

**Airport Well 2**
1,165 feet North and 1,990 feet East from SW corner of Section 11, Township 15 South, Range 15 East (W.M.)

**Airport Well 3**
790 feet North and 2,560 feet East from the SW corner of Section 11, Township 15 South, Range 15 East (W.M.)

**Proposed Airport Well 3**
55 feet North and 3,000 feet East from SW corner of Section 11, Township 15 South, Range 15 East (W.M.)

**Proposed Airport Well 4**
1,070 feet North and 1,710 feet East from SW corner of Section 11, Township 15 South, Range 15 East (W.M.)

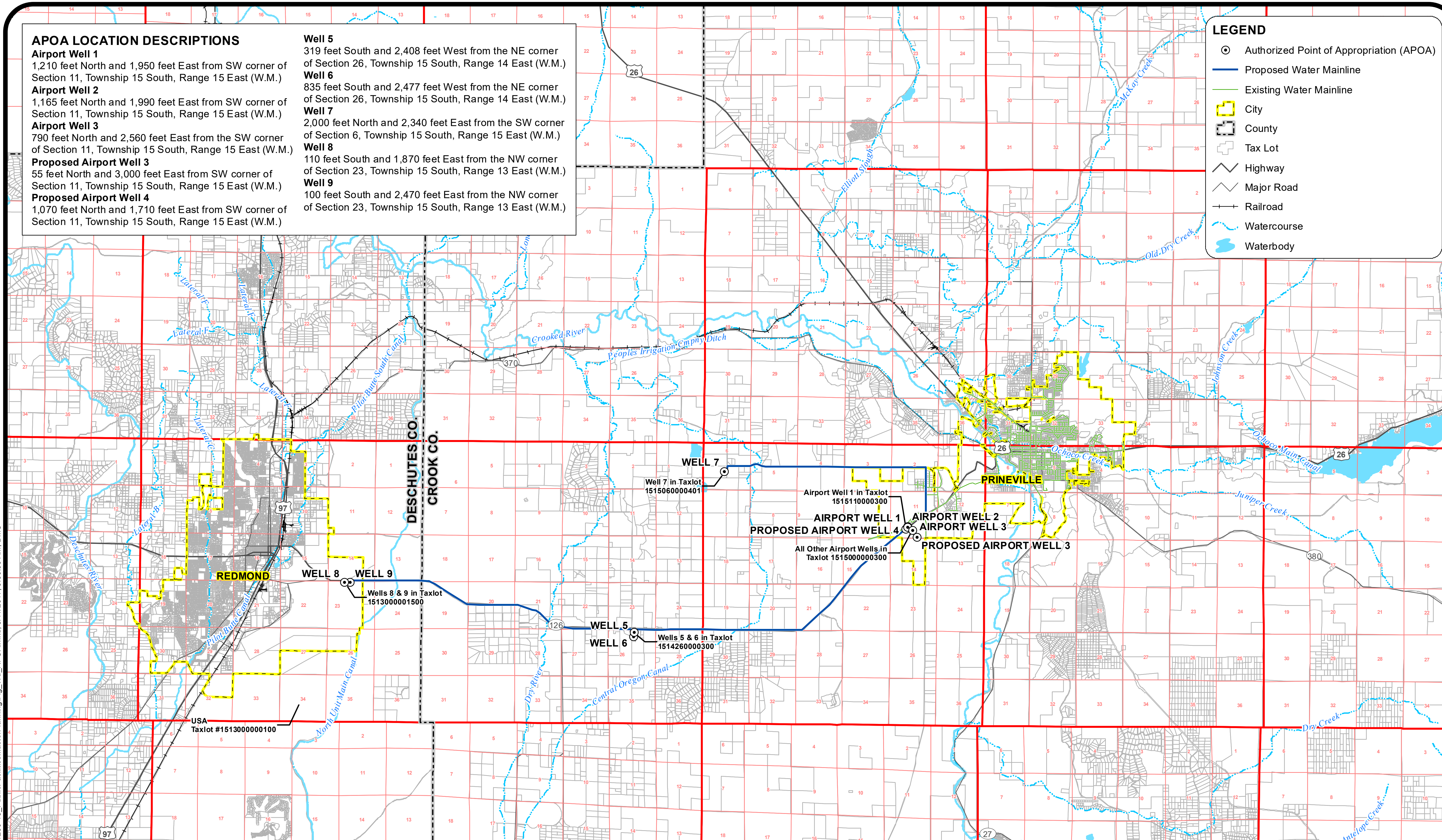
**Well 5**
319 feet South and 2,408 feet West from the NE corner of Section 26, Township 15 South, Range 14 East (W.M.)

**Well 6**
835 feet South and 2,477 feet West from the NE corner of Section 26, Township 15 South, Range 14 East (W.M.)

**Well 7**
2,000 feet North and 2,340 feet East from the SW corner of Section 6, Township 15 South, Range 15 East (W.M.)

**Well 8**
110 feet South and 1,870 feet East from the NW corner of Section 23, Township 15 South, Range 13 East (W.M.)

**Well 9**
100 feet South and 2,470 feet East from the NW corner of Section 23, Township 15 South, Range 13 East (W.M.)




## DISCLAIMER

This map was prepared for the purpose of identifying the location of a water right only and it is not intended to provide legal dimensions or location of property ownership lines.

0 2 4
SCALE IN MILES

Date: May 11, 2017
Data Sources: OWRD, Crook Co. GIS, OGIC, ESRI

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CITY OF
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WATER SYSTEM MASTER PLAN

# AUTHORIZED POINTS OF APPROPRIATION (APOA)

FIGURE
3-3

\\LGSVR6\gisprojects\Prineville\1260-15_PublicFacilitiesMasterPlanning\Fig_Wtr_APOA.mxd, 5/11/2017, 9:30:50 AM, DMC

# Chapter 4 - Water Storage

## Introduction

This chapter presents information about the City's water storage facilities and discusses the purpose for storage in municipal water systems. The condition and needs of the City's existing storage reservoirs are outlined, recommended storage requirements to meet current and 2037 design criteria are presented, and the types of storage facilities generally available are outlined. Cost estimates for storage reservoir improvements are presented at the end of this chapter.

## General

Water storage facilities are constructed to serve several purposes. First, storage reservoirs are often used to provide control for well or booster pump system operation. When a reservoir drops a few feet or more from the full level, the water level can be used as a control for well pump or booster pump activation. The amount of storage required for this type of control is called "operating storage." Second, stored water must be available to supply water during periods in which the demand for water exceeds the available water supply. This reserve is called "equalization storage." Third, reserve storage is usually provided to supply unusually high, short-duration demands, such as fire flows. This is referred to as "fire reserve." Finally, reserve storage is also often provided for emergencies that may arise and interfere with production from water supply sources. Such emergencies could be created by power outages, mechanical equipment failure, or sudden water contamination. The amount of storage to be provided for an emergency depends on the likelihood and the impact of such an occurrence. The amount of emergency storage provided usually becomes a balance between what is needed and what can be afforded. This storage allowance is usually called "emergency reserve."

Storage facilities can be located at approximately the same elevation as the water distribution system. Storage facilities of this type require continuous operation of a booster pump system to maintain distribution system pressure. Storage facilities can also be elevated, in which case the water is stored at an elevation considerably above the distribution system to generate adequate system pressure. For example, a water elevation 120 feet above a distribution system would be required to generate a distribution system static pressure of approximately 50 pounds per square inch. Reservoirs may be elevated by locating them on natural ground high enough above the service area or by construction on top of a steel support frame.

Storage reservoirs are generally constructed of steel, reinforced concrete, or prestressed concrete. The choice is usually based on an economic analysis made for the particular installation. Reservoirs may be constructed either aboveground or buried, with the choice made on cost, location, and community acceptance. The remainder of this chapter reviews the City's existing storage facilities, presents a discussion of future storage needs, and provides alternatives for satisfying those needs.

## Existing Facilities

The City's existing municipal water storage consists of six water storage reservoirs with a total storage volume of 4.5 million gallons (MG). Refer to Table 1-1 in Chapter 1 for a summary of these reservoirs.

The most recent detailed inspections of five of the six reservoirs were completed in 2011 by Inland Potable Services, Inc., of Centennial, Colorado. Copies of the available Inspection Reports for the reservoirs are included in Appendix I. Additional information was gathered from inspection video from each reservoir. Table 4-1 is a summary of the existing conditions and recommendations.

**TABLE 4-1**
**EXISTING CONDITIONS AND RECOMMENDATIONS**

| Reservoir | Inspection Date | Inspection Summary | Recommendations |
|---|---|---|---|
| Airport No. 1 | October 6, 2011 | The exterior and interior of reservoir were generally found to be in good to excellent condition. | Install gasket on access hatch.<br><br>Clean and inspect every 3 to 5 years. |
| Airport No. 2 | N/A | Airport No. 2 was constructed after the 2011 inspections by Inland Potable Services, Inc. | N/A |
| Ochoco No. 1 | October 6, 2011 | The exterior of the reservoir was generally found to be in fair to good condition with surface corrosion ranging from less than 1 percent to 10 percent.<br><br>Nonfunctioning cathodic lines were noted.<br><br>The interior of the reservoir was generally found to be in poor condition with pitting, heavy noduling, and up to 95 percent corrosion noted. | Install gasket on access hatch.<br><br>Replace cathodic lines.<br><br>Blast and recoat interior of the reservoir.<br><br>Repair the epoxy of the exterior of the reservoir.<br><br>Clean and inspect every 3 to 5 years. |
| Ochoco No. 2 | October 6, 2011 | The exterior of the reservoir was generally found to be in good condition with up to 5 percent surface corrosion.<br><br>The interior of the reservoir was generally found to be in poor condition with pitting, heavy noduling, and up to 90 percent corrosion noted. | Install gasket on access hatch.<br><br>Blast and recoat interior of the reservoir.<br><br>Repair the epoxy of the exterior of reservoir.<br><br>Clean and inspect every 3 to 5 years. |
| Barnes Butte | October 5, 2011 | The reservoir was generally found to be in fair to good condition. | Clean and inspect every 3 to 5 years. |
| American Pine | October 5, 2011 | The reservoir was generally found to be in excellent condition. | Clean and inspect every 3 to 5 years. |

Based on a 3- to 5-year time frame, cleaning and inspections are due. Scheduling and completing cleaning and inspections for all the reservoirs is recommended within the next fiscal year.

## System Pressures Provided by the Reservoirs

The City of Prineville currently has six pressure zones serving the distribution system. Where practical, the distribution system is gravity fed from the reservoirs. Chapter 1 provides further detail of the existing pressure zones, including Table 1-3, Summary of Pressure Zones. Fire flow capacity, as well as the evaluation of the distribution system, is discussed in Chapter 5.

Refer to Chapter 5 for a discussion of the water modeling performed as part of this Water System Master Plan, which discusses varying system demand conditions and their impact on distribution system pressures.

## Storage Requirements

Water storage is usually provided for several purposes. Various methods are used to calculate the volumes of each type of storage component required. Most involve a rational approach to estimating the volume of each storage component consisting of operating, equalization, fire reserve, and emergency reserve. The decision can then be made as to which component controls and which storage volumes will be necessary. For example, the decision may be made to provide storage for operating, equalization, and fire reserve only, assuming any emergency storage would be available from the fire reserve. All four of the storage components listed below were considered when evaluating the City's potential storage needs. Refer to the design criteria presented on Figure 2-3 in Chapter 2 for further information on the storage components discussed herein.

### *Operating Storage*

Operating storage is generally provided to facilitate operation of wells or booster pumps in a water system. For example, when water system demands result in the water level lowering in a reservoir, the water level will reach a certain point that can be used to trigger activation of well pumps to refill the reservoir. The storage needed to activate water supply sources is typically referred to as operating storage. This zone of operation can be set as desired but is often set to help ensure circulation occurs during each pump run cycle, allowing water to cycle through the reservoir to help maintain water quality while keeping the reservoir as full as possible.

### *Equalization Storage*

Equalization storage should be provided to balance the difference between peak hour demand and water supply capacity during a peak day demand (PDD) period. An empirical method for estimating the required equalization storage uses the difference between the peak hourly flow and the peak water supply availability for a specific number of peak hours per day. For the purposes of this evaluation, 2-1/2 hours of peak hourly flow has been assumed. Based on providing the current estimated peak hourly flow of 4,626 gallons per minute (gpm) for 2-1/2 hours and using the current supply available, equalization storage of 129,076 gallons is currently required. Due to the anticipated increase in population, the required equalization storage is anticipated to increase by 409,881 gallons in the 20-year design period.

### *Fire Reserve*

Reserve storage for fire suppression is usually determined from either the Insurance Services Office, Inc. (ISO) recommended fire flow or the fire flow recommended by the City's fire chief. Based on the typical maximum fire flow recommended by ISO, a 3,500 gpm fire flow with a 3-hour duration has been set as the design fire flow for the City, as discussed in Chapter 2. A total of 630,000 gallons of fire reserve storage is needed to sustain a fire flow of 3,500 gpm for a 3-hour duration.

### *Emergency Reserve*

Emergency storage is usually provided for a minimum of one to three days' supply in the event of a power outage, mechanical problems, or other problems that would interrupt the reliable supply of water. In most cases, this would be the minimum amount of time to repair or replace a well pump or other equipment. Generally, the City has emergency power supply provisions to operate wells in the event of a power outage and would be less reliant on reserves should a power outage occur. Currently, to serve the City for one day of emergency reserve at the average daily demand, 1,559,726 gallons would be needed. This amount would increase to 2,489,127 gallons in the year 2037.

The City's water storage reservoirs provide the operating storage, equalization storage, fire reserve, and emergency reserve for the existing pressure zones. Not all pressure zones are tied to a specific reservoir. For example, the Valley pressure zone can receive water from the Ochoco Heights reservoirs, the Airport reservoirs (through a pressure reducing valve [PRV]), and the Barnes Butte Reservoir (through PRVs). To evaluate overall system performance, an Existing System Peak Day Extended Period Analysis was completed, modeling the existing system at peak day conditions over time. A diurnal demand pattern was applied to the PDD to account for demand fluctuations over a typical day. This analysis shows the level of the individual reservoirs (by percent full values) over a 2-day period. No issues were observed with the Airport reservoirs (No. 1 and No. 2) or the American Pine Reservoir. The Ochoco Heights reservoirs (No. 1 and No. 2) drain to roughly 50 to 55 percent full, but recover to over 75 percent full. The supply to the Barnes Butte Reservoir is unable to keep up with an expanded PDD, as little recovery is observed. The Existing System Peak Day Extended Period Analysis is provided in Appendix J.

## Storage Components Summary

Regarding all four of the storage components discussed previously, the current storage of 4.5 MG is adequate to meet current demands and 2037 demands. However, additional storage capacity and upgrades to current storage facilities are recommended to meet future operational needs for the City.

### *Future Growth*

Anticipated future growth in the northeast portion of Prineville (on the southerly flank of Barnes Butte) may occur in areas that cannot be served by the current water system pressure levels. The ground elevation rises above the elevations that can be served by the Williamson and Ochoco Heights pressure zones. Establishing two new pressure zones to provide adequate system pressures for future development on the southerly flank of Barnes Butte is recommended. It is further recommended to construct an additional reservoir to supply the new pressure zones with necessary operation, equalization, fire reserve, and emergency reserve storage.

### *Operation and Maintenance*

As noted previously in this chapter, the City of Prineville has conducted periodic inspections of its reservoirs. These inspections indicate the conditions of the Ochoco Reservoirs No. 1 and 2 are deteriorating and require maintenance. The recommended maintenance requires the draining of a tank, sand-blasting, and re-coating of both the interior and exterior surfaces. To achieve the best results, this work should be completed in the summer months. The downside is that the summer months have the greatest water usage. An Existing System Peak Day Extended Period Analysis was modeled to evaluate the draindown and recovery cycle of the current reservoirs. This showed the Ochoco Reservoirs No. 1 and 2 operating as one storage vessel and dipping to just above 55 percent full during the study time.

Due to the modeled conditions, removal of one of the Ochoco Heights reservoirs from the system to complete the recommended maintenance operations is not recommended. A new 1.5 MG reservoir is recommended to be constructed alongside the existing reservoirs. Once this is constructed and in operation, one of the existing 0.5 MG reservoirs can be taken out of service to complete renovations and repairs. Upon completion of the rehabilitation, the reservoir would work in conjunction with the new reservoir, providing a total of 2.0 MG storage at the site. The second 0.5 MG reservoir would be decommissioned.

### *Cost Estimates*

The anticipated cost to construct a new 1.5 MG reservoir, rehabilitate one of the existing 0.5 MG reservoirs, and decommission the second existing 0.5 MG reservoir is $2,039,200 (2017 cost). These improvements are anticipated to be included on the City's Capital Improvement Project list. The anticipated cost for a new 1.0 MG reservoir to serve new pressure levels in northeast Prineville is $1,955,000. System development charges (SDC) are anticipated to help pay for this construction, as it will serve future growth. Further discussion regarding capital improvement projects, SDC, and detailed breakdowns of estimated costs is provided in Chapter 6.

## Summary

The City currently has six operating storage reservoirs, with a total volume of 4.5 MG. With the exception of the Ochoco Heights reservoirs, the existing condition of these reservoirs is generally good to very good. The storage needed for the 2037 planning period is provided by the existing reservoirs. However, maintenance and rehabilitation improvements are recommended for the Ochoco Heights reservoirs. Anticipated future growth in northeast Prineville will require the addition of two new water system pressure zones. A new reservoir is recommended to be constructed with the growth in this area to provide adequate system pressures and fire protection. The lower of the two new pressure zones would be served by gravity flows from the new reservoir. A booster pump station would be necessary to provide adequate pressures to the upper pressure level from the new reservoir.

Due to the logistics and coordination to provide needed maintenance of the existing Ochoco Heights reservoirs a new, larger reservoir is recommended to be constructed at the site. This would enable the existing reservoirs to continue to serve the system as the new reservoir is constructed. Once in operation, the new reservoir could then serve the system as one of the existing reservoirs is repaired and the other is removed. Upon completion, a more reliable and easier to maintain system would be in place.

# Chapter 5 - Distribution System

## Introduction

This chapter discusses the City's existing water distribution system that delivers water to residential and commercial users. Components of the distribution system include pipelines, valves, booster pump stations, water meters, water service lines, and fire hydrants. The distribution system has been evaluated for both present and future City needs. Improvements have been developed to address existing identified deficiencies and provide future service to help meet both Oregon Health Authority - Drinking Water Services (DWS) requirements and Oregon Fire Code (OFC) fire flow requirements.

## Existing System

The City's distribution system main lines are composed of several types of pipe including steel, asbestos cement (AC), ductile iron (DI), wood stave, and polyvinyl chloride (PVC).

The existing distribution system layout, including fire hydrant locations and pipe size and locations, is shown on the Existing Water System Map included at the end of this Water System Master Plan (WSMP). Available resources were utilized to make the map as accurate as possible. There may be inaccuracies in the depiction of the water distribution system layout, and the possibility exists that water distribution system lines and other features are present at locations not shown on the map or are not positioned as shown. The Existing Water System Map has been prepared electronically. If distribution system main lines or other system features are added in the future, the map can easily be updated as the improvements occur so the City always has the most accurate map available for City staff use.

The existing distribution system map developed as part of this WSMP shows that approximately 91 percent of the distribution system piping is composed of 6-inch or larger diameter pipes. The remaining 9 percent are 4-inch or less diameter pipes. The 4-inch diameter or less pipes limit hydraulic capacity and are too small to support fire hydrants.

In general, the distribution system is fairly well looped. There are some dead-end and/or undersized main lines. This can limit capacity and water circulation in the system. These areas are discussed in more detail later in this chapter.

The City has indicated that most water main lines in the distribution system are generally in good condition. However, the existing wood stave lines in the system are recommended to be replaced.

## Booster Pump Stations

The Prineville water system includes two major booster pump stations that boost system pressure to areas that cannot be served adequately by gravity. There are no known deficiencies with these booster pump stations. The booster pump stations appear to be sized appropriately for the current demand. The American Pine booster pump station is a 2,500 gallons per minute (gpm) pump station, which is generally adequate to provide fire flows for the majority of this predominately residential service area. The Ochoco Heights booster pump station has a capacity of 1,500 gpm, which provides adequate fire flow for the majority of the residential service area. There are other limitations due to small diameter mains within the Ochoco Heights pressure zone that limit fire flow for isolated areas of this zone.

The Airport pressure zone also includes a separate booster pump station for the purposes of boosting pressure to provide adequate fire flows within this zone, due to pipe size restriction at the Highway 126 crossing. Fire flow tests performed by City staff indicate the booster pump station is not performing as intended.

Pressure reducing valves (PRV) are currently located on the discharge side of both the American Pine and Ochoco Heights booster pump stations to regulate pressure. Equipping these booster pump stations with variable speed drives would allow the booster pump stations to change speed based on demand conditions to keep the desired downstream pressure constant.

**TABLE 5-1**
**SUMMARY OF BOOSTER PUMP STATIONS**

| Booster Pump Station | Flow | Emergency Backup (Y/N) |
|---|---|---|
| Airport Booster Pump Station | 4,000 gpm | Y |
| American Pine Booster Pump Station | Two domestic pumps at 250 gpm each | |
| | Two fire flow pumps at 1,000 gpm each | |
| Ochoco Heights Booster Pump Station | Three pumps at 200, 400, and 900 gpm, respectively | |

## Water Meters

All services within the City's system are metered. The City is currently in the process of replacing all of its residential meters with automatic reading (AMR) meters. City staff monitors and tests meters monthly for no or atypical reads and repairs or replaces as necessary.

## Water Loss

The City is currently implementing several water management and conservation measures, including conducting annual water audits; replacing residential meters with AMR meters, including software to improve leak detection; utilizing a computerized bulk water station to more accurately track bulk water consumption; continuing to replace old, deteriorating distribution piping; encouraging conservation efforts through education programs; and providing free conservation items to water customers.

The City should continue to encourage water conservation through the measures described above along with continued investigation of other reuse, recycling, and non-potable water use opportunities. In addition, the City should continue to encourage other high water use facilities to develop and implement their own internal water conservation plans.

## Distribution System Pressure

As discussed in Chapter 4, the City has six pressure zones serving the distribution system, with system pressures provided by the elevation of the reservoirs or by booster pump stations for areas of the system that cannot be served by gravity. A summary of the pressure zones is included on Table 5-2.

**TABLE 5-2**
**SUMMARY OF PRESSURE ZONES**

| Pressure Zone | Ground Elevation Currently Served (feet)* | | Hydraulic Control Element | HGL (ft.) (Tank Full or PRV Setting) | Static Pressure (psi) | |
|---|---|---|---|---|---|---|
| | Highest | Lowest | | | Low | High |
| Valley | 2,918 | 2,846 | Ochoco Heights Reservoirs | 2,987 (Tank Full) | 30 | 61 |
| Barnes Butte | 2,981 | 2,906 | Barnes Butte Reservoir | 3,104 (Tank Full) | 53 | 86 |
| Williamson | 3,029 | 2,884 | Williamson PRV | 3,097 (82 psi) | 30 | 92 |
| | | | | 3,060 (66 psi) | 13 | 76 |
| Ochoco Heights | 2,961 | 2,885 | Ochoco Heights booster pump station with PRV | 3,120 (80 psi) | 69 | 102 |
| Northridge | 3,056 | 2,922 | American Pine Reservoir booster pump station with PRV | 3,136 (80 psi) | 35 | 93 |
| Airport | 3,288 | 3,025 | Airport Reservoirs | 3,404 (Tank Full) | 50 | 164 |

**Service elevations do not include locations in the immediate vicinity of tanks, PRVs, or booster pump stations.*

*HGL = hydraulic grade line*

*psi = pounds per square inch*

According to the hydraulic model completed as part of this WSMP, the normal operating pressures in the system during 2017 peak daily demand (PDD) range from approximately 11 to 184 psi, as depicted on Figure 5-1. With the exception of a few isolated areas, the City generally has adequate pressure throughout the system. It should be noted that portions of the system provide pressures in excess of what is typically recommended for residential fixtures, appliances, etc. The City should maintain an educational program to ensure people are aware that PRVs need to be installed on individual services. System pressures are discussed in more detail later in this chapter.

## Fire Protection

### General

The City's existing water supply, storage, and distribution system provides adequate fire protection to the majority of the system, although certain areas of the City do not have adequate fire protection. DWS regulations and the 2014 OFC require the entire water system remain above 20 psi residual pressure while fire flow demands are placed on the system. The City generally has adequate pressure in the system during fire flow events but has a few isolated areas that do not provide adequate pressures and/or the recommended fire flows discussed in Chapter 2. A computer model of system fire flows, along with recommended improvements to address the deficiencies in fire flows, is discussed in more detail later in this chapter.

### Fire Hydrant Flow Tests

For this WSMP, the City completed flow tests on several fire hydrants in the distribution system to calibrate the water model. The flow and pressure data gathered during the flow tests were used to compare water model pressures to data collected in the field and, if necessary, to adjust the model input data so the model more closely resembled the field results. Based on the hydrants tested as part of the hydrant flushing plan, fire flows ranged from approximately 670 to 920 gpm with residual pressures of 42 to 82 psi at nearby hydrants. These flows are the measured flows observed during flow tests. Higher fire flows may be available if more than one hydrant was tested at a time and system pressures were allowed to drop further.

### *Theoretical Fire Flows*

In some cases the available flow from a fire hydrant is calculated using a theoretical formula. The formula assumes the water supply "feeding" the tested area is generally not limited and the 20 psi residual pressure resulting from the fire flow occurs where the hydrants are being tested. In reality, there are likely other connections in the distribution system, such as users in the City on small-diameter main lines or at higher elevation areas that would fall below 20 psi sooner than the formula predicts. Considering this, the theoretical formula can overestimate available fire flows at 20 psi. The hydraulic computer modeling completed as part of this WSMP, as discussed later in this chapter, should present more accurate available fire flows.

### *Fire Hydrant Limitations*

The fire flow tests completed by the City are generally conducted by opening one fire hydrant at a time. If large enough main lines are present, individual fire hydrants can typically provide flows in the range of 800 to 1,200 gpm from a small port and nearly 2,000 gpm from both small ports and the larger "pumper" port, assuming the hydrant has a large port. During a fire there will be some water use from others on the system, so the actual available flow out in the distribution system will be less due to other uses and pipeline pressure losses resulting from higher flows.

Generally, the City's water system provides adequate fire flows. The discussion presented herein is intended to provide caution concerning the actual available fire flows from the City's distribution system and fire hydrants. Considering the limitations previously discussed, the City's water system appears limited in its capacity to meet a fire flow of 1,000 to 2,500 gpm in a few areas of the City. System improvements are needed to provide the recommended fire flows of 1,000 gpm for residential areas and 3,500 gpm for commercial areas while maintaining 20 psi in the system.

### *Fire Hydrant Coverage*

The OFC outlines maximum recommended fire hydrant spacing depending on several factors, such as fire flow requirements of the area, the number of fire hydrants in the area, if the area is on a dead-end street or has limited access, etc. As required by the 2014 OFC, the maximum spacing between any two hydrants for a fire flow requirement of 1,750 gpm or less is 500 feet, and as little as 350 feet for a fire flow requirement of 3,500 to 4,000 gpm. The maximum required distance from any point of a street or road frontage to a hydrant is 250 feet for 1,750 gpm or less and 210 feet for 3,500 to 4,000 gpm.

The spacing of the City's existing hydrants was analyzed to identify areas not covered in accordance with the maximum spacing and frontage distance to a fire hydrant.

To assist with the fire hydrant spacing analysis, a Fire Hydrant Coverage Map, as depicted on Figure 5-2, showing existing fire hydrants was prepared. In preparing the Fire Hydrant Coverage Map, the Existing Water System Map was utilized by placing 450-foot diameter circles around each existing hydrant. On the map, existing fire hydrant coverage areas are shown in green.

Areas with limited fire hydrant coverage become readily apparent on the map. It is assumed that additional hydrants will be installed along with other required utilities within developed areas not currently served by the City's distribution system and within undeveloped areas when these areas are either connected to the system or developed.

This analysis was completed for general compliance to average recommended spacing and frontage distance to a hydrant. The City may wish to modify these requirements, depending on the fire flow demands of a particular area, as recommended by the City's fire chief. This analysis is intended to provide the City with a basic idea of areas lacking fire coverage. It is recommended the City install fire hydrants in areas needing improved coverage as part of an improvements project. All fire hydrant installations should be reviewed and approved by the City's fire chief.

## Water System Modeling

### *General*

As part of this WSMP, a detailed water model of the City's water system was developed to analyze system pressures, hydraulic capacity, and available fire flows from the City's fire hydrants. A general description and the results of each computer run performed for both the existing and improved water systems are described herein.

The City's existing water distribution system model contains all existing piping and water system elements. Pipe, node, and feature elements are labeled according to the City's naming convention. As part of this WSMP, the existing hydraulic model was reviewed, updated, and calibrated to match current waster system demand and operation. Elevations at the locations of water system features such as reservoirs, pipe connections, wells, hydrants, etc., were obtained from an elevation contour map developed utilizing the Natural Resources Conservation Service LiDAR Elevation Dataset Bare Earth Digital Elevation Model.

The computer model evaluates pressure and flows in the distribution system during a simulated water use demand. Available fire flows are then determined during the PDD. Typical water system demands used for the computer model include the average daily demand (ADD) and the PDD previously discussed in Chapter 2.

The computer model also utilizes detailed information about the distribution system pipes. Each individual pipe was assigned a roughness coefficient based on the type of pipe material, such as PVC, DI, AC, steel, etc. This allowed the water model program to calculate water main line pressure losses under any demand condition desired, including fire flow analyses. Junctions were identified in the water model, which allowed the model to know where and at what elevation pipe intersections occur. Water demands can then be placed on the distribution system at each junction (node) to simulate ADD or PDD use demands.

## *Model Overview*

The hydraulic model of the City's water distribution system was developed utilizing the InfoWater modeling system by Innovyze. Demand scenarios for years 2017 and 2037 were derived from the design criteria presented in Chapter 2. Fire flow test data, provided by the City, were used to check the accuracy and calibrate the computer model compared to field conditions. The model was calibrated by adjusting pipe roughness coefficients to simulate available flows and system pressures similar to those reported in the City's fire hydrant tests, where possible. The discrepancies between the model and system conditions in the field could be due to incorrect pipe sizes, missing pipe connections, or other field conditions. In general, the model depicts the existing system conditions relatively well based on the majority of the available hydrant test data.

A water model run provides distribution system pipe flows and junction pressure under a given demand on the system. To represent current conditions, the year 2017 water system demands were selected and distributed among the junctions in the distribution system based on water meter usage records. To represent future conditions in year 2037, demands were added for existing properties within the City not currently connected to the City water system. Demands were also added to account for future growth areas within the urban growth boundary (UGB). Growth areas were identified and demands generated for each area based on whether the area is currently developed or undeveloped. Demands were estimated for developed areas based on the existing number of lots within each area. Demands were estimated for undeveloped areas based on anticipated zoning designations and full build-out development densities. Full build-out densities were proportionally reduced to match the 2037 design criteria presented in Chapter 2. The ground elevation of each growth area was also evaluated to determine which pressures zone the area could most reasonably connect to. The demand conditions used in modeling the system are as follows:

- Year 2017 PDD. The current PDD for the City of Prineville is estimated to be 405 gallons per capita per day (gpcd), or 2,500 gpm, at the current connected population of 8,889.
- Year 2037 PDD. The future PDD for the City of Prineville is estimated to be 487 gpcd, or 3,977 gpm, at a future connected population of 11,752.

The existing system pressures under the 2017 PDD demand scenario are presented on Figure 5-1. As shown on the figure, the system has a few areas with pressures below 35 psi. Improvements are required to provide additional pressure to the system. As previously discussed, portions of the system provide pressures in excess of what is typically recommended for residential fixtures, appliances, etc. In areas with the higher than average pressure provided by the system, the City should continue to inform citizens of the high pressures and ensure that individual PRVs are installed on service lines.

Figure 5-3 presents the fire flow available in the existing system under the 2017 PDD. As discussed previously, fire flow capacity of 1,000 gpm is required in residential areas and approximately 3,500 gpm is required in commercial and institutional areas, as recommended by Insurance Services Office, Inc., and according to OFC. Figure 5-4 identifies the areas in the system not capable of providing adequate fire flow and areas with low system pressure. The northeast portion and higher elevation areas of the City are largely unable to provide adequate fire flows to the residential and commercial areas. The deficiencies are due in part to small diameter (less than 6-inch) pipelines in the system, higher elevation areas not adequately served by existing pressure zones, and inability of the existing system to distribute the existing supply. The majority of the City's water supply is located in the Airport pressure zone. Water from this zone currently has only one way to feed into the lower Valley zone through an existing 8-inch diameter pipeline and PRV. The amount of water this line can deliver is limited. With flows limited from the Airport zone, the Barnes Butte and Williamson zones must meet the supply. As flows increase from the Barnes Butte zone, the system in unable to maintain adequate pressure and fire flow availability is limited.

### *Limitations of Water Model Results*

Reported fire flows from the water model analysis indicate theoretical distribution system piping capacity. Actual field conditions and head loss in fire hydrants may reduce fire flows beyond what is indicated. Individual fire hydrants generally also have a maximum capacity of 1,000 to 1,500 gpm, so multiple hydrants may need to be operated to attain the flows indicated in the model.

## Undersized Main Lines

Many cities have adopted minimum water main line size standards requiring at least 6-inch diameter and, often, 8-inch diameter be installed when a fire hydrant is required. The significant capacity advantages of an 8-inch diameter main line compared to a 6-inch line normally outweigh the small additional cost to install an 8-inch line.

For the purpose of this WSMP, undersized mains have been identified as those mains that do not allow the fire demand and minimum pressure criteria shown on Figure 2-3 in Chapter 2 to be met. There are approximately 34,400 feet of small diameter (less than 6-inch) pipelines within the City's distribution system.

In addition to these undersized main lines, physical restraints such as higher elevation areas in the City result in a few low system pressure areas within the distribution system.

## Recommended Distribution System Improvements

In general, the City's distribution system is fairly well looped and provides adequate system-wide pressures under normal operating conditions. Fire flow availability is limited in areas of the system due to several undersized main lines and areas of higher elevation. The undersized main lines in the system result in fire flow capacity limitations and water circulation issues. Some of these lines have been recommended for upgrading where improved fire flow capacities are needed. It is recommended the City complete improvements to the distribution system to eliminate as many undersized main lines as possible and provide improved system fire flow capacities in areas lacking adequate fire flows. Key water system improvements have been identified to meet the following objectives:

1. Improve system supply and storage.

    a. Install an extension and PRV from the Airport pressure zone that connects into the Valley pressure zone. This improvement is being funded by a private entity and would greatly improve flows throughout the system. The new extension will provide a second distribution option as a means to deliver Airport well water into the Valley zone. This improvement will eliminate stress on the existing 8-inch line, provide redundancy, and free up the Barnes Butte supplies to serve future growth.

   b. Construct a future infiltration gallery and water treatment plant at the south end of town.

   c. Construct a new transmission main, booster pump station, and reservoir to serve the northeast portion of Prineville. In addition to serving growth in northeast Prineville, this improvement will also eliminate some of the low pressure problems currently experienced in the system due to high elevations. This improvement would also offer a source of redundant supply to the Northridge pressure zone.

2. Improve water quality and circulation by replacing old, undersized, deteriorating pipe. Increase flow capacity to the existing system to provide adequate fire flows to residential, commercial, and industrial areas.

   a. Replace existing small diameter or wood stave water pipes. Upsize water pipes in key locations to increase fire flow.

   b. Connect existing homes in the vicinity of Fairview Street to City water.

3. Improve the system to serve future growth.

   a. Construct future mains and booster pump stations to serve growth within the UGB.

The recommended water system improvements are shown on Figure 5-5. The future conditions water model incorporates the recommended improvements and future growth areas and demands. Figure 5-6 depicts the year 2037 PDD system flows and pressures. System pressures are adequate with the recommended improvements and many of the isolated low pressure areas under existing conditions have been eliminated. Areas of marginal pressure (35 to 45 psi) in the Valley pressure zone are also improved. All tanks are filling under peak day conditions, indicating the system has adequate supply. One exception is the American Pine Reservoir, which is draining under peak day conditions. The Ochoco Heights booster pump station may need to be upsized to keep the American Pine Reservoir full under future conditions. Additionally, the American Pine booster pump station is operating at approximately 600 gpm under the future peak day scenario. The existing capacity of the American Pine domestic pumps is 500 gpm. The American Pine booster pump station will need to be upsized to account for future demands.

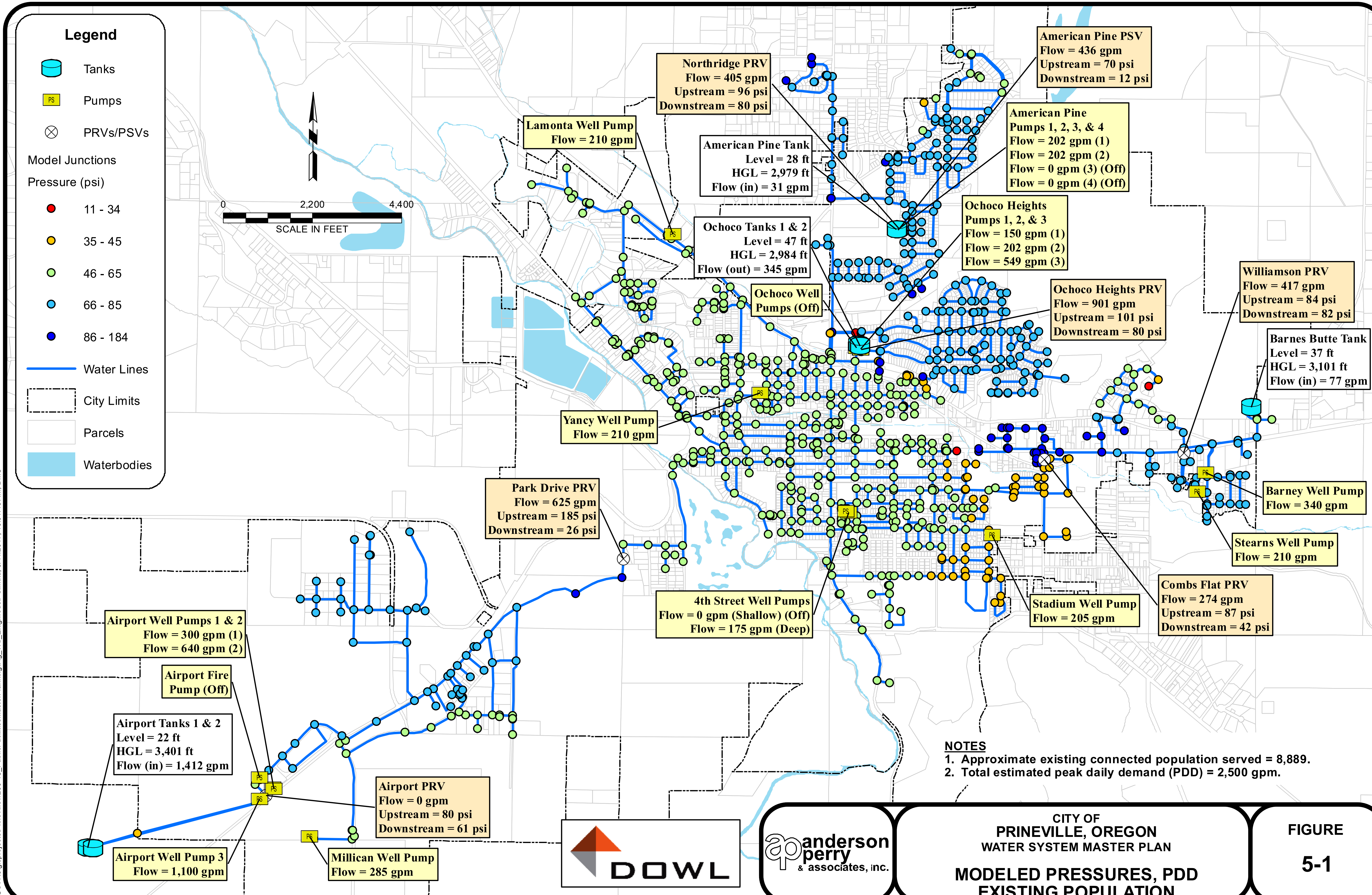
Figure 5-7 depicts the year 2037 available fire flows. With the recommended water system improvements, fire flow availability is generally adequate under future 2037 conditions. The recommended improvements are prioritized and further discussed, including detailed breakdowns of estimated costs, as part of the Capital Improvements Plan presented in Chapter 6.

## Maintenance Records

One of the important operational functions regarding the City's distribution system is accurate records of various system components. These records become valuable over time in planning future improvements and replacing old or deteriorated components. It is recommended the City continue to track and keep accurate records on all distribution system components. The City should continue monitoring residential meters monthly, test compound meters annually, check hydrants annually for proper operation, and exercise all water valves annually, with records kept on their operating condition, location, etc.

## Summary

In general, the City's distribution piping system is in relatively good condition, although a few isolated areas cannot currently provide adequate fire flow. Undersized and old distribution system piping within the City lead to low fire flow capacity and issues with water circulation in these areas. Improvements outlined in this chapter include replacing old, undersized, and deteriorating lines; and additional distribution piping to improve system looping, circulation, and fire flow capacities. These improvements were selected to address key areas of concern to improve fire flow capacity in the system. These recommended improvements are prioritized and further discussed, including detailed breakdowns of estimated costs, as part of the Capital Improvements Plan presented in Chapter 6.




NOTES
1. Approximate existing connected population served = 8,889.
2. Total estimated peak daily demand (PDD) = 2,500 gpm.

CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

MODELED PRESSURES, PDD
EXISTING POPULATION

FIGURE
5-1

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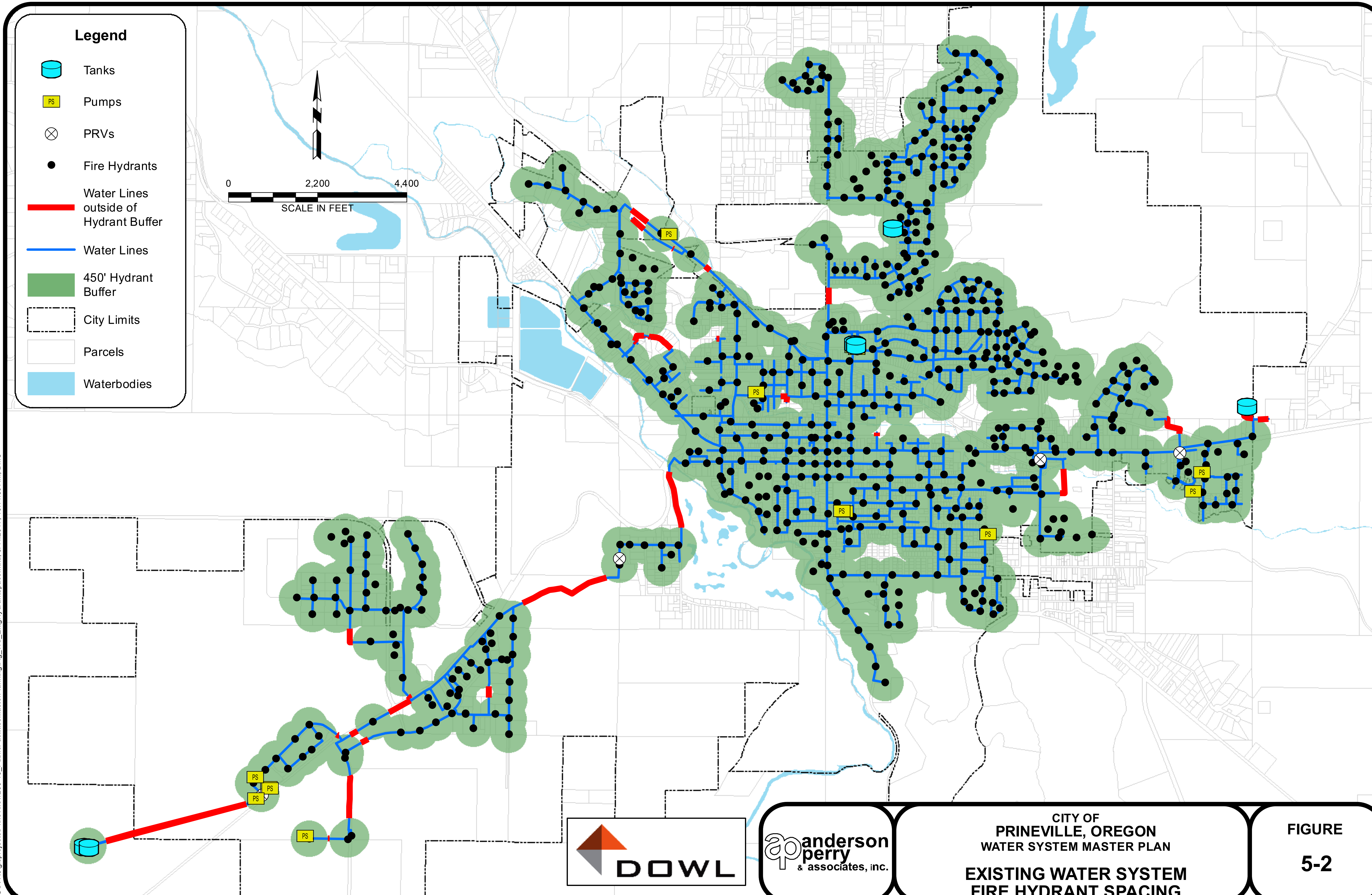


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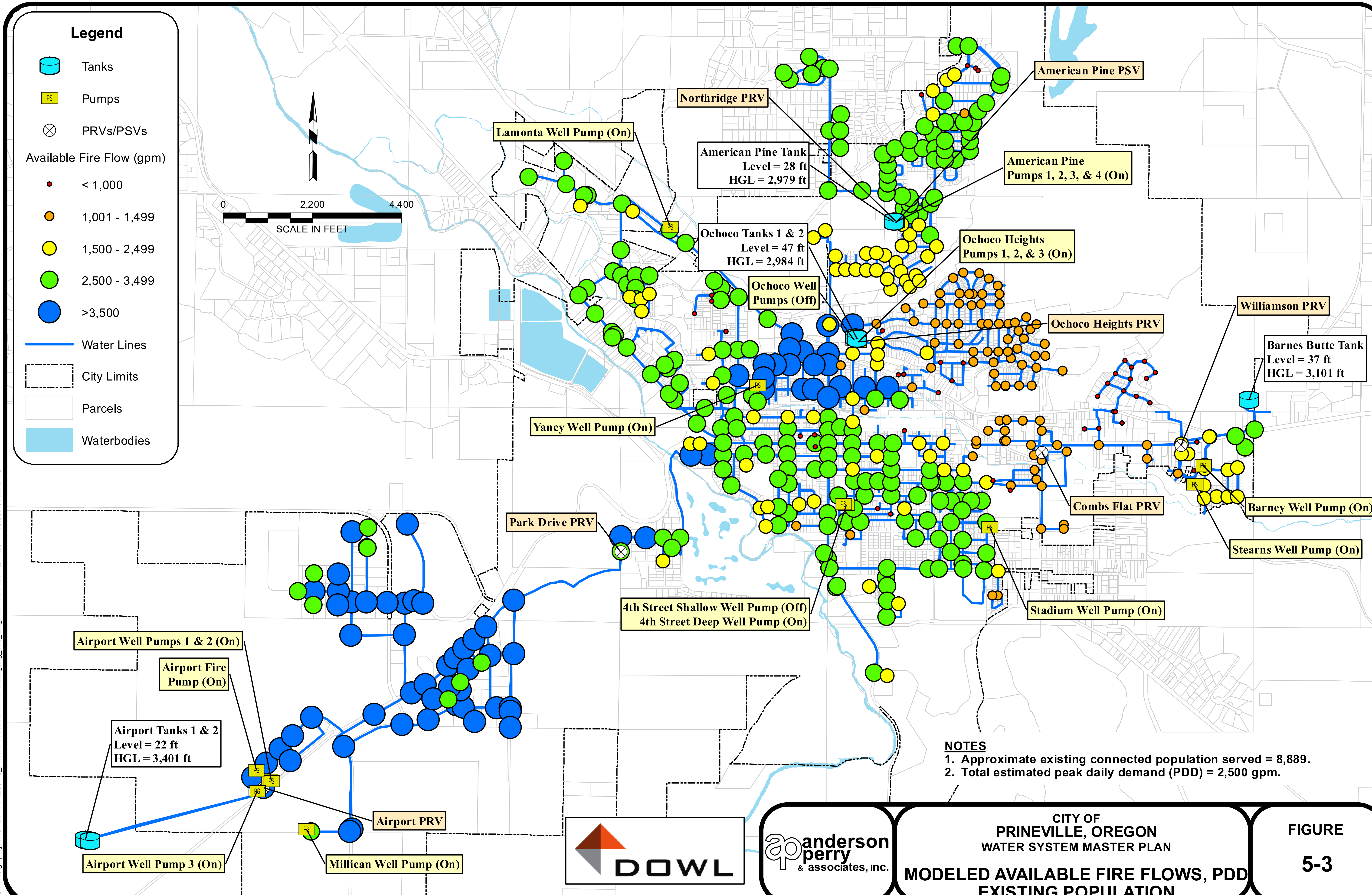


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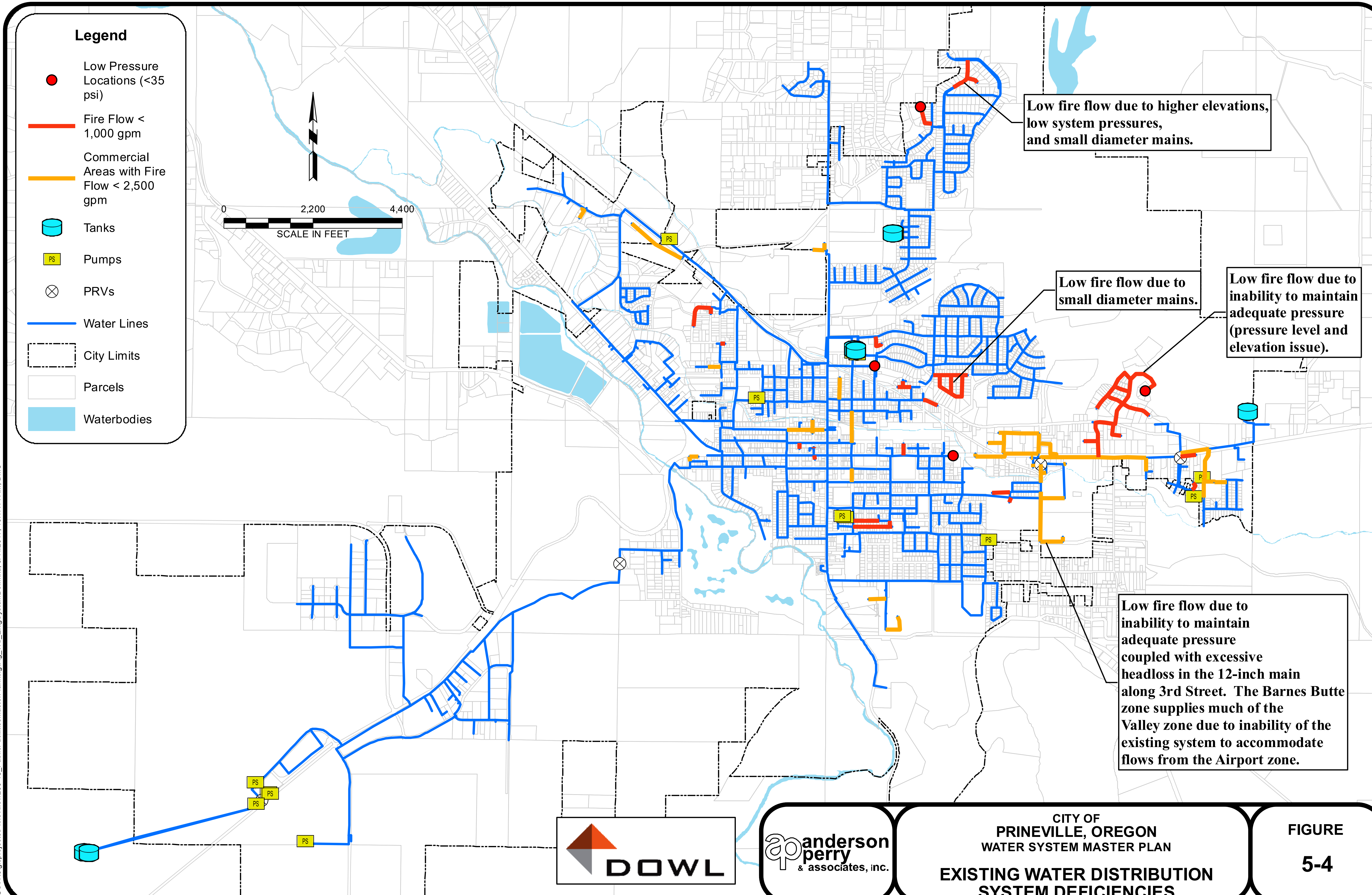
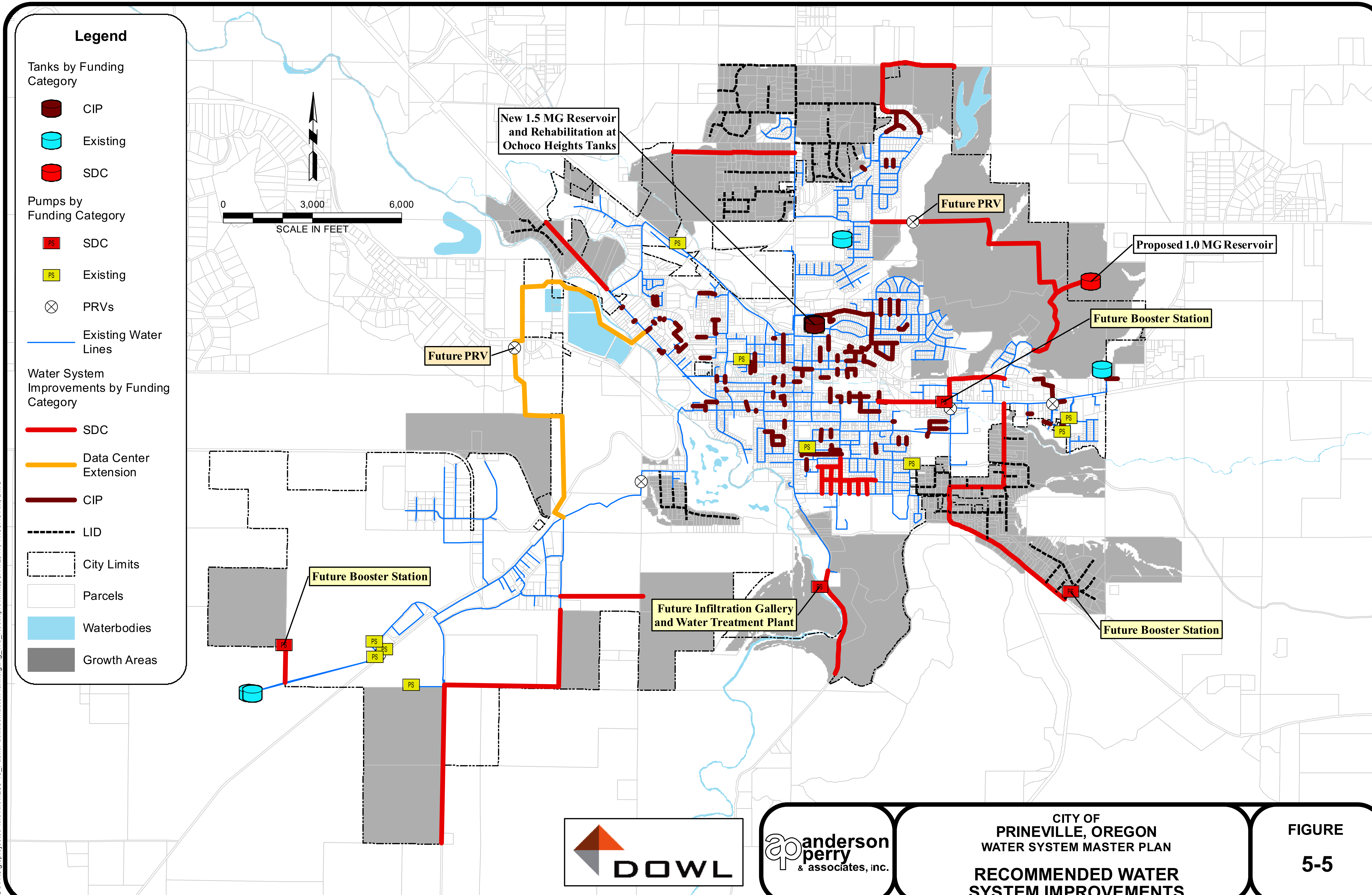



CITY OF PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

EXISTING WATER DISTRIBUTION SYSTEM DEFICIENCIES

FIGURE 5-4

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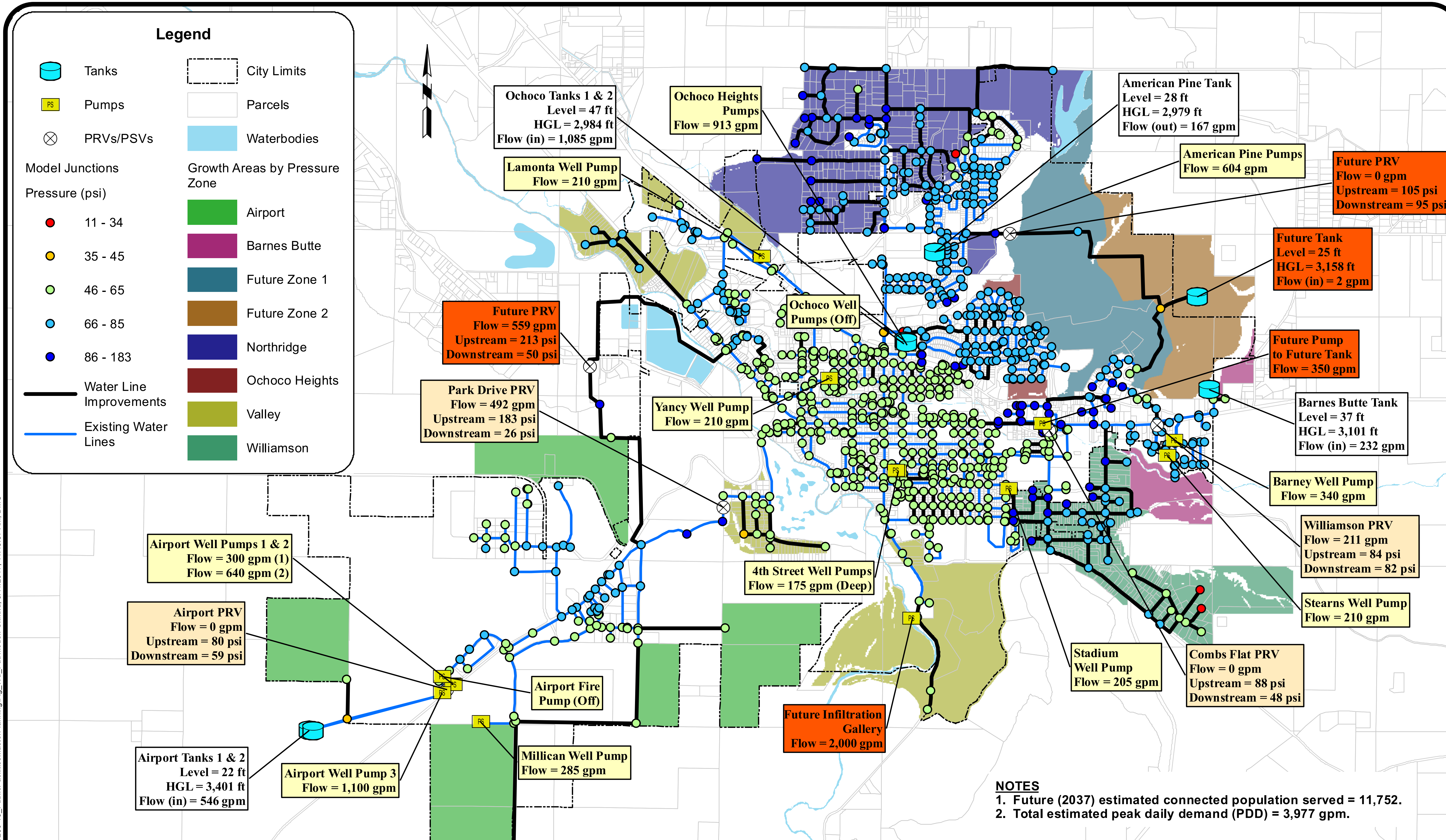


NOTES
1. Future (2037) estimated connected population served = 11,752.
2. Total estimated peak daily demand (PDD) = 3,977 gpm.

DOWL

anderson perry & associates, inc.

CITY OF
PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

MODELED FUTURE PRESSURES, PDD WITH IMPROVEMENTS

FIGURE
5-6

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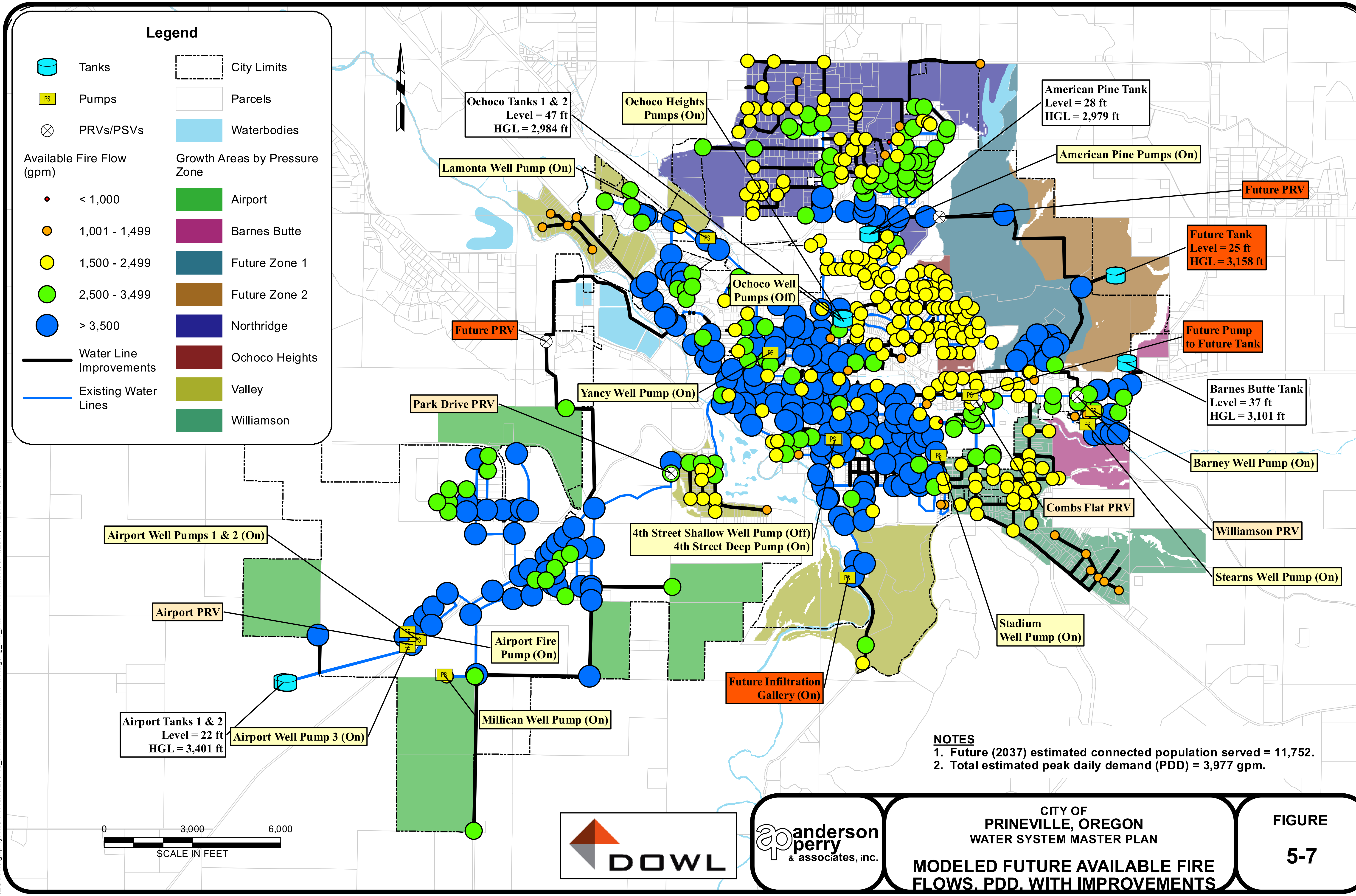


NOTES
1. Future (2037) estimated connected population served = 11,752.
2. Total estimated peak daily demand (PDD) = 3,977 gpm.

CITY OF PRINEVILLE, OREGON
WATER SYSTEM MASTER PLAN

MODELED FUTURE AVAILABLE FIRE FLOWS, PDD, WITH IMPROVEMENTS

FIGURE 5-7

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# Chapter 6 - Proposed Improvements

***This chapter will be completed after review from City staff.***

# Chapter 7 - Project Financing and Implementation

## Introduction

This chapter briefly outlines alternatives for financing the City's water system improvements. A summary of state and federal funding programs is presented, including a review of funding options potentially available to the City for the water system improvements. To construct some or all of the proposed improvements, a financing plan acceptable to the City of Prineville must be developed to complete the improvements. Because of the estimated cost of the improvements, it is recommended that the City pursue financing resources including a low interest loan coupled with grant funds, if available.

A detailed analysis of the City's current water rate structure was completed as part of the City's master planning process. Some discussion of the existing rate structure and how it affects the City's eligibility for certain funding programs is included. Refer to the Water Rate Study for a comprehensive evaluation of water rate options to fund the selected water system improvements while maintaining adequate revenue to support operation and maintenance (O&M) and other system expenditures.

## Current Water Use Rates and Revenue

The O&M of the existing water system is financed through the City's annual budget. The City's fund includes expenses and revenues the water system. Revenue is obtained from water user customer billings and connection fees.

### *Water Use Rates*

The current base water rate per month for residential services inside the city limits is $18.26 plus $1.90 per unit of consumption. Each unit is 750 gallons or 100 cubic feet. The base water rate per month for commercial services inside city limits is dependent on meter size, starting at $27.81 for a 3/4-inch meter up to $698.84 for a 6-inch meter. The commercial base rate includes a base volume of usage varying by meter size. After the base usage is surpassed, there is a consumption charge of $1.90 per unit. The current commercial monthly water rates are summarized on Table 7-1. Refer to the Water Rate Study for more detailed information pertaining to water rates.

**TABLE 7-1**
**2017 COMMERCIAL WATER RATE INFORMATION**

| Meter Size | Units Included | Base Rate Per Month | Water Usage Rate (per 750 gallons/ 100 cubic feet) |
|---|---|---|---|
| 3/4- inch | 14 | $27.81 | $1.90 |
| 1-inch | 17 | $34.15 | $1.90 |
| 1-1/2-inch | 42 | $80.22 | $1.90 |
| 2-inch | 62 | $119.14 | $1.90 |
| 3-inch | 116 | $373.27 | $1.90 |
| 4-inch | 196 | $336.00 | $1.90 |

| Meter Size | Units Included | Base Rate Per Month | Water Usage Rate (per 750 gallons/ 100 cubic feet) |
|---|---|---|---|
| 6-inch | 367 | $698.84 | $1.90 |

## Water System Improvements Funding

To complete the water system improvements discussed in Chapter 6, the City may choose to obtain outside funding assistance. A number of state and federal grant and loan programs can provide assistance on municipal improvement projects to utility districts, cities, and counties. These programs offer various levels of funding aimed at different types of projects. These include programs administered by the U.S. Department of Agriculture Rural Development (RD), the U.S. Economic Development Administration (EDA), the Oregon Business Development Department - Infrastructure Finance Authority (IFA), and others.

These agencies can provide low interest loan funding and possibly grant funding for assisting rural communities on public works projects. Some of the funding programs provide funding only if the improvements address documented water quality compliance issues. A summary of potential funding programs follows.

## Summary of Potential Funding Programs

The following section briefly summarizes the primary funding programs available to assist the City with a water system improvements project. Most of these agencies will require an increase in water rates to support a loan for water system improvements both as a condition of receiving monies and prior to being considered for grant funds. It should be noted that the monthly user rates discussed in this section can represent a combination of monthly usage fees and taxes.

### *Federal Grant and Loan Programs*

#### Rural Development

This agency can provide financial assistance to communities with a population under 10,000 through both loans and direct grants. Under the loan program, the agency purchases local bonds. The interest rate for these bonds is dependent on the median household income (MHI) of the community and other factors and varies from year to year based on other economic factors nationally. The fixed interest rate varies, but is generally approximately 3.0 to 4.0 percent with a repayment period of up to 40 years. Applying for this type of funding is a fairly lengthy process involving development of an environmental report and a detailed funding application.

The agency presently requires communities to establish average residential user costs in the range of similar systems with similar demographics before the community qualifies for grant funds. It should be noted that loans without grant funds may be acquired from RD that may not require rates to reach this level, depending on the results of an RD funding analysis. The user costs must provide sufficient revenue to pay for all system OM&R costs and pay for the local debt service incurred as a result of the project. All project costs above this level may be paid for by grant funds, up to given limits, which are usually not more than 45 percent of the total project cost. The objective of the RD loan/grant program is to keep the cost for utilities in small, rural communities at a level similar to what other communities are paying.

Another of the agency's requirements is that loan recipients establish a reserve fund of 10 percent of the bond repayment during the first 10 years of the project, which can make the net interest rate higher if such a reserve does not already exist. The RD program requires either revenue or general obligation bonds to be established through the agency for the project (refer to the Local Financing Options section of this chapter for further discussion). These bonds can usually be purchased for a period of 40 years if desired. A combination loan and grant from RD may be an option for the City to implement water system improvements.

### U.S. Economic Development Administration

The EDA has grant and loan funds similar to those available through the IFA's Special Public Works Fund (SPWF) program. Monies are available to public agencies to fund projects that stimulate the economy of an area, and the overall goal of the program is to create or retain jobs. The EDA has invested a great deal of money in Oregon to fund public works improvement projects in areas where new industries were locating or planned to locate in the future. In addition, the agency has a program known as the Public Works Impact Program to fund projects in areas with extremely high rates of unemployment. This program is targeted toward creating additional jobs and reducing the unemployment rate in the area. If the City's water system improvements can be linked directly to industrial expansion or job retention, the City would be in a competitive position to receive funding under these EDA programs.

## *State Grant and Loan Programs*

### Oregon Business Development Department - Infrastructure Finance Authority Safe Drinking Water Revolving Loan Fund

This is primarily a loan program for the construction and/or improvement of public and private water systems to address regulatory compliance issues. This is accomplished through two separate programs: the Safe Drinking Water Revolving Loan Fund (SDWRLF) for collection, treatment, distribution, and related infrastructure, and the Drinking Water Protection Loan Fund for protection of sources of drinking water prior to system intake. The SDWRLF program normally lends up to $6 million per project. Loan amounts greater than $6 million may be approved by the IFA Board. The standard SDWRLF loan term is 20 years or the useful life of project assets, whichever is less. Loan terms up to 30 years may be available for "disadvantaged communities." This program offers subsidized interest rates for all successful projects. Interest rates for a standard loan start at 80 percent of the state/local bond rate. Interest rates for loans to disadvantaged communities are based on a sliding scale between the interest rate for a standard loan and 1 percent. Communities may be eligible for some of the principal on their SDWRLF loan to be "forgiven." This forgivable loan feature is similar to a grant and is offered to disadvantaged communities. Special consideration, including partial principal forgiveness, is provided to projects qualifying or having Green Project Reserve components. The SDWRLF program appears to be a beneficial funding source for the City to pursue.

## Water/Wastewater Financing Program

This is a loan and grant program that provides for the design and construction of public infrastructure when needed to ensure compliance with the Safe Drinking Water Act (SDWA) or the Clean Water Act (CWA). To be eligible, a system must have received, or is likely to soon receive, a notice of non-compliance by the appropriate regulatory agency associated with the SDWA or CWA.

While primarily a loan program, grants are available for municipalities that meet eligibility criteria. The loan/grant amounts are determined by financial analysis of the applicant's ability to afford a loan (debt capacity, repayment sources, current and projected utility rates, and other factors). The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is $10 million per project and is determined by financial review and may be offered through a combination of direct and/or bond-funded loans. Loans are generally repaid with utility revenues or voter-approved bond issues. A limited tax general obligation pledge may also be required. Creditworthy borrowers may be funded through the sale of state revenue bonds.

The maximum grant is $750,000 per project based on a financial analysis. An applicant is not eligible for grant funds if the applicant's annual MHI is equal to or greater than 100 percent of the state average MHI for the same year.

## Community Development Block Grant Program

The primary objective of the Community Development Block Grant (CDBG) program is development of viable (livable) urban communities by expanding economic opportunities and providing decent housing and a suitable living environment principally for persons of low and moderate incomes.

This is a federally funded grant program. The state receives an annual allocation from Housing and Urban Development for the CDBG program. Grant funding is subject to applicant need, availability of funds, and any other restrictions in the state's Method of Distribution (i.e., program guidelines). It is not possible to determine how much, if any, grant funds may be awarded prior to an analysis of the application and financial information.

Eligibility for the CDBG program requires that greater than 51 percent of persons within the community fall into the low to moderate income (LMI) category. According to the City and County demographics utilized by the IFA, in 2016 the City of Prineville had approximately 44.4 percent of the population within the LMI category. This puts the City below the threshold criteria to qualify for CDBG funds.

## Special Public Works Fund

The SPWF program was established by the Oregon Legislature in 1985 to provide primarily loan funding for municipally owned infrastructure and other facilities that support economic and community development in Oregon. Loans and grants are available to municipalities for planning, designing, purchasing, improving, and constructing municipally owned facilities, replacing owned essential community facilities, and emergency projects as a result of a disaster.

For design and construction projects, loans are primarily available; however, grants are available for and limited to projects that will create and/or retain traded-sector jobs. A traded-sector industry sells its goods or services into nationally or internationally competitive markets. The maximum grant award is $500,000 or 85 percent of the project cost, whichever is less. The grant amount per project is based on up to $5,000 per eligible job created or retained. Loans range in size from less than $100,000 to $10 million. The SPWF is able to offer very attractive interest rates that reflect tax-exempt market rates for very good quality creditors. Loan terms can be up to 25 years or the useful life of the project, whichever is less. If the City of Prineville can tie the needed improvements to job creation, the SPWF may be a potential funding source for water system improvements.

### For Infrastructure Finance Authority Programs - Contact Regional Development Officer

Since program eligibility and funds availability may change from year to year, potential applicants are encouraged to contact their respective Regional Development Officer to obtain the most accurate and up-to-date information for each program.

## Potential Rate Requirements to Fund System Improvements

To be eligible for RD grant and loan funds, the City must have average water use costs that are comparable to similar systems in the area. Once the City begins to evaluate potential funding sources and attends a "One Stop" meeting (discussed later in this Chapter), RD will provide an estimate of the water rates required for the City of Prineville to be eligible for low interest loans and grants.

The IFA is currently using 1.25 percent of a community's five-year MHI as the basis for residential monthly water user cost requirements to be eligible for grant funding. In the City's case, the five-year MHI is $29,249. This MHI results in a required monthly residential water user cost of $30.47 to qualify for low interest loan or grant funding. IFA's residential rate requirement is also based on an assumed residential use of 7,500 gallons per month. With the City's current rates, $18.26 is charged as a base rate and $1.90 per 750 gallons of water use is also charged. If a residential water user consumed 7,500 gallons, the associated cost would be $37.26. Therefore, it appears the City has already met the 1.25 percent MHI threshold to obtain low interest loans and/or grant funds through IFA. However, additional rate increases may be required to fund the full scope of the proposed water system improvements.

## Project "One Stop" Meeting

To evaluate all potential project funding options, a "One Stop" meeting is generally requested by a city. "One Stop" meetings are often scheduled in Salem where representatives of RD, IFA, and other funding agencies meet with the City to discuss the project and funding needs. This joint meeting provides a forum to evaluate and identify the most suitable funding package for the project and the City. To avoid requiring City representatives to travel to Salem, IFA can hold these meetings locally. After the meeting, the City is usually invited to submit a funding application to the preferred funding program(s) identified in the "One Stop" meeting.

## Local Financing Options

Regardless of the ultimate project scope and agency from which funds are obtained, the City may need to develop authorization to incur debt (i.e., bonding) for the selected project improvements. The need to develop authorization to incur debt depends on funding agency requirements and provisions in the City Charter. The need for bonding by the City has been eliminated by most state funding programs. However, if a bond election is required, there are generally two options the City may use for its bonding authority: general obligation bonds and revenue bonds. General obligation bonds require a vote of the people to give the City the authority to repay the debt service through tax assessments, water revenues, or a combination of both. The City's taxing authority provides the guarantee for the debt. Revenue bonds are financed through revenues of the water system. Authority to issue revenue bonds can come in two forms. One would be through a local bond election similar to that needed to sell a general obligation bond, and the second would be through Council action authorizing the sale of revenue bonds, if the City Charter allows. If more than 5 percent of the registered voters do not object to the bonding authority resolution during a 60-day remonstrance period, the City would have authority to sell these revenue bonds.

Oregon law currently requires a 50 percent voter turnout to pass a bonded debt tax measure, unless the election is held in November of an even numbered year. November elections in even-numbered years require only a majority of those who voted to pass a bonded debt tax measure. Due to current tax measure limitations in Oregon, careful consultation with experienced, licensed bonding attorneys should be made if the City begins to obtain bonding authority for the proposed water system improvements.

## Project Implementation

For the City of Prineville to successfully implement the water system improvements evaluated in this WSMP and presented in the City's Capital Improvements Plan, the City will need to coordinate directly with RD, IFA, and other potential funding agencies if they elect to pursue federal, state, and potentially local financing opportunities provided through low interest loans and potential grants.

### *Project Development Action Items*

The City of Prineville would complete the following items and proposed implementation plan to complete a proposed water system improvements project. The steps outlined are general in nature and include the major steps that need to be undertaken.

1. The City will need to finalize and adopt this WSMP once agencies review the draft WSMP.

2. The City needs to contact the RD area specialist and the IFA regional development officer to initiate funding discussions.

3. The City will need to schedule a "One Stop" meeting with the funding agencies to discuss potential funding options for the proposed improvements.

4. If IFA funding is identified as a potential source in the "One Stop" meeting, the City and IFA will draft a Project Notification and Intake Form (PNIF).

5. The City will need to hold public information meetings to inform citizens of the need for and the scope of the project, to answer questions, and to explain the need for increases in user fees. Some funding programs (such as RD) have specific requirements that need to be addressed in public meetings.

6. Working with the various funding agencies, the City will need to develop a funding plan for the desired improvements.

7. The City will need to prepare funding applications for the water system improvements project and submit them to the appropriate funding agencies. The City will need to budget appropriate up-front funds to go through the funding application process.

## *Proposed Implementation Plan*

Should the City wish to proceed with the identified water system improvements, the following proposed implementation plan outlines the key steps. It is important to note that it usually takes approximately two to three years, at a minimum, from the date a city decides to proceed with an improvements project until the project is completed and serving the community. The Implementation Plan on Table 7-2 uses summer 2017 as a starting date and assumes a three-year implementation schedule. It should also be noted that these implementation steps may be different if the City elects to delay the project and pursue improvements in the future.

**TABLE 7-2**
**IMPLEMENTATION PLAN AND SCHEDULE**

| | Item | Completion Date |
|---|---|---|
| 1. | Initiate funding discussions with IFA and RD. Hold a "One Stop" meeting with agencies. | Summer 2017 |
| 2. | Work with the IFA to submit a PNIF (if IFA funding is identified as a potential source of funds). | Winter 2017 |
| 3. | Conduct a public outreach and education program. | Summer/Winter 2017 |
| 4. | Submit funding application(s) to agencies. | Fall/Winter 2017 |
| 5. | Finalize project funding. | Spring/Summer 2018 |
| 6. | Design system improvements. | Spring/Summer 2018 to Fall/Winter 2018 |
| 7. | Complete Environmental and Cultural Resource Reports and permitting. | Spring/Summer 2018 to Fall/Winter 2018 |
| 8. | Bid and award construction contract. | Winter/Spring 2019 |
| 9.* | Construct system improvements. | Spring/Summer 2019 to Winter/Spring 2019 |
| 10. | Close out project. | Spring/Summer 2020 |

** Additional construction time may be needed for inclement weather.*

The City should work closely with its citizens through public meetings to inform them of the system needs and the necessity for potential increased water user costs. To reduce the financial impact to rate payers, the City could seek low interest loans coupled with grant funds. Increasing rates, as required, will adequately fund O&M of the existing and improved water system and keep up with inflation.

## Summary

The water system improvements outlined herein are anticipated to provide the City with a higher quality water system with significantly improved reliability. The funding sources outlined in this chapter are potential sources of loans and grants for the city to consider if an improvements project is pursued.