WOODBURN
OREGON
Incorporated 1889

Water System Master Plan

June 2018

murraysmith

Water System Master Plan

City of Woodburn

June 2018

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Section 1

Introduction and Existing Water System

1.1 Introduction

The purpose of this Water System Master Plan Update is to perform an analysis of the City of Woodburn's (City's) water system and:

- Document water system upgrades, including significant changes in water supply completed since the 2001 Update to the Water System Master Plan
- Estimate future water requirements including potential water system expansion areas
- Identify deficiencies and recommend water facility improvements that correct deficiencies and provide for growth
- Update the City's water system capital improvement program (CIP)

To identify system deficiencies, existing water infrastructure inventoried in this section is assessed based on estimated existing and future water needs developed in Section 2 and water system performance criteria described in Section 3. The results of this analysis are presented in Section 4. Section 5 identifies improvement projects to mitigate existing and projected future deficiencies and provide for system expansion including a prioritized CIP and discussion of utility funding. The planning and analysis efforts presented in this Master Plan Update are intended to provide the City with the information needed to inform long-term water infrastructure decisions.

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

1.2 Study Area

The City's current water service area includes all areas within the current city limits. The study area of this planning effort includes the current city limits, areas outside the city limits but within the Urban Growth Boundary (UGB), the Chateau Ranchettes Subdivision outside of the UGB, and the City's Urban Reserve Areas (URAs). The current UGB includes the planned Southwest Industrial Reserve (SWIR) development area mostly west of the Interstate 5 freeway (I-5). Development of the URA is considered in the future water system analysis to inform facility sizing needs for long-term growth. However, growth in the URA is not directly incorporated in the water demand forecast in **Section 2**. The study area is illustrated in **Figure 1-1**.

1.3 Water System Background

The City owns and operates a public water system that supplies potable water to all residents, businesses and public institutions within the city limits. This section describes the water service area and inventories the City's water system facilities including existing supply sources, pressure zones, finished-water storage reservoirs, pump stations, and distribution system piping.

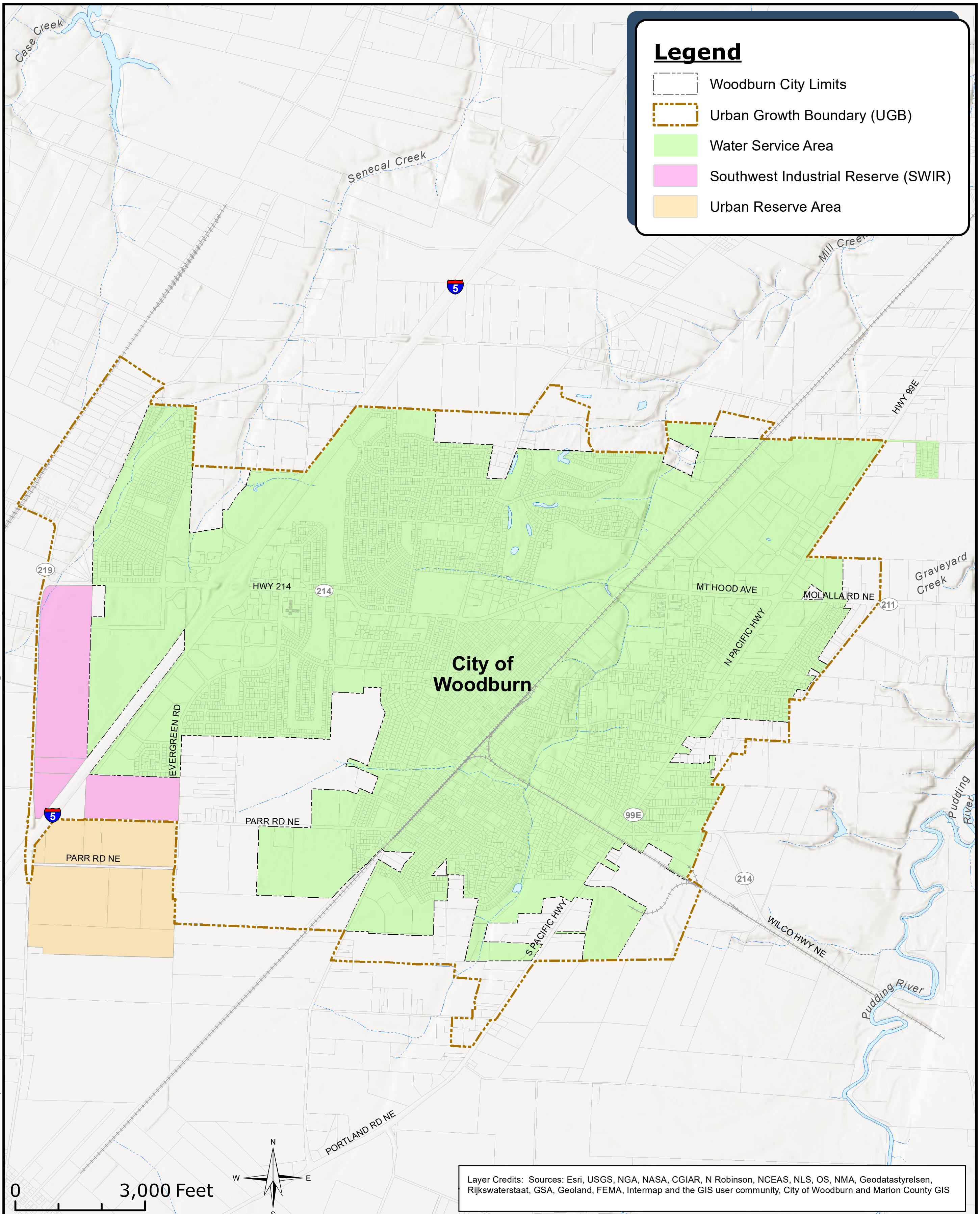
Plate 1 in **Appendix A** illustrates the City's water system service area limits, water system facilities, and distribution system piping. The water system schematic, **Figure 1-2**, at the end of this section shows the existing configuration of water system facilities and pressure zones.

1.4 Supply Facilities

Six active wells supply the City with groundwater from the Troutdale sand and gravel aquifer. The six wells are distributed across the City and pump in pairs to one of three independent water treatment plants (WTPs). In summer months and during peak demand, both wells operate simultaneously to supply each WTP. During normal, non-peak operation, either well can supply the treatment facility. Emergency valving is available at each well to bypass their respective WTP and directly supply distribution, if needed. An additional emergency well, Well No. 7, can similarly pump directly into the distribution system. If used as a backup, these systems need a chlorine feed system to maintain a disinfectant residual before connection to the system. Due to the redundancy of having three treatment plants in the system, it is not likely that the plants will need to be bypassed.

1.4.1 Groundwater Wells

Primary supply is provided by six groundwater wells with a combined maximum capacity of 4,250 gallons per minute (gpm). Individual well capacities range from 400 to 1,350 gpm. Emergency Well No. 7 can supply 1,000 gpm directly to the distribution system, without treatment. Currently, Wells No. 9 and 11, pump sand out of the aquifer if operated at more than 650 gpm each, and 13 operates at reduced capacity due to well screen biofouling. The City is planning to rehabilitate these wells in the near future. Well 12 was recently rehabilitated in 2017 resulting in a partial recovery of the well's capacity, followed by a rapid capacity decline. The summer well production at the City's wells often is reduced by nearby irrigation wells, particularly in the Parr Rd. WTP wells. Iron bacteria has also started to form in small quantities in the wells. Well details are summarized in **Table 1-1** and locations are shown on **Plate 1** in **Appendix A**.



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City of Woodburn Water System Master Plan

Figure 1-1 Study Area

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Table 1-1
Groundwater Well Summary

Well No.	Location	Motor Horsepower (Hp)	Year Constructed	Nominal Design Capacity (gpm)	Current Summer Production Capacity (gpm)	Treatment Site
7	Robin&Woodland Ave	100	1967	1,000	1,000[1]	None
9	Country Club WTP	100	1979	1,000	650	Country Club
10	National Way WTP	100	1988	1,000	800	National Way
11	1108 Astor Way	100	1989	1,000	650	Country Club
12	Parr Road WTP	125	2003	1,200	650	Parr Road
13	555 S Settlemier Rd	75	2003	600	400	Parr Road
14	Pacific Highway	150	2004	1,400	1,000	National Way
	TOTAL NON-EMERGENCY CAPACITY			6,200	4,150	

1. Emergency supply only

1.4.2 Water Treatment Plants

Water from the Troutdale aquifer is naturally high in iron, manganese, arsenic, and radon. Iron, manganese, and radon are considered secondary contaminants under the Clean Water Act. These contaminants may affect water taste and odor but have no documented negative health effects. Arsenic is classified as a primary contaminant and must be kept below maximum contaminant levels (MCLs) for human health. Historically, the City did not treat its groundwater. Due to increasing taste and odor complaints, in 2001 the City built three WTPs in conjunction with well improvements, ground level reservoirs, and increased pumping to improve water quality.

In accordance with the Environmental Protection Agency's (EPA's) Groundwater Rule (GWR), the City is not required to disinfect its groundwater prior to supplying the distribution system. In 2009 an outbreak of midge fly larvae at one of the WTP ground level storage reservoirs caused a system wide response that necessitated flushing the entire system. The problem was controlled and remedied, but this event provided the initiative to begin regular disinfection. In 2011, chloramination was added at each of the three WTPs. Added chlorine combines with naturally occurring ammonia in the raw groundwater to form an effective residual disinfectant, monochloramines, in the water system.

The current treatment process includes coagulation, filtration, and disinfection, and is identical at each of the treatment sites. Potassium permanganate is generated onsite and added to raw well water to aid with coagulation. Treated water is then filtered through green sand and anthracite coal pressure filters. The water is next treated with chloramines for disinfection and cascaded into ground level storage tanks for radon removal.

Treatment capacity at each WTP is summarized in **Table 1-2**. Finished water is stored at each ground level reservoir and pumped to the distribution system as necessary to maintain water level in the elevated tank described later in the section.

Table 1-2
WTP Capacity Summary

Water Treatment Plant	Well Nos.	Current Well Capacity (mgd)	Current WTP Capacity (mgd)	Buildout WTP Capacity (mgd)
Parr Road	12 & 13	2.3	2.9	5.8
National Way	10 & 14	3.5	2.7	2.7
Country Club	9 & 11	1.7	2.7	2.7

1.5 Pressure Zones

The City's existing distribution system operates as a single pressure zone. Pressure zone boundaries are typically defined by ground topography to maintain acceptable service pressures for all customers in the zone. However, elevations within the City vary so little that a single zone can adequately supply the entire system. The hydraulic grade line (HGL) of a zone is set by overflow elevations of water storage facilities or discharge pressures of pump stations serving the zone. In Woodburn, both modes of operation exist: the three pump stations, one at each WTP, can provide pressure by pumping directly into the system, or the elevated tank can provide pressure when pumps are "off". The two operational modes are cycled throughout the day to maintain water levels in the elevated tank. Water system facilities are illustrated on **Figure 1-2** at the end of this section.

1.6 Storage Reservoirs

Woodburn's water system has one elevated reservoir near the City center and three additional ground-level reservoirs, one at each of the WTPs. **Table 1-3** presents a summary of the City's existing storage reservoirs.

Table 1-3
Reservoir Summary

Reservoir	Location	Capacity (MG)	Tank Type
Elevated Tank	Broadway and Front St	0.75	Multi-leg elevated steel
Parr Road	828 Parr Road NE	2.90	Welded steel
National Way	2225 National Way	1.70	Welded steel
Country Club	1084 Country Club Rd	0.30	Welded steel

1.6.1 Elevated Tank

Woodburn's Elevated Tank provides the only gravity service to the City at a maximum HGL of 310 feet. It is centrally located in the City at the corner of Broadway and Front Street. The tank is kept at a fill level of approximately 95% by the pump stations at each of the three WTPs which provides system-wide service pressure between 53.5 pounds per square inch (psi) and 55 psi.

Currently the altitude valve on the reservoir is stuck in the open position. This valve should be rehabilitated or replaced. This reservoir exterior is slated to be repainted in fiscal year 2018-2019.

1.6.2 Ground Level Reservoirs

The three ground level reservoirs were built in 2001 as part of each WTP. They range in capacity from 0.30 MG at Country Club Road to 2.90 MG at Parr Road. The three reservoirs provide suction for their respective pump stations and finished water storage for each WTP.

1.7 Pump Stations

Woodburn's water system includes three booster pump stations, one at each of the WTPs. Under normal conditions, each station operates lead-lag, running a single pump with the second pump available if the elevated tank water level continues to drop. Pumps are activated to maintain elevated tank water levels between 35.5 and 39 feet which provides system pressure between 53.5 and 55 psi. During normal operation, pumps at individual pump stations, are set to mirror each other with a typical running range of 1,200-1,300 gpm for each pump station. When demand exceeds 3,900 gpm, the pumps will ramp up to their full capacities. **Table 1-4** summarizes the City's existing pump stations.

Table 1-4
Pump Station Summary

Pump Station	Location	No. of Identical Pumps	Each Pump Horsepower (Hp)	Each Pump Nominal Capacity (gpm)
Parr Road	828 Parr Road NE	2	75	1,819
National Way	2225 National Way	2	60	1,650
Country Club	1084 Country Club Rd	2	60	1,150

1.8 Distribution System

The City's distribution system is composed of various pipe materials in sizes up to 20 inches in diameter. The total length of piping in the service area is approximately 97 miles. Pipe materials include cast iron, ductile iron, PVC, steel, galvanized steel, and asbestos cement. Most of the piping in the system is ductile or cast iron. **Table 1-5** presents a summary of pipe lengths by diameter.

Table 1-5
Distribution System Pipe Summary

Pipe Diameter	Approximate Length (miles)
4-inch or Less	2.6
6-inch	30.4
8-inch	41.2
10-inch	4.3
12-inch	15.1
14-inch	1.6
16-inch	0.4
18-inch	1.3
20-inch	0.1
Total Length	**97.0**

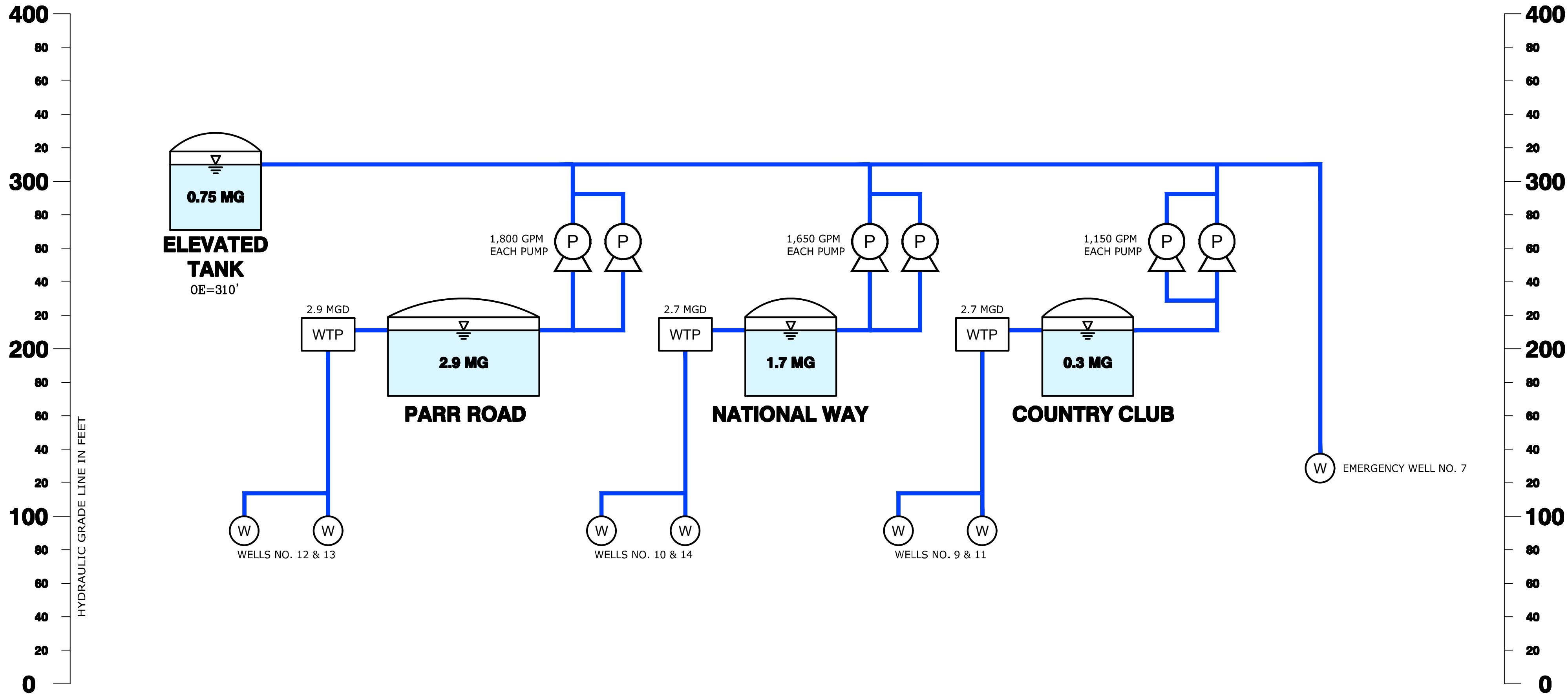
1.9 SCADA System

Woodburn's supervisory control and data acquisition (SCADA) system monitors all storage reservoirs, pump stations, and wells within the City's water system and provides for manual or automatic control of certain facilities and operations. The SCADA system also collects and stores system status and performance data.

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

All signals from the RTUs are collected and transmitted to the water system control center near the elevated tank which enables City staff to view the status of the water system in real time. The system is also capable of automatically dialing City officials 24 hours a day in the event that one of the alarms is triggered at any of the sites. Many of the City's telemetry system facilities have recently been upgraded.

There have been some issues at the Parr Road Booster Station. Sometimes when the booster station is idle, the lead pump will not active until the lag pump set point is hit, and then both pumps will kick on. The City has hired a consultant to troubleshoot the problem but has been unable to remedy the issue to date. Update of SCADA hardware and/or software may be needed at that booster station to correct the issue.



LEGEND

WTP	WATER TREATMENT PLANT
W	WELL
P	PUMP
1.0 MG / OE=1240'	STORAGE TANK (CAPACITY; OVERFLOW ELEVATION)

Figure 1-2

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WOODBURN WATER MASTER PLAN

EXISTING CITY OF WOODBURN WATER SYSTEM HYDRAULIC SCHEMATIC

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Section **2**

Section 2

Water Requirements

2.1 Introduction

This section presents existing and projected future water demands for the City of Woodburn's (City's) water service area. Demand forecasts are developed from future population projections and historical water consumption and water production records.

2.2 Planning Period

The planning period for this Water System Master Plan (WSMP) is 20 years, through the year 2037, consistent with Oregon Administrative Rule (OAR) requirements for Water System Master Plans (OAR 333-061).

2.3 Service Area

As presented in **Figure 1-1,** the City's current water service area includes all properties within the city limits and a small number of customers outside the city limits.

The future service area and the study area for this WSMP includes all areas within the city limits and Urban Growth Boundary (UGB) including the Southwest Industrial Reserve (SWIR), and Chateau Ranchettes Estates which is served outside the UGB. Analysis does not include areas designated as Urban Reserve Areas (URAs) by the City's comprehensive plan. These areas are outside the UGB and anticipated to develop outside of the 20-year planning horizon.

2.4 Historical Population

Woodburn currently supplies water to approximately 24,795 residents. Current and historical population estimates for Woodburn are taken from the Portland State University Population Research Center's (PSU PRC) 2016 Oregon Certified Annual Population Estimates. The PRC reports have historically been used for population estimates and projections and can be relied upon by the City for planning purposes per OAR 660-032-0040. Historical population estimates are summarized in **Table 2-1**.

2.5 Historical Water Demand

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

Water demand can be calculated using either water consumption or water production data. Water consumption data is taken from the City's customer billing records and includes all revenue metered uses. Water production is measured as the water supplied to the distribution system from the City's Water Treatment Plants (WTPs) plus the water volume supplied from the elevated tank. Water production includes unaccounted-for water like water loss through minor leaks and unmetered, non-revenue uses such as hydrant flushing.

For the purposes of this WSMP, water production data is used to calculate total water demand. This approach accounts for all water use, including unmetered use. 2016 customer consumption and billing records are used to distribute current water demands throughout the water system hydraulic model, discussed in **Section 4**. **Table 2-1** summarizes the City's current system-wide ADD and MDD based on water production data. Data was unavailable to calculate PHD thus a PHD:MDD peaking factor of 2 is used, consistent with water use patterns at other Willamette Valley water providers.

Historic water demand in Woodburn has been much higher as recently as 2006, but in 2007, the City first implemented sewer rates based on water consumption, and the water usage in the city has decreased significantly due to conservation efforts, increased fixture efficiency, and as a response to the financial impacts to users. It is expected that water use will follow he trend of the last 5 years into the future.

Table 2-1
Historical Water Demand Summary

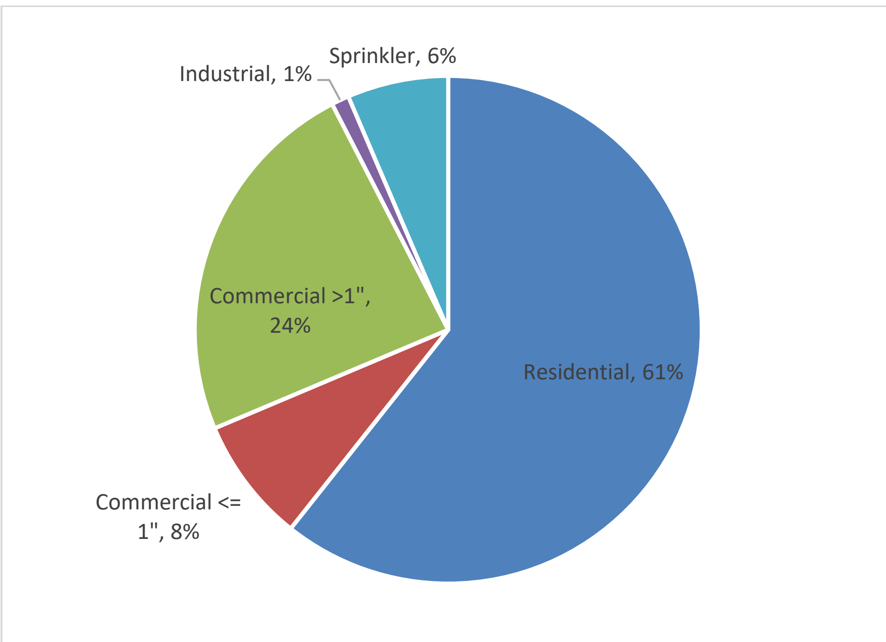
Year	Population	ADD (mgd)	MDD (mgd)	PHD (mgd)
2012	24,090	2.2	4.5	9.0
2013	24,330	2.2	3.9	7.8
2014	24,455	2.3	4.2	8.4
2015	24,670	2.4	4.5	9.0
2016	24,795	2.3	4.0	8.0

2.5.1 Water Consumption by Customer Type

The City's water utility billing records are categorized by service type and meter size. For purposes of this WSMP, records were summarized into five divisions: Residential, Commercial ≤ 1-inch diameter, Commercial > 1-inch diameter, Industrial, and Sprinkler. Sprinkler consumption includes irrigation services supplied from the drinking water system at many of the City's public parks and schools.

Percentages of current water consumption by customer type are calculated based on 2016 City water billing records. As illustrated in **Figure 2-1**, approximately 61% of Water consumption in Woodburn is by residential customers.

Figure 2-1
Current Annual Water Consumption by Customer Type



2.5.2 Per Capita Water Consumption

Per capita water consumption is a typical metric used to quantify system water use. Both residential and non-residential demands are included, allowing for system demand projections based on population alone. Projections based on per capita consumption are more reliable if development is expected to be evenly divided among customer classes. Based on historical data presented in **Table 2-1,** the average per capita water consumption for the past 5 years in 92 gpcd. This is within the range expected for similar communities in this region.

2.5.3 Typical Water Consumption by Zoning

Typical water use, in gallons per day (gpd), per acre, or per metered connection, if applicable, was developed for each of the City's zoning categories using sample areas of each zoning type and 2016 meter data within those areas. Estimated typical demands (ADD) based on zoning are summarized in **Table 2-2.**

Table 2-2
Typical Water Use by Zoning

Zoning Classification	ADD/Acre (gpd/acre)	ADD/Unit (gpd/unit)
Single Family Residential	-	225
Retirement Single Family Residential	-	149
Nodal Single Family Residential	-	187
Medium Density Residential	-	159
Nodal Medium Density	-	136
Mixed Use Village	874	-
Commercial General	850	-
Commercial Office	368	-
Downtown Core	1732	-
Public and Semi-Public	56	-
Light Industrial	118	-
Industrial Park	184	-

2.6 Future Population and Water Demand Forecast

Estimates of future growth and related water demand within the Woodburn UGB are developed for 5-year increments to the year 2037 and a buildout condition. Population projections and the per capita water use developed earlier in this section are used to estimate demands for each 5-year increment, while current water use by zoning and comprehensive planning maps are used to estimate buildout demands.

Buildout or saturation development occurs when all available land is developed to the maximum extent practical under current zoning and land use guidelines. For the purposes of this WSMP, buildout demands are used to check the ultimate capacity need for recommended improvement projects, so they are sized correctly for future growth.

2.6.1 Future Water Demand Forecast Assumptions

Population estimates for the City are developed from PSU's PRC projections. For the period between 2017 and 2037, the City's average annual growth rate (AAGR) ranged from 1.22% to 1.56%.

Average daily water demand for the 20-year period is estimated using the population estimates and the average per capita water use developed earlier in this section. It is assumed that within this timeframe, growth in the city will be distributed among residential and industrial uses and the historic per capita water use will remain a reasonable estimate.

Future maximum day and peak hour demands are estimated using historical peaking factors. The 5-year average historical MDD:ADD peaking factor of 1.9 is calculated based on the data in **Table 2-1**. This is on the low end of the normal range of peaking factors of similar water systems in the region. The assumed PHD:MDD peaking factor of 2.0 is used to estimate future PHD. Estimated 5-year water demands for the years 2017 through 2037 are presented in **Table 2-3.**

2.6.2 Buildout Demand Assumptions

Buildout demand is calculated to include all demands within the UGB, including current vacant land. Buildout ADD is estimated using the water demand by zoning classification as presented in **Table 2-2** and applied to taxlots from zoning and comprehensive plan mapping developed by the City. Along with vacant lots, it is assumed that existing taxlots greater than 1 acre will redevelop to maximum densities based on current zoning. The same peaking factors applied to 20-year water demand projections are applied to buildout demand projections.

Table 2-3
Future Water Demand Summary

Year	Forecast Population	ADD (mgd)	MDD (mgd)	PHD (mgd)
2017	26,211	2.4	4.6	9.2
2022	28,262	2.6	4.9	9.8
2027	30,513	2.8	5.3	10.6
2037	35,025	3.2	6.1	12.2
Buildout		3.8	7.2	14.4

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Section 3

Section 3

Planning and Analysis Criteria

3.1 Introduction

This section presents the planning and analysis criteria used to analyze performance of the City of Woodburn (City) water system. Criteria are presented for water supply, distribution system piping, service pressures, storage, and pumping facilities. Recommended water needs for emergency fire suppression are also presented. These criteria are used in conjunction with the water demand forecasts developed in Section 2 to complete analysis of the City's water system presented in Section 4.

The recommendations of this plan are based on the following performance guidelines, which have been developed through a review of State requirements, American Water Works Association (AWWA) acceptable practice guidelines, *Ten States Standards,* and the *Washington Water System Design Manual*.

3.2 Water Supply Capacity

As described in Section 1, the City draws its supply from a series of wells located within the city limits. Water is supplied from each active well to one of three Water Treatment Plants (WTPs) through raw water transmission mains. Each WTP is served by two wells. At each WTP, raw water is treated through oxidation and pressure tank filtration with adsorptive green sand media to reduce iron, manganese, arsenic, and radon. Finished water at each WTP is stored in a ground level reservoir, then pumped to distribution and a single elevated storage tank. For the purposes of this plan, supply capacity will be evaluated for each step in the supply system: source and treatment. Pumping and storage will be evaluated later in this section.

Source capacity is evaluated based on firm capacity, the total capacity with the largest component out of service. Building facilities to provide firm capacity allows critical system components, like wells, to be taken offline for maintenance or repair without affecting service. The City's WTPs are evaluated based on total capacity. Under normal operating conditions, each supply step should have adequate capacity to provide maximum day demand (MDD). The following criteria are used to evaluate supply capacity:

1. Source: MDD with largest system-wide well (Well No. 14) out of service and emergency Well No. 7 not in operation
2. Treatment: System-wide MDD with all WTPs operating

Each WTP should also have adequate capacity to treat the maximum well capacity for that plant.

3.3 Distribution Storage and Pumping

Due to the relatively flat topography throughout the City of Woodburn, the entire water service area can be served from a single pressure zone. Water system pressure zones are generally evaluated as either "open" or "closed". Open zones are those served by gravity storage facilities which provide pressure to customers. In closed zones customers receive constant pressure from booster pump stations without the benefit of gravity storage. Although the City's system can be considered a combination of both gravity storage (open system) and continuous pumping (closed system), for the purposes of this plan, storage and pumping capacity are evaluated based on *Washington Water System Design Manual* guidelines for closed zones.

3.3.1 Storage Volume

Water storage facilities are typically provided for four purposes: operational storage, equalization storage, fire storage, and emergency storage. Recommended storage volume is the sum of these four components. In a closed system, storage volume must be provided at the suction side of the pump, and additional consideration must be given to pump sizing to meet emergency and fire storage needs. A brief discussion of each storage element is provided below.

3.3.1.1 Operational Storage

Operational storage is the volume of water dedicated to normal operation of the reservoirs. It is calculated as the volume of water stored in a reservoir between the on/off set-points for the supplying pumps. In this case, the operational settings for the wells which supply each WTP determine operational storage in the WTP reservoirs, approximately 3 feet of reservoir level based on current set-points. Operational storage in the elevated reservoir is the volume of water in approximately 3.5 feet of reservoir level. Reservoir levels with operational storage depleted represent the critical analysis condition. For instance, fire flow availability is tested with operational storage depleted, just before the "on" setpoint for the supplying pump(s) is reached.

3.3.1.2 Equalization Storage

Equalization storage is the volume of water needed to meet demands in excess of delivery capacity. Typically, booster pumps or supply facilities serving the system are sized to meet maximum day demands. Equalization storage is provided to supply water to the system when instantaneous demands exceed this pumping capacity. For Woodburn, a volume of 25% of MDD is sufficient for equalization storage.

3.3.1.3 Fire Storage

Fire storage should be adequate to meet the total volume required by the single most severe fire flow demand. The fire storage volume is determined by multiplying the recommended fire flow rate by the expected duration of that flow consistent with the 2014 *Oregon Fire Code*. Specific fire flow and duration recommendations are discussed later in this section.

3.3.1.4 Emergency Storage

Emergency storage is available to supply water from storage in the event of a supply disruption. This is typically provided for emergencies such as pipeline failures, equipment failures, or natural disasters. The amount of emergency storage can be highly variable depending on an assessment of risk and the desired degree of system reliability. Provisions for emergency storage in other systems vary from none to a volume that would supply a maximum day demand or higher. For the City of Woodburn, the emergency storage criterion is two times the difference between average daily demand (ADD) and firm source capacity over a 24-hour period. Firm source capacity is the current operational capacity of all wells with the largest system-wide well out of service and emergency Well No. 7 not in operation.

Emergency capacity represents the average sustained customer demand during a short-term emergency which is approximately 50 to 80 gallons per person in the Willamette Valley. Emergency storage should be no less than this minimum demand. For the purposes of this analysis the minimum emergency storage for Woodburn is calculated as 64 gallons per person.

3.3.2 Pumping Capacity

Although it is desirable to serve water system customers by gravity from storage, in a relatively flat service area like Woodburn's it may not be economically feasible to provide adequate elevated storage capacity. To mitigate storage challenges, constant pressure pumping may be used to provide service pressure.

The existing distribution pump stations at each WTP help to maintain service pressures. The pumps at each WTP:

1. **supply the distribution system** – customers can receive pressure through pumping even with the elevated tank out of service
2. **can operate in response to downstream pressure** – pumps can respond to fire when the elevated tank water level (system pressure) drops below the set point
3. **have on-site back-up power** – pumps can continue to provide service during a power outage
4. **have suction-side storage in ground level reservoirs at each WTP** – storage capacity is available for delivery to customers through pumping

It is recommended that these constant pressure stations have adequate total capacity to supply peak hour demand (PHD) to the system.

3.3.2.1 Standby Power

Standby power should be provided for all wells and pump stations to provide reliable firm capacity in the event of a loss of power. Standby power is typically provided in the form of an on-site backup generator sized to operate the pump station at firm capacity with automatic transfer switches and on-site fuel storage.

3.4 Fire Flow Recommendations

The amount of water recommended for fire suppression purposes is typically associated with the local building type or land use of a specific location within the distribution system. Fire flow recommendations are typically much greater in magnitude than the MDD in any local area. Adequate hydraulic capacity must be provided for these potentially large fire flow demands.

Fire protection within the current water service area is provided by the Woodburn Fire District. Fire flow requirements for individual facilities are determined by the Fire Marshal consistent with the 2014 *Oregon Fire Code.* A summary of fire flow the City plans to proide (after completion of the 20-year CIP) for each land use type and approximate fire duration is presented in **Table 3-1**.

Properties needing additional fire flow will need to supplement City-provided fire protection in order to meet the Fire Code requirements, such as homes over 3,600 sq. ft or some commercial and industrial facilities. It should be noted that short dead-end lines, lines supplying parks, areas where established existing facilities don't match zoning, (such as a residential neighborhood in a commercial zone), and hydrants that are redundant to other hydrants in the area providing enough flow, were excluded from necessitating improvements.

Table 3-1
Summary of Recommended Fire Flows

Land Use Type (City zoning designations)	Fire Flow (gpm)	Duration (hours)
Low Density Residential: (RS, R1S, RSN)	1,000	2
Medium Density Residential: (RMN)	3,000	3
Commercial (CG, CO, DDC)	3,000	3
Public (P/SP)	3,000	3
Industrial (IP, LI)	3,000	3

3.5 Service Pressures

3.5.1 Normal Service Pressure

The desired service pressure range under ADD and normal operating conditions is 40 to 80 pounds per square inch (psi). Whenever feasible, it is desirable to achieve the 40 psi lower limit at the highest fixture within a structure. The maximum 80 psi service pressure limit is required by the *Oregon Plumbing Specialty Code* (OPSC) 608.2. If mainline pressures exceed 80 psi, service connections should be equipped with individual PRVs. Average pressure across the Woodburn water system is currently maintained at approximately 55 psi.

3.5.2 Service Pressure in an Emergency

During a fire flow event or emergency, the minimum service pressure is 20 psi as required by Oregon Health Authority, Drinking Water Services, and OAR 333-061-0025(7). The system should be capable of providing fire flow capacity while simultaneously delivering MDD and maintaining 20 psi throughout the distribution system. The system should meet this criterion with operational storage depleted and firm pumping capacity (one pump supplying distribution) at each of the City's three WTPs.

3.5.3 Distribution Main Criteria

Per the 2008 *City of Woodburn Standard Specifications,* Class 52 ductile iron is the City's standard water main pipe material. The minimum pipe size is 8-inch diameter for new permanently dead ended residential water mains and primary feeder mains in residential areas.

3.6 Water Quality

In Oregon, drinking water quality standards for 95 primary and 12 secondary contaminants are established under the Oregon Drinking Water Quality Act (OAR 333-061) which includes implementation of national drinking water quality standards. To maintain public health, each contaminant has either an established maximum contaminant level (MCL) or a recommended treatment technique.

3.6.1 Source Water

Potential for pathogens in groundwater sources like the City's wells are regulated by the Groundwater Rule (GWR). The City's existing wells have high levels of dissolved iron, manganese, arsenic, and radon. Iron and manganese are both secondary contaminants which cause metallic taste, discoloration, sediment, and staining but are not threats to human health. Arsenic is a primary contaminant and known carcinogen. In its gaseous form, radon is also a known carcinogen and although it has not been regulated as a drinking water contaminant, the City limits customer exposure through treatment.

The City's WTPs were constructed to meet all state and national drinking water standards, including reducing secondary contaminants to meet standards. This is the criteria for source water quality in this WSMP.

3.6.2 Distribution System

There are three drinking water quality standards and potential contaminants that may be exacerbated or originate in the distribution system. Specifically, microbial contaminants (Total Coliform Rule), lead and copper (Lead and Copper Rule), and disinfection byproducts (Disinfectants and Disinfection Byproducts Rule).

3.6.2.1 Total Coliform Rule

There are a variety of bacteria, parasites, and viruses which can cause health problems when ingested. Testing water for each of these germs would be difficult and expensive. Instead, total coliform levels are measured. The presence of any coliforms in the drinking water suggests that there may also be disease-causing agents in the water. A positive coliform sample may indicate that the water treatment system isn't working properly or that there is a problem in the distribution system. Although many types of coliform bacteria are harmless, some can cause gastroenteritis including diarrhea, cramps, nausea, and vomiting. This is not usually serious for a healthy person, but it can lead to more serious health problems for people with weakened immune systems.

The Total Coliform Rule (TCR) applies to all public water systems. Total coliforms include both fecal coliforms and *E. coli*. Compliance with the MCL is based initially on the presence or absence of total coliforms in a sample, then a focus on the presence or absence of E.coli. To achieve total compliance with the TCR, a positive chlorine residual throughout the distribution system must be maintained and required compliance monitoring must be performed.

3.6.2.2 Lead and Copper and Corrosion Control

Lead and copper enter drinking water primarily through corrosion of plumbing materials most commonly caused by a chemical reaction with the water which may be due to dissolved oxygen, low pH or low mineral content. Exposure to lead and copper may cause health problems ranging from gastroenteritis to brain damage. In 1991, the national Lead and Copper Rule (LCR) established action levels for lead and copper concentrations in drinking water. Under the Oregon Drinking Water Quality Act, water utilities are required to implement optimal corrosion control treatment that minimizes the lead and copper concentrations at customers' taps, while ensuring that the treatment efforts do not cause the water system to violate other existing water regulations. It should be noted that an update to the LCR is currently being considered, though implications to the City's water system are anticipated to be minimal.

Utilities are required to conduct monitoring for lead and copper from taps in customers' homes. To achieve compliance with the LCR, compliance monitoring must be completed with contaminant levels below the action level.

3.6.2.3 Disinfectants and Disinfection Byproducts (DBP) Rule

DBPs form when disinfectants, such as chlorine, used to control pathogens in drinking water react with naturally occurring organic materials in source water. DBPs have been associated with increased cancer risk. Compliance with the stage 1 and 2 DBP Rules is based on the results of an Initial Distribution System Evaluation (IDSE) and ongoing compliance monitoring to ensure DBP levels are below the MCL.

Table 3-2
Performance Criteria Summary

Water System Component	Evaluation Criterion	Value	Design Standard/Guideline
Water Supply	Source Capacity (System-wide)	MDD[2] with largest well out of service	Ten States Standards, Washington Water System Design Manual, Murraysmith recommended
	Treatment Capacity (System-wide)	MDD	
	Treatment Capacity (per WTP)	Maximum well supply capacity per WTP	
	Backup Power for Wells	At least two independent power sources	
Service Pressure	Normal Range, during ADD[1]	40-80 psi	AWWA M32
	Maximum	80 psi	AWWA M32, Oregon Plumbing Specialty Code, Section 608.2
	Minimum, during emergency or fire flow	20 psi	AWWA M32, OAR 333-061
Distribution Mains	Minimum Pipe Diameter	8-inch recommended for fire flow, except in short mains without fire service	Murraysmith recommended, Woodburn Standard Specifications
Storage	Operational Storage	Tank level set points	Washington Water System Design Manual
	Equalization Storage	25% of MDD	
	Fire Storage	Required fire flow x flow duration	
	Emergency Storage	2 x [ADD – (all but largest well & emergency Well 7 supply x 24 hours)], not less than 64 gallons per person	
Pump Stations	Total Capacity	PHD	Murraysmith recommended
	Backup Power	Automatic transfer switch and on-site generator	
Required Fire Flow and Duration	Single Family Residential	1,500 gpm for 2 hours	City Standard
	Medium Density Residential, Commercial, Public, Industrial	3,000 gpm for 3 hours	

1. ADD: Average daily demand, defined as the average volume of water delivered to the system or service area during a 24-hour period = total annual demand/365 days per year.
2. MDD: Maximum day demand, defined as the maximum volume of water delivered to the system or service area during any single day.
3. PHD: Peak hour demand, defined as the maximum volume of water delivered to the system or service area during any single hour of the maximum demand day.

Section **4**

Section 4

Water System Analysis

4.1 Introduction

This section presents an analysis of the City of Woodburn's (City's) water distribution system based on criteria outlined in **Section 3**. The water demand forecasts summarized in **Section 2** are used in conjunction with analysis criteria to assess water system characteristics including service pressures, storage and pumping capacity and emergency fire flow availability. This section provides the basis for recommended distribution system improvements presented in **Section 5**.

4.2 Water Supply Capacity

As described in previous sections, City water is supplied from three water treatment plants (WTPs), Parr Road, National Way and Country Club. Each of these WTPs is supplied by two wells. The supply capacity analysis is summarized in **Tables 4-1 and 4-2**.

The capacity of each supply step, source and treatment, should be adequate to provide maximum day demand (MDD) as follows:

- **Source:** MDD with largest system-wide well (Well No. 14) out of service and emergency Well No. 7 not in operation
- **Treatment**:
  - System-wide MDD with all WTPs operating
  - Adequate capacity at each WTP to treat all well capacity serving that plant

4.2.1 Well Capacity

Historically, the City's well operational capacities have declined due to well screen biofouling. When wells in this area are rehabilitated, the anticipated recovery of production capacity is approximately 90 percent of the well's nominal design capacity. Not all wells respond the same to rehabilitation, so the timing of new wells may need to be adjusted earlier or later depending on actual initial and residual results of rehabilitation. For example, Well 12 has already been rehabilitated with multiple technologies, but continues to decline, and is expected to decline to negligible capacity within the next few years. As can be seen in **Figure 4-1**, demand will exceed projected total well capcity in approximately 2021. Additional wells will be needed to address the declines in existing wells as well as to provide for future growth needs.

For the purposes of the 20-year projected supply analysis, a straight-line reduction in future well capacity is assumed based on nominal capacity at construction and current operating capacity. Each well is assumed to be rehabilitated when it reaches 70 percent of nominal capacity. After rehabilitation each well is assumed to recover 90 percent of nominal capacity. Well 12 is anticipated to be taken out of service around 2020, due to continually declining production even after multiple rehabilitations. Assumed future well capacities are summarized in **Figure 4-1** and **Table 4-1**. Due to variability in rehabilitation results, rehabilitation is not accounted for in the table and Figure. Successful rehabilitations will result in a delay of a need for additional supply.

Figure 4-1
Demand and Well Supply Capacity

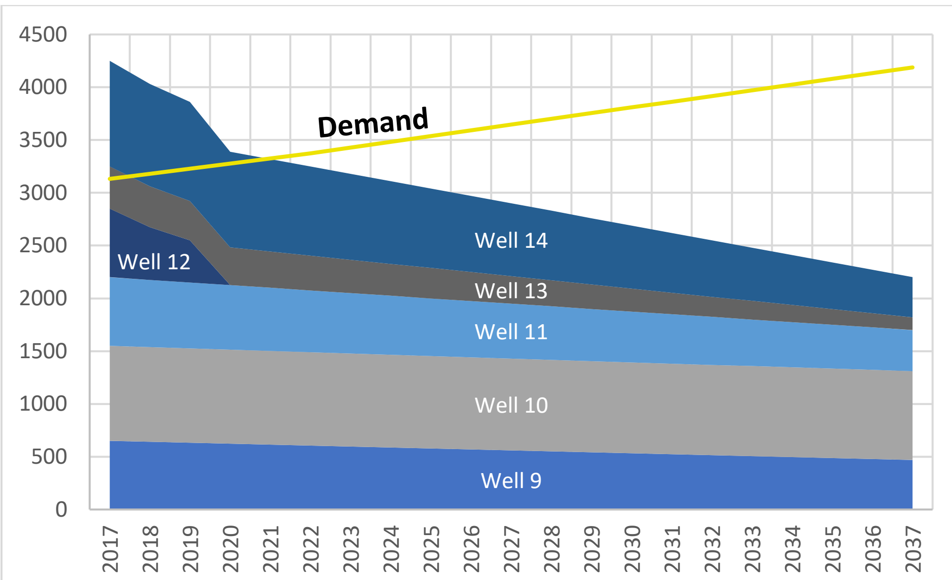


Table 4-1
Source Capacity Summary

Well	Annual Capacity Loss (gpm)	Rehab Year(s)	Est. Operational Capacity (gpm)			
			2017	2022	2027	2037
9	9	2018	650	605	560	470
10	3	-	900	885	870	840
11	13	2018 & 2034	650	585	520	390
12	25	-	650	0	0	0
13	14	2019, 2027 & 2036	400	330	260	120
14	31	2018 & 2028	1,000	845	690	380
		TOTAL WELL CAPACITY	4,250	3,250	2,900	2,200
		MAX DAY DEMAND	3,132	3,375	3,646	4,187
		Additional Capacity Need	**-**	**125**	**746**	**1,987**

Table 4-2
Treatment Capacity Summary

Water Treatment Plant	Treatment Capacity (mgd)	Well Nos.	Well Capacity (mgd)				WTP Capacity Deficit (mgd)
			2017	2022	2027	2037	
Parr Road	2.9	12 & 13	1.5	0.7	0.8	0.8	-
National Way	2.7	10 & 14	2.7	2.9	2.7	2.6	0.2
Country Club	2.7	9 & 11	1.9	2.5	2.3	2.3	-
TOTAL	8.3		6.1	6.1	5.8	5.7	-

4.3 Service Area and Pressure Zones

4.3.1 Existing

The City's current water service area includes all properties within the city limits and a small number of customers outside the city limits. The entire system is served through a single pressure zone. Three pump stations, one at each of the City's three WTPs, and an elevated reservoir work together to supply steady pressure to the system. Since the service area has little change in elevation, pressures are consistent throughout the water system with a maximum pressure of 59 pounds per square inch (psi) and a minimum pressure of 50 psi under peak hour demand (PHD) conditions.

4.3.2 Future

The 20-year future service area for this planning effort is the current Urban Growth Boundary (UGB) including the planned Southwest Industrial Reserve (SWIR) development area mostly west of the Interstate 5 freeway (I-5). Development of the City's Urban Reserve Area (URA) is used to inform facility sizing needs for long-term growth, however, this area is assumed to develop beyond the 20-year planning horizon of this Water System Master Plan (WSMP). Based on existing topography within the City's UGB and URA, it is assumed that the water system will continue to operate as a single pressure zone in the future.

4.4 Closed System Operation

Although it is desirable to serve water system customers by gravity from storage, in a relatively flat service area like Woodburn's it may not be economically feasible to provide adequate elevated storage capacity. To mitigate storage challenges, constant pressure pumping may be used to provide service pressure. This approach is referred to as a "closed pressure zone" or closed system.

Woodburn's existing distribution pump stations at each WTP help to maintain service pressures by pumping through the distribution system to fill the elevated reservoir. Even though these pumps are not configured to act as a true closed system, which responds to changes in downstream pressure rather than the elevated reservoir water level, the pumps come on quickly under fire conditions due to the rapid drawdown of the elevated reservoir due to its low storage volume. For the following storage and pumping capacity analysis, it is assumed the pumps come on quick enough to be considered a closed system.

4.5 Storage Capacity Analysis

Water storage facilities are typically provided for four purposes: operational storage, equalization storage, fire storage, and emergency storage. As presented in **Section 3**, the total storage required is the sum of these four elements. In a closed system, storage volume must be provided at the suction side of the pump, and additional consideration must be given to pump sizing to meet emergency and fire storage needs. The storage analysis is summarized in **Table 4-3**.

Table 4-3
Storage Capacity Summary

Year	Required Storage Capacity (MG)					Existing (MG)	Additional Storage Need
	Operational	Equalization	Fire	Emergency	Total		
2017	0.44	1.1	0.54	1.7	3.78	5.65	-
2022	0.44	1.2	0.54	1.8	3.98	5.65	-
2027	0.44	1.3	0.54	2.0	4.28	5.65	-
2037	0.44	1.5	0.54	2.2	4.68	5.65	-

4.6 Pumping Capacity Analysis

As previously discussed, it is assumed that the City's WTP booster pump stations operate as a closed system. Pump stations supplying constant pressure service to a closed system should have total pumping capacity adequate to meet PHD while simultaneously supplying the largest fire flow demand. The pumping capacity analysis is summarized in **Table 4-4**.

Table 4–4
Pumping Capacity Summary

Year	Existing Total Capacity (gpm)	Required Capacity (PHD+FF)	Additional Pumping Need
2017	9,238	9,264	26
2022	9,238	9,750	512
2027	9,238	10,292	1,054
2037	9,238	11,368	2,130

4.7 Distribution Capacity and Hydraulic Performance

4.7.1 Hydraulic Model

A steady-state hydraulic network analysis model was used to evaluate the performance of the City's existing distribution system and identify proposed piping improvements based on hydraulic performance criteria, such as system pressure, described in Section 3. The purpose of the model is to determine pressure and flow relationships throughout the distribution system for average and peak water demands under existing and projected future conditions. Modeled pipes are shown as "links" between "nodes" which represent pipeline junctions, fire hydrants, or pipe size changes. Diameter, length, and head loss coefficients are specified for each pipe and an approximate ground elevation is specified for each node.

The hydraulic model was developed using the InfoWater modeling software platform, AutoCAD water system mapping from the City and geographic information systems (GIS) base mapping, such as, elevation contours and taxlot data. The model was calibrated using fire hydrant flow test results and operations data provided by the City. Analysis scenarios were created to evaluate existing and projected 20-year water demands.

For distribution system modeling, it is assumed that one pump is supplying distribution at each of the City's three WTPs and the elevated reservoir is approximately 3 feet below overflow.

4.7.1.1 Modeled Water Demands

Existing and projected future demands are summarized in Section 2, Table 2-3. Within the existing water service area, demands are assigned to the model based on current customer billing address and billed water consumption. Most future demand growth is anticipated to occur through infill development, thus these existing demands are scaled for projected future system-wide demand. Future demands for SWIR are estimated based on an average demand per acre by land use type.

4.7.1.2 Model Calibration

Model calibration typically involves adjusting the model parameters such that pressure and flow results from the model more closely reflect those measured at the City's fire hydrants. This calibration process tests the accuracy of model pipeline friction factors, demand distribution, valve status, network configuration, and facility parameters such as tank elevations and pump curves. The required level of model accuracy can vary according to the intended use of the model, the type and size of water system, the available data, and the way the system is controlled and operated. Pressure and flow measurements are recorded for the City's fire hydrants through a process called fire flow testing.

4.7.1.2.1 Fire Flow Testing

Fire flow testing consists of recording static pressure at a fire hydrant and then "stressing" the system by flowing an adjacent hydrant. While the adjacent hydrant is flowing, residual pressure is measured at the first hydrant to determine the pressure drop that occurs when the system is "stressed". Boundary condition data, such as reservoir levels and pump on/off status, must also be known to accurately model the system conditions during the time of the flow test. For this WSMP, hydrant flow tests were conducted in March 2017. The recorded time of each fire hydrant flow test was used to collect boundary condition information from the City's supervisory control and data acquisition (SCADA) system.

4.7.1.2.2 Steady-State Calibration Results

For any water system, a portion of the data describing the distribution system will be missing or inaccurate and assumptions will be required. This does not necessarily mean the accuracy of the hydraulic model will be significantly compromised. Models which do not meet the highest degree of calibration can still be useful for planning purposes.

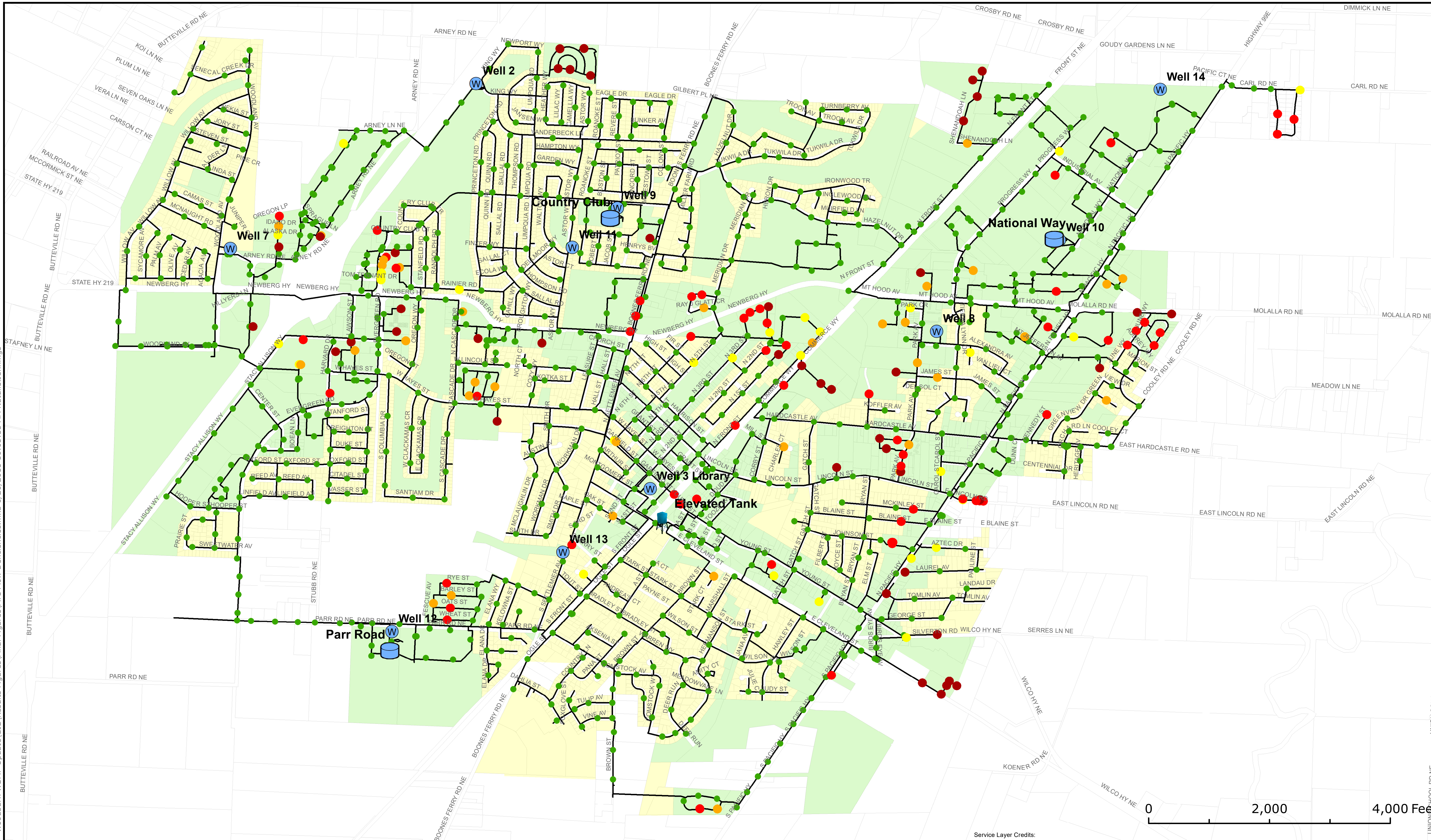
In general, the Woodburn water system hydraulic model calculates slightly higher pressures (+2 percent) than observed field pressures.

4.7.1.3 Fire Flow Analysis

Fire flow scenarios test the distribution system's ability to provide required fire flows at a given location while simultaneously supplying MDD and maintaining a minimum residual service pressure of 20 psi at all services. Required fire flows are assigned based on the zoning surrounding each node as summarized in **Section 3**, **Table 3-1**. **Figure 4-2** at the end of this section illustrates areas with fire flow deficiencies.

4.7.1.4 Peak Hour Demand Analysis

Distribution system pressures were evaluated under peak hour demand conditions to confirm identified piping improvements. As described in **Section 2,** peak hour demands were estimated as 2 times MDD. No additional pressure deficiencies were identified under these conditions.



Deficiency
- No Deficiency
- 1 - 200 gpm
- 201 - 500 gpm
- 501 - 1000 gpm
- 1001 - 2900 gpm

- Elevated Tank
- Reservoir, WTP & Pump Station
- Well

Fire Flow Required
- 3,000 gpm
- 1,000 gpm FF
- Taxlots

murraysmith

WOODBURN OREGON Incorporated 1889

City of Woodburn Water System Master Plan

Figure 4-2 Fire Flow Deficiency

June 2018 16-1934

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Section **5**

Section 5

Recommendations and Capital Improvement Program (CIP)

5.1 Introduction

This section presents recommended improvements for the City of Woodburn's (City's) water distribution system based on the analysis and findings presented in **Section 4**. These improvements include well, pump station, reservoir, and water main projects. The capital improvement program (CIP) presented in **Table 5-4** later in this section summarizes recommended improvements and provides an approximate timeframe for project completion. Proposed distribution system improvements are illustrated on **Plate 1** Water System Map in **Appendix A**.

5.2 Cost Estimating Data

An estimated project cost has been developed for each improvement project recommended in this section. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Estimated project costs are based upon recent experience with construction costs for similar work in Oregon and southwest Washington and assume improvements will be accomplished by private contractors. Estimated project costs include approximate construction costs and an aggregate 45 percent allowance for administrative, engineering and other project related costs. Estimates do not include the cost of property acquisition. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating; the current ENR CCI for Seattle, Washington is 11443 (December 2017).

5.3 Water System Capital Improvement Program

A summary of all recommended improvement projects and estimated project costs is presented in **Table 5-4** at the end of this section. This CIP table provides for project sequencing by showing prioritized projects for the 5-year, 10-year and 20-year timeframes defined as follows:

- 5-year timeframe - recommended completion between 2017 and 2022
- 10-year timeframe - recommended completion between 2023 and 2027
- 20-year timeframe - recommended completion between 2028 and 2037

5.3.1 CIP Cost Allocation to Growth

Water system improvement projects are recommended to mitigate existing system deficiencies and to provide capacity to accommodate growth and water service area expansion. Projects that benefit future water system customers by providing capacity for growth may be funded through system development charges (SDCs). SDCs are sources of funding generated through development and water system growth and are typically used by utilities to support capital funding needs. SDCs are determined as part of a financial evaluation and are based in part on a utility's current CIP. To facilitate this financial evaluation a preliminary percentage of the cost of each project which benefits future water system growth is allocated in the CIP **Table 5-4**.

Well rehabilitation, transmission replacement, and routine pipe replacement are all considered water system performance improvements which benefit all customers. Their estimated costs are allocated 25 percent to future growth based on the ratio of current to projected 20-year system-wide maximum day demands. Pump station projects are allocated to growth based on the ratio of current pumping capacity to 20-year estimated pumping capacity deficiency.

5.4 Water Source and Treatment

As presented in **Tables 4-1** and **4-2** the City has adequate system-wide source and treatment capacity to meet projected maximum day demand (MDD) through the 20-year planning horizon.

5.4.1 On-going Well Rehabilitation

It is recommended that the City continue their current program of well rehabilitation to mitigate the effects of well screen biofouling and maintain existing well capacity to the extent possible. Well rehabilitation costs included in the recommended CIP **Table 5-4** are based on an assumed well rehabilitation at 70 percent of design capacity, approximately in the years listed for each well in **Section 4**, **Table 4-1**. It is assumed that the City will recover approximately 90 percent of design capacity. Timing of new wells depends on the success or failure of rehabilitation.

Wells 9 & 11 have issues with pulling up sand, requiring remediation of the liner and/or filter pack during remediation. Well 11 also needs a new sample port for level measurement.

Well 7 should be continually maintained as a backup, as a minimum, a chlorine addition system should be added, but cost estimates anticipate a total overhaul including well house and pump upgrades as well as construction of a local green sand filter in the well house for treatment of iron and managanese. A chlorine system installation could be less than $10,000 if installed by the City.

5.4.2 National Way Water Treatment Plant (WTP)

There is a small deficit in the National Way WTP's ability to treat the total capacity of supplying Well Nos. 10 and 14. Well 14 is the City's highest capacity well and was completed after National Way WTP was constructed. As there is ground level storage available at the WTP and adequate source capacity in other parts of the system there is no immediate value in modifying the built-out National Way WTP to address this 0.2 million gallons per day (mgd) local treatment deficit after expected rehab results. Current summer well capacity is less than treatment capacity.

5.4.3 Supply Expansion

City staff have expressed concerns with the water system's ability to supply significant future service area expansion expected to occur on the west side of the Interstate 5 (I-5) freeway. Currently only emergency Well No. 7 is located west of I-5 with all other source, treatment, storage and pumping facilities on the east side. Water system hydraulic modeling did not show a need for additional supply west of I-5. Existing 12-inch mains provide adequate looping to meet MDD and fire flow demands through three existing I-5 crossings and a fourth crossing planned at the southern edge of the service area between Parr Road WTP and the anticipated Southwest Industrial Reserve (SWIR) area.

Future development is expected to occur in the vicinity of Stubb Road and Linfield Avenue within the next couple years. The City would like to construct a new well in the new subdivision, adding to the capacity of the Parr Road facility. The first well will provide for immediate need, and a second well to be sited in the future will replace Well 12 as it continues to decline. A hydrogeological study should be performed for siting the second well. It is anticipated that at least in small part, other wells in the vicinity are contributing to the decline of Well 12, so the site of a new well should be carefully planed out. If water needs are still not satisfied by the new wells, well 7 should be reconfigured with a green sand filter and disinfection to pump water directly to the system as described above.

5.4.4 Treatment Expansion

The City's existing treatment is adequate to meet the estimated 7.2 mgd projected max day water demand at buildout of the current Urban Growth Boundary (UGB), but the existing wells cannot provide that much supply. Should this demand projection continue, it is recommended that the City invest in source and treatment expansion at the Parr Road WTP. This WTP can be expanded to an ultimate capacity of 5.8 mgd, double its current capacity and has the shortest large-diameter distribution path to anticipated future customers west of I-5.

5.5 Pump Stations

5.5.1 Pumping Capacity Upgrade

Based on the pumping capacity analysis presented in **Section 4**, **Table 4-4**, it is recommended that the City expand capacity at existing WTP pump stations. Each of these pump stations has a pedestal, plant piping, electrical and controls to add a third identical pump.

It is recommended that the Parr Road WTP pump station be upgraded first to mitigate existing deficiencies with an additional 1,819 gallons per minute (gpm) pump. Parr Road has the shortest large-diameter distribution path to the City's elevated storage reservoir. This WTP will also be a key supply facility for potentially large industrial demands and fire flows in the SWIR development area.

Second, it is recommended the National Way WTP pump station be upgraded between 10 and 20 years (2027 to 2037) to add an additional 1,650 gpm pump and mitigate projected 20-year pumping capacity deficiencies beyond those served by the Parr Road WTP pump expansion.

5.5.2 Parr Road SCADA

The existing SCADA system at the Parr Road Pump station often malfunctions when the pump station goes idle. The lead pump will not come on until the lag pump is triggered to come on. It is believed to be a programming issue that was not decipherable by a SCADA consultant the City hired to investigate. Budgeting for hardware and/or software upgrades is recommended to address this issue.

5.6 Reservoirs

5.6.1 Elevated Reservoir

The elevated reservoir needs exterior coating. It was originally constructed in 1967 and has only been recoated once. The City has already made plans to complete this within the next year.

In addition, the altitiude valve has failed and been permanently locked in the open position to allow use of the reservoir volume to meet system demands. Repalcement of the altitidue valve is recommended to protect the City from overflow of the reservoir.

5.7 Distribution Mains

Table 5-2 presents recommended water main projects for transmission replacement, to serve future development including the SWIR area and to improve fire flow capacity. All recommended water main projects are illustrated on **Plate 1** in **Appendix A**. Water main project costs are estimated based on unit costs by diameter shown in **Table 5-1**.

Table 5-1
Unit Cost for Water Main Projects

Pipe Diameter	Cost per Linear Foot ($/LF)
8-inch	$230
10-inch	$285
12-inch	$345
14-inch & larger	$460

Assumptions:

- Includes approximately 45 percent allowance for administrative, engineering and other project related costs
- Ductile iron pipe with an allowance for fittings, valves and services
- Surface restoration is assumed to be asphalt paving
- No rock excavation
- No dewatering
- No property or easement acquisitions
- No specialty construction included

Table 5-2
Distribution Main Projects

Project No.	Location	Diameter (inches)	Length (LF)		Estimated Project Cost
Transmission Replacement					
M-42	Country Club to elevated tank transmission replacement	14" 16" 18"	7,573	$	3,484,000
Projects for Future Development					
M-38A	SWIR	10" 12" 14"	13,612	$	3,827,000
M-38B	I-5 Waterline Crossing (SWIR)	12"		$	1,200,000
M-39	OR-99E Southern Extension	8"	927	$	214,000
M-40	OR99E: Aztec St to Blaine St	8"	389	$	90,000
M-41	OR-99E: Lincoln St South to Existing Stubout	8"	271	$	63,000
			Future Development Total	$	5,394,000
5-Year Fire Flow Projects					
M-1	Reconnect: Brown St to Vine St	12"	54	$	40,000
M-2	Front St: Stonehedge to Newberg Hwy &Newberg Hwy: Front St to Bulldog Dr	12"	1,817	$	627,000
M-3	Park Ave: Hardcastle Ave to Lincoln St & East/West sections of Woodpark Ter	8"	1,852	$	426,000
M-4	Lincoln St: Park Ave to hydrant west of Bryant St	8"	756	$	174,000
M-5	Nuevo Amencer	8"	1104	$	254,000
M-6	Loop Front St to Salud Medical Center	8"	706	$	163,000
			5-Year (2017-2022) Fire Flow Total	$	1,684,000
10-Year Fire Flow Projects					
M-7	Southeast Industrial Area Improvements	8" 10"	5,390	$	1,520,000
M-9	Front St: hydrant east of Hardcastle Ave to hydrant west of Hardcastle Ave	10"	569	$	163,000
			10-Year (2023-2027) Fire Flow Total	$	1,683,000
20-Year Fire Flow Projects					
M-8	OR-99E: Tomlin Ave to Young St	8"	459	$	106,000
M-10	Loop: Barclay Sq to Harvard Dr	8"	166	$	39,000
M-11	Loop: High St to Settlemier Ave	8"	234	$	54,000
M-12	James St: Legion Park to east end of Apts.& Park Ave: Parkview Ct to James St	8" 10"	1,390	$	339,000
M-13	Woodburn RV Park: North Leg	8"	348	$	81,000
M-14	French Prairie Middle School: Hwy 214 & Boones Ferry Rd	8"	907	$	209,000
M-15	OR-214: Tomlin Ave to Cascade Factory Homes	6" 8"	759	$	150,000
M-16	Blaine St & McKinlet St: OR-99E west to hydrant	8" 10"	882	$	229,000
M-17	Glatt Cir: North and South legs	8" 10"	561	$	143,000
M-18	Loop: 2213 Country Club Ct to Country Club Rd	8"	226	$	52,000
M-19	Loop: Industrial area at end of Shenandoah Ln	10"	703	$	201,000
M-20	Loop: Northernmost Driveway on Commerce Way	8"	762	$	176,000
M-21	West ends of Hayes St and Young St	8"	381	$	88,000
M-22	Park Cir: Park Ave to hydrant, south leg	8"	315	$	73,000
M-23	Yew St: across 3rd	8"	35	$	9,000
M-24	Loop: Lincoln Rd to North Pacific Plaza	8"	515	$	119,000
M-25	Line West of Wellspring Confrence Center	8"	253	$	59,000
M-26	Rainier Rd: Randolph Rd to Cascade Dr	8"	381	$	88,000
M-27	Charles St: Charles Ct to Corby St	6"	342	$	60,000
M-28	Greenview Ct: Greenview Dr. to hydrant	8"	220	$	51,000
M-29	Oak St: 2nd St to 1st St	8"	190	$	44,000
M-30	Nuevo Amencer extention: 5th St to 6th St	8"	423	$	98,000
M-31	Safeway on OR-99E	8"	649	$	150,000
M-32	Loop: Apartments South of Stonehenge	8" 10"	1,114	$	288,000
M-33	Line to Kerr Contractors	10"	159	$	46,000
M-34	Newberg Hwy Dairy Queen	6"	193	$	34,000
M-35	Evergreen Rd to line to North and Evergreen Estates to hydrant east	10"	307	$	88,000
M-36	Lincoln St. OR-99E to first hydrant north on Carol St	8"	493	$	114,000
M-37	Stacy Allison Way: West end of Walmart Parking Lot	8"	512	$	118,000
			20-Year (2028-2037) Fire Flow Total	$	3,306,000
			Distribution Main Projects Total	$	15,551,000

5.7.1 Routine Main Replacement Program

In addition to distribution main projects to address capacity deficiencies, the City should plan for replacement of pipes based on a 100-year life cycle to maintain reliable operation, without significant unexpected main breaks and leaks. **Table 5-3** summarizes the total length of pipe for each diameter (size), the replacement diameter and estimated cost to replace all the mains of that size. While costs will vary for each individual main depending on the piping location, surface conditions, and other constructability issues, this analysis provides a preliminary estimate of the required capital budget to execute an effective and proactive water main replacement program.

The cost for routine main replacement included in this plan is based on the average annual cost for the first 20 years of a 100-year program, approximately $800,000 annually. While it is understood that funding at this level for pipeline replacement may not be feasible, it should be recognized that an adequately funded main replacement program is necessary to minimize the risk of failure for critical water system components that will result in significantly greater costs to repair and replace in the future. Based on the concurrent analysis of rates and SDCs, the initial 10 years of the CIP include funding for $400,000 per year in main replacements followed by an increase to the recommended long-term funding level in the future.

Table 5-3
Distribution Main Replacement Cost Summary

Diameter (in)	Approx. Length (ft)	Replacement Diameter (in.)	Cost per Linear Foot	Estimated Replacement Cost
<=6”	174,240	8	$230	$14,800,000
8	217,536			
10	22,704	10	$285	$300,000
12	79,728	12	$345	$1,100,000
16	2,112	16	$460	$40,000
18	6,864	20	$460	$140,000
20	528			
Total Length	503,712		Total Cost	$ 16,380,000

5.8 CIP Funding

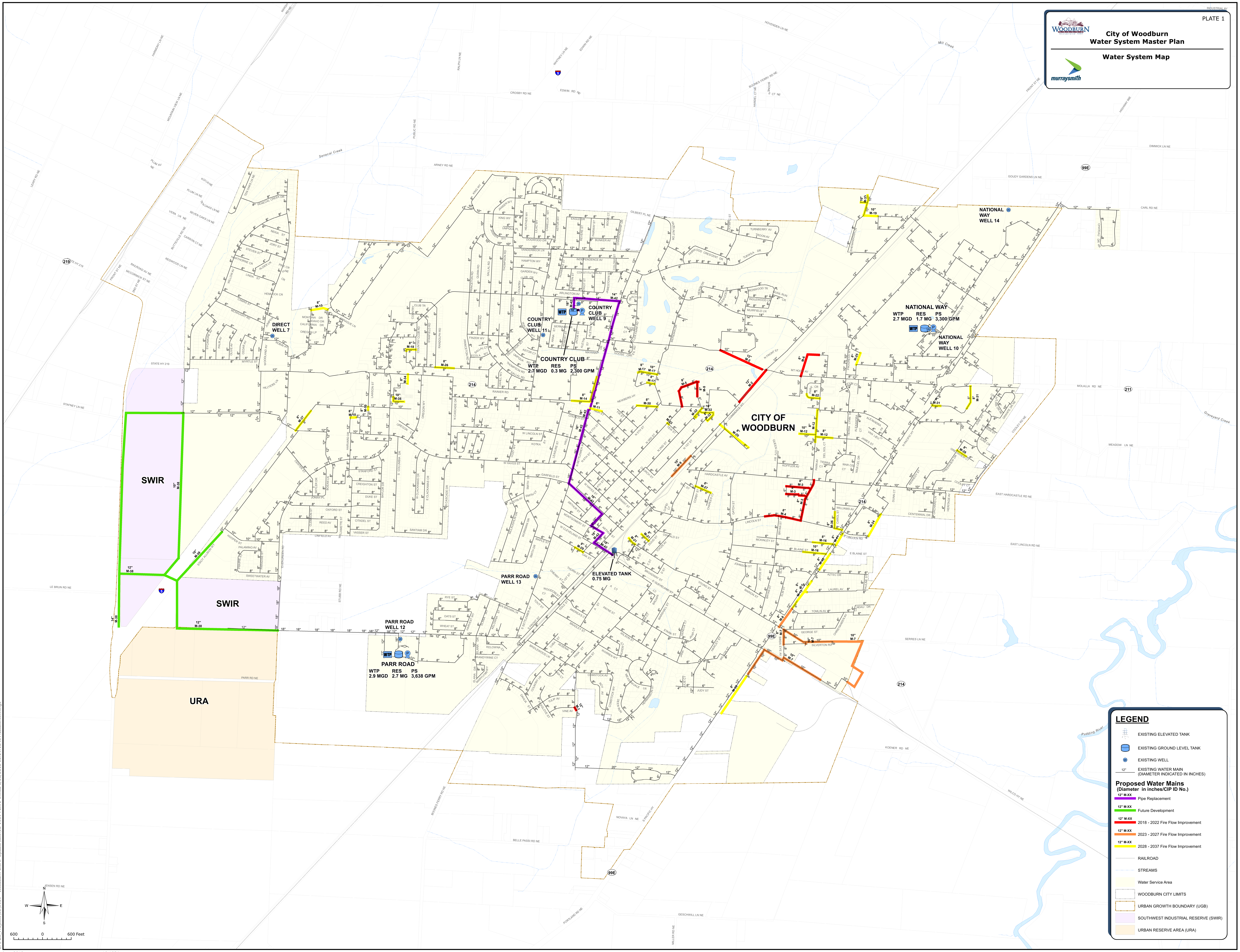
The City may fund the water system CIP from a variety of sources including; governmental grant and loan programs, publicly issued debt and cash resources and revenue. The City’s cash resources and revenue available for water system capital projects include water rate funding, cash reserves, and SDCs. An evaluation of water rates and SDCs in support of the water system CIP will be completed as follow-on work to this Water System Master Plan.

Table 5-4
CIP Summary

Improvement Category	CIP No.	Project Description	Fiscal Year CIP Schedule and Project Cost Summary: 5-year thru 22/23	10-year 23/24-27/28	20-year 28/29-37/38	TOTAL	Preliminary Cost % to Growth
Water Supply	W-1	Well rehabilitation	$ 150,000	$ 150,000	$ 300,000	$ 600,000	0%
	W-2	New Wells	$ 1,300,000		$ 1,300,000	$ 2,600,000	0%
	W-3	Hydrogeological Study	$ 100,000			$ 100,000	100%
	W-4	Well 7 Improvements			$ 1,000,000	$ 1,000,000	100%
	W-5	Water Rights Implementation	$ 40,000			$ 40,000	100%
	W-6	Auxillary power for wells #9, 11 & 14	$ 225,000			$ 225,000	0%
		Subtotal	$ 1,815,000	$ 150,000	$ 2,600,000	$ 4,565,000	$ 1,140,000
Pump Stations	P-1	Parr Rd 3rd booster pump & SCADA update	$ 175,000			$ 175,000	99%
	P-2	National Way 3rd booster pump			$ 150,000	$ 150,000	100%
		Subtotal	$ 175,000	$ -	$ 150,000	$ 325,000	$ 324,000
Reservoirs	R-1	Coating Elevated Reservoir	$ 400,000			$ 400,000	0%
	R-2	Altitude Valve Replacement Elevated Reservoir		$ 80,000		$ 80,000	0%
		Subtotal	$ 400,000	$ 80,000	$ -	$ 480,000	$ -
Distribution Mains	M-42	Country Club to elevated tank transmission replacement		$ 3,484,000		$ 3,484,000	36%
	M-38A	SWIR water system extension	Developer Funded			$ -	100%
	M-38B	I-5 Crossing	$ 1,200,000				
	M-39 to M-41	OR-99E connect existing mains to complete network			$ 367,000	$ 367,000	100%
	M-1 to M-37	Fire flow improvements	$ 1,684,000	$ 1,684,000	$ 3,306,000	$ 6,674,000	36%
		Routine Main Replacement Program	$ 2,000,000	$ 2,000,000	$ 8,000,000	$ 12,000,000	0%
		Subtotal	$ 4,884,000	$ 7,168,000	$ 11,673,000	$ 22,525,000	$ 4,024,000
		CIP Total	**$ 7,274,000**	**$ 7,398,000**	**$ 14,423,000**	**$ 27,895,000**	**$ 5,488,000**

Annual Average CIP Cost		
$1,454,800	**$1,467,200**	**$1,454,750**
5-year	**10-year**	**20-year**

Appendix



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