ACE
Consultants, Inc.

City of Prineville

Water System Mater Plan Update

March 2006

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CIVIL / ENVIRONMENTAL ENGINEERS

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Executive Summary

Introduction

The Prineville water system is marginally meeting the current demands, but during extreme hot days the system could not keep up with heavy demands resulting from irrigation. As the City is growing, the need for water system improvements is becoming a critical issue.

The purpose of this Mater Plan Update is to provide the City of Prineville with an updated analysis of their water sources, distribution, treatment, pumping and storage systems, identification of present needs and deficiencies, a projection of future needs for the next twenty years, and an analysis of alternatives for meeting them.

Study Area

The study area for this Facility Plan is comprised of the City of Prineville, Oregon and the surrounding portion of Crook County within the city's Urban Growth Boundary (UGB) making up the Prineville Urban Area. The Study area as defined by the Urban Growth Boundary encompasses a total area of 9269 acres.

The 2005 population of the City of Prineville is 8942. The population within the Urban Growth Boundary is in excess of 12,750 people.   The projected population for the City of Prineville in 2025 is 17,793

Existing Water System and Projected Demand

The City of Prineville water system includes a total of 42 miles of water distribution mains, nine (9) wells and five (5) storage tanks. Disinfection is the only treatment provided for the water supply. Out of the 42 miles of water main, more than half of the total pipeline footage is made up of 6" and 8" pipes. About 11% of the pipe footage is made up of pipes 4" and smaller in diameter.

It is estimated that future average water demand would increase from the present 1.6 million galleons per day (mgd) to 3.2 mgd in 20 years.

Future Needs

WATER SOURCE – WELLS

The current total well output is about 2,700 gallons per minute or 3.9 mgd. These wells can barely meet the current maximum day demand only if additional storage is provided. To meet the projected water demands, additional well capacity would be required. The existing wells have been redeveloped in the last five years to increase the output, but a total of additional 2,850 gpm well capacity would still be required in 20 years.

WATER STORAGE

To meet the immediate demand, an additional 4 million gallons (MG) of storage would be required. In 20 years, the estimated additional storage would total 10 MG.

WATER DISTRIBUTION SYSTEM

Watermains 4 inches and smaller are too small and unable to carry high fire flows (1,000 gpm to 4,000 gpm or more). This is the weak link of the existing system. They would have to be replaced with mains 8 inches or larger to improve conveyance of fire flows without tremendous loss of pressure.

To meet future water demands and fire flow requirements, the existing distribution main would need to be strengthened by adding 12" and 16" mains to form a distribution grid thus conveying the required flows at sufficient delivery pressures (no less than 30 psi during summer hot days).

Short-Term Improvements

These improvements include replacing existing undersized water mains and wood stave pipes and adding new mains for looping to improve fire flows. They are also targeted to meet the immediate needs for additional well and storage and capacities, i.e. the "Big-Dig" project as named by the City.

The recommended short-term improvements are as follows.

1. Addition of Altitude Valves at Ochoco Hts Tanks.
2. Replacement of wood-stave pipes and wrapped steel and galvanized steel pipes
3. Replacement of undersized mains.
4. Development of Fairground well, American Pine well and New Airport Well. The existing Stadium well will be replaced with a larger well.
5. Stadium Well replacement.
6. Construction of American Pipe Tank No. 2 and Booster Station, Barnes Butte Tank No.2, Airport Tank No.2 and Fairground Tank No. 1.

The estimated total short-term improvement project cost is approximately 14.3 million dollars.

Development Driven Improvements

These improvements are driven by the growth and are to be implemented as necessary to meet the demand.

NORTHWEST AREA (AMERICAN PINE TANK SERVICE AREA)

1. Clear Pine Well
2. Transmission/Distribution Mains with Regulators

BARNES BUTTE SERVICE AREA

1. Barnes Butte Tank No.2, One million gallons
2. Melrose Tank No. 1, One million gallons
3. Transmission/distribution Mains with Pressure regulators for tie-in to the downtown pressure zone.

HUDSPETH AREA

1. Wells with a total capacity of 900 gpm (1,800 gpm for full built-out)
2. Three Buried Prestressed Concrete Storage Tanks with a total capacity of 4.5 million gallons;
3. Storage Tanks with a total capacity of 4.5 million gallons;
4. Booster Pump Stations; and
5. Transmission/distribution Mains with Pressure regulators for tie-in to other pressure zones.

FAIRGROUNDS AREA

1. Storage Tank, one million gallons; and
2. Transmission/distribution Mains with pressure regulators.

AIRPORT AREA

1. Transmission/distribution Mains for the future airport industrial developments.

The estimated total development driven improvement project cost is approximately 26.3 million dollars.

Chapter 2 – Introduction, Purpose and Scope

Introduction

The City of Prineville, the oldest town in central Oregon, was founded in 1868, incorporated in 1880. Because Prineville is the County Seat and only incorporated city in Crook County the city is the economic center of the County and more than half of the County citizens live in Prineville or in its Urban Growth Boundary.

The City owns and operates a municipal water system which obtains water from several wells distributed over the system, stores it in ground level storage reservoirs, and distributes it to residential, commercial, industrial, and public customers within the City limits.

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 Company in January 1985. About 10% of water mains are 4" and smaller, and some are galvanized steel pipe. Over the years, the City replaced some undersized mains and installed new mains, additional wells and storage tanks. But the recent population growth has resulted in water shortage during summer months due to heavy water demands.

Purpose

The purpose of this Mater Plan Update is to provide the City of Prineville with an updated analysis of their water sources, distribution, treatment, pumping and storage systems, identification of present needs and deficiencies, a projection of future needs for the next twenty years, and an analysis of alternatives for meeting them.

Scope

The scope is to update the following key elements:

1. A general description of the water system's existing and future service area.
2. A description of present land use patterns and projected changes based on the adopted land use plans.
3. Present population distribution pattern and population projections.
4. Present water usage and projected water demand.
5. An inventory of the existing water system facilities.
6. Hydraulic analysis of the water system.

7. An evaluation of the water supply quality with respect to conformance with the minimum water quality standards of the Oregon State Health Division (OSHD).

8. Discussion of the system's ability to meet applicable fire codes and fire flow standards.

9. A description and assessment of the system facilities necessary to meet the anticipated needs including associated costs.

This update covers a 20-year planning period from year 2005 to year 2025.

Chapter 3 - Study Area Characteristics

Study Area

The study area for this Facility Plan is comprised of the City of Prineville, Oregon and the surrounding portion of Crook County within the City’s Urban Growth boundary making up the Prineville Urban Area. The Prineville is located on Highway 26 at the approximate geographic center of Oregon, at Latitude N 44^{o} 18’ Longitude W 120^{o} 51’. Prineville was incorporated in 1880 and is the County Seat and the only incorporated city in Crook County.

The City is located in the Crooked River – Ochoco Creek valley, with rimrock formations to the south, southeast and southwest. Barnes Butte, located in the northeastern part of the urban area is also a dominant geographic feature. Surface elevations in the city range from 2800 to 3600 feet above sea level.

The Study area as defined by the Urban Growth Boundary that has been modified since the 2000 Facility Plan was prepared to the areas shown on the map on the following page.

Physical Environment

Climate

The climate in Prineville is characteristic of central / eastern Oregon, moderate temperatures, low precipitation occurring predominantly in the winter months, and moderate winter snowfall. The climate data is summarized in the table below.

Period of Record Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	42.1	47.8	54.1	61.4	69.0	75.9	85.6	84.7	77.4	65.7	51.2	43.5	63.2
Average Min. Temperature (F)	20.5	24.2	25.9	28.8	35.0	40.4	42.7	40.8	35.1	29.5	25.8	22.5	30.9
Average Total Precipitation (in.)	1.1	0.8	0.8	0.7	1.1	1.1	0.4	0.4	0.5	0.8	1.3	1.3	10.1
Average Total Snow Fall (in.)	5.0	2.3	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.2	1.2	2.8	12.8
Average Snow Depth (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Period of Record: 1/ 1/1928 to 8/31/1999
Station: PRINEVILLE 4 NW, OREGON 356883
Western Regional Climate Center, wrcc@dri.edu

Soils

The area is part of the geologic Harney High lava Plain and generally consists of quaternary and tertiary volcanic types overlaying basalt. The soils have been classified in the USDA Soil Conservation Service "Soil Survey Report for the Prineville Area of Crook County". The Atlas of the Pacific Northwest, eighth edition, 1993 indicates that the prevailing soils of the area are typically classified as Argixerolls. These are soils with subsurface clay horizon that are either thin or brownish. These soils are continually dry for long periods of time but when irrigated or when natural moisture is available are used for grain and forage crops.

Natural Hazard Areas

Natural hazard areas within the Urban Growth Boundary include flood hazard, steep slope and slide hazards, and weak, fragile, and erosion susceptible soils. The following paragraphs from the city's draft Urban Area Comprehensive Plan , January 2005, identify the hazards.

"Prineville is located at the base of high plateaus and traversed by many natural drainage ways. Ochoco Creek and the Crooked River run through the center of the community. Various greenbelts and wildlife-rich riparian areas exist within the community. This situation offers opportunities to develop additional preservation greenbelts that can buffer these sensitive lands from the negative impacts of urban development.

The 100-year floodplains near the rivers are potential hazard areas for development. The area within the Prineville UGB has over 320 acres within the floodplain.

Many small drainage tributaries of the major streams often have high flood hazard and erosion potential within localized areas. However, these localized flash flood conditions do not contribute significantly to flood conditions when channeled into the larger drainages. Many hazard areas can or have been partially, or totally, reclaimed through adequate engineering, especially where drainage can be provided within areas of high water tables. High water table problems exist only in the summer months; other times of the year do not have the problem.

Seasonally high water table problems are caused by spring runoff of snow melt, by flood and sprinkler irrigation, and by soils with high enough clay content to make them impervious to ground water flow. The general soil boundaries indicating ground water problems have been further modified by engineering practices such as diversion canals, drainage ditches, and interceptor drain tiles.

The areas indicated as having extreme, or moderate high water tables present problems for foundations, underground utilities, septic tanks, wells and adequate drainage. Engineering techniques may solve these problems. Consequently, increased development costs can be expected.

There are approximately 760 acres of soils poorly suited for foundations in the Prineville Metro Area. These soils, also located within areas of high water tables, create additional limitations for sewers, water systems, and other underground utilities. Severe limitations also exist for roadways because of the soils' high shrink- swell characteristics. Problems associated with these soils include foundation cracking, settling and water damage to structures, and underground utility systems that may result in pollution of the shallow groundwater.

The general geology of the Prineville area is almost entirely volcanic in origin. The oldest rocks exposed in the area are part of the John Day Foundation; a complex assemblage of lava flows, pyro-clastic deposits, sedimentary stouts and volcanic vent deposits. The next oldest is the Prineville Basalt, a dark gray fine-grained lava flow. The Prineville Basalt is overlaid by basalt flows and sedimentary deposits of the Deschutes Formation, the youngest of these basalt flows form the rimrock south and west of Prineville. The Prineville valley was filled to its present level with colluvial deposits of sand, gravel, silt and clay. The main confined aquifer under the City of Prineville is in a thick lens of gravel that was deposited in a wide valley formed within the John Day Foundation. This gravel lens was in turn covered with thick beds of silt, clay and sand.

The steepest slopes (in excess of 30%) generally pose higher development and maintenance costs for structures and utilities, although modern engineering technology and design may alleviate some or all of these limitations. Steep slopes are commonly characterized by shallow rocky soils, high erosion potential, mass movement, septic tank limitations and low agricultural potential. Septic tanks are common in the older parts of the community and in the UGB. The septic sewer suitability maps give an indication of which areas in the county and Prineville valley may support septic tank facilities."

Public Health Hazards

Several areas within the City have wells testing with high nitrate levels constituting a health hazard. The three areas identified below are listed in decreasing hazard level order

1. The Melrose Combs Flat area depends on septic tanks / sand filters / drainfield systems for sewage disposal and individual wells for domestic water. Some of the septic systems have failed resulting in wells in the area testing high in nitrates, constituting a health hazard.

2. The Crestview area depends on septic tanks / sand filters / drainfield systems for sewage disposal and individual wells for domestic water. Some of the septic systems have failed resulting in wells in the area testing high in nitrates, constituting a health hazard.

3. The Main Street / McKay Road area in the vicinity of the Prineville Mobile Home Park is an area where wells also test high in nitrates, thought to be due to agricultural rather than septic tank sources.

In addition, a January 2004 Oregon Health Division Sanitary Survey of the City of Prineville Public Water System identified fifteen Sanitary Hazards that must be addressed as part of water system operations. Some of these have been addressed, but most of them have not been addresses at the time this report is being prepared.

Energy Production and Consumption

There are no energy production facilities in the City of Prineville or built into the City of Prineville wastewater collection and treatment system. Electricity is the predominant form of energy available throughout the service area and natural gas is available in some, but not all, areas of the city. The city is a major user of electrical power, operating the aeration system at the wastewater treatment plant, three pump stations at the treatment plant, and several water and sewage pumping stations distributed across the service area.

The building code requires energy conservation measures for all new construction and when structures are remodeled. The motors at the city pump stations and treatment plants are being upgraded to high efficiency motors as equipment wears out and needs replacement.

Water Resources

The study area is located in the Crooked River – Ochoco Creek valley. The City of Prineville holds water rights for several wells as well as limited surface water rights for municipal water supply and irrigation. Currently only wells are utilized for the city water supply.

Surface water in the area is primarily from Ochoco Creek, which runs directly through Prineville from east to west, and the Crooked River, which flows from Prineville Reservoir through the western portion of the study area from south to north. Ochoco Creek is regulated by the Ochoco Reservoir, which is operated for irrigation. The surface water streams are part of the Deschutes River system. Withdrawal of water from the surface streams is predominantly for irrigation and is regulated by the Oregon Department of Water Resources. Any new or additional withdrawals of surface water are not likely to be permitted.

Prineville obtains its drinking water from city wells and individual wells tapping both deep aquifers and shallow groundwater resources in the area. The City has participated in an interagency study to develop a regional groundwater management program. The City has identified significant groundwater resources in the east central area of the Urban Growth Boundary and potentially significant groundwater resources in the Crooked River drainage south of the Urban Growth Boundary. As the city grows, the adequacy of the water rights it holds, as well as the capacity of the aquifers, may become a constraint to continued development.

The only water impoundment within the Urban Growth Boundary is Hudspeth Lake, a privately owned manmade pond.

Flora and Fauna

Wildlife, including deer, raptors, and mountain quail occur throughout the Urban Growth Boundary. Although not inside the current Urban Growth Boundary, at least four bald eagle nesting sites are located in proximity to the Urban Growth Boundary.

Plant species outside developed areas and greenways or not planted for pasture or crops are those typically found in the dry central Oregon including sagebrush species, fescue grasses and juniper woodlands.

Air Quality and Noise

Air quality and ambient noise in the study area is about what is expected in a city of Prineville's size. Air quality and ambient noise levels are generally good except for localized areas adjacent to heavily traveled major highways.

An air pollution problem attributed to small particle contaminants from woodstove smoke identified in 1994 has been remedied to the extent that the DEQ suspended air quality monitoring in Prineville in 1997.

Environmentally Sensitive Areas

Environmentally sensitive areas in the study area include:

Waterway-Riparian Habitat Areas: Both the Crooked River greenway as it passes through the southwestern portion of the Urban Growth Boundary and the Ochoco Creek greenway passing through the central area of the study area are sensitive wildlife habitat.

Bull Trout Habitat: the September 26, 2005 Federal Register published critical habitat for the Bull Trout recently listed as an endangered species. The entire length of the Crooked River between Prineville and the point where the River crosses Highway 97 in Madras is shown as the critical habitat. The Bull Trout listing together with identification of the Crooked River down stream from the City's WWTP outfall as critical habitat will severely limit how much effluent will be permitted to be discharge into the Crooked River and many other water resources related issues effecting the City.

Crooked River Rimrocks: The area identified as Crooked River Rimrocks visible along the southwestern and southeastern perimeters of the Crooked River Canyon are important geological resources, wildlife habitat, and significant open space reserves.

Wetlands: All wetland areas within the study area have been inventoried, and those identified as significant natural wetlands have been classified as important open space. The major areas are along the shores of Crooked River, Ochoco Creek and Hudspeth Lake and the drainageway southwesterly from Hudspeth Lake.

Land Use Issues

The City of Prineville and Crook County zoning ordinances are in place to regulate land use within the study area.   The primary land use issue in Prineville is how to provide an adequate supply of land for residential, commercial, and industrial uses as growth occurs in the region. The city is currently experiencing unprecedented development. Maintaining adequate public services to support the development is taxing City resources. The current City of Prineville Comprehensive Plan is the best source of information concerning land use issues.

Population

The 2005 population of the City of Prineville is 8942. The population within the Urban Growth Boundary is in excess of 12,700 people.

The following table presents the historical population in the City of Prineville along with the annualized growth rate for each 5-year period between 1975 and 2005.

1975	1980	1985	1990	1995	2000	2005
5285	5260	5280	5435	6095	7356	8942
	-0.09%	0.08%	0.58%	2.32%	3.83%	3.98%

Population Growth Projections

Updated population projections for use in this Master Plan Update are based on growth information furnished by Prineville Planning Department who indicated that the current population of 8942 should be projected to grow at a rate of 3.5% annually over the study period resulting in a City population of 17793 in 2025.

The growth rate experienced over the last 10-years exceeds 3.5% and the numbers of residential building permits being issued in recent years together with developer interest in Prineville also indicate higher growth for Prineville. Prineville is currently growing at a rate greater than 5%. If current growth continues the projected 2025 population of 17793 will be reached at an earlier year. The projected population capacity of the current UGB is about 36,000 people.

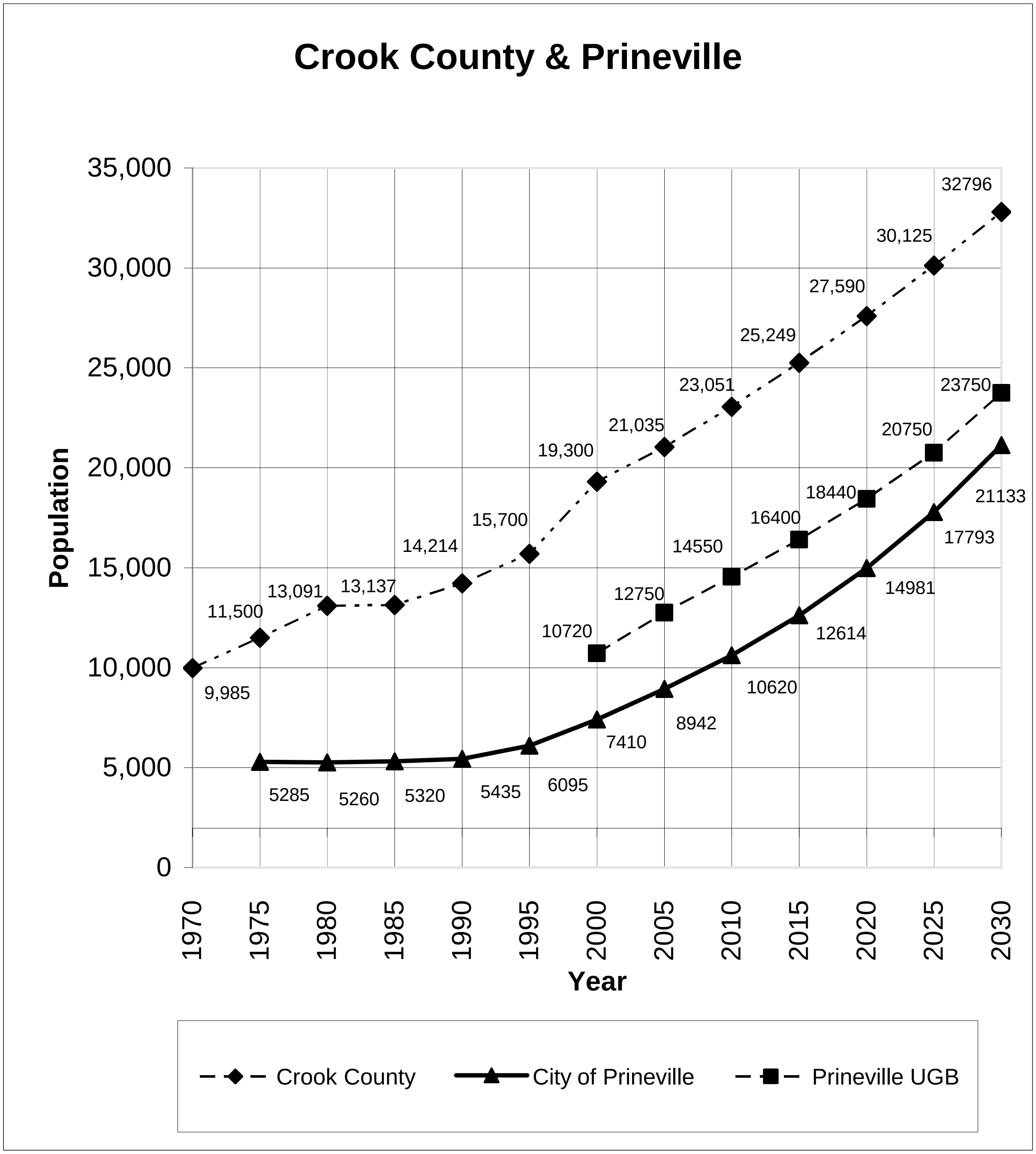
Growth Rate 3.5%

2005	2010	2015	2020	2025	2030	2035
8942	10620	12614	14981	17793	21133	25100
	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%

Growth Rate 5.0%

2005	2010	2015	2020	2025	2030	2035
8942	11412	14566	18590	23727	30282	38648
	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

A graph presenting the historical and projected population of Prineville used in this Master Plan Update, the Prineville Urban Growth Boundary, and Crook County is presented on the next page.



Crook County & Prineville
Population
Year
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
9,985
11,500
13,091
13,137
14,214
15,700
19,300
21,035
23,051
25,249
27,590
30,125
32796
10720
12750
14550
16400
18440
20750
23750
5285
5260
5320
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6095
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8942
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14981
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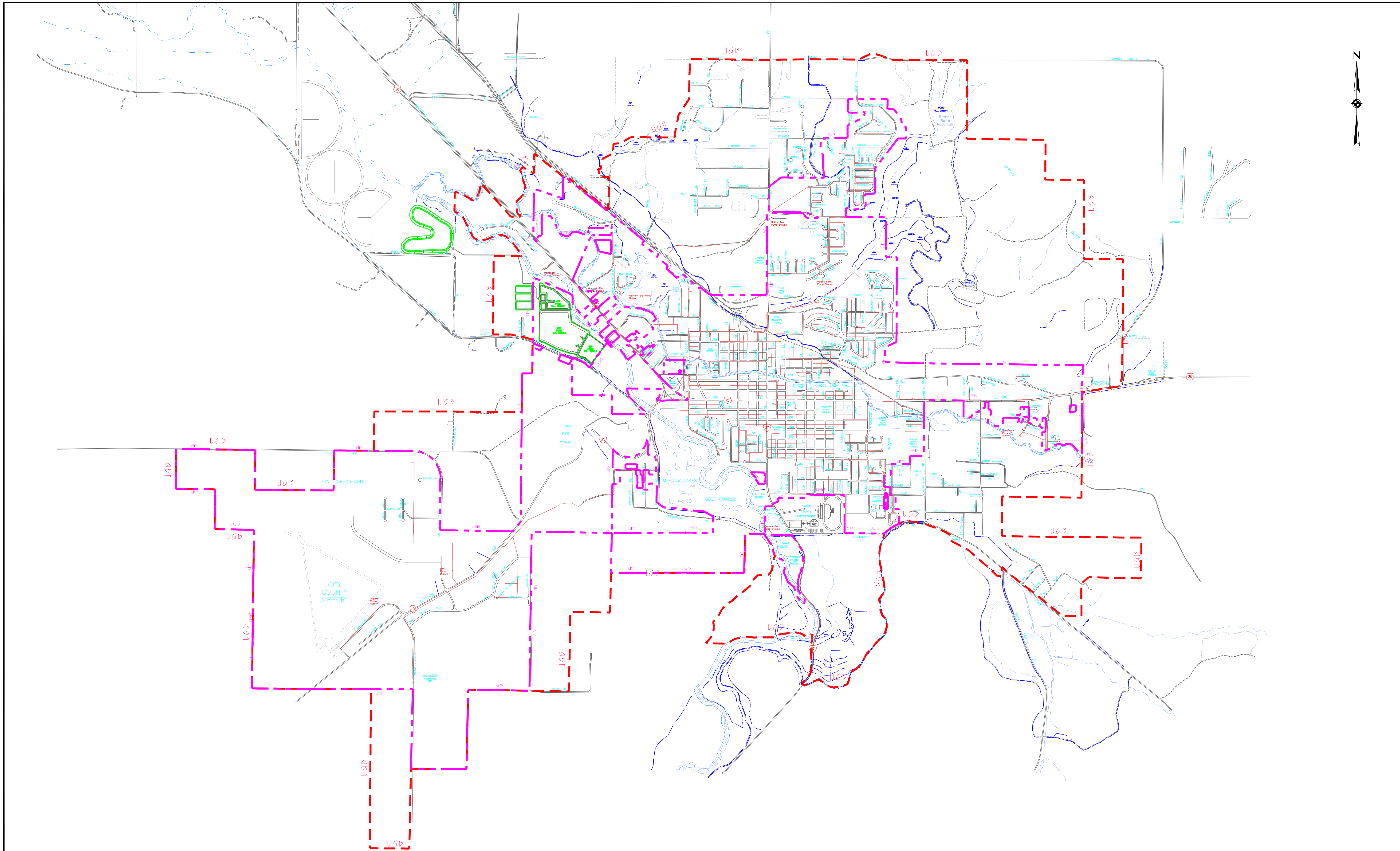
21133
Crook County
City of Prineville
Prineville UGB



STUDY AREA MAP

\\SERVER\PROJECTS\PRINEVILLE\PRINEVILLE 050201\2005 WW REPORT\PRINEVILLE WW FACILITY PLAN UPDATE 2005\
STUDY-AREA.DWG

Background Information

Substantial effort was expended to gather and update the existing water system maps and inventory because of lacking accurate and updated records. The water system maps the City inherited from Pacific Power and Light Company were used and scaled to prepare a base map and then updated with many as-constructed drawings obtained from the City. The water system maps and inventory were further reviewed by the City Public Works and revised accordingly. The information presented herein has been gathered and prepared based on the available records and to the best knowledge of all contributors.

Water Sources and Water Rights

The City's current water supplies are primarily from six (6) "deep" wells, which extract ground water from depths ranging from 150 feet to 400 feet, and are all located within the Ochoco-Crooked River Valleys. The six (6) primary wells are identified as the Yancey Well, the South 4th Street "deep" Well, the Lamonta Well, the Airport Well, the Stearns Well, and the Barney Well. Other wells within the overall system include the Ochoco Heights Well, the South 4th Street "shallow" Well, and the Stadium Well.

The Yancey Well was first constructed in 1947, and reconstructed in 1975. The well is an 8-inch diameter well cased to a depth of 239 feet. The well is equipped with a 40 HP turbine pump, is rated at a production level of 350 gpm, and currently produces an average of 210 gpm.

The South 4th Street "Deep" Well was constructed in 1960 with a 12-inch casing. The well is 252 feet deep, and is equipped with a 50 HP turbine pump. The well was rehabilitated in April 2005 and its capacity has increased from 200 gpm to 450 gpm.

The Lamonta Well was constructed in 1957 to a depth of 256 feet with a 12-inch casing inside a 24-inch casing. The well is fitted with a 50 HP turbine pump currently producing an average of 250 gpm with a rated capacity of 450 gpm.

The Barney Well was first drilled in 1995 with a 12-inch casing to a depth of approximately 250 feet. A 75-hp American Turbine Model 8-H-50 well pump was installed in 1999 with a rated capacity of 600 gpm at 322 feet of total head. The well was put in service at the end of 1999 and was rehabilitated in 2001-2002. The Stearns Well was constructed in 1974 at a depth of 246 feet with a 12-inch casing. The well is fitted with a 75 HP turbine pump currently producing an average of 600 gpm with a rated capacity of 550 gpm. Although Barney and Stearns Wells can each produce more than 500 gpm, their combined output was tested to be around 700 gpm because of their proximity to each other.

The Airport Well, although initially constructed a number of years prior, was reconstructed in 1996 to a depth of about 450 feet with a 12-inch casing. The well is equipped with a 60 HP Pump (replaced in Uly 2005) with a rated capacity of 325 gpm and is currently producing an average of 270 gpm.

The Ochoco Heights Well was constructed in 1943 to a depth of 318 feet with a 12 inch casing. The well, equipped with a 30 HP turbine pump, was rehabilitated in June 2003 and its production has increased from the rated 160 gpm to 380 gpm. This well was reactivated and put in use recently after rehabilitation.

The South 4th Street "Shallow" Well was constructed in 1950 to a depth of only 41 feet. The well was completed with a 10-inch casing, and is equipped with a submersible pump with a rated capacity of 180-200 gpm.

Stadium Well was constructed in 1987 to a depth of 260 feet with a 12-inch casing. The well, equipped with a 40 HP turbine pump, has a limited capacity of 240 gpm with considerable drawdown. This well has sand and iron problems and the City has installed a filter to remove them. This well is, therefore, utilized only as an emergency backup source for short periods of time.

Recharge of the aquifers serving Prineville is from the Crooked River, Ochoco Creek, and McKay Creek drainage basins. Annual recharge from these three (3) drainage basins is estimated to average 13 mgd (million gallons per day). This is more than 4 times the ultimate average demand for water forecast for a city of 25,000 persons. No water from any of the streams within these drainage basins directly enters the City's wells. The City holds water rights equal to 5.42 mgd as shown below.

	Permitted Rate		
Exist Water Rights	(cfs)	(gpm)	(mgd)
4th Street Deep	1.1	494	0.71
4th Street Shallow	1	449	0.65
Airport	Limited License	8 hours/day	
	0.668	300	0.43
Barney*	Combined Barney and Stearns Permitted Rate=		
Stearns*	*1.56*	*700*	*1.01*
Lamonta	1.1	494	0.71
Stadium (permitted**)	0.947	425	0.61
Yancey	0.8	359	0.52
Ochoco Hts	1.2	539	0.78
Total	**8.375**	**3,760**	**5.42**

** The permitted combined output of Barney and Stearns wells is 700 gpm.*
***The Stadium Well water right is a permit, rather than a certificate.*

The inventory of existing wells is shown at the end of this chapter.

Water Storage

Four covered water storage reservoirs are in place throughout the City with a total storage capacity of 3.5 million gallons. The overflow elevation and the maximum storage volume in mg(millions of gallons) of each reservoir are shown in the table below.

Reservoir	Overflow (Ground Surface) Elevation (feet above sea level)	Capacity (mg)
Ochoco Hts. #1	2983 (2933)	0.5
Ochoco Hts. #2	2983 (2933)	0.5
American Pine	2978 (2947.5)	1.0
Barnes Butte	3099 (3060.5)	0.5
Airport	3400 (3376)	1.0
	Total	3.5

The Ochoco Heights Reservoir No. 1 is an aboveground welded steel tank constructed in 1955 with a diameter of 41.5 feet and a height of 50 feet. The tank has an operating range of 40 to 50 feet. The Ochoco Heights Reservoir No. 2 is also an aboveground welded steel tank constructed in 1964 with the same dimensions as Reservoir No. 1, and the same operating range. These two reservoirs provide the water supplies for a significant part of the City, primarily to the north and northwest of the tanks.

The Barnes Butte Reservoir is also an above ground welded steel tank that was constructed in 1978. The tank has a diameter of 47 feet and a height of 40 feet with an operating range of 28 to 38 feet. The Airport Reservoir, constructed in 1996, is an above ground bolted steel tank with a diameter of 85 feet and a height of 24 feet. The operating range of said tank is 22.5 to 23.8 feet.

The American Pine Tank No. 1 located south of Perters Road is an aboveground welded steel tank constructed in 2002 with a diameter of 73 feet and a height of 33 feet. Unable to attain the property for the 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.

Water Treatment

The well water receives no further treatment other than chlorination to ensure safe drinking water.

Water Distribution and Booster Stations

DISTRIBUTION NETWORK

The City of Prineville water distribution network is made up of a combination of asbestos- cement, cast / ductile iron, galvanized steel, wrapped steel, woodstave pipe, and PVC pipelines ranging from 1" to 18" in diameter. The pipeline system totals about 42 miles. The table below presents a breakdown of the length for each nominal pipe size. More than half of the total pipeline footage is made up of 6" and 8" pipes. About 11% of the pipe footage is made up of pipes 4" and smaller in diameter which are smaller than the 6" diameter minimum pipe size established by most municipal systems.

Diameter (inches)	Length (feet)	%
2" and smaller	7,600	3.43%
3"	720	0.32%
4"	15,000	6.78%
6"	65,400	29.55%
8"	61,000	27.56%
10"	7,300	3.30%
12"	46,400	20.97%
16"	14,600	6.60%
18"	3,300	1.49%
Total	**221,820**	**100%**
	(42 miles)	

In order to provide services to the Northridge area north of Ochoco Hts Tanks, a booster pump station was installed in 1998. There are three Syncroflo close-coupled pumps with 15 HP, 25 HP and 50 HP motor respectively. The station was designed to deliver up to 1500 gpm with three pumps in operation. A pressure regulator on the pump discharge limits the delivery pressure to 80 psi.

In conjunction with the construction of American Pine Tank, a booster pump station was installed in 2002 to provide water to the Northridge area. There are three Cornell close-coupled pumps with two 20 HP and one 75 HP motor respectively. The station was designed to deliver up to 1530 gpm at 181 feet of head with three pumps in operation.

In 1999, a fire booster station was constructed to provide 4000-gpm fire flow to the yard hydrant at Les Schwab warehouse site at the Airport. One 75 HP Cornell Model 10YB booster pump with a design capacity of 4000 gpm at 60 feet of total head was installed and a space was provided for the installation of a second pump in the future.

PRESSURE ZONES

The existing network is divided into various pressure zones, i.e. Airport Industrial Area, Downtown, Ochoco Heights Area, Northridge area, and Barnes Butte Area to the east as summarized below.

Pressure Zone	Highest Ground El	Hydraulic Control	Tank Full El	Tank Empty El	High Static Pressure (psi)	Low Static Pressure (psi)
Airport	3280	Airport Tank	3400	3377	52	42
Downtown	2890	Ochoco Tank	2983	2933	40	19
Ochoco Hts	2950	Booster Station w/ Discharge Regulator			80	
Barnes Butte	2920	Barnes Butte Tank	3099	3059	77	60
American Pine Tank		American Pine Tank w/Booster Pumps	2978 3158	2948 3128		
Northridge	3050	Ochoco & American Pine Booster Pumps			47	34

Pressure regulars listed below are used to link two pressure zones.

- Airport Well PRV : 65 psi
- Airport PRV at Park Drive : 18 psi
- Williamson PRV : 66 psi (adjusted higher in the summer)
- Combsflat PRV : 46 psi (adjusted higher in the summer)

Existing Water System Inventory

WELLS

Ochoco Heights Well

Constructed	1943
Depth	318 feet
Casing	12 inch diameter
Pump	7 stage 8" turbine pump
Motor	40 HP GE 240 volts
Column	220 feet / 7" diameter
Disinfection	Chlorine down well - 1968
Capacity	
Rated	160 gpm
Current	380 gpm

Yancey Well

Constructed	1947 / 1975
Depth	239 feet
Casing	8 inch diameter
Pump	Fairbanks Morse 20 stage 7" Fig. 6927
Motor	40 HP GE 240 volts
Column	188 feet / 5" diameter
Disinfection	Chlorine down well - 1973
Capacity	
Rated	350 gpm @ 310 ft
Current	300 gpm

South 4th Street Deep Well

Constructed	1960
Depth	252 feet
Casing	24 inch gravel pack with 12 inch casing
Pump	Fairbanks Morse 8 stage 8" turbine pump
Motor	50 HP US 240 volts
Column	222 feet / 6" diameter
Screen	20.5 feet / 12" diameter 100 mm slot
Disinfection	Chlorine down well
Capacity	
Rated	400 gpm
Current	250 gpm

South 4th Street Shallow Well

Constructed	1950
Depth	41 feet
Casing	10 inch
Pump	Submersible
Motor	
Column	21 feet / 6” diameter / foot valve
Disinfection	Chlorine into main (6000 gal detention tank)
Capacity	
Rated	NA
Current	150 gpm

Lamonta Well

Constructed	1958
Depth	252 feet
Casing	10”
Pump	Fairbank Morse 8 stage 6” turbine
Motor	50 HP GE 440 volts
Column	230 feet / 6” diameter
Disinfection	Chlorine down well
Capacity	
Rated	450 gpm
Current	360 gpm

New Stearns Deep Well

Constructed	1974
Depth	246 feet
Casing	24” gravel pack 12” casing
Pump	7 stage 6” Layne Bowler turbine
Motor	75 HP US 440 volts
Column	151 feet / 6” diameter
Disinfection	Chlorine down well
Capacity	
Rated	550 gpm
Current	675 gpm

Stadium Well

Constructed	1987
Depth	260 Feet
Casing	12-inch Casing
Pump	Berkeley 6T-250
Motor	
Column	feet / ” diameter
Disinfection	
Capacity	
Rated	Gpm
Current	220 gpm

Airport Well

Constructed	1996
Depth	Feet
Casing	Casing
Pump	Crown S6-290
Motor	60 HP
Column	Feet / ” diameter
Disinfection	Chlorine to discharge
Capacity	
Rated	300 gpm
Current	300 gpm

Barney Well

Constructed	1999
Depth	250 Feet
Casing	12” Casing
Pump	American Turbine 8-H-50
Motor	75 HP
Column	Feet / ” diameter
Disinfection	
Capacity	
Rated	600 gpm
Current	600 gpm

WATER STORAGE TANKS

Ochoco Heights Storage Tank 1

Constructed	1955
Capacity	500,000 gal
Material	Welded Steel
Diameter	41.5 feet
G.S. Elevation	2933.0 feet
Height	50 feet
Operating	40.0 to 50.0 feet
Control	

Ochoco Heights Storage Tank 2

Constructed	1964
Capacity	500,000 gal
Material	Welded Steel
Diameter	41.5 feet
G.S. Elevation	2933.0 feet
Height	50 feet
Operating	40.0 to 50.0 feet
Control	

Barnes Butte Storage Tank

Constructed	1978
Capacity	500,000 gal
Material	Welded Steel
Diameter	47 feet
G.S. Elevation	3060.5 feet
Height	40 feet
Operating	28.0 to 38.0 feet
Control	

Airport Storage Tank

Constructed	1996
Capacity	1,000,000 gal
Material	Bolted Steel
Diameter	85
G.S. Elevation	3376 feet
Height	24 feet
Operating	22.5 to 23.8 feet
Control	

American Pine Storage Tank

Constructed	2002
Capacity	1,000,000 gal
Material	Welded Steel
Diameter	73 feet
G.S. Elevation	2948 feet
Height	33 feet
Operating	
Control	

BOOSTER PUMP STATIONS

Ochoco Heights Booster Pump

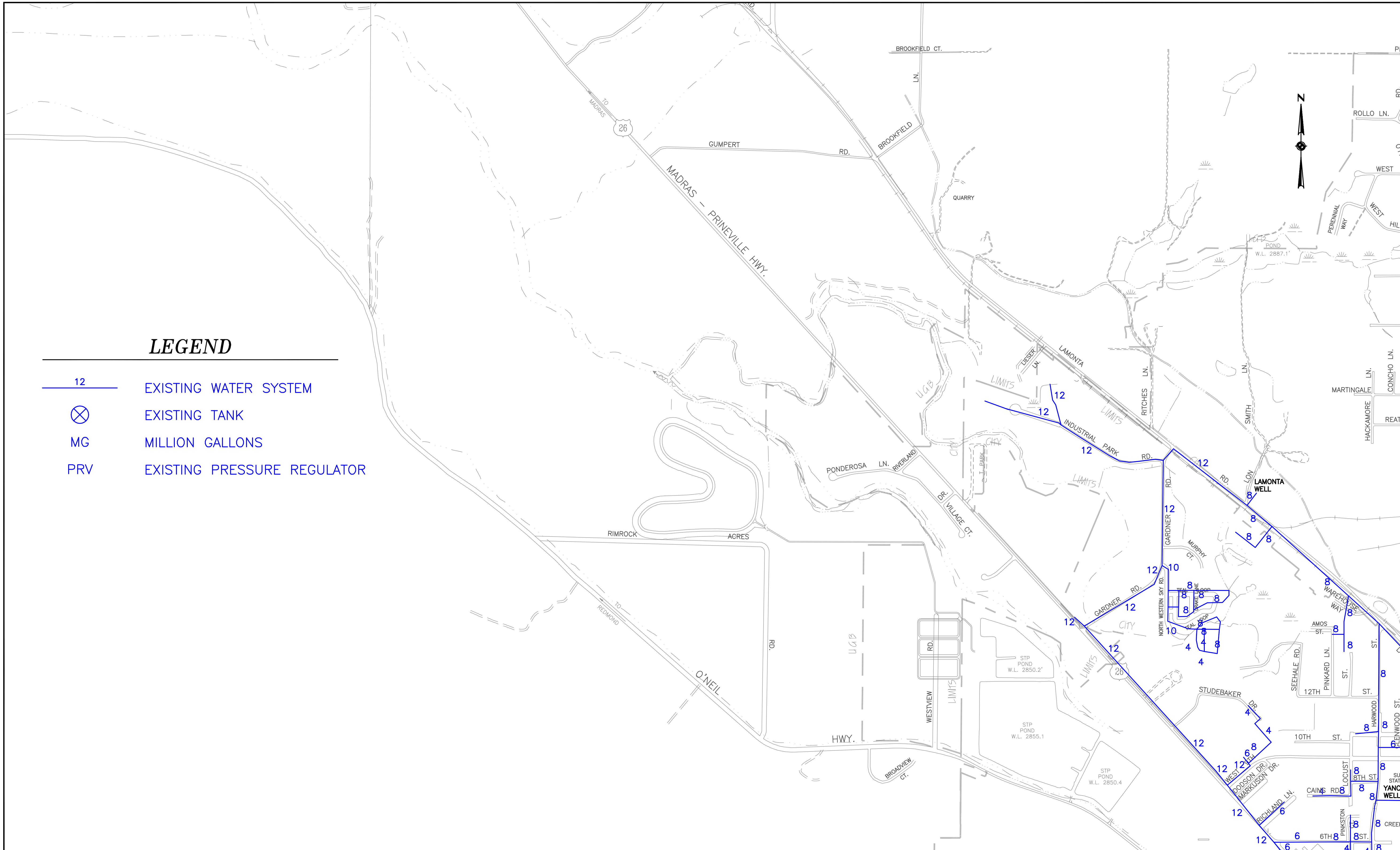
Constructed	1997
Pump 1	Syncroflo CC 1570-5
	15 HP
	200 gpm @ 166 feet
Pump 2	Syncroflo CC 2570-7
	25 HP
	400 gpm @ 166 feet
Pump 3	Syncroflo CC 4070-7
	50 HP
	900 gpm @ 166 feet

Airport Fire Booster Pump

Constructed	1999
Pump 1	Cornell 10YB-75-4
	75 HP
	4000 gpm @ 60 feet
Pump 2	Future

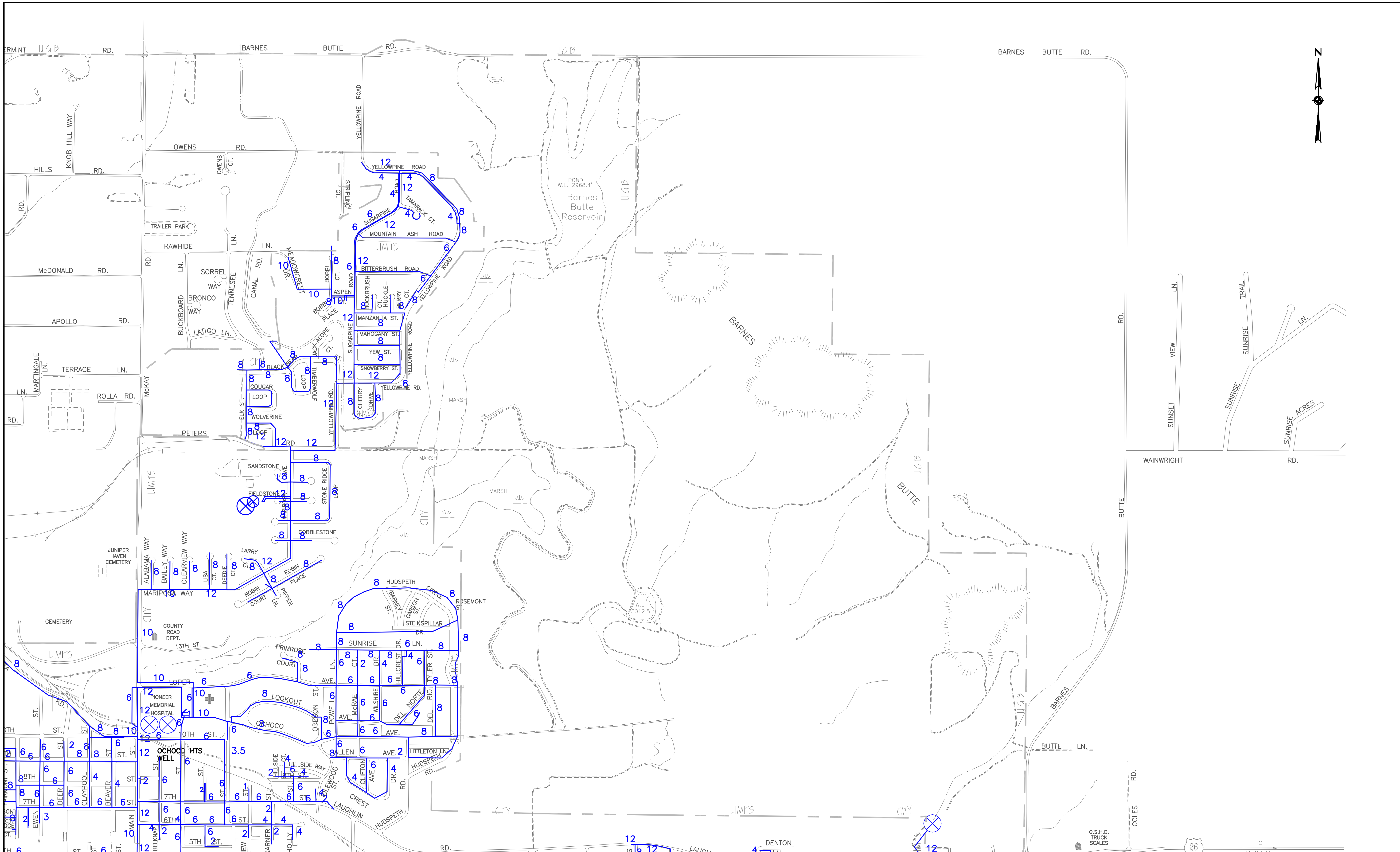
American Pine Booster Pump

Constructed	2002
Pump 1	Cornell 2.5WB
	20 HP
	250 gpm @ 185 feet
Pump 2	Cornell 2.5WB
	20 HP
	250 gpm @ 185 feet
Pump 3	Cornell 5WB
	75 HP
	1000 gpm @ 181 feet

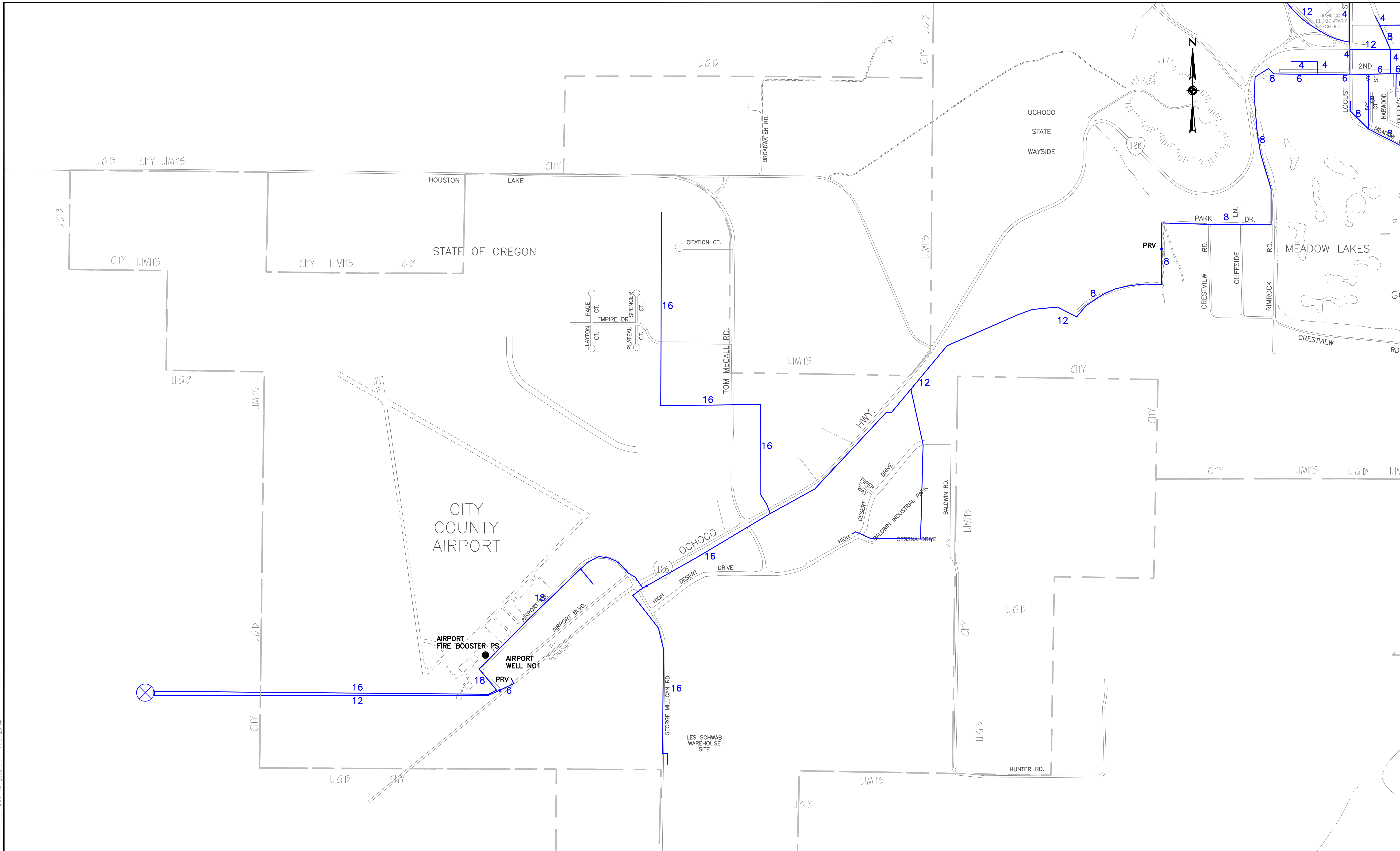


PRINEVILLE EXISTING WATER SYSTEM – NW | *FIG 4–1*

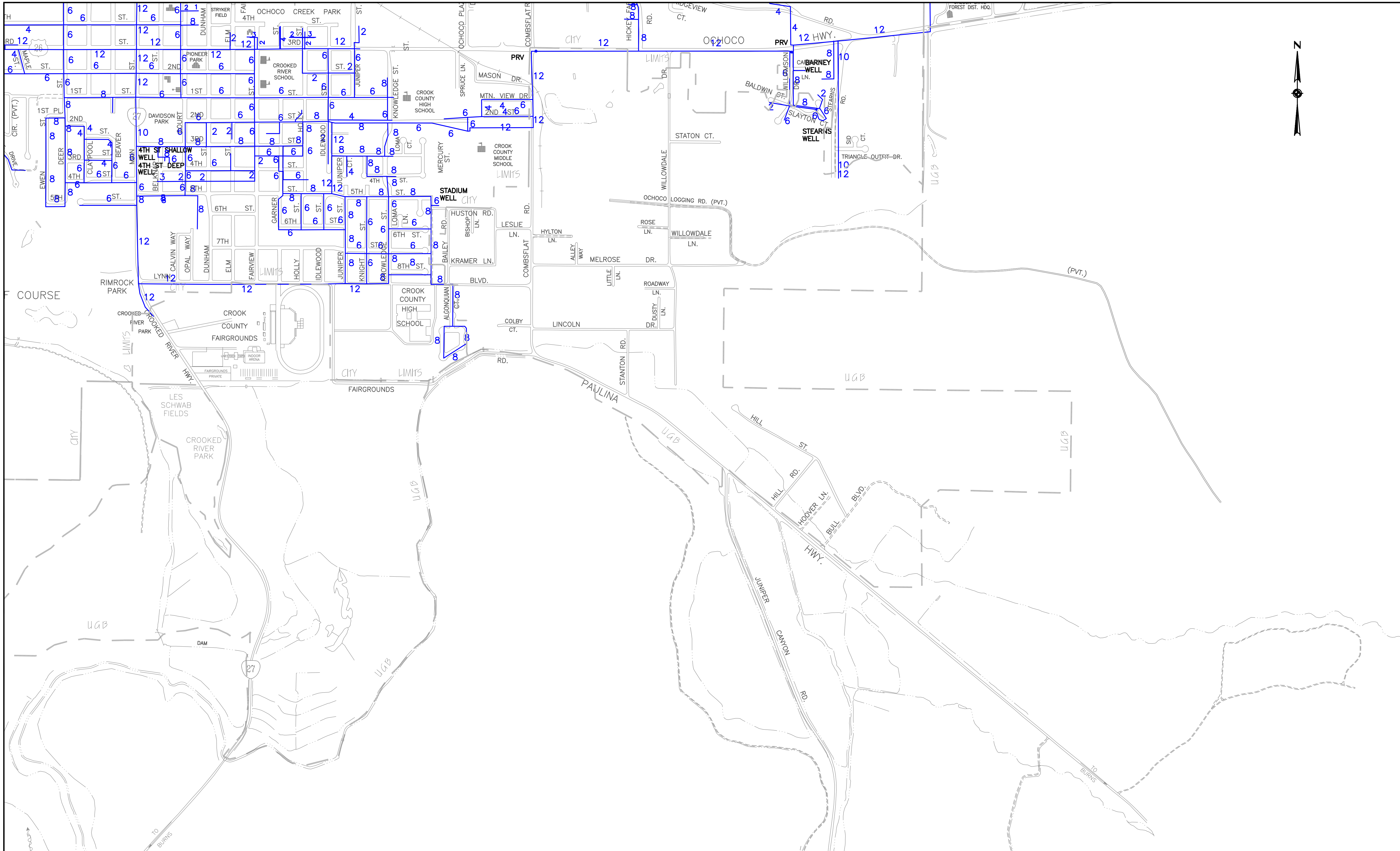
\\SERVER\PROJECTS\PRINEVILLE\PRINEVILLE 050201\WATER MASTER PLAN UPDATE\REPORT\REPORT DRAWINGS\
FIG 4-1.DWG



PRINEVILLE EXISTING WATER SYSTEM – NE | **FIG 4–2**



PRINEVILLE EXISTING WATER SYSTEM – SW | *FIG 4–3*



PRINEVILLE EXISTING WATER SYSTEM – SE | FIG 4–4

Chapter 5 - System Evaluation Criteria and Design Standards

Summarized in the following are system evaluation criteria and design standards used in this facility plan.

Oregon Drinking Water Quality Act / OAR 333

OAR Chapter 333 provide a basis for implementing the Oregon Drinking Water Quality Act of 1081. The OAR 333-061-0030 stipulates the maximum contaminant levels (MCLs) for inorganic chemicals, organic chemicals, turbidity, microbiological contaminants, radioactive substances secondary contaminants, and Acrylamide and Epichlorohydrin.

The rules also spell out the disinfection requirements for systems without filtration. The disinfection treatment must be sufficient to ensure at least 99.9 percent (3-log) inactivation of *Giardia lamblia* cysts and 99.99 percent (4-log) inactivation of viruses, every day the system serves water to the public, except any one day each month. Each day a system serves water to the public, the public water system must calculate the CT value(s) from the system's treatment parameters and determine whether this value(s) is sufficient to achieve the specified inactivation rates for *Giardia lamblia* cysts and viruses.

Design Fire Flows

The 1997 Uniform Fire Code has been adopted by the City of Prineville to determine the fire flow requirements for buildings. The requirements are divided into two categories.

1. One- and two- Family Dwellings: The minimum fire flow and flow duration for dwellings having a fire area not exceeding 3,600 square feet shall be 1,000 gpm for 2 hours. Dwellings with a fire area in excess of 3,600 square feet shall not be less than that specified in the code. A reduction in required fire flow of 50% is allowed when the building is provided with an approved automatic sprinkler system.
2. Buildings other than One- and two- Family Dwellings: The minimum fire flow and flow duration range from 1,500 gpm for 2 hours to 8,000 gpm for 4 hours depending on the fire area and type of building construction (per Building Code). A reduction in required fire flow up to 75% is allowed when the building is provided with an approved automatic sprinkler system, but the required fire flow shall not be less than 1,500 gpm.

The fire flow is measured at 20 psi residual pressure. Generally, the fire flow for single family dwellings would be 1,000 gpm, whereas that for commercial buildings would be in the 3,000 gpm range. For industrial buildings, schools and other large structures, fire flow would likely be 4,000 gpm or more. The Fire Marshall shall have the authority to determine the required fire flow and duration in accordance with the Uniform Fire Code. To avoid having to construction large mains for delivering 3,000 to 4,000 gpm fire flows and provide additional fire storage, the City shall require every new or improved building for commercial and industrial uses to have an approved automatic sprinkler system. This will reduce the required fire flow to 1,500 gpm for 2 hours.

Insurance Services Office (ISO) determines the needed fire flow (NFF) and classifies public fire protection system. The Public Protection Classification (PPC) rating has a relative scale from 1 to 10 with 10 indicating the poorest system (below the minimum recognized protection) and 5 being the average.

Sources

The calculated additional well capacity required is based on the condition that well pumps are sized to meet maximum day demand and additional water storage is available to provide flow equalization during peak hour demand periods. For the City of Prinevilee, the required source capacity should be based on a minimum of 730 gpd per EDU for the proposed residential development plus the projected maximum day demand for commercial and industrial associated with the development.

Storage Volume and Locations

The total required storage volume is the sum of

1. Equalization storage, which is the volume of water required to meet peak hour demand in excess of maximum day demand
2. Reserve storage sufficient to supply the system's needs during disruption of supply capabilities
3. Fire Storage equal to the volume of water needed to meet a fire flow of given flow rate and duration in the reservoir service area

The reserve and fire-fighting storage volume is defined as standby storage to meet demands during an emergency, such as a transmission line failure, well pump failure or pump power outage, or a fire. The required storage volume for the City of Prineville should be calculated based on the following:

Storage Volume = MDD +ADD + Equalization Storage + Fire

The equalization storage is calculated based on providing the excess flow over the MDD for 6 hours assuming peak flow is 4 times of the average day demand.

The reservoir or storage tank shall be located at an elevation that provides minimum static pressures of no less than 40 psi at the minimum operating water level.

Distribution System

Although 6” pipe was used extensively in distribution in the past, 8-inch pipe is fast becoming the minimum size now installed. Many communities have limited the pipe used in the distribution system to 8-inch, 12-inch or 16-inch with no intermediate sizes permitted. The City of Prineville has already adopted the 8” size as the minimum distribution pipe. For the commercial and especially industrial development, a minimum size of 12” should be established. The City should also require looping of distribution mains to avoid deadend situation and promote fire flow.

The distribution system should be designed to convey water to customers at adequate service pressures and to provide fire flows. During the peak hour demand, the system pressures should not be less than 30 psi. The distribution system should also be designed so that the residual pressure under the required fire during the maximum day demand periods is 20 psi or more.

The hydrant spacing shall be no more than 500 feet for residential areas and 300 feet for commercial and industrial areas.

Valves should be provided at every tee and cross to facilitate isolation. A minimum of two valves should be required for a tee and three valves for a cross. The distance between any two isolation valves shall not exceed 1,000 feet.

Cost Estimate Reliability

The cost estimates made for this Facility Plan are order-of-magnitude cost estimates made without detailed engineering design data. They are based on estimating book values, cost curves, ratio of comparable data from other comparable facilities and our best estimates. The American Association of Cost Engineers estimates the reliability of such estimates as normally expected to be accurate within +50% and –30%, meaning that the real cost might be as much as 50% more of 30% less than the estimated amount. The order-of-magnitude level estimates are generally accepted as appropriate for planning level studies like facility plans.
Once an alternative has been selected and preliminary design calculations, layouts, equipment details, and 50% plans have been prepared a budget level estimate, normally accurate to within +30% or –15% can be made. When final plans and specifications have been completed and estimate expected to reflect bid prices within +15% and –5% can be made.

Chapter 6 - Water Requirements and Existing System Evaluation

Background Data

The City converted their billing system to a new system in May 2005. The water metering records prior to May 2005 were not available from the new system. Therefore actual water usage cannot be analyzed and presented in this update.

Much of effort in the 2000 Water Facility Plan was expended in gathering and analyzing the water usage and supply data. The monthly meter reading and account number and name for each account were manually entered in the spreadsheet from the printout data provided by the City (electronic data not available). The data was then categorized according to each water use classification (i.e. residential, commercial, industrial, public and school). The data was further refined and revised based on interviews with the City staff and inputs from the Public Works to correct possible data errors. Unmetered water usage including that through bulk water sale, City Hall cooling water and Golf Course usage, main break, etc. was estimated based on the data provided by the City. The well production data was analyzed and compared with the water usage (metered amount plus estimated unmetered amount).

Lacking inflow and outflow data at each reservoir, no diurnal curve (flow or water demand fluctuations during a 24 hour period) could be prepared and presented.

Water Requirements

USE CLASSIFICATION AND EXISTING WATER USAGE

The City of Prineville currently classifies water users under three general classifications; Residential, Commercial, and Industrial. The Residential classification is further divided into classes for multi-family units and complexes (apartments), mobile homes, and single-family units. Other major uses include public (government) and school users.

The primary and predominant use of water within the City of Prineville is residential. The dominant residential use is single-family owner-occupied housing and it is expected to remain so. The Comprehensive Plan and the per capita use that the City has experienced, and the fact that more than 80% of the installed meters are 3/4-inch and 1-inch sizes support this conclusion.

The table below shows water usage by major use classification for the 12 months from January 1998 through December 1998. Based on this data, the average 1998 residential water use was 130 gallons per capita per day (gpcd). The City does not maintain records for peak day usage but keeps monthly production and usage records. The highest monthly production period in 1998 was for the months of June through September, with the highest usage months being July through September.

Month	Residential	Commercial	Industrial	Public	School	Total
	Million Gallons					
Jan	19.3	4.8	0.9	0.7	0.6	26.3
Feb	10.5	3.1	1.0	0.3	0.5	15.4
Mar	13.7	4.2	1.9	0.3	0.5	20.6
Apr	11.1	3.5	1.7	0.8	0.5	17.6
May	21.9	6.0	2.2	1.5	0.8	32.4
Jun	20.4	6.3	1.8	1.5	0.9	30.9
Jul	42.5	6.5	2.6	2.8	0.9	55.3
Aug	36.6	6.5	2.1	2.0	1.4	48.6
Sep	36.3	7.5	2.0	1.7	1.3	48.7
Oct	15.1	3.2	1.2	0.9	1.6	22.1
Nov	18.3	3.2	2.4	0.5	0.5	24.9
Dec	17.1	4.6	2.2	0.6	0.6	24.8
Estimated Unmetered Usage				*29.1*		*29.1*
Total	**262.8**	**59.4**	**22.0**	**42.5**	**10.1**	**396.8**
%	**66%**	**15%**	**5.5%**	**11%**	**2.5%**	**100%**

The estimated unmetered water usage (gallons) includes,

Bulk Water Usage	794,510
Estimated Public Usage:	
City Hall (*)	23,725,000
Golf Course Irrigation	4,500,000
Main Break in October (**)	120,000
Total	**29,139,510**

(*) Assumed 65,000 gpd usage

(**) 4,000 gpm for 30 minutes

During these periods, the City's system produced an average of 1,234,800 gallons per day (1.23 mgd), and the average daily usage was 1,087,200 gallons per day (1.09 mgd). The difference between the water production and usage represents the water unaccounted for or water loss of about 12%. Residential usage is calculated to be about 66% of the total usage for this period even though over 80% of water accounts are residential.

WATER PRODUCTION AND DEMAND FLUCTUATIONS

The City of Prinville operates wells manually and manages water supply to meet fluctuating water demands. Figure 6-1 shows the well production vs. average daily water consumption for 12 months in the Year 1998. The daily water production rate and average daily water usage generally follow the same trending pattern, i.e. peaking in July and August. The total water production was recorded every day, whereas the metered monthly water usage was read at different times according to the route schedule and meter reading cycle. Therefore, the metered water usage may not accurately depict the actual monthly usage because of various meter reading cycles and routes. As expected, water use is greatest in the summer months. The highest monthly day demand occurred in July.

Fig. 6-1 Average Daily Well Production vs Water Consumption

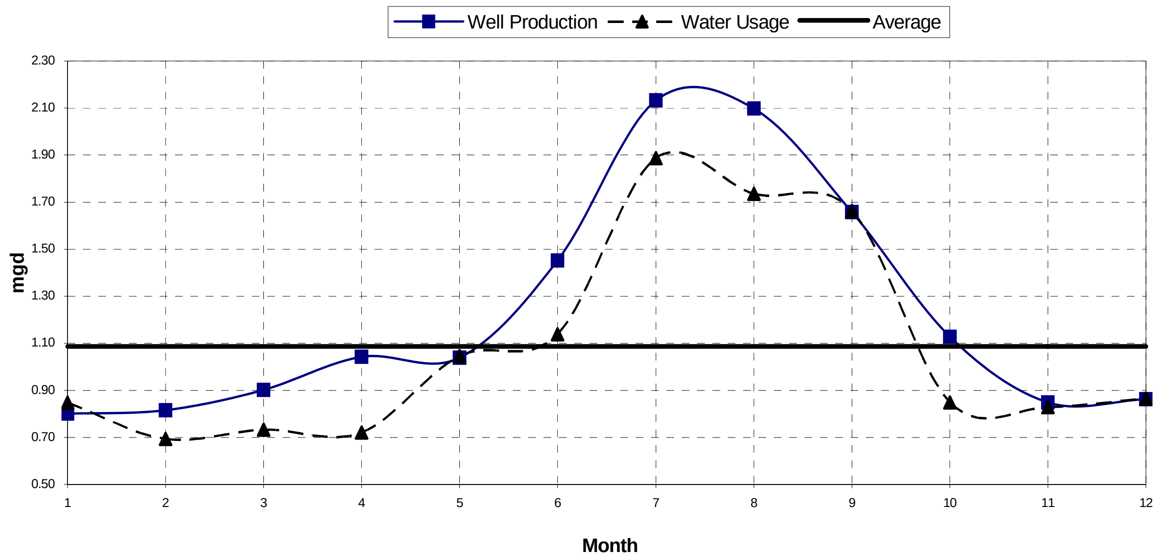
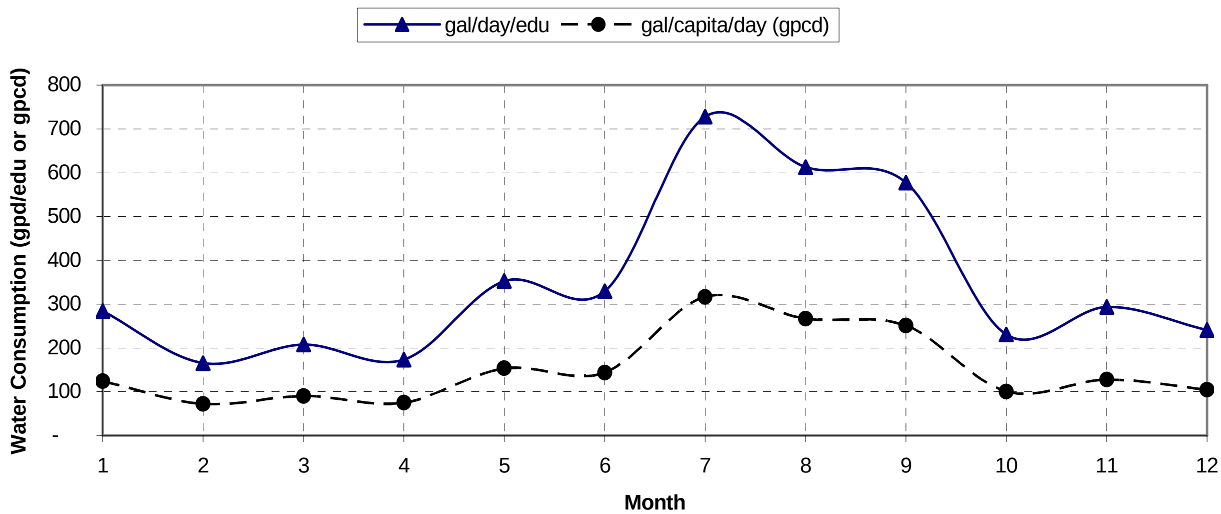


Figure 6-2 depicts the residential water usage variations over a 12-month period in 1998. The high usage in summer months resulted from the heavy use of water in irrigation. The water usage was generally low from October to April and stayed fairly constant. The maximum day demand (MDD) to average day demand (ADD) ratio was about 2.5, fairly consistent with the other cities in eastern Oregon such as Madras and Heppner.

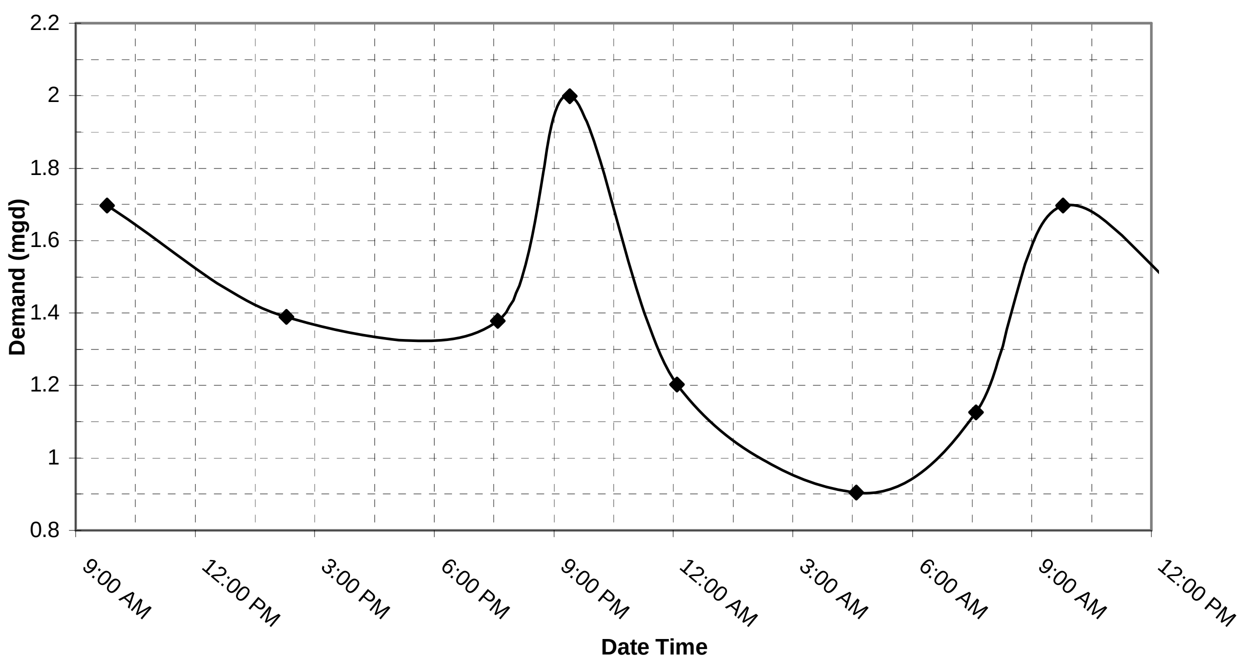
Fig, 6-2 Residentail Water Consumption



Based on the ADD of 130 gpcd (gallons per capita per day) for residential use and the Year 2005 average of 2.5 persons per dwelling unit, the ADD of 325 gpd per EDU (equivalent dwelling unit) and MDD of 810 gpd per EDU have been used in this update for the system network analysis.

The City does not have flow meters at storage reservoirs or tanks. Hourly flow or demand fluctuations during maximum demand days were not available. The available reservoir level charts indicated that the lowest levels usually occurred in late evenings during summer months, resulting from the heavy irrigation in these periods. This pattern is consistent with findings in other eastern Oregon cities. Figure 6-3 depicts a maximum day water consumption fluctuations (diurnal curve) in the Heppner City water system over a 24-hour period. The peaks occurred in the mornings and late evenings. The peak hour demands totaled about 6 hours, which have been assumed in this Mater Plan Update.

Fig. 6-3 Max Day Demand Curve (Diurnal)

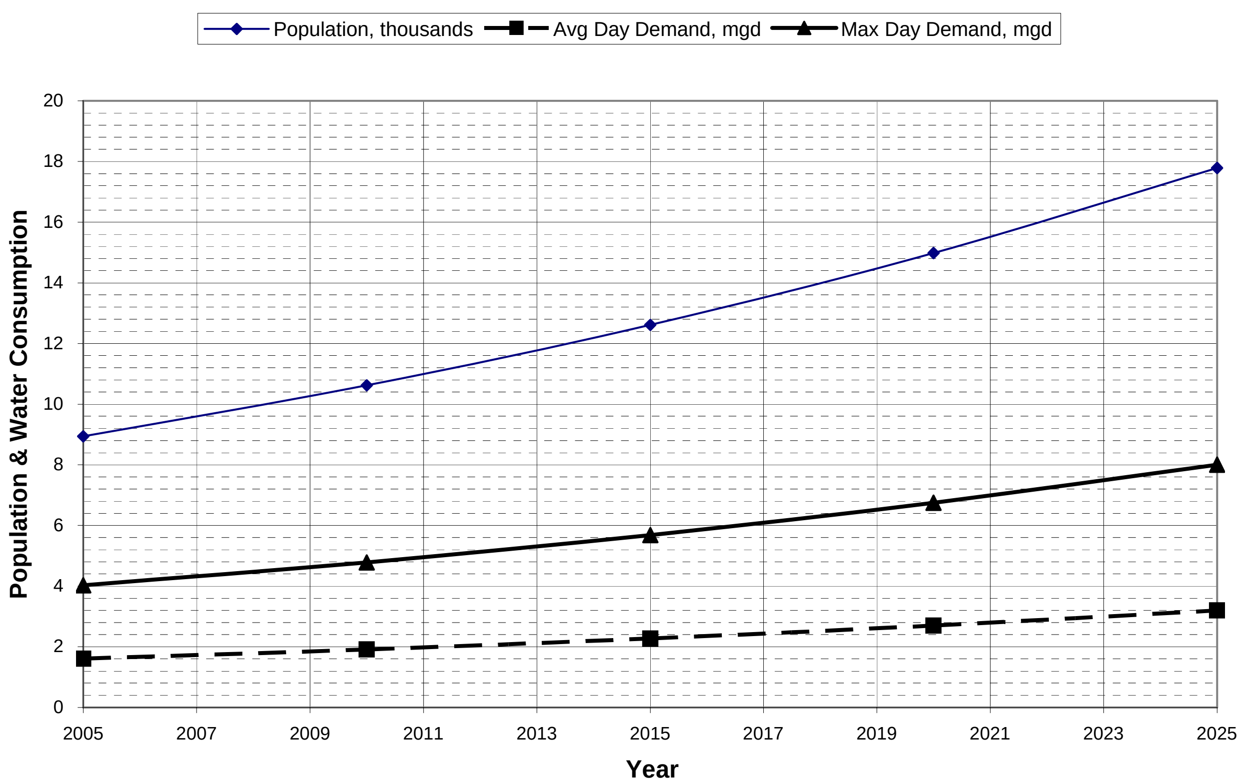


PROJECTED DEMANDS

Based on the population projections and historical water usage, the average day demand and the maximum day demand are projected and summarized below. The average day and maximum day demands are projected to double in the next 20 years from 1.6 mgd to 3.2 mgd and from 4.0 mgd to 8.0 mgd. Figure 6-4 shows the population vs. projected water demands from Year 2005 to Year 2025 and for the built-out.

Year	Population thousands	Avg Day Demand mgd	Max Day Demand mgd
2005	8.94	1.61	4.03
2010	10.62	1.91	4.78
2015	12.61	2.27	5.68
2020	14.98	2.70	6.75
2025	17.79	3.20	8.00
Built-Out	34.65	6.24	15.60

Fig. 6-4 Population & Water Consumption Projections



FIRE FLOW REQUIREMENTS

According to the Insurance Services Office (ISO) in Chicago, the City's water system is rated as Class IV/9 based on the last survey performed by ISO. The needed fire flows as determined by the Insurance Service Office for some of the surveyed buildings in Prineville are summarized in the following:

Building Description	Location	Needed Fire Flow (gpm)
Cecil Sly Elementary School	1400 SE 2nd	5,500
Crook County Middle School	Knowledge	4,500
Millwork Ltd	Lamonta	4,500
CLM Produce & Ochoco Fuel Office	McKay	4,000
Ochoco Feed & Farm Supply	W 10th, Lamonta	4,000
Nelson Co	Lamonta	3,500
Arjo Inc-Crook Co Nursing Home	1201 N Elm	3,000
Best Western Motel	1475 E 3rd St.	3,000
Bishop Tire Service	740 N Main	3,000
Prineville Country Club Restaurant	Meadow Lakes	1,750

Water Sources

REGIONAL AQUIFER SYSTEM

The City of Prineville uses three separate aquifer systems to supply drinking water. The principal source of ground water used by the City is the confined aquifer that underlies the Prineville Valley floor. The City supplements the water supply during periods of peak water demand by using the shallow groundwater table that also underlies the Prineville Valley floor. The third aquifer is the regional Upper Deschutes Aquifer located west of the City.

The main confined aquifer that underlies the Prineville Valley floor is a ten to twenty foot thick lens of sand and gravel located about 250 feet below a series of clay, sand and silt beds; the elevation of the top of this aquifer ranges from 2,678 at the Barney well to 2,619 at the Lamonta well. A segment of the confined aquifer is also present north of the Prineville Valley, west of Barnes Butte and passes beneath the American Pine and Coin Mills properties before merging with the main confined aquifer one mile Northwest of downtown Prineville. The elevation of the top of this aquifer is around 2,700 feet.

The shallow water-table aquifer is present below the Prineville Valley floor in the sand and gravel from 15 to 30 feet below the surface. The regional Upper Deschutes Aquifer is located west of the Prineville Valley and Upper Crooked River Valley and about 450 feet below the surface in sedimentary deposits of the Deschutes Formation.

EXISTING WELLS

The City of Prineville uses nine water wells to supply water. The main confined aquifer is tapped by the following six wells:

1. Barney Well
2. Stearns Well
3. Stadium well
4. South 4th Street-Deep Well
5. Yancy Well
6. Lamonta Well

The northern segment of the confined aquifer is tapped by the Ochoco Heights well, the shallow aquifer is used by the South 4th Street-Shallow well and the Airport well taps the Upper Deschutes Aquifer

WELL CONSTRUCTION

The June 2005 Source Water Assessment-Interim Report discusses potential problems with the construction of surface seals for the Cities water supply wells. The issues concerning each well are discussed below.

Barney Well

This casing seal is considered inadequate because not enough cement was used to seal from the surface to a depth of 207 feet.

The grout used to seal the well was placed through a tremie pipe with the opening at the bottom of the well per OAR 690-210-320 Methods of Placement of Cement Grout or Concrete. The grout was pumped until the grout reached the surface. Using this method there is no possibility that a gap in the seal given the weight and head pressure created by the grout. The low amount of grout needed to seal the well may have been caused by swelling of clay into the boring. Jonathan Sprecher RG observed the sealing of the well.

Stearns well

This casing is considered inadequate because not enough cement was used to seal from the surface to a depth of 75 feet.

The Water Well Report shows that cement grout was placed from 32 feet to 75 feet and ready mix from 0 feet o 32 feet. It appears that the 38 sacks of cement were used for the seal from 32 feet to 75 feet and the amount of ready mix was not documented.

Stadium well

Comment: The casing surface seal considered adequate.

South 4th Street-Deep well

Comment: This casing is considered inadequate because according to current Oregon Water Resources Department standards, the casing seal should extend at least five feet into the confining unit.

Answer: The well seal fulfills the requirements of OAR 690-210-130 Sealing of Wells in Unconsolidated Formations Without Significant Clay Beds.

Yancy well

Comment: The well record contains no information about a casing seal.

Answer: The Yancy well was constructed in 1917 and there is no documentation concerning a surface seal. The well was drilled using a cable tool using the drill-and-drive method; the casing was driven to 218 feet.

Lamonta well

Comment: This casing is considered inadequate because according to current Oregon Water Resources Department standards, the casing seal should extend at least 18 feet below the surface. In addition, there appears to be no casing seal outside the 24-inch diameter casing, which can allow potentially contaminated surface water to travel down the outside of the casing and into the well.

Answer: The surface seal reaches the first confining layer at 12 feet but only was placed 3 feet into the confining layer. While the surface seal does not extend to the confining layer the potential that water from the shallow aquifer reaching the confined aquifer is low to non-existent since clay, and gravel with a clay binder, is present from 12 to 31 feet.

The 24-inch casing was placed using the standard drill-and-drive method using a cable tool. This was, and still is, a common method for constructing water wells. This method does not create a boring outside of the casing that would allow the placement of a casing seal, the casing is in contact with the formation (that is why the casing is driven and not just lowered into the boring).

South 4th Street-Shallow well

Comment: The well record contains no information about a casing seal. Under these circumstances, the water system will likely be required to evaluate the construction of the current well and bring it up to current standards or formally abandon the well in favor of a new well that would be protective of the aquifer.

Answer: The shallow formations encountered during the drilling of the well are as follows:

0 feet to 6 feet	Clay and silt
6 feet to 11 feet	Coarse gravel
11 feet to 13 feet	Cemented gravel
13 feet to 28 feet	Gravel
28 feet to 38 feet	Brown sand
38 feet to 65 feet	Black sand
65 feet to 75 feet	Clay

If the surface casing seal was placed into the confining layer at 65 feet, the well would not produce any water. The surface casing seal issue is not the real problem, since any impact to the shallow aquifer would affect the groundwater. The main problem is that the 4th Street-Deep well taps the shallow aquifer in an urban area and has a higher potential to be impacted by hazardous substances from a leaking petroleum underground storage tank or chemicals disposed into a sump. The 4th Street-Shallow well is only used when water demand exceeds the water that is produced by all of the deeper wells in the water system.

Airport well

Comment: The casing surface seal considered adequate.

EXISTING WATER RIGHTS AND WELL OUTPUT

The current output from the existing wells is summarized below.

	Permitted Rate			Current Output	
Exist Water Rights	(cfs)	(gpm)	(mgd)	(gpm)	(mgd)
4th Street Deep	1.1	494	0.71	450	0.65
4th Street Shallow	1	449	0.65	200	0.29
Airport	Limited License	8 hours/day			
	0.668	300	0.43	270	0.39
Barney*	Combined Barney and Stearns Permitted Rate=			400	0.58
Stearns*	*1.56*	*700*	*1.01*	400	0.58
Lamonta	1.1	494	0.71	215	0.31
Stadium (permitted**)	0.947	425	0.61	250	0.36
Yancey	0.8	359	0.52	200	0.29
Ochoco Hts	1.2	539	0.78	315	0.45
Total	**8.375**	**3,760**	**5.42**	**2700**	**3.90**

* *The combined output of Barney and Stearns wells is 800 gpm, but only 700 gpm is permitted.*
***The Stadium Well water right is a permit, rather than a certificate.*

The City has water rights of 5.42 mgd now, which is about 2.6 mgd short of the projected 20-year MDD of 8.0 mgd. The current well output totals only about 3.9 mgd. An additional well capacity of 4.1 mgd or about 2,850 gpm would be required to meet the future demand as demonstrated in the following table.

Year	Population	Avg Day Demand	Max Day Demand	Additional Well Capacity Req'd	
	thousands	mgd	mgd	mgd	gpm
2005	8.94	1.61	4.03	0.13	90
2010	10.62	1.91	4.78	0.88	611
2015	12.61	2.27	5.68	1.78	1236
2020	14.98	2.70	6.75	2.85	1979
2025	17.79	3.20	8.00	4.1	2847
Built-Out	34.65	6.24	15.60	11.7	8124

- *Additional required well capacity = Capacity Above the existing well total output of 3.9 mgd or 2,700 gpm*

The required additional well capacity is based on that well pumps are sized to meet maximum day demand and additional water storage is available to provide flow equalization during peak hour demand periods.

Water Storage

The required storage volume in the study area is calculated and summarized in the table below based on the following:

Storage Volume = MDD +ADD + Equalization Storage + Fire

The equalization storage is calculated based on providing the excess flow over the MDD for 6 hours assuming peak flow is 4 times of the average day demand.

Year	Avg Day Demand mgd	Max Day Demand mgd	Peak Hr Demand mgd	Req'd Storage Million Gal	Additional Storage Req'd * Million Gal
2005	1.6	4.0	6.4	***7.4***	***3.9***
2010	1.9	4.8	7.6	***8.5***	***5.0***
2015	2.3	5.7	9.1	***9.9***	***6.4***
2020	2.7	6.8	10.8	***11.6***	***8.1***
2025	3.2	8.0	12.8	***13.5***	***10.0***
Built-Out	6.2	15.6	25.0	***25.3***	***21.8***

** Above the existing 3.5 million gallons storage volume; fire storage=0.96 million gallons for a 4,000 gpm fire with a 4-hour duration*

STORAGE VOLUME

Les Schwab Tire was required to meet the 4,000-gpm fire flow for a duration of 4-hour at their airport warehouse. This fire flow was used to calculate the required fire storage. Any fire storage beyond the 4,000 gpm for 4 hours could be provided from the reserve storage. With the additional fire flow of 1,500 gpm for 4 hours, the

required additional storage is 360,000 gallons reducing the reserve storage of 4.3 million gallons (Year 2000) by about 8 percent. Optionally a sprinkler system could be installed in each of those buildings to reduce the fire flow requirements.
In order to provide the required equalization, reserve and fire storage, the City needs to immediately increase the storage capacity by 4.2 million gallons. An additional storage of 10 million-gallons above the existing 3.5 million gallons would be required by Year 2025.

Water Treatment

EXISTING CONDITIONS

The well water receives no treatment, but the City is currently injecting about 0.2 mg/l chlorine solution down the well for maintaining some chlorine residual in the distribution system despite there is no evidence of coliform problems. This procedure is a continual practice from the days when the system was a private water system owned and operated by Pacific Power and Light.

Under Rule 333-061-0032 (6), "Disinfection requirements for systems using ground water" Systems using ground water sources shall provide continuous disinfection as prescribed in OAR 333-061-0050 (6) under the following conditions:

(a) When there are consistent violations of the total coliform rule attributed to source water quality;
(b) When a health hazard exists as determined by the Division.

Based on this rule, there is no need to disinfect well water at present unless the source water quality is a problem. But if the source water does not meet the coliform rules, then a disinfection system shall be provided to achieve CT values capable of 4-log inactivation of viruses, or a free chlorine residual of 0.2 mg/l after 30 minutes contact time.

WELL WATER QUALITY

Tests conducted to date by the City have shown that well water quality meets the State minimum drinking water standards. Records of testing results are referenced in Appendix A in the Final Report.

Additional tests of iron concentrations in source water were conducted in October 2002 and results are summarized in the following.

Well Location	Iron Concentration (mg/L)
4th Street	ND *(*)*
Airport	ND *(*)*
Barney	ND *(*)*
Lamonta	0.1
Stadium	0.7
Stearns	ND *(*)*
Yancey	ND *(*)*

(*) None Detected at or below delectable limit of 0.1 mg/L

All well water has a non-detectable iron concentration at 0.1 mg/L or lower except Stadium Well source water has an iron concentration of 0.7 mg/L, exceeding the secondary maximum containment level of 0.3 mg/L. This level may adversely affect the aesthetic quality of the drinking water, but there have been no reported health problems associated with it.

PROPOSED GROUNDWATER RULE

Section 1412(b)(8) of the Safe Drinking Water Act requires EPA to develop regulations requiring disinfection for groundwater systems "as necessary." Preliminary Ground Water Rule was proposed by EPA in May 2000 and Final Ground Water Rule is anticipated in May 2006.

The proposed strategy addresses risks through a multiple-barrier approach that relies on five major components:

1. Periodic sanitary surveys of ground water systems requiring the evaluation of eight elements and the identification of significant deficiencies;
2. Hydrogeologic sensitivity assessments to identify wells sensitive to fecal contamination;
3. Source water monitoring for systems drawing from sensitive wells without treatment or with other indications of risk;
4. Corrective actions for significant deficiencies and fecal contamination (by eliminating the source of contamination, correcting the significant deficiency, providing an alternative source water, or providing a treatment which achieves at least 99.99 percent (4-log) inactivation or removal of viruses)
5. Compliance monitoring to insure disinfection treatment is reliably operated where it is used.

Although the forthcoming Groundwater Rule will require source water sampling, additional treatment (e.g. continuous chlorination) will not be required unless there is a water quality problem, well construction problem, or hydrogeological assessment problem.

The current method of chlorination in Prineville can continue under the present rules and regulations, but there are several deficiencies relative to future Groundwater Rule.

1. The residuals are inconsistent throughout the distribution system.
2. Chlorine is not applied proportional to flow. The injection of chlorine solution into the well makes this difficult to control.
3. Sampling raw water is difficult because the chlorination system needs to be shut off first. A sample can only be collected after the added chlorine has been pumped out of the well.

In anticipation of the Groundwater Rule implementation, the following actions and future improvements are recommended.

1. Install a source water sampling tap at each well to facilitate collecting samples.
2. Inject chlorine solution into the well pump discharge. Pace the chlorine dosage in proportion to flow to facilitate control and to ensure proper chlorine dosage.
3. Increase chlorine dosage to maintain a free chlorine residual of 0.2 mg/l in the system.

In addition, the City should pursue a wellhead protection plan.

The well water receives no further treatment other than chlorination to ensure safe drinking water. Tests have shown that well water quality meets the State minimum drinking water standards. Records of testing results are referenced in Appendix A.

Existing Water System Network Analysis

Water system maps and as-constructed drawings obtained from the City were used to prepare a system base model, which was reviewed by the City and revised per City's input. Most of water mains were modeled except service pipes. Nodes were placed generally at street intersections and locations of significance. Ground elevations were obtained from aerial contours and supplemented by known elevations from the available water and sewer drawings.

Water service connections were counted and distributed to the tributary nodes. The average demand per residential connection was calculated based on 325 gallons per EDU (2.5 persons per connection for Year 2005). For commercial and industrial flows, water usage from the meter record was entered at respective nodes.

The assumptions and parameters used in the modeling are as follows.

Hazen-Williams Friction Factors:

Cast Iron or Ductile Iron ;	
5 yrs old	120
10 yrs old	110
20 yrs old	90
30 yrs old	80
40 yrs old	70
50 yrs old	60
Steel Pipe	Values same as for cast iron pipe, 5 years older
PVC	140
AC	120

Reservoirs:

Tank	Overflow Elevation (feet above sea level)
Ochoco Hts. #1	2983
Ochoco Hts. #2	2983
Barnes Butte	3099
Airport	3400
American Pine	2978

PEAK HOUR DEMAND SIMULATION

The existing system was modeled at a peak hour demand of 6.4 mgd or approximately 4,500 gpm with all well pumps operating and existing tanks full. The resulting tank inflow or outflow is summarized in the following:

Tank	Flow into Tank (gpm)	Flow out of Tank (gpm)
Ochoco Hts. #1		660
Ochoco Hts. #2		790
Barnes Butte	640	
Airport		90

The analysis showed that during peak hour demand periods Barnes Butte Tank was unable to share the load. Additional simulation showed that the downstream pressure setting at Williamson and Combsflat pressure regulators would have to be raised higher during heavy demands in the summer so that the downtown area could benefit from Stearns and Barney Wells.

Pressures in the system are generally above 40 psi except the southeast area south of Lynn Blvd could experience pressures lower than 40 psi. As presented in Chapter 4, Ochoco Tanks provide the hydraulic control of the downtown area. Even with the Tanks full, highest static pressure would be about 40 psi for this area (El 2890). When the tank is about empty, the static pressure would drop to 19 psi. The City usually operates these tanks between 40 to 50 feet (10 foot operating range) to keep pressures in the area as high as possible. Pressures lower than 40 psi can be expected.

Most of the wells serving downtown area are turned on and off manually. Without automatic control, overflows from the Ochoco Hts tanks would and did occur. Adding altitude valves at these tanks will prevent these tanks from overflowing and will also allow the Comsflat and other regulators to be set at higher pressures to improve pressures to the southeast area.

LOW DEMAND SIMULATION

The system was also modeled to see how the existing tanks could be replenished with all pumps in operation. The results showed that Barnes Butte Tank would be filled at about 1,000 gpm whereas the combined filling rate for Ochoco Tanks would be about 600 gpm. Stearns and Barney wells would fill Barnes Butte Tank at a faster rate than they would fill Ochoco Tanks because of their proximity to Barnes Butte Tank. This demonstrates the need for additional wells and storage tanks closer to the Ochoco Tanks in order to augment supply to the downtown area. The recently reactivated Ochoco Hts Well should help in alleviate this situation.

MAXIMUM DAY DEMAND AND FIRE FLOW SIMULATION

The existing distribution network was modeled under the MDD and the required fire flow conditions.

Fire flows were simulated at various locations. The 4-inch and smaller mains are too small to carry the required fire flows. The simulation showed that negative pressures in these undersized mains could occur even with a fire flow as low as 1,000 gpm.

The following is a summary of those areas tested for fire flows, resulting in negative pressures.

Location	**Simulated Fire Flow (gpm)**
Lamonta Rd between Lamonta Well and Harwood	4,000
Industrial Park Rd	4,000
Madras Hwy & W 9th	2,750
Crook County Middle School	4,500

Again the resulting negative pressures generally occurred at the undersized or unlooped mains and deadends.

The Ochoco Booster Pump Station was designed to provide 1,500 gpm in case of fire. The analysis indicated that under this maximum flow pump starvation and cavitation could result from excessive head loss produced by the 6" suction pipe from Ochoco Tanks to the Pump Station. As recommended in the previous master plan, this section of water main was replaced in the last 5 years. The City is in the process of replacing the existing 15-Hp Booster Pump No.1 with a 30-Hp variable speed pump. This will help meeting the low flow demands without cycling the pump.

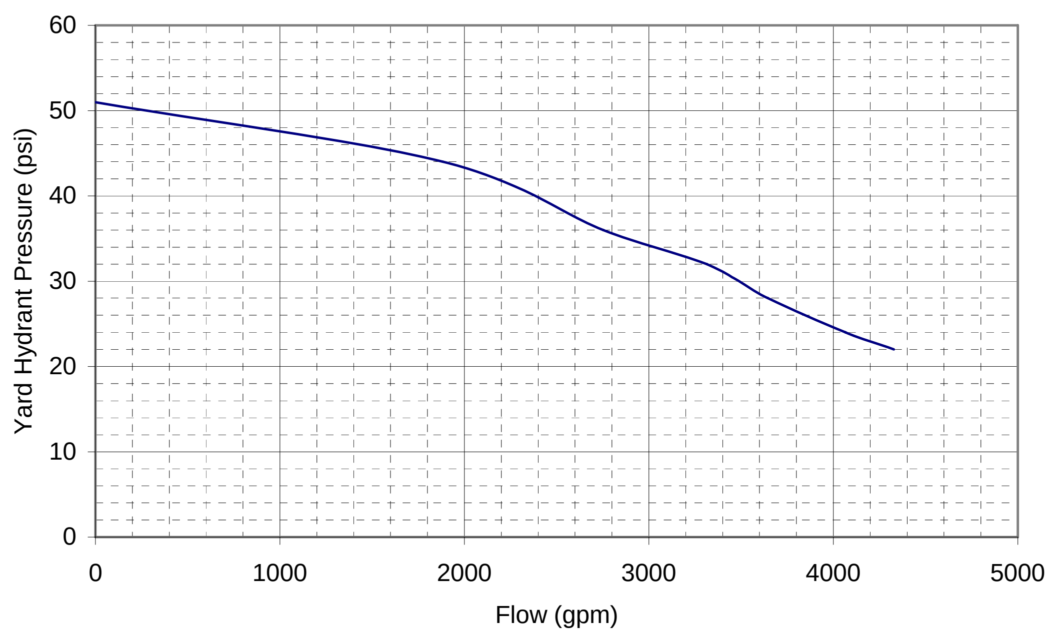
The Ochoco pumps transfer flows to the existing American Pine Tank. The Analysis showed that pressure reducing/sustaining valve in the feed line to the tank needs to be adjusted to prevent draining of Ochoco Hts tanks and the valve at Stone Ridge Loop tie-in to the Mariposa Ochoco pump main needs to be closed to prevent water from recalculating back into the tank when the American Pine booster pumps are operating.

The proposed improvements are discussed and presented in Chapter 7.

AIRPORT BOOSTER PUMP TESTS

Based on tests performed by Hydronix on May 1, 1997, the Airport Fire Pump at Airport Booster Pump Station was capable of delivering 4,000 gpm with a residual pressure of about 25 psi at Les Schwab warehouse, matching the simulation results. The fire pump is capable of delivering the required fire flow with the residual pressure meeting the Uniform Fire Code requirements. The yard hydrant pressures at the warehouse vs the measured flows are presented in Figure 6-5.

Figure 6 - 5 Supply Pressures vs Fire Pump Flows
Prineville Les Schwab Warehouse
(Based on the hydrant tests performed on 5/1/97 by Hydronix)



Future Growth Areas and Development Timing

The City Planning Department has identified the following future growth areas.

Area Designation	EDU	
	Residential	Commercial
Areas North and West of Hudspeth Property	900	
Aspen Heights	225	
Barney 1	99	
Barney 2	500	
Brooks/Hudspeth	2,951	
C-5 Development		15
Canal Road	29	
Chandler	175	
Colson & Colson	1,200	
Fairgrounds		40
Harper	8	
Ochoco Mill Site	244	489
Prineville Trailer Park	40	
Rhoden	550	
Saddle Ridge	52	
Smith	345	
Terrace Mobil Home Park	72	
White Deer Ranch	400	
Total	**7,790**	**544**

For the new development areas, it is difficult to predict which area would likely be developed first. As the development occurs, the related system components can be added as required to meet the increased demands.

Water Source

According to the projection the City will require an additional 2,850 gpm of production capacity by the Year 2025 as the population increases. The demand will have to be met by a combination of various strategies such as redeveloping the existing wells, constructing new wells and acquiring existing wells from others in an exchange, etc. as discussed below.

Redeveloping the existing wells is the most cost effective way to increase the water supply to the system. After the existing wells have been brought to maximum capacity, any additional water needs would have to be met by obtaining the existing wells at strategic locations or drilling new ones. New wells are best located in the highly permeable sand and gravel zone in the valley fill, primarily in the western and southern portion of the formation. The majority of the existing City wells are in this area as also.

EXISTING WELL REDEVELOPMENT

As presented in Chapter 4, the following wells have been rehabilitated recently.

1. Barney
2. South 4th Street – Shallow
3. South 4th Street – Deep
4. Ochoco Hts

The Lamonta well is scheduled for rehabilitation in 2006. The Yancy well will be evaluated and the pump and/or motor may need to be replaced in 2006.

PLANNED NEW WELL CONSTRUCTION

The City is planning to construct three new water wells and replace one well in 2006. The new wells will be the Fairground well, the American Pine well and the New Airport Well. The existing Stadium well will be replaced with a larger well.
The Fairground well will be located south of the Crook County Fairgrounds and will tap both the main confined aquifer and a confined aquifer present beneath the Upper Crooked River. The American Pine well will be located in the north of downtown Prineville near the American Pine Tank north of Prineville will tap the northern segment of the main confined aquifer. The Airport well will be located between the existing Airport well and the Airport Tank and will tap the separate Upper Deschutes Aquifer. The Stadium well will tap the main confined aquifer.

NEW WATER SOURCES

The main confined aquifer beneath the City of Prineville has a limited capacity to produce additional groundwater. The 1963 USGS Water Supply Paper *Ground Water in the Prineville Area, Crook County, Oregon* study of the main confined aquifer estimated that 2,000 acre-feet per year (1.8 mgd) is recharged to the this aquifer annually. The amount of groundwater available for withdraw by wells is limited by the ability of water to pass through the aquifer, not by the amount of recharged water.

This estimate of the annual recharge appears to be low given the amount of water presently produced by the six wells that tap this confined aquifer (3.5 mgd in July 2005). There appears to be enough capacity in the aquifer to meet the existing and planned wells, but additional ground water withdrawals from the main portion of the main confined aquifer will exceed the availability of the aquifer to pass water through the aquifer. Since there is a limited amount of water in the main confined aquifer, the City will need to find other groundwater sources for future water supply wells.

The best potential for future groundwater sources will be from the following aquifers:

1. The northern segment of the main confined aquifer,
2. The confined aquifer beneath the Upper Crooked River Valley and
3. The regional Upper Deschutes Aquifer west of Prineville.

As irrigated land east and northwest of the City is replaced with housing developments there is the potential that additional groundwater sources from the main confined aquifer will become available to supply additional municipal wells.

Areas that have been identified as offering the best potential to supply future groundwater sources are listed below and shown in Figures 7-1 to 7-4. The placement of future wells will be based on information collected during the construction and testing of the three new well that will be construction in 2006. This information will determine what effect constructing additional well within the same aquifer would have on the existing wells.

Northwest

1. NE quarter of the NE quarter of section 31 T14S R16E (Clear Pine well #1)
2. NE quarter of the NW quarter of section 31 T14S R16E (Clear Pine well #3)
3. SE quarter of the SW quarter of section 30 T14S R16E

Northeast

1. East half of the southeast quarter of section 32 T14S R16E
2. SW quarter of the SW quarter of section 33 T14S R16E

East

1. North half of section 3 T15S R16E

South

Center of section 8 T15S R16E

West

Center of section 6 T15S R16E
East Half of Section 14 T1SS R15E

Base on the present demand and the City would have storage tanks in place shortly, the City would need an additional 100 gpm of production capacity now. This will increase to a need of about 2,850 gpm by the year 2025 as the population increases. The demand will have to be met by either making the existing wells more efficient at collecting water out of the formation and/or bringing new wells on line to the City system.

EXCHANGE FOR PRIVATE WELLS

The City has a program that allows private irrigation well owners to trade their wells and water rights for an equal amount of water from the Prineville Reservoir. This will allow the City to obtain ground water for municipal supply while the farmer will get water that is appropriate for his irrigation needs. It will also allow the City to obtain proven water supplies while saving the cost of drilling new water wells.

At this time, the City is planning to acquire or drill a well close to the existing American Pine Tank thorough the process of exchange. The well has an estimated potential well output of 500 to 600 gpm.

Water Storage

As presented in Chapter 6, the City has an immediate need for increasing the storage capacity to provide emergency and fire storage, thus improving the system's reliability. An additional storage capacity of 10.0 million gallons (MG) or more would be required by Year 2025.

The short-term improvements will include the addition of 4.0 MG storage capacity to the system. The Airport area, the Northwest area, Faigrounds area and Barnes Butte area are the targeted tank locations for the following reasons:

1. The existing one MG Airport Tank would only be sufficient for providing the required fire storage to the Airport industrial area. In order to provide reserve storage and equalization to the area, a new one MG storage tank located next to the existing Airport Tank would be required.

2. Presently the water service to the Northwest area is provided from Ochoco Tanks via a booster pump station. An additional storage tank at American Pine would improve the reliability of water service and provide the needed storage capacity to the area north of the Hospital.

3. The Barnes Butte Tank has only 0.5 MG storage capacity, short of about 2 MG storage capacity required.

4. There is no storage tank at the southwest side. The construction of Fairgrounds Tank No. 1 will augment the water supply to the south side and downtown area.

As the City grows and additional areas are annexed, more storage capacity is required. The following table summarizes the proposed reservoir or tank locations and capacities for the study period.

Planning Period	Tank Name/Location	Capacity (MG)
Short Term	Airport Tank No. 2	1.0
	American Pine Tank No. 2	1.0
	Barnes Butte Tank No.2	1.0
	Fairgrounds Tank No. 1	1.0
	Total	**4.0**
Development Driven	Fairgrounds Tank No. 2	1.0
	Hudspeth Tank No. 1	2.0
	Hudspeth Tank No. 2	1.5
	Hudspeth Tank No. 3	1.0
	Melrose Tank No. 1	1.0
	Total	**6.5**

Improvement Requirements by Development Areas

Although area wide water source and storage requirements are presented in Chapter 6, specific requirements for the growth areas with different pressure zones will need to be considered in locating these improvements. The well capacities and storage volumes presented below are for the built-out and the requirements for Year 2025 are assumed to be half of the built-out.

NORTHWEST AREA (AMERICAN PINE TANK)

Area	EDU (Built-Out)	ADD gpd	MDD gpd	PHD gpd
Aspen Heights	225	73,125	182,813	292,500
Harper	8	2,600	6,500	10,400
Prineville Trailer Park	40	13,000	32,500	52,000
Mariposa Basin	628	204,214	510,534	816,855
Owens Road	223	72,625	181,563	290,501
Willowdale	118	38,350	95,875	153,400
PLRR Basin	274	89,042	222,605	356,168
Terrace Lane Buckboard	532	173,050	432,626	692,201
Areas North and West of Hudspeth Property	900	292,500	731,250	1,170,000
Total	**2,949**	**958,506**	**2,396,266**	**3,834,025**

	Built-Out	Yr 2025	
Req'd Well Capacity	**1,664**	**832**	**gpm**
Req'd Booster Pump Capacity			
Max Day Plus Fire at 1,500 gpm	**3,164**	**1,582**	**gpm**
Peak Hour Deamnd	**2,663**	**1,331**	**gpm**
Req'd Additional Storage Capacity	**2.9**	**1.45**	**MG**
w/1,500 gpm fire flow for 2 hrs			

The recommended 20-yr improvements consist of the following major components.

1. American Pine Well and Clear Pine Well with a total capacity of 900 gpm
2. American Pine Tank No. 2, One million gallons, south of the existing American Pine Tank No. 1
3. Transmission/Distribution Mains with Pressure regulators for tie-in to the downtown pressure zone.

OCHOCO HTS BOOSTER PUMP STATION AREA

Area	EDU Yr 2005	ADD gpd	MDD gpd	PHD gpd
Ochoco Hts East	600	195,000	487,500	780,000

	Ochoco Hts	Northwest	Total Built-Out	Total Yr 2025
Max Day Demand	**339**	**1,664**	**2,003**	**1,171**
Req'd Ochoco Booster Pump Capacity				
Max Day Plus Fire at 1,000 gpm	**1,339**	**3,164**	**3,503**	**2,671**
Peak Hour Deamnd	**542**	**2,663**	**3,204**	**1,873**

At present the supply to the Northwest Area is dependent on Ochoco Hts booster station to transfer water to the north. Assuming that American Pine and Clear Pine wells in Northwest area can meet the projected Year 2025 maximum day demand, this station can deliver the needed service to the Ochoco Hts area east of the Hospital.

The City recently purchased a new 30-HP booster pump to replace the existing 15-HP Booster Pump No. 1 and plans to install it with a variable speed drive.

BARNES BUTTE SERVICE AREA

The existing Barney and Stearns Wells have a combined output of 787 gpm (limited by the existing water right to no more than 700 gpm). The deficiency of 280 gpm will need to come from other wells at the potential well sites north of Laughlin (See Fig. 7-2).

The recommended 20-yr improvements consist of the following major components.

1. Laughlin Area Well
2. Barnes Butte Tank No.2, One million gallons
3. Melrose Tank No. 1, One million gallons
4. Transmission/Distribution Mains with Pressure regulators for tie-in to the downtown pressure zone.

HUDSPETH AREA

Area	EDU (Built-Out)	ADD gpd	MDD gpd
Brooks/Hudspeth	2,951	959,075	2,397,688
Chandler	175	56,875	142,188
Total	**3,126**	**1,015,950**	**2,539,876**

	Built-Out	Yr 2025	
Req'd Well Capacity	**1,764**	**882**	**gpm**
Req'd Additional Storage Capacity	**4.1**	**2.1**	**MG**

w/1,500 gpm fire flow for 2 hrs

The existing Ochoco Booster Station does not have extra capacity to serve the entire Hudspeth area. The development cannot rely on the existing Barney and Stearns wells either, as those wells are used primarily for the area south of Laughlin and east of Combsflat. New wells must be provided to meet the maximum day demand in this area.

The Hudspeth area developer, Brooks Resources Corporation (BRC), anticipates full built-out in 20 years. The southwest area with lower elevations will be developed first and the area north of Laughlin Road will be developed next. Because of its terrain with extreme elevation variations, the water service will need to be divided into many pressure zones as follows based on the minimum static pressure of 50 psi and maximum pressure of 120 psi.

1. Pressure Level Zone 1 – El 2980 and lower, Tank Overflow El 3099
2. Pressure Level Zone 2 – El 2980 to El 3140, Tank Overflow El 3260
3. Pressure Level Zone 3 – El 3140 to El 3260, Tank Overflow El 3375
4. Pressure Level Zone 4 – El 3260 and higher, Service to be provided by Booster Pumps

The recommended 20-yr improvements consist of the following major components.

1. Wells with a total capacity of 900 gpm (1,800 gpm for full built-out);
2. Three Buried Prestressed Concrete Storage Tanks with a total capacity of 4.5 million gallons;
3. Booster Pump Stations for transferring water from lower pressure zones to higher pressure zones and to serve their respective pressure zone; and
4. Transmission/Distribution Mains with Pressure regulators for tie-in to other pressure zones.

FAIRGROUNDS AREA

Area	EDU (Built-Out)	ADD gpd	MDD gpd
Colson & Colson	1,200	390,000	975,000
White Deer Ranch	400	130,000	325,000
Total	**1,600**	**520,000**	**1,300,000**

	Built-Out	Yr 2025	
Req'd Well Capacity	**903**	**451**	**gpm**
Req'd Additional Storage Capacity	**2.2**	**1.1**	**MG**

w/1,500 gpm fire flow for 2 hrs

The recommended 20-yr improvements consist of the following major components.

1. Stadium Well replacement;
2. Fairgrounds Well;
3. Two Storage Tanks, one million gallons each; and
4. Transmission/Distribution Mains with pressure regulators.

AIRPORT AREA (AIRPORT TANK)

Area	EDU (Built-Out)	ADD gpd	MDD gpd
Industrial Prop	198	64,350	160,875
Baldwin Ind Park	36	11,700	29,250
SE Airport Overlay	18	5,850	14,625
Les Schwab	78	25,350	63,375
Airpport Not Zoned	154	50,050	125,125
Quarry	23	7,475	18,688
Freund	159	51,675	129,188
Airport PS Basin	33	10,725	26,813
Airport Industrial	374	121,550	303,875
Property West of Baldwin	146	47,450	118,625
Total	**1,219**	**396,175**	**990,439**

	Built-Out	Yr 2025	
Req'd Well Capacity	**688**	**344**	**gpm**
Req'd Additional Storage Capacity	**1.5**	**0.75**	**MG**

w/4,000 gpm fire flow for 4 hrs

The recommended 20-yr improvements consist of the following major components.

1. Airport Well;
2. Storage Tank, one million gallons; and
3. Transmission/Distribution Mains.

Future System Modeling

As analyzed and evaluated in Chapter 6, the existing system's undersized distribution mains (4" and smaller) and unlooped mains are unable to provide the required fire flows even at 1,000 gpm. These mains were replaced in the computerized simulation model with a minimum of 8" to improve conveyance of fire flows. A grid of 12" mains was also formed in the downtown area to strengthen the distribution system and to improve fire flows. The proposed transmission mains, storage tanks and supply wells were modeled to meet future demands.

The simulation showed that the 6" loop at Knowledge Street by the Crook County Middle School restricted the flow and resulted in excessive pressure loss through this section of pipe. Further analysis indicated the need of installing a 12" along Knowledge from 2nd street to 1st connecting to the existing 12" PVC at 1st and Juniper.

The proposed improvements resulting from the hydraulic network analysis are presented in Figures 7-1 through figure 7-4. They have been divided into two categories.

1. Short-term Improvements – These improvements include replacing existing undersized water mains and wood stave pipes and adding new mains for looping to improve fire flows. They are also targeted to meet the immediate needs for additional well and storage and capacities, i.e. the "Big-Dig" project as named by the City.
2. Development Driven Improvements – Other proposed improvements are driven by the growth and are to be implemented as necessary to meet the demand.

Short-Term Improvements

The recommended short-term improvements are as follows.

1. Addition of Altitude Valves at Ochoco Hts Tanks.
2. Replacement of wood-stave pipes and wrapped steel and galvanized steel pipes, i.e.
   Wood-stave Pipe:
   - NW Locust form NW 3rd to NW 5th
   - NW Harwood from NW 2nd to NW 3rd
   - NW Ewen forn NW 7th to NW 8th
   - NW 10th from Main to NW Claypool

   Wrapped Steel Pipe:
   - NW 4th from NW Harwood to NW Deer
   - NE 7th from Main to NE Fairview

Galvanized Steel Pipe:
NE Garner from NE 6th to NE 7th
Alley between SE 4th to SE 5th from SE Fairview to SE Belknap

3. Replacement of undersized mains.
4. Development of Fairground well, American Pine well and New Airport Well. The existing Stadium well will be replaced with a larger well.
5. Stadium Well replacement.
6. Construction of American Pipe Tank No. 2 and Booster Station, Barnes Butte Tank No.2, Airport Tank No.2 and Fairground Tank No. 1.

The recommended short-term transmission/distribution main improvements are summarized in Tables 7.1 and 7.2.

Table 7.1 – Short-term Transmission/Distribution Main Improvements Big-Dig Project

NAME OR LOCATION	FROM	TO	SIZE	L (ft)
2006-2007				
Lynn Blvd-Melrose Dr.	Knowledge	Ochoco Creek	16	7190
Stearns Rd	Ochoco Creek	Ochoco Hwy	12	1715
Ochoco Hwy	Stearns Rd	Barnes Butte Tank	16	1800
2008-2010				
Supply Line to Fairgrounds Tank	Ochoco Hwy	Fairgrounds Tank	12	8610
Outflow Line from Fairgrounds Tank	Fairgrounds Tank	Crooked River Hwy	16	2320

Table 7.2 – Short-term Transmission/Distribution Main Improvements
Other Short-Term Improvements

NAME OR LOCATION	FROM	TO	SIZE	L (ft)
NW 2nd	Locust	End	8	945
NW 2nd	Locust	Ivy St	8	230
Locust	MW 2nd	NW 3rd	8	315
Locust (Woodstave Pipe)	NW 3rd	NW 5th	8	650
Locust	NW 5th	NW 6th	8	190
Harwood (Wood Stave Pipe)	NW 2nd	NW 3rd	8	350
Harwood	NW 4th	NW 5th	8	325
NW 5th	Harwood	Locust	8	280
NW 4th (Wrapped Steel)	Harwood	Deer	8	1225
Maple	SW 2nd	SW 3rd	8	335
2nd and Deer	S To 3rd and Claypool	Loop N On Beaver	8	1735
Alley between SE 4th and 5th (Galv Steel)	Belknap	Fairview	4	1310
Dunham	3rd North To	2nd	8	320
SE 5th	Dunham	Garner	8	1130
SE 4th	Elm	Fairview	8	325
Fairview	5th	4th	8	510
Holly	NE 1st	NE 3rd	8	650
NE 2nd	Holly	Idlewood	8	210
NE 2nd	Idlewood	Juniper	12	360
Idlewood	SE 2nd	NE 3rd	12	2400
SE 2nd	Idlewood	Mercury	12	1420
Knowledge	SE 2nd	NE 3rd		
then west on NE 3rd	Knowledge	Juniper	12	1430
SE 2nd	East of Mercury		Two 8	990
SE 2nd/Mnt View Dr.	2nd		8	1510
NW 10th (Woodstave Pipe)	Main	Claypool	8	635
NW 10th	Claypool	Fairmont	8	1140
Deer	NW 9th	NW 10th	8	325
Claypool	NW 7th	NW 9th	8	610
Beaver	NW 7th	NW 10th	8	960
Ewen (Woodstave Pipe)	NW 7th	NW 8th	6	300
Main	NE 5th	NE 6th	12	245
NE 6th	Main	Court	8	560
NE 5th	Court	Elm	8	970
Fairview	NE 5th	NE 6th	6	175
NE 6th	Fairview	Holly	8	600
Garner (Galv Steel)	NE 6th	NE 7th	8	300
NE 7th (Wrapped Steel)	Main	Fairview	12	1500
NE 7th	Fairview	Idlewood	12	1100
Elm	NE 8th	NE 10th	8	620
Crest Loop	Allen	Allen	8	1970
McRae	Loper	Sunrise	8	485
Wilshire	Loper	Sunrise	8	485
Hillcrest	Loper	Sunrise	8	485
Denton Ln	Laughlin Rd	North	8	640

Development Driven Improvements

Development driven improvements as presented above are summarized below.

NORTHWEST AREA (AMERICAN PINE TANK SERVICE AREA)

1. Clear Pine Well
2. Transmission/Distribution Mains with Regulators

BARNES BUTTE SERVICE AREA

1. Barnes Butte Tank No.2, One million gallons
2. Melrose Tank No. 1, One million gallons
3. Transmission/distribution Mains with Pressure regulators for tie-in to the downtown pressure zone.

HUDSPETH AREA

1. Wells with a total capacity of 900 gpm (1,800 gpm for full built-out)
2. Three Buried Prestressed Concrete Storage Tanks with a total capacity of 4.5 million gallons;
3. Storage Tanks with a total capacity of 4.5 million gallons;
4. Booster Pump Stations; and
5. Transmission/distribution Mains with Pressure regulators for tie-in to other pressure zones.

FAIRGROUNDS AREA

1. Storage Tank, one million gallons; and
2. Transmission/distribution Mains with pressure regulators.

AIRPORT AREA

1. Transmission/distribution Mains for the future airport industrial developments.

The recommended development driven transmission/distribution main improvements are summarized in Table 7.3.

Table 7.3 – Development Driven Transmission/Distribution Main Improvements

NAME OR LOCATION	FROM	TO	SIZE	L (ft)
Northwest Area				
Madras-Prineville Hwy	Gardner	Industrial Park	12	3720
West 9th	Dodson Dr.	Fairmont St	12	2630
Lamonta	Ron Smith Rd	Harwood	12	2400
Lon Smith Rd	Lamonta	Peters Rd	12	810
Peters Rd	Lon Smith Rd	Elk Street	12	5240
Lon Smith Rd	Peters Rd Down Apollo	McKay Rd	12	5780
McKay Rd	Mariposa Way To Owens Rd	Yellowpine Rd	12	10330
Barnes Butte Service Area				
Combsflat Rd	NE 3rd	Laughlin	12	790
Laughlin Rd	Idlewood	Coombsflat Rd	12	2860
Laughlin Rd	Coombsflat Rd	Hickey Farms Rd	12	1285
Laughlin Rd	Ridgewood Ct	Ochoco Hwy	12	2765
Williamson	Ochoco Hwy	Laughlin Rd	12	530
Combsflat Rd	Melrose Rd	NE 2nd	12	1820
Combsflat Rd	Lynn Blvd	S On Paulina Hwy	12	6420
Willowdale Dr	Ochoco	Laughlin	12	800
Ochoco Logging Rd		Melrose Tank	16	2000
Triangle Ct	Stearns	Ochoco Hwy	12	2700
Hudspeth Area				
Ochoco Ave	Oregon	Hudspeth Rd	12	1930
Hudspeth Rd			12	3890
Combsflat Rd Extension North			12	4160
Peters Rd	Yellowpine Rd	Hudspeth Tank No. 1	16	5950
Hudspeth Tank No. 2 Supply Line	Hudspeth Tank No. 1	Hudspeth Tank No. 2	16	1560
Hudspeth Tank No. 3 Supply Line	Hudspeth Tank No. 2	Hudspeth Tank No. 3	12	3000
Fairgrounds Area				
Fairgrounds Rd	Crooked River Hwy	Lynn Blvd	12	3025
Crooked River Hwy	South From Fairgrounds	Crooked River Park	12	1960
Crooked River Hwy	Crooked River Park	South	12	4560
Airport Area				
Tom McCall Rd	High Desert Drive	Ochoco Hwy	12	680
High Desert Dr	George Millican	Baldwin Rd and North	12	6100

Water System Improvement Probable Project Costs

The probable project costs of implementing the recommended water system improvements are summarized and tabulated in the following tables.

Table 7.4 – Probable Project Cost for Short-Term Improvements

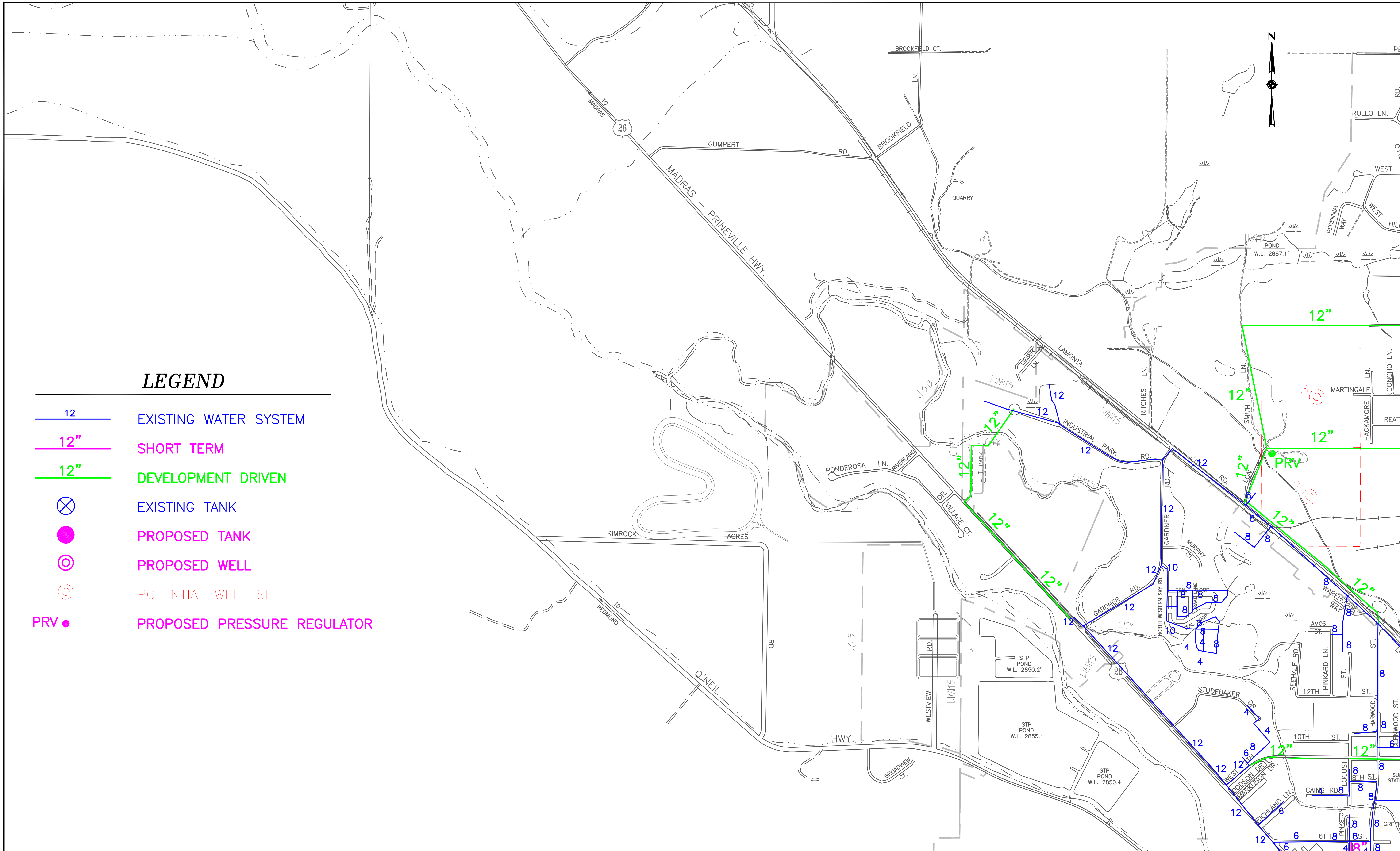
Description	Size (in)	Length (ft)	Unit Price	Total
Big-Dig (2006-2007)				
Transmission/Distribution Mains	12	1,715	90	$ 154,350
	16	8,990	110	$ 988,900
PRV Vaults (Three)				$ 240,000
American Pine Tank No. 2 (1.0 MG)				$ 850,000
Barnes Butte Tank No. 2 (1.0 MG)				$ 850,000
Booster Station Upgrade				$ 200,000
Airport Tank No. 2 (1.0 MG)				$ 850,000
Ochoco Tank Altitude Valve Vault				$ 60,000
Stadium Well Replacement				$ 200,000
American Pine Well				$ 350,000
Airport Well				$ 350,000
Fairgrounds Well				$ 350,000
			Subtotal	$ 5,443,250
Big-Dig (2008-2010)				
Supply Line to Fairgrounds Tank	12	8,610	90	$ 774,900
Outflow Line from Fairgrounds Tank (including Creek Crossing)	16	2,320	150	$ 348,000
Fairgrounds Tank No. 1 (1.0 MG)				$ 1,250,000
PRV Vault (One)				$ 80,000
			Subtotal	$ 2,452,900
Other Improvements				
Undersized Main Replacement	6	175	$ 70	$ 12,250
and Looping	8	19,850	$ 80	$ 1,588,000
	12	6,955	$ 90	$ 625,950
Woodstave Pipe Replacement	8	1,935	$ 80	$ 154,800
Wrapped Steel Pipe Replacement	8	1,225	$ 80	$ 98,000
	12	1,500	$ 90	$ 135,000
Galv. Steel Pipe Replacement	4	1,310	$ 60	$ 78,600
	8	300	$ 80	$ 24,000
			Subtotal	$ 2,716,600
		Total		$ 10,612,750
		Eng. & Contigency	35%	$ 3,714,250
		Total Short-Term Improvements		**$ 14,327,000**

Table 7.5 – Probable Project Cost for Development Driven Improvements

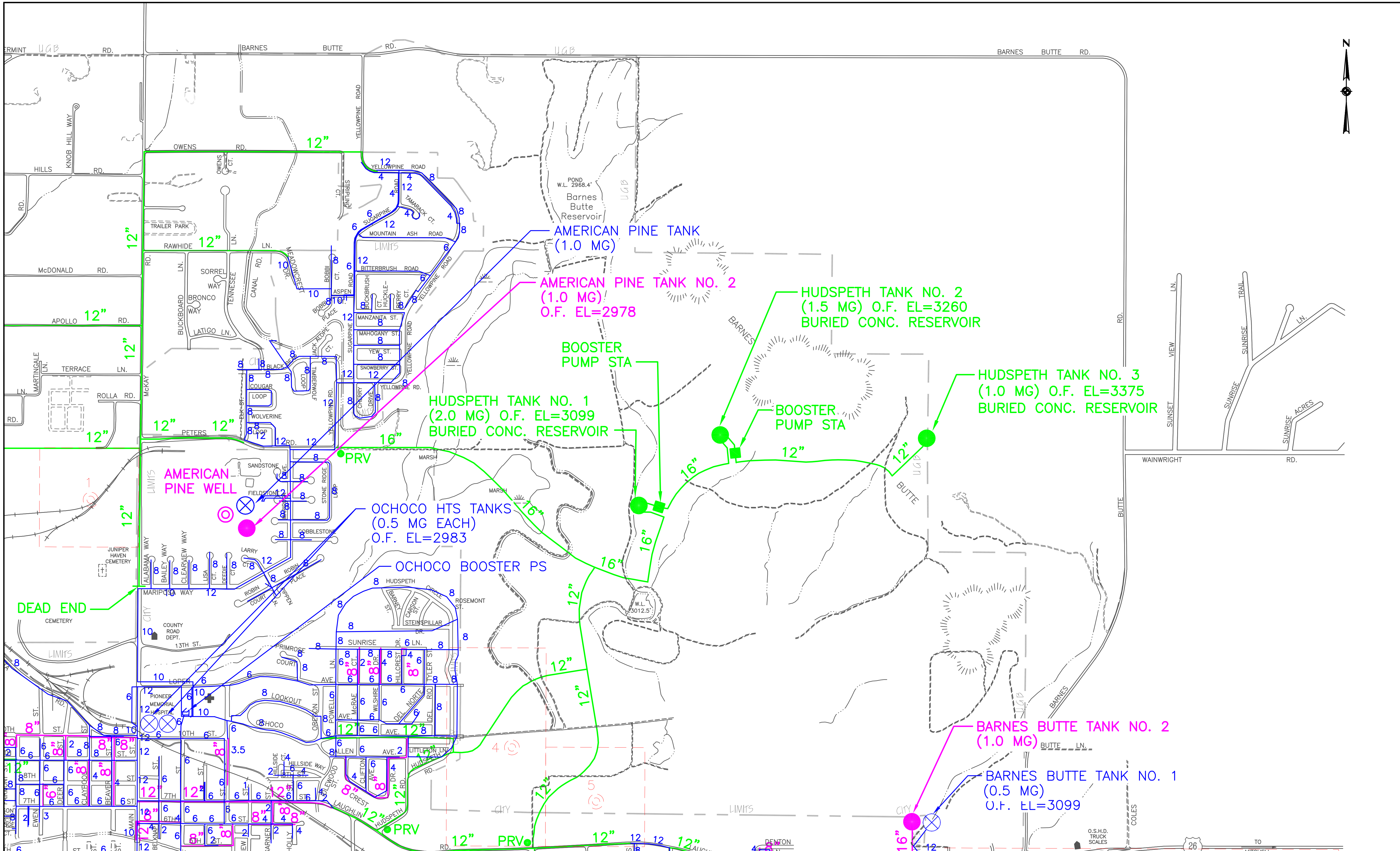
Description	Size (in)	Length (ft)	Unit Price	Total
Northwest Area				
Transmission/Distribution Mains	12	30,910	$ 90	$ 2,781,900
Clear Pine Well				$ 350,000
PRV Vault (One)				$ 80,000
Barnes Butte Service Area				
Transmission/Distribution Mains	12	19,970	$ 90	$ 1,797,300
PRV Vault (One)				$ 80,000
Laughlin Well				$ 350,000
Melrose Tank No. 1 (1.0 MG)				$ 1,000,000
Hudspeth Area				
Transmission/Distribution Mains	12	12,980	$ 90	$ 1,168,200
	16	7,510	$ 110	$ 826,100
PRV Vaults (Three)				$ 240,000
Two to Three Wells				$ 1,050,000
HudspethTank No. 1 (2.0 MG)				$ 2,500,000
HudspethTank No. 2 (1.5 MG)				$ 1,875,000
HudspethTank No. 3 (1.0 MG)				$ 1,250,000
Booster Stations (Three)				$ 1,050,000
Fairgrounds Area				
Transmission/Distribution Mains	12	9,545	$ 90	$ 859,050
Additional Well Supply from Airport Well Field				$ 350,000
Fairgrounds Tank No. 2 (1.0 MG)				$ 1,250,000
Airport Area				
Transmission/Distribution Mains	12	6,780	$ 90	$ 610,200
		Total		$ 19,467,750
	Eng. & Contigency		35%	$ 6,813,250
Total Development Driven Improvements				**$ 26,281,000**

Water Management and Conservation

As pointed out in Chapter 6, heavy watering in summer months contributed to high water demands. Reducing maximum day demands would prolong the life of City’s water facilities. Water management and conservation programs aimed at promoting efficient use and conservation of the City's present and future water resources would certainly achieve this goal. “Water Management and Conservation Plan” prepared by the City as a separate document has been approved by Water Resources Department.

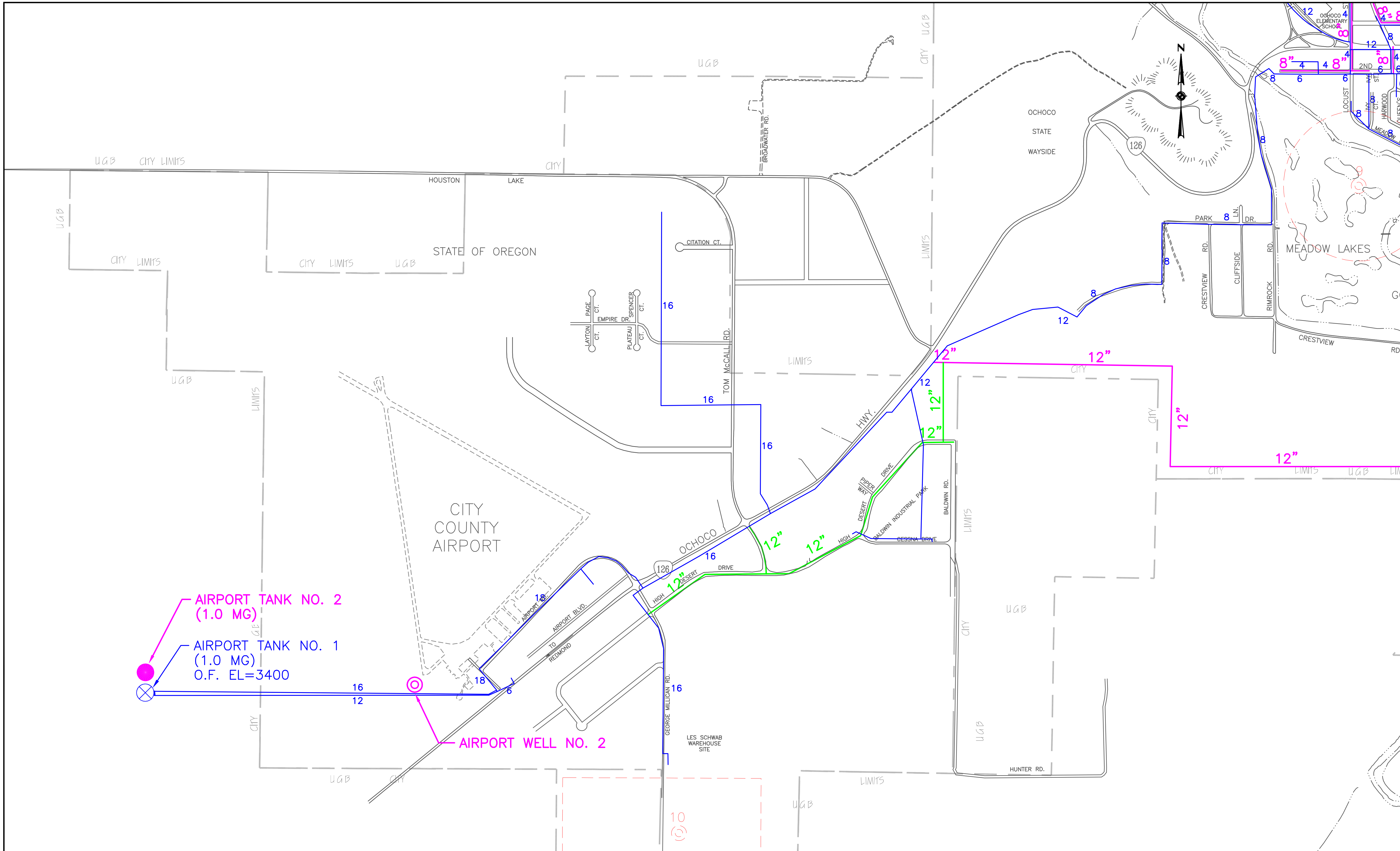


PRINEVILLE WATER SYSTEM IMPROVEMENTS – NW | FIG 7–1

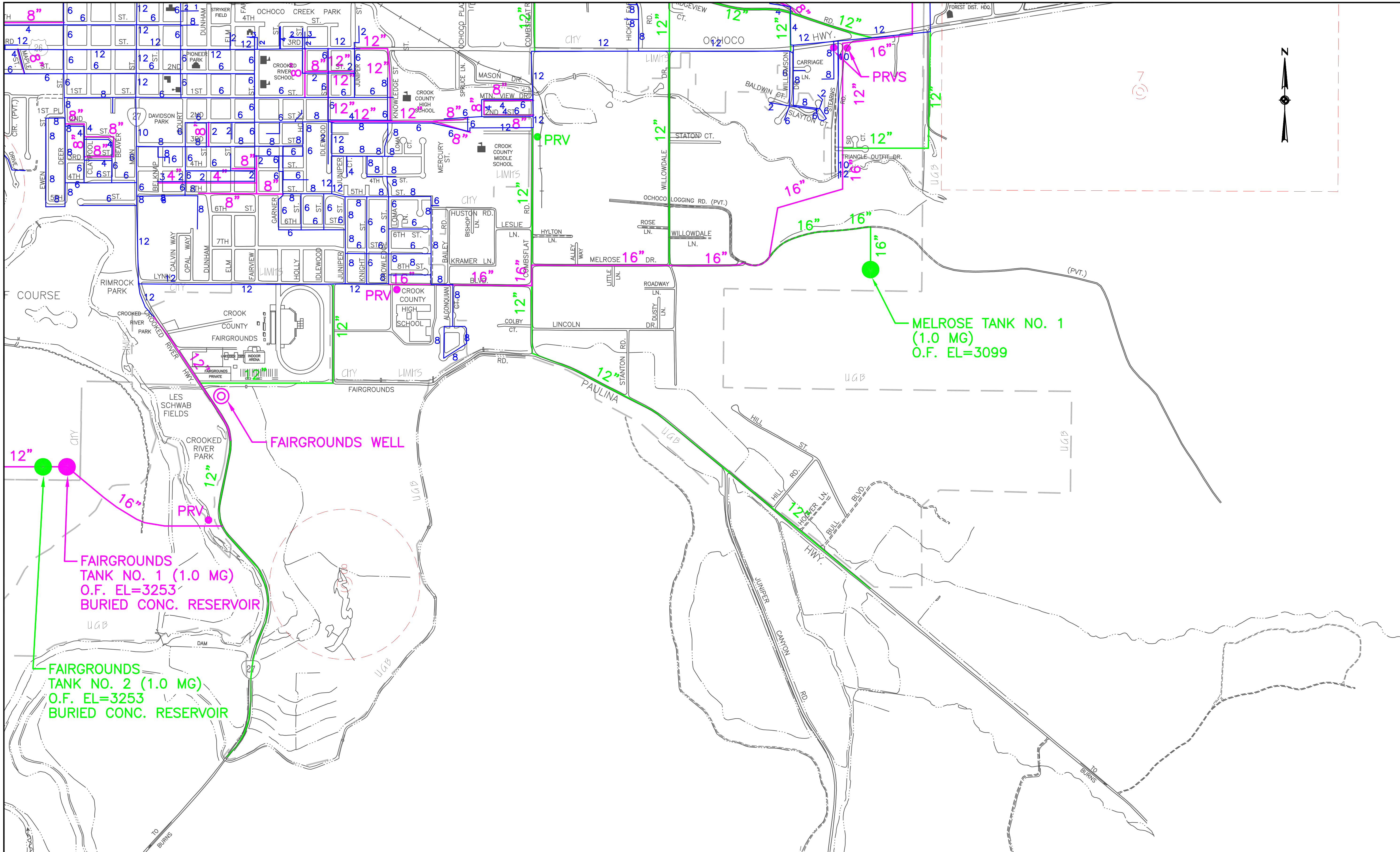


PRINEVILLE WATER SYSTEM IMPROVEMENTS – NE

FIG 7–2



PRINEVILLE WATER SYSTEM IMPROVEMENTS – SW | FIG 7-3



PRINEVILLE WATER SYSTEM IMPROVEMENTS – SE

FIG 7-4

Chapter 8 – Summary and Recommendations

Summary

Summarized in the following are findings from the analysis of City's water sources, distribution, treatment, pumping and storage systems, identification of present needs and deficiencies, a projection of future needs for the next twenty years (2000-2020), and an analysis of alternatives for meeting them.

1. The average day demand (ADD) for residential use was calculated to be 130 gpcd (gallons per capita per day), or 325 gpd per EDU (equivalent dwelling unit) and the maximum day demand (MDD) was about 810 gpd per EDU. The MDD was estimated to be about 2.5 times ADD.

2. The present ADD and MDD are 1.6 mgd and 4.0 mgd respectively. The ADD and MDD are projected to double in the next 20 years to 3.2 mgd and 8.0 mgd.

3. The existing wells have been redeveloped in the last five years to increase the output, but a total of additional 2,900 gpm well capacity would still be required in 20 years.

4. In order to provide the required equalization, reserve and fire storage, the City needs to immediately increase the storage capacity by 4 million gallons. An additional total storage capacity of 10 million gallons above the existing 3.5 million gallons would be required by Year 2025.

5. The well water receives no further treatment other than chlorination to ensure safe drinking water. Tests have shown that well water quality meets the State minimum drinking water standards.

6. The Airport Booster Pump is capable of delivering the required 4,000 gpm fire flow with a residual pressure of about 25 psi at Les Schwab warehouse, meeting the Uniform Fire Code requirements.

7. The Ochoco Booster Pump Station was designed to provide 1,500 gpm in case of fire. The analysis indicated that under this maximum flow pump starvation and cavitation could result from excessive head loss produced by the 6" suction pipe from Ochoco Tanks to the Pump Station. The suction line was replaced as recommended in the last 5 years.

8. Fire flows were simulated at various locations under MDD conditions. The 4-inch and smaller mains are too small to carry the required fire flows. The simulation showed that negative pressures in these undersized mains could occur even with a fire flow as low as 1,000 gpm.

9. To avoid having to construction large mains for delivering 3,000 to 4,000 gpm fire flows and provide additional fire storage (except for the Airport area), the City shall require every new or improved building for commercial and industrial uses to have an approved automatic sprinkler system. This will reduce the required fire flow to 1,500 gpm for 2 hours.

10. Stearns and Barney wells would fill Barnes Butte Tank at a faster rate than they would fill Ochoco Tanks because of their proximity to Barnes Butte Tank. This demonstrates the need for additional wells and storage tanks closer to the Ochoco Tanks in order to augment supply to the downtown area.

11. The analysis showed that during peak hour demand periods Barnes Butte Tank was unable to share the load. Additional simulation showed that the downstream pressure setting at Williamson and Combsflat pressure regulators would have to be raised higher during heavy demands in the summer so that the downtown area could benefit from Stearns and Barney Wells.

12. During peak hour demand periods, pressures in the system are generally above 40 psi except the southeast area south of Lynn Blvd could experience pressures lower than 40 psi. Even with Ochoco Tanks full, highest static pressure would be about 40 psi for this area (El 2890). The static pressure would drop to 19 psi when the tank is nearly empty. Pressures lower than 40 psi can be expected unless Ochoco Tanks are kept close to full or this area is placed in a higher-pressure zone.

Recommendations

We recommend the following water system improvements to rectify the identified system deficiencies and build a water system network to meet the projected growth demands. The proposed improvements are shown in Figures 7-1 through 7-4.

1. Short-Term Improvements

    a. Replace the existing undersized distribution mains, woodstave pipe, wrapped steel pipe, and galvanized steel pipe.
    b. Drilling wells at Airport, American Pine and Fairgrounds, and replacing Stadium Well with a larger well.
    c. Construct new 12” and 16” supply mains and PRV (pressure regulating valve) vaults, connecting new tanks to the distribution system.
    d. Construct 1.0 MG Airport Tank No. 2 next to the existing tank at Airport.
    e. Construct 1.0 MG American Pine Tank at Northridge area.
    f. Construct 1.0 MG Barnes Butte Tank No. 2 next to the existing tank.
    g. Construct 1.0 MG Fairgrounds Tank No. 1.

2. Development Driven Improvements

   It is recommended that the development driven improvements as summarized in Tables 7.3 and 7.5 for the five growth areas (Northwest, Barnes Butte, Hudspeth, Fairgrounds and Airport) be tailored to meet the development needs.