2017 Water Capital Facilities

Plan Update

City of Sisters, Oregon

April 2017

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EXECUTIVE SUMMARY

S.1 PURPOSE

The purpose of this Water System Capital Facilities Plan is to provide the City of Sisters with a comprehensive water utility planning document through the year 2037, and to identify improvements needed to satisfy water demand of a growing community, including anticipated future regulatory requirements. In addition, the Capital Facilities Plan, with Oregon Human Services approval, will provide the basis for funding application preparation and approval.

S.2 POPULATION AND GROWTH

The population was certified at 2,390 residents on July 2016 by the Population Research Center at Portland State University (PSU). Year 2037 population of 4,579 residents was projected and based on projected growth rates from analysis provided by the Population Research Center at PSU. ***It should be noted that Sisters has experienced periods of rapid growth in the recent past, therefore, it is recommended that a population forecast update be prepared at a minimum of every 5 years, and, if necessary, corresponding revisions to the capital facilities plan. Regular population forecast updates will ensure that the capital facilities plan remains closely aligned with current population and current demand on City infrastructure.***

S.3 EXISTING WATER SYSTEM

Sisters' water system dates back to the 1930's. Supply is currently provided by three wells. Water is treated by disinfection for public safety, currently by a gaseous chlorine feed system and liquid chlorine onsite generation systems. There is one 1.6 MG pre-stressed, post-tensioned concrete reservoir, constructed in 1995. Distribution mains vary from 4" to 16" diameter. The system includes 1,316 active service connections, three (3) of which are located outside City limits.

S.4 WATER REQUIREMENTS

Current (2016) Water Requirements:

Average Daily Demand:	0.771 million gallons per day (mgd)
Maximum Monthly Demand:	1.420 mgd
Maximum Day Demand:	1.987 mgd
Peak Hour Demand:	3.458 mgd

Year 2037 water requirements:

Average Daily Demand:	1.349 mgd
Demand: Maximum Day Demand:	4.049 mgd
Peak Hour Demand:	8.86 mgd

Year 2037 water requirements are projected with system losses of 15%, based on current water usage. This assumes that leakage and losses will be reduced, and that conservation efforts will reduce peak usage during the planning period.

S.5 FIRE FLOW

Fire flow rates are generally adequate throughout the City, and meet the requirements of the Sisters-Camp Sherman RFPD. However, the computer analysis identified a few areas of low capabilities for fire protection, primarily in areas where old 4" mains exist. These lines need to be replaced because of age and service to residents, and will provide major benefit to fire capabilities throughout the City. In addition, infill is occurring in many of the areas with smaller existing mains, and this growth may require increasing water volumes. The reliability of adequate fire flows will be evaluated in this update.

S.6 WATER SOURCES

Sisters has three developed well sources: Well No.1 (City Well), Well No.2 (High School Well) and Well No. 3 (Sun Ranch). The City holds groundwater rights and numerous surface water rights. Existing groundwater rights should provide for average daily demands through the planning period, but some means of establishing mitigation credits needed for the City's newest permit as required under the Deschutes Basin Groundwater Mitigation Program will become of increasing important. The most effective and viable solution to providing additional water capacity will come from the development of a fourth (4th) well during the planning period. Ideally, the City could acquire an existing groundwater right to place on the additional well. This additional well is identified as a capital improvement in this plan.

Two of the existing wells are located within City limits, and one is outside City limits. Continuous review of the Source Water Assessment Report prepared in 2004 by Oregon Department of Human Services (DHS) is recommended.

S.7 WATER QUALITY AND DISINFECTION

Water quality associated with the active production wells is generally non-problematic. All measurable chemical concentrations are well within regulated maximum contaminant limits (MCLs) or established standards. Distribution water quality is also good with levels of lead and copper well below actionable.

Sisters is not required to disinfect, but provides disinfection for public safety. Each of the well sources has gaseous or liquid chlorination for disinfection, and there are supplemental disinfection systems provided at the 1.6 MG storage reservoir, and in the transmission system for emergency purposes.

S.8 WATER STORAGE

Sisters has a single 1.6 MG reservoir of pre-stressed, post-tensioned, concrete type, constructed in 1995. The reservoir is in adequate condition and should provide sufficient storage through the planning period.

S.9 DISTRIBUTION

The majority of the City's waterlines were installed since 1980, including major system improvements in 1995. There are old and undersized waterlines in the system that are proposed to be replaced and upsized during the planning period and these are included in this Master Plan. A second 12" transmission main was installed in 2002, providing redundancy to protect against a loss of portions of the single trunk line from the storage reservoir to the City. The distribution system is looped with very few dead end lines. Layout is rational and systematic with water lines forming the distribution grid with internal loops. Commercial areas are well served with looped water lines to provide fire flows.

S.10 IMPROVEMENT AND RECOMMENDATIONS DISCUSSION

S.10.1 Well Supply Recommendations

Sisters water supply is adequate at this time for meeting water demands of the community during Maximum Daily Demand periods. The City relies on Well 1 as the primary source of supply during the non-peak demand season and Well 3 during the peak-demand season. During both seasons, the City relies on Well 2 to provide peaking supply. Based on anticipated population growth, increased well capacity will become necessary within the planning period. A fourth City well is projected to become necessary by 2028. This fourth well would provide the City with water availability to meet peak flows and fire flows beyond the planning period.

S.10.2 Water Rights Recommendations

The City has four existing groundwater rights, authorizing the use of 4.60 million gallons per day (mgd). Of these existing rights, 3.30 mgd were obtained prior to 2002 and therefore do not require mitigation under the Deschutes Basin Groundwater Mitigation Program. The City only is required to provide mitigation when it appropriates more than 3.30 mgd as compared to a current Average Daily Usage of 1.3 mgd and a Maximum Day Demand of 2.727 mgd. The annual volume of water use that will necessitate mitigation was calculated by multiplying the Estimated Daily Demands over 3.30 mgd by the number of days in each month. This volume of water was then multiplied by 0.40 (40% consumptive use) to determine the number of mitigation credits required. Currently, the City holds 88.4 permanent mitigation credits. The City may want to consider maintaining a cushion for projecting future mitigation needs. If the 2037 population estimate is exceeded by a factor of 25%, the City would need an additional 40 mitigation credits, which could potentially be obtained through the transfer of existing owned surface water irrigation rights currently held by the City on the Lazy Z property.

S.10.3 Treatment/Disinfection Recommendations

To maintain water quality and to provide protection against coliform findings in the distribution system, it is recommended that each well be provided with an on-site chlorine generator. This type of disinfectant system provides for employee and public safety, and will assure that a chlorine residual is maintained at all times. Costs are provided with recommended improvements for the existing well that needs to be upgraded (Well 1) and for the proposed new well (Well No. 4). Opinions of probable cost for adding on-site generated disinfection to Well No. 1 and Well No. 4 are provided within the estimate provided in Section 10 for Well Supply Recommendations.

S.10.4 Storage Evaluation

The City has one reservoir tank which has a 1.6 MG storage capacity. The reservoir is located at an elevation that is higher than the City and therefore provides consistent water pressure for the water system. The reservoir is sized to provide water to the City in the event of a temporary well pump outage or in the case of extraordinary water use, such as to fight a fire. This Plan includes a recommendation for the reconditioning of the exterior walls on the existing 1.6 MG reservoir.

S.10.5 Distribution Recommendations

The Master Plan includes an analysis and recommendations for distribution improvements in the system. These distribution improvements are necessary for the replacement of old and undersized main lines and service connections. Replacement / upsizing of the existing main lines will provide greater reliability and additional capacity to the system. The distribution system improvements proposed in Section 9 have identified as necessary to serve the anticipated population growth through the planning period.

S.11 WATER RATES

The last water rate increase became effective in 2012. Current minimum usage charges are $20.59 per month for a ¾" residential service (our most common), which includes 1,000 cubic foot minimum allotment per month. The City should consider a new rate structure based on a "pay for what you use" approach with no minimum allotments. Water conservation can be encouraged through creative rate structures, low-water vegetation and xeri-scape landscaping.

This new water rate structure is recommended to provide revenues for project costs of the system improvements that are related to equipment replacement and increased operation and maintenance expenses in accordance with Oregon Administrative Rules.

S.12 FINANCIAL AND RATE IMPACTS

Probable financing will likely be limited to grants and loans (based on project scope, cost, impact on

rates, and City eligibility). Grants and loans can be obtained from either USDA, Oregon Department of Environmental Quality (DEQ) or Oregon Infrastructure Finance Authority (IFA).

S.13 SYSTEM DEVELOPMENT CHARGE (SDC) RECCOMENDATIONS

A System Development Charge (SDC) is a reimbursement fee, an improvement fee or a combination thereof assessed or collected at the time of increased usage of a capital improvement or issuance of a development permit, building permit, or connection to the capital improvement.

The City should modify the current water system SDC to include recommended system improvements planned for development with SDC's. Water SDCs are typically based on some definable indicator of relative system utilization. The Equivalent Dwelling Unit of measurement (EDUs) are a commonly used basis. EDU's are most accurately determined from accumulated water meter sizing and estimated usage for planned developments.

Improvement SDCs apply to capacity related system upgrades or expansions. Maintenance costs, such as the water reservoir rehabilitation, are not eligible. Reimbursement SDCs are intended to cover costs associated with capital improvements, already constructed or under construction when the fee is established, for which the local government determines that capacity exists. They can also be used to pay for loan costs specifically related to a construction project, and used for repayment of costs incurred for planned improvements. SDCs of either type can be updated annually to account for inflation based on an index such as the Engineering News Record Index.

1 INTRODUCTION

1.1 GENERAL

Sisters is located in Deschutes County, 21 miles northwest of Bend and 20 miles west of Redmond (Figure 1.1). The major transportation routes between the mid-Willamette Valley and central and eastern Oregon pass through Sisters. The City is a focal point for travelers, tourists, and part-time residents. Sisters was established along the Santiam and McKenzie Wagon Roads (then Highways), around 1880, and became an incorporated City in 1946.

Resident population was estimated in December 2015 as approximately 2,315 people, with a significant influx of retirees, tourists, travelers, part time residents and associated commercial development. Sisters has been rapidly growing since completion of a new wastewater system in 2002, which allowed for a number of residential developments to occur.

1.2 BACKGROUND

The City of Sisters owns and operates a municipal water supply system. The system dates back to at least the 1930's, when records show the City began to obtain water rights. An upgrading of source capabilities was completed in the late 1960's, with a new surface water intake and impoundment on Pole Creek, a transmission main into town along Elm Street (Three Creek Lake Road), and new disinfection facilities. In addition, a supplemental intake was provided south of town, where the Pole Creek line crossed Squaw Creek, and surface water from Squaw Creek was planned to supply the community during extreme cold weather periods. Much of the distribution system was originally installed in very shallow trenches, often with 12" or less of protection from cold weather. During 1973, Pole Creek froze completely above the impoundment, and residents faced periodic water outages. Reports of freezing of the distribution system inside the community were also frequently heard, and some of the original wrapped steel pipe had the wrapping burned off in an attempt to defrost the pipelines and furnish water to the community.

Much of the original steel and asbestos cement water system has been replaced over time, with PVC AWWA C-900 Piping. A well was developed in 1975 as a supplemental water source for the City, a second well was added in 1991 and a third well was added in 2007. During 1994, major improvements were provided to the municipal water system, including construction of a 1.6 MG pre-stressed, post-tensioned, concrete reservoir. Older lines in the system will need replacement and continued community growth will dictate upsizing in regards to capacity. An infiltration gallery was installed in the Pole Creek impoundment in the 1980's, and this was converted to a slow sand filter in later years, but the surface water system was unable to supply a reliable water supply to meet requirements of the Surface Water Treatment Rule. At this time, groundwater is the only water source for the City of Sisters.

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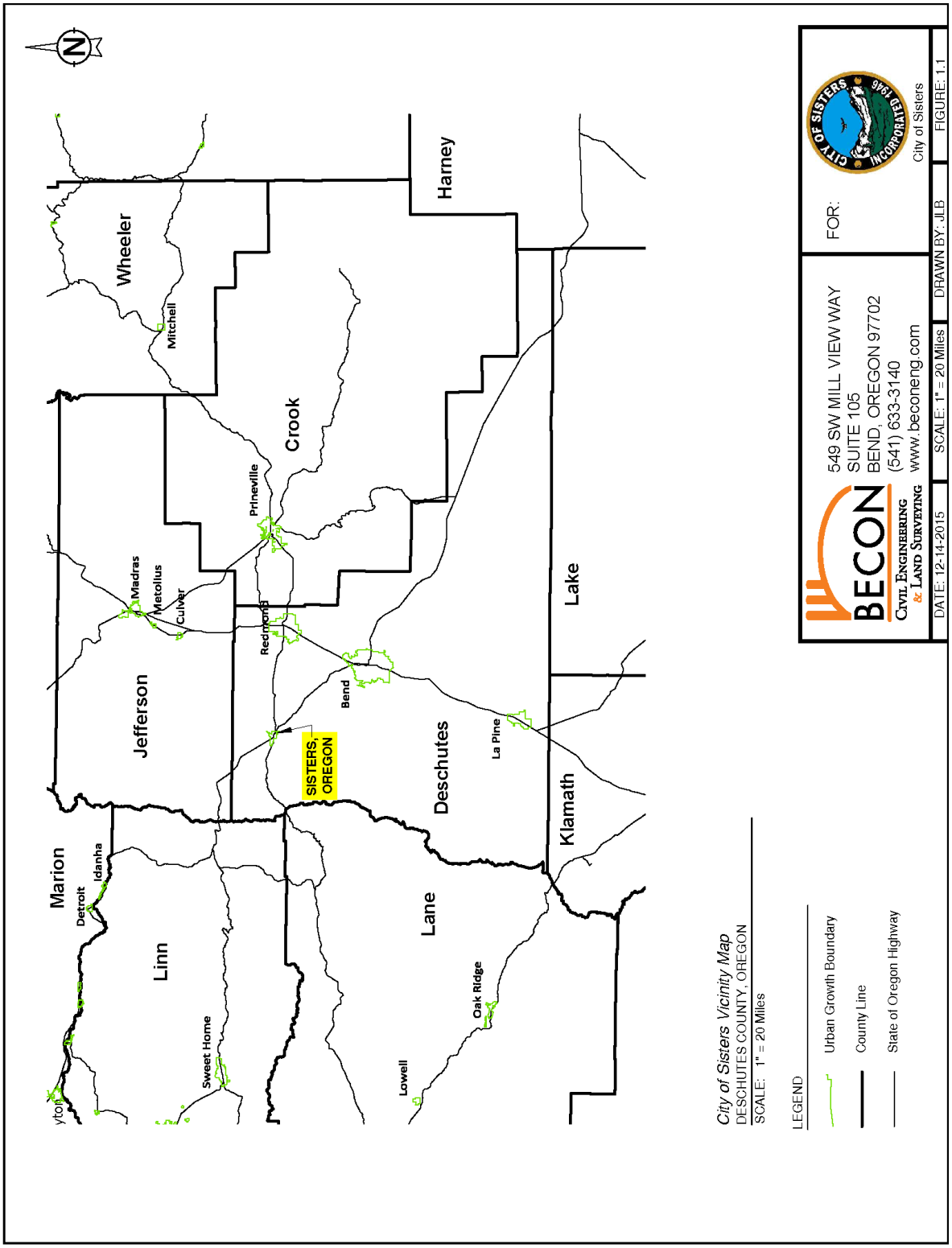


Figure 1.1: City of Sister Vicinity Map

1.3 PREVIOUS PLANNING DOCUMENTS

Master Planning for public water improvements in Sisters has occurred on a regular basis in Sisters since the early 1970's, including the following:

1. "Comprehensive Water System Development Program," February 1975, HGE Inc. Engineers & Planners.
2. "Comprehensive Water System Development Program Update," September 1982, OBEC Consulting Engineers.
3. "Water Facilities Study," April 1988, Westech Engineering, Inc.
4. "Municipal Water Supply Data Package," May 2005, Newton Consultants Inc., and David Evans and Associates, Inc.
5. "Water System Capital Facilities and Water Conservation and Management Plan," September 2005, HGE Inc., Architects, Engineers, Surveyors, & Planners

1.4 CURRENT SITUATION

The City of Sisters has and continues to experience rapid growth and an update to the 2005 Water System Capital Facilities Plan is needed to evaluate and provide capacity for anticipated growth to year 2037. The water production and distribution systems are all owned and maintained by the City of Sisters and expansion and replacement plans will be addressed in the Capital Facilities Plan update.

1.5 AUTHORIZATION

The City of Sisters has prepared this Water System Capital Facilities Master Plan Update for current zoning of property within the Sisters Urban Growth Boundary (UGB).

1.6 ORGANIZATION

The overall structure of this Water System Capital Facilities follows the flow of water from the source to the consumer. Separate chapters have been written to evaluate each of the following system components; water requirements, water supply, water quality and treatment, treated water storage, and treated water transmission and distribution. Tables and figures in this report are numbered consecutively within each chapter, and they generally appear in the text of the report on the page or pages following the first reference. A complete list of tables, figures, and plates is contained in the Table of Contents.

1.7 PLANNING AREAS

The planning area used in this Water System Capital Facilities Plan is the area encompassed by the current Sisters UGB. Areas outside these boundaries are included only to the extent that they pertain to

water supply, storage, or transmission. The planning area, including adjacent areas relevant to planned facilities outside the UGB, are shown in Figure 1.2.

1.8 PLANNING SCOPE

The objective of this plan is to establish a short-term and long-term water system capital facilities plan for the present and future needs of the City of Sisters. Overall, the scope of work is meant to provide documentation for securing future water rights from the Oregon Water Resources Department, and to satisfy requirements for potential funding sources. Needs will be addressed relative to water source, treatment, storage, transmission, and distribution. An outline of basic considerations of the facilities plan is as follows:

1. Describe the existing water facilities and the area to be served. Include land use, current and estimated future population, and environmental concerns.

2. Determine existing water requirements based on estimated water consumption, land use plans, and fire flow requirements. Include estimates of average daily use, maximum daily use, maximum hourly use, and peak instantaneous demand. Prepare an estimate of water demands for the next 20 years, to the year 2037.

3. Evaluate the potential water sources for present and future needs, including quantity and water rights. Include description of required or anticipated treatment /disinfection needs.

4. Description of the existing distribution, transmission, and storage systems and their ability to meet existing and future water demand. Long-range system needs will also be developed by the application of growth projections into the model, and with a detailed layout of future system needs arranged in priorities.

5. Conduct cost-benefit analysis of fire protection capabilities.

6. Prepare a base map and show the existing and proposed water distribution system.

7. Planning level cost estimates for the proposed improvement projects will be prepared and recommendations will be separated into priorities for development.

8. Recommendations will include a detailed plan for financing proposed improvements with local funds, State and federal financing, and/or a bonding program.

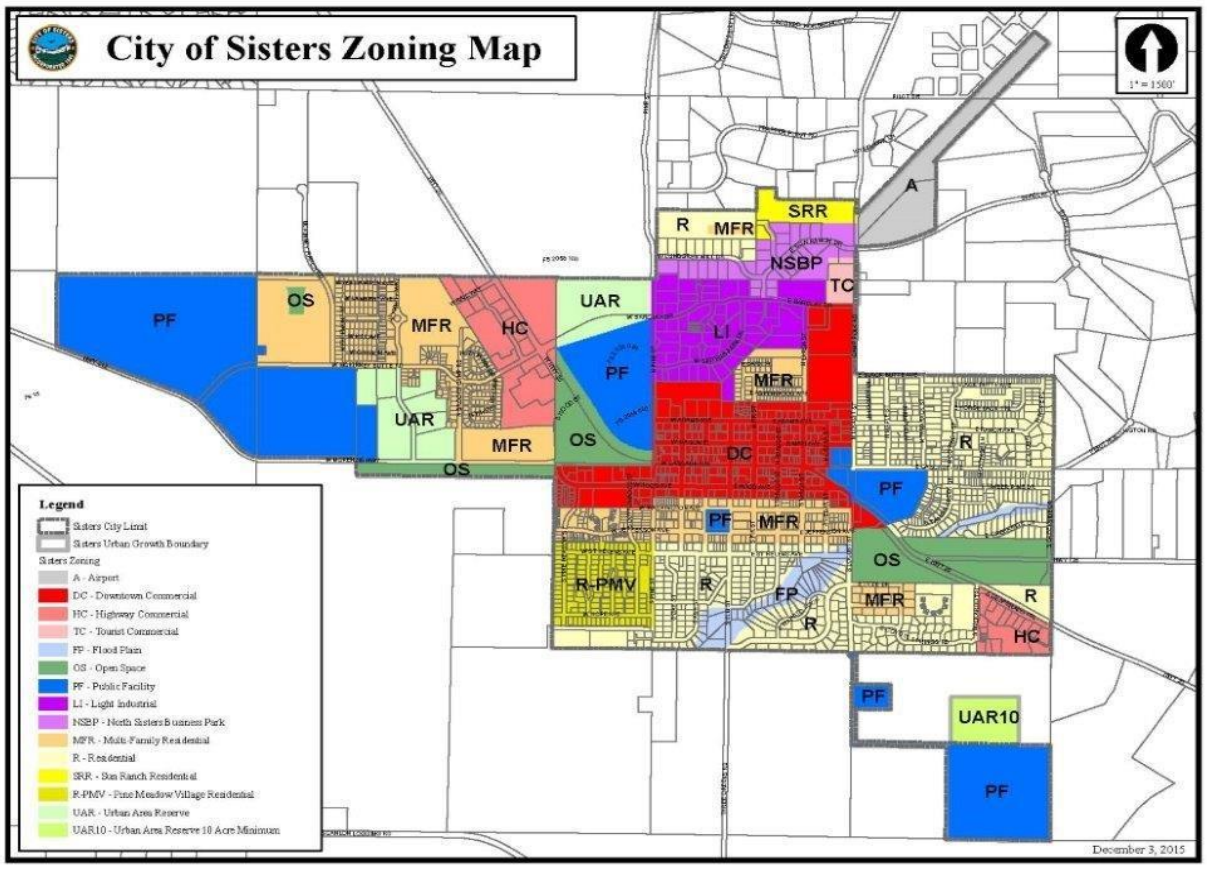


Figure 1.2: City of Sisters Zoning Map

2 METHODOLOGY USED FOR WATER SYSTEM EVALUATION

2.1 GENERAL

This section of the study covers the procedure used to establish the design parameters for the proposed water system, priorities for implementation, and the method used to develop opinions of cost.

2.2 ANALYSIS PERIOD

This study is based on a 20-year planning period with future projections to the year 2037. It is felt that this time frame is adequate to allow for adaptation to future needs, while being short enough to ensure that the facilities will be effectively utilized within their economic life. System recommendations are developed for construction in phases (priorities) and components are designed to allow for future expansion.

2.3 SYSTEM CAPACITY AN LAYOUT

Capacity requirements and consequent system sizing are based on evaluations of population, land use, and fire flow requirements. Potential water demand is estimated based on system history. System layout includes an allowance for service connections; however, several of the larger commercial, industrial, and institutional customers, may require additional piping to service or reach all of its buildings or all of their connections. The larger facilities will also require larger meters, service lines, and possibly on-site hydrants.

2.4 REGULATORY REQUIREMENTS

Pertinent regulatory stipulations and requirements of the Safe Drinking Water Act are summarized in Chapter 7. Appendix 1 contains a stand-alone Water Management and Conservation Plan as required under OAR Chapter 690, Division 86.

2.5 PRIORITIES

In developing a water system capital facilities plan, prioritization is necessary. System improvements are designed to occur on an as-needed basis based on projected growth assumptions which are recommended to be updated regularly.

2.6 BASIS FOR OPINIONS OF COST

2.6.1 General

Planning costs presented in this study include four components, each of which is discussed separately in this section. It must be recognized that opinions of cost are preliminary and are based on the level and detail of planning presented in this study. As any project element proceeds forward, it may be necessary to update the costs from time to time, as more information becomes available.

2.6.2 Construction Cost

Opinions of construction costs in this capital facilities plan are based on actual construction bidding results for similar work, published cost guides, and other construction cost experience of the authors within the state of Oregon. Opinions of cost are based on preliminary layouts of the proposed improvements.

Future changes in the cost of labor, equipment, and materials, may justify comparable changes in the opinions of cost presented herein. For this reason, it is common engineering practice to relate the costs to a particular index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) Construction Cost Index is most commonly used. It is based on a value of 100 for the year 1913, and the values since 1982 are shown in Table 2.1 along with calculated annual percent increases.

All costs in this study are based on the July 2015 ENR Construction Cost Index value of 10,055. Opinions of costs should be updated at the actual time of funding applications and prior to a general obligation bond election. Note that when the community secures financing, a "reserve factor" should be added at that time for estimated increases in cost due to inf1ation. Estimates can be prepared at any future date by comparing the future ENR Construction Cost Index with the index value of 10,055; however, this approach is generally only considered valid for a 2 or 3 year period since construction techniques and materials change with time. If more time than this has elapsed, opinions of cost should be updated by an Engineer.

Table 2.1: Engineering News Record Construction Cost Index with Calculated Annual Percent Increases

YEAR	***20-CITY ENR*** *(August)*	***% CHANGE***	***YEAR***	***20-CITY ENR*** *(August)*	***% CHANGE***
1982	3,899		1999	6,091	2.7
1983	4,066	4.3	2000	6,233	2.3
1984	4,146	2.0	2001	6,389	2.5
1985	4,195	1.2	2002	6,592	3.2
1986	4,295	2.4	2003	6,733	2.1
1987	4,401	2.5	2004	7,188	6.8
1988	4,541	3.2	2005	7,479	4.0
1989	4,607	1.5	2006	7,722	3.2
1990	4,752	3.1	2007	8,007	3.7
1991	4,892	2.4	2008	8,362	4.4
1992	5,032	2.9	2009	8,564	2.4
1993	5,230	3.9	2010	8,837	3.2
1994	5,424	3.7	2011	9,088	2.8
1995	5,506	1.5	2012	9,351	2.9
1996	5,652	2.7	2013	9,524	1.9
1997	5,854	3.6	2014	9,840	3.3
1998	5,929	1.3	2015	10,055	2.2
Average Annual Increase (%)					**2.9**

2.6.3 Contingencies

In recognizing that the opinions of cost are based on preliminary design, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties that cannot be foreseen at this time, but which may tend to increase final costs. A contingency factor of 10 percent of the construction cost has therefore been added.

2.6.4 Engineering, Legal and Administrative

An allowance of 10 percent of the projected construction cost has been added for engineering, legal and administration. This allowance is intended to include internal project planning and

budgeting, grant administration, liaison, interest on interim financing, legal services, review fees, legal advertising, and other related expenses associated with the project.

2.6.5 Opinion of Cost and Summary

Opinions of costs presented in this study include a combined allowance of 20 percent for contingencies combined with engineering, legal, and administrative costs.

2.7 RECOMMENDED IMPROVEMENTS

The assessment of the proposed water system will be summarized and a recommended plan for construction will be developed in Section 10. Financing of the construction will be considered in Sections 11 & 12.

3 EXISTING WATER SYSTEM

3.1 INTRODUCTION

This section includes a description of existing water facilities in Sisters. Following sections discuss components of the system in more detail and present recommended improvements.

System locations and sizing were developed from available records in the City, including extensive as-built files, prior planning studies and construction plans, on-site inspections, and the detailed knowledge of City staff.

3.2 WATER SOURCES

Sisters currently relies on three developed groundwater sources (Well No. 1 [City Well], Well No. 2 [High School Well]) and Well No. 3 (Sun Ranch Well) to supply the City's water needs. Two wells are located inside City limits and one well is located outside City limits. Figure 3.4 and Figure 3.5 (shown at the end of this Section 3) show well locations. Well 1 and 3 function as the primary well for portions of the year, with Well No. I functioning as the primary well in the winter months, and Well No. 3 functioning as the primary well during summer usage periods. Well 2 functions as the pressure back-up (When pressure drops in the system due to high demand Well 2 starts and runs until pressure stabilizes) during the entire year. All wells are controlled via radio telemetry, based on water level in the reservoir.

Figure 3.1: Well No. 1

Wells 1 and 2 were originally designed to pump 750 gpm, the pump and motor in Well No. 1 was replaced in 2011 to provide the original design capacity of 750 gpm. Well 3 was constructed in 2007 and is designed to pump 1,560 gpm. Photographs of Wells 1, 2 and 3 are presented as Figures Figure 3.1, Figure 3.2, and Figure 3. 3, respectively.

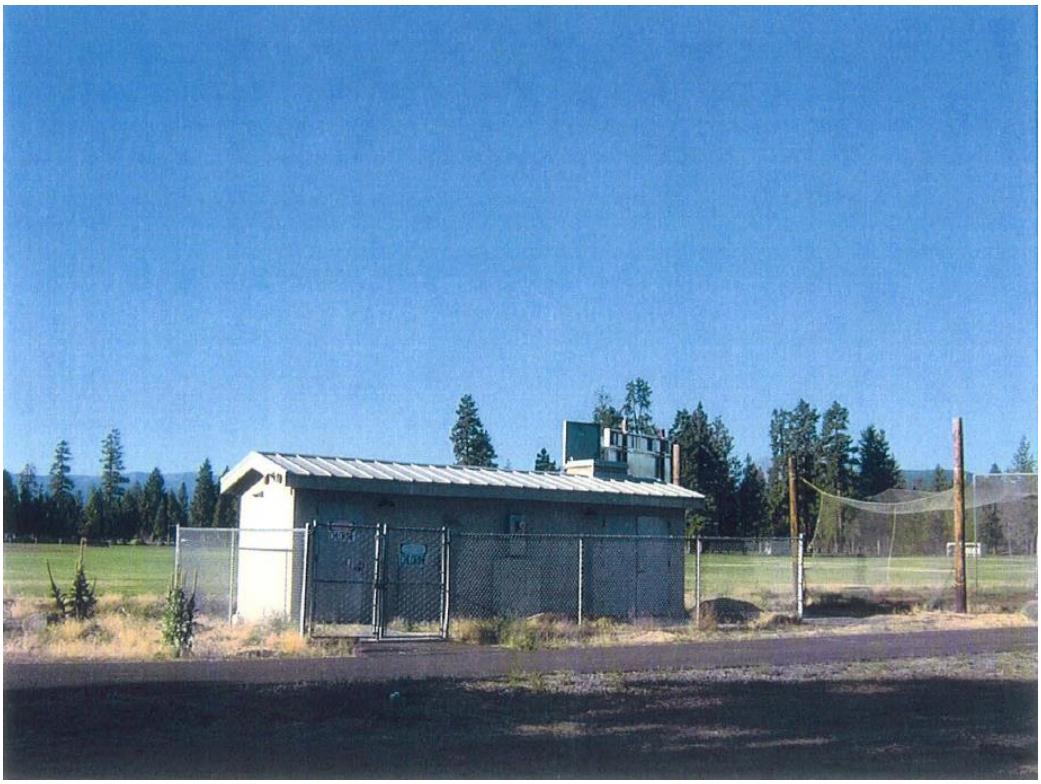


Figure 3.2: Well No. 2

3.3 WATER TREATMENT

Source water is disinfected at Well 1 with a chlorine gas injection system and Well 2 and 3 use on-site generation due to their location and the dangers associated with chlorine gas. While Oregon Department of Human Services (DHS) does not require disinfection for groundwater sources, the City of Sisters maintains a chlorine residual to provide positive protection for public health. No other treatment is required or provided in the Sisters water system.

3.4 WATER PRESSURES AND SERVICE ZONES

The City of Sisters' water system operates within a single pressure and service zone. Static system pressures range from approximately 70 psi in the south end of the City to 79 psi at the northeast corner of the City; 70 psi along Hwy. 20 near the Three Winds Shopping Complex (BiMart), and approximately 54 psi at the high school on the west end of the City. Pressurization is provided by the City reservoir located approximately 2 miles southwest of Sisters, and located on U.S.F.S. land. System pressures typically increase when wells are running.

3.5 DOMESTIC WATER STORAGE

Sisters has one 1.6 million gallon reservoir. The reservoir was constructed in 1995, rehabilitated in 2003 including the roof panels. This reservoir is located adjacent to the Pole Creek surface water reservoir (former), which supplied the City with surface water for many years. Figure 3.5 indicates the location of the existing 1.6 million gallon reservoir, and Figure 3. 3, below, is a photograph of the existing facility.

Figure 3. 3: Existing 1.6 Million Gallon Reservoir

3.6 TRANSMISSION AND DISTRIBUTION

One transmission main provides water to the City from the reservoir a point where a second mainline was installed into South Pine Meadow Street in 2002. An upgrade of the transmission system was completed in the 1960's, which included a 12" transmission main from the current location of the reservoir northeasterly to the Old Brooks-Scanlon road, and along the road to Elm Street where the system is connected with the distribution system. When Well No. 1 was constructed in 1975, it provided an interconnection between the existing transmission main on Elm Street, and the distribution system at the South end of Pine Street. This transmission main crosses under Whychus Creek. A second 12" transmission main was extended from the Brooks-Scanlon road in 2002, extending in a North-South direction across Pine Meadow Ranch to connect with the distribution system in South Pine Meadow Street.

The 1960's transmission system was constructed of asbestos-cement pipe materials, and the 2002

transmission main utilized AWWA C-900 PVC pipe materials.

Distribution mains within the City total approximately 36.81 miles and range in diameter from 4 inches to 12 inches. Major portions of the distribution system were replaced in 1994 during a major upgrade of the water system. Pipe materials in the distribution system include asbestos cement, PVC, and steel.

3.7 FIRE PROTECTION

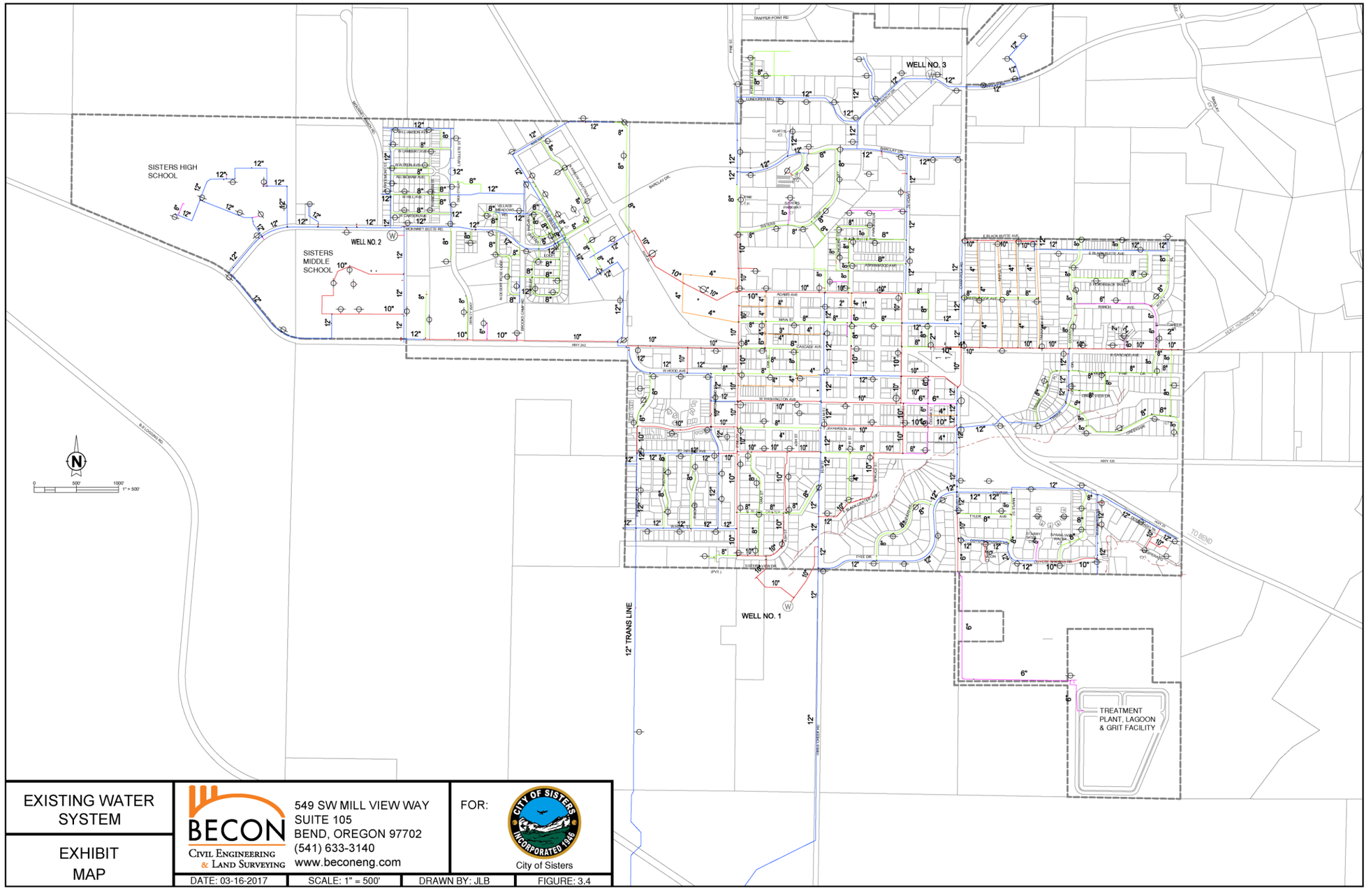
Capabilities and Resources. The amount of water used in firefighting in comparison to total yearly water consumption is negligible, but heavy demands during major potential fires greatly influence the design of the distribution system and storage reservoirs. Fire protection in Sisters is provided by the Sisters-Camp Sherman Rural Fire Protection District. Inside the City, the fire district relies on fire hydrants to supply water for fire protective purposes. Minimum requirements are 1,500 gpm in residential areas, and 2,500 gpm in commercial and industrial areas, for 3 hours.

Fire Protection Class Rating. The Insurance Service Office (ISO) sets the class rating for a community's ability to provide fire protection. A community's class rating is one of the criteria insurance companies use for establishing homeowners' insurance rates. Six inches is the minimum pipe diameter recognized by the Insurance Services Office as providing fire protection. Generally the rating involves both the capabilities of the water system and the fire department. Class 1 is the highest rating, and Class 10 is the poorest. Sisters has a Class 4 rating within the City limits.

In addition to the distance from a hydrant, the amount of water f1ow (fire flow) available at the hydrant is considered when setting insurance rates. Recommended quantities of fire f1ow are different for commercial and residential property, and are dependent on a number of factors such as building size, distance between buildings, building construction type, etc.

Fire flow evaluations are based on a limited level of fire suppression deficiencies. Fully sprinklered buildings, regardless of size, and any building with a needed fire flow of over 3,500 gpm will not be considered when establishing a community's protection class, except for response distance and aerial ladder needs. Buildings that have larger than a 3,500 gpm needed fire f1ow, and are not sufficiently protected, may have a poorer class assigned to that individual property. This puts the responsibility of fire protection for large properties or large fire protection problems on the individual property owners instead of on the community.

Distribution lines need to be adequately sized to carry fire f1ow from storage reservoirs to fire hydrants. In the evaluation of distribution line sizing for Sisters, the desired fire f1ows are 2,500 gpm in the main commercial district and industrial parks, and 1,500 gpm for residential areas. The Sisters-Camp Sherman Rural Fire Protection District has recommended that the City's fire hydrants supply 3,000 gpm for 3 hours for commercial structures per the Oregon Fire Code 2014 Edition. The evaluation of distribution line sizing will be discussed in greater detail in Chapter 9.



EXISTING WATER SYSTEM EXHIBIT MAP	BECON Civil Engineering & Land Surveying 549 SW MILL VIEW WAY SUITE 105 BEND, OREGON 97702 (541) 633-3140 www.beconeng.com	FOR: City of Sisters	
DATE: 03-16-2017	SCALE: 1" = 500'	DRAWN BY: JLB	FIGURE: 3.4

Figure 3.4: Existing Water System

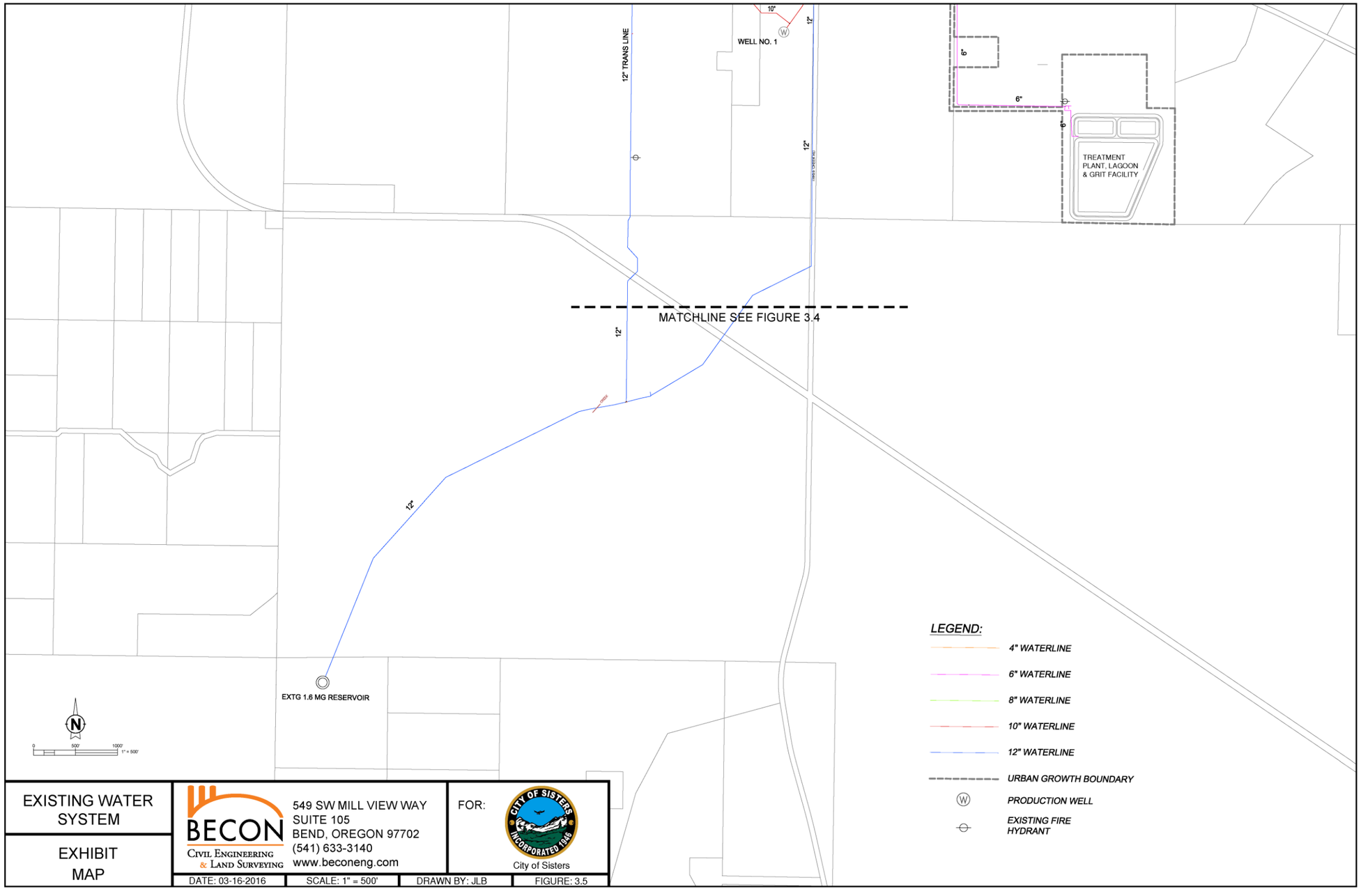


Figure 3.5: Existing Water System

4 POPULATION AND LAND USE

4.1 HISTORICAL POPULATION

Sisters maintained a historical population from 600 residents to 690 residents for more than 30 years through the year 1990. Population growth was relatively stagnant between 1980 and 1990, but averaged approximately 2 percent a year from 1990 to 1996. The population reached 775 residents in 1996. Beginning in 1997, when the citizens approved construction funding for the community sewer system, growth escalated rapidly, in similar fashion to the growth throughout all of Deschutes County. By the year 2003, population in Sisters had reached 1,430 residents, and despite the slowing of growth during the recession of 2008-2013, Sisters population surpassed 2,300 in 2015.

4.2 CURRENT POPULATION

The certified population for the City of Sisters was 2,390 residents in July 2016, by the Population Research Center at Portland State University.

4.3 PROJECTED FUTURE POPULATION IN YEAR 2037

The City of Sisters Comprehensive Plan projects that population in the City will be moderate within the planning period. From 2017 to 2037 the Average Annual Growth Rate (AAGR) for the City is anticipated to be 3.2% per year. The Population Research Center at Portland State University has also published population forecasts using a five year interval (2020, 2025, etc.). Assuming that the projections are realistic, and that the growth is constant between every 5 year interval, the City should anticipate a 98% population growth or a population of 4,375 residents by the year 2037. It should be noted that Sisters has experienced periods of rapid growth in the recent past, therefore, it is recommended that a population forecast update be prepared at a minimum of every 5 years, and, if necessary, corresponding revisions to the capital facilities plan. Regular population forecast updates will ensure that the capital facilities plan remains closely aligned with current population and current demand on City infrastructure.

4.4 COMPARISON WITH PREVIOUS GROWTH PROJECTION

Previous population projections by various agencies, and projections in the 1988 Water Facilities Study (Westech Engineering), and 1997 Wastewater System Facilities Plan (HGE Inc., Architects, Engineers, Surveyors & Planners) substantially underestimated the growth that has occurred in the City. The 1988 projection estimated that approximately 1,100 people would reside in Sisters by the year 2005, while the remaining projections all anticipated a population in the range of 1,000 people by the year 2005. Growth has been much more rapid than anticipated in projections during the 1980's and 1990's.

4.5 BUILDOUT OF CURRENT UGB

The aforementioned population estimates assume year 2037 growth will occur as a result of the buildout of infill land within the existing UGB. Ultimate population in the Sisters UGB is difficult to estimate with continuing infill and partitioning of lots in older sections of the City. It is anticipated that future

years will see a tendency toward partitioning of lots for coming generations, taking into account increasing land values. Growth projections should occur within the existing UGB, with the potential for continuing population expansion as existing land area continues to be redeveloped into smaller partitions. The Sisters Planning Department anticipates stable occupancy rates to occur within the 20-year planning period with an average of 2.08 people per dwelling unit by 2037 and approximately 2,104 dwelling units.

4.6 LAND USE

4.6.1 Current Land Use

Current land use is shown on Figure 1.2 based on Sisters' Comprehensive Plan and zoning ordinances, effective in 2017. The Urban Growth Boundary (UGB) may be adequate for anticipated growth in the planning period.

4.6.2 Comprehensive Plans and Zoning Ordinance Revisions (Amended 2014)

The current Comprehensive Plan was adopted by the City of Sisters in 2005, and amended in 2014. Revisions since the 2005 plan include adoption of mixed use developments incorporating residential and light industrial development. The revisions also allow and encourage smaller minimum lot sizes, a density bonus and a height bonus when residential is incorporated with commercial development. Both have an impact on increasing needs for public infrastructure.

4.6.3 General Comments

Sisters is primarily a residential community, with a significant tourist-based economy. The City has a commercial district located on either side of U.S. Highway 20, and room for considerable expansion within the industrial district. The City has developed a zoning system that restricts industrial development to designated areas, while permitting mixed-use residential development in areas zoned for industrial purposes. Future industry, according to the City's Comprehensive Plan, will be encouraged to locate in areas with readily available utilities and minimal conflicts with existing development.

5 WATER REQUIREMENTS

5.1 INTRODUCTION

This section analyzes current water requirements for Sisters, including water production and water demand. The analysis was developed using water production records provided by City staff, and obtained from the web site for Oregon Water Resources.

5.1.1 Basis for Projected Future Water Requirements

Future water requirements are based in part, on future water demand being proportional to future population growth. Implicit in this determination is the assumption that the relative proportions of residential, commercial, industrial, and institutional use will remain constant.

5.1.2 Demand Definitions

The following terminology is used to define characteristics of water use:

Average Daily Demand (ADD): Total use for the year divided by the number of days in the year: expressed in gallons per day (gpd).

Maximum Month Demand (MMD): Total use for the month with the highest total use during the year, divided by the number of days in the month; expressed in gpd.

Maximum Day Demand (MDD): Total use for the day with the highest total use during the year; expressed in gpd.

Peak Hour Demand (PHD): Total use for the hour with the highest total use for the year: expressed in gpd.

Flow and demand parameters are typically abbreviated and expressed as:

mgd: millions of gallons per day

gpd: gallons per day

gpcd: gallons per capita per day

Other flow and demand rates commonly used include:

gpm: gallons per minute

cfs: cubic feet per second

Totalized flow and demands are commonly referred to as:

gal: gallons

MG: million gallons

cf: cubic feet

5.2 CURRENT WATER REQUIREMENTS

To determine water requirements, water usage records for a 3-year period from January 2013 to December 2016 were examined. Production records for this period are presented as a monthly summary in Table 5.1 for each calendar year.

Table 5.1: Well Water Production (January 2013 – December 2016)

Month/Year	(gal.)[1]	Average Day		
		(gal.)	(gpm)	(gpcd)[2]
2013				
January	9,598,000	309,613	215	142
February	8,799,000	314,250	218	145
March	9,213,000	297,194	206	137
April	13,870,000	462,333	321	213
May	27,421,750	884,573	614	407
June	32,734,380	1,091,146	758	502
July	40,592,070	1,309,422	909	602
August	39,146,460	1,262,789	877	581
September	27,519,230	917,308	637	422
October	13,902,470	448,467	311	206
November	8,715,370	290,512	202	134
December	8,688,960	280,289	195	129
TOTAL	240,200,6	658,084	457	303
2014				
January	7,646,000	246,645	171	113
February	9,657,000	344,893	240	157
March	9,161,810	295,542	205	135
April	14,190,000	473,000	328	216
May	27,303,440	880,756	612	402
June	33,977,950	1,132,598	787	517
July	41,166,400	1,327,948	922	606
August	37,565,920	1,211,804	842	553
September	30,790,740	1,026,358	713	469
October	19,300,470	622,596	432	284
November	8,729,000	290,967	202	133
December	7,727,000	249,258	173	114
TOTAL	247,215,73	677,303	470	309

Month/Year	(gal.)[1]	Average Day		
		(gal.)	(gpm)	(gpcd)[2]
2015				
January	7,225,000	233,065	162	102
February	8,095,000	289,107	201	127
March	9,572,000	308,774	214	135
April	17,653,000	588,433	409	258
May	22,871,400	737,787	512	324
June	37,576,850	1,252,562	870	549
July	44,032,270	1,420,396	986	623
August	42,441,670	1,369,086	951	600
September	31,845,880	1,061,529	737	466
October	14,394,980	464,354	322	204
November	15,283,740	509,458	354	223
December	9,336,260	301,170	209	132
TOTAL	260,328,05	713,228	495	313
Month/Year	**(gal.)[1]**	**Average Day**		
		(gal.)	**(gpm)**	**(gpcd)[2]**
2016				
January	10,252,000	330,710	230	138
February	9,128,000	314,759	219	132
March	10,283,000	331,710	230	139
April	21,072,990	702,433	488	294
May	31,160,310	1,005,171	698	421
June	38,343,360	1,278,112	888	535
July	42,479,030	1,370,291	952	573
August	43,371,970	1,399,096	972	585
September	35,869,770	1,195,659	830	500
October	18,700,510	603,242	419	252
November	10,348,000	344,933	240	144
December	10,625,570	342,760	238	143
TOTAL	281,634,51	771,601	536	323

1. All monthly flows recorded on final day of listed month.
2. Population Bases: 2013: 2,115 persons; 2014: 2,190 persons; 2015: 2,280 persons; July 1, 2016: 2,390 PSU estimates.

Average daily production (2013 – 2016 from Table 5.1) is approximately 0.717 mgd, but flows are increasing to correspond with construction of new homes and increased tourism. Peak usage occurs in summer (typically July or August). Maximum month demand (MMD) from Table 5.1 is 1.420 mgd (July

2015). Maximum day demand (MDD), based on known well production records reviewed, is 1.987 mgd. Peak hour demand (PHD) is estimated at 3.545 mgd. The PHD estimate is based on an empirical formula (Equation 5-3) from "Water System Design Manual, 2009" by the Washington State Department of Health. The equation and computation are provided below:

$$PHD= (MDD/1440)[(C)(N)+F]+18$$

Where:	PHD:	*Peak Hourly Demand (gallons per minute, gpm)*
	C:	*Coefficient Associated with Ranges of ERUs*
	N:	*Number of Equivalent Service Connections, ERUs*
	F:	*Factor Associated with Ranges of ERUs*
	MDD:	*Maximum Day Demand, (gpd/ERU)*

There are approximately 1,685 active service connections, including many restaurants, motels, commercial buildings, and three schools. For purposes of the computation, equivalent residential units (ERUs) are estimated at 1,318. For a range of N(ERUs) > 500: C = 1.6 and F = 225.

$$PHD = (MDD/1318)[(1.6)(1318)+225]+18$$

$$= 2,401 \text{ gpm}$$

$$= 3.545 \text{ mgd}$$

Current water demands are summarized in Table 5.2.

Table 5.2: Water Production Demands (2016)

Demand Parameter	Current Demand (mgd)	Ratio of Demand Parameter to ADD	Estimated Production Flow per Capita[1] (gpcd)
ADD	0.717	1.00	300
MMD	1.420	1.980	594
MDD	1.987	2.771	831
PHD	3.545	4.944	1483

1 Based on Population of 2390 and 2016 water usage records.

ERUs are typically determined by examining metered water use records for typical customers and customer categories. An ERU is the amount of water consumed by a typical full-time single-family residence. The ERU using the average water usage of single-family residential as reported in the City's 2016 Water Management Conservation plan.

5.3 CONCERNS REGARDING CURRENT WATER REQUIREMENTS

Relative to population, water consumption in Sisters is high. In smaller communities, typical residential water consumption, is approximately 50-70 gpcd. With allowances for commercial and institutional use, seasonal irrigation, and limited unaccounted for water, overall average water production expressed on a per capita basis would be 100- 120 gpcd. The influence of seasonal tourists and residents is obviously a major factor in Sisters water usage. Table 5.2 shows an annual average for Sisters of 290 gpcd.

Review of winter monthly data in Table 5.1 shows averages of 133 - 155 gpcd for some of the winter months. Sisters has developed numerous weekend events to bring tourists to the City, and this is evident with the level of water consumption throughout most of the year. Summer water production is approximately 5 to 6 times higher than winter, indicating high summer irrigation usage for homes, the impact of summer tourists and seasonal residents.

System losses also contribute to higher production requirements. Many older lines within the distribution system were replaced between 1994 and 2017; however, some older lines remain and could be a source of system losses. Several creek crossings also exist, and could be potential locations for leaks. All service line water consumption is metered, however, hydrant flushing, system maintenance and water removed by fire fighters accounts for approximately 5 MG of unmetered water per year.

5.4 WATER CONSERVATION

As a general term, water conservation refers to the recognition of water as a limited resource and the policies and efforts implemented to limit water withdrawals accordingly. In Oregon, most municipal water providers are required by Oregon Water Resources Department to develop and submit a Water Management and Conservation Plan (WMCP).

5.5 FIRE FLOW REQUIREMENTS

The amount of water used for firefighting in comparison to total yearly water consumption is negligible; however, heavy demands during major fires greatly influence the design of the distribution system and storage reservoirs. Recommended quantities of fire flow are different for commercial, industrial and residential property, and are dependent on a number of factors such as building size, distance between buildings, building construction, etc.

Recommended fire flows for single-family residential dwellings can be based on a complicated formula that includes square footage as a variable. A typical residential fire flow recommendation is 1,000 to 1,500 gpm, though smaller dwellings and wider spacing generally reduce the actual need. Dwellings with less than 3,600 square feet are identified by the Uniform Fire Code (UFC) as requiring a minimum of 1,000 gpm. Insurance Services Office (ISO) recognizes distance between residences as a

significant factor. ISO recommendations include a needed fire flow of 500 gpm for one and two family dwellings, two stories or less, with a distance between buildings of over 100 feet. The ISO recommendations increase to 1,500 gpm for separation distances of less than 11 feet. Higher fire flows are needed for larger buildings and higher densities of construction characteristic of core commercial areas and schools.

Actual fire flow needs in any given area may vary widely according to the actual construction present. The Sisters-Camp Sherman Fire Protection District has established minimum hydrant flow requirements of 1,500 gpm for residential areas, and 2,500 gpm for commercial and industrial areas. They also require that fire hydrants be available within 400 feet of any structure (800 foot hydrant spacing). Fire hydrant capacity is established to provide for needed flow at 20 psi residual pressure, and hydrant capacity in Sisters is often substantially greater than the fire department minimum requirements. Sisters currently has a Class 4 fire protection rating (where Class 1 is best and Class 8 is worst). 40 percent of the overall grading is based on the community's water supply and characteristics. The class rating is very important in establishing local property insurance premiums. Cost of maintaining or upgrading a water system to the individual customer can often be offset, at least in part, by reduced insurance premiums associated with a more favorable system rating.

The City has completed substantial distribution improvements and major system expansions between 1994 and 2017 which have greatly enhanced flow capabilities of the water system. Flow duration is also adequate with the City's three wells (3,060 gpm combined capacity) and a 1,600,000 gallon gravity storage reservoir. Current PHD is estimated at 2,462 gpm which exceeds the combined capacity of the City's wells; consequently, during peak usage times, stored water in the City's reservoir would be the sole source for fire flows. Table 5.3 shows generalized fire flow capabilities of the current water system.

Table 5.3: Current (Generalized) Fire Flow Capability in Sisters

Well Capacity		**Reservoir Capacity**		**System Capacity**	
System Water Demand (gpm)	**Excess Well Capacity (gpm)**	**Flow (gpm)**	**Associated Duration (minutes)**	**System Water Demand (gpm)**	**Excess Well Capacity (gpm)**
2462 (PHD)	598	3,000	666	2462 (PHD)	598
2462 (PHD)	598	2,500	841	2462 (PHD)	598
2462 (PHD)	598	1,500	1,774	2462 (PHD)	598
2462 (PHD)	598	500	No Limit	2462 (PHD)	598
1380 (MDD)	1,680	3,000	1,212	1380 (MDD)	1,680
1380 (MDD)	1,680	2,500	1,951	1380 (MDD)	1,680
1380 (MDD)	1,680	1,500	No Limit	1380 (MDD)	1,680
1380 (MDD)	1,680	500	No Limit	1380 (MDD)	1,680

490 (ADD)	2,570	3,000	3,721	490 (ADD)	2,570
490 (ADD)	2,570	2,500	No Limit	490 (ADD)	2,570
490 (ADD)	2,570	1,500	No Limit	490 (ADD)	2,570
490 (ADD)	2,570	500	No Limit	490 (ADD)	2,570

City Staff met with Sisters Camp Sherman Fire District Chief Roger Johnson and Fire Safety Manager Gary Marshall who recommended that a fire flow of 3,000 gallons per minute for a 3 hour period would be desirable for the dense commercial core of the City. Sisters currently has the system capacity to meet recommended fire flows during peak hour demand usage for over 8 hours. More capacity is always desirable and no specified flow or duration can assure the City that it is fully protected from all fire related scenarios, particularly in a wild fire situation.

Generally, fire flow is provided by means of reservoir storage capacity that is allocated and reserved for fire protection. A flow of 3,000 gpm for a duration of three hours would require 540,000 gallons of reservoir storage capacity; a flow of 2,500 gpm for a duration of two hours would require 300,000 gallons of reservoir storage capacity; and a flow of 1,500 gpm for a duration of two hours would require 180,000 gallons of reservoir storage capacity. As an alternative to reservoir storage capacity, fire flow strategies may rely on excess supply (well) capabilities which are discussed further in Chapter 6.

5.6 PROJECTED WATER PRODUCTION REQUIREMENTS

Projecting water production requirements for Sisters requires a fair amount of speculation, anticipating reduction in water losses and conservation by the community. Quantifying that reduction is highly uncertain and speculative until the sources of leakage are found, and until conservation results are achieved. For planning purposes, projected water requirements in Sisters will be based on the current usage plus a planned for goal of 10% system losses for a year 2037 population of 4,579 persons. Design per capita demands and water production requirements are shown in Table 5.4, anticipating conservation to reduce system demands. Total system demand is illustrated in Table 5.4.

Table 5.4: Year 2037 Design Per Capita Demands and Water Production Requirements

Flow Parameter	Per Capita Demand (gpcd)	Per Capita Demand (gpcd)
ADD	1.350	295
MDD	4.050	884
PHD	11.80	2577

1 Population Basis: 4,579 persons

6 WATER SOURCES

6.1 WATER RIGHTS INVENTORY

To meet municipal demands, the City currently relies solely on its four municipal groundwater rights, which authorize the use of up to 7.12 cfs (4.6 mgd). In addition, the City holds six municipal surface water rights, one municipal storage right, eight irrigation surface water rights, and four irrigation groundwater rights. The City's municipal water rights are shown in Table 6.1; water right permit and certificates are included in the Appendix B.

Table 6.1: City of Sisters Municipal Water Rights

Application	*Permit*	*Certificate and/or Transfer*	*Priority Date*	*Type of Use*	*Rate (cfs)*	*Volume (AF)*	*Source*	*Notes*
Ground Water								
G-10545	G-9979	88184	2/24/1983	MU	1.78		Well #1, Well #3	T-11284 added Well #3
G-12591	G-11418	87247	6/25/1991	MU	1.78		Well #3	
G-12591	G-11418	*N/A*	6/25/1991	MU	1.56		Well #2	Permit Extended to October 1, 2029
G-17058	G-16794	*N/A*	5/27/2008	MU	2		Wells #1, #2, #3 and #4	88.4 mitigation credits provided to date
Groundwater Total:					**7.12**			
Surface Water								
S-44263	S-32854	65091 (IL-1243)	11/17/1967	MU	1.45		Pole Creek & Sister Reservoir	Instream lease IL-1243 expires 12/31/2016
S-17149	S-12869	13509 (IL-1243)	11/1/1937	MU	1.25		9 Springs	Instream lease IL-1243 expires 12/31/2016
S-16404	S-12597	13501 (IL-1243)	4/7/1937	MU	1.25		Pole Creek Swamp Springs	Instream lease IL-1243 expires 12/31/2016
S-12560	S-8906	10028 (IL-1243)	2/11/1929	MU	0.2		Springs	Instream lease IL-1243 expires 12/31/2016
Squaw Creek Decree		*~~67706 T-11300 (MP-159)~~*	*12/31/1885*	*MU*	*0.2*		*Pole Creek*	Transfer moved water right instream to create mitigation credits for the City; instream water right (held by OWRD), c.91489
Squaw Creek Decree		*81663 T-11321*	*1883*	*IR*	*0.08*		*Whychus Creek*	*Pending instream transfer to generate 7.2 mitigation credits*
S-5551	S-3384	3227 (IL-1243)	5/18/1917	MU	1.5		Whychus Creek	Instream lease IL-1243 expires 12/31/2016
Surface Water Total:					**5.73**			
Storage								
R-43919	R-5054	65090 (IL-1243)	8/10/1967	MU		6.3	Pole Creek	Instream lease IL-1243 expires 12/31/2016
Storage Total:						**6.3**		

Per capita water demand for Average Daily Demand and Maximum Daily Demand was estimated by annual population growth projections, utilizing existing usage figures, with potential conservation.

These estimates of future water demand were used to generate the projections shown in Figure 6.1.

The authorized rates of appropriation for both groundwater and surface water rights presently held by the City of Sisters are also shown on Figure 6.1.

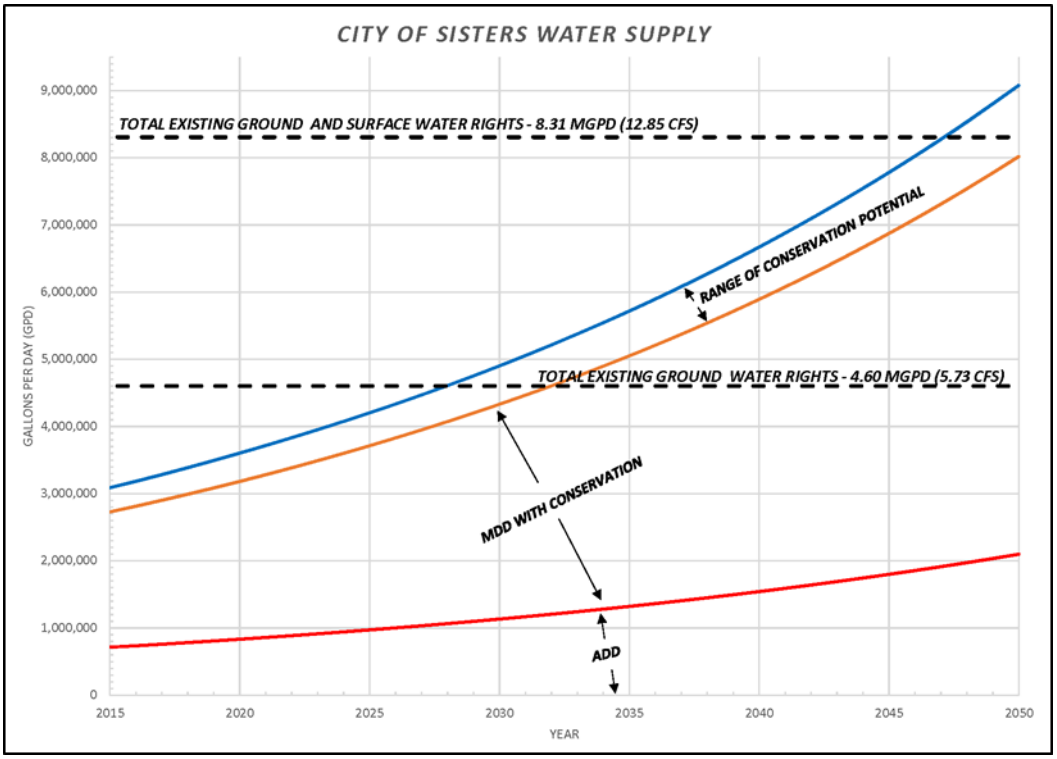


Figure 6.1: Demand Graph

Figure 6.1 illustrates that Sisters is projected to utilize all of its groundwater rights by 2028, on a Maximum Daily Demand Basis based on projected growth. Well before the City reaches its maximum authorized rate of appropriation under its water rights (7.12 cfs) it will need to begin the process of obtaining a "new" water right authorization to meet projected demands.

At the present time, new groundwater permits in a large portion of the Deschutes Basin are subject to regulatory constraints for protection of scenic waterways and for existing senior water rights. Mitigation rules were developed in 2002 under OAR Chapter 690, Division 505 to offset potential groundwater pumping impacts on surface waters, and to allow issuance of new groundwater permits by the Oregon Water Resources Department. New water use permits are required to provide mitigation for the estimated volume of consumptive use of the proposed appropriation. The City currently holds 155 acres of senior priority date irrigation rights on the Lazy Z Ranch property, and therefore, it may be possible for the City to use those water rights to establish the needed mitigation for a "new" municipal use groundwater permit at Well 4 to meet projected Maximum Day Demands. Conversely, the City may need to retain the Lazy Z Ranch water rights for a number of reasons, including the need to apply freshwater to the areas being irrigated with reclaimed effluent. Ideally, the City could acquire an existing groundwater right

(that does not require mitigation) to place on the additional well (Well 4) through a water right transfer. This option would allow the City to meet its projected Maximum Day demands and obviate the need to provide mitigation.

6.2 FUTURE WATER SUPPLY NEEDS

The City of Sisters is projected to need average daily flows of 1.37 MGD by the year 2037 to meets total system demands. Maximum daily demands are anticipated to reach 5.23 MGD by the year 2037. It is anticipated that the City's Maximum Day Demand will exceed its current water rights by 2028. The City should begin the process to secure an additional water right well in advance of 2028.

6.3 WELL SOURCES

Well data for Well No.1, Well No. 2, and Well No.3 is summarized in Table 6.2. Well logs are included in Appendix B. Well locations are shown on Figure 3.5. Additional well information and photographs are provided in Section 3.

Table 6.2: Well Data Summary

Item	Well No.1 (City Well)	Well No.2 (High School Well)	Well No. 3 (Sun Ranch Well)
Construction Date	1975	1991	2008
Well Depth (ft.)	211'	302'	293'
Static Water Depth (ft.)	78'	113'	63'
Pump Setting (ft.)	120'	158'	150'
Casing Perforation Depth Range (ft.)	50' - 195.6'	242'- 302'	188' – 268'
Grout Seal Depth (ft.)	40'	34'	130'
Casing Diameter (in.)	14"-12"	14"-10"	16"
Pump Type	Line Shaft Turbine	Line Shaft Turbine	Line Shaft Turbine
Horsepower	75 Hp	75 Hp	150 Hp
Capacity	750 gpm	750 gpm	1560 gpm
Flowmeter	Yes	Yes	Yes
Flowmeter Type	Propeller	Propeller	Propeller
Emergency Generator	Installed in 2005	Installed in 2005	None

Fuel/Tank	Diesel mounted under generator	Diesel mounted under generator	N/A
Alarm	Siren at wellsite. Light at wellsite.	Siren at wellsite. Light at wellsite.	Siren at wellsite. Light at wellsite.

The well building for Well No.1 (City Well) was constructed in 1976, and is in poor condition. The structure includes within a single room: piping, valving, flowmeter, controls and pump to waste.) The station is small, lacks ventilation, and has safety concerns that need to be addressed such as a gas chlorination system which should be converted to a liquid, on site chlorine generator. The motor for the pump has been rebuilt twice (most recently in 2011 with a new well pump), and has functioned well since the original construction. Soft starting equipment was installed in 1995 to extend motor life, and the installation was modified to allow remote operation.

The well building for Well No. 2 (High School Well), was constructed in 1992, and is generally in good condition. A chlorine leak developed in the mid 1990's, and electrical controls were rebuilt in 1995. The pump motor was rebuilt in 2011 and is in good condition. This facility includes two rooms within a single building. One room includes piping, valving, flowmeter, pump to waste, and electrical controls. A second room is provided for liquid on-site chlorine generation, which is used as a disinfectant.

The electrical controls include soft starts, and a radio controlled telemetry system to allow remote operation.

The well building for Well No. 3 (Sun Ranch Well), was constructed in 2007, and is generally in good condition. This facility includes one room which contains piping, valving, flowmeter, pump to waste, electrical controls, and on-site chlorine generation.

Vibration testing is performed annually on all 3 well pumps and motors to detect wear on the bearing and shaft in order to prevent catastrophic failure. The entire system will benefit from the installation of Variable Frequency Drives (VFDs) on Well No. 1, 2 and 3. These will provide increased energy efficiency, extend motor and pump life, reduce system pressure fluctuations and provide improved system-wide reliability.

6.4 WATER AVAILABILITY

The City's water supply is adequate at this time for meeting water demands of the community during Maximum Daily Demand periods. The City relies on Well 1 as the primary source of supply during the non-peak demand season and Well 3 during the peak-demand season. During both seasons, the City relies on Well 2 to provide peaking supply. Since water rights are currently monitored on an Average Daily Demand basis, water rights are available for projected needs.

One well should always be available for redundancy purposes, and City projections for water availability have been developed with the conservative assumption that one well would be out of service. Based on anticipated population growth, increased well capacity will become necessary within the planning period. A fourth City well (Well No. 4) is projected to become necessary by 2028. This fourth well would

provide the City with water availability to meet peak flows and fire flows beyond the planning period.

Sisters has installed standby generation units for Well No. 1 and Well No.2. Well No. 3 does not have an emergency generator and the installation of a standby generation unit should be a high priority to ensure water availability during power outages. Costs for standby generation should be an integral part of the electrical system for Well No. 4.

- The following must be considered to maintain availability of an adequate water supply:
- If a power outage should occur during times of Maximum Daily Demand, the existing wells must have standby generating capabilities to keep the City supplied and to maintain reservoir levels;
- Construction of a proposed Well No.4 should provide needed system capacity for the design period;
- Ongoing efforts should be maintained in order to minimize water losses including the testing and replacement of water meters on an as needed basis;
- Water rates should be structured to promote conservation and provide rate equity;
- Community growth must be monitored and compared with projections on a regular basis;
- The maintenance of all wells shall be performed during non-peak usage periods, so that all wells are available during periods of high demand;
- Prevention of source contamination.

6.5 SOURCE PROTECTION

All water sources are susceptible to contamination. Source protection involves a delineation of the area of significance surrounding the source, identification of potential risks, and contamination sources, and development of strategies to preserve source quality.

Oregon Department of Human Services (DHS) completed a delineation of a drinking water protection area (DWPA) for Sisters on September 26, 2002. Contours were developed for 1, 2, 5, and 10 year time of travel intervals. A full report (Source Water Assessment Report) was prepared in May 2004. The resulting report is included in Appendix B. Major segments of the City are included within the 10 year time of travel contours.

Contaminated sources typically require treatment (at best) or abandonment (at worst). Treatment or development of a new source would be very expensive for Sisters and could result in considerable inconvenience to water users prior to construction of the needed facilities. Compliance by neighboring, or other, properties within the designated protection area will require goodwill efforts from both the City and property owners to ensure compliance with setbacks as well as other land and materials use issues that could adversely affect groundwater quality. City staff should be mindful of precautions related to fuel and chemical storage near the well sites, including potential hazards associated with leaks and spills. Minimum setback distances for wells are included in OAR 690-210-0030 and can be summarized as:

- 50 feet of any septic tank;
- 100 feet of a septic drain line or sewage disposal structure or facility;
- 50 feet of a closed sewage or storm drainage system;
- 50 feet of a confined animal feeding or holding area;
- 50 feet of any animal waste holding area such as a pond or lagoon;
- 100 feet of any sewage sludge disposal area;
- 5 feet from a permanent structure or the roof, eaves or overhangs of a permanent structure (does not include pump houses or other related structures);
- 500 feet of hazardous waste storage, disposal, or treatment unit.

6.6 WELL SUPPLY RECOMMENDATIONS

A new Well No. 4 will need to be constructed during the planning period. Well No. 1 will need a complete new building and electrical system and be converted to utilize a liquid, on-site, chlorine generation system. Pumps and motors from any of the wells may need to be rebuilt or replaced at some point in the planning period; therefore a standby pump and motor is recommended to be warehoused in the event of an emergency replacement. Costs for rehabilitation or replacement of a pump can typically be handled with reserve funds or operating contingencies.

Prior to constructing Well No. 4, a site would need to be located that provides minimum setbacks (see Section 6.4) either through purchase or from a proposed subdivision. While the existing wells are constructed in alluvial materials (sand, gravel, clay, etc.) and, presumably, these alluvial deposits extend throughout the City, it would nevertheless be advisable to include a qualified hydrogeologist on the design team to assist with locating a site. In addition, site selection should consider proximity to known potential contamination sources (see Appendix B). Ideally, the well will be comparable to Well No. 3: approximately 300 feet deep, 16" casing, approximately 1000 - 1,500 gpm, with a total dynamic head of approximately 290 feet. The well should be provided with on-site chlorine generation and backup power generation.

An opinion of probable cost for water rights related work is provided in Section 10. New construction of a building, electrical, telemetry, and on-site chlorine generation improvements at Well No. 1, is developed in Section 10. An opinion of probable cost for a complete new Well No. 4 is developed in Section 10, and a summary of water source costs is provided in Section 10.

6.7 WATER RIGHTS RECOMMENDATIONS

The City should engage a Certified Water Rights Examiner to develop and submit a Claim of Beneficial Use and water right certificate request for the water right permit at Well No 2. The City should explore the option of obtaining an existing water right to transfer to Well No 4. In the event such a water right is unavailable, the City should apply for a "new" water right permit well in advance of 2028.

7 WATER QUALITY AND TREATMENT

7.1 REGULATORY OVERVIEW

The 1974 Safe Drinking Water Act (SDWA) and subsequent amendments regulate drinking water quality at the federal level. The states may utilize the minimum requirements provided for by the federal regulations or develop more stringent standards. States also have flexibility in regulating treatment technologies and design parameters to achieve or assure the minimum requirements for finished water quality.

In Oregon, the Oregon Department of Human Services (DHS), Drinking Water Program has the primary responsibility of administering federal and state regulations of public water systems. Oregon Administrative Rules (OAR) Chapter 333 includes the rules for public water systems. The complete rules are available in several formats online at http://oregon.gov/DHS/ph/dwp/pwsrules.shtml.

Sisters is in compliance with all State Regulations of Chapter 333. However, to assure compliance with the regulations, the City has elected to provide groundwater disinfection in accordance with OAR 333-061-0032. Disinfection is provided to approximately 0.3 mg/1 on a normal basis.

In 1994, the DHS notified the City of new monitoring requirements for disinfection by- products (DBPs) and maximum residual disinfection levels (MRDLs). Any community using a disinfectant is required to meet the new standards. The City routinely tests for DBP's according to DHS requirements and levels are below MRDL's. The DHS Oregon Health Authority Drinking Water Program website has a considerable amount of guidance information.

7.2 WATER QUALITY

7.2.1 Well Water Quality

Water quality associated with the two production wells is generally non-problematic with all measurable chemical concentrations well within regulated maximum contaminant limits (MCLs) or established standards. Table 7.1 includes chemical concentrations for selected chemicals. Selection is from the Oregon Department of Human Services (DHS) Drinking Water Program database for Sisters, and from existing records of the City. Only chemical tests showing a positive result - as opposed to "no detection" (ND) - are included in the Table. DHS' database for Sisters includes test results from 1982 to 2015.

Parameter (mg/1)	Well No. 1 Concentration (mg/l)	Well No.2 Concentration (mg/l)	Well No. 3 Concentration (mg/l)	Maximum Contaminant Limit (MCL) (mg/1)
Arsenic	0.0018-0.0030	0.0013		0.01
Barium	-	0.003		2
Nitrate	0.08-0.49	0.17-1.02		10
Sodium	0.36 -5.00			--

Fluoride	0.08-0.13	0.12		4
Chromium	0.0005	-		0.1
Sulfate		41		--
TThm*	0.0017- 0.0086	ND		0.01

*Total Trihalomethanes

7.2.2 Distribution System Water Quality

Distribution system sampling for copper has always been well below the action level for copper of 1.3 mg/1.

Distribution system sampling for lead has also always been well below the action level for lead of 0.015 mg/1.

7.3 EXISTING TREATMENT AND DISINFECTION FACILITIES

On site generation for disinfection is currently utilized at Well No. 2 and Well No. 3. Gaseous chlorination is used at Well No. 1. While disinfection is not currently being used at the reservoir, it is available for emergency usage, and is available in the event of terrorist activities. A vacuum operated chlorinator feeds directly into the water supply at Well 1 and dosing pumps are used at Wells 2 and 3. Monitoring of chlorine residual occurs throughout the distribution system. Disinfection is used when well pumps operate on a daily basis.

Currently the only treatment deficiency is the gaseous chlorination system at Well No.1. The gaseous chlorination system will be replaced with an on-site chlorine generator to eliminate safety hazards associated with gas leaks. This determination does not extend to monitoring requirements - the City must comply with all monitoring and submittal requirements including new requirements for DBPs and MRDLs.

7.4 POTENTIAL FUTURE TREATMENT AND DISINFECTION NEEDS

There is always some potential for future regulatory changes, or water quality changes that will necessitate treatment or disinfection.

Positive and recurring coliform findings in the distribution system could necessitate increased disinfection and the maintenance of a higher chlorine residual. On-site mixed oxidant generation, such as the systems used at Well No. 2 and Well No. 3, is the generally preferred disinfectant in community water systems because of flow operating cost, relative safety, and ease of handling. As part of recommended replacement of the well building at Well No. 1, the City should include provision of an on-site mixed oxidant generator, which would entail the following:

- Provision of adequate contact time (30 minutes minimum) between mixed oxidant injection and

first customer. Therefore, each source would need to have its own disinfection facilities.

- On-site mixed oxidant generation equipment consists of an on-site mixed oxidant generator, a small mixing tank and chemical feed system. Typically, this is housed in a building of sufficient size to accommodate the equipment and mixing tank(s) such as a well building. The feed system is sophisticated enough to allow precise adjustment and consistent delivery of the mixed oxidant solution.

A degradation in well water quality could also result in the need for treatment if any of the regulated chemical parameters are exceeded. A large unincorporated area is within the 10-year travel time area to well Nos. 1, 2, and 3 and consequently, there will always be some potential for well contamination. Because of the very high cost of providing true treatment facilities, it is generally preferable to rehabilitate the well, or move it to another area. If contamination of a well should occur, the City should immediately contact DHS for guidance. Addressing the matter will probably require engineering assistance to develop short and long-term strategies for dealing with the problem.

8 WATER STORAGE

8.1 REGULATORY OVERVIEW

There are no specific regulatory requirements related to capacity and sizing of reservoir storage for finished water in the State of Oregon. OAR 333-061-0025 requires water systems to maintain a minimum of 20 psi pressure at all service connections in the distribution system at all times. This requirement is related to reservoir storage insofar as compliance is generally not practicable without sufficient storage to meet equalization, fire flow, and emergency reserve demands. In Oregon, system storage needs are determined in accordance with applicable general standards or specific guidelines (Section 8.2).

8.2 STORAGE DESIGN GUIDELINES

8.2.1 Design Considerations

Typical reservoir storage requirements can be analyzed into three components: operational (or equalization) storage, emergency storage, and fire reserve.

Operational (or equalization) storage provides for any period during a 24-hour day where water demand exceeds supply capabilities (i.e., wells or treatment facilities) or when supply sources are off-line. Operational storage can allow treatment facilities (with adequate capacity) to be operated for a minimal and continuous period of time, thereby reducing staff demands and associated costs. For well-based systems, it allows efficient cycling of well pumps.

Emergency storage provides for interruption of supply. Supply can be interrupted for many reasons including, but not limited to: mechanical failure of required treatment or pumping facilities; source contamination; electrical outage with no, or inadequate, backup power provisions; or shut-downs for maintenance or improvements. Emergency storage is not intended to provide for extended interruptions of supply associated with droughts or catastrophic system failures requiring prolonged repairs or replacement.

Fire reserve provides storage volume based on the desired fire flow rate and duration of availability. It is important to note that in many communities, there are parts, such as isolated pressure zones with relatively few connections that may not be economically served with fire protection to the same extent as the bulk of the community. Fire reserve storage for reservoirs in these areas may be functionally nonexistent. Often, telemetry can be utilized on such reservoirs to trigger booster pumping as the reservoir level drops, and with further level drops, possibly triggering a high service pump to provide some minimal fire flows to the area.

Emergency storage and fire reserve are essentially a kind of insurance. As with any insurance, cost increases with extent of coverage and, to a large extent, the actual risks for any particular case are not fully known or quantified. Also, there are no guarantees associated with any storage recommendations that the volume will be adequate for any specific fire or emergency condition that may arise.

8.3 EXISTING STORAGE FACILITIES

The City has one reservoir which holds 1.6 million gallons of water. The reservoir is at an elevation higher than the City so it ensures consistent water pressure in the City. The reservoir is also sized to provide water to the City in the event of a temporary well pump outage or in the case of extraordinary water use such as to fight a fire. The reservoir was constructed in 1995.

Location: The reservoir is located adjacent to the Pole Creek surface water reservoir, some 2.5 miles southwest of the City. This facility is located on U.S.F.S. land, and the City was granted a conditional use permit for construction and continued operation of the storage reservoir, piping, and building structures on the site. In addition to the reservoir, a chlorination facility is provided at this site, for emergency reservoir disinfection in the event of potential terrorist activities, and for supplemental disinfection in the event that the water system should experience contamination concerns.

Site Characteristics: The reservoir site is timbered and is relatively flat, providing a serene setting for a reservoir. This site is immediately below the Pole Creek reservoir, which was utilized as an open storage facility for the City for many years, but is no longer operable. Disinfection is available at the site from a gaseous chlorination installation housed in a building structure, and reservoir controls and electrical are supplied from this structure. Chain-link fencing topped with barbed wire and locked gates surround the site. Site (fenced) dimensions are approximately 140' x 160'. Location is found on Figure 3.5. The site is bounded by Forest Service land, with a residence constructed in close proximity on the access road from the South.

Capacity: The existing reservoir is a pre-stressed post-tensioned concrete storage reservoir of the Morse Bros. type. Capacity is 1,600,000 gallons. It has dimensions of 112 feet (diameter) by 22 feet (height). The uppermost section is a conical roof that does not provide storage capacity. The top water level is at 22 feet and a reservoir located level controller is used to transmit telemetry for operations to Well # 2, although both wells pump based on levels received at Well# 2.

Water Surface Elevation: The reservoir's maximum water surface elevation is 3349.0 based on mean sea level. An overflow from the reservoir is provided with discharge to the abandoned Pole Creek Reservoir.

Construction: The reservoir is a pre-stressed concrete reservoir cast in the Morse Bros. Pre-cast factory in Harrisburg, Oregon. Walls and roof panels are pre-cast, with closure pours in the field after panels are welded together. There are forty (40) wall panels and forty (40) roof Tee sections which were delivered by truck and placed on a poured in-place concrete f1oor. Closure strips were installed in the field, and the reservoir was post-tensioned. A concrete shot-crete layer was placed on the wall sections after post-tensioning was complete. The reservoir is accessed by an exterior ladder that extends to a fenced catwalk on one access hatch, and each of the hatches are surrounded by a similar fenced safety protection. Two access hatches are

provided on top of the reservoir. There is also an interior ladder that extends down into the reservoir. A large vent is provided for ventilation. Depth information is conveyed to controls inside the Well No.2 building.

Condition: The reservoir roof structure was rehabilitated by replacing the original closure pours and by reconditioning of the entire roof structure in 2003. The reservoir interior was also cleaned before being placed in operation. Work was completed by D & R Masonry Restoration, Inc. of Portland, Oregon. At completion, the reservoir was in excellent condition, and remains in good condition today, with the exception of the exterior wall paint system, which needs to be reconditioned. There was very little sediment in the reservoir after nine (9) years of operation, and the interior of the reservoir was in excellent condition. This reservoir is in excellent structural condition, and will function well through the year 2025. The only noted deficiency was a need to paint the exterior walls of the reservoir, and this should be scheduled within the next 10 years.

8.4 CAPACITY REQUIREMENTS

The ability of the water system to provide the maximum day demand plus fire flow (emergency storage) has been analyzed to determine the storage volume required within the planning period. Calculations for maximum day demand plus fire flow includes contributions from wells and from storage volume.

The most economical way to provide additional water capacity to meet 2037 demand would be to construct a new well with a new pump and a backup generator. A new well with backup generator could increase the City's capacity to a minimum of 3 of the 4 pumps at any given time (assuming that no more than 1 well is off-line at any given time). Table 8.1 below shows how a 4th well for the City would affect the City's water capacity until population build out in the City. (3,060 gallons per minute for 24 hours).

As shown in the table above, the addition of a new well would ensure that the City will have water supply available to meet design demand at build out population, without the need for storage infrastructure improvements.

8.5 IMPROVEMENT OPTIONS

As described in Section 8.4, no reservoir storage improvements are recommended within the planning period.

9 WATER TRANSMISSION AND DISTRIBUTION

9.1 GENERAL

This section includes a description and consideration of the City's water transmission and distribution system. Transmission mains include the total length of piping from the reservoir through the two transmission mains to the distribution system in the City. Both transmission mains allow water flow in each direction, from the two well sources to the reservoir, and from the reservoir back to the distribution system that carries flow to residential, commercial, and industrial usage. Much of the distribution system has been replaced or enhanced since 1980, generally with piping of adequate capacity to provide for the growing community. Previous planning documents, and capable staff in Public Works have worked together to provide the community with a good water system that can be enhanced and expanded for year 2025 needs of the community.

9.2 EXISTING SYSTEM

Two transmission mains are utilized to provide water to the City. An initial upgrade of the transmission system was completed in the 1960's, which included a new 12" transmission main from the current location of the concrete storage reservoir Northerly to the Old Brooks- Scanlon haul road, and along the haul road to Elm Street where the system was interconnected with the distribution system. When Well No. 1 was constructed in 1975, it provided an interconnection between the existing transmission main on Elm Street, and the distribution system at the South end of Pine Street. This transmission main crosses under Squaw Creek, which previously had been a source of concern for damage caused by high water f1ows. A second crossing of Squaw Creek was installed for the interconnection to the South end of Pine Street. A second 12" transmission main was extended from the Brooks-Scanlon haul road in 2002 extending in a North-South direction across Pine Meadow Ranch to interconnect with the distribution system in South Pine Meadow Street. The 1960's transmission system was constructed of asbestos-cement pipe materials, and the 2002 transmission main utilized AWWA C-900 PVC pipe materials. A single 12" transmission main of asbestos-cement material remains above the interconnection with the new 12" transmission main to town, and this extends up to the reservoir site.

Transmission and distribution mains in the City water system total approximately 36.81 miles and range in diameter from 4 inches to 12 inches. Major portions of the distribution system were replaced in 1995 during a major upgrade of the water system.

9.2.1 Pipelines

The majority of the City's waterlines have been installed since 1980, including major system improvements completed in 1995. Table 9.1 presents a pre-and post-1980 distribution pipe inventory.

Table 9.1: Distribution Pipe Inventory

	Length		
Diameter	***Pre-1980 (LF)***	***Since 1980 (LF)***	***Combined Total (LF)***
4"	17,065	--	17,065
6"	2,660	13,623	16,283
8"	0	56,722	56,722
10"	1,710	32,677	34,387
12"	10,600	61,906	72,506
Subtotal	**32,035**	**164,928**	**196,963**

Pipe materials include steel, PVC, and asbestos cement (AC). The distribution of materials in the system is largely related to age, with the smaller pipes installed prior to 1980 being steel, and larger pipes installed prior to 1980 being asbestos cement. All materials installed since 1980 are AWWA C-900 PVC.

9.2.2 Pressure Zones and Booster Pump Stations

There is a single pressure zone in the Sisters water system, with static system pressures typically ranging from 54 - 79 psi, dependent on elevation. Water is supplied to the system either directly from the well pumps or through the two transmission mains from the 1.6 MG storage reservoir, there are no booster pumps in the system.

Pressures range from approximately 70 psi in the South end of the City to 79 psi at the Northeast corner of the City; 70 psi along Hwy 20 near the Three Winds Shopping Complex, and approximately 54 psi at the high school on the West end of the City. The storage reservoir provides pressure to the system, and is located approximately 2 miles Southwest of Sisters.

9.2.3 Service Connections

In 2016 there were 1789 active service connections, with 7 connections outside City limits, and 17 services for City owned facilities. In 1995, some commercial meters existed, but the majority of the system was not metered. The water system upgrade installed water services for all users. Since that time, service connections have been metered in order to determine potential water losses in the system, and all new construction has provided new services and meters. All meters have been converted from manual read to radio read, which reduces manpower needs substantially for meter reading. It is believed that all water usage is currently metered. Automated meter reading technology is constantly developing and the city will need to update/replace equipment as it wears out or is no longer supported.

9.3 CRITERIA FOR DISTRIBUTION NETWORK EVALUATION AND DESIGN

Pressure: DHS requires that a minimum pressure of 20 psi be maintained throughout the system. However, most household water-using appliances require pressures of 40 psi to operate properly. Maximum daily pressures should not exceed 90-100 psi. Variations in pressure throughout the system are related to piping size and arrangement, local fluctuations in demand, and, especially for static pressures, elevation. Generally, the lowest elevation users have the highest average system pressure. The Sisters water system easily meets all of this criteria.

Flow: Water mains are generally designed to provide the greater of either peak hour demand or maximum day demand plus fire flow. Fire flows are considerably more significant in the determination of main diameter. Generally, it is desired to size pipes large enough to keep frictional energy loss to less than 5 feet of head loss per 1000 feet of line length (equivalent to 2.2 psi of pressure loss per 1000 feet offline) during normal flows. This maintains residual water pressures at acceptable levels and conserves electrical costs for well pumping into the distribution reservoir(s).

Another general guideline is that water velocities in pipe lines should be less than 5 feet per second. This helps keep momentum forces (due to changes in flow directions), at fittings such as elbows, at acceptable levels. It may be acceptable to exceed these limits during emergency conditions such as a major fire. However, in general it is important to maintain velocities much lower than 5 fps (especially if it is a condition that occurs frequently, such as pumping from the wells) to minimize pressure surges and water hammer. For normal operating conditions it is recommended that pipe line velocity be kept at less than 2.5 fps.

Flow capacity of various size mains are tabulated below for the recommended maximum velocity of 5 fps for f1ow in one direction, and for flow arriving from two directions. The latter would reflect flow at a hydrant off a looped line. The table highlights why 6” and 8” lines are often specified as the minimum size desirable for municipal service, and why fire f1ows in Sisters are limited in capacity where 4” lines remain in service.

Table 9.2: Pipe Flow at 5fps

Line Diameter	***Flow at 5 fps***	
	In One Direction (gpm)	***From Two Directions (gpm)***
4”	196	392
6”	441	881
8”	783	1,567
10”	1,224	2,448
12”	1,762	3,525

Layout: Main construction should be interconnected into the system to form or complete loops or a gridiron wherever possible. In general, such construction will enhance the hydraulic performance of the system. The Sisters water system is interconnected at most junctions, and offers a good gridiron for fire protective purposes. A comparison of looped distribution versus branching (also known as tree or dendritic) distribution is presented below. A looped system is desired because:

A. Water is carried by many interconnected pipes, which significantly increases the hydraulic capacity of the system.

B. Increased factor of safety. If a pipe is out of service, water can still be fed to customers from a different direction (pipeline).

C. Decreased line flushing.

Branching distribution systems are not desirable, if economics, land ownership, and geography allow a looped system, since:

A. Water is carried through single pipes which restricts the hydraulic capacity of the system.

B. If branched pipeline is out of service, customers are without water.

C. Sediments tend to settle out in dead end lines, which leads to the need for line f1ushing and, due to decaying chlorine residual, increases the potential of bacterial contamination.

Hydrants should be located at intersections, midway along blocks, and in general 400 feet or less from the nearest hydrant or user. Spacing can very according to land use and main layout. Placement at the end of dead end lines facilitates f1ushing and maintenance.

9.4 SYSTEM ASSESSMENT

Overall, Sisters has a very good distribution system for a community of its size. Notable characteristics include:

- The system is generally well looped, forming a grid; there are very few dead-end lines. Most of the dead-end lines are short (one block or less) and have a terminal hydrant to facilitate f1ushing.

- There is a rational and systematic layout of 8”, 10” and 12” lines forming larger loops that promote hydraulic efficiency.

- The commercial and industrial areas are well served with 10” and 12” mains.

- Wells and reservoirs connect to looped 10” and 12” lines thereby allowing efficient transmission.

- System pressures are well within normal ranges - there are no low pressure or high pressure service areas.

- There are two 12” diameter transmission mains for much of the distance from the existing water reservoir and a combination of the three municipal wells and the transmission lines provide adequate reliability and transmission in the event that one transmission main or one well is isolated for maintenance or repairs.

Hydrants are, generally, well distributed throughout the system. The 400 foot diameter radiuses desired by the fire department provide adequate coverage based on ISO standards. However, in practice, service can be extended further though there will be proportional losses in fire flow capabilities due to the longer hose lengths involved. Hydrants off 4” lines do not provide recognized fire protection, and all 6” and smaller lines should be replaced to upgrade the overall capabilities of the distribution system, and to improve fire flows. Line replacements will improve fire protection for anticipated community growth. However, the current lines do provide fire flows that meet minimum standards adopted by the Sisters-Camp Sherman RFPD.

Hydrant flow capabilities are generally excellent in areas served by the larger 8”, 1 0” and 12” mains (Figure 9. I). A computer generated fire system capability map is provided as Figure 9. 2, which indicates where fire protective capabilities and volumes are available. These will all be substantially enhanced with recommended improvements. Flow capabilities of the system exceed current minimum standards of the fire department, but fire service to satisfy growth needs, will be dramatically improved with replacement of the older 4” and 6” distribution lines.

The proposed layout of proposed improvements will suggest additional water sources and a second ground level reservoir that will interconnect with the distribution grid, dramatically improving fire flow capabilities for community growth.

Notable deficiencies include:

The areas identified with less than 1,500 gpm fire capabilities are limited, and generally are located in close proximity to existing 4” water mains. Replacement of these pipelines will improve performance of the entire water system for fire protection and growth demands.

The single 12" transmission main from the reservoir to where the line splits into two 12" transmission mains restrict flow into the system during peak domestic and fire demands. 4” lines are still present in several areas. These lines provide adequate service for current community needs, but additional growth will demand improved performance. In addition, the smaller lines are of an age and condition that warrants replacement. 6” mains are the smallest diameter recognized as providing fire protection by the American Water Works Association (AWWA).

Older lines in the system may have age related problems that include leaks. This could be a factor in the City's relatively high water consumption, although losses seem to be higher in summer months than during the remainder of the year.

9.5 RECOMMENDED SYSTEM IMPROVEMENTS

Recommended system improvements are outlined in Table 10.1 in section 10 of this Water System Capital Facilities Plan update. System improvements include the replacement and decommissioning of distribution piping less than 6-inches in diameter. A new transmission main is proposed to improve water supply capacity. It is recommended that the existing 12" diameter transmission main remain in place to serve as a dual pipe system for redundancy. In addition, improvements to the City's hydraulic capacity include a new well (Well No. 4).

10 WATER CAPITAL IMPROVEMENT PLAN

10.1 GENERAL

This section provides a summary of the City's water system capital improvement needs for the 20-year planning period, to the year 2037. Since financing of improvements will occur through separate funds, a breakdown of costs is provided for funding eligibility. It is recommended that financing of recommended improvements be achieved through grants and loans from financing entities, which would allow for construction of needed improvements at the least possible cost to residents of the City. However, priorities are also provided to allow for construction as financing becomes available.

10.2 SOURCE RECOMMENDATIONS

A thorough review of water source needs is provided in Section 6. Improvements to Well No. 1 include replacement of the existing well house structure with a new 10’ x 20’ building, retrofitted electrical and telemetry controls, a new flow meter, and a new on-site chlorination system. In addition the replacement of existing equipment, with the exception of telemetry and on-site chlorine generation.

Well #3 currently does not have a backup electrical generator, although a proposed generator for Pump 3 would significantly improve the reliability of Well no. 3 water supply and the overall supply capacity of the City water system. With an electrical generator on Well #3, the City will have the reliable water supply capacity to meet design demand until 2028. On or before 2028, improvements are recommended to increase reliable water supply capacity through the full build out of the UGB.

The most economical way to provide additional water capacity to meet 2028 demand would be to construct a new well with a new pump and a backup generator. A new well with backup generator could increase the City's reliable capacity to a minimum of 3 of the 4 pumps at any given time (assuming that no more than 1 well is off-line at any given time).

Telemetry and on-site chlorine generation costs are eligible for Systems Development Charges because they provide improved service for future users of the water system. All other source improvements are needed to provide capacity for growth, and will be eligible for System Development Charges.

10.3 RESERVOIR RECCOMENDATIONS

As described in Section 8.4, no reservoir storage improvements are recommended within the planning period. However, reservoir storage improvements are identified as a long term improvement, which will become necessary beyond the planning period.

10.4 TRANSMISSION AND DISTRIBUTION RECOMMENDATIONS

Transmission and distribution improvements are shown in Table 10.1. Transmission and distribution improvements are eligible for Systems Development Charges because they provide improved service to future users of the water system.

10.5 FUNDING FOR IMPROVEMENTS

All costs should be eligible for funding with Systems Development Charges. It is recommended that funding be obtained through one of the grant and loan programs discussed in Section 11. This will provide for construction with current dollars, and repayment at very favorable rates that are available through several programs. In the long term, residents of the City of Sisters will receive the greatest benefit from this approach, at the least possible cost. Repayment of the needed loans should be from a combination of increased water rates and Systems Development Charges, as discussed in Section 12.

10.6 TOTAL CAPITAL INPROVEMENTS

A summary of capital improvements to the City of Sisters Water System appears in Table 10.1, which includes prioritization (timing), and project cost.

Table 10.1: Timing and Cost Summary

ID	Project Description	Timing	Project Cost
1	6" Water Behind Barclay Square	2016-17	$52,500
2	Water System Spare Parts including 75 hp Pump Motor	2017-18	$70,000
3	8" Water in Alley, Fir to Larch	2018-19	$60,000
4	Variable Frequency Drives for Wells 1, 2, and 3	2018-19	$61,620
5	Backup Generator on Well #3	2019-20	$148,500
6	8" Water, Oak Street, Main to Adams	2019-20	$34,000
7	8" Water, Fir Street, Main to Adams	2019-20	$37,000
8	Hood Ave S. Alley /Pine to Ash (Reconnections)	2020-21	$36,000
9	Wash. Ave S. Alley/Cedar to Locust (Reconnections)	2020-21	$28,800
10	Jeff Ave S. Alley/Cedar to Locust	2020-21	$33,700
11	New Well Building and Chlorination for Well #1	2021-22	$297,000
12	8" Water, Edge O the Pines	2022-23	$368,000
13	Main Ave. N. Alley/Pine to Elm (Reconnections)	2023-24	$72,000
14	Water Right Acquisition for New Well #4	2023-24	*
15	Construct New Transmission Main from Reservoir	2026-27	$914,760
16	New Well #4 with Backup Generator	2027-28	$861,300
17	New 1.6 MG Steel Tank Reservoir	Beyond 2037	**
18	Creekside Drive Ext. to Hwy 126	TBD by Development	$37,200
19	Locust St. Ext/B. Butte to Barclay	TBD by Development	$36,000
20	Forest Service Ext/Pine to Ponderosa Lodge	TBD by Development	$168,000
21	Trinity Way Ext/LDS to Catholic Church	TBD by Development	$42,240

22	Brooks Camp Ext/ Hwy 242 to Pines	TBD by Development	$60,480
Total			**$3,419,100*** **

** Cost will depending on future market value and conditions associated with mitigation credit acquisition.*

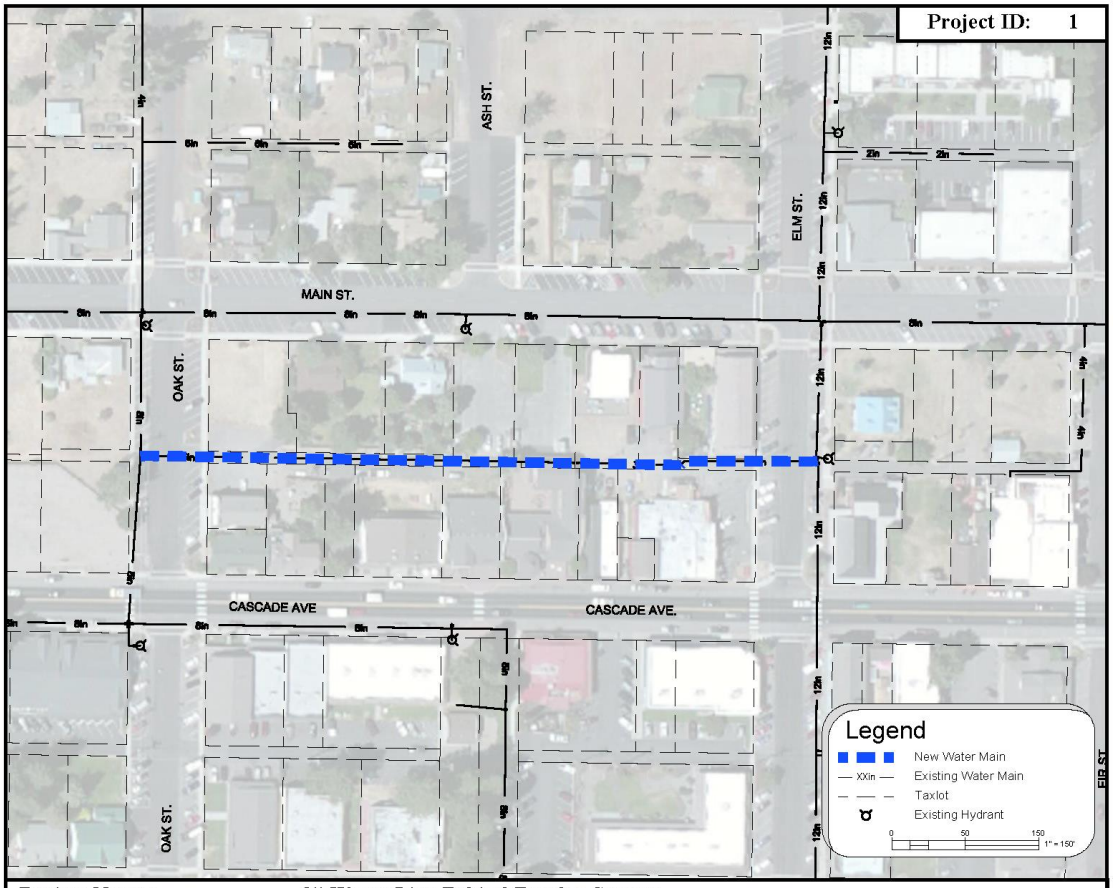
*** The need for a reservoir is beyond the planning period and is shown for informational purposes only.*

**** This total does not include cost for the water right acquisition for Well No.4 or the new 1.6 MG reservoir*

Exhibit maps for projects 1-17 are shown. Each exhibit includes information and figures describing the proposed project. These exhibits provide additional detail and context for each project as they progress from planning to construction. As applicable, each project includes the following information:

- Project ID: Unique identification number designated for the project
- Project Name: Unique name of the project
- Project Category: Classification or reason for project (e.g. Hydraulic Capacity)
- Implementation Timeframe: Period of time the project will be carried out
- Objective: Purpose of the project
- Description: Explanation of the project
- Project Estimate: The opinion of project costs based on planning level preliminary estimates for the year 2017

Projects 18 – 23 are not shown as they linked to future development in each project area.



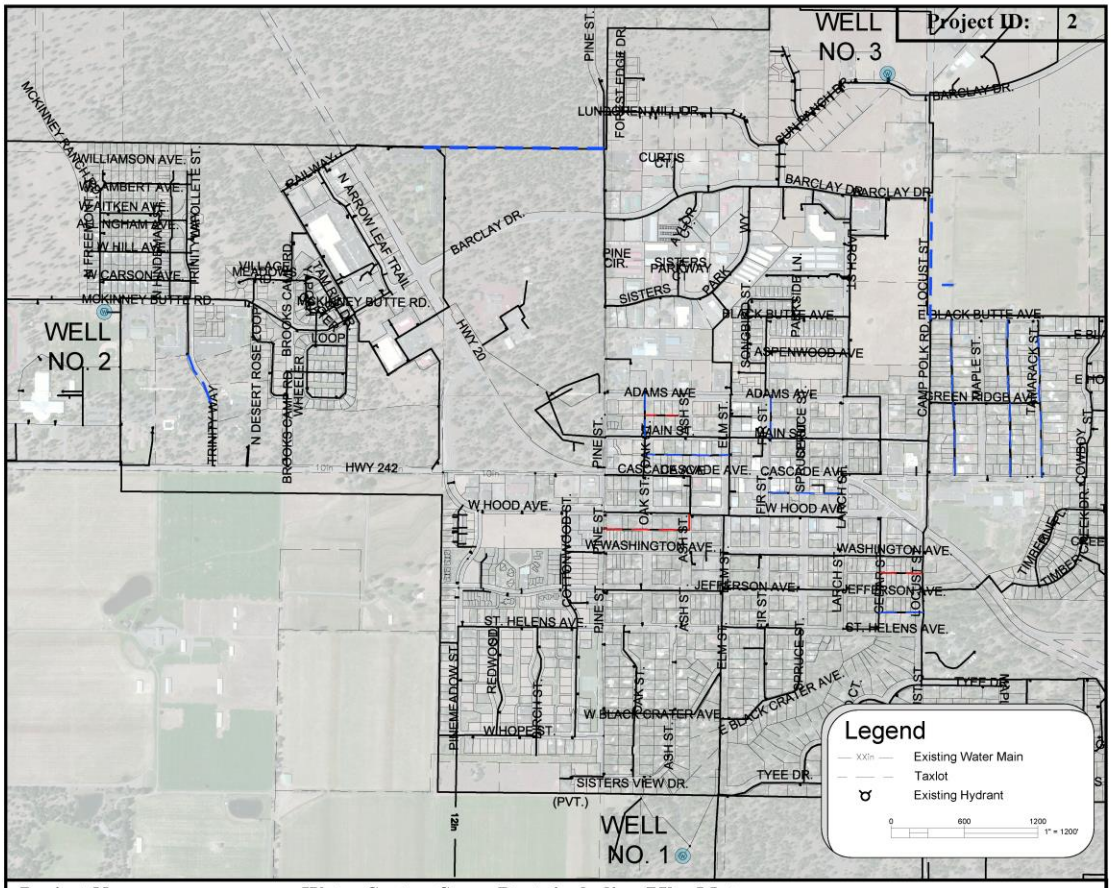
Project Name:	**8" Water Line Behind Barclay Square**
Location:	Along Cascade Ave N. Alley between Oak St and Elm St
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2017
Objective:	Upsize the existing waterline and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 3-inch water main will be replaced with a new 8-inch water main, approximately 700-feet in length. Services will be re-connected to new main. Existing line will be abandoned in place.
Total Project Estimate	*$52,500.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	NTS
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**Water System Spare Parts including 75hp Motor**
Location:	City of Sisters Public Works
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2017 - 2018
Objective:	Increase the inventory of hydraulic equipment and thereby increase the ability to operate and maintain the City's public utility infrastructure.
Description:	Spare equipment will ensure that the City can quickly repair any water system components that are off line. Spare parts include a backup pump motor, well components, piping, fittings and other associated water system infrastructure.
Total Project Estimate	*$70,000.00*

City of Sisters ◦ Exhibit Drawing		SCALE:	NTS
		DRAWN BY:	EJH/JLB
2017 Water Capital Facilities Plan Update		APPROVED BY:	PB
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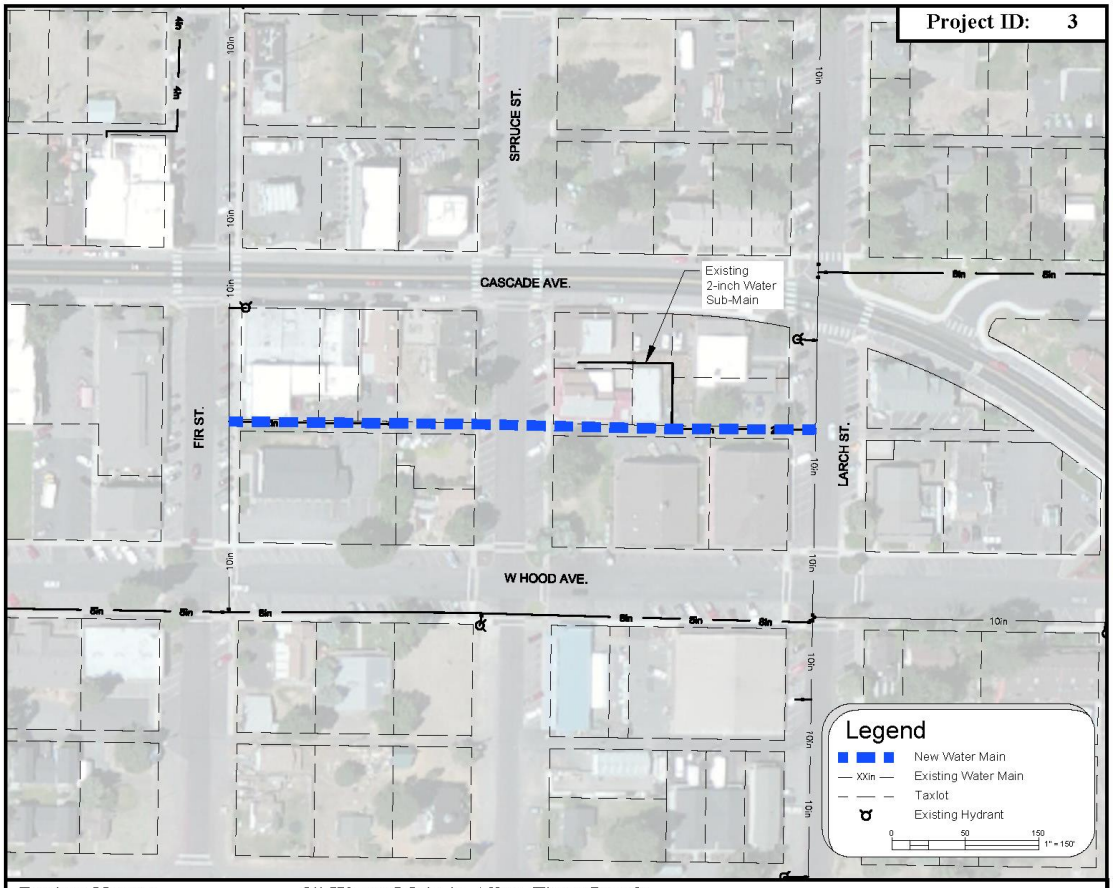
BECON Civil Engineering & Land Surveying



Project Name:	**8" Water Main in Alley, Fir to Larch**
Location:	Along Hood Ave N. Alley between Fir St. and Larch St.
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2018 - 2019
Objective:	Upsize the existing waterline and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 2-inch water main will be replaced with a new 8-inch water main, approximately 800-feet in length. In addition to providing higher hydraulic capacity, two dead end mains will be eliminated, and thus provide redundancy and increase the fire flow in the City's water system. Services shall be reconnected to new main.
Total Project Estimate	***$60,000.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	NTS
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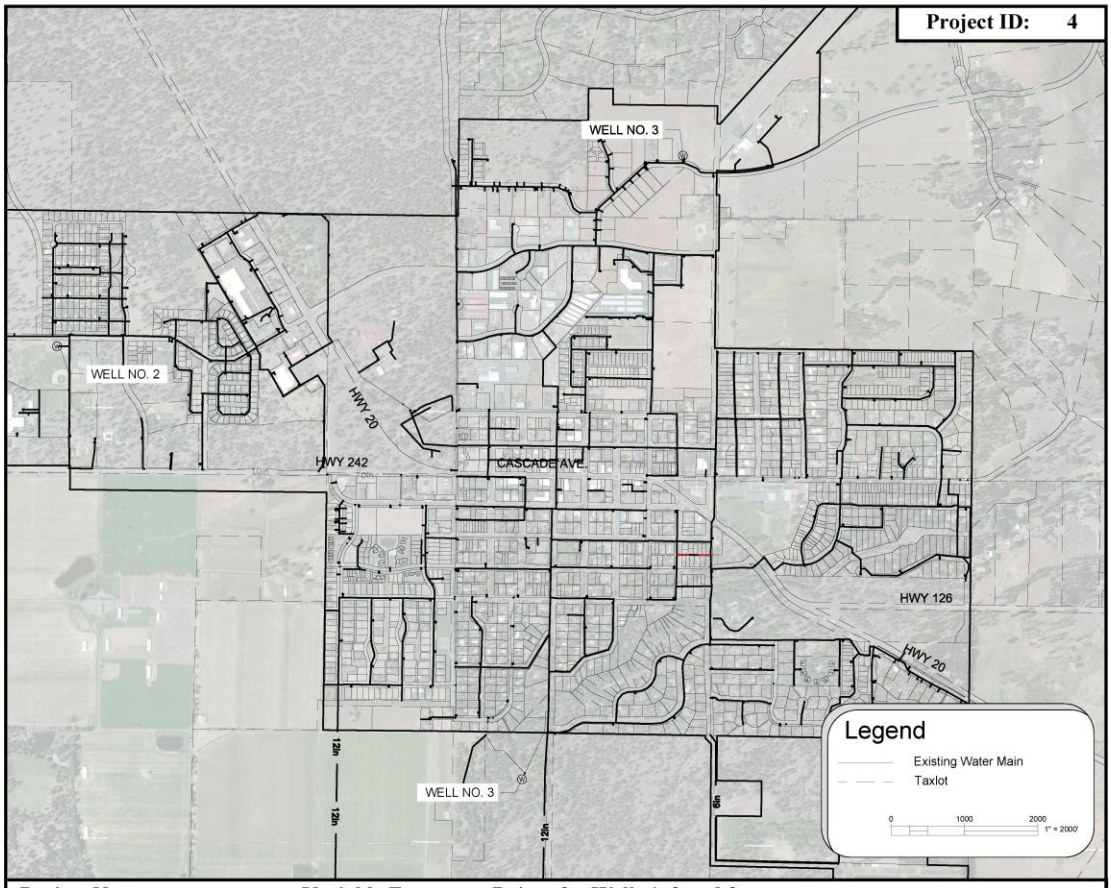
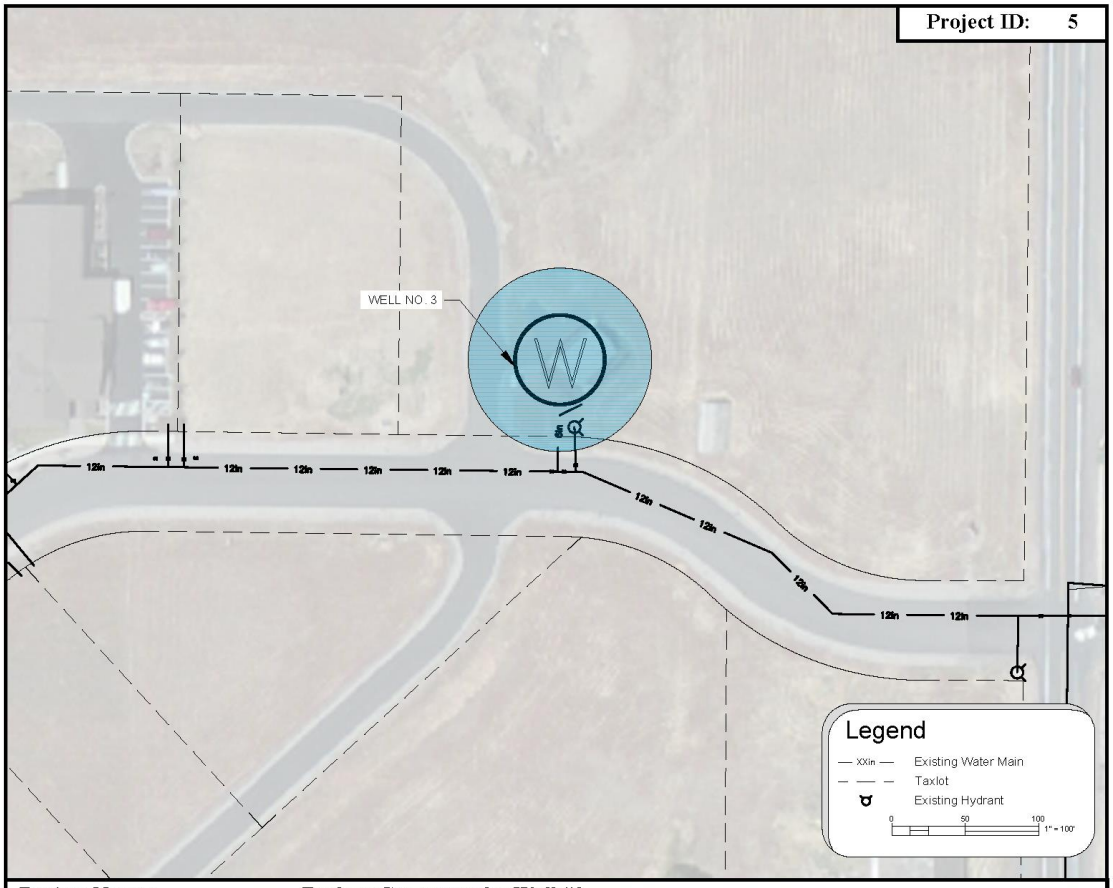


Project Name:	**Variable Frequency Drives for Wells 1, 2 and 3**
Location:	See Map
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2018 - 2019
Objective:	Increase the electrical efficiency of the City's wells.
Description:	Variable frequency drives (VFDs) are a system for controlling the rotational speed of a motor. They are used for adjusting flow in a pump to meet actual demand. Currently, the City's well pumps operate either on or off, full power or no power. VFDs can provide electrical savings by matching the speed of the pump motor to actual demand. Perhaps more importantly, VFDs are a solution to minimize stress on pump motors, reduce mechanical wear and tear, and extend the life of the pumps, therefore, VFDs will be installed at each well.
Total Project Estimate	*$61,620.00*

City of Sisters ◦ Exhibit Drawing		SCALE:	1" = 1200'
		DRAWN BY:	EJH/JLB
2017 Water Capital Facilities Plan Update		APPROVED BY:	PB
		REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**Backup Generator for Well #3**
Location:	See Map
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2019 - 2020
Objective:	Provide a backup generator for well #3 and thereby increase the reliability of the City's water system.
Description:	A backup generator will be installed at Well #3.
Total Project Estimate	*$148,500.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 100'
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REVISION DATE:	03/13/2017

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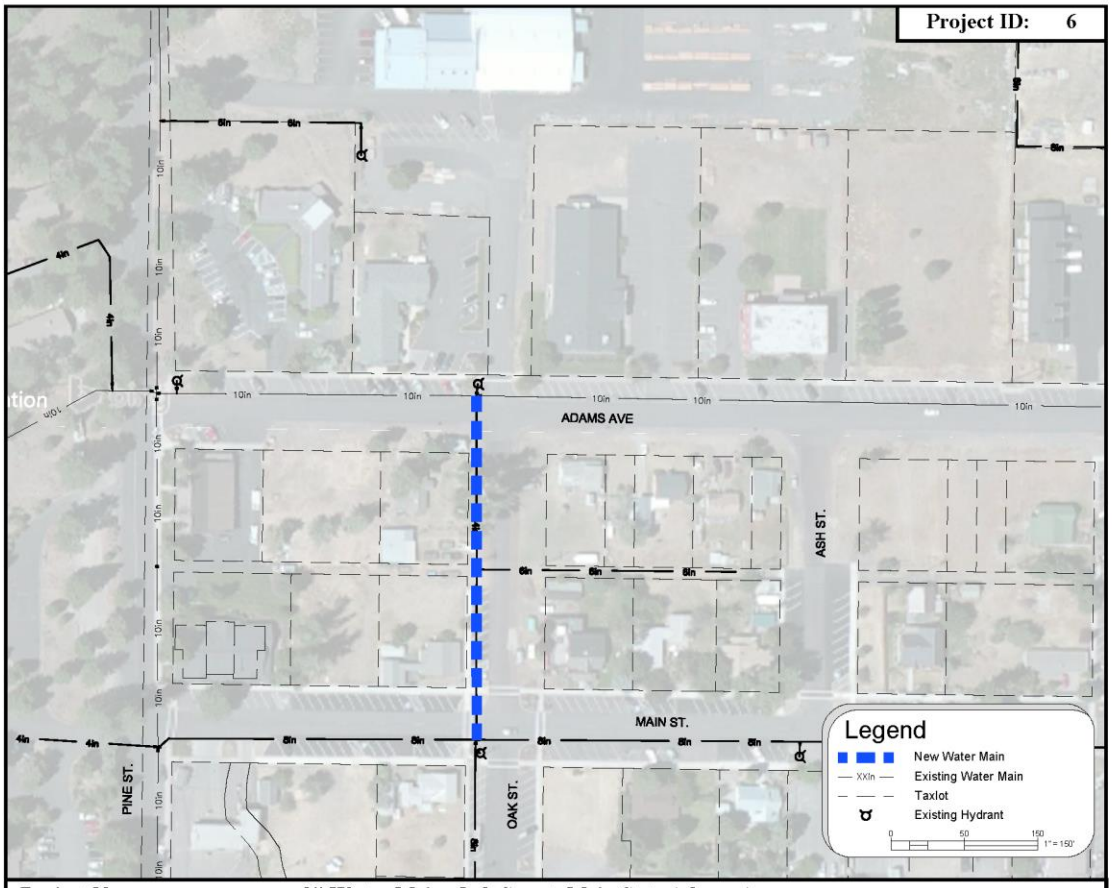


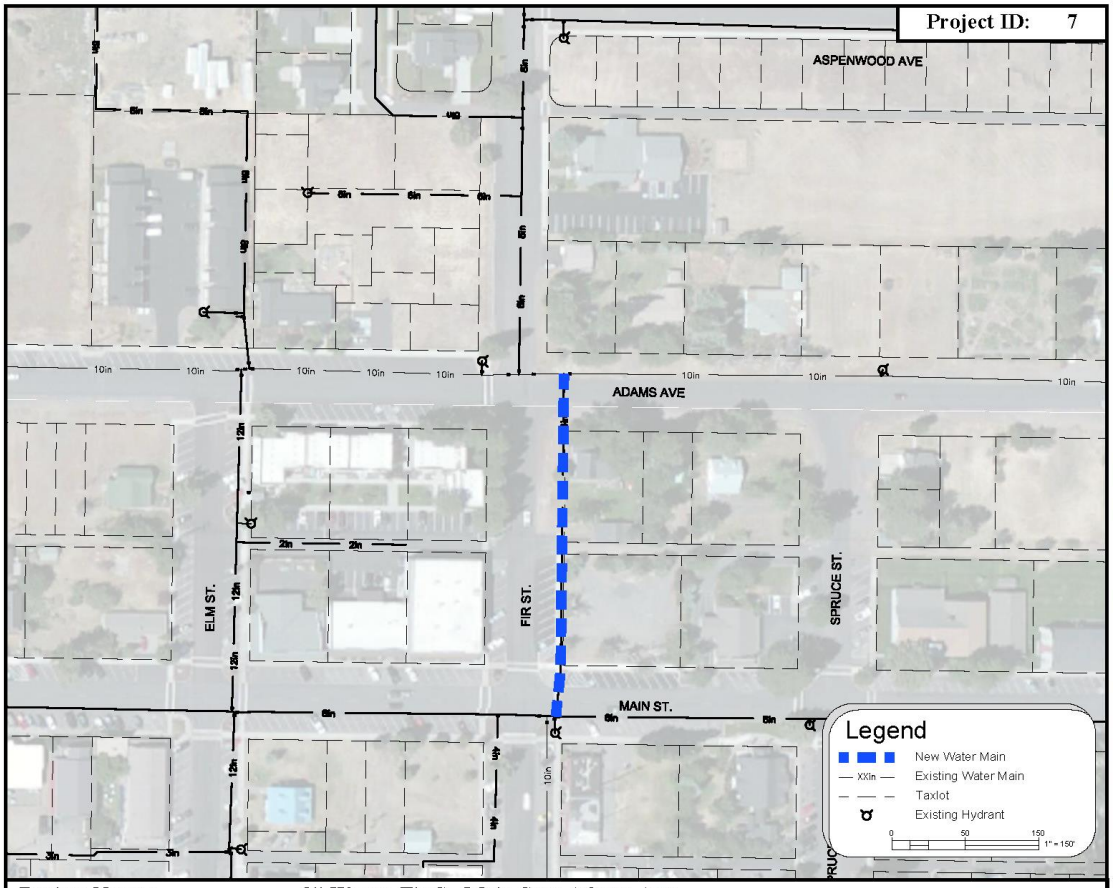
Project Name:	**8" Water Main, Oak Street, Main St to Adams Ave**
Location:	Along Oak St between Main St and Adams Ave
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2019 - 2020
Objective:	Upsize the existing waterline and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 4-inch water main along Oak St will be replaced with a new 8-inch water main, approximately 350-feet in length. Services will be re-connected to new main line and the existing 4-inch line will be abandoned in place.
Total Project Estimate	*$34,000.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 150'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



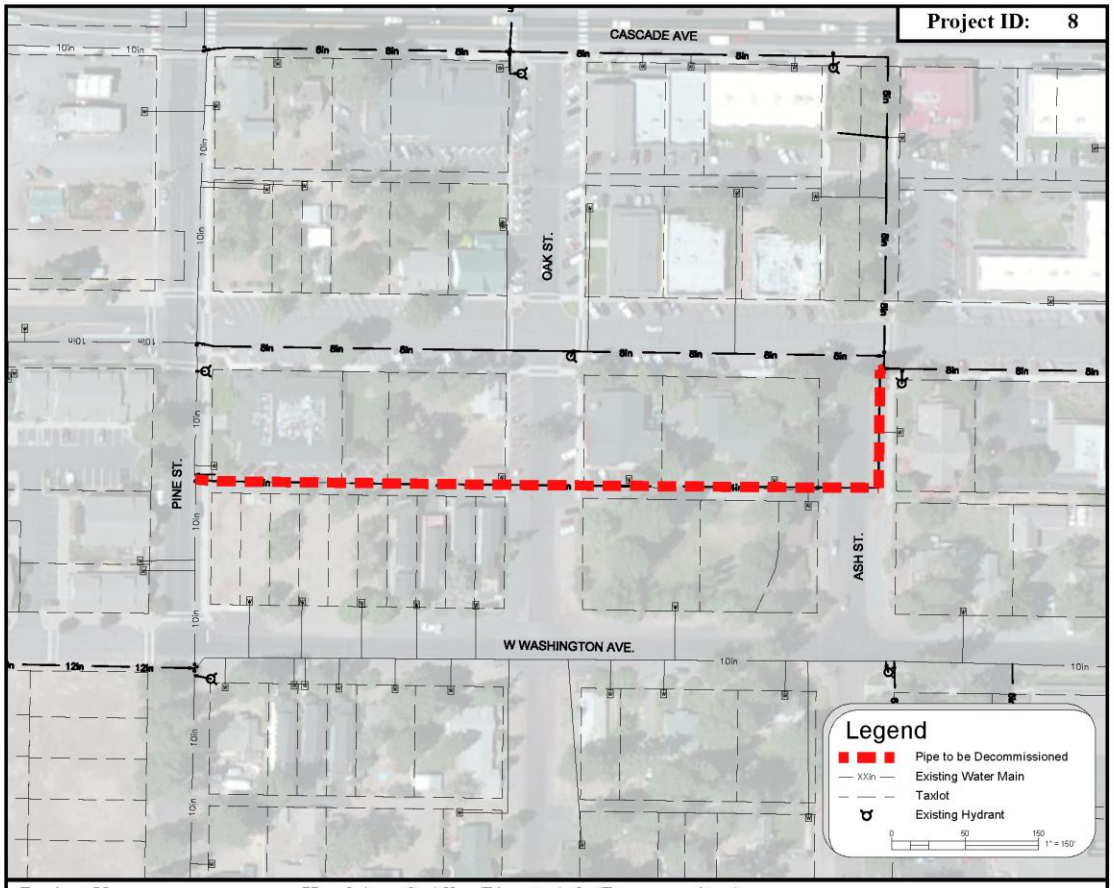
Project Name:	**8" Water, Fir St, Main St to Adams Ave**
Location:	Along Fir St from Main St to Adams Ave
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2019 - 2020
Objective:	Upsize the existing waterline and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 4-inch water main along Fir St will be replaced with a new 8-inch water main, approximately 350-feet in length. Services shall be reconnected to new main, existing 4-inch line will be abandoned in place.
Total Project Estimate	***$37,000.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

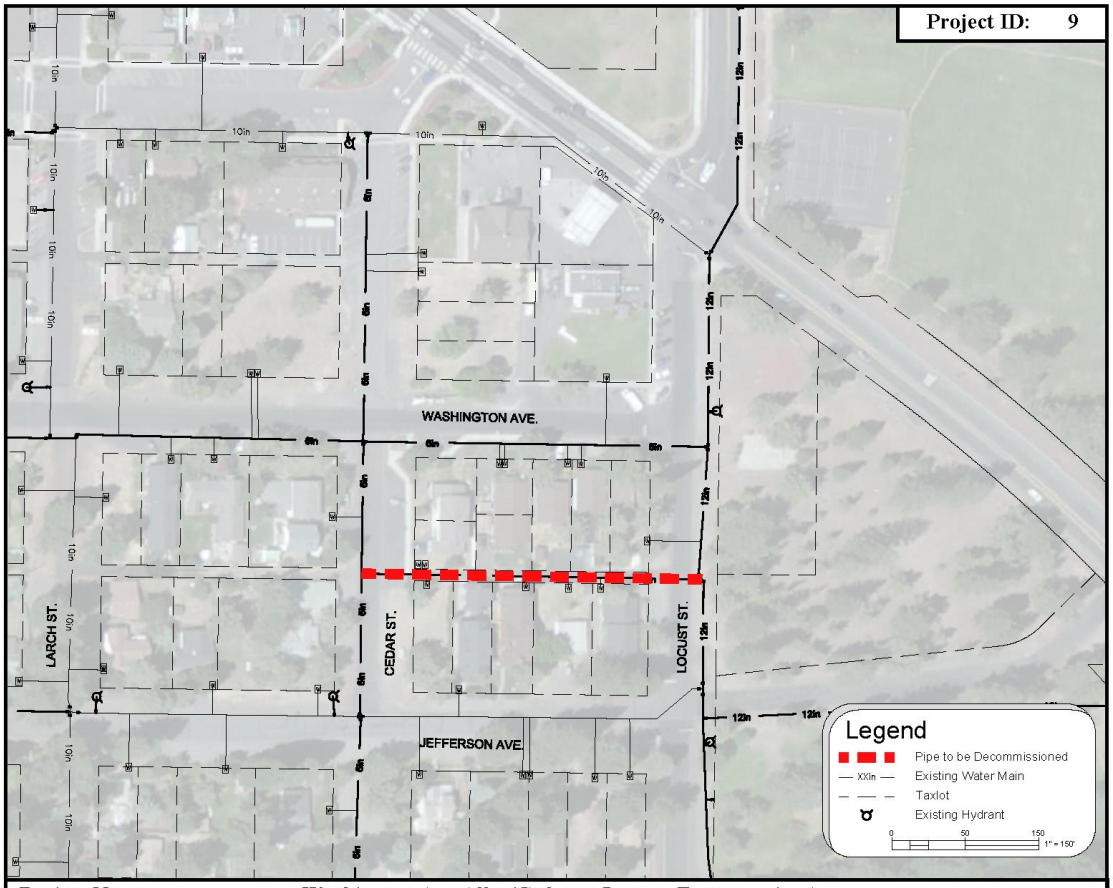
SCALE:	1" = 150'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**Hood Ave S. Alley/Pine to Ash (Reconnections)**
Location:	Along Hood Ave
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2020 - 2021
Objective:	To remove outdated and inadequate water piping in the City's water system, and to reconnect water services to water lines that meet the City's current design standards.
Description:	The existing 4-inch water main in the southern alley along Hood Ave will be decommissioned (pipe will be abandoned and left in place). New services will be provided through the existing 8-inch water main along hood Avenue or Washington Avenue.
Total Project Estimate	*$36,000.00*

City of Sisters ◦ Exhibit Drawing		SCALE: 1" = 150'	BECON Civil Engineering & Land Surveying
		DRAWN BY: EJH/JLB	
2017 Water Capital Facilities Plan Update		APPROVED BY: PB	
		REVISION DATE: 03/13/2017	



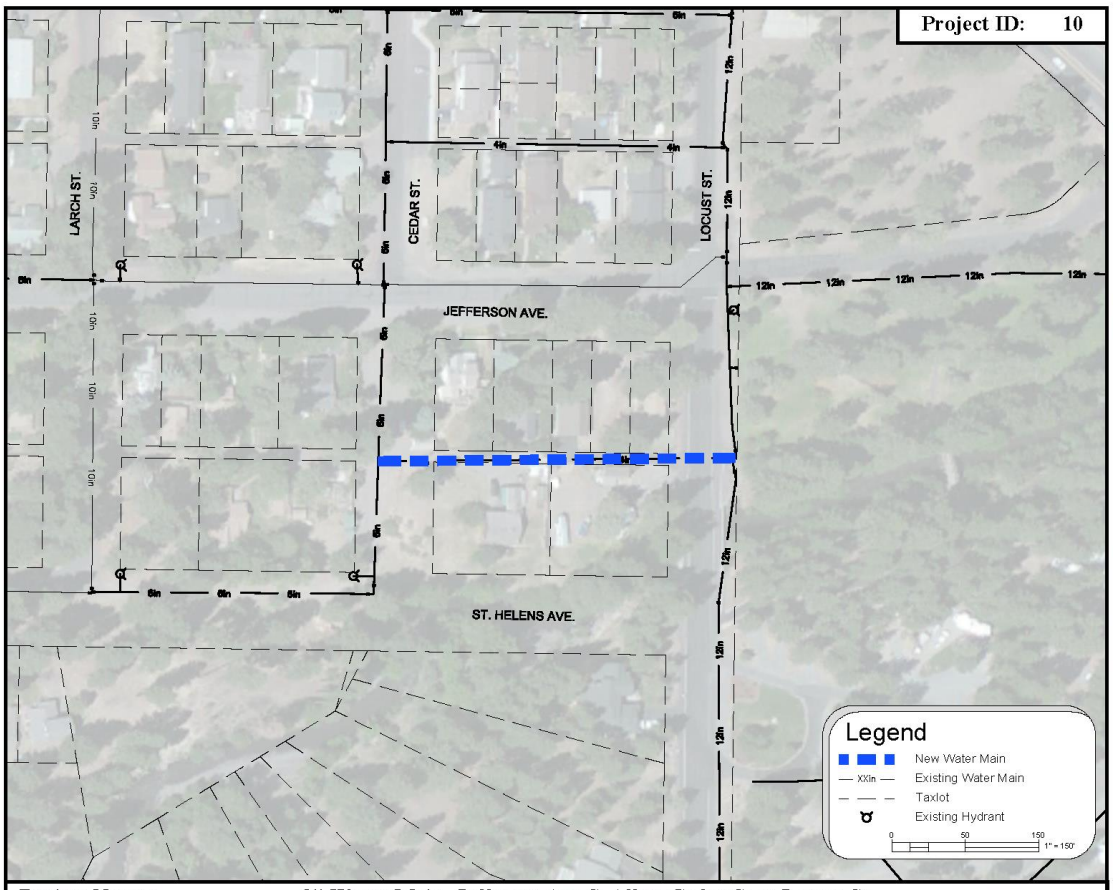
Project Name:	**Washington Ave Alley/Cedar to Locust (Reconnections)**
Location:	Alley South of Washington Avenue from Cedar to Locust
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2020 - 2021
Objective:	Remove outdated and inadequate water piping in the City's water system, and to reconnect water services to water lines that meet the City's current design standards.
Description:	The existing 4-inch water main in the southern alley along Hood Ave will be decommissioned (pipe will be abandoned and left in place). New services will be provided through the surrounding water mains.
Total Project Estimate	***$28,800.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 150'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**8" Water Main, Jefferson Ave S. Alley, Cedar St to Locust St**
Location:	Alley South of Jefferson Ave from Cedar St to Locust St
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2021 - 2022
Objective:	Upsize the existing waterline and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 4-inch water main along Fir St will be replaced with a new 8-inch water main, approximately 360-feet in length. Services shall be reconnected, the existing 4-inch line will be abandoned in place.
Total Project Estimate	***$33,700.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE: 1" = 150
DRAWN BY: EJH/JLB
APPROVED BY: PB
REVISION DATE: 03/13/2017

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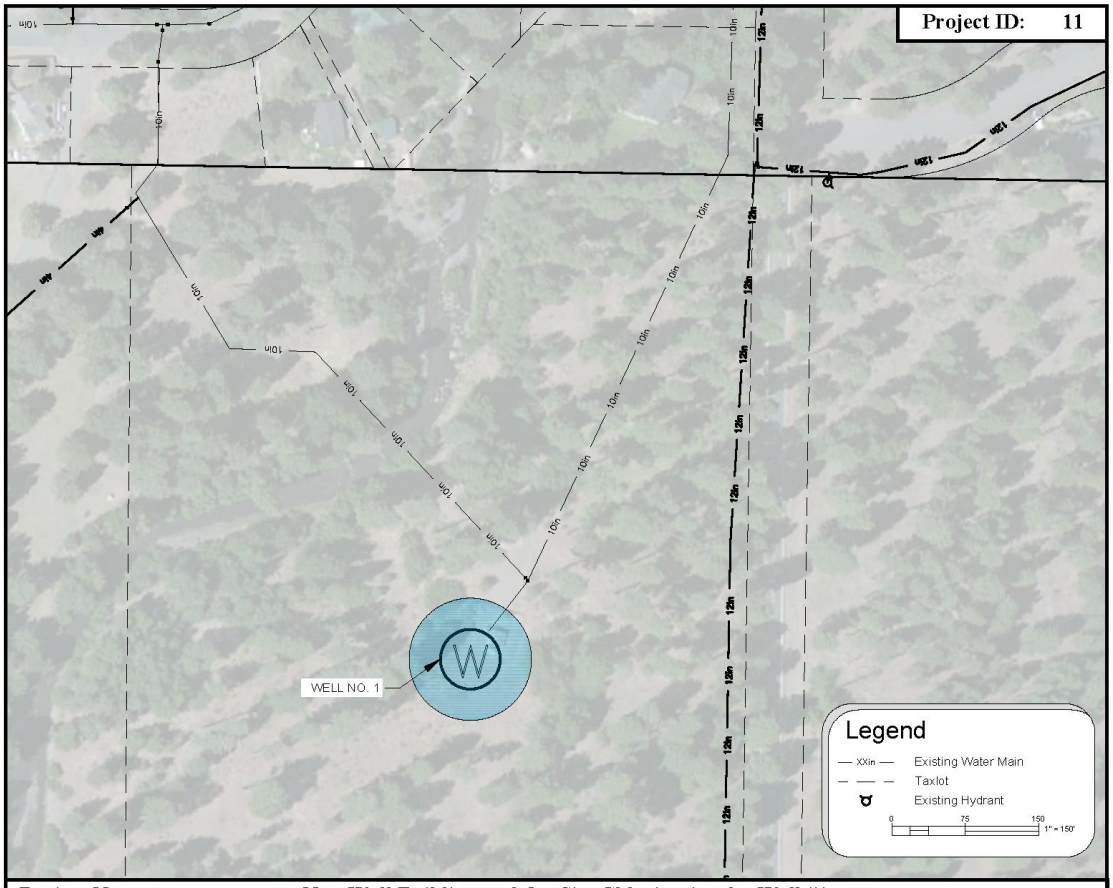

Project Name:	**New Well Building and On-Site Chlorination for Well #1**
Location:	See Map
Project Category:	Public Facility Improvement
Implementation Timeframe:	2021 - 2022
Objective:	Update the condition of essential City facilities.
Description:	The existing well building will be replaced and a new chlorination system will be installed.
Total Project Estimate	***$297,000.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 100'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

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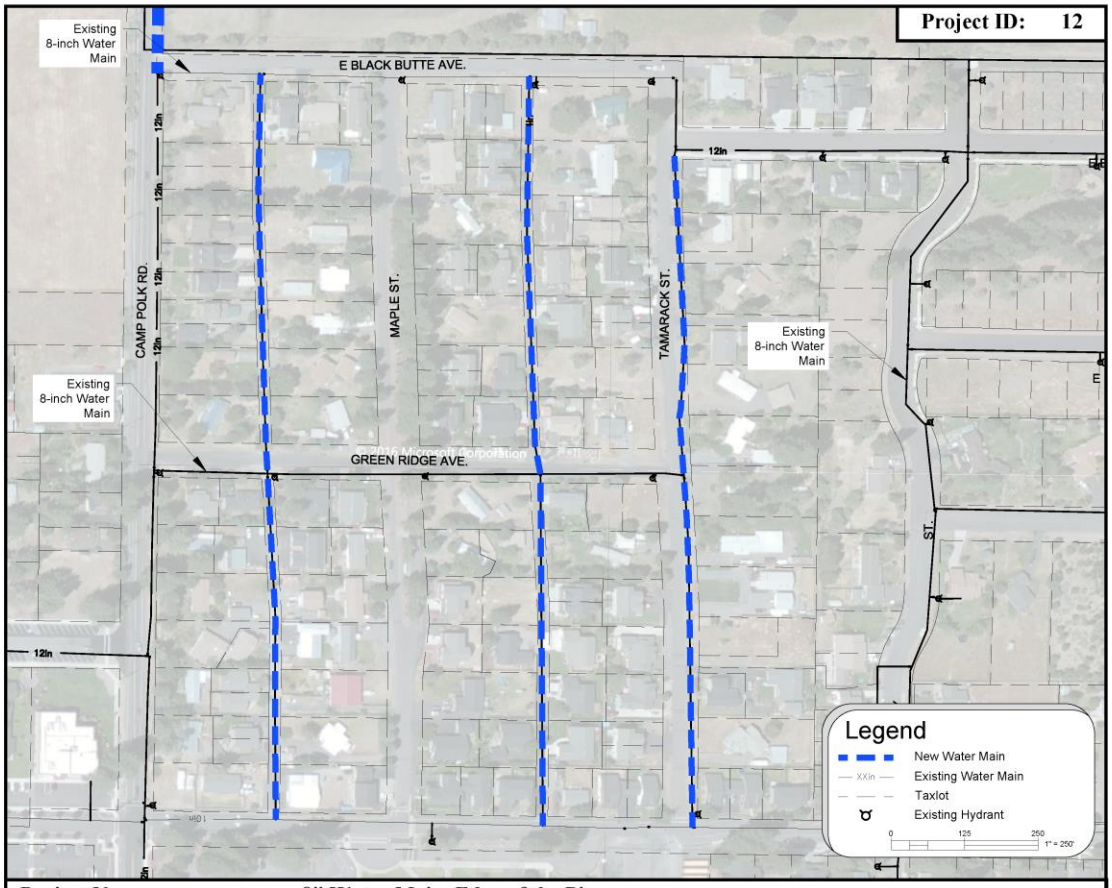

Project Name:	**8" Water Main, Edge of the Pines**
Location:	Locust Ln, Maple Ln, and Tamarack St
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2022 - 2023
Objective:	Upsize the existing waterlines and thereby increase the hydraulic capacity of the City's water system.
Description:	The existing 4-inch water mains in Locust Ln, Maple Ln, and Tamarack St will be replaced with new 8-inch water mains, new water pipe total is approximately 3700-feet. Services shall be re-connected to new water mains, the existing 4-inch lines will be abandoned in place.
Total Project Estimate	*$368,000.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	NTS
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03-13-2017

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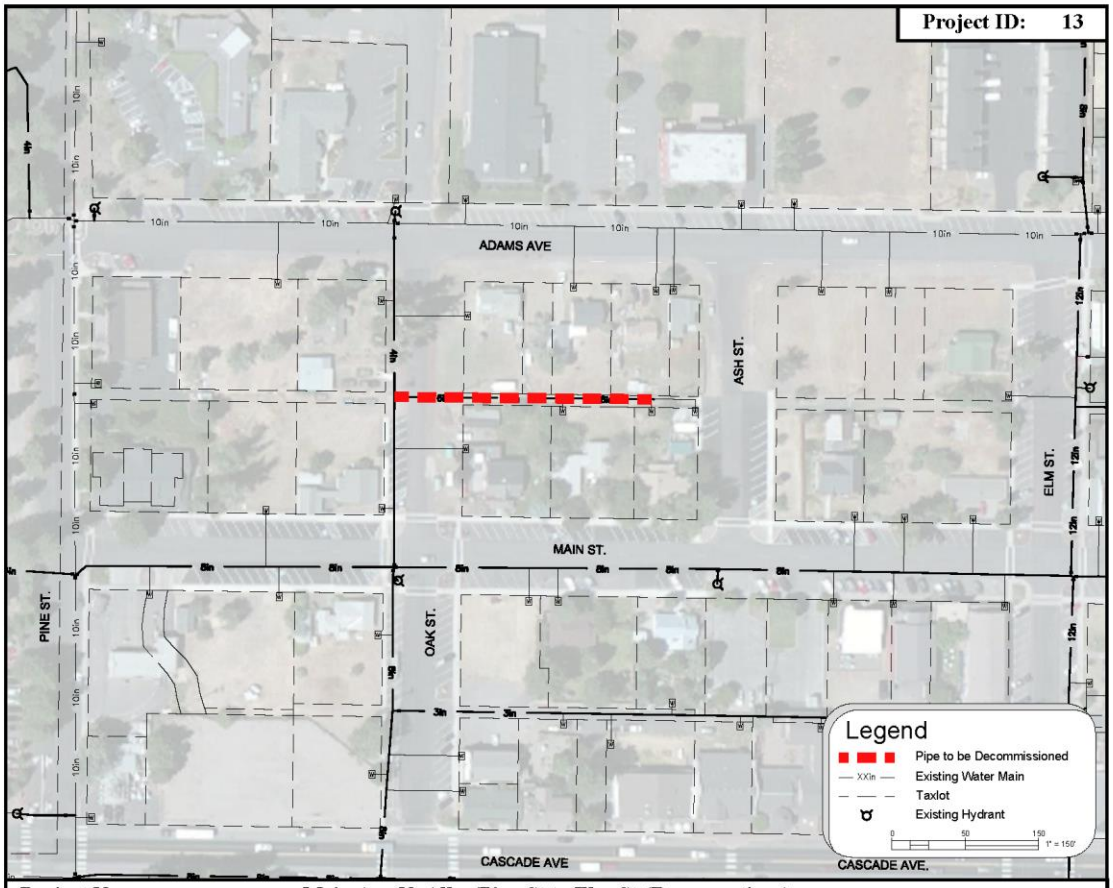

Project Name:	**Main Ave N. Alley/Pine St to Elm St (Reconnections)**
Location:	Along the Main Avenue North Alley from Pine St to Elm Street
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2018 - 2019, prior to Main Ave grind and in-lay work.
Objective:	Remove outdated and inadequate water piping in the City's water system, and to reconnect water services to water lines that meet the City's current design standards.
Description:	The existing 6-inch water main in the northern alley along Main Ave will be decommissioned (pipe will be abandoned and left in place). New services will be provided through the existing 8-inch water main along Main Ave or 10-inch main along Adams Ave.
Total Project Estimate	*$72,000.00*

City of Sisters ◦ Exhibit Drawing		SCALE:	1" = 150'
		DRAWN BY:	EJH/JLB
2017 Water Capital Facilities Plan Update		APPROVED BY:	PB
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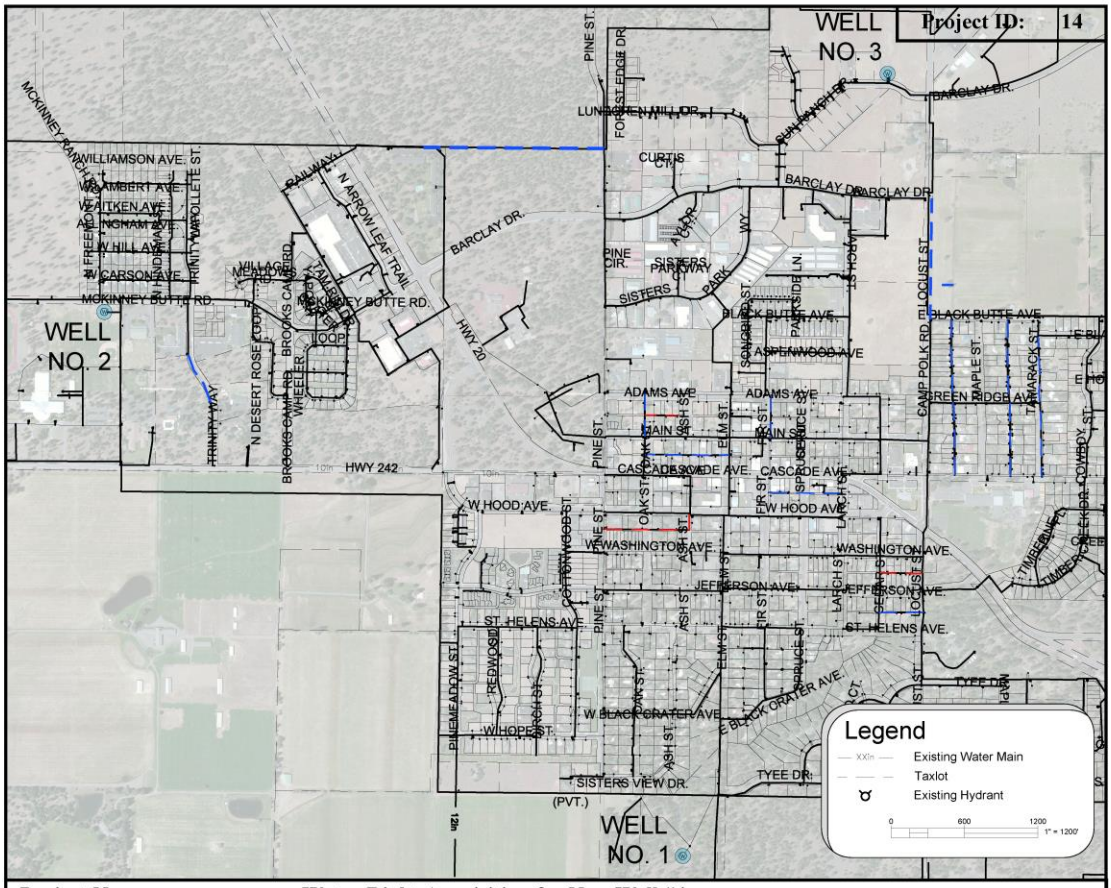

Project Name:	**Water Right Acquisition for New Well #4**
Location:	TBD
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2024 - 2025
Objective:	Increase the City's hydraulic capacity.
Description:	Water rights will be obtained for the new well.
Total Project Estimate	*$250,000.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 1200'
DRAWN BY:	EJH/JLB
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REVISION DATE:	03/13/2017

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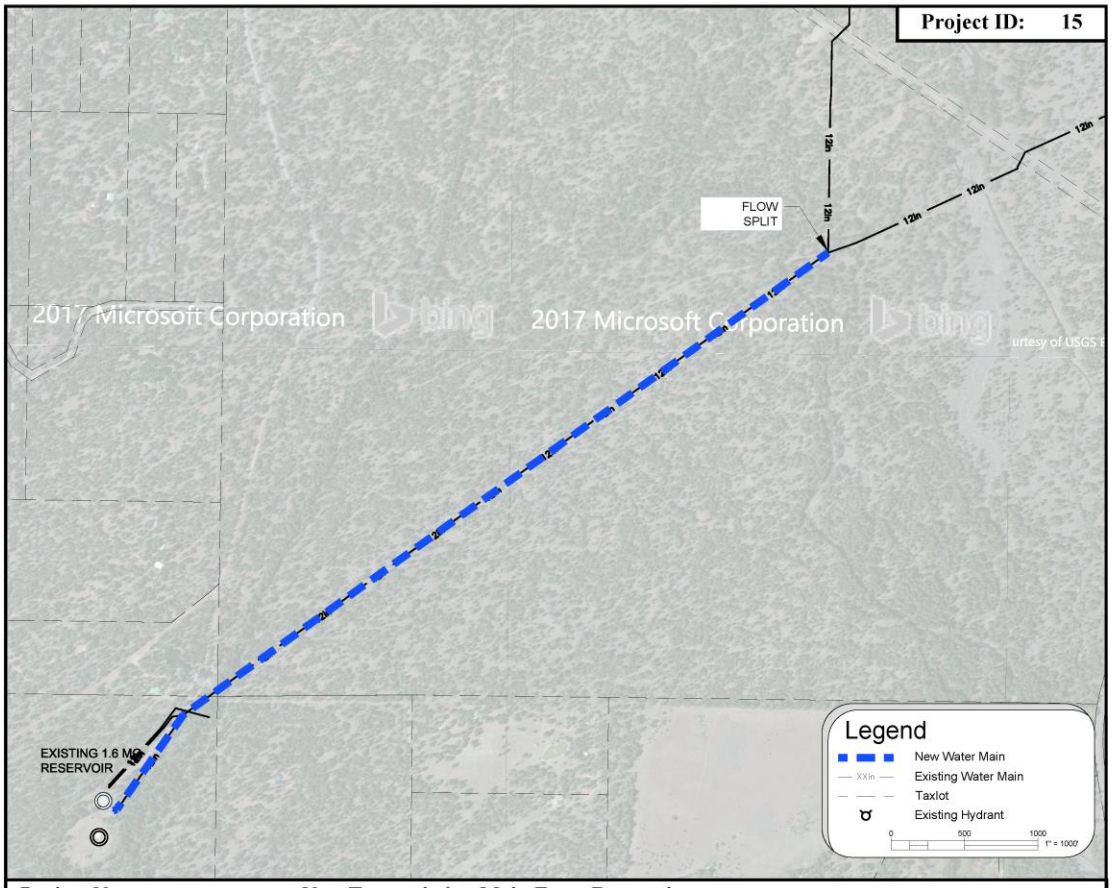

Project Name:	**New Transmission Main From Reservoir**
Location:	Reservoir to 1st Transmission Main Split
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2022 - 2023
Objective:	Provide a second transmission main and thereby increase the hydraulic capacity and redundancy of the City's water system.
Description:	A second 16-inch diameter transmission water main will be installed along the existing transmission main alignment, approximately 6220-feet in length.
Total Project Estimate	***$914,760.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 1000'
DRAWN BY:	EJH/JLB
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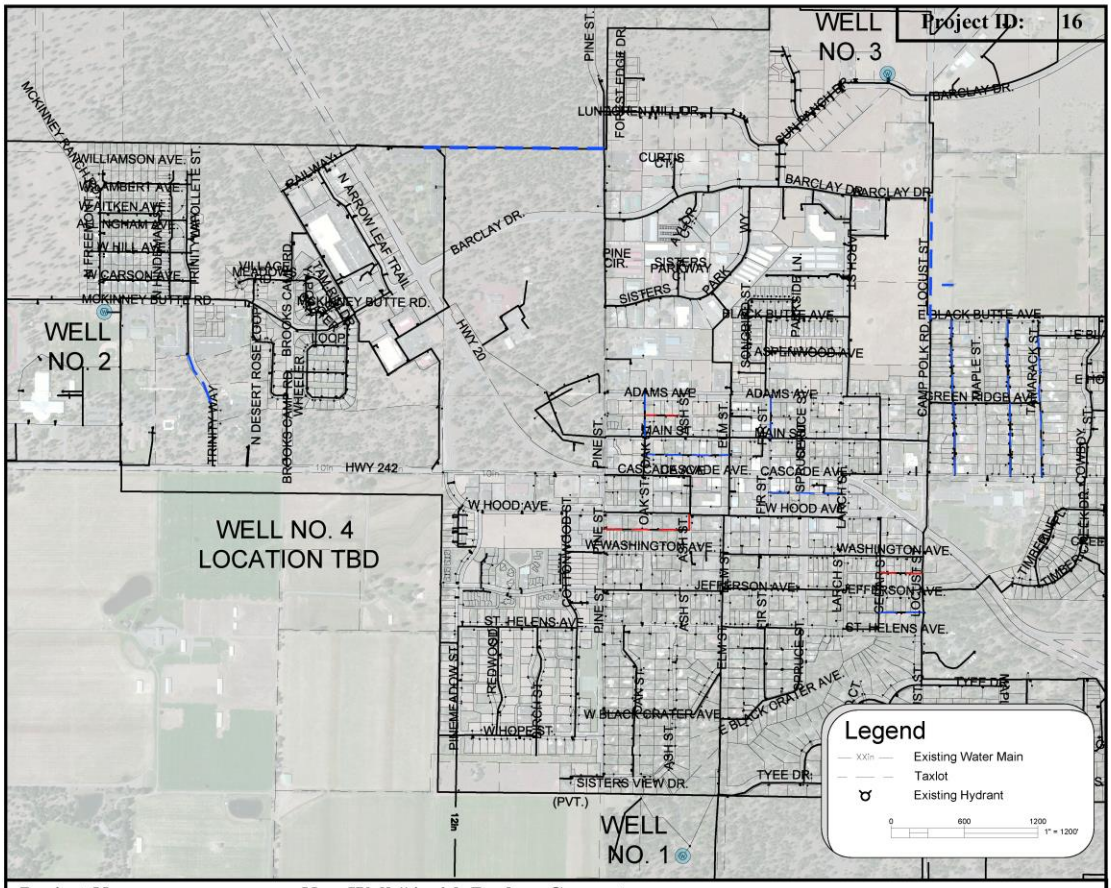
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**New Well #4 with Backup Generator**
Location:	TBD
Project Category:	Hydraulic Capacity
Implementation Timeframe:	2027 - 2028
Objective:	Increase the City's hydraulic capacity.
Description:	A new well (Well #4) with a backup generator will be installed. Design specifications are to be determined by the design engineer.
Total Project Estimate	*$861,300.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 1200'
DRAWN BY:	EJH/JLB
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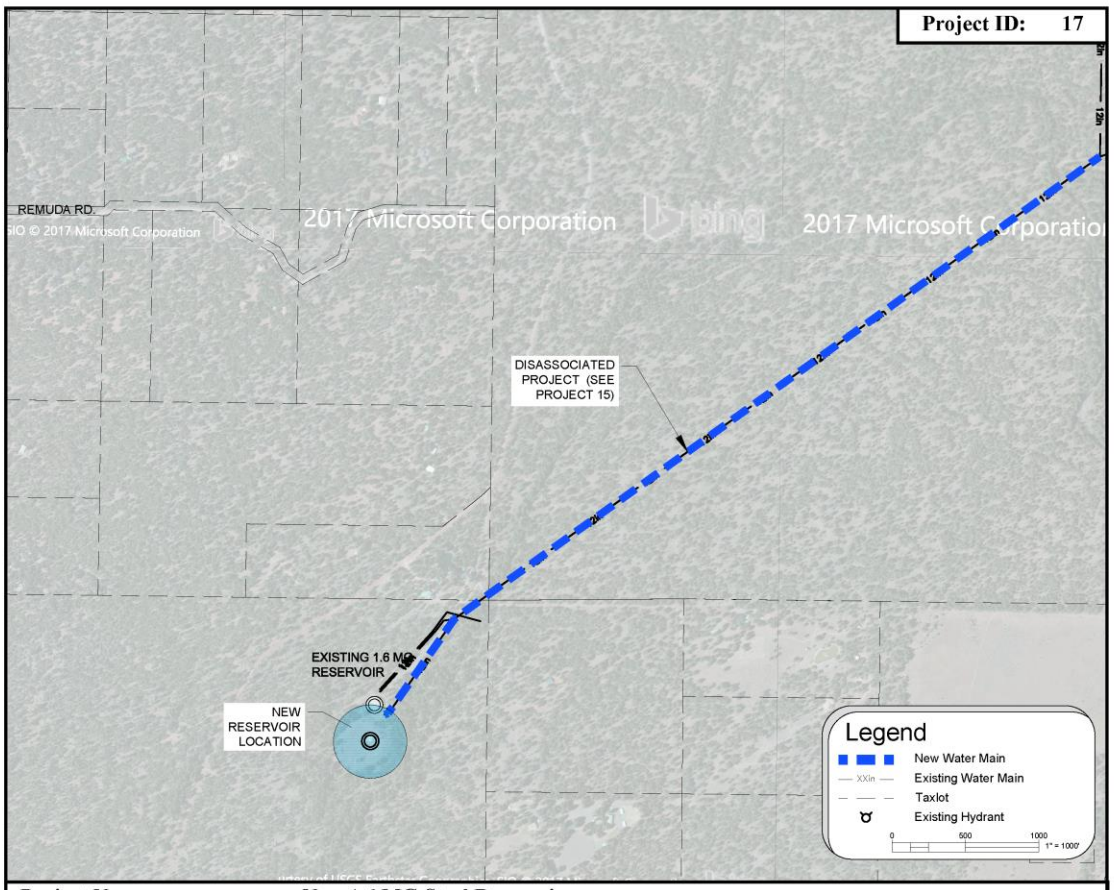

Project Name:	**New 1.6 MG Steel Reservoir**
Location:	TBD
Project Category:	Hydraulic Capacity
Implementation Timeframe:	Beyond 2037
Objective:	Increase the City's hydraulic storage capacity.
Description:	A new 1.6 MG reservoir will be installed. The new reservoir will increase the City's storage capacity by 100% in an effort to meet Camp Sherman Fire District storage capacity requirements.
Total Project Estimate	*$861,300.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 500'
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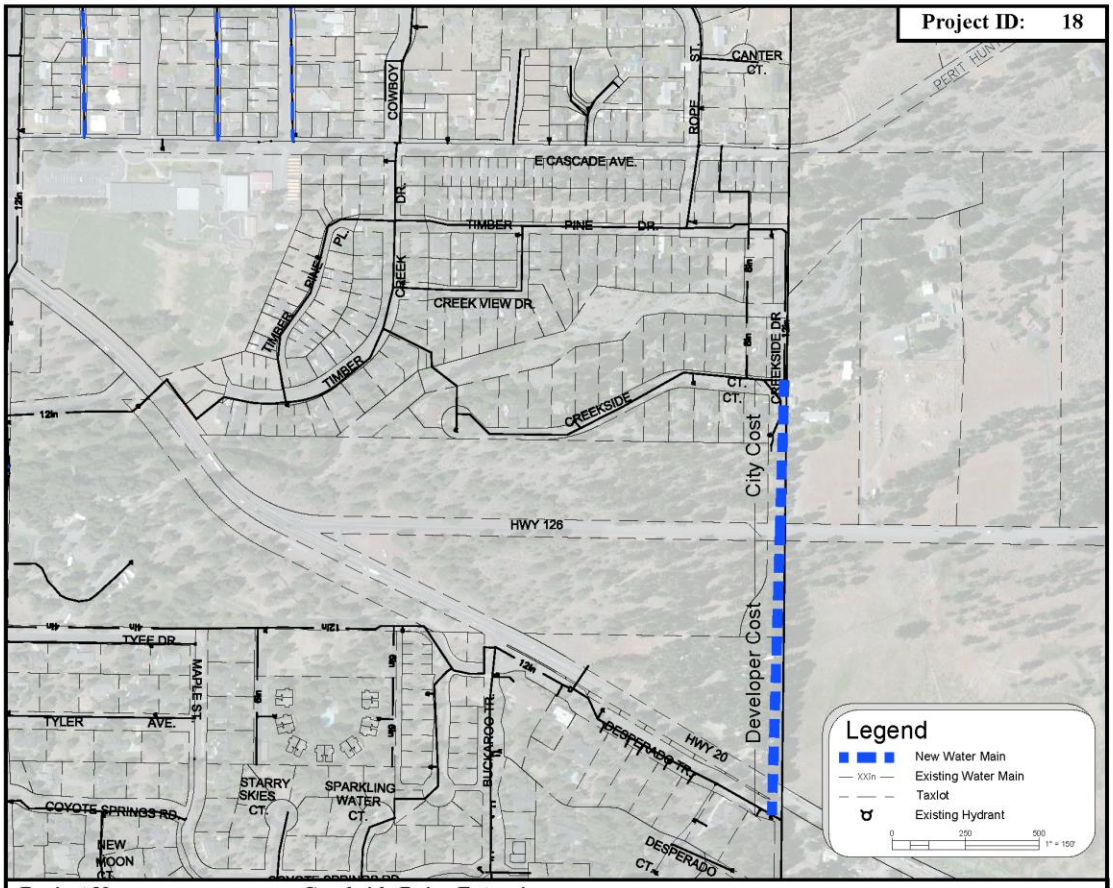
BECON Civil Engineering & Land Surveying



Project Name:	**Creekside Drive Extension**
Location:	Along Creekside Drive from Creekside Court to Desperado Trail.
Project Category:	Hydraulic Capacity
Implementation Timeframe:	TBD by development.
Objective:	To improve the existing water system and thereby increase fire flow and water quality.
Description:	Continue the 12-inch line from Creekside Ct. across Hwy 126 and Hwy 20, and connect to the existing 12-inch line at Five Pine. The new 12-inch line that is to be installed by the City is approximately 520-feet in length.
Total Project Estimate	*$37,200.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 500'
DRAWN BY:	EJH/JLB
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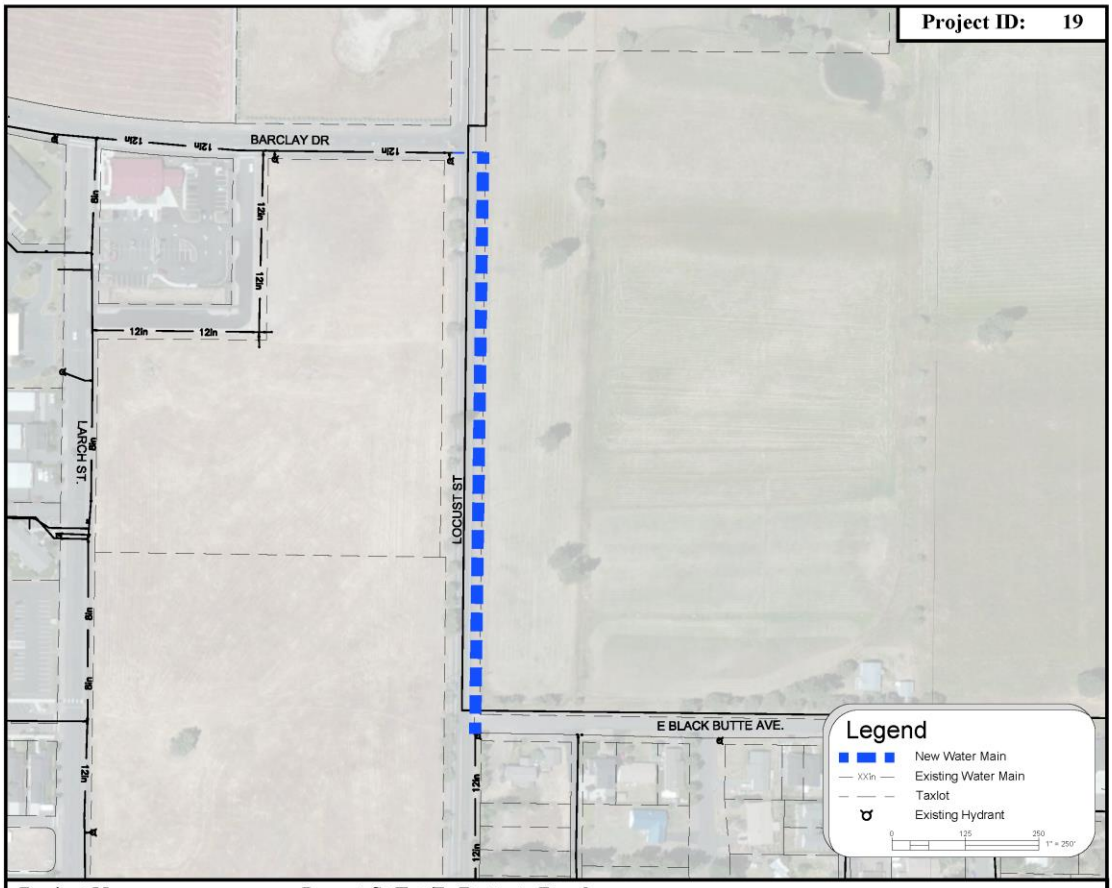


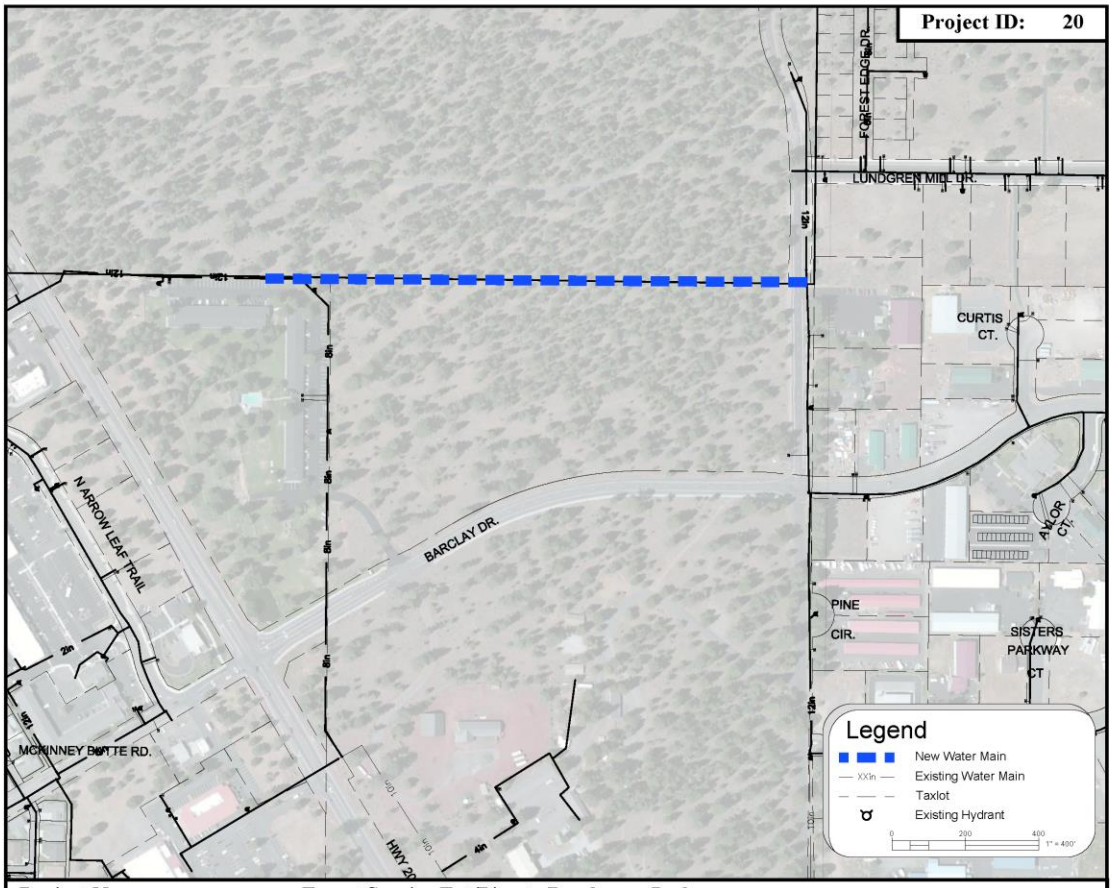
Project Name:	**Locust St Ext/B. Butte to Barclay**
Location:	Along Locust street from Barclay Drive to East Black Butte Avenue.
Project Category:	Hydraulic Capacity
Implementation Timeframe:	TBD by Development
Objective:	To improve the existing water system and thereby increase fire flow and water quality.
Description:	Connect the existing 12-inch water main at Barclay Dr. to the existing 12-inch water main at Black Butte Ave. The new 12-inch main will be approximately 1000-ft in length.
Total Project Estimate	*$36,000.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 250'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



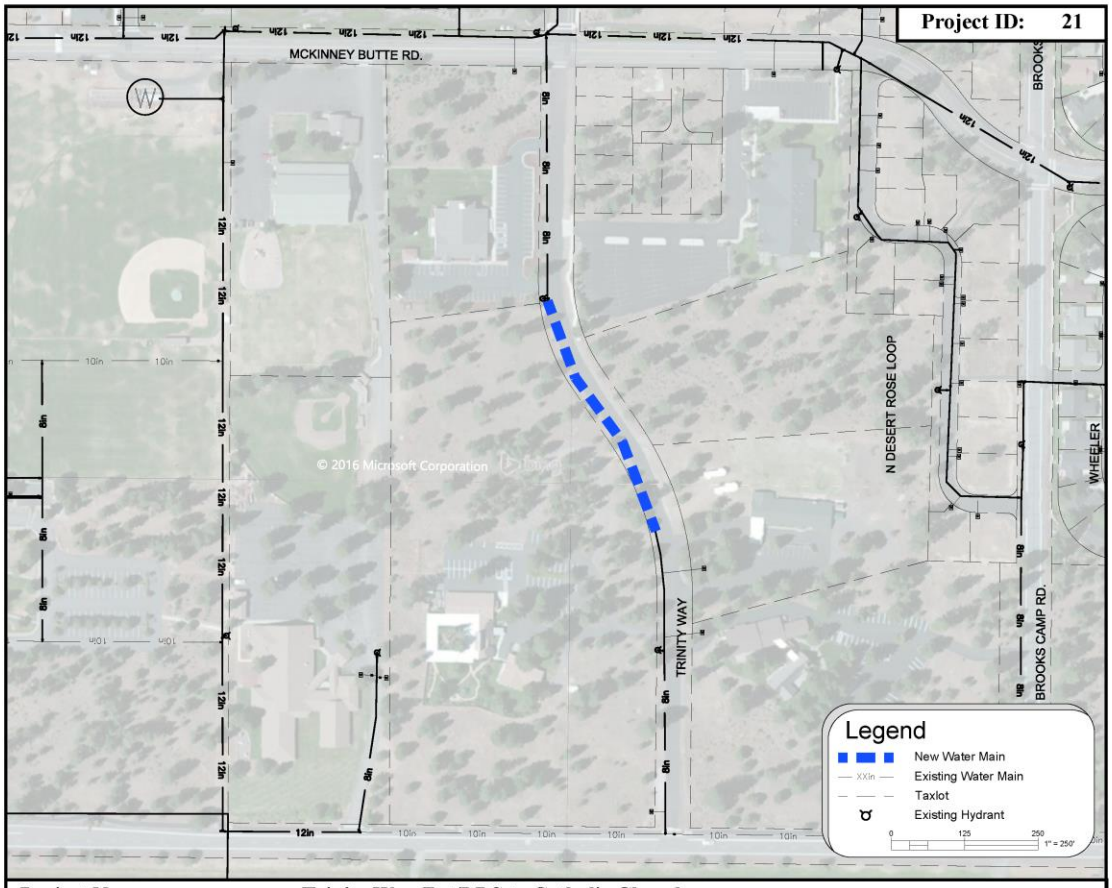
Project Name:	**Forest Service Ext/Pine to Ponderosa Lodge**
Location:	Ponderosa Lodge to Pine St.
Project Category:	Hydraulic Capacity
Implementation Timeframe:	TBD by Development
Objective:	To improve the existing water system and thereby increase fire flow and water quality.
Description:	A new 12-inch main will be constructed from Ponderosa lodge to the existing 12-inch main at Pine St, approximately 1475-feet in length.
Total Project Estimate	*$168,000.00*

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 400'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

BECON Civil Engineering & Land Surveying



Project Name:	**Trinity Way Ext/LDS to Catholic Church**
Location:	Along Trinity Way between the termination points of existing pipelines.
Project Category:	Hydraulic Capacity
Implementation Timeframe:	TBD by Development
Objective:	To improve the existing water system and thereby increase fire flow and water quality.
Description:	Connect existing 8-inch along Trinity Way.
Total Project Estimate	***$42,240.00***

City of Sisters ◦ Exhibit Drawing

2017 Water Capital Facilities Plan Update

SCALE:	1" = 250'
DRAWN BY:	EJH/JLB
APPROVED BY:	PB
REVISION DATE:	03/13/2017

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11 FINANCE OPTIONS

11.1 INTRODUCTION

The funding of needed water improvements for the City of Sisters may utilize one or more of the following funding sources:

- Sale of Bonds by Acquiring Federal or State Grants and/or Loans
- Special Assessments
- Local Improvement Districts
- Serial Levies
- Capital Improvements (Sinking) Funds
- Systems Development Charges

The most successful financing plans utilize state or federal grants and/or loans that best address the characteristics of needed improvements. It is difficult to finance improvements with grant funding alone, and grant funding in general is limited. Some level of local funding or borrowing from available loan programs is usually necessary, although some cities accumulate sufficient reserves for construction. Funding programs vary in terms of their economic impact on the community, and often are created with specific program focuses. Some programs are available to create and retain jobs or benefit areas of low to moderate income families. Other programs provide for specific types of infrastructure improvements, such as improvements to address wastewater related compliance issues. A thorough consideration of applicable state and federal funding programs, in addition to a potential means of securing local funding, is needed to minimize the long-term cost of water system improvements, while providing quality construction.

If the City decides to pursue agency funding for recommended projects, it should contact Oregon DEQ, Oregon Business Development (Infrastructure Finance Authority), USDA and Rural Community Assistance for information and scheduling of a one-stop meeting. One-stop meetings are held in Salem or in Sisters. These meetings bring together staff from the various agencies that could potentially contribute funds, and representatives of the community, to discuss the project and funding needs. Staff has already begun this process and preliminary meetings have occurred in anticipation of adoption of this Master Plan.

This section is intended to provide a general overview of recently available programs. Agency and program policies are continually evolving and specifics may vary if funding of improvements is delayed to any major extent.

11.2 PUBLIC WORKS FINANCING PROGRAMS

Four grant programs and five loan/bond sale programs, which have the potential to provide funding for the City, are listed below.

Grants

Federal	$ USDA / Rural Development
State	$ DEQ – Clean Water Revolving Fund (principle forgiveness) $ IFA - Special Public Works Fund

Loans/Bond Sales

Federal	$ USDA / Rural Development
State	$ DEQ – Clean Water Revolving Fund $ IFA – Safe Drinking Water / Special Public Works Fund $ League of Oregon Cities – LOC Capital Asset Program

Each of the available grant and loan programs varies in terms of the extent and complexity of the application process. In all cases, it is extremely important to communicate the program needs to the funding agency at the earliest possible date. A close working relationship with the potential grantor or lending agency can optimize the timing and amount of the grant and/or loan assistance. A brief overview of potential public works financing programs and an assessment of their availability follows.

11.2.1 US Department of Agriculture (USDA) Rural Development

Water Environmental Programs – Offer funds for construction, repair or improvement of Water, Wastewater, Solid Waste or Storm Water projects. Loans can be amortized for up to 40 years at current Municipal Bond market rates. Rate subsidies are available for distressed communities.

11.2.2 Department of Environmental Quality (DEQ)

Clean Water State Revolving Fund (CWSRF) – This program offers funding for planning, design and construction of Wastewater projects. Loans can be amortized for up to 30 years, current rates can go as low as 1.47% (depending on demographics / economic distress). Up to $500,000 in principle forgiveness is available for distressed communities. Between $500,000 and $1,000,000 can be available for Green Infrastructure / Storm Water restoration projects.

11.2.3 Infrastructure Finance Authority (IFA)

Oregon Health Authority / Safe Drinking Water Revolving Loan Fund (SDWRLF) – This program offers funding for resolving potential or existing compliance issues. Loans can be amortized for up to 20 years at 80% of the current Municipal Bond market rate. For distressed communities loans are available for up to 30 years at 1% interest.

11.2.4 League of Oregon Cities (LOC)

Capital Asset Program – This loan program is available through LOC for cities that lack the expertise to avail themselves of public market financing. It offers Municipal Bond funds at market rates.

11.2.5 Municipal Bond Financing

The city of Sisters can use the Municipal Bond markets, through an underwriter, to obtain financing at then current market rates.

11.3 LOCAL FUNDING SOURCES

A significant portion of a project may need to be financed with local funding sources. Local funding sources are listed below:

General Obligation Bonds
Revenue Bonds
Improvement Bonds (Local Improvement District)
Serial Levies
Sinking Funds
Ad Valorem Tax
System User Fees
Assessments
System Development Charges (SDC)

The 1991 legislature clarified and defined the impact of Ballot Measure 5 on municipal finance in several special ways. Cities, counties, and special districts need to clearly understand, and follow these rules, when they consider bonding for the financing of needed improvements.

The following information was provided in part by Howard A. Rankin, retired Bond Counsel:

1. Chapters 287 and 288 of the Oregon Revised Statutes describe the borrowing and bonding of counties, cities, and special districts.

2. The advance sheets of the Laws of 1991 indicate that the general bond limitations of ORS 287.004 are still in force. Except with regard to the old 3% limitation on all issued and

outstanding bonds, on true-cash value of all taxable property within the city's boundaries, has been changed to a 3% limitation on "real market value" as determined by the County Assessor.

3. The above limitation still does not apply to bonds issued for water, sanitary or storm sewers, sewage disposal plants; nor to bonds issued to pay assessments for improvements in installments under statutory or charter authority (i.e. revenue bonds).

A description of each of the preceding listed funding sources follows.

11.3.1 General Obligation Bonds

Financing of water improvements by General Obligation (G.O.) Bonds is accomplished by the following procedures:

1. The Consulting Engineer prepares a detailed cost estimate to determine the total monies required for construction.

2. An election is held.

3. When voter approval is granted (by a simple majority or a majority of the registered voters, depending on when the vote occurs), bonds are offered for sale. The money for detailed planning and construction is obtained prior to preparation of final engineering plans and the start of project construction unless interim financing has been developed.

G.O. bonds are backed by the full credit of the issuer and authorize the issuer to levy ad valorem taxes. The issuer can make the required payments on the bonds solely from the new tax levy or may instead use revenue from assessment, user charges, or some other source.

Oregon Revised Statutes limit the maximum term of G.O. bonds to 40 years for cities and 30 years for water districts. Except in the event that RD purchases the bonds, the realistic term for which general obligation bonds would be issued is 15 to 20 years.

Ballot Measure 5 has limited the ability of communities to levy property taxes. Capital improvement projects, such as the proposed water system improvements, are exempt from property tax limitations if an election is held and new public hearing requirements are met.

Cities, counties and special districts (all non-school taxing entities) must be very careful when seeking approval from the voters for a general obligation bond, new tax base, annual budget levy, or special levy. The current law now requires that all non-school taxing entities, including cities, counties, and special districts, hold a special public hearing more than 30 days before filing the election statement with the County Clerk. Notice of this special public hearing must be sent to all other non-school taxing entities with overlapping taxing jurisdictions no later than 10 days before the special public hearing. This special public hearing offers the opportunity for all overlapping taxing entities to determine the compaction impact of the proposed election on their respective assessment capability. Effectively, the municipality proposing the election

measure must be thoroughly prepared with notice of special public hearing published no later than 41 days before a final public hearing and filing of the election statement.

If the special public hearing procedures are not followed, and no certificate is included in the filing that attests that the special public hearing was conducted pursuant to law, the County Clerk is required to reject the filing for an election. This results in additional unnecessary delays. Consideration should be given to hiring a competent Bond Counsel before proceeding with a General Bond Election. This action will insure that all requirements of current law are met.

Since bonding requirements are very stringent, most recent municipal improvements have been financed with either revenue bonds or one of the state financing programs which can be accomplished outside of bonding requirements.

11.3.2 Revenue Bonds

A revenue bond is one that is payable solely from charges made for the services provided or from collection of Systems Development Charges, although the City would need to be very careful that SDC's would be collectible. Such bonds cannot be paid from tax levies or special assessments, and their only security is the borrower's promise to operate the water system in a way that will provide sufficient net revenue to meet the obligations of the bond issue. Revenue bonds are most commonly retired with revenue from user fees.

Successful issuance of revenue bonds depends on bond market evaluation of the dependability of the revenue pledged. Normally there are no legal limitations on the amount of revenue bonds to be issued, but excessive bond issue amounts are generally unattractive to bond buyers because they represent high investment risk. In rating revenue bonds, buyers consider the economic justification for the project, reputation of the borrower, methods for billing and collection, rate structures, and the degree to which forecasts of net revenues are realistic. RD will fund revenue bonds in which user rates are committed for the repayment of the bonds.

Under the provisions of the Oregon Uniform Revenue Bond Act (ORS 288.805- 288.945), municipalities may elect to issue Revenue Bonds for revenue producing facilities without a vote of the electorate. In this case, certain notice and posting requirements must be met including a mandatory 60-day waiting period. A petition signed by 5% of the municipalities' registered voters may cause the issue to be referred to an election.

Laws enacted by the 1991 legislature have eliminated the limitation on revenue bonds. The law formally required that the revenues pledged for payment of the bonds have a direct relationship to the services financed by the bonds. Current law now allows revenue bonds to be paid with any revenue pledged for “any public purpose,” without the relationship restriction.

11.3.3 Improvement Bonds (Local Improvement District)

Improvement bonds may be issued to assess certain portions of water improvements directly against the parties being benefitted. An equitable means of distributing the assessed cost must be utilized so that all property, whether developed or undeveloped, receives the assessment on an equal basis. Cities are limited to improvement bonds not exceeding 3% of true cash value. For a particular improvement, all property within the assessment area is assessed on an equal basis, regardless of whether it is developed or undeveloped.

Improvement bond financing requires that an improvement district be formed, the boundaries established, and that benefitted properties and property owners be determined. The engineer usually determines an approximate assessment based on a square-foot, a front-foot basis, or a combined basis. Property owners are then given an opportunity to remonstrate against the project. The assessment against the properties is usually not levied until the actual total cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. It is common practice to issue warrants, which are paid when the project is completed, to cover debts.

The primary disadvantages to this source of revenue (improvement bonds) are described below:

1. The property to be assessed must have a true cash valuation at least equal to 50% of the total assessments to be levied. This may require a substantial cash payment by owners of undeveloped property.

2. An assessment district is very cumbersome and expensive when facilities for an entire community are contemplated.

3. The project is impacted by Measure 5 tax limitations because the improvement bonds are backed or guaranteed by the city's authority to raise revenue via taxation. If the city is in compaction, then a general election (same procedures as for a general obligation bond) is required. If the city's property taxes are not under compaction, then the city can proceed with a L.I.D. as in the past; however, the project cost will count against the $10.00 limitation for non-school taxes.

This program should not be considered for improvements to satisfy the City's needs in general, but could be a definite consideration for specific projects benefitting an area of the community.

11.3.4 Serial Levies

Under Oregon Revised Statutes, if approved by the voters, the City can levy taxes for a fixed period of time to construct new facilities and maintain existing facilities. Generally, when a serial levy is presented to the voters, it is based upon a specific program and listing of planned

improvements.

Since the time frame required for construction of the needed water improvements is quite limited, it is doubtful that residents could afford a serial levy of sufficient size to provide for needed construction revenues.

11.3.5 Sinking Funds

Sinking funds can be established by budget for a particular capital improvement need. Budgeted amounts, from each annual budget, are carried in a sinking fund until sufficient revenue is available for the needed project. Funds can also be developed with revenue derived from system development charges or serial levies. The City's water system financial needs can be met with a sinking fund, although the cost of needed facilities will be higher after funds are collected than if revenues are utilized to repay a loan for construction in the near term.

11.3.6 Ad Valorem Tax

Many communities utilize an ad valorem tax as the basis for repaying general obligation bonds for system expansions, and provide partial or full repayment through means of additional water use charges. This means of financing reach all properties to be ultimately benefitted by the water system, whether the property is presently developed or not. Construction costs are more equally distributed among all property owners and the program does not impose a penalty on existing residential or business development. However, with Oregon tax limitations and the public's perception of taxes, this means of securing funds would not be popular.

11.3.7 System User Fees

Monthly charges are made to all residences, businesses, etc., that are connected to the water system. Water use charges are established by resolution, and can be modified as needed to serve increased or decreased operating costs. Rates are established depending on the various classes of users and the metered demand through their connection. By establishment of proper use charges, the City could repay the local share of bond amortization without imposition of property taxes. An increase in user fees could finance portions of the water system that are maintenance related, particularly if done in conjunction with a revenue bond.

11.3.8 Assessments

In some cases the beneficiary of a public works improvement can simply be assessed for the cost of the project. It is not uncommon for an industrial or commercial developer to provide up-front capital to pay for a community administered improvement which serves the development.

11.3.9 System Development Charges

System Development Charges (SDC's) are charges assessed against new development to

recover the costs incurred by local government who provide the capital facilities required to serve the new development. SDC's apply to new developments that generate revenue for the expansion or construction of facilities located outside the boundaries of new development. When capital improvements increase usage, SDC's can be billed for water, wastewater, drainage and flood control, transportation, and parks or recreational facilities.

11.4 PROPOSED FINANCIAL PROGRAM

Initially it appears that either the DEQ or IFA programs may be the most attractive since they offer lower rates and the potential for grants / principle forgiveness as well as loans at below market rates. Funding is likely to be predominantly loan, under any of the available funding programs.

A combination of loan, grant and systems development charges are recommended for funding of needed system improvements. Systems Development Charges should fund system improvements either through repayment of loans, or potentially by utilizing sinking funds to pay for improvements as monies become available. After selection of the initial project scope, the City will contact the IFA, DEQ and Regional Solutions Team to schedule a one-stop meeting with available state and federal funding agencies, to discuss project needs. When the project is presented to all funding agencies, each agency will evaluate their program's potential to assist with financing the needed water system improvements, and the City can determine how construction can best be implemented.

12 WATER RATES AND FINANCING

12.1 WATER FUND BUDGET

Table 12.1 includes recent water fund budgets. Table 12.2 provides the information in summary form with a focus on ordinary revenue and expenses.

Table 12.1: Recent Water Fund Budgets

Description	Actual FY 12/13	Actual FY 13/14	Actual FY 14/15	Actual FY 15/16
Revenues				
Water Receipts	$509,768	$501,980	$532,239	$565,783
Interest Earned	$1,088	$1,627	$2,484	$3,807
Public Works Fees	$1,588	$9,227	$10,194	$2,800
Bulk Water	$1,584	$(1,907)	$1,269	$1,066
Water Penalties	$0	$4,824	$6,940	$8,096
Backflow Testing Fees	$8,879	$11,483	$12,244	$8,231
Water Processing/Trans Fee	$3,080	$3,875	$3,800	$4,400
Service Reconnect Fee	$210	$195	$75	$120
Miscellaneous	$4,832	$150	$3,238	$755
Meter Installation & Repair	$13,075	$23,680	$20,209	$20,582
Water Tap Fees	$0	$1,500	$2,000	$2,500
Refunds and Reimbursements	$93,643	$12,471	$857	$1,888
State Grants	$0	$0	$20,761	$63,380
Total Revenues	$637,747	$569,105	$616,310	$683,408
Cash Carry Forward-Beginning Fund Balance	$99,611	$222,748	$403,267	$581,272
Transfers In	$0	$36,706	$0	$0
Total Resources	**$737,358**	**$828,559**	**$1,019,577**	**$1,264,680**
Expenditures				
Personal Services	$201,240	$190,820	$214,577	$220,914
Materials & Services	$164,720	$197,668	$194,394	$224,355
Capital Outlay	$124,650	$12,734	$20,761	$72,597
Reserves				
System Reserves	$0	$0	$0	$0
Total Capital Improvements:	$0	$0	$0	$0
Transfers				
Total Transfers	$24,000	$24,000	$8,653	$20,705
Depreciation	$175,976	$180,586	$184,426	$181,299
Operating Contingency	$0	$0	$0	$0
Total Water Fund Expenditures:	**$690,586**	**$606,078**	**$622,811**	**$719,870**
Excess (Deficiency) of Revenues Over Expenditures	**$46,772**	**$222,481**	**$396,766**	**$544,810**

Table 12.2: Water Fund Budget Summary Ordinary Revenue and Expenses

Description	Actual FY 12/13	Actual FY 13/14	Actual FY 14/15	Actual FY 15/16
Revenue:				
Total Revenue	$637,747	$569,105	$616,310	$683,408
Total Revenue:	**$637,747**	**$569,105**	**$616,310**	**$683,408**
Total Expenses:	**$690,586**	**$606,078**	**$622,811**	**$719,870**

Reference to these Tables are made in sub-sections that follow.

12.2 WATER SYSTEM REVENUE

12.2.1 Current Water Rates

Current water rates became effective in June 2017. The current rate structures is provided in Table 12.3.

Table 12.3: Existing Water Rates

METER SIZES	LOCATION	BASE RATE	1,000 CUBIC FT. BASE RATE	OVERAGE
3/4”	Inside City Outside City	$ 20.59 $ 30.89	1,000 Cubic Feet 1,000 Cubic Feet	$1.00 per 100 Cubic Ft. over base $1.00 per 100 Cubic Ft. over base
1” and 1-1/2”	Inside City Outside City	$ 23.09 $ 34.64	1,000 Cubic Feet 1,000 Cubic Feet	$1.00 per 100 Cubic Ft. over base $1.00 per 100 Cubic Ft. over base
2”	Inside City Outside City	$ 25.58 $ 38.37	1,000 Cubic Feet 1,000 Cubic Feet	$1.00 per 100 Cubic Ft. over base $1.00 per 100 Cubic Ft. over base
3”, 4”, 6”, 8”	Inside City Outside City	$62.40 $93.60	1,000 Cubic Feet 1,000 Cubic Feet	$1.00 per 100 Cubic Ft. over base $1.00 per 100 Cubic Ft. over base
Standby Fire 4” and Smaller	Inside City Outside City	$10.00 $15.00	Flat Fee Flat Fee	$ 0.00 fire protection only $ 0.00 fire protection only
Standby Fire 6”	Inside City Outside City	$15.00 $22.50	Flat Fee Flat Fee	$ 0.00 fire protection only $ 0.00 fire protection only
Standby Fire 8”	Inside City Outside City	$20.00 $30.00	Flat Fee Flat Fee	$ 0.00 fire protection only $ 0.00 fire protection only
Bulk Rate By the Gallon				$3.30 per 1,000 gallons

12.2.2 Current Rate Revenue

Potential rate revenue, based on current service connections, is projected to equal $ 694,900 in

the adopted 15/16 fiscal budget.

12.2.3 Property Taxes

Currently water system revenue includes no property tax component.

12.2.4 "Other" Revenue

Other revenue may include such revenue as contractor water purchases, interest, carry over funds, grants, etc. These sources, typically, contribute a relatively small portion of overall revenue and may vary considerably from year to year. Grant funding revenue may be significant; however, it is typically obtained and obligated for specific projects or purposes. Hook-up fees are generally developed to cover the actual cost of making a new connection. System development charges (SDCs) can only be used for adding system capacity and cannot be used for general operating and maintenance expenses.

12.3 WATER SYSTEM EXPENSES

12.3.1 Debt Service

The water system is currently debt free.

12.3.2 Operations and Maintenance (O&M)

Operations, maintenance, and administrative costs are summarized in Table 12.1. Current expenditures appear to approximate revenues in both actual and adopted budgets. Sisters has a relatively simple water system, but replacements and maintenance are necessary. Mechanical equipment, including meters, should be repaired or replaced as needed.

12.4 CURRENT RATES- ANALYSIS AND RECOMMENDATIONS

A simple formula for budget viability is: Revenue- Expenses. At the present time, with a minimum level of reserves for emergencies, the budget is in balance.

Rates should be adjusted to keep up with inflation and operating expenses while maintaining adequate replacement reserves (reviewed and adjusted annually).

The current rate structure is very simple and easy to apply. However, rates will need to be adjusted for equipment replacement and increased operation and maintenance expenses addressed in the Capital Improvement Plan provided in Section 12.

12.5 FUTURE RATES

Usage fees are currently divided into a base rate and an overage rate, which is typical for most municipal water systems. The base rate is fixed by meter size and category, and includes an allowance of 1000 cubic feet of water for all meter sizes. Overage is currently charged at a rate of for all usage over the base rate. Oregon Administrative Rules encourage an escalating rate for overage, and this is recommended as a conservation incentive.

In Sisters, with largely residential usage, the majority of revenues are derived from the base rate. The purpose of rate development is to ensure a reliable revenue stream to meet the water system cost of operations, and an increase appears necessary at this time for only the needed revenue to pay for bond repayment. The overage component should encourage water conservation and should lead to reduction of wasteful utilization practices. The combined base and overage cost are the basis of the monthly water system billing.

12.6 CAPITAL IMPROVEMENTS PLAN

12.6.1 Capital Improvements

Recommended Capital improvements are addressed in detail in the Water Capital Improvement Plan provided as Section 10. Projects are listed in order by year based on anticipated needs due to projected population growth.

12.6.2 Financing

A general discussion of financing options is presented in Section 11. Probable financing is limited to loans (based on project scope, cost, impact on rates, and City eligibility). Loans can be obtained from either Rural Development (RD) or Oregon Economic and Community Development (OECDD).

RD has a longer term (40 years vs. 20 years), but a lower interest rate (4.5% versus 6.5%). RD tends to have more complicated application and environmental reporting requirements. Since growth is occurring rapidly in Sisters, and needed funding to be financed with user fees is a relatively small amount, it is recommended that the repayment period be limited to 20 years with any funding option.

After a selection of the initial project scope, the City should contact OECDD to schedule a one-stop meeting with available state and federal funding agencies, to discuss project needs. When the project is presented to all the funding agencies, each agency will evaluate their program's potential to assist with financing the needed water improvements.

12.7 SYSTEMS DEVELOPMENT CHARGES (SDCS)

System Development Charges (SDCs) can be charged to all users of transportation, water, sewer, storm drainage, and parks and recreation facilities. The fee is usually charged as each piece of property is

developed in the future and goes into a capital construction fund to pay for improvements required by growth in the community. The Oregon System Development Charges Act, House Bill 3224, became effective in 1991. Legislation requires that capital improvement plans be developed, and that methodology used to compute SDCs be documented and reviewed by the community before SDCs can be charged.

The Oregon System Development Charges Act permits two types of charges: 1) a reimbursement fee, and 2) an improvement charge. A reimbursement fee is a charge for unused capacity in existing capital improvements. An improvement charge is associated with capital improvements to be constructed, which creates new capacity. Both types of fees will likely be utilized for needed Systems Development eligible elements of needed improvements to the Sisters Water System.