Water Distribution Facilities Planning Study for Stayton, Oregon

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KELLER ASSOCIATES

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SECTION 1 - INTRODUCTION

1.1 Authorization

In 2002 the City of Stayton, Oregon contracted with Keller Associates, Inc. to prepare a Water Distribution Facilities Planning Study for the City.

1.2 Introduction

The City of Stayton is a rural community located approximately 17 miles southeast of Oregon's capital city, Salem. The area's economic base consists of agriculture and industry. The community also serves as a bedroom community for Salem, with a 15-20 minute commute each way.

The City is committed to providing the community with quality water and adequate fire protection for all residential, commercial and industrial areas. This master plan evaluates the existing system and makes recommendations for improvements and upgrades necessary to accommodate future conditions and City objectives for water supply, distribution and storage.

1.3 Related Studies

The City currently owns and operates its own water supply, storage and distribution facilities. The document *Water Supply and Treatment Facilities Planning Study* addresses water supply and treatment needs and recommendations.

As part of the master planning, Keller Associates also completed a *Water Management and Conservation Plan* which satisfies Oregon Administrative Rules 690-315 and 690-086. The *Water Management and Conservation Plan* contains four major elements including a water system description, a water conservation element, a water curtailment plan, and a water supply element.

In June 2004, Keller Associates also completed a *Water System Vulnerability Assessment* as required by the "Bioterrorism Preparedness and Response Act". The *Water System Vulnerability Assessment* identified water system vulnerabilities, and outlined improvements that will minimize vulnerabilities.

Keller Associates has also been commissioned to complete wastewater and storm drain master plans. Additionally, the City of Stayton has recently completed transportation, trails and parks master plans. The completion of these studies will enable the City to acquire necessary funding to implement critical improvements now and also make accommodations for future growth.

1.4 Scope

The scope of this document includes the following:

- Review Regulatory Requirements

  - Identify State and Federal requirements, including the Safe Drinking Water Act, Bioterrorism Preparedness and Response Act, Oregon Administrative Rules, and others which influence the management of the City's water system.

  - Prepare a Water Management and Conservation Plan.

- Characterize Existing and Projected Water Use

  - Compile and review the following information: study area boundaries, inventory of existing facilities and pipelines, type and amount of water consumption and production, existing and projected land use and populations.

  - Perform a water balance to compare total well production with water consumption, in order to define water system demands and non-revenue water losses.

  - Develop current water demands by use, and utilize these design criteria to develop future water demands.

- Water Transmission, Storage, and Distribution Criteria

  - Compile standards and recommendations for water storage, pressure requirements and fire protection.

- Assess Existing Transmission, Distribution and Storage System

  - Review the existing water system conditions, including an analysis of the following: system pressures, pressure zones, facility and pipe capacities, available fire protection, well supply, water storage, transmission, delivery and SCADA control.

  - Provide the City a schematic of the City water system.

  - Develop and calibrate a working computer water model of the City's water system. Evaluate system performance including operating pressures, available fire protection, tank circulation, and finish booster pump operation with working water model.

- Water Transmission, Storage, and Distribution Improvement Plan
  - Investigate and evaluate alternatives that will address City planning goals. Review environmental impacts of each alternative.
  - Develop a plan of phased improvements to water transmission, storage, and distribution with their respective costs. Develop a system replacement program.
- Implementation
  - Prepare a Master Plan outlining costs for future facility needs, replacements and pipeline extensions. Develop an estimated schedule for capital improvements and a summary of all potential impacts on rates or funding sources.
- Report Preparation
  - Prepare a report with a copy submitted to the Oregon Department of Human Services, Drinking Water Division for review and approval.
- Public Participation, Presentations and Meetings

1.6 Acknowledgements

Keller Associates would like to acknowledge those that provided time and assistance in furnishing information for this report. A Technical Review Committee (TRC) was formed in order to facilitate communication and evaluation with the City. The TRC met on a regular basis to discuss project progress and findings. The following individuals were members of the TRC and were of particular assistance in developing this master plan: Stayton Public Works Director Mike Faught, Water Supervisor Tom Etzel, Water Treatment Plant Operator Bob Zeller, Engineering Technician Allan Drawson, and City consultants Ed Sigurdson and Steve Applegate.

SECTION 2 - WATER SYSTEM REQUIREMENTS

2.1 Study Area

The existing city limits of the City of Stayton encompass an area of approximately 1,768 acres between Highway 22, also known as Santiam Highway, and the North Santiam River. The study area corresponds to the urban growth boundary (UGB) which includes an additional 1,440 acres of land, for a total of 3,208 acres. The study area (UGB) represents the expected areas of growth and development. Figure 2.1 in Appendix A illustrates the city limits and the study area boundary (UGB).

2.2 Land Use

The City of Stayton includes lands designated as commercial general, commercial retail, industrial, industrial agriculture, industrial commercial, light industrial, interchange development, low, medium and high density residential, and public/semi-public zoning inside the city limits. Figure 2.2 in Appendix A graphically reflects the land use distribution adopted by the City. The table below summarizes the breakdown in acreage for each land use type.

Table 2.1
Existing Land Use Inside Stayton City Limits

Stayton		
Land Use	Acres	% of Total
Commercial General	104	6%
Commercial Retail	47	3%
Industrial Agriculture	60	3%
Industrial Commercial	17	1%
Light Industrial	320	18%
Low Density Res.	709	40%
Medium-High Density Res.	273	15%
Public and Semi-Public	238	13%
Total Acreage	**1,768**	

2.2.1 Future Land Use

Keller Associates worked with the technical review committee (TRC) and Stayton planning personnel in developing future land use outside the existing City Limits, but within the urban growth boundary (UGB). Future land uses assumed for this study are illustrated in Figure 2.4 in the Appendix A.

A corridor of light industrial use is expected along the west urban growth boundary of Stayton. Most of the remaining growth area is designated as low density residential with medium-high density residential areas scattered throughout. Some of the public lands correspond to potential areas identified by the City and school district as future school sites and parks.

The development densities for residential areas illustrated in Table 2.2 were developed as targets for future residential development based on consultation with City planners.

Table 2.2
Household Residential Densities

Low Density Residential (ERUs/ac)	Med-High Density Residential (ERUs/ac)	Household Size (people/ERU)
3.5	6	2.7

*ERU refers to the Equivalent Residential Unit

2.3 Population

The estimated 2003 population for the City of Stayton is approximately 7,300. Historical population in the City of Stayton and in Marion County retrieved from census data is shown in the following table.

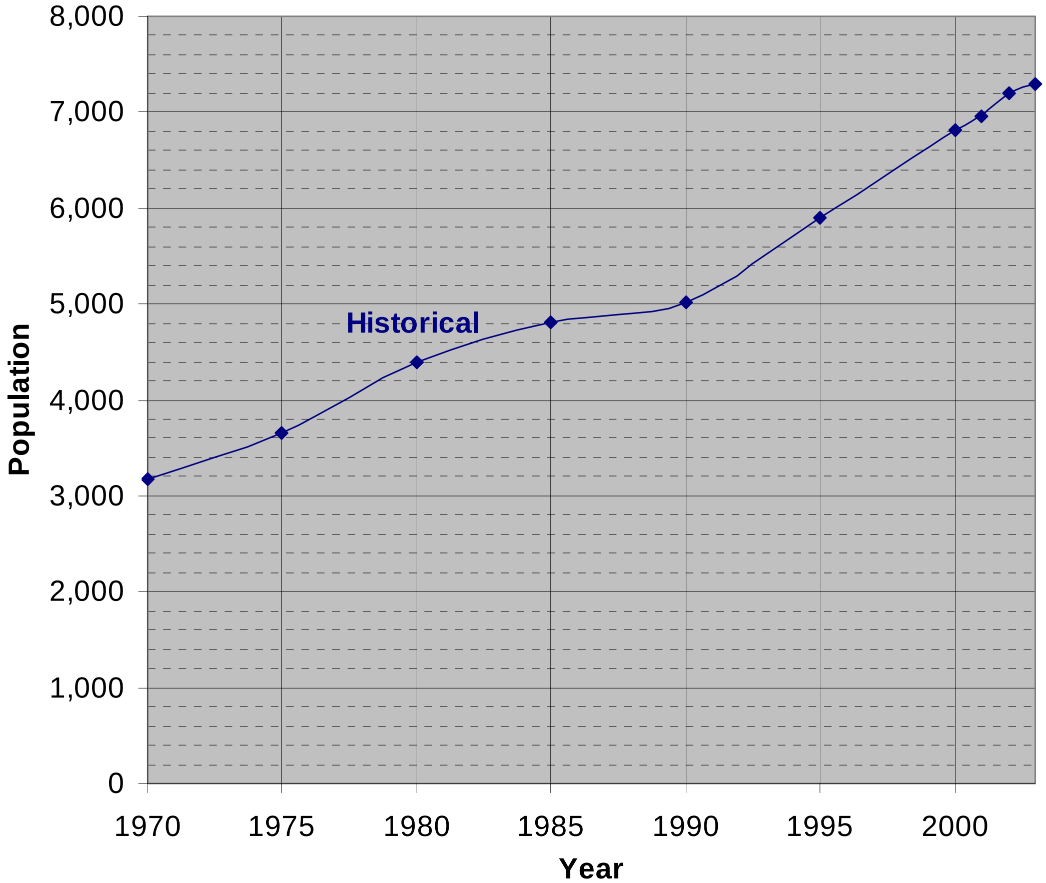
Table 2.3
Stayton and Marion County Historical Population

Year	Office of Economic Analysis, State of Oregon and US Census—Marion Co.	Stayton Population Census Data	Marion County Growth Rate	Stayton % of Marion County	Stayton Annual Growth Rate
1970	151,309	3,170		2.10%	
1975	171,700	3,650	2.56%	2.13%	**2.86%**
1980	204,692	4,396	3.58%	2.15%	**3.79%**
1985	213,019	4,815	0.80%	2.26%	**1.84%**
1990	228,483	5,011	1.41%	2.19%	**0.80%**
1995	260,600	5,907	2.34%	2.27%	**3.34%**
2000	284,834	6,816	1.06%	2.39%	**2.90%**

As can be seen from the preceding table, the annual growth rate in Stayton declined between 1980 and 1990 and then rose sharply after 1990. The average annual growth rate for Stayton was 3.34 % between 1990 and 1995 and 2.9%

between 1995 and 2000. The growth rate in Stayton has generally been higher than Marion County. Chart 3.1 illustrates historical population trends.

Chart 2.1
City of Stayton Historical Population

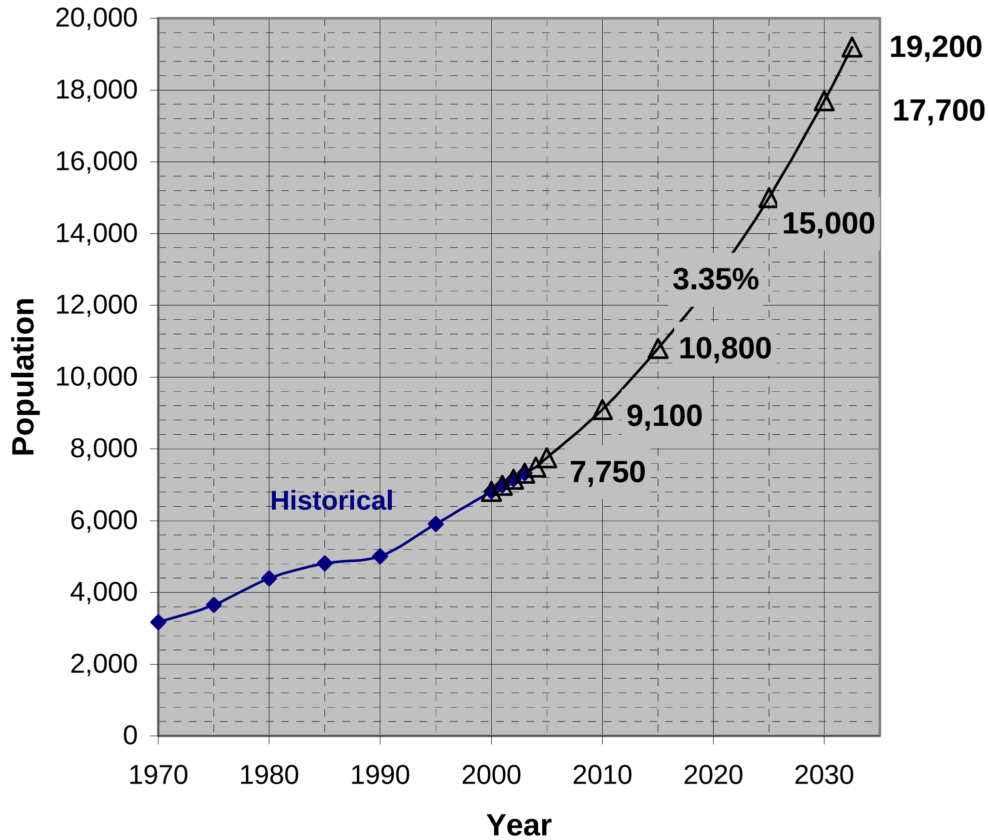


2.3.1 Population Projection

City population estimates from 2001 to 2004 were approximated using Stayton building permit information (refer to memorandum from Ed Sigurdson in Appendix B). Growth projections are based on a continued growth of 3.35%.

Build-out of the study area (UGB) using a growth rate of 3.35% will occur sometime around 2032.

Chart 2.2
City of Stayton Population Projections



2.4 Water Production

A summary of the City's adjusted historical water production and consumption was presented in the *Water Production/Use Summary Technical Memorandum* dated March 26, 2004. A copy of the memorandum is included for reference in Appendix B.

The main water source for the City is the Stayton Ditch. The Stayton Ditch is fed from the North Channel of the Santiam River via a diversion structure situated about 1 mile east of the water treatment plant site. The City's use of the Stayton Ditch is made possible through an interagency agreement with the Santiam Water Control District, which includes an annual use fee.

The Water Treatment Plant (WTP) also operates three shallow infiltration wells that are located adjacent to and between the canal and the North Santiam River. The wells supply supplemental water during peak demand and high turbidity events.

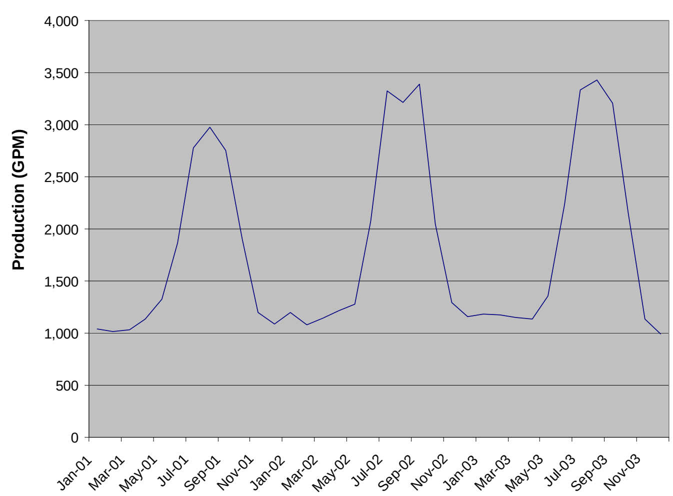
Water production data is recorded by a water meter at the finish booster station located near the water treatment plant. After completing multiple flow tests, it was determined that the flow meter at the finish booster station was inaccurate when the 200-hp pumps were operating. As a result, the original production data were adjusted to correct for the error in the water meter readings. The testing and adjustment process is described in much greater detail in the *Water Treatment Plant Meter Analysis Technical Memorandum* dated March 26, 2004 included in Appendix B. The data presented below reflect the corrected production results.

Water production has increased by nearly 12% from 2000 to 2003. This corresponds to an increase in the City's population during that period. Table 2.4 lists water production statistics for the past three years. Water production data for 2001-2003 were used to develop water demand conditions for Stayton's existing water users. These water demand conditions were used to evaluate the City's existing facilities and also to forecast future water demands.

Table 2.4
Stayton WTP Water Production

	Historical Water Production				
	2001 (MGD)	2002 (MGD)	2003 (MGD)	2001-03 Average (MGD)	2001-03 Average (GPM)
Average Day	2.42	2.70	2.71	2.61	1813
Peak Day	5.19	6.08	6.65	5.97	4146
Dry Weather (May-Oct)	3.26	3.68	3.77	3.57	2480
Wet Weather (Nov-Apr)	1.56	1.70	1.63	1.63	1132

Chart 2.3
Stayton Monthly Water Plant Production (2001-2003)



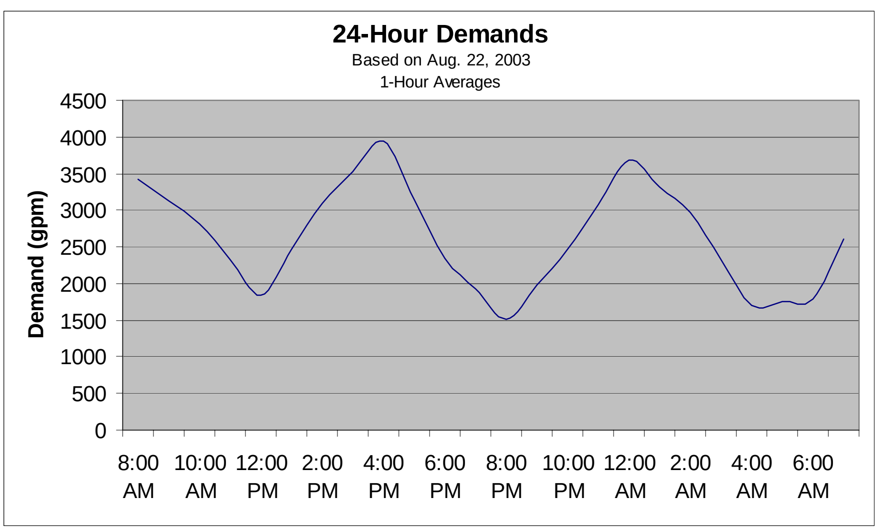
As illustrated in Chart 3.3, peak month flows correspond to the summer months (June through September) during which demands are more than double average annual demands. This peak in production is generally a result of irrigation and a peak in summer use from the City's largest water consumer, Norpac Foods, Inc. The processing of beans and corn creates a peak in Norpac Food's water demand from July through October.

2.4.1 Daily Demand Patterns

A 24-hour flow monitoring analysis was completed with the help of City personnel on August 22, 2003 to develop a 24-hour water demand pattern. This was done by recording flow meter readings at the finish, Regis and Pine Street booster stations; water levels at all of the City reservoirs; and meter readings for all of the Norpac water meters every hour. This data was then used to develop system water demands every hour. This analysis was done in August, which is a peak water demand period, because water demands are most critical during dry weather periods.

Chart 2.4 shows the 24-hour demand pattern for August 22, 2003. The average water demand for this day was 2630 gpm, which is slightly higher than the average dry weather demand. During this season, as seen in this chart, three peak demand periods occur. Peak demand periods occur around 8:00 am and 5:00 pm, which correlates to times before and after school and work. The third peak period occurs in the middle of the night (at about 1:00 am), which is likely created by large water demand processes observed at Norpac. The peak hour for this day (3950 GPM), which should represent typical dry weather periods, is about 1.5 times greater than the average day demand of 2630 gpm.

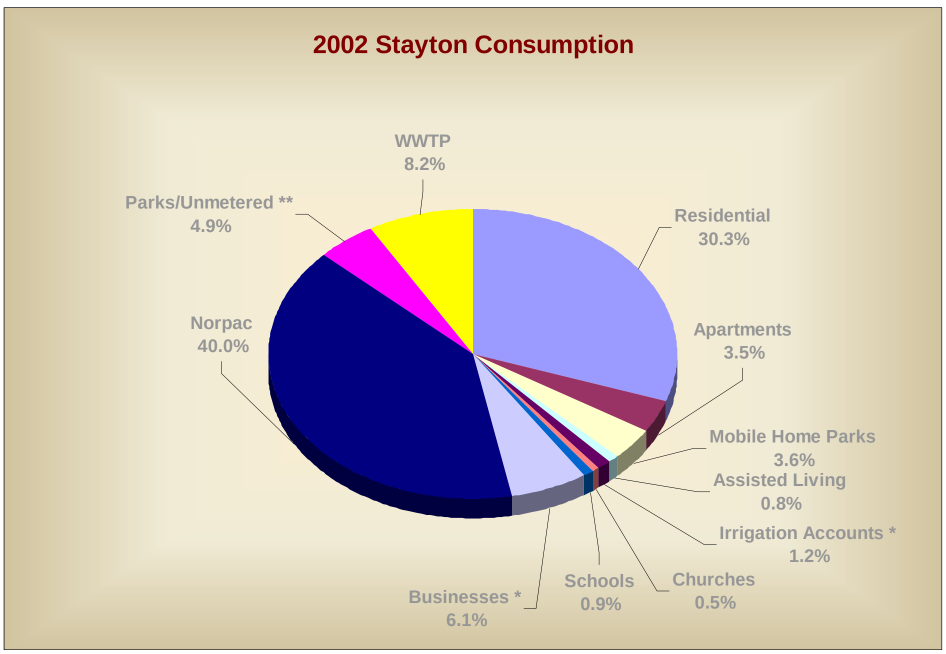
Chart 2.4
Stayton Summer 24-Hour Demand Curve



2.5 Water Consumption

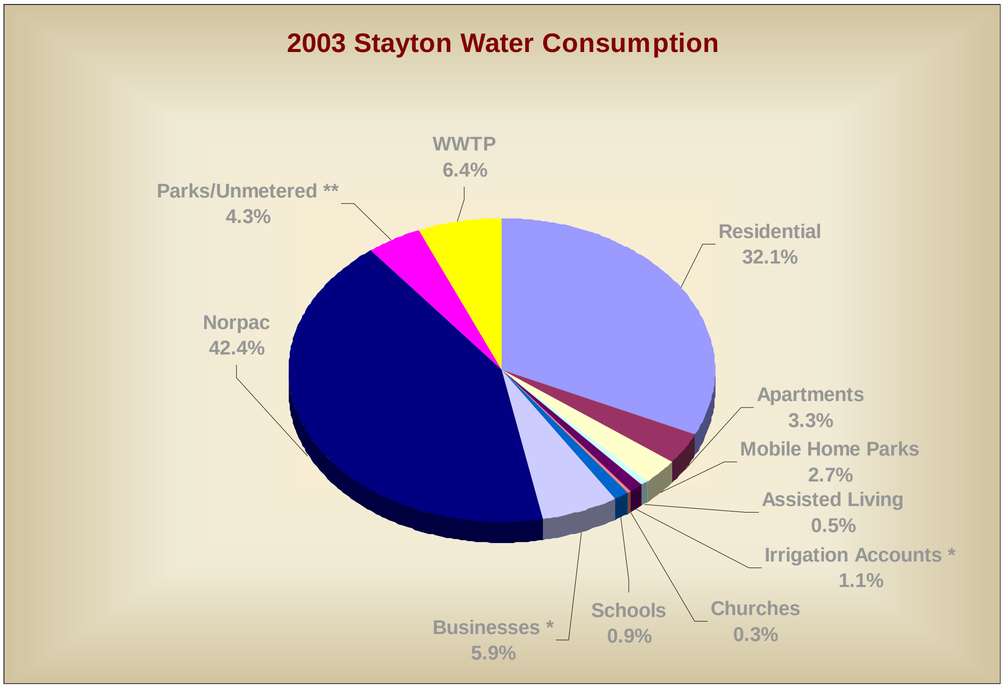
Water users include single-residence homes, apartments, mobile home parks, assisted living centers, irrigation accounts, churches, schools, commercial users, and industrial water consumers. The industrial user, Norpac Foods, Inc., is the largest water consumer and accounts for approximately 42 percent of the annual water consumption. The general customer categories and their percentage of water use are illustrated in Chart 2.5 and Chart 2.6 for 2002 and 2003, respectively. In 2003, the City of Stayton service population included approximately 7,300 people.

Chart 2.5
Water Use Statistics for 2002



* Irrigation and Business totals exclude Norpac's consumption

Chart 2.6
Water Use Statistics for 2003



* Irrigation and Business totals exclude Norpac's consumption

The "Residential" category for 2003 includes both rental and owner-occupied single-family residences, and accounts for 32% of the water use for the City. Norpac Foods, Inc. accounts for 42% of the total water consumption for the City. The "Parks/Unmetered" category includes the water used by the library, city hall, theatre, community center, cemetery, water plant, public works building, the pool, and the city parks. The Wastewater Treatment Plant (WWTP) uses approximately 6.4% of the total water provided in 2003.

2.5.1 Commercial and Industrial Use

Special consideration was given in accounting for the peak water users on the community water system. Because of their impact on operation of the water system, the top 30 water users were identified and their water consumption was analyzed. Table 3.7 lists the top 30 users and their associated total consumption, plus average month, winter and summer water consumption rates based on 2001-2002 consumption records. The top 30 users account for 59% of the annual total water consumption.

Norpac is by far the largest water user in Stayton and, as such, plays a central role in water planning, both in terms of infrastructure needs and overall water system budgeting. In recent years, Norpac implemented water conservation. According to City staff, Norpac water demands are anticipated to hold steady. For planning purposes, Keller Associates has assured the Norpac's demands will not increase or decrease substantially.

Next to Norpac, the City's wastewater treatment plant is the next largest water consumer. A majority of the water at the wastewater treatment plant is used as rinse water for the filter press. Other water is used for plant flushing, irrigation, and domestic use. Other top water users include schools, mobile home parks, apartment complexes, and commercial and industrial establishments.

The WWTP could eliminate the use of potable water to clean the filter press by using the water from the biosolids instead, but this reuse program is not yet in operation. Other conservation or reuse measures could include using treated water for irrigation. However, this type of reuse would require chlorination. Since the plant uses UV to disinfect, substantial improvements would be required to enable water reuse for irrigation. Water reuse at the WWTP is an identified improvement on the WWTP capital improvement plan.

Table 2.5
Top 30 Water Users for Stayton, Oregon

User	Average Annual Usage (gallons)	GPM			
		Peak Month	Average	Summer	Winter
Norpac	265,186,000	1,746.46	504.53	839.51	93.77
WWTP *	54,778,793	132.01	104.22	112.10	107.99
Oak Estates Home	22,073,500	72.70	42.00	54.52	39.46
Philips Products 57	7,836,500	20.66	14.91	18.98	8.97
Boulders MH Park	5,455,000	17.42	10.38	12.62	10.13
Stayton Union High School	3,579,500	13.72	6.81	8.87	4.99
Wolf Ridge Apartments	3,570,500	14.41	6.79	8.53	5.49
City Parks	3,503,700	243.31	6.67	243	0.00
Santiam Memorial Hospital	3,086,500	13.09	5.87	8.70	3.54
Pioneer Apartments	2,975,000	6.84	5.66	6.14	5.70
Shell Station	2,579,500	8.54	4.91	6.57	3.05
Safeway Stores	2,407,500	6.42	4.58	5.03	3.68
Lakeside Assisted Living	2,377,500	10.56	4.52	7.10	2.58
East Santiam Manor	2,097,500	7.33	3.99	2.61	3.98
Rivertown Apartments	2,052,000	4.50	3.90	3.92	4.12
Stayton Middle School	1,906,500	11.64	3.63	7.13	1.15
Summit Window	1,843,000	5.81	3.51	4.74	2.41
Stayton Elder Manor	1,810,500	9.02	3.44	7.08	1.35
Marion Co. Housing	1,792,000	17.74	3.41	4.93	1.25
Santiam Cleanery Service	1,698,500	3.64	3.23	3.21	3.06
Northridge Apartments	1,439,000	8.81	2.74	7.47	0.12
Fir Crest Village	1,319,500	3.44	2.51	2.95	2.15
Regis High School	1,214,500	7.52	2.31	5.11	0.91
Community Center/Library	987,600	68.58	1.88	69	1.88
Dairy Queen	888,000	4.42	1.69	2.97	0.65
Arco AM/PM	870,500	4.44	1.66	3.43	0.27
McDonalds	859,000	4.55	1.63	2.37	0.70
Cemetary	768,000	25.00	1.46	25	0.00
Princeton Property Mgt.	715,000	2.15	1.36	1.54	1.13
Trus Joist Corp	698,500	1.93	1.33	1.54	1.26
Slayden Construction	692,500	5.01	1.32	2.95	0.23
Roth's IGA	658,500	1.55	1.25	1.38	1.19
WTP Irrigation	587,400	40.79	1.12	40.79	0.00
A&W Drive In	522,000	1.67	0.99	1.27	0.75
Ixtapa	497,000	1.19	0.95	1.05	0.96
Karsten Co.	273,500	1.04	0.52	0.58	0.18
TOTAL TOP USER CONSUMPTION	**405,599,993**	**2,548**	**772**	**1,535**	**319**
% of TOTAL WATER CONSUMPTION	**59.2%**	**81.8%**	**59.2%**	**81.3%**	**28.1%**

Notes:
1) Summer includes June-August.
2) Winter includes December of the previous year and January through February.
3) Peak Month is the average usage during the peak month.
4) Domestic and Irrigation meters for each user are included in the calculations.
5) Total water consumption was adjusted to include unmetered water usage at parks and unbilled, metered usage at the Wastewater Treatment Plant.
6) The peak month flow for the WWTP is actually a peak week flow.
7) Total water consumption represents 2002 data.

2.6 Water Balance

Table 2.6 compares reported water production data to consumption data. Water consumption for unmetered users such as the City Parks was approximated and included in the water consumption data reported below. The difference between water production and water consumption represents the amount of system water loss.

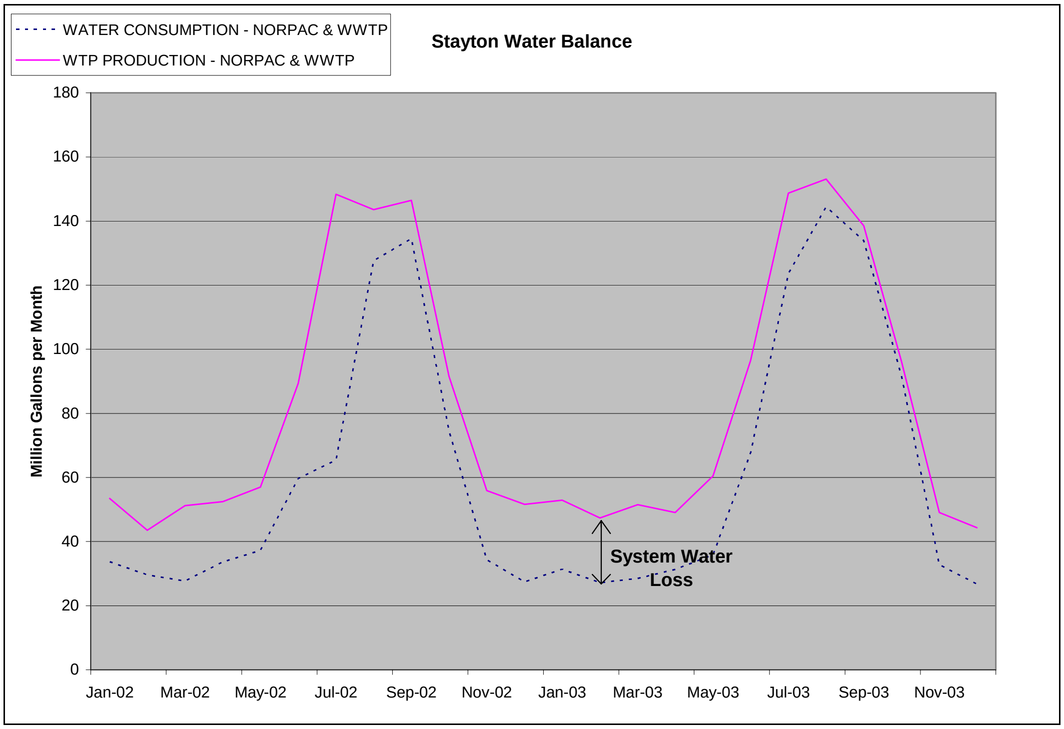
Based on this data, water losses account for 24 to 33% of all water leaving the water treatment plant. It should be noted that the water loss quantified below includes only water lost somewhere between the finish booster station and the customer. Additional water loss may occur within the water treatment plant as discussed in the *Stayton Water Supply and Treatment Facilities Planning Study* report.

Table 2.6
System Water Loss Summary

	2001	2002	2003
Water Consumption (gals)	616,612,508	685,393,053	774,859,053
Water Production (gals)	883,414,920	984,453,840	987,805,020
System Losses (%)	**30.2%**	**30.4%**	**21.6%**

For additional comparisons purposes, Chart 3.7 graphically illustrates the comparisons between water production and consumption. Because Norpac and the WWTP are such large water users and there is a lag between water consumption data versus water production data (billing cycle), Norpac and the WWTP were excluded from these comparisons.

Chart 2.7
Stayton Water Balance



Factors that could contribute to system water loss include:

- Inaccurate water meters. Generally, water meters underestimate flows as they age. Based on discussions with water meter manufacturers, a residential water meter in a treated surface water system (generally soft, non-corrosive water) should accurately meter for 15-20 years. According to City staff, most of the flow meters have been installed since the 1970s. Based on housing records from census data, approximately 1,100 meters (41%) could be more than 20 years old and have likely been in operation beyond their period of accuracy.

- Although meter accuracy generally declines over time, Tom Etzel tested 30 random meters and determined that all but one of the meters was within 4% accuracy, and 17 of the 30 were within 2%. All but two of the meters that were tested pre-dated the touch read meters. Of the 30 meters analyzed by Tom, the "older" meters were generally accurate. Further testing is needed to determine if this trend is consistent with all the "older" meters throughout town.

- Leaky pipelines and services. This is believed to be the largest source of water loss as evidenced by the relatively constant year-round deficiency between what is pumped into the system and what is metered out of the system. The structural integrity of water pipelines and services naturally degrades over time. Pipeline deterioration, improper installation procedures, and other factors can also create leaks. Pipes constructed with certain materials, including steel and asbestos cement, are generally more susceptible to leaks. Fifty-seven percent (57%) of the water lines in the Stayton water system are steel or asbestos cement. One extreme example of a leaky pipeline section is the two-block section of steel pipe located on Burnett Street near the public pool. Thirteen separate spot repairs have been made on this section of pipeline within the last several years. Another example of a leaky pipeline section is the 6-inch steel water line on Elwood Street.

- Unaccounted water use. Since water loss represents the difference between the water produced and the water consumed, water consumption that is not metered increases the apparent water loss. Occasionally, cities use water for city purposes like street cleaning, public buildings, pools, fire protection, and line flushing that is not metered. Keller Associates has accounted for known unmetered water uses like the public buildings, parks, and cemetery in the water balance calculations presented above. However, there are likely other unmetered water uses that add to the water loss, such as street cleaning, line flushing, and others. Keller Associates recommends that all water uses be metered where possible, regardless of whether or not they are invoiced.

Division 86 in the Oregon Administrative Rules requires any water supplier with water loss greater than 10% to establish a leak detection program. Division 86 further requires a leak repair or line replacement program for water suppliers with water loss greater than 15%. **Given the City's system loss, Stayton is required to establish both leak detection and leak repair programs.** These programs are described in Chapter 7.

It is to the City's advantage to minimize system water loss by addressing the potential problems above. System loss represents water the City pays to pump and treat but for which it is not reimbursed through water utility rates. Water loss represents a loss in potential income and a valuable natural resource.

Keller Associates suggests the City implement the following recommendations to reduce the system water loss.

- Begin a flow meter calibration and replacement program. By replacing 125 meters every year, the residential water meters will be replaced every 20 years. We have identified the priority areas for the meter replacement program in Figure 7.1. Part of the motivation in implementing a meter replacement program is also to switch to a radio read system.

- As part of the replacement program, Keller Associates recommends that the old meters be tested for accuracy. The accuracy versus age of the meters will be tracked in order to determine if a correlation between age and accuracy can be drawn. In addition, this program would attempt to quantify actual system loss versus inaccuracies in the meter. It is recommended that, at a minimum, a set of representative meters in an area be tested every 5 years.

- Because of the high volume of water demand from Norpac, a faulty Norpac meter could result in a large unaccounted water loss and lost revenue. Therefore, it is recommended that the Norpac water meters be tested at least annually.

- Complete a leak detection study. Special attention should be given to those pipes constructed with steel and asbestos cement (AC) because they are generally more susceptible to leak problems (See Figure 4.2). The schedule of the leak detection program should also reflect the age of the pipe, with attention given to the older pipes first. A few large leaks could account for much of the unaccounted water usage.

- Develop a pipe replacement program based on the results of the leak detection study. Coordinate pipeline replacement projects with street improvements wherever possible to minimize costs.

2.7 Water Demand Projections

Water demands were calculated by adding the existing water usage recorded at the WTP and future demands projected for currently undeveloped land inside the Stayton study area. In an effort to project future water demands, the existing water usage was categorized into residential, non-residential, Norpac, and water loss. The non-residential category includes commercial, industry excluding Norpac, WWTP consumption, and public water demand. For comparative purposes, the demand for each of these categories was averaged over the Stayton population so demands could be compared and projected on a per capita basis.

Table 2.8 summarizes the demand for each category in gallons per capita per day. The severity of the system water loss is apparent by comparing the residential demand and the water loss. On an average day, the same amount of water used by the entire residential sector is lost from the system. The non-residential water demand stays fairly constant on a seasonal basis, averaging out to be about 46 gpcd. Norpac uses the largest percentage of water in comparison to the other categories.

Table 2.7
Existing Flow Summary

Yearly Statistics	Existing Demands (MGD)	Existing Demands Per Capita				
		Total System [1] (gpcd)	Residential Only (gpcd)	Non-Residential (gpcd) [2]	Norpac (gpcd)	Water Loss (gpcd)
Average Day	2.71	371	106	46	114	106
Peak Day	6.50	890	N/A	N/A	N/A	N/A
Dry Weather (May-Oct)	3.75	514	147	56	197	113
Wet Weather (Nov-Apr)	1.65	226	64	35	29	97

Notes:

(1) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(2) Non-residential flow per capita per day excludes Norpac Demand.

Future system demands were generated by adding the existing system demands to the additional water demand created by new development. The demands assumed for new development are presented in Table 2.8. The average day demand for new development is based on 210 gpcd (106 gpcd residential + 45 commercial/public + 50 industrial + 5% water loss).

Future water projections assume existing demands remain constant for existing development. This provides for some conservatism in future projections if the City pursues an aggressive leak detection and removal program. The projected demands for 2015, 2025, and build-out are summarized in Table 2.8.

Table 2.8
Water Demand Projections

	Evaluation Flows in MGD				
Yearly Statistics	**New Development (gpcd) (3)**	**2003 Demands (MGD) (2)**	**2015 Flow (MGD)**	**2025 Flow (MGD)**	**Build-out Flow (MGD)**
Stayton Population (1)	N/A	7,300	10,800	15,000	19,200
Average Day	210	2.71	3.45	4.33	5.20
Peak Day (4)	500	6.50	8.25	10.35	12.44
Dry Weather (May-Oct)	270	3.75	4.70	5.83	6.96
Wet Weather (Nov-Apr)	160	1.65	2.21	2.88	3.55

Notes:

(1) Population projections assume a 3.35% growth rate.

(2) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(3) New development includes residential and non-residential flows plus 5% water loss (which is substantially less than observed in the existing system). Some additional industrial demand (50 gpcd) but not to the magnitude of Norpac, was also assumed. Actual future demands will be a function of the type of future industry that locates within Stayton.

(4) In determining peak day demand for new development, a peak day factor (peak day divided by average day) of 2.4 was used. This is consistent with the existing peak day factor (890/371 = 2.4).

The projected 2025 peak day demand of 10.35 MGD. When the Stayton urban growth boundary is at build-out, peak day demands are projected to be about 12.45 MGD, which is still less than the existing 17.62 MGD summer water right.

The existing treatment capacity is the limiting factor for growth. Additional supply and treatment capacity will be required to meet projected demands. Additional discussion on treatment plant capacity can be found in the *Stayton Water Supply and Treatment Facilities Planning Study* report.

SECTION 3 - DESIGN CRITERIA

3.1 General

This section summarizes the design criteria and regulatory requirements as they pertain to the City's water distribution system.

3.2 Water Storage

Keller Associates recommends a minimum storage capacity equal to the operational, peaking and fire protection storage.

- *Operational Storage.* Operational storage is the volume of water drained from the reservoirs during normal operation before the wells begin pumping to refill the reservoirs. The operational storage recommended for Stayton is approximately 1,040,000 gallons.

- *Peaking Storage.* Peaking storage refers to the additional storage required to meet peak hour demands while pumping at a constant rate from the wells. The needed peaking storage is expected to increase from the existing 350,000 gallons required to 670,000 gallons at build-out.

- *Fire Protection Storage.* City fire protection needs require 1,080,000 gallons reserved to fight a 4,500 gpm fire for 4 hours.

- *Emergency Storage.* Keller Associates recommends that the City consider securing additional emergency storage above the operating and fire needs to allow for extenuating circumstances such as extended power outages or other unanticipated circumstances.

Stayton personnel have also expressed an interest in acquiring additional emergency storage to meet average water demands (less Norpac) for 3 days. This would equal 5.4 MG of emergency storage now and 13.08 MG at build-out. Of course, this amount could be reduced by backup or alternative water supply capabilities (i.e. a deep well).

3.3 Distribution System

3.3.1 System Pressures

The Oregon Administrative Rules requires public water systems to maintain a minimum system pressure of 20 psi during peak hour and fire flow conditions to prevent contamination of the drinking water. Normal operating pressures should range between 60 and 80 psi, but not less than 35 psi.

3.3.2 Sizing Future Pipelines

There are many undeveloped areas surrounding Stayton, which will require water pipelines be extended to serve them as the community grows and expands. In sizing these new pipelines the principal design criterion is that the pipelines be large enough to deliver peak hour and fire protection demands while maintaining adequate system pressures. The following are additional design criteria that that are recommended when extending new waterlines to these areas:

- The distribution system must be capable of delivering fire demands while maintaining 20 psi residual pressure throughout the system

- Fire demands for residential areas are between 1,000 and 1,500 gpm.

- Fire demands for commercial and industrial areas are 2,500+ gpm.

- Build-out demands should be considered in sizing new waterlines, due to the potential 75+ year life of the pipe.

- Future demands per capita are expected to be less than the existing water consumption per capita. This is consistent with the City's goal of encouraging water conservation.

- As a general rule, Keller Associates recommends placing 12-inch pipelines on the mile and 10-inch pipelines on the half mile.

In preparing the Master Plan, some pipelines may be slightly oversized to allow for flexibility in future land use, and in how and where future development occurs.

3.3.3 Water Meters

Manufacturers recommend that residential water meters be replaced every 15-20 years. State requirements in the Oregon Administrative Rules 690-086 require that water suppliers that are not fully metered implement a plan to become fully metered in the next five years. A fully metered system meters all sources and consumers.

3.4 Fire Protection

The Stayton Fire Department depends upon the City's potable water supply drawn from the fire hydrants on the City distribution system to fight fires. Providing adequate fire protection in residential, commercial and industrial zones often governs distribution pipeline sizes, pipe looping requirements, and reservoir storage needs.

The International Fire Code states the minimum fire flow requirements for one and two family dwellings having a fire area less than 3,600 square feet is 1,000 gpm for a duration of two hours. Homes larger than 3,600 square feet require 1,500 gpm fire protection. Larger buildings, such as the Stayton High School, Regis High School, Junior High School, and the hospital may require fire flows as high as 4,500 gpm for a duration of 4 hours, dependent upon size, construction material type, and if the buildings are equipped with sprinklers.

3.5 Water Quality

Water systems in Oregon are required to maintain a minimum chlorine residual of 0.2 mg/L in the distribution system. This residual will eliminate the growth of bacteria and other contaminants throughout the distribution system.

SECTION 4 - EXISTING FACILITIES' CONDITION AND EVALUATION

4.1 General

This section summarizes existing storage and booster facility conditions. In addition, an overview of the water distribution system conditions is presented. Additional computer analysis of the water distribution system is presented in Section 6.

4.2 Water Storage Facilities

The City of Stayton has four water reservoirs, which include Schedule "M", Pine Street, Regis, and the Water Treatment Plant (WTP) Clear Well. An overview for each facility is provided below.

4.2.1 Schedule "M" Reservoir

The Schedule "M" reservoir was constructed in 1971 for peaking needs and backup supply for the cannery. It is a 1.0 MG welded steel reservoir with a diameter and height of 65 feet and 40 feet, respectively. Prior to Schedule "M", the cannery had a pump that pulled water directly from the Salem water supply line.

Located at the reservoir site is a booster station that is discussed in Section 5.3.3. Before completion of the Pine Street reservoir, the Schedule "M" booster station would run almost every day.

The Schedule "M" reservoir has not been painted in at least 12 years. The interior was inspected by the City approximately 9 years ago and was found to be clean, in good shape, and void of rust.

Under normal operation, flow enters the reservoir from the City's distribution system through a pressure-reducing valve. This requires the water to be pumped again to serve the distribution system. During emergency events, flow could also enter the reservoir from the Salem pipeline.

Approximately 30 gpm of water is wasted continuously from the reservoir to provide circulation through the tank. Pipeline improvements, water looping projects and the completion of the Pine Street reservoir has marginalized any fire protection benefit provided by the Schedule "M" reservoir. Redundancy is the primary contribution that Schedule "M" makes to the City's existing water system. Keller Associates recommends that this reservoir be relocated to the water treatment plant (WTP) site when additional storage is required for chlorine contact time at the WTP. This is discussed in more detail in the water treatment plant analysis.

4.2.2 Pine Street Reservoir

The Pine Street reservoir and booster station are located on the east side of Stayton. The facility consists of a fenced site with a 5.0 MG concrete reservoir and a building housing the booster pumps. The facilities at this site were constructed in 1995. The City uses the Pine Street reservoir during the summer to meet domestic demands and fire protection needs.

The Pine Street reservoir is about 40 feet high and 148 feet in diameter. An access ladder located on the south side of the reservoir provides access to the top. The water supply line enters the bottom of the reservoir from the south side through a check valve. A line tap into the effluent pipe runs westward to the booster pump station. The effluent line acts as the suction pipe for the booster pumps.

The reservoir is a DYK prestressed concrete tank with a wire wrap structure and spray-on mortar on the outside. The mortar is probably about ½ to ¾ inch thick (typical of gunite mortar coatings used on this type of tank). The reservoir has a gravel roof coating over the concrete structural cover.

The outside of the reservoir has cracking of the entire mortar. Crack separation is moderate to wide. The cracking is extensive in a random map pattern, which is typical of shrinkage cracks in the mortar due to moisture drying during the curing process of the mortar. These cracks are easier to see after a rain because the moisture next to the cracks amplifies the crack location.

Moisture intrusion into the cracks has caused efflorescence in many places, but the efflorescence was not extensive. The efflorescence is occurring due to moisture being trapped in the cracks, and leaching the salts from the mortar mix.

Sounding of the surface indicates there is some delamination occurring between the mortar and the underlying concrete and wire wrap. Although some delamination has occurred, there is not extensive rust staining on the outside from the interior bars or wire wrap at this time.

The interior of this reservoir has not been inspected since its construction. The size of this reservoir causes some problems for the city. During the winter months, low water consumption creates issues with maintenance of chlorine residual and stagnation of the water in the reservoir. In order to maintain a 0.2 mg/l chlorine residual in the reservoir, the city feeds 0.7 milligrams of chlorine at the treatment plant.

The city would like to be able to do something different to avoid having to feed excessive chlorine at the treatment plant. One possibility is to add a chlorination system at the Pine Street Reservoir to keep the chlorine level up at that point without having to add high chlorine at the water treatment plant. A less expensive alternative involves increasing the storage dedicated for operations. This can be accomplished by adjusting control set points to fluxuate the tank levels and increasing pump run times during periods of low system demands.

Currently, the Pine Street reservoir levels are used to control the on/off set points for the pumps in the finish booster station at the water treatment plant.

4.2.3 Regis Street Reservoir

Reservoir. The Regis Street reservoir was constructed in 1971. It is a 0.4 MG welded steel reservoir with a diameter and height of 31 feet and 80 feet, respectively. The inside of the tank has never been painted. The exterior of the reservoir was last repainted in 1995. Located at the reservoir site is a booster station that is discussed in Section 4.3.3.

The reservoir has a steel bottom plate that is resting on a concrete foundation. There are locations where hold-downs have been welded to the shell and extend down into the foundation. The anchors are apparently embedded in the foundation, since there are no anchor bolts showing above the top of the foundation. The hold-downs are likely used to prevent overturning from wind or seismic forces on the stand pipe.

The bottom plate on the concrete foundation is stained by considerable rust along the bottom due to moisture intrusion and water standing at the base of the reservoir. The concrete foundation was cast with the top level so water does not drain away from the tank. Water stands near the edge of the plate and accelerates the rust. There was a mastic seal along the joint between the steel and the concrete, but the seal appears to have failed a long time ago.

No one is aware of a case over the past twenty-two years where the interior of the tank was inspected. The reservoir is due to have the inside inspected either by dry or wet inspection.

Two cell phone companies have cell equipment on the Regis tank. A number of years ago, Sprint installed a cell communication system at the top of the stand pipe with the cable running down the stand pipe and across the racks on the ground. Cable trays and other communication facilities are located next to the pump station. The cell system apparently has a lightning arrester ground system on the antenna, since there is a ground wire in the cable bank coming down the stand pipe. The ground wire to the system is grounded at the foundation, and the cable trays are all grounded at the connection of the cable tray mounting into the foundations. Apparently this whole system grounds the stand pipe as well as the cell communication system.

There is an impressed current corrosion system on the reservoir. When last tested a few years ago, it was not working.

Appurtenances. The valve house next to the reservoir consists of a small block building with a roof. The valve house contains an altitude valve that shuts off when the reservoir reaches full, controlling the water level in the reservoir. On the south side of the reservoir, there is an overflow pipe coming out the top of the reservoir that spills on the ground below in the event of an overflow. There is no sign of any past overflow from the reservoir ever reaching the ground below the reservoir overflow, so apparently the altitude valve works.

A drain valve was installed a number of years ago in the bottom of the reservoir on the north side. The drain consists of a 4-inch steel pipe welded into the reservoir shell, with a gate valve mounted on the stub out. There is a provision to hook a hose on the drain pipe to take water to waste at some location away from the reservoir.

The piping for the reservoir passes through the yard and connects to the water main in Regis Street. (In the past, an 8-inch valved bypass line was connected to the suction and discharge of the booster station in an attempt to eliminate the need for the booster station. However, the bypass was not successful and the bypass line is not used.) Water flows through the booster station from the main supply line that comes from the treatment plant. The discharge of the booster station goes to the upper pressure service area distribution system in Regis Street.

Summary. Pipeline improvements, water looping projects and the completion of the Pine Street reservoir has marginalized the fire protection benefit provided by the Regis reservoir. Redundancy is the primary contribution Regis reservoir makes to the City's water system. It provides redundant storage capacity, minimal fire protection, and a redundant facility to control the finish booster station if Pine Street is off-line. It is believed that residence times during winter months may be 20 days or more.

Keller Associates recommends that the tank be maintained until 2020 or 2025. Refurbishing is recommended now and will include repair of the base plate and anchor bolts, repairing and modifications to the foundation.

4.2.4 Clear Well at the WTP

The Clear Well at the WTP was constructed in 1971. It is a 0.5 MG welded steel reservoir with a diameter and height of 53 feet and 30 feet, respectively. A comprehensive discussion is presented in a separate document as part of the water treatment plant evaluation.

4.3 Booster Stations

The City of Stayton currently has four booster station facilities. Both the finish and Schedule "M" booster stations supply water to the Pine and Regis reservoirs and lower pressure zone. The Regis and Pine Street booster stations draw water from the lower pressure zone and service the upper pressure zone. With the exception of the finish booster station, each of these booster stations will be discussed below. A comprehensive discussion of the finish booster station is presented in a separate document as part of the water treatment plant evaluation.

4.3.1 Schedule "M" Booster Station and Salem Inter-tie

The Schedule "M" booster station was constructed in 1971 in order to improve fire protection to Norpac and surrounding areas. The booster station includes both an electric and diesel-powered pump that can produce approximately 3125 gpm and 3225 gpm at 72 psi and 68 psi, respectively (based on pump tests conducted on June 3, 2004). Pumps can either withdraw water from the adjacent reservoir or from the inter-tie with Salem. The booster station is controlled with the City's SCADA system, but can be operated manually if necessary.

According to City personnel, the pumps are in decent condition, and the control valve was recently rehabilitated. However, the electrical and controls need to be upgraded if the booster station is going to continue to be used. The Schedule "M" booster station facilities are old, which makes replacement and repair costs high. The age of the system also makes the system less reliable.

Also located at the reservoir site is an inter-tie with the City of Salem, managed under an intergovernmental Mutual Water Agreement with Salem. An 18-inch pipeline connects Stayton's Schedule "M" booster station and the 54-inch transmission line that feeds the City of Salem. Typical pressure in the Salem pipeline is approximately 23 psi. Flow from Salem to Stayton must pass through a double check valve. The check valves can be manually opened to allow flow from Stayton to Salem in the event of an emergency (which has occurred in the past). The City of Stayton used the inter-tie in December 2004 during the installation of the baffle curtains in the City's clear well.

The primary benefits the Schedule "M" booster station provides to the system are redundancy and the inter-tie with Salem. The Schedule "M" booster station can provide the City's average day water demands, with the finish booster station off-line, even at build-out. The gas-powered pump at Schedule "M" could also meet the City's winter water demands in the event of a City-wide power failure. Keller Associates recommends that the Schedule "M" booster station not be abandoned without relocating the inter-tie with Salem to the water treatment plant and equipping the finish booster station with standby power.

4.3.2 Pine Street Booster Station

The Pine Street booster station was constructed in 1995. It includes a 3000-gallon pressure tank and three can-type pumps, with provisions to add two additional pumps.

Booster Pumps. The booster station has five pump setting locations, with three pumps installed. There are two demand pumps installed, and space for a third. The third demand pump will be installed when development in the area requires additional pumping from the booster station. The two demand pumps currently installed are 7.5 hp and 10 hp. The fire pump arrangement has space for two pumps, with one 15 hp currently installed.

All five pump mounting locations have inlet piping connected to a common manifold that runs along the north side of the pump station. The pumps are can-set submersible pumps with the suction pipe connection at the top of the can. The discharges are out to the south through the floor.

The fire pumps are connected together and discharge to the main near the street. The demand pumps are connected together into the hydropneumatic tank. They are piped out through a valve to the water main in Pine Street south of the booster station.

There have been some problems with the booster pumps overheating. The cause of the overheating is believed to result form two things—inadequate flow and a pipe arrangement that does not encourage flow around the motor. The submersible pumps require flow through the pumps to cool the motor. Additionally, the pressure on the system is such that even when the 7.5 hp pump is running, with low demands and other pumps in the system running, there is little or no flow from the 7.5 hp pump.

Flow Meter. The flow meter, located in the suction manifold between the fire pumps and the demand pumps, is an inline type propeller meter with a magnetic drive and register head. The meter is located so the flow through the demand pumps goes through the flow meter but the flow through the fire pumps does not.

The operators of the system indicate the meter has erratic flow indication. When the 7.5 hp pump (Pump No. 1) is started, the flow meter stays on zero except for an occasional movement of the needle. The 10 hp pump causes the flow meter to bounce from 0 to 200 gpm, and flutter around that range. With the 10 hp pump running and the flow meter fluctuating, a noise comes from the meter sounding like a mechanical device catching –

clicking – rubbing. There has not been any work done on the meter to determine the cause of the noises.

Hydropneumatic Tank. The hydropneumatic tank is a steel tank, 6 feet in diameter and 13-½ feet long, in a horizontal configuration. It's purpose is to provide surge protection and a small storage volume to facilitate the on / off operations of the pumps. A small air compressor mounted on the wall next to the tank supplies air to the tank. The capacity of the air compressor is small, but the air demand is also low. It appears that there is a level control probe and a pressure switch that are supposed to keep the water level in the tank within certain operating limits.

There have been problems in the past with the hydropneumatic tank getting waterlogged. City personnel have added a glass sight tube to the outside of the hydropneumatic tank to indicate the water level in the tank. The water level in the tank currently runs about 22 inches below the top of the tank. To prevent waterlogging, the maintenance crew goes out three or four times per year and uses the manual drain to remove some of the water from the tank.

Malfunctioning of the level control system is probably the source of the hydropneumatic tank waterlogging. The level controls in the top of the tank are apparently not working properly to control the water level in the tank.

Control System. The pumps are controlled from mercury pressure switches. The switches are set to turn the pumps on at specified low pressures.

There is also a telemetry panel in the booster station to send a signal to the main water treatment plant to indicate the water level in the 5.0 MG storage tank. The telemetry system was installed after the booster station was complete, when it was discovered the tank level was needed to control the finish booster station pumps at the water treatment plant. Pine street tank water levels are currently monitored with a hydraulic connection through a copper tube to a pressure transducer that sends a signal through a phone line to the water treatment plant.

4.3.3 Regis Street Booster Station

The Regis Street booster station was constructed in 1972 and is located adjacent to the Regis Tank. The booster station includes two 15-hp pumps and a gas-powered 40-hp fire pump.

There are three pumps in the booster station, including two production pumps and one fire pump. The production pumps are 15 hp horizontal frame-mounted pumps with suction and discharge piping from the floor to 3-foot high concrete pedestals where the pumps are mounted above the floor. The production pumps supply water to the upper pressure service area.

The fire pump is a combination electric/gas pump. The fire pump is a horizontal split-case centrifugal pump with prime mover input shaft on both ends. An electric motor drives one end and a gas engine drives the other end. The discharge of the fire pump goes through a Cla-Val pump control valve into the discharge manifold of the production pumps.

All the pumps in the booster station operate with mercury pressure switches that control the on/off operation of the pumps. The fire pump starts automatically (electric drive only) on low pressure in the system. The gas-driven engine is a manual start only and has to be engaged to drive the pump. The engine for the fire pump is an old International Harvester gas engine. City personnel have had problems acquiring parts for engine maintenance and repair. The engine is long since out of production, and parts are hard to find.

The cooling system for the gas engine is a heat exchanger, with cooling water provided from the municipal water supply. The cooling water is turned on manually and passes through the engine once and then is discharged to waste.

One of the 15 hp demand booster pumps runs continuously in order to maintain pressures in the upper pressure service area. The system was set up years ago for continuous operation, and it continues to work that way today. As a result, water bleeds from the upper to the lower pressure zone continuously to equalize the pressures. The electrical components of the Regis booster station are old and outdated.

Controls. The motor control system is of a 1970's-vintage and has an incoming power main disconnect and main control modules. The MCC has been tested for wiring problems and heat generation, but has not exhibited any problems yet. The motor control system seems to be working adequately at this time.

Near the MCC is a radio telemetry system that was installed years ago. The system never worked, so it was abandoned. If the system has any rework in the future, the control system should be changed to provide control through a programmed SCADA system.

4.4 Distribution System

This section outlines the pipe materials, pipe conditions, meter conditions, and valve and fire hydrant needs. A hydraulic analysis of the distribution system is presented in Section 5 of this report.

The City's water distribution system is composed of a network of pipelines totaling more than 44 miles, and ranging from 1 to 24 inches in diameter. The majority of the pipeline network consists of 6-inch lines, with the most prevalent pipe materials being asbestos cement and ductile iron, as illustrated in the following tables. Table 4.1 lists the length of pipe and percent of total for each pipe size.

Table 4.1
Water Distribution Pipe Size Summary

Pipe Size (in)	Total Length (ft)	% of Total
<= 2	28,537	12%
3	3,825	2%
4	28,227	12%
6	56,377	24%
8	39,524	17%
10	26,589	11%
12	26,664	11%
14	713	0.3%
16	9,213	4%
18	3,696	2%
20	8,977	4%
24	522	0.2%
Total	**232,864 feet**	**44 miles**

The water distribution system is composed of various pipe materials as shown in Table 4.2.

Table 4.2
Water Distribution Pipe Material Summary

Pipe Type	Total Length (ft)	% of Total
Asbestos Cement	85,928	37%
Cast Iron	1,404	1%
Ductile Iron	72,146	31%
Galvanized Iron	10,320	4%
PVC	15,818	7%
Steel	47,076	20%
Total	**232,864 feet**	**44 miles**

Figure 4.1 in Appendix A illustrates the waterline network and the location of the reservoirs, and pressure-reducing valves (PRVs). The water booster stations and transmission lines provide water service to pressure zones that are isolated by closed valves and PRVs.

The distribution network consists of two pressure service areas. The upper service zone generally encompasses the area north of Jefferson Street and east of 6th Avenue. The Regis and Pine Street booster stations pressurize this zone, with pressures typically between 44 and 105 psi. Pressure-reducing valves, as shown in Figure 5.1, allow flow from the upper to the lower zone in the event of pressure loss in the lower pressure service area.

The lower pressure zone serves the majority of the city, including downtown Stayton. The 5.0 MG Pine Street reservoir, the 0.4 MG Regis reservoir, and the finish booster station located at the WTP provide the storage and pressure for this zone. Typical pressures in this zone range from 45 psi to 73 psi. The PRV on 28th Ave. and a check valve on Jefferson Street allow water to flow from the lower to the upper zone in the event of a pressure loss in the upper service area.

4.4.1 Water Meters

The City has had a program in place for the last five years to replace 40 water meters per year. Additionally, Norpac Food's water meters are checked annually. A history of housing development in Stayton is presented in Table 5.3 which was developed from 2000 Census Data. A general correlation exists between the age of the homes and the water meters.

In large part, the housing units are served by their original water meters. This would imply that close to 35% of the water meters are at least 35 years old, 23% are between 25 and 35 years old, 12% are between 15 and 25 years old, and 30% are less than 15 years old.

Table 4.3
History of Housing Development in Stayton

	1970	1980	1990	2000
Total Housing Units	938	1,546	1,867	2,668
Additional Housing Units / Meters	-	608	321	801
Estimated % of Total	35%	23%	12%	30%

Consumers. All city water consumers, excluding those listed below, are metered and billed monthly. Most water services are fitted with a ¾" meter. Currently, the City's waster system contains 881 touch-read meters and 1,608 manual-read meters. The authorized consumers that are not metered every month fall into two categories: consumers without meters, and consumers with meters that are not read.

Consumers without meters:

- City parks
- WTP
- Cemetery
- City Shops
- Fire hydrant @ Fire Station

Consumers with meters that are not read:

- Public Works Building
- City Hall
- Theatre
- WWTP
- Library
- Police Department
- Pool
- Community Center

The City plans to install water meters for the consumers without meters within the next three years. The City intends to read all water connections, including those listed above, monthly whether or not they are invoiced. This information will be important for future water audits.

4.5 Water Valves and Fire Hydrants

The City's base mapping was updated as part of this project. Each water valve and hydrant was GPS located. The age of the valves and fire hydrants generally corresponds to the age of the adjacent water lines.

The City has approximately 1,120 water valves and 370 fire hydrants. There are approximately 50 double-port hydrants and 320 triple-port fire hydrants. The triple-port hydrant is equipped with a steamer port. The City has historically conducted an annual flushing program to clean the water lines as well as inspect fire hydrant performance.

SECTION 5 - ANALYSIS

5.1 Hydraulic Model

Haestad Methods' WaterCAD v6.5 was used to create the hydraulic model of the City of Stayton water distribution, storage and delivery system. The software applies the Hazen-Williams formula in an iterative manner for complex networks to determine system pressures based on various flow scenarios. The software also has the ability to determine fire flows available to each node by systematically analyzing each node (pipe junction) at different flow rates, and checking every other node to determine the maximum amount of water available without drawing the pressure levels below 20 psi at any node in the system.

Information regarding pipe diameters, network connectivity, and material types were determined through available mapping and consultations with City staff familiar with the water system. Demands (flows) were distributed based on number of estimated Equivalent Residential Units (ERUs), and water consumption billing records for the top users in the City.

5.2 Model Calibration

Model calibration refers to the process of adjusting model parameters, such as pipe roughness, so that model outputs match observed field conditions. For this study, fire hydrant flow tests served as the basis for model calibration.

A series of 14 tests were conducted in 2003 (tests #1-6 on July 30, tests #7-13 on Nov. 19, test # 14 on Dec. 15), and one was conducted in 2004 (test #15 on Feb. 15). Static and residual pressures (i.e. pressures before and during the fire tests) and flows were recorded. System conditions at Pine, Regis, and the finish booster stations, and at the reservoirs and water treatment plant (WTP) were also recorded using the City's SCADA system and personnel. A table with these recorded boundary conditions and fire flow test results is included in Appendix C.

A comparison of model versus field pressures was conducted to determine the accuracy of the model in replicating the water system conditions. Table 5.1 shows the result of the comparison between the field observed values and the model results. The "error" column represents the pressure difference between the field measurement and the model result. The test locations designated in the table are shown on Figure 5.1.

The calibration resulted in a model that reflects the actual conditions of the water system. For 88% of the tests, the error was less than or equal to 3 psi. This illustrates that the water model is well calibrated and will serve as an excellent tool for evaluation and planning in Stayton.

Table 5.1
Fire Hydrant Calibration Results

Test No.	Location	FH Flow (gpm)	Field Observed Static (psi)	Field Observed Residual (psi)	Field Observed Diff (psi)	Model Results Static (psi)	Model Results Residual (psi)	Model Results Diff (psi)	Error (psi)
1	1A	490	69	48	21	72	53	19	2
	1B		58	39	19	58	39	19	0
	1C		72	52	20	76	57	19	1
2	2A	1290	60	46	14	62	49	13	1
	2B		58	56	2	63	60	3	-1
3	3A	1560	67	55	12	71	58	13	-1
	3B		66	58	8	70	62	8	0
4	4A	1500	64	56	8	68	60	8	0
	4B		64	55	9	67	58	9	0
5	5A	1700	68	61	7	72	65	7	0
	5B		67	62	5	70	65	5	0
6	6A	600	66	56	10	68	59	9	1
7	7A	450	74	40	34	72	41	31	3
	7B		60	40	20	60	39	21	-1
	7C		60	40	20	60	40	20	0
	7D		78	38-44	38	74	43	31	7
8	8A	550	92	40	52	92	40	52	0
	8B		86	34	52	85	32	53	-1
	8C		61	39	22	60	40	20	2
	8D		78	30	48	74	34	40	8
9	9A	700	58	58	0	59	59	0	0
	9B		57	56	1	59	58	1	0
	9C		58	57	1	58	57	1	0
10	10A	1600	58	56	2	59	56	3	-1
	10B		57	55	2	59	58	1	1
	10C		58	52	6	58	54	4	2
11	11A	626	60	58	2	61	59	2	0
	11B		60	57	3	62	58	4	-1
12	12A	950	60	57	3	61	56	5	-2
	12B		60	56	4	62	55	7	-3
13	13A	1400	57	50	7	59	56	3	4
	13B		58	54	4	57	53	4	0
14	14A	600	92	68	24	98	67	31	-7
	14B		95	65	30	95	65	30	0
	14C		62	46	16	61	43	18	-2
	14D		70	34	36	70	43	27	9
	14E		75	34-42	35	74	41	33	2
15	15A	860	64	32	32	66	37	29	3
	15B		65	35	30	66	36	30	0
	15C		66	52	14	67	52	15	-1
	15D		64	63	1	66	64	2	-1

As part of the calibration process, Keller Associates and City personnel were able to identify areas where the model was not matching up with field observations. Further investigation identified two locations where closed valves or incorrect mapping data reduced the fire protection in the area. This type of discovery highlights the usefulness and utility of a water model.

Actual demands at the time of the fire hydrant tests, inaccuracy in gauge and pitot (hydrant flow) measurements and small variations in system boundary conditions are believed to account for most of the discrepancies between the actual pressures and the model results. Partially closed valves and inaccurate as-built data may also result in discrepancies between model and field results.

5.3 Existing Distribution System Hydraulic Evaluation

The model was used to simulate the existing Stayton water system based on 2003 peak day, peak hour and average summer and winter day demand scenarios.

It was determined that the existing distribution system was capable of delivering 2003 peak hour demands with moderate effect on system pressures. Under these conditions, the pressures in the upper zone range from 44 psi near the higher elevations to 105 psi along E. Santiam Street. Typical pressures in the lower zone range from a high of 73 psi in the southwest corner of town, down to 35 psi near the corner of Shaff Road and 1st Avenue.

The distribution system was also evaluated using WaterCAD to determine available fire protection throughout the service area, with a minimum system pressure of 20 psi during a fire event. The minimum fire flow assumed for residential areas was 1,000 gpm. Larger buildings (such as the Stayton High School, Regis High School, Junior High School, and the hospital) may require fire flows as high as 4,500 gpm for a duration of 4 hours, depending on size, construction material type, and if the buildings are equipped with sprinklers. Buildings such as the schools, which use more than one hydrant, were evaluated separately, using each of the fire hydrants available to provide fire protection.

The areas that are lacking fire protection are illustrated in Figure 5.2 in Appendix A. This figure highlights the areas that do not meet the 1,000 gpm minimum residential requirement or the fire flow necessary for other commercial and public facilities. The amount of available fire flow is shown in these areas.

Some of the areas indicated in Figure 5.2 lack adequate fire protection because the fire hydrants are served by 4-inch lines. Other areas shaded in yellow either have undersized pipes or are public facilities or commercial zones requiring greater fire protection than the existing pipelines can deliver. Recommended improvements to address these inadequacies are discussed further in the following section.

5.3.1 Future Distribution Conditions

The existing distribution system was also evaluated to determine if the existing water mains were capable of delivering future peak hour demands plus fire protection in the City and the areas of future development. The projected year 2025 population of 15,000, and build-out of the urban growth area as determined by the City were used to evaluate the future needs and conditions of the distribution system. To handle build-out densities, a grid with 12-inch water mains and 10-inch water mains is recommended. Section 7 of this report discusses the recommended improvements that will provide adequate water distribution, storage and pressures for the future conditions of Stayton.

5.4 Distribution Water Quality

Water quality modeling of the distribution system was not completed as part of this study. However, according to City staff, water quality tasting routinely confirms that chlorine residuals are maintained throughout the distribution system with winter time low residuals observed at Pine Street tank. Figure 5.3 illustrates 2005 water quality sampling.

5.5 Water Storage Needs

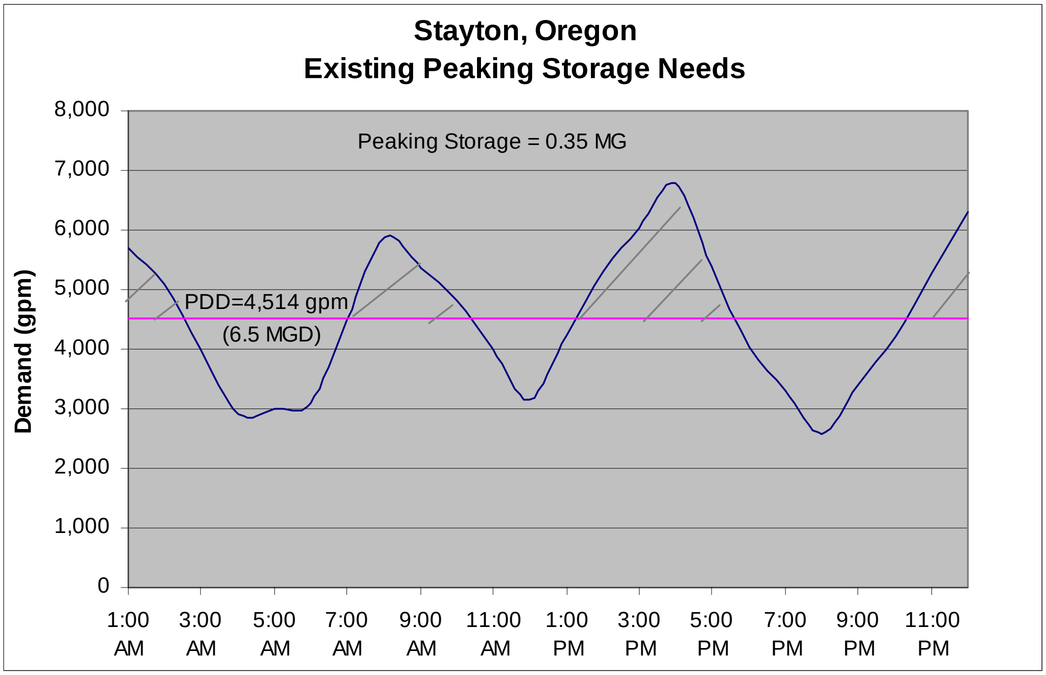
The City of Stayton has four finish water storage facilities with a combined storage volume of 6.9 million gallons (MG). The following table summarizes the reservoir data.

Table 5.2
City of Stayton Storage Reservoirs

Reservoir	Construction Type	Diameter (ft)	Height (ft)	Constructed/ Rehabilitated	Volume (MG)
Schedule "M"	Bolted Steel	65	40	1970	1.0
Pine Street	Concrete	148	40	1995	5.0
WTP Clear Well	Welded Steel	53	30	1971	0.5
Regis	Welded Steel	31	80	1971	0.4
				Total Finish Water Storage	**6.9 MG**
				Raw Water Storage in Existing Filter Beds	2.7
				Total Water Storage	**9.6 MG**

Storage is designed to provide fire protection demand plus operational and peaking (daily peaking demand) storage. The fire protection storage, as stipulated by the International Fire Code, was calculated by assuming a four-hour fire event with a demand of 4500 GPM. This correlates to fire storage of 1.08 MG. Operational storage is the volume of water between the pump "on" and "off" setting, which for Stayton equates to 15% of existing storage or 1.04 MG. Peaking storage is developed based on a local demand pattern which represents the variation in hourly demand. The 24-hour demand pattern in Chart 5.1 was generated based on 24-hour monitoring data gathered on August 22, 2003.

Chart 5.1
Existing Peaking Storage Needs



Based on the data and the assumptions outlined above, the estimated storage needs for 2003, 2015, 2025, and build-out are as presented in Table 5.3. A comparison of the minimum recommended storage vs. existing storage suggests the City has adequate storage both now and into the future to meet minimum storage requirements.

The City would also like to provide three days of storage to meet other emergency situations such as failure of the WTP, contamination of the surface water source, or other natural disasters that would restrict the City's ability to supply water. This storage would be in addition to the minimum recommended storage. However, during an emergency of this magnitude, water consumption would be curtailed such that residential demands would be minimized and industrial water demands would be restricted. The Storage Goal section of Table 5.3 illustrates the additional storage needed to provide a 3-day backup storage with and without the storage in the filters. If the water in the filter beds is included, the City would essentially have a 3-day storage for the next 10 years.

Table 5.3
Storage Requirements and Goals

Storage Requirements	2003 (MG)	2015 (MG)	2025 (MG)	Build-out (MG)
Population	7,300	10,800	15,000	19,200
Peaking Storage [1]	0.35	0.44	0.56	0.67
Operating Storage [2]	1.04	1.04	1.04	1.04
Fire Storage [3]	1.08	1.08	1.08	1.08
Minimum Recommended Storage	**2.47**	**2.56**	**2.68**	**2.79**
Needed Storage	-	-	-	-
Storage Available for Emergencies (Total Storage less Minimum Recommended Storage)				
Existing Storage w/o Filters[4]	4.43	4.34	4.22	4.11
Including Filters[4]	7.13	7.04	6.92	6.81
Comparisons to:				
Average Wet Weather Demand	1.65	2.21	2.88	3.55
Average Dry Weather Demand	3.75	4.70	5.83	6.96
Annual Average Day Demand	2.70	3.45	4.33	5.21
Norpac Average Annual Demand	0.9	0.9	0.9	0.9
Storage Goal -- 3 Days Average Day Demand with Complete WTP Shutdown				
Desired 3-Day Emergency Storage[5]	5.4	7.6	10.3	12.9
Less Available Emergency Storage[6]	(4.43)	(4.34)	(4.22)	(4.11)
Storage Need Without Filter Beds[7]	**0.97**	**3.30**	**6.06**	**8.82**
Storage Need With Filter Beds[7]	**-**	**0.60**	**3.36**	**6.12**
Equivalent 3-Day Well Capacity (MGD)	0.32	1.10	2.02	2.94
Equivalent 3-Day Well Capacity (GPM)	**220**	**760**	**1400**	**2040**

Notes

1. Calculated peaking storage using observed 24-hour demand pattern (8/22/2003) and assumes constant production equal to the peak day demand (PDD).
2. Assumed approximately 15% of existing storage to allow for volume between "on" and "off" set points.
3. Assumed a 4-hr 4500 gpm fire event.
4. The city also has approximately 2.7 MG of additional storage in the filter beds.
5. Assumed average day demand without Norpac.
6. Filter bed storage not included, all existing available emergency storage included.
7. This assumes complete autonomy -- no supply from Salem or Sublimity.

One alternative to acquiring additional storage to provide redundancy in the event of a WTP failure or surface water contamination is to construct a municipal well. This alternative would provide a water source independent of surface water behavior. The table illustrates the necessary capacity of the well to meet water demands now and in the future. Another alternative may involve constructing an inter-tie with the City of Sublimity. The City of Sublimity has a groundwater supply, so the benefits would be similar to a municipal well.

Recommended Storage to Meet City Goals and Emergency Storage. No additional storage is required within the projected 20-year horizon. However, additional storage may be desired to achieve the City's goal for providing 3 days of emergency water storage. Keller Associates recommends that the City reevaluate storage needs and City goals around 2015, prior to taking Regis tank off-line (2025) and prior to constructing additional storage. For planning purposes, a future 5.0 MG concrete tank was assumed to be constructed sometime between 2020 and 2025 adjacent to the Pine Street Reservoir.

5.5.1 Average Tank Residence Times

Average residence times during winter and summer months have been calculated with the aid of the water model. The average residence times for each reservoir are presented in Table 5.4.

Table 5.4
Season Average Residence Times

Tank	Winter	Summer
Schedule "M"	20+ days	8 days
Pine	23 days	7.5 days
Regis	23 days	23 days

It can be seen that during the winter months when the water demand is low, the average residence times in all three reservoirs increase substantially. High residence times leads to water stagnation and poor water quality.

Another factor that contributes to the long residence times in the Regis tank is the pipe and valve arrangements. The piping and valve arrangement at the Regis allows water pumped through the Regis booster station to bypass the tank. The Regis booster station can pump water directly from the distribution system in the lower pressure zone rather than from the Regis tank. This leads to high residence times and poorer water quality at the Regis tank. The simplest solution to shortening residence times and improving water quality is to increase the operational storage to include 15% of the total volume.

5.6 Water System Staffing Evaluation

The City's water system consists of the following main components:

- Four water storage reservoirs
- Four booster pumping stations
- A slow sand filter water treatment plant
- Approximately 44 miles of water distribution pipelines, valves, fire hydrants, and water services

Each of the system elements have differing O & M requirements which are discussed further below.

5.6.1 Water Storage Reservoirs

Three of the water storage reservoirs are of steel construction and one of prestressed concrete construction. Operation and maintenance requirements consists of:

- **Steel Tank Painting**. This is normally required approximately every 15-20 years and should be contracted out to a painting contractor with the necessary expertise and safety equipment.

- **Reservoir Inspection and Cleaning**. Each tank should be drained approximately every 5 years and any sediment flushed from the tank. The interior and exterior should be inspected for signs of coating wear, cracking (concrete tank), foundation settlement, and appurtenances such as ladder, overflow, inlet and outlet piping, valves, etc. should be checked for any abnormalities.

- **Routine Maintenance**. Checking for leaks and recording of water levels, grounds maintenance, and access security should be performed daily. Leaks should be evaluated for cause and repaired promptly. Most reservoir repair work, due to its specialized nature, should be subcontracted out. Routine reservoir O & M duties should require approximately 2-3 manhours per day.

5.6.2 Booster Pump Station Facilities

The City has four booster pump stations and it has been recommended by Keller Associates that the Schedule M Booster Station eventually be relocated to the WTP site. The pump and drive types and configurations vary at each pump station with sizes ranging from 7.5 to 40 Hp fire pumps. Some of the equipment and electrical/control systems are old and outdated. Each pump station should be inspected daily to insure equipment is operating properly. Pump and drive equipment not normally used such as fire pumps should be exercised every 2-3 months. Drive and pump equipment should be regularly lubricated. Minor repairs can be made by City staff with major repairs subcontracted out. An average of ½ manday should be allowed for O & M of the booster stations.

5.6.3 Water Treatment Plant

The water treatment plant is the key component of the City's water system and should be continuously monitored to insure production of a high quality safe drinking water that meets Oregon Department of Health Services requirements. The plant consists of the following primary components.

- Intake screen & pipeline from the North Santiam River to the plant
- Three large slow sand filter basins and distribution facilities
- Chemical dosing facilities for pH adjustment and disinfection
- Clearwell storage and treated water booster pumps
- Monitoring and control equipment
- Lab analysis equipment

Work tasks at the plant include cleaning of the intake screen, periodic removal and replacement of the filter bed surface sand layer, changing of chemical supplies, monitoring of turbidity and water quality analysis, maintenance and repair of equipment, and grounds maintenance. Due to the importance of this facility it is recommended that at least two operators be continuously assigned to the plant from 6:00 am to 8:00 pm with overlapping shifts.

5.6.4 Water Distribution System Facilities

The City has over 44 miles of water distribution lines ranging from 1 to 24-inches in diameter. There are also 1120 valves, 370 fire hydrants, and approximately 2500 water meters. Primary duties in operation and maintenance of the water distribution system include:

- Locating and repairing leaks (0.3 person) - Repair of leaks for lines 4-inch and larger is contracted out. The system has a significant leakage problem with an average water loss of 29% over the last three years.

- Service turn on and offs and line locates (1.0 person).

- Annual flushing of the water system to remove sediment from lines and exercise and maintain fire hydrants (0.2 person).

- All system valves should be exercised at least annually to insure they will not freeze up and operate properly when needed (0.2 person).
- Meter reading and bill preparation on a monthly basis (0.5 person including clerk time). This time could be reduced by addition of a remote driveby readout and computer billing system.
- The City also desires to implement a GIS utility tracking system that will require a full-time person with approximately 0.3 of his time allocated to the water system.

5.6.5 Water System

Summarizing the above, Keller Associates recommends the following levels of staffing for the City's water utility:

Facilities	Equivalent Manpower
Water Storage Reservoirs	0.3
Booster Pump Station	0.5
Water Treatment Plant	2.0
Water Distribution System	2.5
Water System Supervisor	1.0
TOTAL STAFF	**6.3**

The City's 2005 budget for the water system included funding for 5.3 people including clerks and not including the GIS work which has not yet been implemented. Therefore, it appears the water utility has duties requiring 6.0 personnel (excluding GIS work), and is slightly understaffed if all personnel funded to the water utility actually performed only water utility work. However, in many cases the water utility staff also spend significant time assisting with roads, sewer, and parks and recreation work, which take away from time that should be used for performing water utility functions. It is recommended that the equivalent of 6.3 water utility staff be dedicated to future water utility duties.

SECTION 6 - DEVELOPMENT AND EVALUATION OF ALTERNATIVES

6.1 General

The following discussion outlines the options for water storage and distribution improvements in both the upper and lower pressure service areas to meet current needs and accommodate future development, including build-out within the UGB.

6.2 Water Storage and Booster Stations

The existing reservoir facilities provide 6.9 MG of storage capacity, which is adequate to meet the City's storage needs for the next 20 years. The discussion below addresses future alternative improvements for the three reservoirs and associated booster stations. These alternatives were evaluated with the technical review committee (TRC) in September 2004. Subsequent to this initial evaluation, tracer studies completed at the water treatment plant (WTP) clear well facility demonstrated that existing contact times are woefully inadequate and that immediate baffling would be necessary.

6.2.1 Schedule "M"

Schedule "M" has long residence times, which creates stagnant water conditions. Pipeline improvements, water looping projects and the completion of the Pine Street reservoir have marginalized any fire protection benefit provided by the Schedule "M" reservoir. Redundancy is the primary contribution Schedule "M" makes to the City's water system.

Based on water model results, the absence of the Schedule "M" tank and booster station has very little impact on system pressures. Although there is a slight (200-300 GPM) reduction in fire protection in the east part of town, those areas would still have adequate fire protection.

Four alternatives were developed in conjunction with the TRC to improve the utility of the Schedule "M" reservoir. These alternatives are illustrated in Figure 6.1 in Appendix A, and are discussed in detail below.

Alternative A-Convert Schedule "M" to Clear Well. One alternative to maximize the utility of Schedule "M" is to leave it at its current location but convert it to clear well storage. The following improvements would be necessary to make this alternative possible:

- Construct a large (16-inch) diameter low pressure transmission line from the WTP to Schedule "M".

  - New transmission line could potentially be constructed inside Salem's existing water line easement to offset costs.
  - Yard piping improvements at the WTP would be necessary.

- Upgrade pumps at WTP to deliver flow to the Schedule "M".
- Upgrade Schedule "M" tank by separating the inlet and outlet pipe to improve circulation, and installing baffling.
- Upgrade the electrical and SCADA for the Schedule "M" booster station.

Estimated Project Cost for these improvements = $973,000.

This alternative would provide the following benefits:

- Redundancy in clear well storage capacity allows either clear well to be taken offline and maintained without pause in water supply.
- Redundancy in finish booster station pumping facilities.
- The diesel-powered pump at Schedule "M" can provide flow to system during power outage, thereby delaying the need for standby power at the WTP.
- The existing Salem inter-tie would continue to service Stayton as an emergency supply.
- Improved circulation in Schedule "M" and regular exercise of pumping facilities.
- Additional clear well capacity may allow for reduced chlorine dosages, depending on needed chlorine residuals.
- Adequate pumping capacity for build-out demands with redundancy.

This alternative would have the following drawbacks:

- High capital cost.
- Additional O&M Costs associated with maintaining two clear wells and two finish pump stations.

Alternative B-Relocate Schedule "M" to WTP. Another alternative to maximize the utility of Schedule "M" is to relocate the Schedule "M" reservoir to the WTP site, and convert it to clear well storage. The booster station and inter-tie at the Schedule "M" site would be abandoned, and a new inter-tie with Salem would be constructed at the WTP site. The following improvements would be necessary to make this alternative possible:

- Dismantle and haul the reservoir to the WTP site.
- Modify yard piping and valves as necessary to deliver flow to the Schedule "M" tank.
- Upgrade Schedule "M" by separating the inlet and outlet pipe to improve circulation, and install baffling.
- Construct a new inter-tie to the Salem pipeline at the WTP site.
- Install standby power at the finish booster station. This is something that is recommended for the WTP regardless of the alternative improvements. Therefore, this cost is not included in the Project Cost. Costs for standby power will be presented in the *Water Treatment Plant Master Plan Report*.

Estimated Project Cost for these improvements = $510,000.

This alternative would provide the following benefits:

- Eliminates need to construct the transmission line to Schedule "M" (required under Alternative A).
- Relocating tank is less expensive than constructing a new tank.
- Redundancy in clear well storage capacity such that either clear well could be taken offline and maintained without pause in water supply.
- Schedule "M" booster facility could be phased out, thus eliminating capital and O&M costs associated with this facility. A single finish booster station could be used for water supply and the emergency inter-tie with Salem.
- Additional clear well capacity may allow for reduced chlorine dosages, depending on chlorine residuals (O&M Savings).

This alternative would have the following drawbacks:

- High capital cost.
- No redundancy in finish booster stations. The reliability of the Salem inter-tie would be dependent on the operation of the finish booster station unless standby power is installed at the WTP.

Alternative C-Keep Schedule "M" Online, Expand Clearwell at WTP. Another alternative is to simply maintain the Schedule "M" reservoir and booster station as is (status quo). Baffles would be required at the existing clear well reservoir at the WTP to provide the necessary contact time. The following improvements would be necessary to make this alternative possible:

- Equip the clear well reservoir at the WTP with baffles to increase contact time. This was completed in December 2004.
- Upgrade the electrical and SCADA system for the Schedule "M" booster station.
- Add another clear well at WTP by 2009.

Estimated Project Cost for these improvements = $1,151,000.

This alternative would provide the following benefits:

- The diesel-powered pump at Schedule "M" can provide flow to system during power outage.
- The existing Salem inter-tie could be used to provide redundancy in water supply if the WTP is offline.

This alternative would have the following drawbacks:

- High capital costs.
- Additional improvements to the clear well reservoir would likely be necessary for build-out contact time.
- Additional O&M costs associated with maintaining Schedule "M" booster station and reservoir.
- Continued wasting of 30 GPM of water required to maintain circulation through the tank.

Alternative D-Abandon Schedule "M" and Expand Clearwell Storage at WTP. Under this alternative, the Schedule "M" tank and booster station would be abandoned. Additional clearwell storage will be required at the WTP by 2009, and the Salem inter-tie would need to be relocated to the WTP. The following improvements would be necessary to make this alternative possible:

- Equip the clear well reservoir at the WTP with baffles to increase contact time (completed in December 2004).
- Relocate the Salem emergency inter-tie to the WTP site.
- Install standby power at the finish booster station. (This is recommended for the WTP regardless of the alternative improvements. Therefore, this cost is not included in the Estimated Project Cost. Costs for standby power will be presented in the Water Treatment Plant Master Plan Report).

Estimated Project Cost for these improvements = $1,061,000.

This alternative would provide the following benefits:

- Schedule "M" booster facility would be phased out, thus eliminating capital and O&M costs associated with this facility. A single finish booster station could be used for water supply and the emergency inter-tie with Salem.
- Schedule "M" reservoir would be abandoned, thus eliminating O&M costs for maintenance, painting, inspection, operation, etc.

This alternative would have the following drawbacks:

- High capital costs.
- Increased dependency on finished pump station for supply to City water system.

Recommended Alternative

Keller Associates acknowledges the need for installing baffles in the existing clearwell, (completed December 2004) and recommends the following:

- No electrical upgrades at Schedule "M" – not needed once we have new inter-tie and standby power at WTP.
- Construction of a new inter-tie at the WTP as part of the new Salem pipeline project.

- Completion of Standby Power at the WTP.

- Relocation of Schedule "M" tank to the WTP site.

The alternative provides the City redundancy in its water supply options. Costs for these improvements are outlined in more detail in the *Water Treatment Plant Analysis* report.

6.2.2 Upper Pressure Zone Alternatives – Delivery and Storage

The peak hour water demands in the upper pressure service are expected to grow from approximately 500 GPM in 2003 to 1,815 GPM at build-out.

There are some improvements that will be necessary to correct existing fire flow and operation deficiencies in the upper pressure zone. Since these improvements are needed regardless of what else is done, their cost is not included in the cost comparisons for various alternatives considered. These improvements include the following:

- Upsize the 4-inch water lines on Pine Street, Mt. Jefferson Drive, Highland Drive, and Scenic View Drive with 12-inch lines.

- Upsize the water line on Cedar Ave. to an 8-inch line.

- Install a pressure-reducing valve near the intersection of Hollister Street and 6th Avenue, and construct the adjacent 8-inch water lines as shown.

- Construct a 12-inch water line along 10th Avenue that connects the existing 12-inch dry water line on 10th Avenue to Pine Street, and add another water service to the Hospital from the 6-inch water line that runs west of the Hospital.

- Replace the 4-inch lines on E. Santiam Street, 10th Avenue, and Jefferson Street with 8-inch lines.

- Replace the 6-inch water line from Highland Drive to Stayton Place on E. Santiam Street with a 12-inch water line.

- Upgrade the Pine Street Booster Station to allow control for the upper pressure zone to be transferred from Regis to Pine. Upgrades should include the following:

    - Replace the existing submersible pumps with turbine pumps.

- Upgrade existing pressure tank controls and air compressor system.
- Add standby power connection/hookup capabilities.
- Install a new flow meter.

All these improvements, along with their related costs, are included as part of the recommended plan in Section 7.

Impacts of Regis Booster Station to the Upper Pressure Service Area. Although the Regis tank has minimal impact on fire protection and existing peak hour static pressures, the Regis booster station does play a modest role in both the fire protection and peak hour static pressures for the upper pressure service area. If the Regis booster station is taken offline, the existing fire protection drops in some places as much as 1400 GPM (illustrated in Appendix D). Many areas, including the mobile home park on Fern Ridge Road, would not have adequate fire protection. In addition, pressures during peak hour demand periods would drop by as much 20 psi, with pressures as low as 39 psi in some places.

The available fire protection to the upper pressure service area will depend on the capacity of the pumps installed at the Pine booster station. However, the transmission lines should be capable of distributing necessary fire protection to the upper pressure service area with the priority improvements and Regis booster station offline. The Regis booster station can not be taken offline without transmission line improvements.

Given the considerations outlined above, a number of alternatives are presented below that will enable the City to meet the growing water demands in the upper pressure service area and enhance the utility of the City's existing facilities including the Pine and Regis tanks and booster stations. These alternatives are illustrated in Figure 6.2 in Appendix A.

Alternative A-Maintain Status Quo at Regis Tank and Booster Station. This alternative is to maintain the status quo, which includes continuous pumping at Regis booster station with Pine Street booster station used to supplement demands as needed. The existing pumping capabilities in both Regis and Pine Street booster stations could meet the projected water demands and fire protection requirements for the upper pressure zone for 20 years and beyond, even with the fire pump at Regis offline. (At build-out, with the current capabilities, there would be a reduction in pressures during peak hour demand periods of approximately

10 psi in the upper pressure zone.) This alternative involves the following:

- Upgrade the Regis booster station including the electrical, pumps, and SCADA.

Estimated Project Cost for these improvements = $234,000.

This alternative would provide the following benefits:

- Redundancy—Either Pine Street or Regis booster facilities could be used as primary supply to upper pressure zone.
- Provides necessary fire protection and static pressures now and for the next 20 to 40 years.
- Relatively low cost.

This alternative would have the following drawbacks:

- Additional O&M costs associated with upgrading and maintaining the Regis booster station.
- Additional operation and maintenance costs associated with maintaining two booster stations.
- Requires continuous pumping.

Alternative B-Abandon Regis Tank and Booster. Another alternative is to abandon the Regis tank and booster station, and use only the Pine Street booster station to meet water demands. If the Regis tank and booster station are abandoned, the following improvements would need to be completed first to make this alternative possible:

- Construct standby power at the Pine Street booster station for emergency supply in the case of power outage.
- Add additional pumping capacity to the Pine Street booster station to meet future water demands.
- In order to take Pine Street Reservoir offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system. This is recommended as a future improvement at the WTP, so the cost has not been included.

Estimated Project Cost for these improvements = $236,000.

This alternative would provide the following benefits:

- Eliminate the O&M costs for maintaining the old Regis booster facility and tank.

- More efficient operation at Pine versus continuous pumping at Regis.

- Pine Street is better equipped with a few modifications to act as primary control for upper pressure zone.

This alternative would have the following drawbacks:

- No booster station redundancy. If Pine Street Booster Station had to be taken off-line, pressures as low as 10 psi would result.
- No control redundancy for the finish booster station unless it is equipped with a variable frequency drive.

- Reduces emergency storage capacity with Regis tank off-line.

- The cell tower arrangement would no longer be possible if the tank is dismantled.

- Available fire flow and pressures in upper pressure zone not adequate without other improvements.

- Additional pumping capacity at Pine Street booster station would be necessary at an earlier date.

Alternative C-New Bench Reservoir. Another alternative is to construct a new bench reservoir that will serve the upper pressure area and then abandon the Regis tank and booster station. The following would be necessary to make this alternative possible:

- Construct a 0.5 MG reservoir on the bench which would include the following:

  - Property purchase.
  - Site work.
  - SCADA.
  - Chlorine injection facilities.

- Construct 5,500 feet of large diameter (16”) transmission line from the new reservoir to the existing line on Fern Ridge Road which would require a highway crossing.

- Abandon the Regis tank and booster station.

- In order to take Pine Street offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system (Optional).

Estimated Project Cost for these improvements = $1,746,000.

This alternative would provide the following benefits:

- Continuous pumping not required to serve upper pressure zone.
- Provides operational and emergency water storage available directly to the upper pressure zone, and additional overall emergency storage for the entire City.
- Eliminate the O&M costs for maintaining the old Regis booster facility and tank.

This alternative would have the following drawbacks:

- Long residence times in the tank and transmission line may result in water quality problems (disinfection byproducts and inadequate chlorine residuals).
- Additional O&M costs to maintain an additional storage facility.
- High capital costs.

Alternative D-Abandon Regis Tank, but Maintain Single Backup Pump at Regis Booster Station. The final alternative is to abandon the Regis tank, but maintain a single pump at the Regis booster station for backup water supply and fire protection to the upper pressure zone. The following improvements would be necessary to make this alternative possible:

- Upgrade the electrical and SCADA at the Regis booster station such that it has one backup pump with VFD capabilities.
- Add additional pumping capacity to the Pine Street booster station to meet future water demands.
- In order to take Pine Street offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system (Optional).

Estimated Project Cost for these improvements = $207,000.

This alternative would provide the following benefits:

- Eventually allow the Regis tank to be abandoned, eliminating the O&M costs for maintaining this tank.

- Pine Street is better equipped with a few modifications to act as primary control for upper pressure zone.

- Lowest cost alternative.

- Maintains dual booster station redundancy for water supply to the upper pressure service area.

This alternative would have the following drawbacks:

- No control redundancy for the finish booster station unless it is equipped with a variable frequency drive.

- Reduces emergency storage capacity.

- If the tank is dismantled, the cell tower arrangement would no longer be possible.

- Available fire flow in lower pressure zone reduced slightly but not consequentially.

Keller Associates **recommends that Alternative D be adopted**. This is the lowest cost alternative, and will meet both the water supply and fire protection needs for the upper pressure service area both now and into the future. The Regis tank can be abandoned when it is most economically advantageous to the City.

6.2.3 Regis Tank versus Transmission Line Alternatives

Impacts of Regis Tank to the Lower Pressure Service Area. As mentioned in Section 4.2.3, pipeline improvements, water looping projects and the completion of the Pine Street reservoir have marginalized the existing fire protection benefit provided by the Regis tank. Furthermore, system operations create long residence times in the tank and stagnant water during the winter. Given the age and condition of the tank, Keller Associates estimates the remaining life of the Regis tank to be approximately 20 years.

Evaluation of the system after 2025 was performed with Regis tank offline. Available fire protection and peak static pressures, with and without the Regis tank, are shown in Appendix D.

As shown in Appendix D, there is very little additional fire protection provided under existing conditions to the lower pressure service area by the Regis tank. Also, there is only a 2 psi drop in the peak hour static pressures in a few locations in town without the tank. Redundancy is the primary contribution Regis reservoir makes to the City's water system. It provides redundant storage capacity and a redundant facility to control the finish booster station if Pine Street is off-line.

While absence of Regis tank makes little difference to existing peak hour pressures, peak hour pressures in the lower pressure service area at build-out of the UGB were as much as 10 psi lower than existing peak hour pressures. Furthermore, if the finish booster station is offline with Pine Street reservoir as the sole source of water, peak hour pressures drop by as much as 35-40 psi. There are sections of town which might have pressures below 20 psi.

Similarly, while the absence of Regis tank makes little difference to existing fire protection, fire protection in the areas around the Regis tank site (including Sylvan Meadows, the commercial corridor on 1st Avenue near Highway 22 and the adjacent assisted living center) decreased at build-out of the UGB by as much as 1500 GPM. The residential areas maintained sufficient fire protection, but the assisted living center and commercial corridor had fire protection between 2000 and 2500 GPM.

Therefore, three alternatives were considered to improve available fire protection and pressures during peak hour demands when the life of Regis tank has expired and demands approach build-out conditions. These alternatives are illustrated in Figure 6.3.

Alternative A-Maintain Status Quo. One alternative is to rely on the existing system as is to provide both fire protection and peak hour pressures. Under this alternative, there would be greater dependence on the single 20-inch transmission that carries water to and from the Pine Street reservoir. Under normal conditions with all the finish booster station pumps in operation and the Pine Street reservoir on-line, peak hour pressures at build-out would be 8-10 psi lower than existing peak hour pressures and available fire protection in the Sylvan Meadows area would drop by 1500 GPM. There would be no additional improvements necessary beyond the improvements identified in Section 7.2.2.

Estimated Project Cost for this alternative = $0.

This alternative would provide the following benefits:

- Lowest cost alternative.

This alternative would have the following drawbacks:

- During peak demand periods, if the finish booster station is off-line, pressures drop below 20 psi and fire protection in the lower pressure service area essentially vanishes.

- Greater dependence on both the finish booster station and the single 20-inch transmission line to and from the Pine Street reservoir.

Alternative B-Replace Regis Tank. Another alternative is to replace the Regis tank when its life has expired. Under this alternative, peak hour pressures and available fire protection would be similar to existing conditions. If the finish booster station is off-line, the supplemental flow from the new "Regis" tank would meet both peak hour demands and fire protection needs.

It should be noted that the duration of the fire protection provided by the new "Regis" tank would be dependent on the size of the new tank. For example, if the new "Regis" tank is the same size as the existing tank (0.4 MG), the new "Regis" tank may drain in about one hour with a fire demand and the finish booster station offline. The following improvements would be necessary to make this alternative possible:

- Replace the Regis tank (for comparison purposes, it was replaced with a 0.4 MG tank).

Estimated Project Cost for these improvements = $686,000 with annual O & M of $6,000 per year.

This alternative would provide the following benefits:

- Replacement of lost emergency water storage when the life of the existing Regis tank expires.

- Less dependence on the finish booster station and transmission line from Pine Street reservoir.

- Provides adequate peak hour pressures and available fire protection

This alternative would have the following drawbacks:

- Additional O&M costs associated with maintaining new "Regis" tank including inspection, painting, ect.

- Still some dependence on a single transmission line to and from Pine Street reservoir.

Alternative C - Construct Parallel 16-inch Loop from Pine Street Reservoir along Fern Ridge Road. Another alternative is to construct about a mile of 16-inch transmission line from the Pine Street Reservoir north to Fern Ridge Road and then west along Fern Ridge Road to the existing 16-inch line just west of 10th Avenue. This transmission line would be a low-pressure line, and would have no services. Approximately 2600 feet would be along Fern Ridge Road, which may require asphalt repair.

This alternative provides peak hour pressures and fire protection under normal operating conditions. Even with the finish booster station off-line, peak hour pressures only drop about 15 psi with tolerable lows of about 35 psi. The system can also still provide fire protection that is comparable to existing fire protection. The following improvements would be necessary to make this alternative possible:

- Construct a large (16-inch) diameter low pressure transmission line from the Pine Street Reservoir to the existing 16-inch line just west of 10th Avenue.

Estimated Project Cost for these improvements = $779,000.

This alternative would provide the following benefits:

- Redundancy in major transmission lines to and from the finish booster station to the Pine Street Reservoir.

- Redundancy in major transmission lines from the Pine Street Reservoir to the distribution system in the event that the finish booster station is offline. Appendix D illustrates the available fire protection and static pressures at build-out of the urban growth boundary under this alternative with the finish booster station offline.

- Low O & M costs.

This alternative would have the following drawbacks:

- The City would construct approximately a mile of 16-inch transmission line with no services.

- Additional O&M Costs associated with maintaining two large transmission lines to and from the Pine Street Reservoir.

Keller Associates **recommends that Alternative C be adopted**. Since this improvement is not necessary until about 2025 when the life of the Regis tank expires, the City can begin collecting money now to offset costs. Furthermore, pipe alignment can be coordinated with development in the area to avoid the need to purchase easements. Finally, this alternative provides the most redundancy to the entire system and will meet peak hour pressure demands and fire protection needs even if the finish booster station is off-line.

6.3 Pressure Zone Alternatives

Currently, the City's water distribution system is divided into two pressure zones that are isolated with closed valves, pressure reducing valves, and check valves. These pressure zones are illustrated in Figure 4.1. Keller Associates evaluated alternative pressure zone configurations to improve service and simplify operation.

The most viable alternative to the current configuration is to convert the upper pressure water lines along Jefferson, E. Santiam, and their side streets to the lower pressure zone. In essence, this would move the boundary between the two pressure zones to the base of the hill. Water model runs were performed to evaluate this alternative. Static pressures in the affected areas would drop by approximately 45 psi. Furthermore, pressures in this area could be as low as 40 psi during peak water demand periods. As a result, Keller Associates recommends that the City maintain the current pressure zone configuration.

SECTION 7 - SUMMARY OF RECOMMENDATIONS

This section summarizes the recommended improvements and associated costs for the water storage and distribution facilities. Future recommendations and potential rate impacts are also discussed.

7.1 Master Plan

Recommended master plan improvements are shown on Figures 7.1 and 7.2. As shown on Figure 7.2, the Master Plan for the City of Stayton includes an expansion of both the upper and lower pressure zone service areas. The yellow shaded area reflects future upper pressure service area. The remainder of the area would be served by the lower pressure service area. The red shaded lines are the highest priority improvements (discussed in further detail in Section 7.3). The blue shaded lines are improvements to be completed in the next 3-5 years. The green lines represent future lines to be installed as development occurs.

7.1.1 Pressure Zones

In order to meet growing demands in both the upper and lower pressure service areas, additional production capacity will be required at both the Finish Booster and the Pine Street Booster stations. The existing pumps at the finish booster station can meet the build-out peak day demands with no redundancy. Additional pumping capacity will be needed to provide redundancy. The current pumping capacity at the Pine Street booster station is approximately 500 GPM. Peak hour demands are expected to increase to approximately 1,825 GPM at build-out, which represents an additional 1,325 gpm of pumping capacity (not including redundancy needs and fire protection).

The master plan also calls for three additional pressure-reducing valves in order to enhance interaction between the two zones in the event of fire or emergency conditions. These three locations are the corner of Fern Ridge Road and 10th Ave., the intersection of 6th Ave. and Hollister Street, and near Hwy 22.

7.1.2 Control Theory

In order to reduce large residence times in the Pine Street and Regis reservoirs, Keller Associates recommends increasing the interval between the ON and OFF water level settings at Pine Street Reservoir. Table 7.1 illustrates the proposed Pine Street control set points. A larger interval between the ON and OFF settings will create better circulation and water quality throughout the system. Reducing tank residence times will improve chlorine residuals throughout the system.

Table 7.1
Controls for Finish Booster Station
Based on Pine Street Reservoir Level

Controls for Finish Booster Station Based on Pine Street Reservoir Level	Tank Level	
Well	**On**	**Off**
100-hp finish pump	30'	36'
#1 200-hp finish pump	28'	38'
#2 200-hp finish pump	26'	37'

For backup and emergency purposes, the City's SCADA system should be capable of operating the Finish Booster Station using either Pine Street or Regis reservoirs. Additionally, the City should equip one of the finish booster pumps with a variable frequency drive (VFD) prior to abandoning the Regis Tank. This would allow the City to provide continuous water supply during periods when the Pine Street Reservoir is out of service.

7.1.3 Water Storage

Keller Associates does not recommend that the City pursue additional storage at this time. When it becomes cost-prohibitive to maintain the Regis Tank or its life expires (estimated to occur around 2025), it should be abandoned. In order to achieve the City's goal of providing 3 days of emergency storage, the City should consider constructing another storage reservoir near the existing Pine Street reservoir site sometime between 2020 and 2025.

7.1.4 Water Distribution

Recommended improvements are broken into priority illustrated in Figure 7.1 and 7.2 of Appendix A. Priority 1 improvements correct existing transmission and fire flow deficiencies, and should be completed within the next couple of years. Priority 2 improvements are primarily to enhance the existing system, and should be completed within the next three to five years. Future improvements should be driven and largely funded by development.

7.2 Existing System Replacement / Rehabilitation Recommendations

Many of the existing facilities were constructed several decades ago. The City of Stayton needs to take measures to upgrade these facilities to maintain the integrity of the water system. A replacement/rehabilitation program for each component of the water system is presented in the following sections.

7.2.1 Storage Facilities

Tank Inspection. The Schedule "M", Regis, and Clear Well reservoirs are steel reservoirs. The Schedule "M" and Regis tanks have not been inspected for some time, and are in need of inspection now. Due to the condition and age of these two reservoirs, Keller Associates recommends that these reservoirs be inspected every two to three years. The Pine Street reservoir also has not been inspected since its construction and is due for an internal inspection. Due to its age, construction materials, and condition, Keller Associates recommends that the Pine Street reservoir be inspected every 10 years.

Tank Repainting. All three steel tanks (Regis, Clear Well, and Schedule "M") need repainting of the exterior and interior. Given the durability of current paint finish products, the interior and exterior of steel tanks should be recoated every 15 years. The Pine Street reservoir is concrete and therefore does not require recoating. No significant maintenance or rehabilitation efforts are anticipated for the Pine Street reservoir during the next 20 years. Repainting of Schedule "M" should be postponed until after it is relocated to the water treatment plant site.

7.2.2 Booster Station Facilities

The Schedule "M" booster station is old and not used regularly. To ensure they will function in the event of an emergency, the pumps and valves should be exercised regularly (every 2-3 months) as long as the booster station is kept in service. Keller Associates recommends that the Schedule "M" booster station eventually be abandoned.

The Regis booster station is also old, and will require substantial improvements to upgrade the electrical and mechanical components. Keller Associates recommends that this booster station be upgraded with a single backup pump to the Pine Street Booster Station.

7.2.3 Leak Detection and Water Line Replacement

The new state regulations require any water suppliers that have a system loss greater than 10% to implement a leak detection program. Regulations further stipulate that any water supplier with a system loss greater than 15% must implement a leak repair or line replacement program to reduce system loss. The City of Stayton falls into both these categories with an average system loss of 29% over the last three years.

The City has discussed performing leak detection on all ductile iron and steel pipes. The City intends to conduct a comprehensive leak detection study within the next five years. The estimated cost for the leak detection study is $25,000. Those areas determined to contain the most leaks should be targeted first. To minimize costs, pipeline replacements should be coordinated with street improvements.

Keller Associates recommends the City adopt a water line replacement program in order to maintain the integrity of the water distribution system. The asbestos cement and steel lines have historically been most problematic, and thus should be targeted first. (Figure 4.2 in Appendix A illustrates the pipe types throughout the water system.)

Appendix E includes a detailed analysis of the length of each pipe type and size that will need to be replaced in the next 20 years. Based on this analysis, the City should work towards establishing an annual pipeline replacement budget of $249,000 per year. Over the next 20+ years, this will allows the City to replace all of the steel, cast iron, and galvanized iron pipes, and approximately 25% of the asbestos cement water lines. In order to minimize road repair inconvenience and expense, pipeline replacement should be coordinated with street improvements.

7.2.4 Water Meters

A water meter testing program can provide direction and priority for the meter replacement program. Old meters can be tested for accuracy. An alert meter reader should be able to spot an under-registering meter by a quick comparison with past readings. The accuracy versus location of the meters can be tracked to determine if a correlation between location and accuracy can be drawn. Those areas with meters that consistently test poorly should be targeted for meter replacement. A set of representative meters in an area can be tested every 5 years to track meter accuracy in an area.

Currently, the City's waster system contains 881 touch-read meters and 1,608 manual-read meters. Touch-read meters can be converted to radio-read meters by installing a transmitter on the existing touch-read meter. The City intends to convert the system to a radio-read meter system by implementing the following program.

- Replace all manual-read meters with touch-read meters within the next 10 years. This requires the replacement of approximately 160 meters per year ($24,000).
- Require all new developments to install radio-read meters.
- Purchase radio-read equipment and software once the City reaches 500 radio-read meters. This equipment costs approximately $50,000.

- After all manual-read meters have been replaced, convert the touch-read meters to radio-read meters by adding a transmitter to each at a cost of $145 apiece. If 125 meters are replaced annually at a cost of approximately $18,000 per year, all touch-read meters could be replaced in 7 years.

In addition, Keller Associates recommends that the City install water meters on any un-metered facilities including the city parks, cemetery, city shop, and water treatment plant within the next 5 years. The estimated cost to install meters on all these facilities is $68,000.

7.2.5 Fire Hydrants

The City has approximately 370 fire hydrants, of which approximately 50 are double-port hydrants and 320 are triple-port fire hydrants. Keller Associates recommends that the City replace all 50 double-port hydrants in the next 10 years, which represents 5 hydrants per year. Assuming a replacement cost of $3,000 per hydrant, Keller Associates recommends an annual fire hydrant replacement budget of $15,000 for the next 10 years. (It should be noted that the fire hydrant replacement program should be coordinated with the pipeline replacement program so as to prevent placing a new hydrant on a 4-inch existing main.)

Keller Associates also recommends that the City conduct an annual flushing program to clean the water lines as well as inspect fire hydrant performance.

7.3 Capital Improvement Plan

The Capital Improvement Plan (CIP) outlines priority improvements necessary to ensure sufficient water and fire service to the City, both now and in the future. The CIP also outlines a meter and pipeline replacement program with an estimated annual budget.

7.3.1 Priority 1 Improvements (2005)

Priority 1 improvements are those improvements necessary to correct inadequate fire protection or replace water lines that have serious maintenance and leakage problems. Upgrades to the Pine Street Booster Station and water services in designated areas have also been included in the Priority 1 improvements.

- **Elwood Street Improvements.** Construct an 8-inch water line in Elwood Street from 3rd Ave. to 6th Ave., north to Hollister and then east to the southwest corner of the Stayton Hospital. The existing smaller diameter lines along this alignment can be abandoned, and any service lines should be reconnected to the new 8-inch line. The new line will bridge the high and low pressure zones, so a PRV should be installed near the corner of Hollister and 6th Ave., as shown in Figure 7.1. This will improve local fire protection and water looping. The PRV should be equipped with a backflow option to allow flow from the lower zone to enter the high zone in the event of a fire event in the low pressure zone.

- **Community Center Improvements.** Replace the existing 2-inch water line on West Burnett between N. Evergreen and W. Virginia Street with an 8-inch line, and connect to the existing water line near Community Center Complex. This will improve looping and fire protection to Community Center.

- **Kathy Street Improvements.** Construct a new 8-inch water line along E. Kathy Street from Sixth Ave. to the 850 block, and abandon the section of water line along the back of lots on E. Kathy Street. This will simplify access for repairs to the water main, and eliminate damage to the backyards.

- **Maple Avenue Area Improvements.** Replace the undersized water lines on Gardner Ave., Maple Avenue, and Fern Ave. with 8-inch lines to improve fire protection and looping.

- **2nd Ave Improvements.** Replace undersized water line on 2nd Ave. from Burnett Street to Virginia Street and from Hollister Street to Pine Street with an 8-inch line, to improve local fire protection and water looping.

- **Bowling Alley Area Improvements.** Replace the undersized water lines on E. Santiam Street from 10th Ave. to the fire hydrant near the bowling alley, on 10th Ave. from E. Santiam Street to Jefferson Street, and on Jefferson Street from 10th Ave. east to the fire hydrant located about 600 feet away with 8-inch lines. This will improve local fire protection.

- **Locust Road Improvements.** Reconnect the fire hydrants and service lines along Locust Road from Gardner Road to 1st Ave. to the 10-inch water line, and abandon the parallel 4-inch line. This will improve fire protection for the area surrounding the Stayton High School.

- **Florence Street Improvements.** Replace the undersized water line on Florence Street from 3rd Ave. east with an 8-inch line to improve local fire protection.

- **E. Santiam Street Improvements.** Replace the undersized line along E. Santiam Street from 15th Ave. to Stayton Place with a 12-inch water line, and add a fire hydrant at Scenic View Drive to improve water transmission and fire protection in the upper pressure zone.

- **Pine Street Improvements.** Replace undersized line along Pine Street from 10th Ave. to Mt. Jefferson Drive with a 12-inch water line, to improve water transmission and fire protection in the upper pressure zone.

- **Highland Drive Area Improvements.** To improve local fire protection and extend service to the north, replace the undersized lines north of Pine Street including Mt. Jefferson Drive, Highland Drive, and Scenic View Drive with 8-inch lines.

- **Cedar Street Improvements.** Replace the undersized line on Cedar Street from 6th Ave. west for 250 feet with an 8-inch line to improve fire protection.

- **Safeway Complex Improvements.** Construct an 8-inch water line that will loop from the end of existing water line on Fir Street to water line in Safeway complex, to improve water looping and local fire protection.

- **Shaff Road Improvements.** Construct new 16-inch water line along Shaff Road from east edge of Stayton Middle School to east of Douglas Road. Also replace undersized line along Fern Ave. from Shaff Road to Kathy Street with an 8-inch line. These two improvements will enhance water transmission and local fire protection.

- **Pine Street Booster Station Improvements.** Upgrade the Pine Street Booster Station to allow control for the upper pressure zone to be transferred from Regis to Pine. Upgrades should include the following:

  - Replace the existing submersible pumps with turbine pumps
  - Upgrade existing pressure tank controls and air compressor system
  - Add standby power connection/hookup capabilities
  - Install a new compound flow meter
  - Eliminating need for control “bleeding” of water from upper pressure zone to lower pressure zone

- **Add Valves on Shaff Road**

- **10th Avenue Improvements.** Replace the undersized water lines along 10th Avenue from Fir to Pine Street with a 12-inch water line to improve water transmission and fire protection in the upper pressure zone. To provide redundancy, add another water service to the Hospital Campus that would draw water from the 6-inch water line west of the Hospital.

- **Repaint Interior and Exterior of Regis and Schedule “M” Tanks.**

7.3.2 Priority 2 Improvements (2010)

Priority 2 improvements primarily include water line replacements that will improve water circulation by reducing the number of undersized pipes, increasing water line looping, and eliminating old and decaying water lines. In general, the Priority 2 Improvements are not needed for meeting minimum fire protection requirements, but will improve service, looping, and fire protection.

- **Water Street Improvements.** Reconnect service lines from 2-inch to 16-inch line, and abandon 2-inch parallel line along Water Street.

- **West Ida Street Improvements.** Replace undersized and old piping along Ida Road from Wilco Road to Holly Ave. with 8-inch lines. Also from Holly to Evergreen Ave., reconnect all service lines from the 4-inch to the 16-inch line and abandon the 4-inch line.

- **Marion Street Area Improvements.** Replace undersized lines on Marion Street from 1st Ave. to 2nd Ave. and north to Burnett Street, with an 8-inch line. Also replace undersized lines on Marion Street from 4th Ave. to 7th Ave. and north to Virginia Street with an 8-inch line.

- **Washington Street Improvements.** Replace undersized line along Washington Street from 1st to 3rd Ave. with an 8-inch water line. Also, reconnect service lines from the 4-inch line to the 16-inch line along Washington Street from Evergreen to 3rd Ave., and then abandon the 4-inch line.

- **Robidoux Street Area Improvements.** Replace undersized water lines in the area from Jefferson to Fir Street and from 3rd to 6th Ave. with 8-inch lines.

- **Jefferson Street Improvements.** Replace undersized water lines not previously identified as Priority 1 improvements along Jefferson Street from 6th to 15th Ave. and north to E. Santiam Street with 8-inch lines.

- **Douglas Ave Area Improvements.** Replace undersized water lines between Shaff and Regis Road (including Birch, Douglas, and E. Kathy Street) with 8-inch lines.

- **Birch Ave Area Improvements.** Replace undersized water lines on Birch and Douglas Ave. between Washington Street and Locust Road, with 8-inch lines.

- **Hollister Street Area Improvements.** Replace undersized water lines in the area from Hollister to Cedar Street and 1st Ave. to 3rd Ave. with 8-inch lines.

- **Salem Inter-tie Improvements.** Construct inter-tie with Salem water transmission pipe at the water treatment plant. This will enable the City to ultimately abandon the Schedule "M" Booster Station. The new inter-tie at the WTP could be piped directly to the existing finish booster station pumps.

- **Regis Booster Station.** Upgrade the Regis Booster Station with one reliable emergency pump to provide redundancy for the upper pressure zone.

- **Water Service Improvements.** Water services should be replaced as soon as possible in both the Northslope Subdivision and the Westown Subdivision.

- **Secure Land for Future Tank Site.**

7.3.3 Priority 3 Improvements (2015)

Priority 3 improvements primarily include:

- **Abandon Schedule "M" Booster Station.**

- **Pine Street Capacity Improvements.** Increase the pumping capacity at the Pine Street Booster Station by 1,325 GPM to meet build-out water demands. Also provide VFDs.

7.3.4 Priority 4 Improvements (2025)

Priority 4 improvements primarily include:

- **Fern Ridge Road Improvements.** Construct a parallel 12-inch upper-pressure water line along 10th Ave. from Dawn Drive to Fern Ridge Road, and east along Fern Ridge Road from 10th Ave. to the mobile home park. The existing water line should be converted to a low-pressure line to provide water service to the area north of Fern Ridge Road. A PRV with backflow capabilities should separate the upper and lower pressure zones.

- **Abandon Regis Tank.** Abandon Regis Tank when it becomes cost-prohibitive to maintain, or it has reached the end of its useful life.

- **16-inch Transmission Loop From Pine St.** Construct a 16-inch low pressure transmission line from the Pine Street reservoir to the existing 16-inch water line on Fern Ridge Road.

- **3rd Avenue Future Improvements.** Construct a 16-inch transmission line from the existing 24-inch water line at Water Street to Virginia Street along 3rd Avenue.

- **Construct New Reservoir.** Construct a 5.0 MG reservoir near the existing Pine Street reservoir site.

7.3.5 Future Improvements – Coordinate with Growth and Street Repairs (2010-2025)

Future Improvements are intended to expand the water system to meet future growth. These improvements will be necessary to maintain fire protection and water pressure requirements in the future. As Stayton continues to grow, the following improvements are recommended:

- **Future Pipeline Improvements.** Construct new pipelines needed to extend water service to growth areas as illustrated in Figure 7.2.

- **Small Diameter Pipeline & Looping Projects.** Replace small diameter pipelines and loop water lines wherever possible as part of the pipeline replacement program.

- **Shaff Road Future Improvements.** Extend the 16-inch water line from Middle School to Wilco Road as part of pipe replacement program.

- **Wilco Road Future Improvements.** Construct 16-inch water line from Ida to Shaff Road along Wilco Road as part of pipe replacement program.

- **Construct Mill Creek Booster Station and East Pine Small Booster Station.** (Refer to Figure 7.2). The Mill Creek booster station will be sized to deliver normal operating demands plus fire protection demands to future water users located between Mill Creek and the Santiam Highway. The small booster station proposed to serve the area east of the Pine Street water tank will boost pressures to an acceptable 40 – 80 psi range, and will not need to be capable of pumping fire demands. Instead, fire demands will be provided from the existing booster station via bypass valving to the East Pine Booster service area.

7.3.6 Summary of Costs

Table 7.2 summarizes the water distribution capital improvements by priority.

Table 7.2
Capital Improvement Plan – Water Distribution System
Estimate of Most Probable Cost (2005 Dollars)

Item	Project Costs				
	Priority 1	Priority 2	Priority 3	Priority 4	Future
Priority 1 (2005)					
Pipeline / Distribution Improvements					
• Elwood Street	$280,000				
• Community Center	86,000				
• Kathy Street	69,000				
• Maple Blvd	208,000				
• 2nd Ave	58,000				
• Bowling Alley Area	133,000				
• Locust Road	46,000				
• Florence Street	95,000				
• E. Santiam Street	72,000				
• Pine Street	200,000				
• Highland Drive Area	169,000				
• East Ida Road	288,000				
• Cedar Street	29,000				
• Safeway Complex	73,000				
• Shaff Road	341,000				
• Add Valves To Shaff Road	11,000				
• 10th Ave	75,000				
• Complete Leak Detection Study	25,000				
• Meter Unmetered Facilities	68,000				
• Repaint Interior & Exterior of Regis Tank	135,500				
Booster Station Upgrades					
• Pine St. Booster Station	97,000				
• City Hall	409,200				
Total Priority 1	**$2,967,200**				
Priority 2 (2010)					
Pipeline / Distribution Improvements					
• Water Street		$25,000			
• West Ida Road		235,000			
• Marion Street Area		189,000			
• Washington Street		93,000			
• Robidoux Street Area		378,000			
• Jefferson Street		299,000			
• Douglas Ave Area		261,000			
• Birch Ave Area		92,000			
• Hollister Street Area		123,000			
• Water Service		418,000			
Other Upgrades					
• Regis Booster Station		182,000			
• Install Radio-read Meter System		50,000			
• Salem Inter-tie		58,000			
• Secure Land Tank/Well Site		150,000			
Total Priority 2		**$2,553,000**			
Priority 3 (2015)					
• Abandon Schedule "M"			$29,000		
• Pine Street Add't Capacity w/VFDs			74,000		
Total Priority 3			**$103,000**		
Priority 4 (2025)					
• Fern Ridge Road				$198,000	
• 16-Inch Transmission Loop from Pine Street				779,000	
• Abandon Regis Tank (2025)				$42,000	
• Construct new 5.0 MG				$2,862,000	

Storage Reservoir					
• 3rd Avenue Future – upsize cost				$37,000	
Total Priority 4				**$3,918,000**	
Future—Coordinate w/ Growth & Street Repairs (2010-2025)					
Pipeline / Distribution Improvements					
• Upsize Costs for Future Pipeline					$990,000
• Shaff Road Future					90,000
• Wilco Road Future					132,000
Other Upgrades					
• East Pine Street Small Booster					130,000
• Mill Creek Booster Station					427,000
TOTAL (rounded)	**$2,967,200**	**$2,553,000**	**$103,000**	**$3,918,000**	**$1,769,000**

Notes: Costs include engineering and contingencies.
Future Costs are in 2005 dollars.

7.3.7 Additional Annual Budget Considerations

In addition to the capital improvements recommended above, the city of Stayton should begin phasing in additional staffing and replacement programs:

- Additional Operating Staff ($60,000/year)
- Pipeline Replacement Program ($249,000/year)
- Meter Replacement Program ($24,000/year)
- Fire Hydrant Replacement Program ($15,000/year)

7.3.8 Budget & Rate Impacts

An evaluation of budget and rate impacts of the proposed water distribution and treatment capital improvement plans was completed by Economic and Financial Analysis. As part of this evaluation, priority capital improvements, staffing, and replacement programs were phased over the course of the next 10 years to minimize initial rate impacts. A detailed evaluation can be found in Appendix F of the water distribution facilities planning study. Recommended rate increases are presented in the executive summary.

7.4 System Development Charges

Keller Associates evaluated each improvement to determine which improvements where growth related and which ones were not. Where correcting existing deficiencies also benefits future growth, a portion of the improvement costs have been assessed growth. A detailed evaluation of SDCs was completed by Economic and Financial Analysis and can be found in Appendix G of the Water Distribution Facilities Planning Study.

7.5 Potential Funding Sources

To accommodate the recommended system improvements, a financing program will need to be established that can support implementation of this improvement program. A variety of funding resources exist in both the private and public sector. It is recommended that funding from both sectors be considered. Some of those resources in the public field are listed below.

- **Oregon Department of Environmental Quality (Wastewater-Clean Water State Revolving Fund)—**20 year, 3.6% interest rate loans.

- **Oregon Economics and Community Development Department (Community Development Block Grant Program)—**Availability dependent on the median household income and user rates; Grant funds up to a maximum of $750,000; Priority given to cities with compliance infractions.

- **U.S. Economic Development Administration—**Grant and loan funds; Priority based on economic development potential.

- **Oregon Economics and Community Development Department (Water/Wastewater Financing Program)—**State funded program (Oregon Lottery); Grant and loan funds generally provided on a 50/50 basis; Grant funds have a maximum of $750,000; 25-year loan at 4.6+% interest rate; Eligibility based on average household income and compliance issues.

- **Oregon Economics and Community Development Department (Special Public Works Program)—**State funded program (Oregon Lottery); Loan funds only; 25-year loan at 4.6+% interest rate; Eligibility based on average household income and compliance issues.

The State of Oregon holds a One-Stop Meeting monthly at which representatives from the various funding agencies attend. At the One-Stop Meeting, projects are reviewed and the representatives discuss the funding available from their respective agencies. Recommendations about the most appropriate funds or combination of funds are agreed upon as a funding community.

Appendix A

Figures

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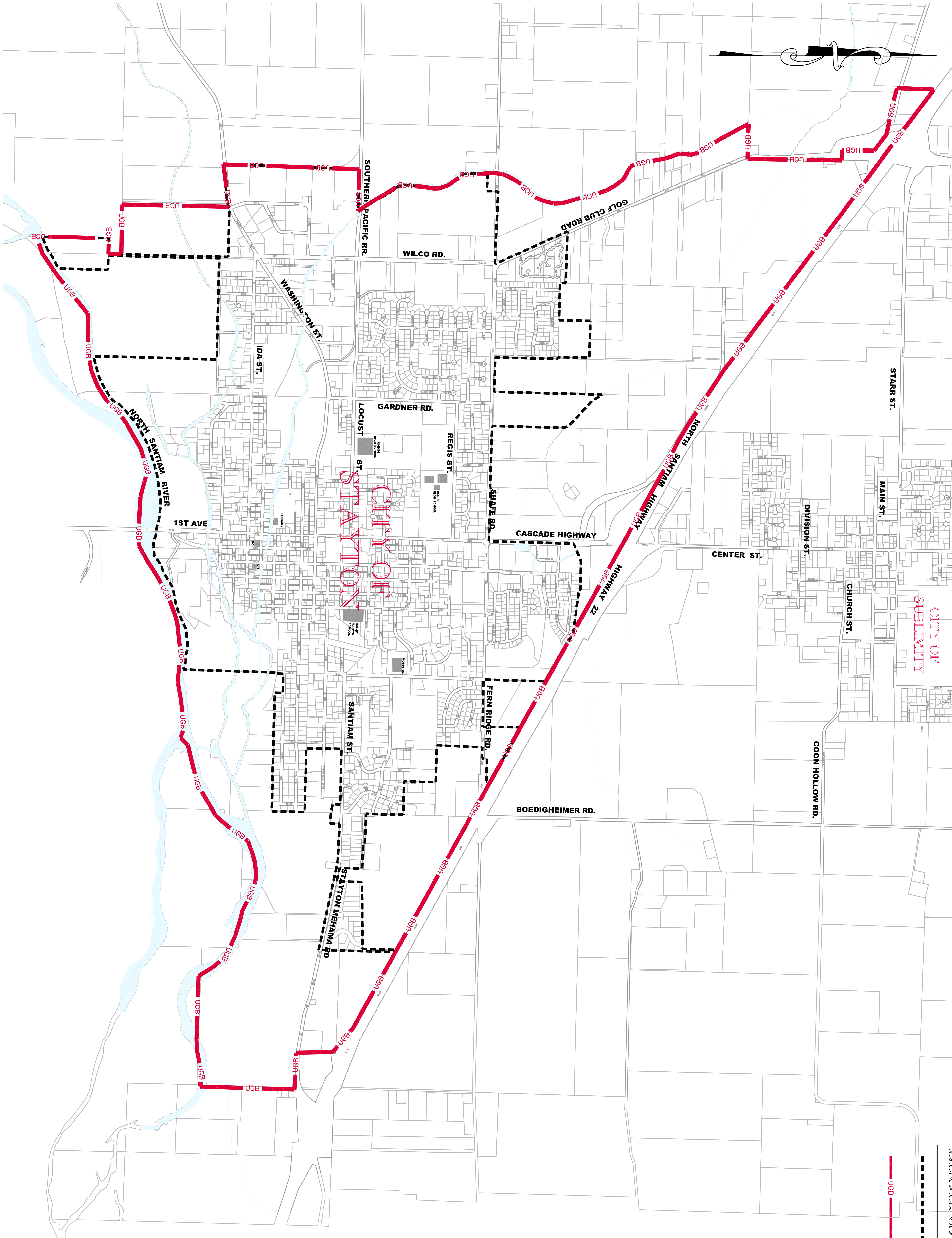

FIGURE 2.1

Water Study Area

Water Distribution Facilities Planning Study

CITY OF STAYTON

KELLER ASSOCIATES

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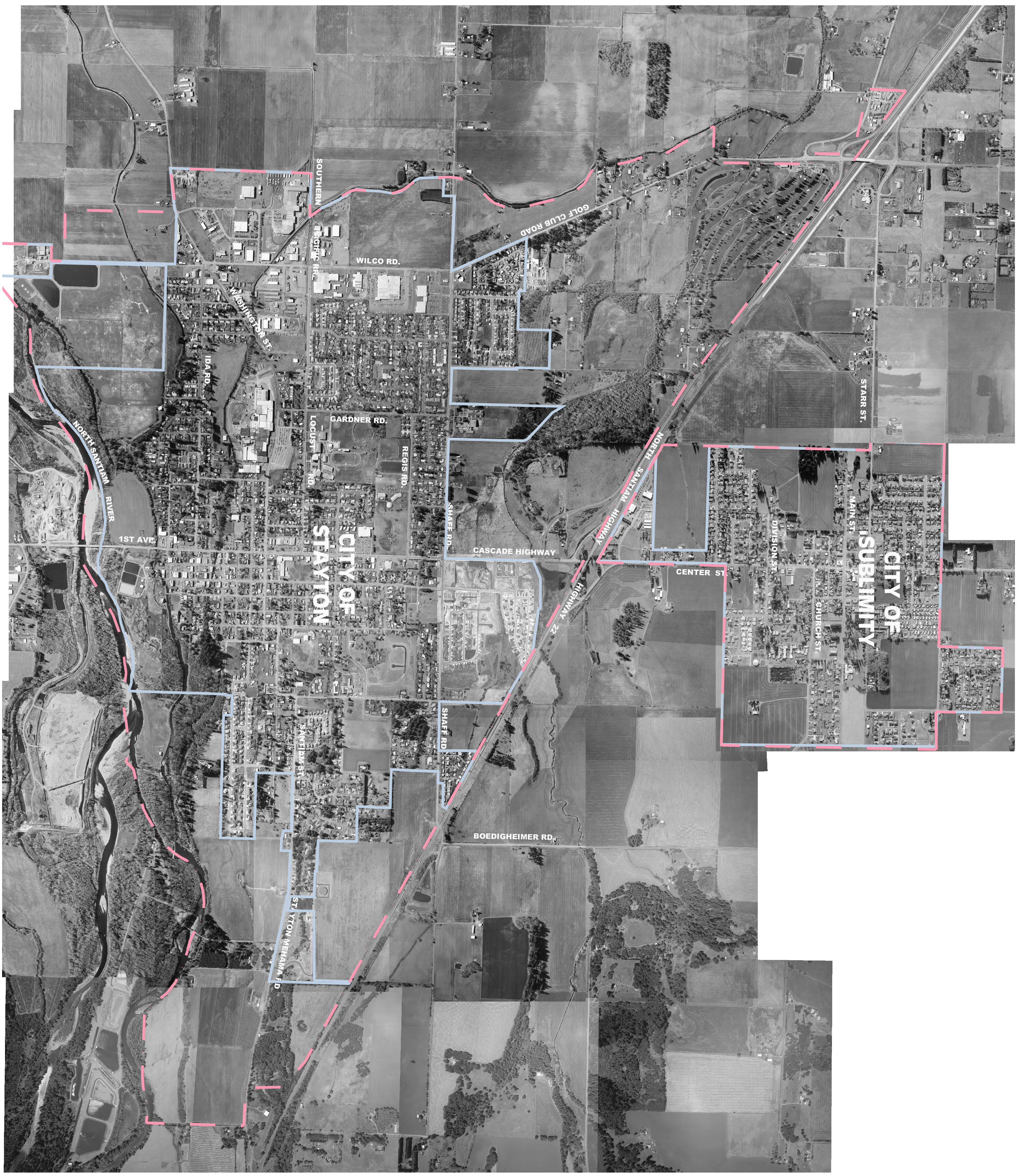

FIGURE 2.2

Aerial Map

Water Distribution Facilities Planning Study

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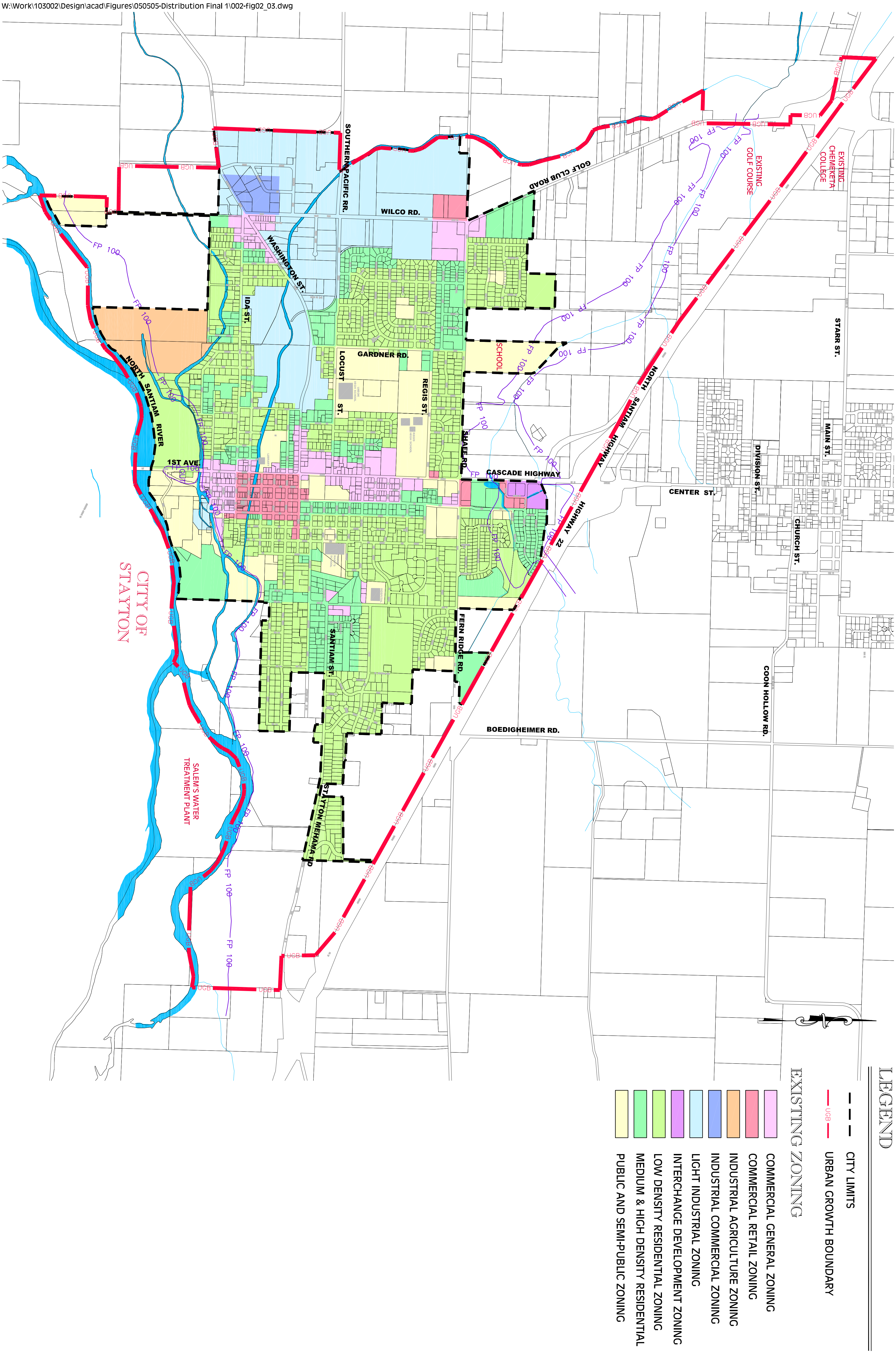

FIGURE 2.3

Existing Land Use

Water Distribution Facilities Planning Study

CITY OF STAYTON

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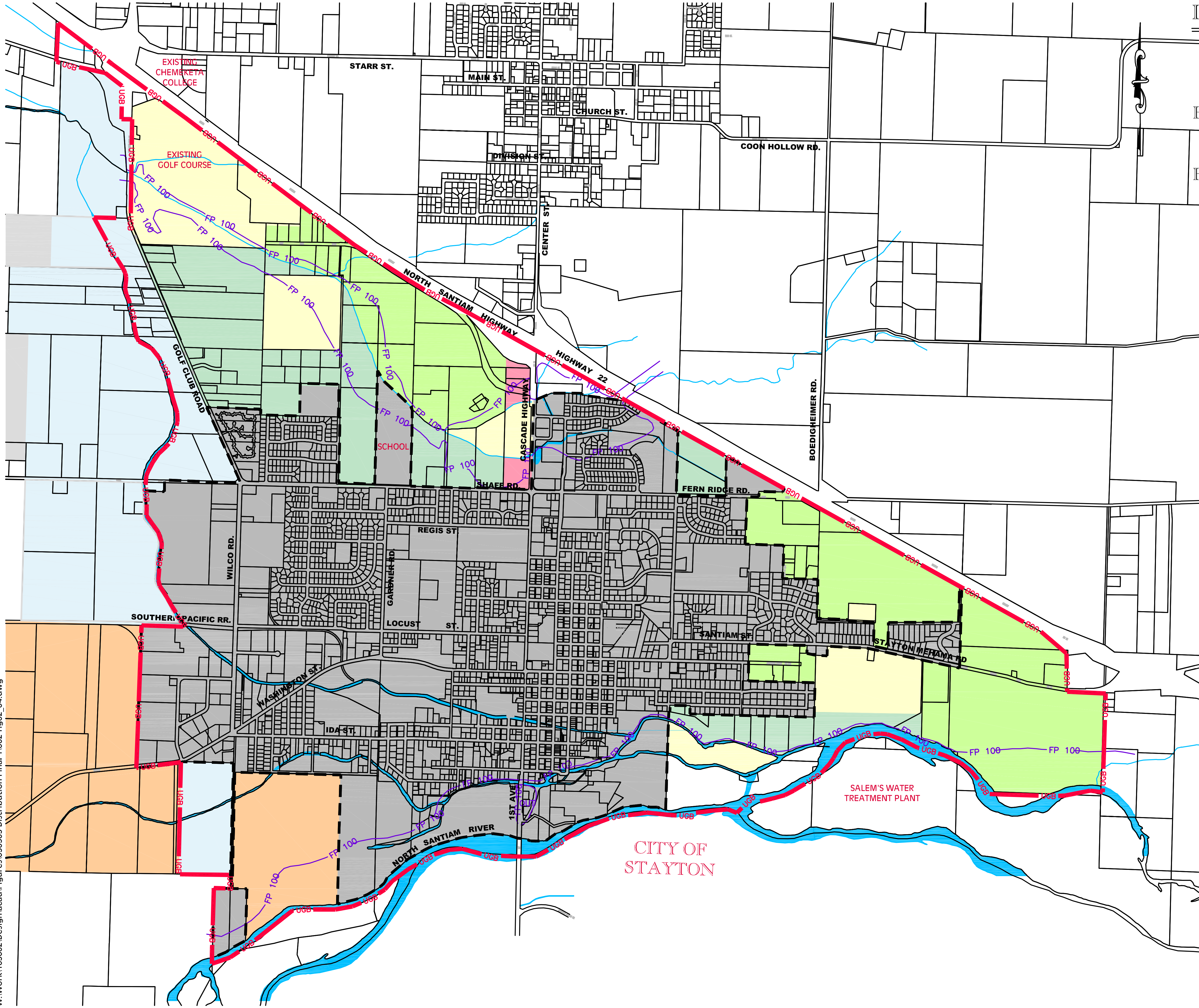

LEGEND

- CITY LIMITS
- URBAN GROWTH BOUNDARY

EXISTING ZONING

- EXISTING ZONING (SEE FIGURE 1 FOR LAND USE)

FUTURE ZONING

- COMMERCIAL ZONING
- COMMERCIAL RETAIL ZONING
- INDUSTRIAL AGRICULTURE ZONING
- INDUSTRIAL COMMERCIAL ZONING
- LIGHT INDUSTRIAL ZONING
- INTERCHANGE DEVELOPMENT ZONING
- LOW DENSITY RESIDENTIAL ZONING
- MEDIUM TO HIGH DENSITY RESIDENTIAL
- PUBLIC AND SEMI-PUBLIC ZONING

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KELLER ASSOCIATES

Water Distribution Facilities Planning Study

Future Land Use

FIGURE 2.4

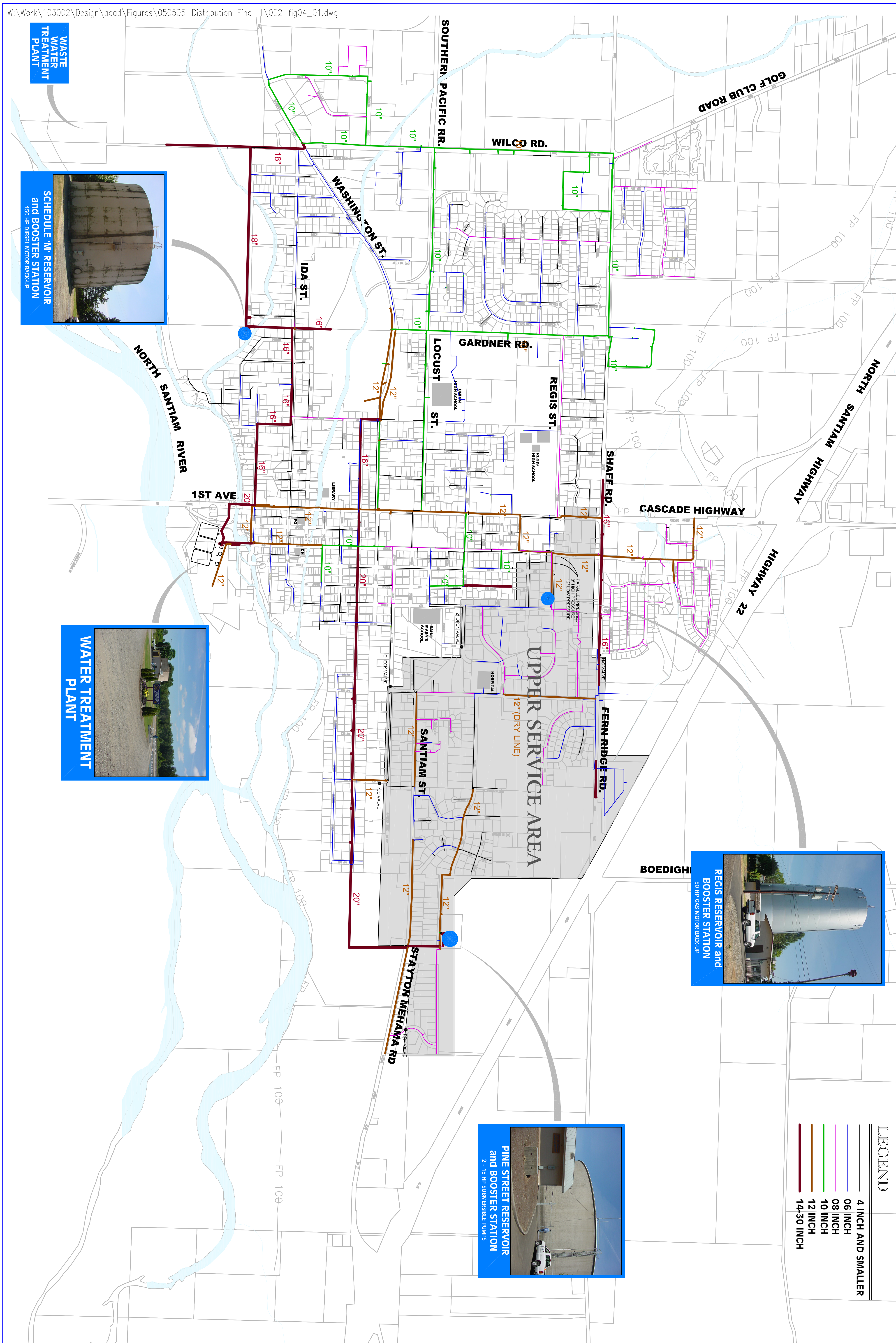

FIGURE 4.1

Existing Distribution System

Water Distribution Facilities Planning Study

CITY OF STAYTON

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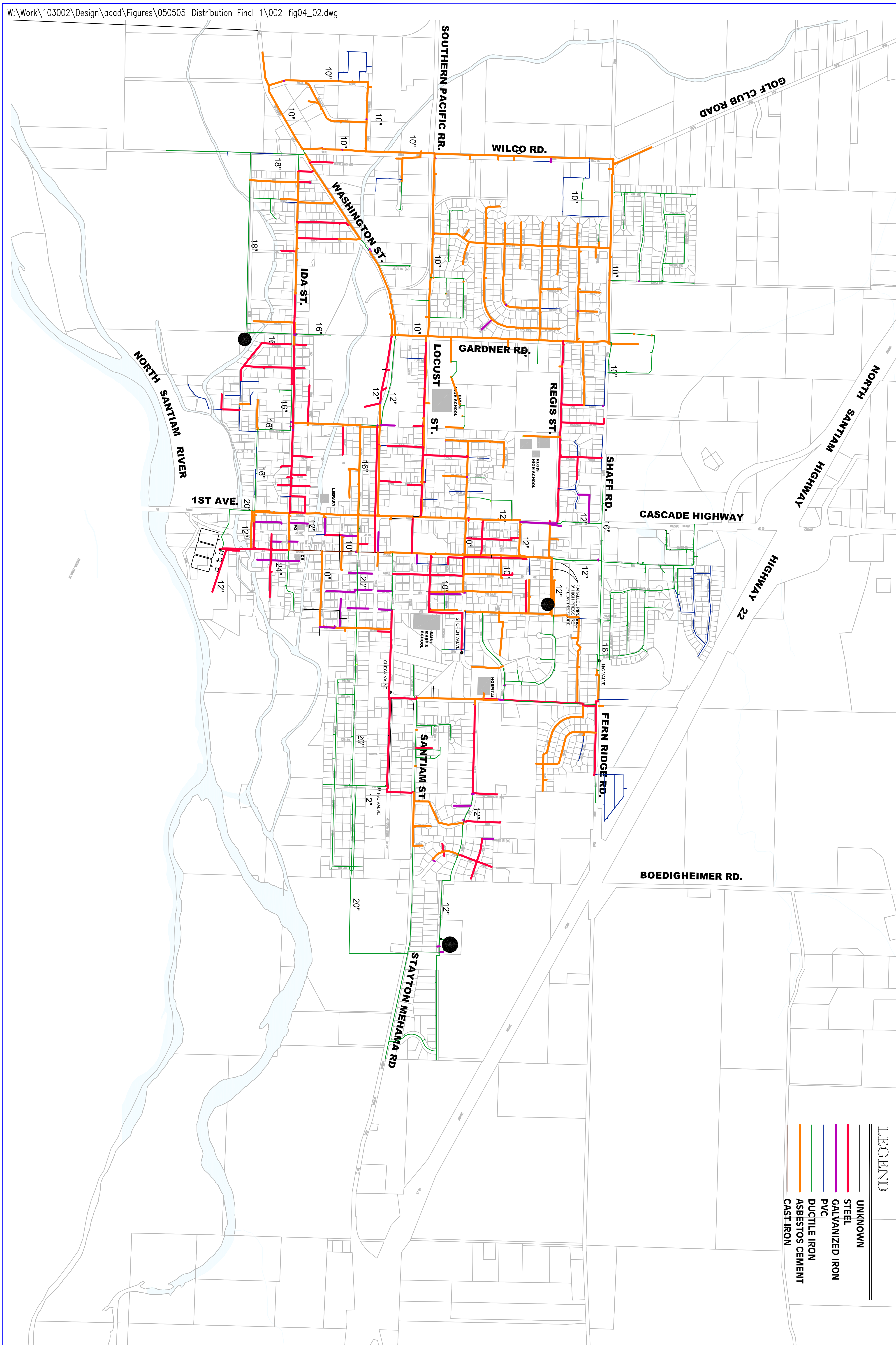

FIGURE 4.2

Existing Pipe Types

Water Distribution Facilities Planning Study

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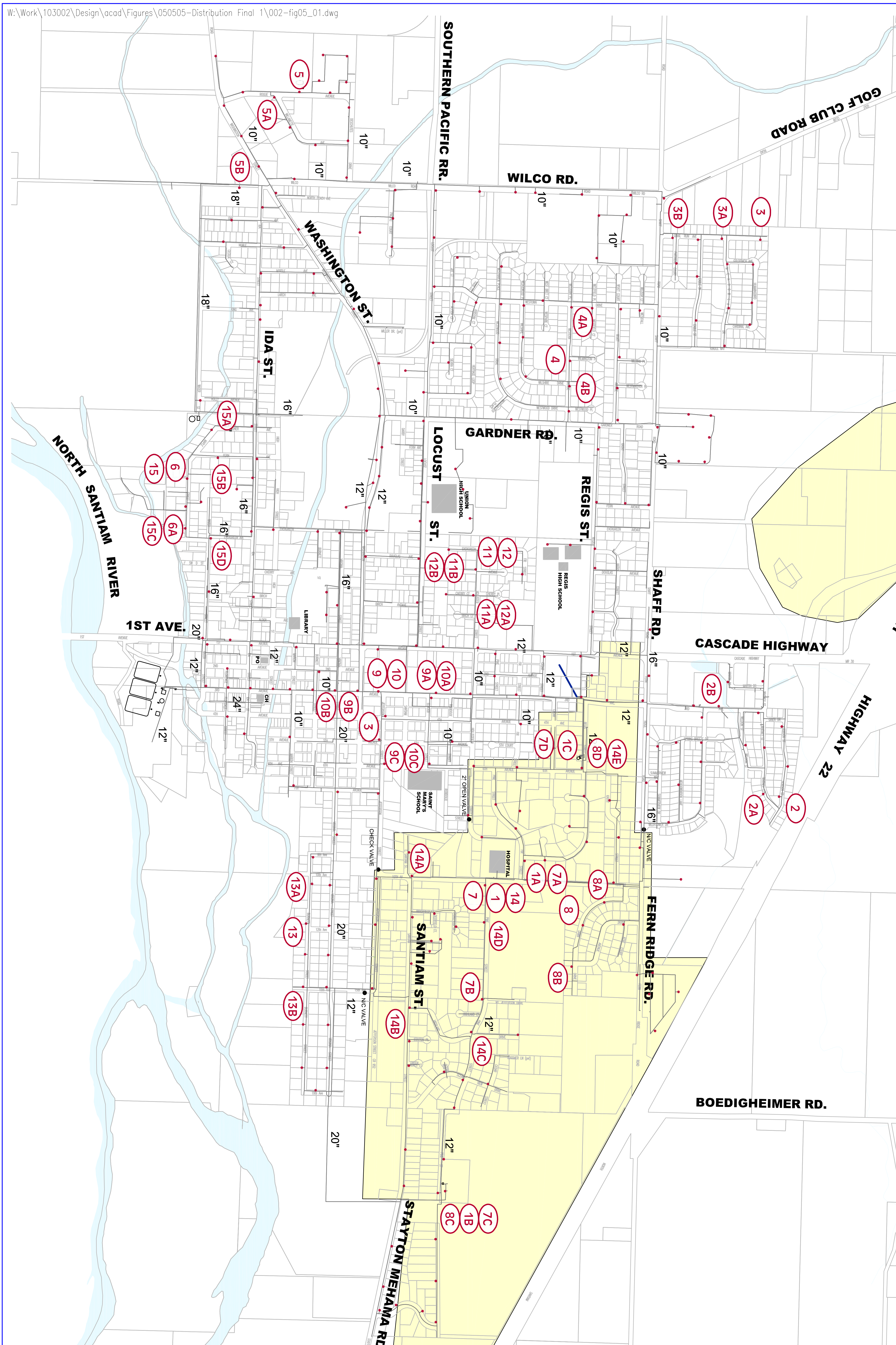

FIGURE 5.1

Fire Flow Test Locations

Water Distribution Facilities Planning Study

City of Stayton

KELLER ASSOCIATES

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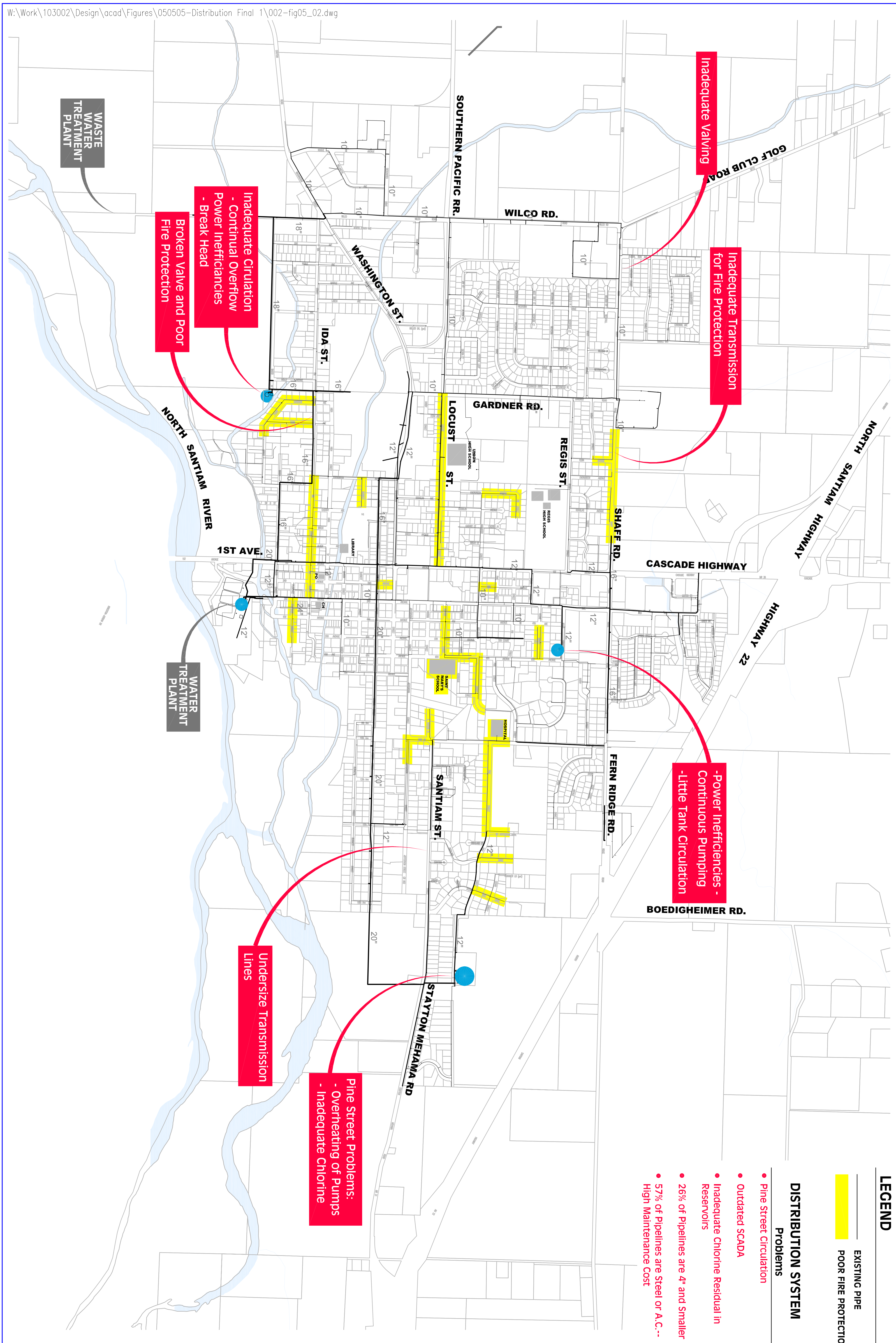

FIGURE 5.2

Existing Problems

Water Distribution Facilities Planning Study

CITY OF STAYTON

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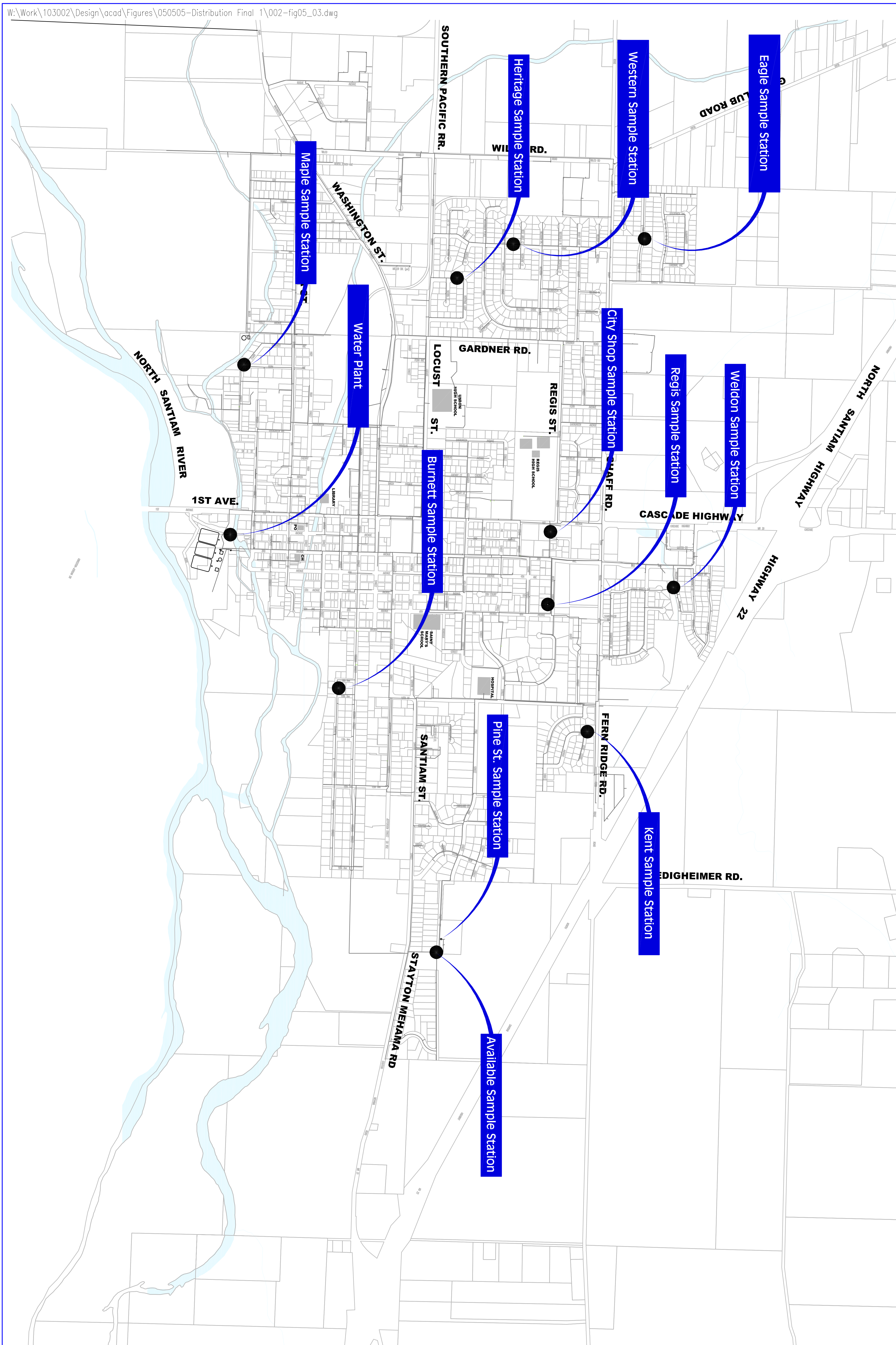

FIGURE 5.3

Water Quality Sampling Locations

Water Distribution Facilities Planning Study

CITY OF STAYTON

KELLER ASSOCIATES

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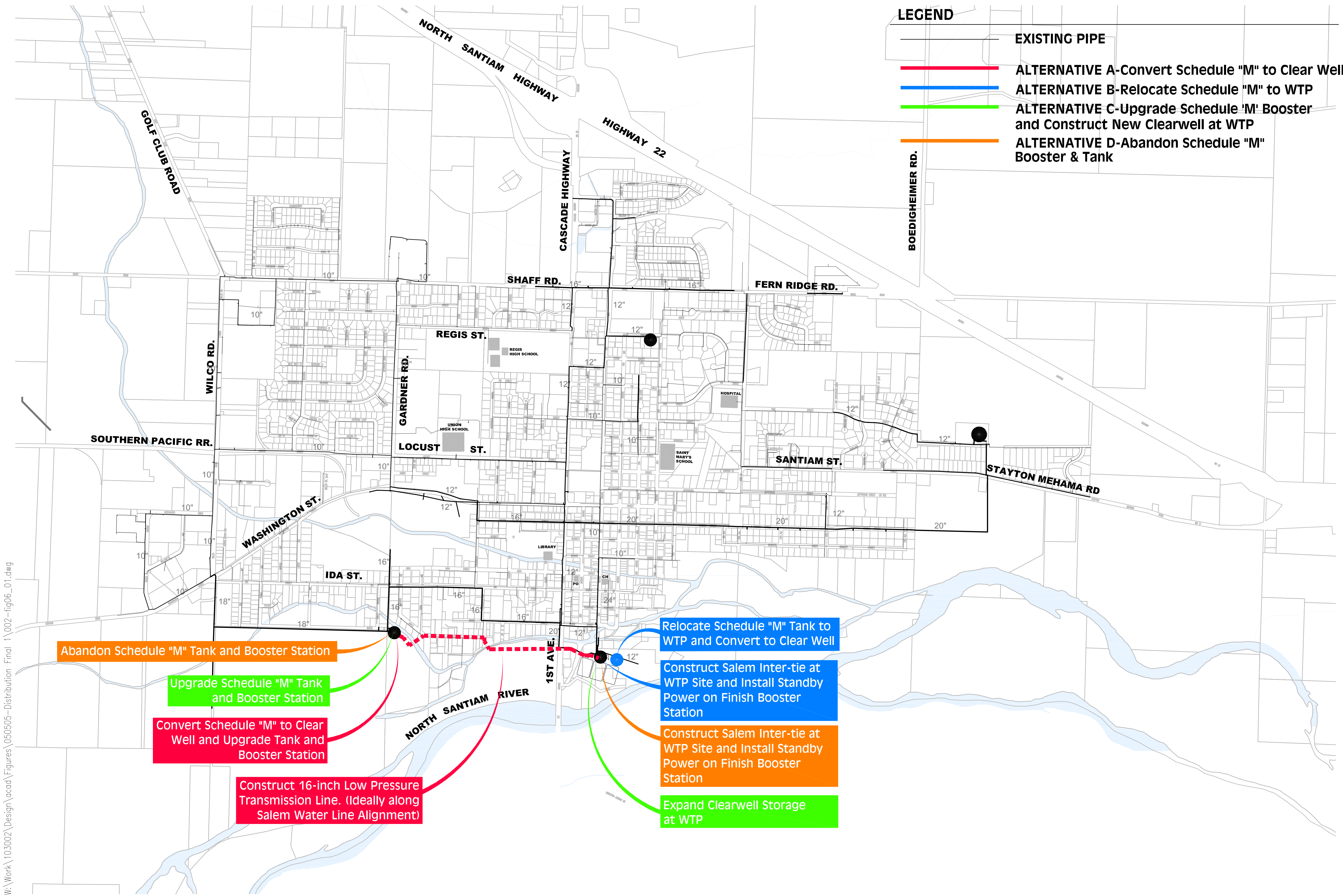

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FIGURE 6.1

Schedule "M" Alternatives

Water Distribution Facilities Planning Study

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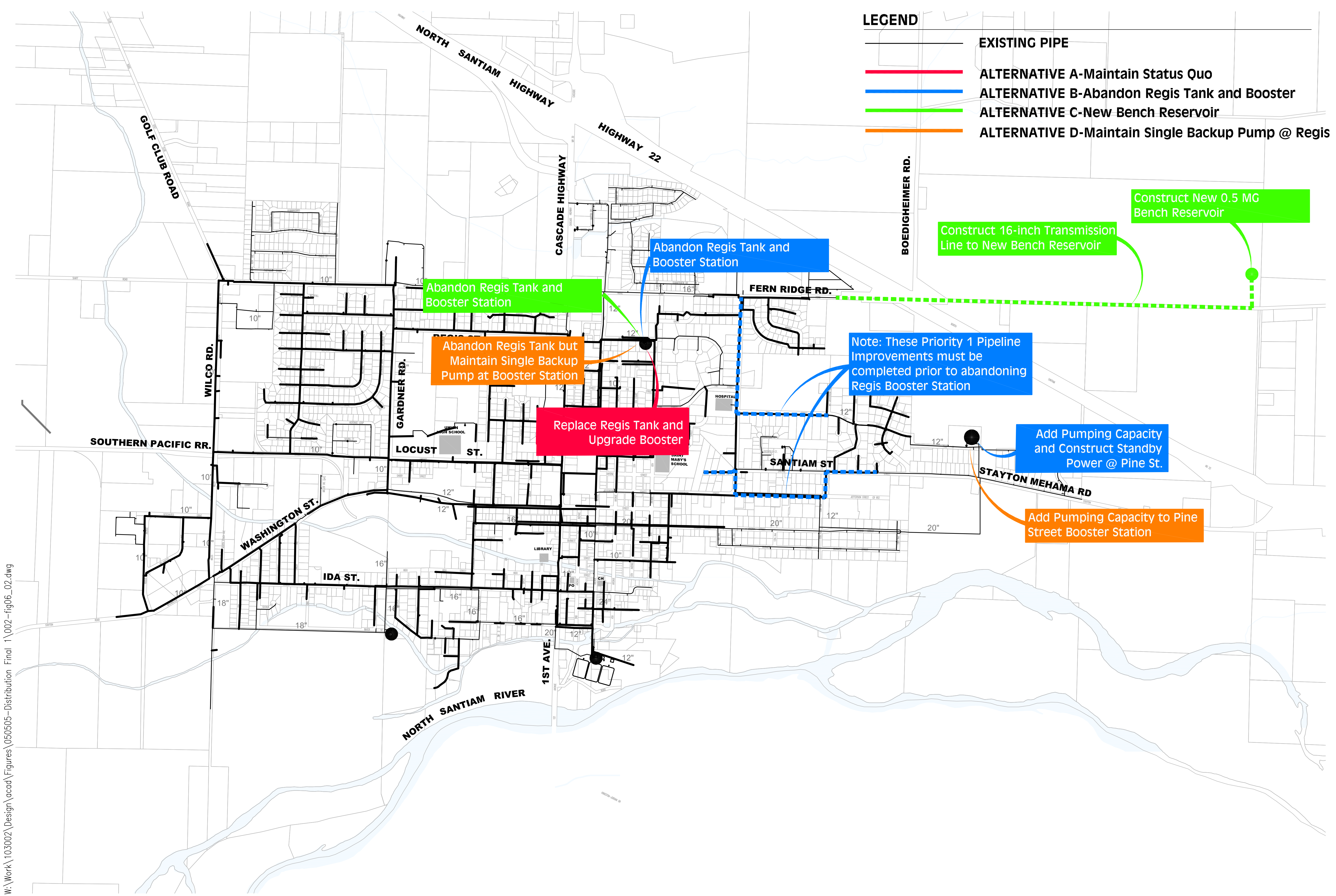

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FIGURE 6.2

Upper Pressure Zone Delivery Alternatives

Water Distribution Facilities Planning Study

KELLER ASSOCIATES

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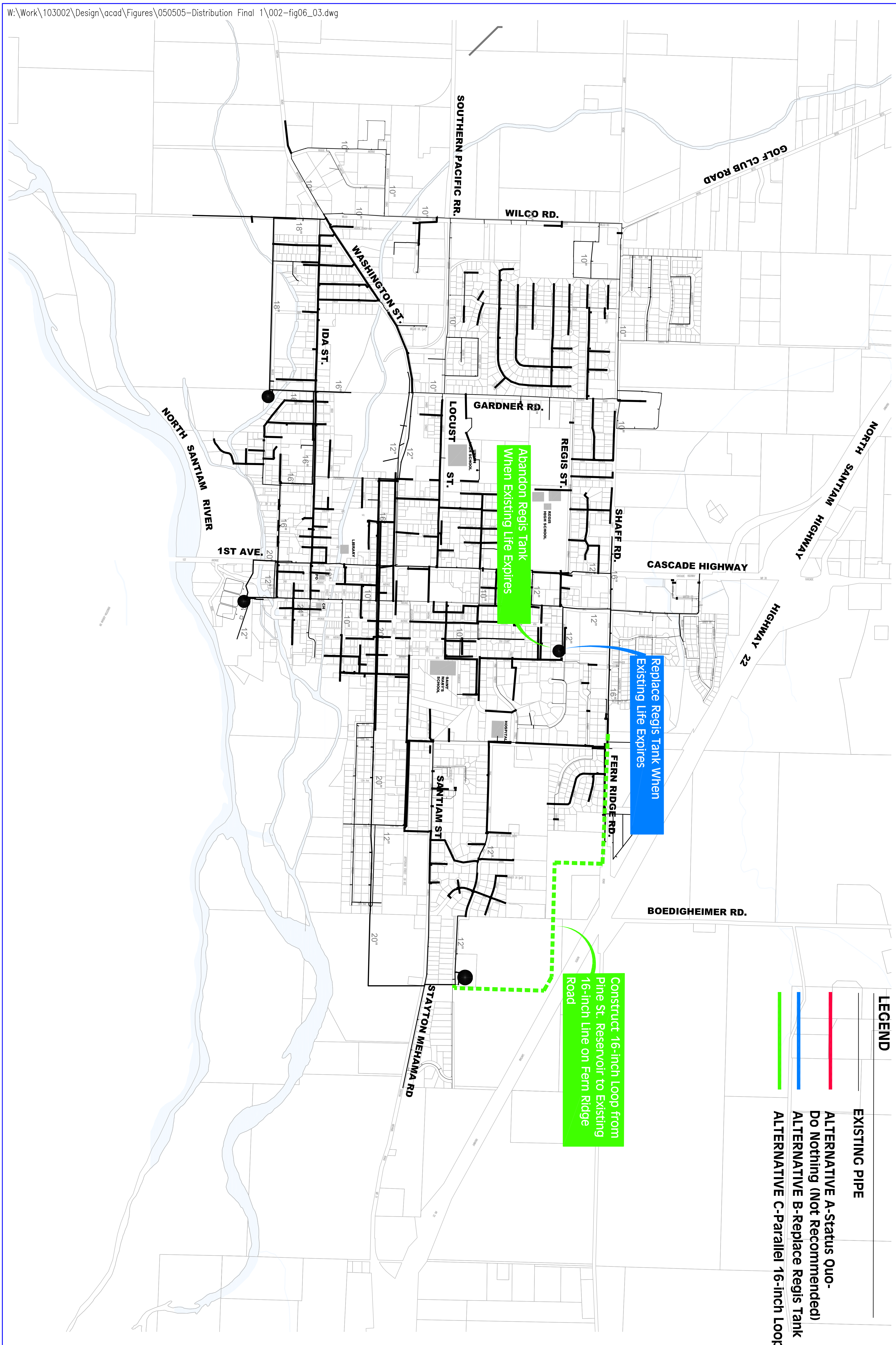

FIGURE 6.3

Regis vs Transmission Alternatives

Water Distribution Facilities Planning Study

CITY OF STAYTON

KELLER ASSOCIATES

KA:103002

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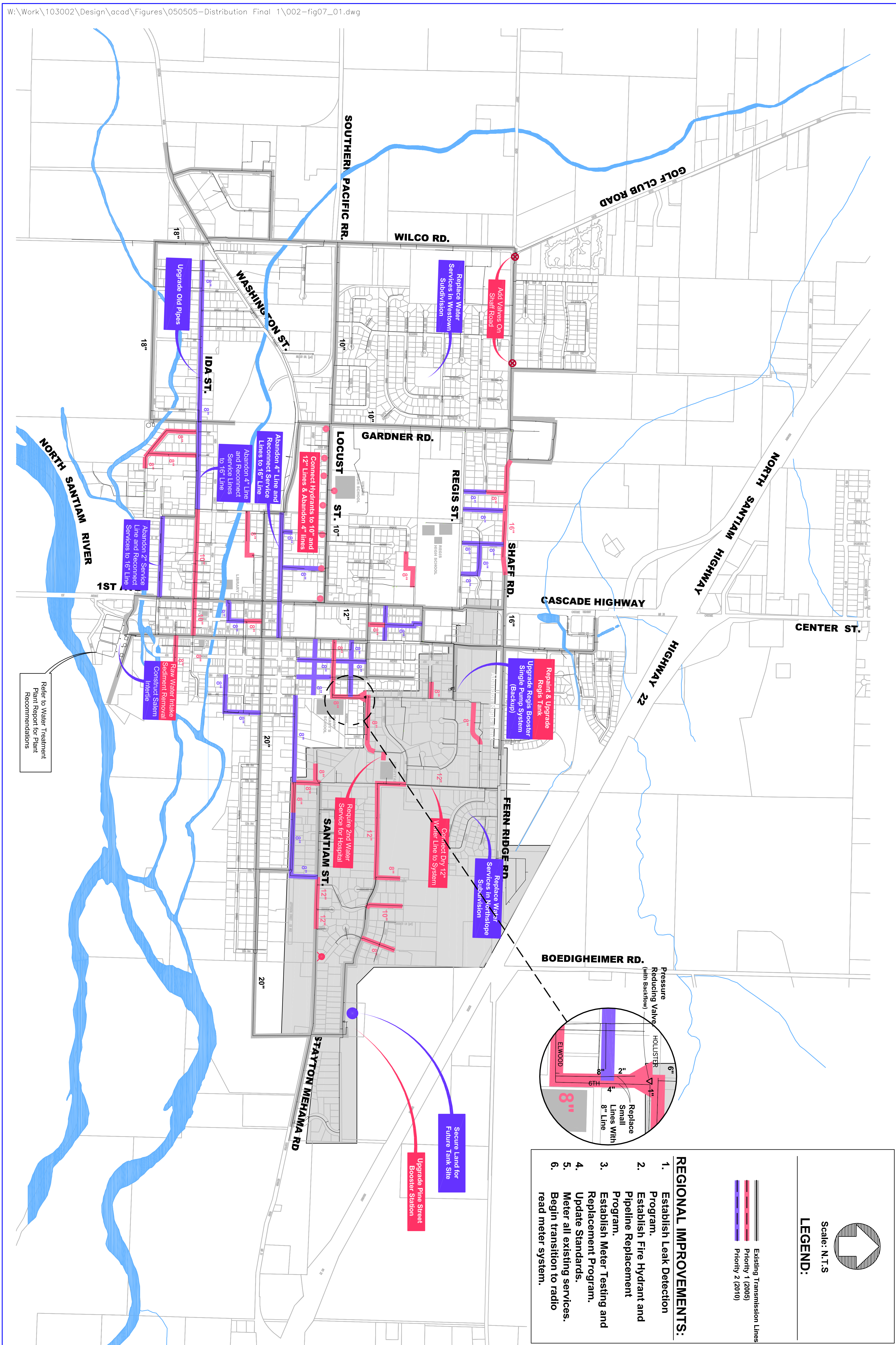

FIGURE 7.1

Priority Improvements

Water Distribution Facilities Planning Study

CITY OF STAYTON

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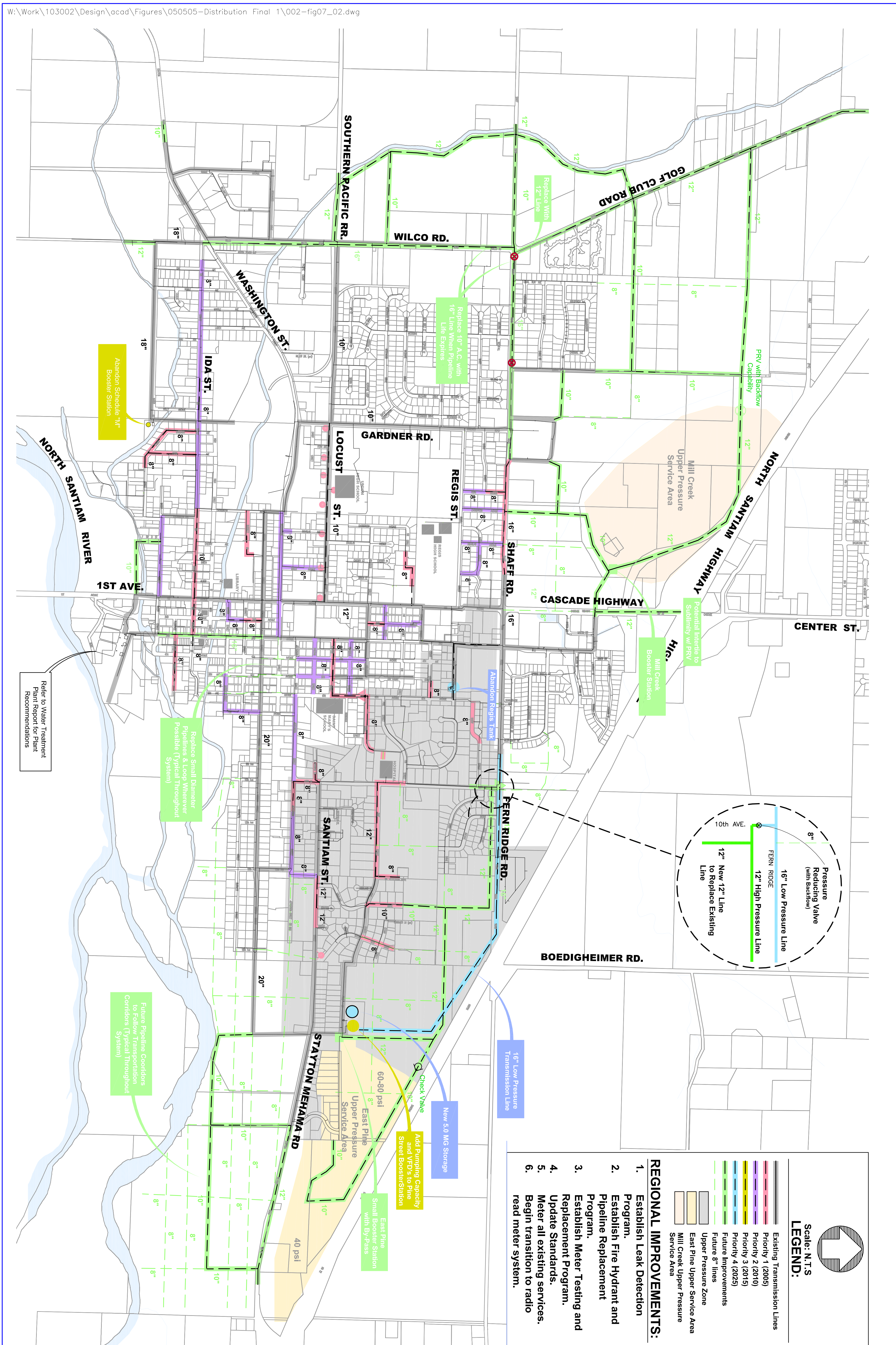


FIGURE 7.2

Water Master Plan

Water Distribution Facilities Planning Study

KELLER ASSOCIATES

KA:103002

002-fig07_02.dwg

Appendix B Water Reference Material

KELLER ASSOCIATES

Technical Memorandum

TO: Mike Faught, Public Works Director, City of Stayton
Tom Etzel, Water Superintendent, City of Stayton

FROM: James Bledsoe, P.E. and Justin Walker E.I.T.

DATE: March 26, 2004

SUBJECT: **Water Production/Use Summary**

Historical Water Production: The City of Stayton currently serves about 7,300 people located inside the city limits. These customers include single-residence homes, apartments, mobile home parks, assisted living centers, irrigation accounts, churches, schools, commercial users, and industrial water consumers. The industrial user, Norpac, is the largest water consumer and accounts for approximately 40 percent of the annual water consumption.

The main water source for the City is the Stayton Ditch. The Stayton Ditch is fed from the North Channel of the Santiam River via a diversion structure that is situated about 1 mile east of the water treatment plant site. The City's use of the Stayton Ditch is made possible through an interagency agreement with the Santiam Water Control District, which includes an annual use fee.

The Water Treatment Plant (WTP) also operates three shallow infiltration wells that are located adjacent to and between the canal and the North Santiam River. The wells supply supplemental water during peak demand and high turbidity events. It is reported that these wells collectively deliver between 800 gallons per minute (gpm) and 1,200 gpm of water to the WTP. The water levels in the wells are reported to fluctuate with the levels of the river, as would be expected with a shallow well source that is significantly influenced by the river.

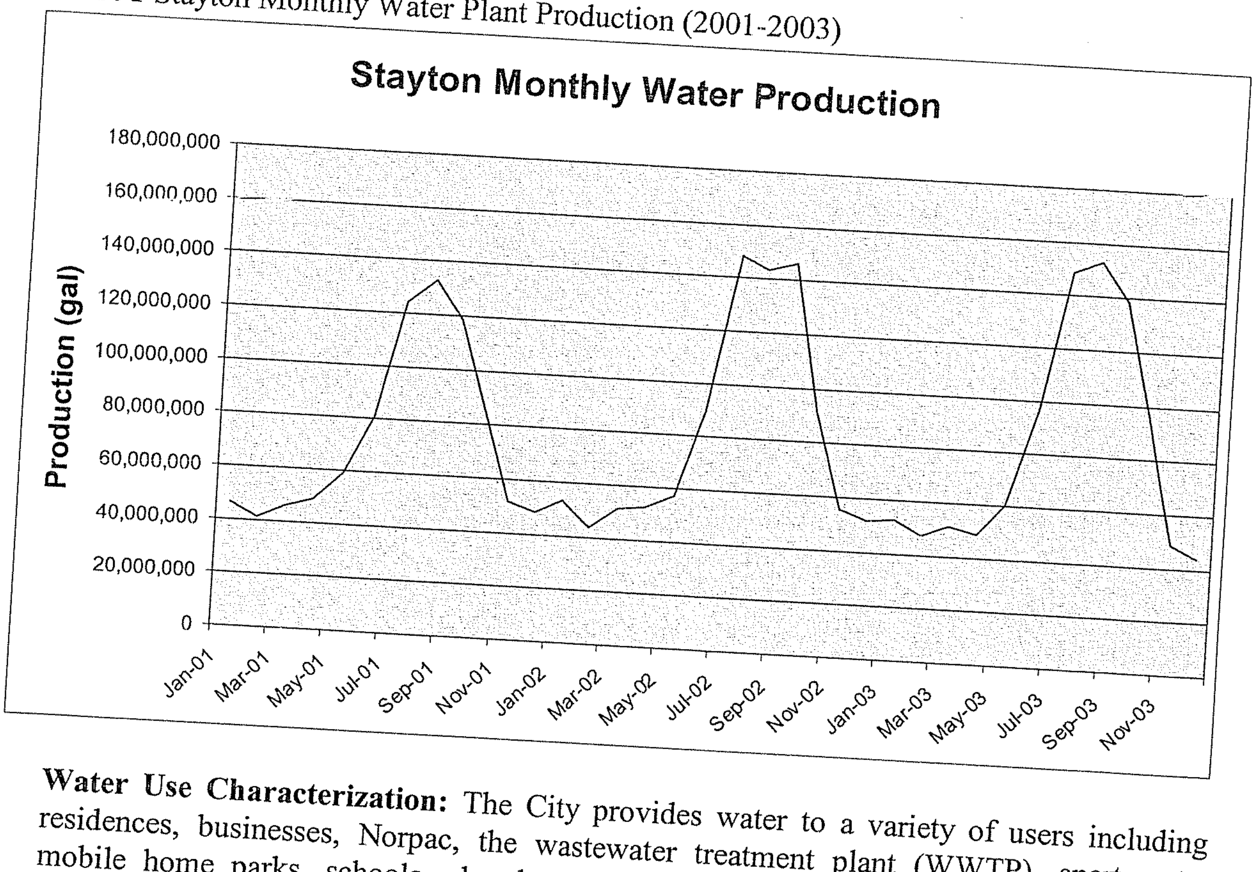
Water production has increased by nearly 12% over the last three years. Population inside the city limits has also experienced an increase, growing at about 4% over the last three years. Table 1 lists water production statistics for the past three years. Water production for 2001-2003 was used to develop the "Existing Demands", which were used for both evaluation and predictive purposes and correspond most closely to the production statistics of 2003.

Table 1 Historical Water Production in Stayton, Oregon

	Historical Water Production in MGD				Existing Demands (MGD)
	2001	2002	2003	2001-03 Average	
Average Day	2.42	2.70	2.71	2.61	2.71
Peak Day	5.19	6.08	6.65	5.97	6.50
Dry Weather (May-Oct)	3.26	3.68	3.77	3.57	3.75
Wet Weather (Nov-Apr)	1.56	1.70	1.63	1.63	1.65

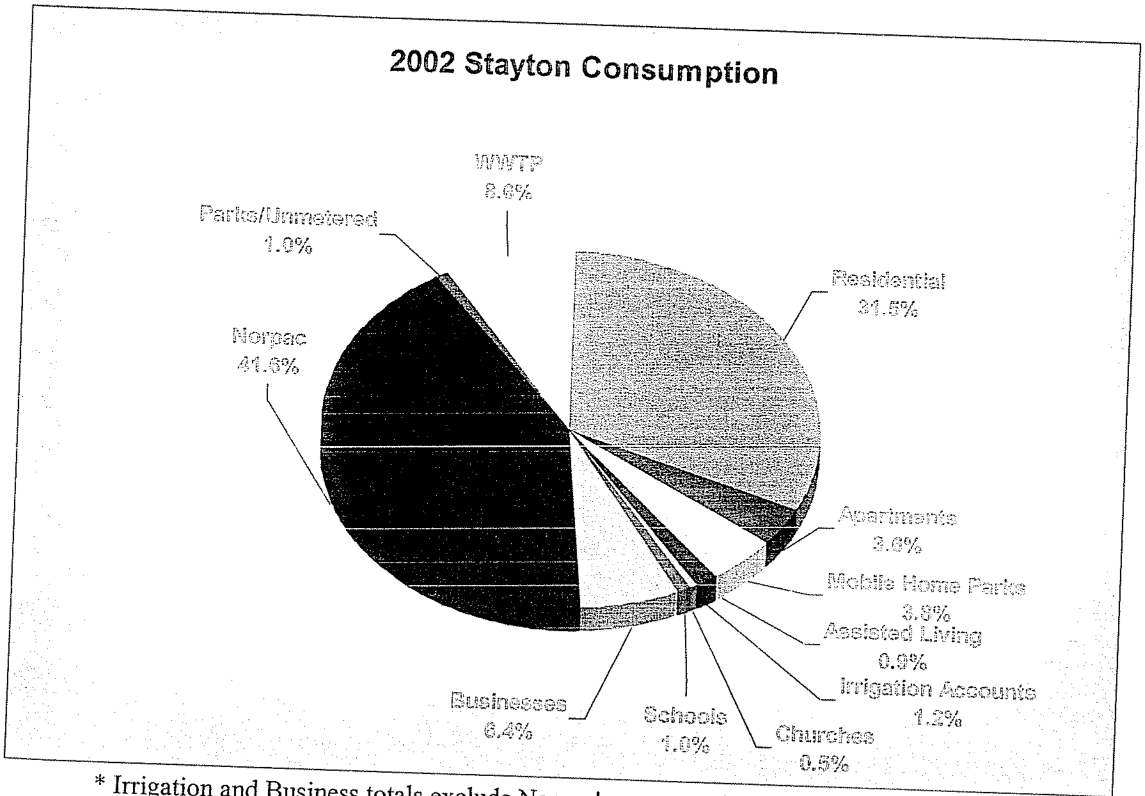
Chart 1 illustrates the seasonal variation in water production over the past three years. The peak in production during dry weather periods is generally a result of irrigation plus a peak in water use by the City's largest water consumer, Norpac Industries. The processing of beans and corn creates a peak in Norpac's water demand during the months of July through October. Chart 1 also illustrates the general increase in water demands, as both wet-weather and dry-weather production show an increase every year.

Chart 1 Stayton Monthly Water Plant Production (2001-2003)



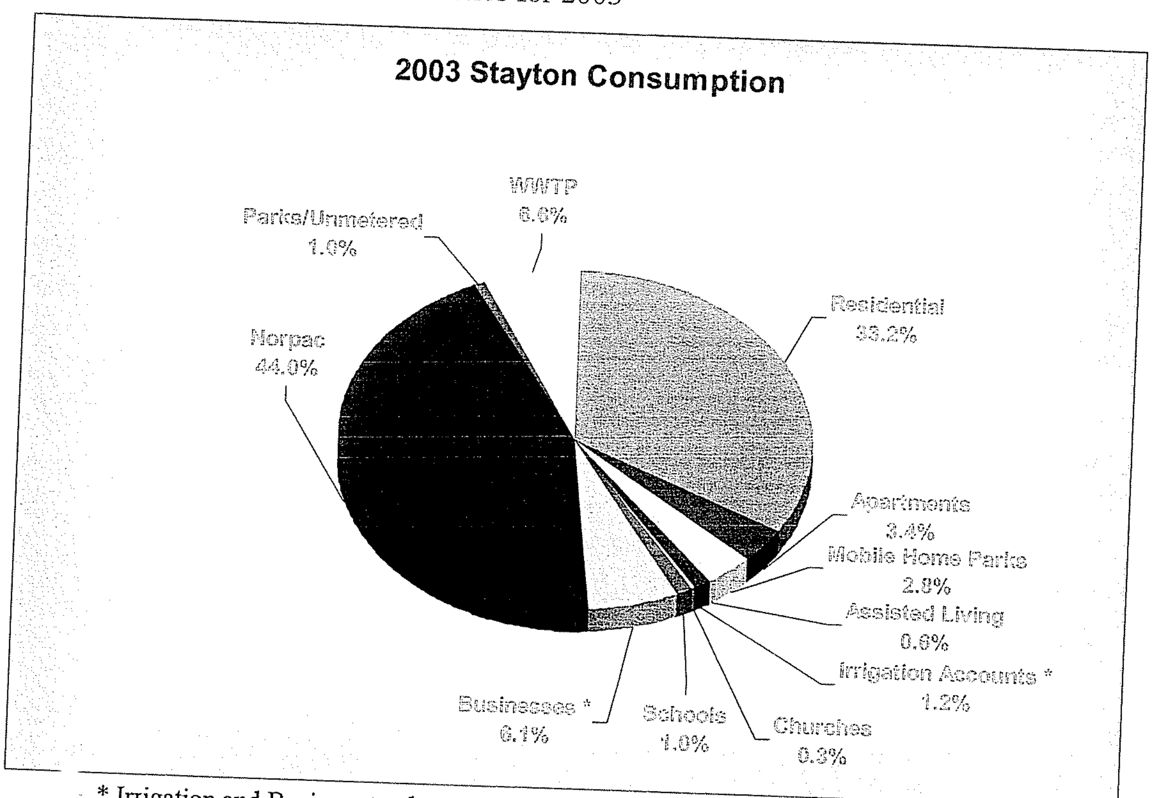
Water Use Characterization: The City provides water to a variety of users including residences, businesses, Norpac, the wastewater treatment plant (WWTP), apartments, mobile home parks, schools, churches, assisted living facilities, and parks and other unmetered water users. The general customer categories and their percentage of water use for 2002 and 2003 are illustrated in Chart 2 and Chart 3 respectively.

Chart 2 Stayton Water Use Statistics for 2002



* Irrigation and Business totals exclude Norpac's consumption.

Chart 3 Stayton Water Use Statistics for 2003



* Irrigation and Business totals exclude Norpac's consumption.

The "Residential" category includes both rental and owner-occupied single-family residences, and dominates the domestic water use for the city. Norpac accounts for around 41-44% of the total water consumption for the City. The "Parks/Unmetered" category includes the water used by the library, city hall, theater, community center, cemetery, water plant, public works building, and the pool in addition to the city parks. The water use for this category was estimated using information provided by the City.

Top Water Users: Because of their impact on operation of the water system, the top 30 water users were identified and their water consumption was analyzed. A summary of these top 30 water users and their demand is provided in Table 3. Next to Norpac, the City's wastewater treatment plant is the next largest water consumer. A majority of the water at the wastewater treatment plant is used as rinse water for the filter press. Other water is used for plant flushing, irrigation, and domestic use. Other top water users include schools, mobile home parks, apartment complexes, and commercial and industrial establishments.

The WWTP has the capability of eliminating the use of potable water to clean the filter press by using the water from the biosolids instead, but this reuse program is not yet in operation. Other conservation or reuse measures could include using treated water for irrigation. However, this type of reuse would require chlorination. Since the plant uses UV to disinfect, substantial improvements would be required to enable water reuse for irrigation.

Table 2 Top 30 Water Users in Stayton, Oregon

User	Average Annual Usage (gallons)	GPM			
		Peak Month	Average	Summer	Winter
Norpac	265,186,000	1,746	504.53	839.51	93.77
WWTP	54,778,793	132	104.22	112.10	107.99
Oak Estates Home	22,073,500	72.70	42.00	54.52	39.46
Philips Products 57	7,836,500	20.66	14.91	18.98	8.97
Boulders MH Park	5,455,000	17	10.38	12.62	10.13
Stayton Union High School	3,579,500	13.72	6.81	8.87	4.99
Wolf Ridge Apartments	3,570,500	14.41	6.79	8.53	5.49
City Parks	3,503,700	243	6.67	243	0.00
Santiam Memorial Hospital	3,086,500	13.09	5.87	8.70	3.54
Pioneer Apartments	2,975,000	6.84	5.66	6.14	5.70
Shell Station	2,579,500	8.54	4.91	6.57	3.05
Safeway Stores	2,407,500	6.42	4.58	5.03	3.68
Lakeside Assisted Living	2,377,500	10.56	4.52	7.10	2.58
East Santiam Manor	2,097,500	7.33	3.99	2.61	3.98
Rivertown Apartments	2,052,000	4.50	3.90	3.92	4.12
Stayton Middle School	1,906,500	11.64	3.63	7.13	1.15
Summit Window	1,843,000	5.81	3.51	4.74	2.41
Stayton Elder Manor	1,810,500	9.02	3.44	7.08	1.35
Marion Co. Housing	1,792,000	17.74	3.41	4.93	1.25
Santiam Cleanery Service	1,698,500	3.64	3.23	3.21	3.06
Northridge Apartments	1,439,000	8.81	2.74	7.47	0.12
Fir Crest Village	1,319,500	3.44	2.51	2.95	2.15
Regis High School	1,214,500	7.52	2.31	5.11	0.91
Community Center/Library	987,600	69	1.88	69	1.88
Dairy Queen	888,000	4.42	1.69	2.97	0.65
Arco AM/PM	870,500	4.44	1.66	3.43	0.27
McDonalds	859,000	4.55	1.63	2.37	0.70
Cemetary	768,000	25	1.46	25	0.00
Princeton Property Mgt.	715,000	2.15	1.36	1.54	1.13
Trus Joist Corp	698,500	1.93	1.33	1.54	1.26
Slayden Construction	692,500	5.01	1.32	2.95	0.23
Roth's IGA	658,500	1.55	1.25	1.38	1.19
WTP Irrigation	587,400	40.8	1.12	40.79	0.00
A&W Drive In	522,000	1.67	0.99	1.27	0.75
Ixtapa	497,000	1.19	0.95	1.05	0.96
Karsten Co.	273,500	1.04	0.52	0.58	0.18

TOTAL TOP USER CONSUMPTION	**405,599,993**	**2,548**	**772**	**1,535**	**319**
% of TOTAL WATER PRODUCTION	**42.6%**	**60.3%**	**42.6%**	**48.6%**	**28.8%**

Notes:
1) Summer includes June-August and winter includes December through February.
2) Domestic and Irrigation meters for each user are included in the calculations
3) Total water consumption was adjusted to include unmetered water usage at parks and unbilled, metered usage at the Wastewater Treatment Plant
4) The peak month flow for the WWTP is actually a peak week flow.

Water Balance: Table 3 compares reported water production data to consumption data. The difference between these two values represents the amount of system water loss. Based on this data, water losses account for 24 to 33% of all water leaving the water treatment plant. Division 86 in the Oregon Administrative Rules requires any water supplier with water loss greater than 10% to establish a leak detection program. Division 86 further requires a leak repair or line replacement program for water suppliers with water loss greater than 15%. Given the City's system loss, Stayton will be required to establish both programs.

Table 3. System Water Loss Summary

	2001	2002	2003
Water Consumption (gals)	622,800,848	658,667,442	748,133,442
Water Production (gals)	883,414,920	984,453,840	987,805,020
System Losses (%)	**29.5%**	**33.1%**	**24.3%**

Factors that could contribute to system water loss include:

- Inaccurate water meters. Generally, water meters underestimate flows as they age. Based on discussions with water meter manufactures, a residential water meter in a treated surface water system (generally soft, non-corrosive water) should accurately meter for 15-20 years for typical Stayton domestic use. According to City staff, most of the flow meters have been installed since the 1970s. As a result, a substantial percentage of the residential water meters have likely been in operation beyond their period of accuracy.

- Leaky pipelines and services. The structural integrity of water pipelines and services naturally degrades over time. Root penetration, improper installation procedures, and other factors can also create leaks which result in system water loss. Pipes constructed with certain materials, including steel and asbestos cement, are generally more susceptible to leaks. Figure 1 highlights pipes in the Stayton water system that are steel or asbestos cement. One extreme example of a leaky pipeline section is the two-block section of steel pipe located on Burnett Street near the public pool. Thirteen separate spot repairs have been made on this section of pipeline within the last several years. Another example of a leaky pipeline section is the 6-inch steel water line on Elwood Street.

- Unaccounted water use. Since water loss represents the difference between the water produced and the water consumed, water consumption that is not metered increases the water loss. Occasionally, cities use water for city purposes like street cleaning, public buildings, pools, fire protection, and line flushing that is not metered. Keller Associates has accounted for known unmetered water uses like the public pool, public buildings, parks, cemetery, WWTP, and WTP in the water balance calculations presented above. However, there are likely other unmetered water uses that add to the water loss, such as street cleaning, line flushing, and others. Keller Associates recommends that all water uses be metered where possible, regardless of whether or not they are invoiced.

It is to the City's advantage to minimize system water loss by addressing the potential problems above. System loss represents water for which the City pays to pump and treat but is not reimbursed through water utility rates. Water loss represents a loss in potential income and a valuable natural resource.

Keller Associates suggests the City implement the following recommendations to reduce the system water loss.

- Begin a flow meter calibration and replacement program by replacing 125 meters per year. By replacing 125 meters every year, the residential water meters will be replaced every 20 years. We have identified the priority areas for the meter replacement program in Figure 1.

- As part of the replacement program, Keller Associates recommends that the old meters be tested for accuracy. An alert meter reader should be able to spot an under-registering meter by a quick comparison with past readings. The accuracy versus age of the meters will be tracked in order to determine if a correlation between age and accuracy can be drawn. It should be noted that the priority areas identified in Figure 1 would likely contain water meters with ages that range from 5 to 30 years old. In addition, this program would attempt to quantify actual system loss versus inaccuracies in the meter. It is recommended that at a minimum, a set of representative meters in an area be tested every 5 years.

- Because of the high volume of water demand from Norpac, a faulty Norpac meter could result in a large unaccounted water loss and lost revenue. Therefore, it is recommended that the Norpac water meters be tested at least annually.

- Develop a leak detection program. Special attention should be given to those pipes constructed with steel and asbestos cement (AC) because they are generally more susceptible to leak problems (See Figure 2). The schedule of the leak detection program should also reflect the age of the pipe, with attention given to the older pipes first.

- Develop a pipe replacement program and use leak detection techniques and results to prioritize pipeline replacements. Coordinate pipeline replacement projects with street improvements wherever possible.

Water Production Projections: A similar procedure to that used for both Mill Creek and the Stayton wastewater flow projections was used to project Stayton water demands over the next 20 years. Water demands were calculated by adding the existing water usage recorded at the WTP and future demands projected for currently undeveloped land inside the Stayton study area.

In an effort to project future water demands, the existing water usage was categorized into residential, non-residential, Norpac, and water loss. The non-residential category includes commercial, industry excluding Norpac, WWTP consumption, and public water demand. For comparative purposes, the demand for each of these categories was averaged over the Stayton population so demands could be compared and projected on a per capita basis. Table 4 summarizes the demand for each category in gallons per capita per day. The severity of the system water loss is apparent by comparing the residential demand and the water loss. On an average day, the same amount of water used by the entire residential sector is lost from the system. The non-residential water demand stays fairly constant on a seasonal basis, averaging out to be about 46 gpcd. Norpac uses the largest percentage of water in comparison to the other categories.

Table 4 Existing Flow Summary

Yearly Statistics		**Existing Demands Per Capita**				
	Existing Demands (MGD)	**Existing System (1) (gpcd)**	**Residential (gpcd)**	**Non-Residential (gpcd) (2)**	**Norpac (gpcd)**	**Water Loss (gpcd)**
Average Day	2.71	371	106	46	114	106
Peak Day	6.50	890	N/A	N/A	N/A	N/A
Dry Weather (May-Oct)	3.75	514	147	56	197	113
Wet Weather (Nov-Apr)	1.65	226	64	35	29	97

Notes:

(1) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(2) Non-residential flow per capita per day excludes Norpac Demand.

Future demands were generated by adding the existing demands to the additional water demand created by development. The demands assumed for new development, presented in Table 5 were calculated by adding the existing demand, 45 gpcd for new non-residential demand, 50 gpcd for industrial water use, and 5% assumed water loss. The average day demand for new development is based on 210 gpcd (106 gpcd residential + 45 commercial/public + 50 industrial + 5% water loss).

It is assumed that the City will pursue a leak detection, pipe replacement, and meter replacement and testing programs to reduce the current water loss. If future water improvements experience water loss at the current rate, the future projections could be too low because actual water loss would be larger than the 5% water loss assumed in new development. Future projections assume existing demands remain constant for existing development. This provides for some conservatism in future projections if the City pursues an aggressive leak detection and removal program. The projected demands for 2015, 2025, and build-out are summarized in Table 5.

Table 5 Water Demand Projections

Yearly Statistics	Evaluation Flows in MGD				
	New Development (gpcd) [3]	Existing Demands (MGD) [2]	2015 Flow (MGD)	2025 Flow (MGD)	Build-out Flow (MGD)
Stayton Population [1]	N/A	7300	8570	10213	19172
Average Day	210	2.71	2.98	3.32	5.20
Peak Day [4]	500	6.50	7.14	7.96	12.44
Dry Weather (May-Oct)	270	3.75	4.09	4.54	6.96
Wet Weather (Nov-Apr)	160	1.65	1.85	2.12	3.55

Notes:

(1) Population data from Portland State University Research Center (PSU).

(2) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(3) New development includes residential and non-residential flows plus 5% water loss (which is substantially less than observed in the existing system). Some additional industrial demand (50 gpcd) but not to the magnitude of Norpac, was also assumed. Actual future demands will be a function of the type of future industry that locates within Stayton.

(4) In determining peak day demand for new development, a peak day factor (peak day divided by average day) of 2.4 was used. This is consistent with the existing peak day factor (890/371 = 2.4).

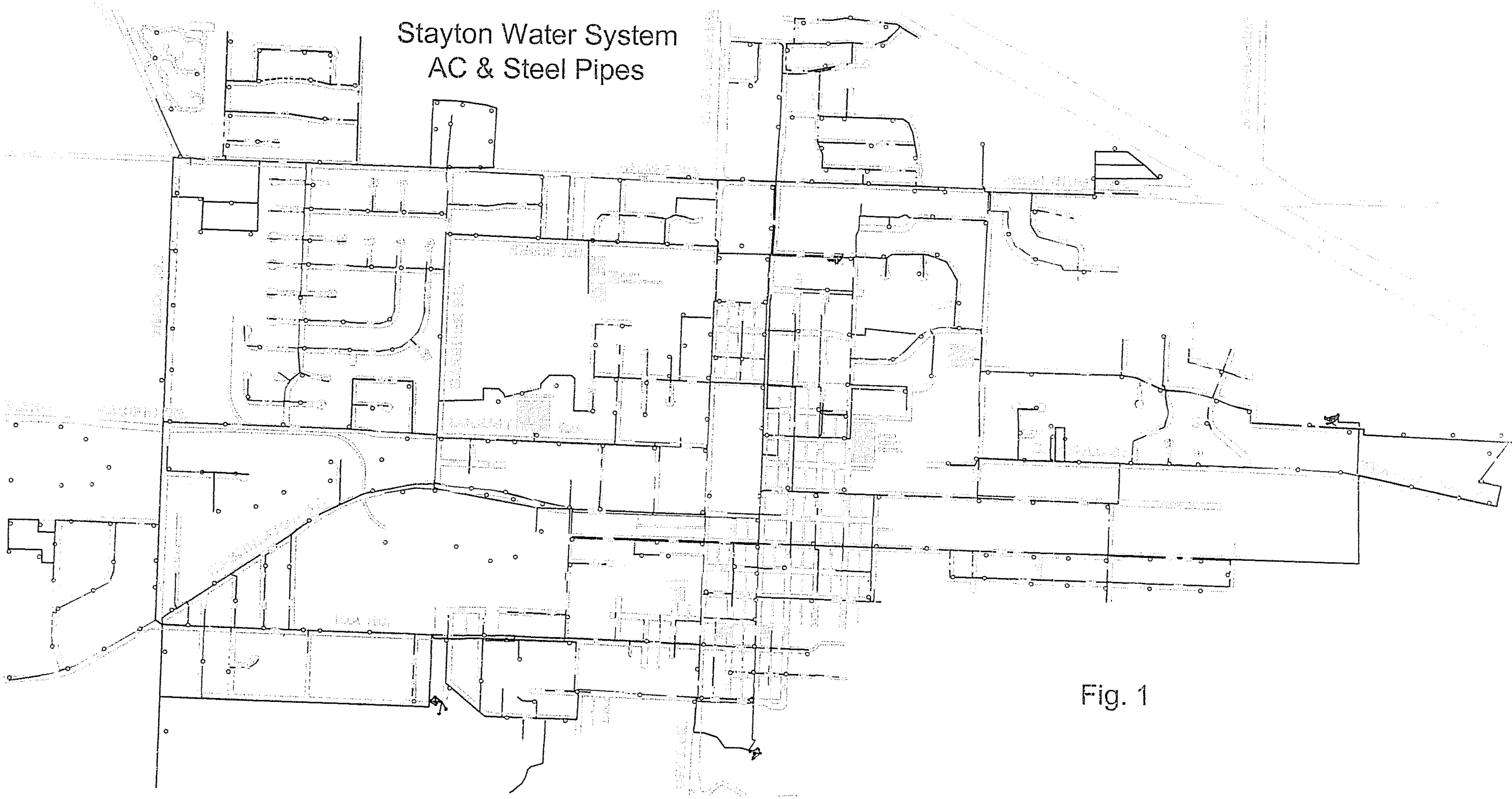
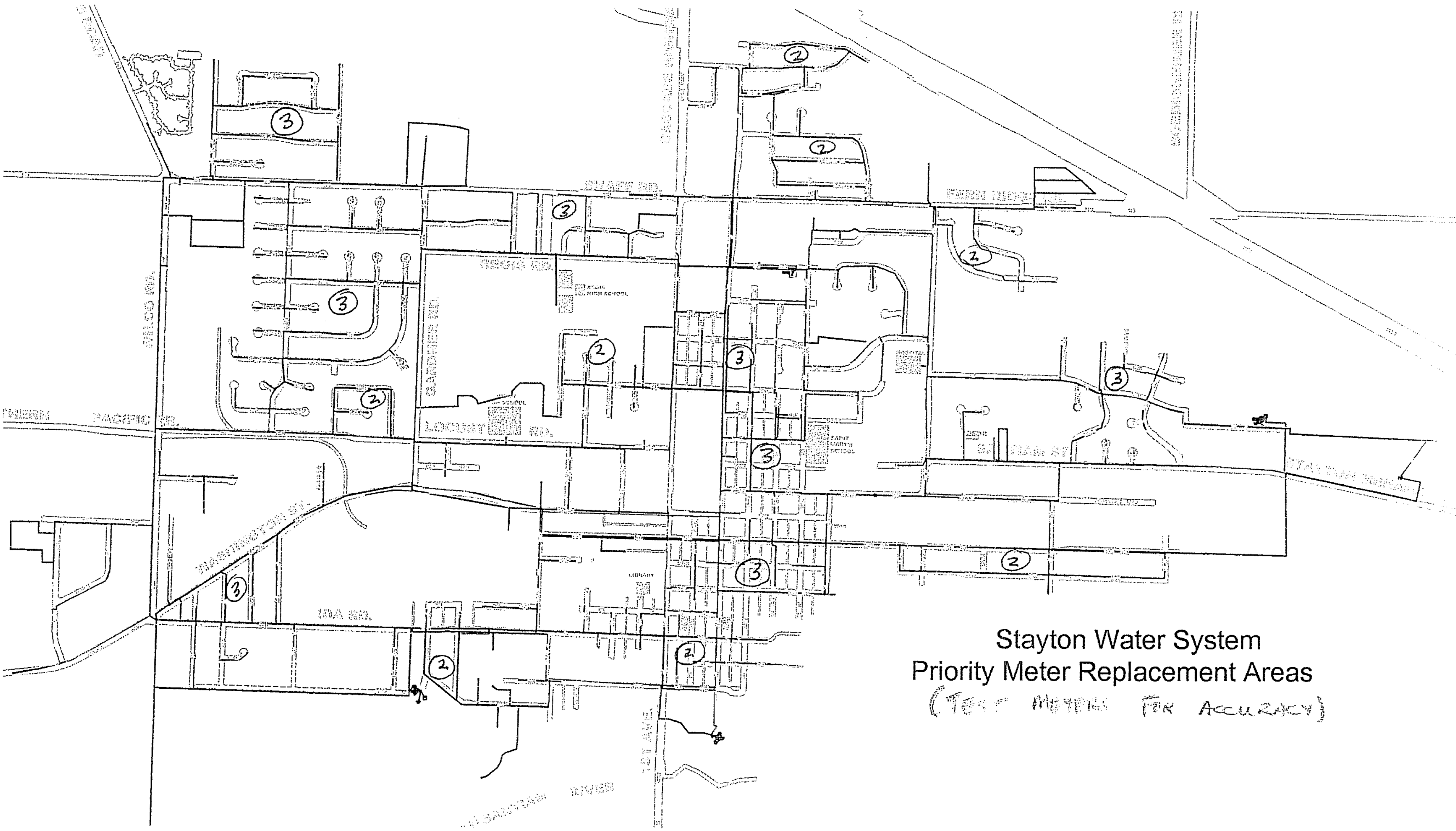


Fig. 1



Stayton Water System
Priority Meter Replacement Areas
(TEST METERS FOR ACCURACY)

Fig. 2

Steven P. Applegate Consulting
532 Inverness Dr. SE
Salem, OR 97306
Voice/Fax (503)362-4040

June 18, 2003

Post-it® Fax Note 7671	Date 01/29	# of pages ▶ 4
To James Bledsoe	From Steve Applegate	
Co./Dept. Keller & Assoc.	Co.	
Phone #	Phone # 503-362-4040	
Fax # (206) 788-1979	Fax #	

Mr. Mike Faught
Public Works Director
City of Stayton
362 North 3rd Avenue
Stayton, OR 97383

REFERENCE: City of Stayton Water Rights

Dear Mr. Faught :

This is an update to my May 30, 2002, report. It reflects all of the changes and clarifications we have been able to develop over the past year.

The table below lists all of the rights the City currently holds, their significant data and current status. Attached to this report are copies of the relevant documents that define these rights in the official record at the Water Resources Department (WRD).

City of Stayton Water Rights

Appl*	Permit	Cert.	Source	Use	Q(cfs)	POD	Priori	Remarks
T-5883		80346	N. Santiam	Mun	2.78+	Power Canal	1909	779.5 AF annual limit
T-5884		80347	N. Santiam	Mun	0.82+	Salem Ditch*	1911	230.6 AF annual limit
T-5885		80348	N. Santiam	Mun	0.39+	Power Canal	1909	78.5 AF annual limit
T-8871		80349	N. Santiam	Mun	0.6~	Power Canal	1907	No annual limit
39297	29266	57094	N. Santiam	Mun	7~	Power Canal	1963	
71584	52447		N. Santiam	Mun	25#	Power Canal	1991	Extension pending to 2050
		Subtotal-Surface Wtr			36.59			
GR-145	Gr-139		Inf. Trench	Mun	2.67~	NWNE Sec15	1930	Groundwater adjudication
G-270	G-173	24587	Well 2	Mun	3~	NENE Sec.15	1956	
		Subtotal-Groundwtr			5.67			
		Total			42.26 cfs			

**- Salem Ditch and Stayton Power Canal assumed in the record to be the same point- 1800 feet South and 2830 feet East from the West 1/4 Corner Section 11.*
+-May through September only-3.99cfs; ~Year around use-13.27cfs; #- October through April only-25cfs.

The water rights allow for the total use of up to 36.59 cfs (16,429 GPM or about 24 MGD) from surface water and 5.67 cfs (2,545 GPM, or 3.6 MGD) from groundwater. However, as noted on the table and further described below, many of the rights have season of use limitations. The individual rights are further described below.

<u>Surface Water Rights-</u>

The City holds six rights that allow for use of up to 36.59 cubic feet per second (cfs) (16,429 GPM) from the North Santiam River. Priority dates range from 1907 to 1991. All but one of these are final rights evidenced by certificates that total 11.59 cfs.. One of the rights from the river (Permit 52447, 25 cfs) is "inchoate," or incomplete. Proof has not been made by the City to allow the final water right to be issued. The City has requested an extensions of the time limits for this permit until such time as the full amount of the use is actually developed. The alternative is to give up any undeveloped water at some point. Obviously, it will be some time before even peak demands approach 36 cfs.

Certificates 80346, 80347 & 80348- Transfers 5883, 5884 5885 were obtained by the City in 1986 through changes in character of use of irrigation rights previously held by the Santiam Water Control District and its patrons to municipal use by the City. The three certificates combined allow up to 3.99 cfs. These are some of the City's oldest rights. Because these water rights were initially for irrigation purposes, their exercise is limited to within the legal irrigation season, from May 1 to September 30. In addition, the three rights carry an annual aggregate volume limit of 1088.6 acre-feet, which was the original limit on the irrigation rights prior to the transfers.

Certificate 80349 -Transfer 8871 provided for a change of a 1907 right for 0.6 cfs for manufacturing use to Municipal use by the City. It is the oldest right held by the City. Exercise of the right is allowed year around and there is no annual volume limit.

Certificate 57094 - This is a 1963 right from the river for 7.0 cfs (4.4 MGD). The use is allowed year around and there are no special conditions or volume limits.

Permit 52447- This is the most recent (1991), and the largest (25 cfs) of the City's rights. In 1999, the City applied for an extension of the October 1, 1999, completion date for the permit. The request is to extend the required completion to the year 2060. That request is still pending. We recently submitted an updated extension request to conform with WRD's newly adopted rules for municipal extensions.

The most significant aspect of this permit is that use is allowed only from October through April. This was based upon a finding of limited water availability from natural flow when the permit was issued in 1996. Given that condition, this right may be of limited value to the City, especially given the quantities of water under the other rights that are available year around and during the summer months.

Permit 52447 also contains a condition that required the City to submit a Water Management & Conservation Plan (WMCP) within two years after the permit was issued, which would have been by July 8, 1998. As of this date, development of a Master Plan is under way. We will need to ensure that this plan is constructed to include all of the required elements of a WMCP to satisfy the requirements of WRD.

Potential New rights - The City of Salem, through an agreement with Stayton, is currently working on a proposed place of use transfer of 10 cfs of its 1923 municipal right from the river. The right is currently described under certificate 12033. I did not include this in the table. Although it would appear to be a "slam dunk," there are no guarantees the transfer will be approved. If it is approved, this will raise the City's rights from the river to a total 46.59 cfs, with 17.6 cfs being allowed year around.

Groundwater Rights-
Groundwater Registration (GR) #139- This is simply a claim in the statewide groundwater adjudication for uses that began prior to the 1955 Groundwater Act. The City's claim is for 2.67 cfs (1199 GPM) from an "infiltration trench" for municipal use. The claim is for a 1930 priority date, the date the development was allegedly constructed. This will remain in claim status until such time as the State (WRD) conducts a full survey and analysis of the use under all of the claims and submits their findings to the courts. The State still has about ½ of the state to complete this process for surface water, so it does not seem likely it will occur in most of our lifetimes. It is possible they could choose to initiate this process in small geographic areas if significant disputes were to arise relative to the claims, but this is not likely. The only caution is that the claim, its validity to be determined when the adjudication does occur, must remain in relatively continuous use, without significant (five years?) lapses. I do not know the status of use from this well. If the City is not using this well, but is using another well which develops the same groundwater supply, it is advisable to notify WRD of that fact. The information will be placed in the file and the validity of the claim ultimately will be decided by the courts. There are no guarantees.

Permit G-173 is a certificated (C.24587) right for 3.0 cfs (1,347 GPM) from "Stayton Municipal Well #2." I did not attempt to retrieve specific information about this well, but presumably, if a well log exists, it would be readily available. Since this right is certificated, there is nothing the City need do to maintain it. The certificate protects the right from forfeiture. No further use is required.

Recommendations- As described above there are a few items needing attention from the City relative to their existing water rights.

1. Permit 52447- Once a Water Management & Conservation Plan is ultimately submitted to and approved by WRD and the pending extension application is approved, this permit will be in good status. As discussed above, the Master Plan currently in progress must be developed with the state's requirements for WMCP's firmly in mind. Assuming the extension is approved, we will

have a set time within which to develop the WMCP.

2. GR-139 - If this source continues to be used, nothing is needed. If not, consideration should be given to protection of the claim. Further discussion is needed to determine how to proceed

3. Undeveloped Water- Since the City holds rights to a significant amount of water that is not yet developed, options may exist for marketing some of it to other municipal entities in the area, or forming some type of water authority. Water marketing transactions are becoming more common around the state, and can be done either on a lease or permanent basis. The commodity has a significant monetary value. I have some data on this activity in Oregon if you care to see it.

I hope this provides the analysis you need. Please feel free to contact me if you have questions or if I can be of further assistance.

Respectfully Submitted,

Steven P. Applegate
Steven P. Applegate Consulting

cc: Bryan Phinney, Keller Associates

ATTACHMENTS

KELLER ASSOCIATES

Technical Memorandum

TO: Mike Faught, Public Works Director, City of Stayton
Tom Etzel, Water Superintendent, City of Stayton

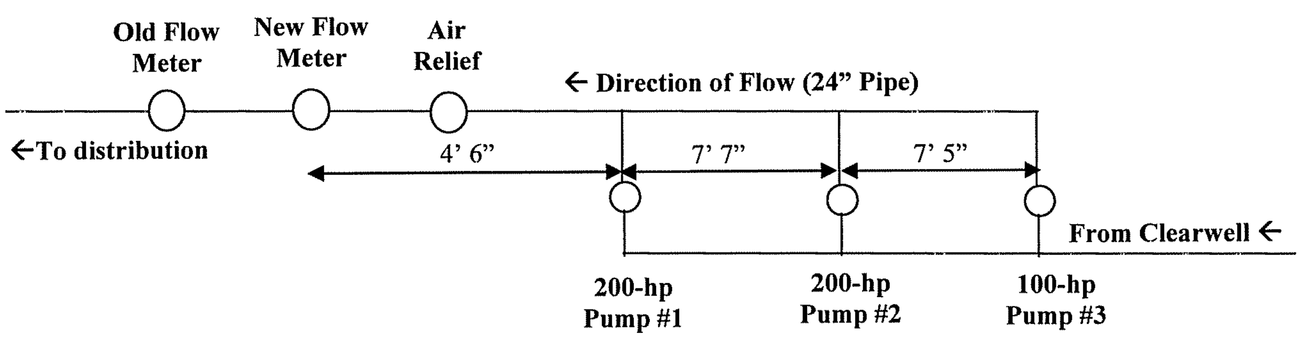
FROM: James Bledsoe, P.E. and Justin Walker E.I.T.

DATE: March 26, 2004

SUBJECT: **Water Treatment Plant Meter Analysis**

Background: Three booster pumps transmit water from the Stayton Water Treatment Plant (WTP) into the City water system. The three pumps include two 200-hp pumps and a 100-hp pump. The quantity of water distributed into the City water distribution system is metered by two different meters, an old and new meter. The old meter recorded flow based on pressure differentials across an orifice. Because of questions about the accuracy of the old meter, a new 200 Series Data Industrial meter was installed which reports instantaneous flow in gallons per minute (GPM) and total volume in one-gallon increments. The new meter records flow based on flow velocities as recorded by a propeller.

When the new meter was installed, the two meters were reportedly calibrated so as to report the same volume. The chart recorder was not compatible with the new flow meter. Therefore, the chart recorder continues to record instantaneous flow from the old flow meter. All production data reported for the plant correspond to data from the old flow meter. The schematic below illustrates the arrangement of each pump and their proximity to the flow meters. Because of Pump #1's proximity to the flow meter and the suspicion that its location results in erroneous flow readings, City staff uses Pump #1 very little.



Problem: It has become apparent that the accuracy of the flow meters is in question. The following points substantiate this theory.

- **Flow Readings:** The table below compares the instantaneous and totalized flow rates reported for each flow meter to the approximated pumping rate based on the pump curve and the flow rate measured on February 23, 2004. The flow rates reported from each flow meter are not consistent with each other. Additionally, instantaneous flows recorded by the flow meters are not consistent with totalized flow recorded by the same flow meter. Neither flow meter correlates with reported pump curves.

Table 1. Flow Meter Comparisons in GPM.

	Old Meter		New Meter		Pump Curves	Measured Flow Rate (2/23/04)
	Totalizer	Instantaneous	Totalizer	Instantaneous		
200-hp Pump #1	2607	-	3631	4175	~3500	**3355**
200-hp Pump #2	2024	2570	2503	3235	~3500	**3528**
100-hp Pump #3	2020	1909	1965	1944	~1820	**1808**

The totalizer and the chart recorder of the old meter record two different flows for both 200-hp pumps. Similarly, the instantaneous flow and totalizer flow recorded by the new meter do not correspond to each other when either 200-hp pump is operating. The two 200-hp pumps are identical and should theoretically discharge approximately the same flow.

Discrepancies between the actual flow rate measured on February 23, 2004 and the flow rate reported as plant production is largest for Pump #2 and Pump #1 with measured flows being 37% and 29% higher than reported values respectively. Flows reported from both the old and new meters appear to be fairly close to measured flows for Pump #3. This would result in reported rates correlating more closely to actual rates during low demand periods (i.e. winter months).

- **Water Balance Using Plant Reported Data:** A water balance of the overall water system reports high demand periods (i.e. summer) when the quantity of water consumed (billed for) exceeds the quantity of water reportedly produced. This is illustrated in Chart 1.

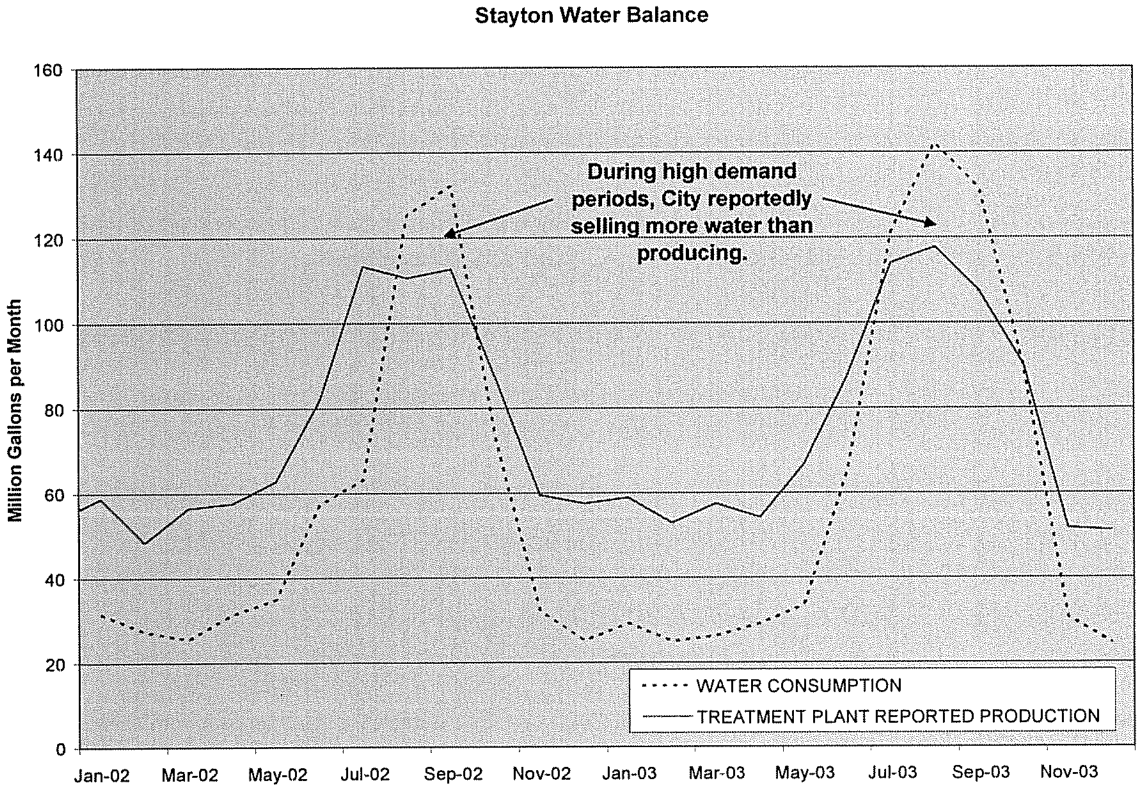


Chart 1. Stayton Water Balance

- **Proximity of Pumps to Flow Meter:** According to representatives from Emerson, a flow meter manufacturer, the type of flow meters at the WTP must have 10-22 pipe diameters of straight pipe upstream of the flow meter to assure reasonable accuracy. From the schematic above, only 2.25 pipe diameters exist upstream of the flow meter when pump #1 is operating. When pump #2 is operating, only 6 pipe diameters of straight pipe exist upstream of the meter, and when pump #3 is operating almost 10 pipe diameters of straight pipe exist upstream of the meter.

Water Flow Test: To determine the actual pumping rates for each of the pumps, a flow test was conducted on each pump at the WTP. The flow into the clearwell was blocked, and each pump was operated for 15 minutes. A water level was recorded in the clearwell before and after the 15 minutes of operation. The change in volume in the clearwell was divided by the duration of the test to determine the operating flow rate for each pump. The actual flow rate for each pump corresponded very closely to the flow rate predicted by the design pump curves. These flow rates are listed in Table 1 above.

Flow Meter Conclusions:

- Flows recorded by both meters seem to be accurate when only the 100-hp pump is operating. As can be seen in Chart 1, the production and consumption curves behave as expected in the winter months with the consumption curve paralleling the production curve. However, in the summer when the 200-hp pumps would operate to supplement flow, the consumption exceeds the production which confirms that the flow meters underestimate flows when the 200-hp pumps are operating.

- The existing meters are inaccurate and inconsistent with themselves when measuring instantaneous and totalized flows.

- The accuracy of both flow meters seems to be directly related to their proximity to each pump. When the 100-hp pump is operating which is furthest from the flow meters, the accuracy of the meters is the best. When either 200-hp is operating the accuracy declines sharply.

Correction to Production Data: It was determined by Keller Associates the most accurate way of adjusting production data to reflect actual pumping rates was to base production data on actual pump-run times. As a result, the pump run-time data for each of the WTP pumps for 2000-2003 were multiplied by the actual pumping rates determined from the water flow test to determine the corrected production data. A water balance chart showing the corrected production data versus consumption data is illustrated below in Chart 2. The behavior of the two curves is typical of water production and consumption data. The consumption curve essentially parallels the production curve with a slight negative offset which represents the system loss present in all water systems. Furthermore, there is a slight lag in the consumption curve due to the monthly billing process.

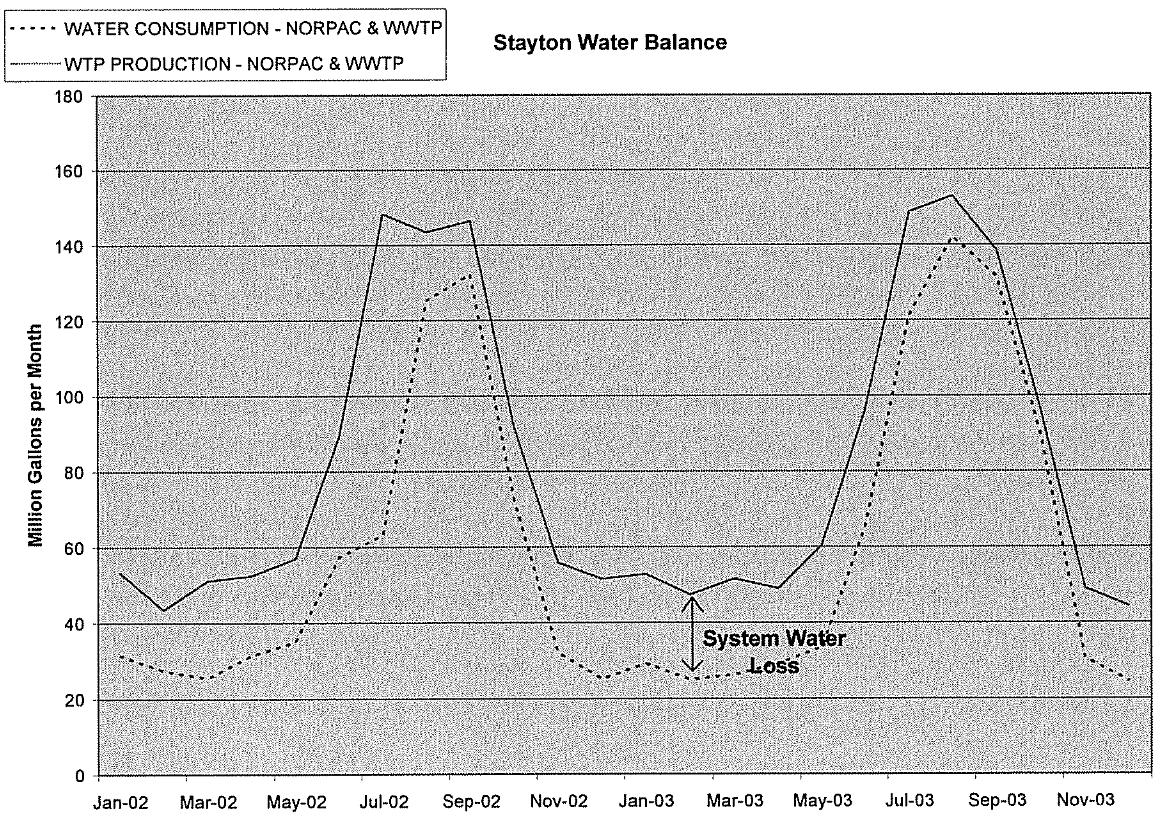


Chart 2. Corrected Stayton Water Balance.

Table 2 compares the old production data statistics to the corrected production statistics for 2001 through 2003. There was not a substantial flow change in the average day production. During high-flow times when the 200-hp pump was running, the existing flow meter underestimates water production by as much as 33%. During low-flow times when only the 100-hp pump operated, the flow meter overestimated water production by as much as 16%.

Table 2 Production data comparison.

	Old Production Data			Adjusted Production Data			% Change		
GPM	**2001**	**2002**	**2003**	**2001**	**2002**	**2003**	**2001**	**2002**	**2003**
Average Day	1626	1731	1737	1681	1873	1885	3%	8%	8%
Peak Day	2746	3031	3240	3602	4220	4862	24%	28%	33%
Peak Month	2369	2608	2638	2977	3391	3430	20%	23%	23%
Summer	2319	2541	2559	2839	3309	3324	18%	23%	23%
Winter	1185	1242	1307	1049	1147	1128	-13%	-8%	-16%

Recommendations: The proximity of the pumps to the flow meter is the primary reason for the poor meter accuracy. Flow meters need proper flow conditions to give constant and reliable results. The best way to get suitable flow conditions is to mount the flow meter in a section of pipe where there is nothing to cause a turbulent unpredictable flow condition. **For the City of Stayton, we recommend installing a new 30-inch electromagnetic flow meter in a vault outside of the finish pump station building.** Keller Associates estimates the probably cost for this improvement to be $42,360.

Mutual Water Agreement

This Agreement is made and entered into this 9th day of April, 2001, by and between the City of Salem, Oregon, an Oregon municipal corporation ("City of Salem"), and the City of Stayton, Oregon, an Oregon municipal corporation ("City of Stayton").

WHEREAS, City of Salem is the owner and operator of a community water system that supplies safe drinking water to customers in the Salem area, whose primary water source is from surface water withdrawn from the North Santiam River at Geren Island;

WHEREAS, City of Stayton is the owner and operator of a community water system that supplies safe drinking water to customers in the Stayton area, whose primary water source is from surface water withdrawn from the North Santiam River downstream from Geren Island;

WHEREAS, both Cities have community water systems that meet all current requirements of the Oregon Health Division for safe drinking water supplied to customers;

WHEREAS, both Cities have an adequate safe drinking water supply to serve their respective communities under normal conditions, peak season conditions, and most emergency situations;

WHEREAS, both Cities have a desire to further develop their emergency sources of safe drinking water supply with the capability to handle emergency conditions resulting from an unusual calamity such as a flood, storm, earthquake, drought, civil disorder, volcanic eruption, an accidental spill of hazardous material, or other occurrence which disrupts water service or can endanger the quality of the water produced by a water system;

WHEREAS, both Cities have a desire to occasionally provide surplus safe drinking water to one another and to occasionally use surplus safe drinking water from one another;

WHEREAS, both Cities have entered into previous water agreements with one another dated June 3, 1957, February 10, 1971, and August 27, 1999;

WHEREAS, both Cities are currently in the process of negotiating a separate agreement for construction of a transmission water conduit.

NOW, THEREFORE, in consideration of the covenants and agreements hereinafter set forth to be kept and performed by the parties hereto, it is mutually agreed as follows:

City of Salem Agrees:

1) To sell safe drinking water to the City of Stayton during emergency conditions (See Section 9);

2) To sell surplus safe drinking water to the City of Stayton (See Section 10);

3) To sell safe drinking water to the City of Stayton at the rate of $0.35 per 100 cubic feet ($0.4679 per 1,000 gallons). This includes emergency safe drinking water or surplus safe drinking water;

4) To limit future annual rate increases in the sale of safe drinking water to Stayton by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

City of Stayton Agrees:

5) To sell safe drinking water to the City of Salem during emergency conditions (See Section 9);

6) To sell surplus safe drinking water to the City of Salem (See Section 10);

7) To sell safe drinking water under either emergency conditions or surplus safe drinking water to the City of Salem at the commodity rate charged other Stayton customers, which is $0.581 per 1000 gallons ($0.4346 per 100 cubic feet);

8) To limit future annual rate increases in the sale of safe drinking water to Salem by an amount not to exceed the year end percentage change for the month ending in June in the Consumer Price Index for the West, as published by the Department of Labor, Bureau of Labor Statistics, for all urban consumers;

Both Cities Agree:

9) To provide safe drinking water to one another for emergency conditions. When emergency safe drinking water is required by either City, the requesting City shall contact the other City to ensure safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether safe drinking water is available for the emergency condition. Once the availability of safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

10) To provide surplus safe drinking water to one another. When surplus safe drinking water is required by either City, the requesting City shall contact the other City to ensure surplus safe drinking water is available. Only Stayton's City Administrator or Salem's Public Works Director, or their designee, of the City receiving the request is authorized to determine whether surplus safe drinking water is available. Once the availability of surplus safe drinking water has been determined, representatives of each City shall coordinate the operations of appropriate valves, measuring devices, and auxiliary systems;

11) To acknowledge and understand that the supply of emergency safe drinking water or surplus safe drinking water may be limited at times and seasons to specific locations if required to meet Safe Drinking Water Act standards of the Oregon Health Division. Additional treatment such as corrosion control and additional chlorine contact time may be required;

12) To jointly conserve safe drinking water during a regional water shortage, that may be caused by either a drought, a flood, or other regional emergency condition by following each Cities' individual water curtailment program. Conserving safe drinking water will maximize its availability to both communities, and subject to Section 9, water will be provided to each community during a water shortage on a per capita basis;

13) To support the other City's legal purchase, sale, lease, or maintenance of water rights by not contesting these actions; including, but not limited to, water right transfers, changing or modifying a water right permit, processing a water right time extension, filing proof of completions, and perfecting water rights;

14) To maintain an active water system backflow prevention program in their own respective water systems in accordance with Oregon Statutes for the life of this agreement;

15) For purposes of this Agreement "Safe Drinking Water" shall have the same definition as found in OAR 333-061-0020 (122).

16) This Agreement supercedes the Emergency Water Agreement between the parties dated August 27, 1999; the Agreement between the parties dated February 10, 1971; and paragraph 11 of the Agreement between the parties dated June 3, 1957. All other provisions of the 1957 Agreement shall remain in full force and effect.

17) This Agreement shall be effective simultaneously upon execution of the "Agreement for Construction of a Transmission Water Conduit," in substantially the same form as Exhibit A hereto.

18) This Water Agreement can be terminated with or without cause by either City by giving the other 180 calendar days' written notice.

19) Should a dispute arise over any of the items contained in this agreement, both Cities agree to participate in non binding mediation or non binding arbitration proceedings endeavoring to resolve the issue in dispute. The mediator or arbitrator shall be mutually agreed upon by both Cities.

City of Salem, Oregon

By: Robert A. Wells
City Manager, Pro Tem

City of Stayton, Oregon

By: Gerry Aboud
Mayor
3/20/01

ATTEST: C. Childs
City Administrator

Approved as to form:

David A. Rhoten
City Attorney

Exhibit A—Agreement for Construction of a Transmission Water Conduit

Appendix C Model Calibration

Stayton Water Study
Model Calibration

Calibration Data (Fire Flow Tests)

Date of Flow Test: 30-Jul-03

		Location #1							Location #2							Location #3						
		Observed	Observed		Model	Model			Observed	Observed		Model	Model			Observed	Observed		Model	Model		
Fire Flow Test	gpm	S1	R1	Diff	S1	R1	Diff	Error	S2	R2	Diff	S2	R2	Diff	Error	S3	R3	Diff	S3	R3	Diff	Error
Upper 1	490	69	48	21	72	53	19	2	58	39	19	58	39	19	0	72	52	20	76	57	19	1
Lower 2	1290	60	46	14	62	49	13	1	58	56	2	63	60	3	-1							
Lower 3	1560	67	55	12	71	58	13	-1	66	58	8	70	62	8	0							
Lower 4	1500	64	56	8	68	60	8	0	64	55	9	67	58	9	0							
Lower 5	1700	68	61	7	72	65	7	0	67	62	5	70	65	5	0							
Lower 6	600	66	56	10	68	59	9	1														

Assumes 7.5 and 10 hp pumps on at Pine

Date of Flow Test: 19-Nov-03

		Location #1							Location #2							Location #3						
		Observed	Observed		Model	Model			Observed	Observed		Model	Model			Observed	Observed		Model	Model		
Fire Flow Test	gpm	S1	R1	Diff	S1	R1	Diff	Error	S2	R2	Diff	S2	R2	Diff	Error	S3	R3	Diff	S3	R3	Diff	Error
Test A	450	74	40	34	72	41	31	3	60	40	20	60	39	21	-1	60	40	20	60	40	20	0
Test B	550	92	40	52	92	40	52	0	86	34	52	85	32	53	-1	61	39	22	60	40	20	2
Test C (1 port)	700	58	58	0	59	59	0	0	57	56	1	59	58	1	0	58	57	1	58	57	1	0
Test C (2 ports)	1600	58	56	2	59	56	3	-1	57	55	2	59	58	1	1	58	52	6	58	54	4	2
Test D (1 port)	626	60	58	2	61	59	2	0	60	57	3	62	58	4	-1							0
Test D (2 ports)	950	60	57	3	61	56	5	-2	60	56	4	62	55	7	-3							
Test E (2 ports)	1400	57	50	7	59	56	3	4	58	54	4	57	53	4	0							

Pitot (psi) 16
Q (gpm) 600

Date of Flow Test: 15-Dec-03

	Test						
	Observed	Observed		Model	Model		
Fire Flow Test	S1	R1	Diff	S1	R1	Diff	Error
Location 1	92	68	24	98	67	31	-7
Location 2	95	65	30	95	65	30	0
Location 3	62	46	16	61	43	18	-2
Location 4	70	34	36	70	43	27	9
Regis	75	34-42	35	74	41	33	2

Pitot (psi) 26
Q (gpm) 860

Date of Flow Test: 15-Feb-04

	Test						
	Observed	Observed		Model	Model		
Fire Flow Test	S1	R1	Diff	S1	R1	Diff	Error
Location 1	64	32	32	66	37	29	3
Location 2	65	35	30	66	36	30	0
Location 4	66	52	14	67	52	15	-1
Location 5	64	63	1	66	64	2	-1

Appendix D

Model Data

Scenario: PH (Existing)
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	448.00	Zone-1	Demand	5	System Diurnal Curve	8	585	59
J-2	448.20	Zone-1	Demand	6	System Diurnal Curve	9	591	62
J-3	446.00	Zone-1	Demand	10	System Diurnal Curve	15	591	63
J-5	453.40	Zone-1	Demand	9	System Diurnal Curve	13	567	49
J-6	448.60	Zone-1	Demand	3	System Diurnal Curve	4	592	62
J-7	447.50	Zone-1	Demand	3	System Diurnal Curve	5	591	62
J-8	447.90	Zone-1	Demand	3	System Diurnal Curve	4	590	61
J-9	445.80	Zone-1	Demand	1	System Diurnal Curve	1	591	63
J-10	453.40	Zone-1	Demand	0	System Diurnal Curve	0	586	57
J-11	455.00	Zone-1	Demand	3	System Diurnal Curve	5	584	56
J-12	456.80	Zone-1	Demand	6	System Diurnal Curve	9	586	56
J-13	458.20	Zone-1	Demand	5	System Diurnal Curve	8	587	56
J-14	435.20	Zone-1	Demand	2	System Diurnal Curve	3	591	67
J-15	438.30	Zone-1	Demand	3	System Diurnal Curve	5	592	66
J-20	457.50	Zone-1	Demand	8	System Diurnal Curve	11	583	54
J-21	460.00	Zone-1	Demand	8	System Diurnal Curve	11	590	56
J-22	457.50	Zone-1	Demand	4	System Diurnal Curve	6	589	57
J-23	457.50	Zone-1	Demand	7	System Diurnal Curve	10	588	57
J-27	456.00	Zone-1	Demand	3	System Diurnal Curve	4	586	56
J-28	440.00	Zone-1	Demand	4	System Diurnal Curve	6	590	65
J-29	432.30	Zone-1	Demand	11	System Diurnal Curve	17	581	64
J-30	447.40	Zone-1	Demand	5	System Diurnal Curve	8	588	61
J-31	453.40	Zone-1	Demand	6	System Diurnal Curve	9	585	57
J-33	460.00	Zone-1	Demand	3	System Diurnal Curve	5	582	53
J-34	458.30	Zone-1	Demand	3	System Diurnal Curve	5	585	55
J-35	460.00	Zone-1	Demand	2	System Diurnal Curve	3	588	55
J-36	453.50	Zone-1	Demand	3	System Diurnal Curve	5	573	52
J-37	462.00	Zone-1	Demand	6	System Diurnal Curve	9	572	48
J-38	454.00	Zone-1	Demand	4	System Diurnal Curve	6	582	55
J-43	460.00	Zone-1	Demand	2	System Diurnal Curve	3	588	55
J-44	460.80	Zone-1	Demand	6	System Diurnal Curve	9	556	41
J-45	461.90	Zone-1	Demand	5	System Diurnal Curve	8	589	55
J-46	445.00	Zone-1	Demand	1	System Diurnal Curve	1	592	64
J-47	443.00	Zone-1	Demand	9	System Diurnal Curve	13	549	46
J-48	557.50	Upper Zone	Demand	3	System Diurnal Curve	4	660	44
J-49	552.00	Upper Zone	Demand	4	System Diurnal Curve	6	663	48
J-51	460.00	Zone-1	Demand	10	System Diurnal Curve	15	590	56
J-58	460.50	Zone-1	Demand	2	System Diurnal Curve	3	587	55
J-62	448.00	Zone-1	Demand	3	System Diurnal Curve	4	543	41
J-63	449.50	Zone-1	Demand	3	System Diurnal Curve	4	597	64
J-65	448.30	Zone-1	Demand	10	System Diurnal Curve	15	544	42
J-66	447.70	Zone-1	Demand	4	System Diurnal Curve	6	545	42
J-67	448.70	Zone-1	Demand	6	System Diurnal Curve	9	598	65
J-68	450.00	Zone-1	Demand	4	System Diurnal Curve	6	591	61
J-69	450.00	Zone-1	Demand	3	System Diurnal Curve	4	598	64
J-70	450.00	Zone-1	Demand	8	System Diurnal Curve	11	573	53
J-71	451.10	Zone-1	Demand	7	System Diurnal Curve	10	599	64
J-72	453.00	Zone-1	Demand	23	Composite	34	595	61
J-76	450.00	Zone-1	Demand	5	System Diurnal Curve	8	590	61
J-77	450.00	Zone-1	Demand	8	System Diurnal Curve	11	601	65
J-78	450.40	Zone-1	Demand	7	System Diurnal Curve	10	600	65
J-79	450.70	Zone-1	Demand	7	System Diurnal Curve	10	582	57

Scenario: PH
Steady State Analysis
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Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-82	450.00	Zone-1	Demand	1	System Diurnal Curve	1	589	60
J-86	447.50	Zone-1	Demand	2	System Diurnal Curve	3	590	62
J-87	447.60	Zone-1	Demand	4	System Diurnal Curve	6	588	61
J-89	464.00	Zone-1	Demand	3	System Diurnal Curve	4	590	54
J-92	442.60	Zone-1	Demand	4	System Diurnal Curve	6	584	61
J-93	442.70	Zone-1	Demand	8	System Diurnal Curve	11	569	55
J-94	468.00	Upper Zone	Demand	3	System Diurnal Curve	5	661	84
J-98	468.00	Upper Zone	Demand	7	System Diurnal Curve	10	661	84
J-100	468.10	Upper Zone	Demand	41	System Diurnal Curve	61	661	84
J-101	468.50	Upper Zone	Demand	0	System Diurnal Curve	0	661	83
J-102	435.70	Zone-1	Demand	5	System Diurnal Curve	8	591	67
J-103	438.00	Zone-1	Demand	2	System Diurnal Curve	3	592	66
J-104	441.40	Zone-1	Demand	13	System Diurnal Curve	19	585	62
J-105	442.40	Zone-1	Demand	3	System Diurnal Curve	4	585	62
J-106	475.00	Zone-1	Demand	3	System Diurnal Curve	4	587	48
J-107	480.00	Zone-1	Demand	7	System Diurnal Curve	10	589	47
J-108	460.00	Zone-1	Demand	2	System Diurnal Curve	3	589	56
J-110	449.60	Zone-1	Demand	4	System Diurnal Curve	6	601	65
J-111	449.20	Zone-1	Demand	4	System Diurnal Curve	6	601	66
J-112	558.50	Upper Zone	Demand	2	System Diurnal Curve	3	665	46
J-113	548.30	Upper Zone	Demand	4	System Diurnal Curve	6	665	50
J-115	436.70	Zone-1	Demand	0	System Diurnal Curve	0	592	67
J-116	425.50	Zone-1	Demand	132	System Diurnal Curve	198	590	71
J-119	437.10	Zone-1	Demand	13	System Diurnal Curve	19	590	66
J-121	440.00	Zone-1	Demand	3	System Diurnal Curve	5	597	68
J-122	438.30	Zone-1	Demand	11	Composite	17	597	69
J-123	441.00	Zone-1	Demand	3	System Diurnal Curve	5	597	67
J-124	442.00	Zone-1	Demand	9	System Diurnal Curve	13	597	67
J-126	433.80	Zone-1	Demand	4	System Diurnal Curve	6	595	70
J-127	448.30	Zone-1	Demand	4	System Diurnal Curve	6	584	59
J-128	445.50	Zone-1	Demand	8	System Diurnal Curve	11	587	61
J-129	454.00	Zone-1	Demand	2	System Diurnal Curve	3	585	57
J-130	453.00	Zone-1	Demand	7	System Diurnal Curve	10	585	57
J-131	454.00	Zone-1	Demand	5	System Diurnal Curve	7	588	58
J-133	452.20	Zone-1	Demand	9	System Diurnal Curve	13	588	59
J-134	453.20	Zone-1	Demand	5	System Diurnal Curve	8	588	58
J-136	461.30	Zone-1	Demand	3	System Diurnal Curve	5	589	55
J-137	459.70	Zone-1	Demand	5	System Diurnal Curve	8	589	56
J-138	461.60	Upper Zone	Demand	3	System Diurnal Curve	5	665	88
J-140	486.00	Upper Zone	Demand	1	System Diurnal Curve	1	666	78
J-141	460.00	Zone-1	Demand	9	System Diurnal Curve	14	589	56
J-142	469.70	Upper Zone	Demand	0	System Diurnal Curve	0	663	84
J-143	473.70	Upper Zone	Demand	13	System Diurnal Curve	19	660	80
J-144	485.00	Upper Zone	Demand	30	System Diurnal Curve	45	659	75
J-145	493.10	Upper Zone	Demand	3	System Diurnal Curve	5	665	74
J-146	440.00	Zone-1	Demand	4	System Diurnal Curve	6	585	63
J-147	439.20	Zone-1	Demand	2	System Diurnal Curve	3	585	63
J-148	449.30	Zone-1	Demand	5	System Diurnal Curve	8	586	59
J-149	451.70	Zone-1	Demand	0	System Diurnal Curve	0	587	58
J-150	452.90	Zone-1	Demand	4	System Diurnal Curve	6	588	58
J-151	454.00	Zone-1	Demand	7	System Diurnal Curve	10	586	57
J-154	440.00	Zone-1	Demand	2	System Diurnal Curve	3	595	67

Scenario: PH
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Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-155	442.00	Zone-1	Demand	3	System Diurnal Curve	5	591	65
J-156	441.50	Zone-1	Demand	2	System Diurnal Curve	3	595	66
J-157	442.00	Zone-1	Demand	7	System Diurnal Curve	10	592	65
J-159	443.70	Zone-1	Demand	15	System Diurnal Curve	22	593	65
J-160	442.10	Zone-1	Demand	5	System Diurnal Curve	8	593	65
J-161	444.00	Zone-1	Demand	3	System Diurnal Curve	5	594	65
J-162	446.50	Zone-1	Demand	5	System Diurnal Curve	8	592	63
J-163	444.70	Zone-1	Demand	3	System Diurnal Curve	4	593	64
J-164	440.00	Zone-1	Demand	3	System Diurnal Curve	4	597	68
J-166	444.00	Zone-1	Demand	4	System Diurnal Curve	6	591	64
J-167	444.00	Zone-1	Demand	7	Composite	10	589	63
J-168	447.60	Zone-1	Demand	0	System Diurnal Curve	0	594	63
J-169	470.00	Upper Zone	Demand	9	System Diurnal Curve	14	661	83
J-170	473.10	Upper Zone	Demand	4	System Diurnal Curve	6	664	82
J-172	506.00	Upper Zone	Demand	11	System Diurnal Curve	17	666	69
J-173	549.50	Upper Zone	Demand	18	System Diurnal Curve	27	658	47
J-174	539.70	Upper Zone	Demand	3	System Diurnal Curve	5	665	54
J-175	543.70	Upper Zone	Demand	3	System Diurnal Curve	4	665	52
J-176	458.00	Zone-1	Demand	4	System Diurnal Curve	6	584	55
J-177	457.20	Zone-1	Demand	5	System Diurnal Curve	8	586	56
J-179	458.10	Zone-1	Demand	4	System Diurnal Curve	6	590	57
J-180	458.70	Zone-1	Demand	0	System Diurnal Curve	0	589	56
J-181	454.80	Zone-1	Demand	3	System Diurnal Curve	4	589	58
J-182	455.60	Zone-1	Demand	5	System Diurnal Curve	8	588	57
J-184	459.10	Zone-1	Demand	1	System Diurnal Curve	1	589	56
J-185	447.80	Zone-1	Demand	5	System Diurnal Curve	8	584	59
J-186	448.70	Zone-1	Demand	7	System Diurnal Curve	10	586	60
J-187	440.00	Zone-1	Demand	10	System Diurnal Curve	15	595	67
J-188	436.00	Zone-1	Demand	4	System Diurnal Curve	6	594	69
J-192	514.00	Upper Zone	Demand	9	System Diurnal Curve	14	666	66
J-193	493.00	Upper Zone	Demand	4	System Diurnal Curve	6	665	74
J-194	512.20	Upper Zone	Demand	0	System Diurnal Curve	0	666	66
J-195	506.00	Zone-1	Demand	3	System Diurnal Curve	4	589	36
J-197	431.20	Zone-1	Demand	0	System Diurnal Curve	0	586	67
J-198	432.00	Zone-1	Demand	3	System Diurnal Curve	4	586	66
J-199	439.00	Zone-1	Demand	14	System Diurnal Curve	22	585	63
J-200	450.80	Zone-1	Demand	5	System Diurnal Curve	8	587	59
J-202	452.40	Zone-1	Demand	4	System Diurnal Curve	6	588	59
J-203	451.40	Zone-1	Demand	5	System Diurnal Curve	8	588	59
J-204	447.50	Zone-1	Demand	3	System Diurnal Curve	5	582	58
J-205	442.00	Zone-1	Demand	3	System Diurnal Curve	5	582	61
J-206	505.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	69
J-207	505.00	Upper Zone	Demand	17	System Diurnal Curve	26	664	69
J-208	468.70	Upper Zone	Demand	5	System Diurnal Curve	8	603	58
J-209	467.10	Zone-1	Demand	0	System Diurnal Curve	0	593	54
J-210	439.00	Zone-1	Demand	6	System Diurnal Curve	9	597	68
J-211	440.00	Zone-1	Demand	3	System Diurnal Curve	5	597	68
J-217	477.80	Upper Zone	Demand	0	System Diurnal Curve	0	664	81
J-219	434.30	Zone-1	Demand	3	System Diurnal Curve	5	585	65
J-220	434.50	Zone-1	Demand	2	System Diurnal Curve	3	585	65
J-221	438.00	Zone-1	Demand	7	System Diurnal Curve	10	585	64
J-222	438.00	Zone-1	Demand	13	System Diurnal Curve	19	585	64

Scenario: PH
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Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-223	438.80	Zone-1	Demand	7	System Diurnal Curve	10	585	63
J-224	438.80	Zone-1	Demand	14	System Diurnal Curve	22	585	63
J-225	438.70	Zone-1	Demand	6	System Diurnal Curve	9	585	63
J-226	437.80	Zone-1	Demand	8	System Diurnal Curve	11	585	64
J-227	441.80	Zone-1	Demand	0	System Diurnal Curve	0	585	62
J-228	442.00	Zone-1	Demand	7	System Diurnal Curve	10	585	62
J-229	434.60	Zone-1	Demand	3	System Diurnal Curve	5	585	65
J-230	434.00	Zone-1	Demand	5	System Diurnal Curve	8	585	65
J-231	434.90	Zone-1	Demand	6	System Diurnal Curve	9	585	65
J-232	438.00	Zone-1	Demand	20	System Diurnal Curve	29	585	63
J-234	434.80	Zone-1	Demand	6	System Diurnal Curve	9	585	65
J-235	435.00	Zone-1	Demand	8	System Diurnal Curve	11	585	65
J-236	437.10	Zone-1	Demand	26	System Diurnal Curve	39	585	64
J-237	437.80	Zone-1	Demand	14	System Diurnal Curve	22	585	64
J-238	436.90	Zone-1	Demand	7	System Diurnal Curve	10	585	64
J-239	436.90	Zone-1	Demand	14	System Diurnal Curve	20	585	64
J-240	436.00	Zone-1	Demand	13	System Diurnal Curve	19	585	65
J-241	436.00	Zone-1	Demand	4	System Diurnal Curve	6	586	65
J-242	436.00	Zone-1	Demand	2	System Diurnal Curve	3	586	65
J-243	436.00	Zone-1	Demand	3	System Diurnal Curve	5	586	65
J-244	448.00	Zone-1	Demand	7	System Diurnal Curve	10	586	59
J-245	434.50	Zone-1	Demand	2	System Diurnal Curve	3	585	65
J-246	436.00	Zone-1	Demand	10	System Diurnal Curve	15	585	64
J-247	434.70	Zone-1	Demand	9	System Diurnal Curve	13	586	65
J-248	434.70	Zone-1	Demand	7	System Diurnal Curve	10	586	65
J-249	436.60	Zone-1	Demand	4	System Diurnal Curve	6	586	65
J-250	438.00	Zone-1	Demand	4	System Diurnal Curve	6	586	64
J-251	434.00	Zone-1	Demand	6	System Diurnal Curve	9	585	65
J-252	443.80	Zone-1	Demand	4	System Diurnal Curve	6	585	61
J-253	445.90	Zone-1	Demand	10	System Diurnal Curve	15	585	60
J-254	451.10	Zone-1	Demand	3	System Diurnal Curve	5	587	59
J-255	446.00	Zone-1	Demand	6	System Diurnal Curve	9	586	61
J-256	455.60	Zone-1	Demand	3	System Diurnal Curve	4	587	57
J-257	449.50	Zone-1	Demand	4	System Diurnal Curve	6	587	59
J-258	450.00	Zone-1	Demand	13	System Diurnal Curve	20	587	59
J-262	456.00	Zone-1	Demand	6	System Diurnal Curve	9	589	57
J-263	455.40	Zone-1	Demand	6	System Diurnal Curve	9	589	58
J-265	455.40	Zone-1	Demand	11	System Diurnal Curve	17	589	58
J-268	462.90	Zone-1	Demand	9	System Diurnal Curve	14	590	55
J-269	468.10	Upper Zone	Demand	0	System Diurnal Curve	0	661	84
J-270	467.50	Upper Zone	Demand	8	System Diurnal Curve	12	664	85
J-273	557.80	Upper Zone	Demand	5	System Diurnal Curve	8	665	47
J-275	562.50	Upper Zone	Demand	3	System Diurnal Curve	4	665	45
J-276	562.50	Upper Zone	Demand	4	System Diurnal Curve	6	665	45
J-278	530.00	Upper Zone	Demand	4	System Diurnal Curve	6	666	59
J-280	452.60	Zone-1	Demand	5	System Diurnal Curve	8	588	59
J-281	451.40	Zone-1	Demand	9	System Diurnal Curve	13	588	59
J-286	455.00	Zone-1	Demand	3	System Diurnal Curve	5	589	58
J-287	453.20	Zone-1	Demand	10	System Diurnal Curve	15	587	58
J-289	460.00	Zone-1	Demand	0	System Diurnal Curve	0	590	56
J-290	474.70	Upper Zone	Demand	13	System Diurnal Curve	19	664	82
J-291	442.00	Zone-1	Demand	3	System Diurnal Curve	4	588	63

Scenario: PH
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Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-292	442.00	Zone-1	Demand	1	System Diurnal Curve	1	588	63
J-293	440.00	Zone-1	Demand	7	System Diurnal Curve	10	590	65
J-294	441.00	Zone-1	Demand	13	System Diurnal Curve	19	590	65
J-295	439.00	Zone-1	Demand	7	System Diurnal Curve	10	597	68
J-296	442.00	Zone-1	Demand	0	System Diurnal Curve	0	593	65
J-297	430.60	Zone-1	Demand	0	System Diurnal Curve	0	585	67
J-298	430.60	Zone-1	Demand	3	System Diurnal Curve	5	585	67
J-299	430.00	Zone-1	Demand	16	System Diurnal Curve	24	586	67
J-300	435.40	Zone-1	Demand	7	System Diurnal Curve	10	585	65
J-301	435.40	Zone-1	Demand	7	System Diurnal Curve	10	585	65
J-302	438.00	Zone-1	Demand	2	System Diurnal Curve	3	585	64
J-303	441.00	Zone-1	Demand	6	System Diurnal Curve	9	585	62
J-304	441.00	Zone-1	Demand	4	System Diurnal Curve	7	585	62
J-308	445.20	Zone-1	Demand	3	System Diurnal Curve	5	586	61
J-309	446.50	Zone-1	Demand	1	System Diurnal Curve	1	586	61
J-310	447.00	Zone-1	Demand	1	System Diurnal Curve	1	587	60
J-311	448.80	Zone-1	Demand	0	System Diurnal Curve	0	587	60
J-312	450.80	Zone-1	Demand	11	System Diurnal Curve	17	587	59
J-313	450.80	Zone-1	Demand	4	System Diurnal Curve	6	587	59
J-314	449.50	Zone-1	Demand	8	System Diurnal Curve	11	587	59
J-315	451.40	Zone-1	Demand	0	System Diurnal Curve	0	588	59
J-316	455.40	Zone-1	Demand	11	System Diurnal Curve	17	589	58
J-317	450.00	Zone-1	Demand	13	System Diurnal Curve	19	588	60
J-318	506.00	Upper Zone	Demand	2	System Diurnal Curve	3	665	69
J-319	517.00	Upper Zone	Demand	0	System Diurnal Curve	0	665	64
J-320	516.50	Upper Zone	Demand	2	System Diurnal Curve	3	665	64
J-321	468.30	Upper Zone	Demand	6	System Diurnal Curve	9	665	85
J-322	521.00	Upper Zone	Demand	0	System Diurnal Curve	0	666	63
J-324	458.70	Zone-1	Demand	6	System Diurnal Curve	9	589	56
J-325	533.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	57
J-326	515.00	Upper Zone	Demand	4	System Diurnal Curve	6	664	64
J-327	520.00	Upper Zone	Demand	14	System Diurnal Curve	21	664	62
J-328	522.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	61
J-329	492.00	Upper Zone	Demand	3	System Diurnal Curve	5	665	75
J-333	467.60	Upper Zone	Demand	0	System Diurnal Curve	0	663	85
J-334	469.70	Upper Zone	Demand	7	System Diurnal Curve	10	663	84
J-335	507.00	Upper Zone	Demand	0	System Diurnal Curve	0	663	68
J-336	477.40	Upper Zone	Demand	3	System Diurnal Curve	5	664	81
J-337	478.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	80
J-339	475.20	Upper Zone	Demand	0	System Diurnal Curve	0	664	82
J-341	556.30	Upper Zone	Demand	8	System Diurnal Curve	11	665	47
J-342	461.60	Zone-1	Demand	23	System Diurnal Curve	34	590	55
J-343	456.00	Zone-1	Demand	10	System Diurnal Curve	15	592	59
J-346	456.00	Zone-1	Demand	2	System Diurnal Curve	3	592	59
J-349	456.00	Zone-1	Demand	14	System Diurnal Curve	20	592	59
J-351	451.00	Zone-1	Demand	11	System Diurnal Curve	17	589	60
J-353	450.00	Zone-1	Demand	72	System Diurnal Curve	108	589	60
J-356	444.00	Zone-1	Demand	4	System Diurnal Curve	6	587	62
J-358	446.00	Zone-1	Demand	3	System Diurnal Curve	4	589	62
J-359	448.30	Zone-1	Demand	13	System Diurnal Curve	20	601	66
J-360	447.20	Zone-1	Demand	16	System Diurnal Curve	24	594	64
J-362	440.00	Zone-1	Demand	2	System Diurnal Curve	3	597	68

Scenario: PH
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Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-364	442.00	Zone-1	Demand	4	System Diurnal Curve	6	586	62
J-365	440.00	Zone-1	Demand	1	System Diurnal Curve	1	589	65
J-367	448.70	Zone-1	Demand	5	System Diurnal Curve	8	582	58
J-368	447.90	Zone-1	Demand	16	System Diurnal Curve	24	582	58
J-369	449.10	Zone-1	Demand	1	System Diurnal Curve	1	582	58
J-370	438.00	Zone-1	Demand	4	System Diurnal Curve	6	590	66
J-371	439.10	Zone-1	Demand	8	System Diurnal Curve	11	591	66
J-372	439.10	Zone-1	Demand	0	System Diurnal Curve	0	591	66
J-374	437.90	Zone-1	Demand	7	System Diurnal Curve	10	592	66
J-375	439.10	Zone-1	Demand	10	System Diurnal Curve	15	591	66
J-376	437.00	Zone-1	Demand	5	System Diurnal Curve	8	592	67
J-378	436.00	Zone-1	Demand	10	System Diurnal Curve	15	592	67
J-379	437.50	Zone-1	Demand	5	System Diurnal Curve	8	591	66
J-380	435.00	Zone-1	Demand	9	System Diurnal Curve	13	588	66
J-387	557.00	reservoir and pur	Demand	0	System Diurnal Curve	0	590	14
J-388	432.00	Zone-1	Demand	86	System Diurnal Curve	130	585	66
J-389	433.60	Zone-1	Demand	16	System Diurnal Curve	24	585	65
J-390	432.00	Zone-1	Demand	7	System Diurnal Curve	10	585	66
J-391	436.00	Zone-1	Demand	4	System Diurnal Curve	6	585	64
J-392	431.00	Zone-1	Demand	4	System Diurnal Curve	6	585	67
J-393	433.60	Zone-1	Demand	12	System Diurnal Curve	18	585	66
J-394	442.00	Zone-1	Demand	0	System Diurnal Curve	0	585	62
J-395	440.50	Zone-1	Demand	0	System Diurnal Curve	0	585	63
J-396	442.50	Zone-1	Demand	10	System Diurnal Curve	16	585	62
J-398	432.50	Zone-1	Demand	0	System Diurnal Curve	0	585	66
J-399	432.00	Zone-1	Demand	5	System Diurnal Curve	7	585	66
J-400	469.70	Upper Zone	Demand	4	System Diurnal Curve	6	664	84
J-401	439.50	Zone-1	Demand	0	System Diurnal Curve	0	586	63
J-402	440.00	Zone-1	Demand	7	System Diurnal Curve	10	586	63
J-403	442.30	Zone-1	Demand	8	System Diurnal Curve	11	586	62
J-404	445.30	Zone-1	Demand	30	System Diurnal Curve	45	586	61
J-405	441.10	Zone-1	Demand	8	System Diurnal Curve	11	586	63
J-406	438.50	Zone-1	Demand	9	System Diurnal Curve	13	586	64
J-407	436.00	Zone-1	Demand	0	System Diurnal Curve	0	588	66
J-408	437.40	Zone-1	Demand	0	System Diurnal Curve	0	588	65
J-409	436.90	Zone-1	Demand	0	System Diurnal Curve	0	592	67
J-410	437.00	Zone-1	Demand	3	System Diurnal Curve	4	591	67
J-411	438.00	Zone-1	Demand	3	System Diurnal Curve	5	591	66
J-412	438.60	Zone-1	Demand	5	System Diurnal Curve	8	591	66
J-413	458.60	Zone-1	Demand	95	System Diurnal Curve	142	590	57
J-414	457.60	Zone-1	Demand	18	System Diurnal Curve	27	590	57
J-415	462.50	Zone-1	Demand	11	System Diurnal Curve	17	590	55
J-416	468.40	Zone-1	Demand	9	System Diurnal Curve	14	590	53
J-417	463.30	Zone-1	Demand	17	System Diurnal Curve	26	590	55
J-418	463.70	Zone-1	Demand	9	System Diurnal Curve	14	590	55
J-419	457.50	Zone-1	Demand	12	System Diurnal Curve	18	590	57
J-420	452.00	Zone-1	Demand	12	System Diurnal Curve	18	599	63
J-421	456.80	Zone-1	Demand	4	System Diurnal Curve	6	592	59
J-422	455.00	Zone-1	Demand	10	System Diurnal Curve	15	592	59
J-429	442.90	Zone-1	Demand	0	System Diurnal Curve	0	598	67
J-432	457.00	Upper Zone	Demand	0	System Diurnal Curve	0	589	57
J-433	477.40	Upper Zone	Demand	17	System Diurnal Curve	26	663	80

Scenario: PH
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-436	471.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	83
J-437	470.70	Upper Zone	Demand	8	System Diurnal Curve	11	664	83
J-439	489.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	76
J-440	494.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	74
J-445	457.00	Zone-1	Demand	2	System Diurnal Curve	3	589	57
J-446	458.50	Zone-1	Demand	5	System Diurnal Curve	8	589	56
J-447	460.00	Zone-1	Demand	3	System Diurnal Curve	5	589	56
J-448	461.90	Zone-1	Demand	8	System Diurnal Curve	11	589	55
J-450	452.60	Zone-1	Demand	34	System Diurnal Curve	51	584	57
J-451	438.00	Zone-1	Demand	2	System Diurnal Curve	3	592	66
J-452	440.00	Zone-1	Demand	9	System Diurnal Curve	13	590	65
J-453	439.50	Zone-1	Demand	8	System Diurnal Curve	11	590	65
J-454	449.50	Zone-1	Demand	4	System Diurnal Curve	6	601	65
J-455	452.00	Zone-1	Demand	9	System Diurnal Curve	13	600	64
J-458	451.40	Zone-1	Demand	4	System Diurnal Curve	6	603	65
J-459	428.00	Zone-1	Demand	75	System Diurnal Curve	112	585	68
J-460	430.00	Zone-1	Demand	7	System Diurnal Curve	11	585	67
J-461	435.00	Zone-1	Demand	6	System Diurnal Curve	9	585	65
J-462	435.30	Zone-1	Demand	7	System Diurnal Curve	10	585	65
J-463	435.40	Zone-1	Demand	3	System Diurnal Curve	5	585	65
J-464	436.90	Zone-1	Demand	14	Composite	22	585	64
J-465	437.10	Zone-1	Demand	8	System Diurnal Curve	11	586	64
J-466	438.00	Zone-1	Demand	15	System Diurnal Curve	23	586	64
J-467	443.00	Zone-1	Demand	3	System Diurnal Curve	4	586	62
J-468	435.20	Zone-1	Demand	2	System Diurnal Curve	3	591	67
J-469	431.00	Zone-1	Demand	11	System Diurnal Curve	16	591	69
J-470	445.80	Zone-1	Demand	7	System Diurnal Curve	10	596	65
J-471	445.80	Zone-1	Demand	0	System Diurnal Curve	0	596	65
J-472	441.20	Zone-1	Demand	4	System Diurnal Curve	6	595	66
J-474	459.20	Zone-1	Demand	3	System Diurnal Curve	5	590	56
J-475	498.00	Upper Zone	Demand	17	System Diurnal Curve	26	664	72
J-476	496.00	Upper Zone	Demand	19	System Diurnal Curve	28	663	72
J-477	500.00	Upper Zone	Demand	39	System Diurnal Curve	59	663	71
J-478	458.60	Zone-1	Demand	2	System Diurnal Curve	3	590	57
J-480	559.00	Upper Zone	Demand	10	System Diurnal Curve	15	666	46
J-481	570.00	Upper Zone	Demand	0	System Diurnal Curve	0	666	41
J-483	567.00	Upper Zone	Demand	0	System Diurnal Curve	0	666	43
J-484	460.70	Upper Zone	Demand	4	System Diurnal Curve	6	665	88
J-485	534.00	Upper Zone	Demand	3	System Diurnal Curve	5	664	56
J-486	446.20	Zone-1	Demand	8	System Diurnal Curve	12	589	62
J-487	446.60	Zone-1	Demand	0	System Diurnal Curve	0	589	61
J-488	445.30	Zone-1	Demand	1	System Diurnal Curve	1	589	62
J-489	475.30	Upper Zone	Demand	10	System Diurnal Curve	15	667	83
J-490	447.00	Zone-1	Demand	6	System Diurnal Curve	9	589	61
J-491	449.00	Zone-1	Demand	8	System Diurnal Curve	11	589	60
J-492	465.20	Zone-1	Demand	14	System Diurnal Curve	22	589	53
J-493	463.00	Zone-1	Demand	4	System Diurnal Curve	6	589	54
J-494	468.90	Zone-1	Demand	8	System Diurnal Curve	11	589	52
J-495	479.00	Zone-1	Demand	9	System Diurnal Curve	13	589	47
J-496	446.50	Zone-1	Demand	7	System Diurnal Curve	10	589	61
J-497	450.00	Zone-1	Demand	14	System Diurnal Curve	22	589	60
J-498	455.40	Zone-1	Demand	15	System Diurnal Curve	23	589	58

Scenario: PH
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-499	469.70	Zone-1	Demand	0	System Diurnal Curve	0	589	51
J-500	430.00	Zone-1	Demand	8	System Diurnal Curve	11	585	67
J-501	430.80	Zone-1	Demand	7	System Diurnal Curve	10	585	67
J-502	434.40	Zone-1	Demand	4	System Diurnal Curve	6	585	65
J-503	432.00	Zone-1	Demand	3	System Diurnal Curve	4	585	66
J-504	436.00	Zone-1	Demand	5	System Diurnal Curve	8	585	64
J-505	436.50	Zone-1	Demand	2	System Diurnal Curve	3	585	64
J-507	446.10	Zone-1	Demand	13	System Diurnal Curve	19	588	62
J-508	448.20	Zone-1	Demand	12	System Diurnal Curve	18	588	61
J-509	448.80	Zone-1	Demand	14	System Diurnal Curve	22	588	60
J-510	447.20	Zone-1	Demand	9	System Diurnal Curve	13	588	61
J-511	447.00	Zone-1	Demand	0	System Diurnal Curve	0	589	61
J-512	446.70	Zone-1	Demand	5	System Diurnal Curve	8	588	61
J-515	448.00	Zone-1	Demand	5	System Diurnal Curve	8	588	61
J-516	442.00	Zone-1	Demand	19	System Diurnal Curve	28	585	62
J-517	457.50	Zone-1	Demand	0	System Diurnal Curve	0	589	57
J-519	457.00	Zone-1	Demand	7	System Diurnal Curve	10	589	57
J-520	457.20	Zone-1	Demand	10	System Diurnal Curve	15	589	57
J-521	460.00	Zone-1	Demand	8	System Diurnal Curve	11	589	56
J-523	457.60	Zone-1	Demand	0	System Diurnal Curve	0	589	57
J-526	450.00	Zone-1	Demand	13	System Diurnal Curve	19	595	63
J-527	441.70	Zone-1	Demand	633	Fixed	949	586	62
J-529	434.00	Zone-1	Demand	4	System Diurnal Curve	6	587	66
J-530	439.50	Zone-1	Demand	48	System Diurnal Curve	71	586	63
J-531	446.00	Zone-1	Demand	3	System Diurnal Curve	4	586	61
J-532	436.40	Zone-1	Demand	9	System Diurnal Curve	14	590	67
J-533	437.30	Zone-1	Demand	4	System Diurnal Curve	6	592	67
J-534	432.00	Zone-1	Demand	0	System Diurnal Curve	0	591	69
J-536	450.00	Zone-1	Demand	6	System Diurnal Curve	9	599	64
J-538	440.00	Zone-1	Demand	0	System Diurnal Curve	0	585	63
J-540	444.00	Zone-1	Demand	5	System Diurnal Curve	8	585	61
J-541	442.00	Zone-1	Demand	3	System Diurnal Curve	5	585	62
J-542	434.00	Zone-1	Demand	3	System Diurnal Curve	5	585	65
J-543	434.00	Zone-1	Demand	0	System Diurnal Curve	0	585	65
J-544	432.00	Zone-1	Demand	3	System Diurnal Curve	4	585	66
J-545	428.00	Zone-1	Demand	0	System Diurnal Curve	0	585	68
J-546	521.00	Upper Zone	Demand	4	System Diurnal Curve	6	666	63
J-547	521.60	reservoir and pur	Demand	0	System Diurnal Curve	0	590	29
J-548	461.30	Zone-1	Demand	0	Fixed	0	589	55
J-549	455.30	Zone-1	Demand	10	System Diurnal Curve	15	589	58
J-550	455.90	Zone-1	Demand	4	System Diurnal Curve	6	589	57
J-551	455.90	Zone-1	Demand	0	System Diurnal Curve	0	589	57
J-552	444.00	Zone-1	Demand	0	Fixed	0	585	61
J-553	455.90	Zone-1	Demand	0	System Diurnal Curve	0	591	58
J-554	456.40	Zone-1	Demand	13	System Diurnal Curve	19	590	58
J-555	460.00	Upper Zone	Demand	0	Fixed	0	664	88
J-556	430.00	Zone-1	Demand	0	Fixed	0	591	70
J-557	443.40	Zone-1	Demand	5	System Diurnal Curve	7	586	62
J-558	452.20	Zone-1	Demand	0	System Diurnal Curve	0	588	59
J-559	455.00	Zone-1	Demand	22	System Diurnal Curve	33	589	58
J-560	454.00	Zone-1	Demand	13	System Diurnal Curve	19	589	58
J-561	431.20	Zone-1	Demand	0	Fixed	0	591	69

Scenario: PH
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-562	454.80	Zone-1	Demand	0	System Diurnal Curve	0	589	58
J-563	436.00	Zone-1	Demand	0	Fixed	0	588	66
J-564	478.00	Zone-1	Demand	2	System Diurnal Curve	3	589	48
J-565	473.00	Upper Zone	Demand	3	System Diurnal Curve	5	663	82
J-566	477.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	81
J-567	475.30	Zone-1	Demand	0	System Diurnal Curve	0	589	49
J-568	506.50	Zone-1	Demand	13	System Diurnal Curve	19	589	36
J-569	446.70	Zone-1	Demand	20	System Diurnal Curve	30	589	61
J-570	437.00	Zone-1	Demand	0	Fixed	0	588	65
J-571	444.00	Zone-1	Demand	0	Fixed	0	596	66
J-572	442.00	Zone-1	Demand	0	Fixed	0	596	66
J-573	451.40	Zone-1	Demand	0	Fixed	0	588	59
J-574	498.00	Upper Zone	Demand	0	Fixed	0	665	72
J-575	443.50	Zone-1	Demand	0	System Diurnal Curve	0	586	62
J-576	444.00	Zone-1	Demand	633	Fixed	949	585	61
J-577	470.00	Zone-1	Demand	3	System Diurnal Curve	4	589	51
J-578	459.90	Zone-1	Demand	5	System Diurnal Curve	8	589	56
J-579	440.00	Zone-1	Demand	3	System Diurnal Curve	5	594	67
J-580	472.00	Upper Zone	Demand	0	Fixed	0	663	83
J-581	470.00	Upper Zone	Demand	0	Fixed	0	663	83
J-582	476.00	Upper Zone	Demand	0	Fixed	0	663	81
J-583	443.80	Zone-1	Demand	0	System Diurnal Curve	0	589	63
J-584	444.20	Zone-1	Demand	7	System Diurnal Curve	10	589	63
J-585	455.00	Zone-1	Demand	14	System Diurnal Curve	22	590	58
J-586	460.30	Zone-1	Demand	0	System Diurnal Curve	0	589	56
J-587	467.00	Upper Zone	Demand	7	System Diurnal Curve	10	664	85
J-588	469.70	Upper Zone	Demand	0	System Diurnal Curve	0	664	84
J-589	467.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	85
J-590	482.00	Upper Zone	Demand	22	System Diurnal Curve	33	663	78
J-591	438.00	Zone-1	Demand	3	System Diurnal Curve	4	594	67
J-592	436.00	Zone-1	Demand	3	System Diurnal Curve	4	594	68
J-593	480.00	Upper Zone	Demand	0	Fixed	0	663	79
J-594	448.30	Zone-1	Demand	0	System Diurnal Curve	0	601	66
J-595	442.00	Zone-1	Demand	0	System Diurnal Curve	0	603	70
J-596	458.90	Zone-1	Demand	4	System Diurnal Curve	6	590	57
J-597	459.20	Zone-1	Demand	2	System Diurnal Curve	3	590	57
J-598	458.40	Zone-1	Demand	6	System Diurnal Curve	9	590	57
J-599	455.20	Zone-1	Demand	3	System Diurnal Curve	4	590	58
J-600	456.70	Zone-1	Demand	9	System Diurnal Curve	13	590	58
J-601	451.00	Zone-1	Demand	3	System Diurnal Curve	5	601	65
J-602	472.00	Upper Zone	Demand	0	Fixed	0	663	83
J-603	468.00	Upper Zone	Demand	0	Fixed	0	664	85
J-604	456.00	Zone-1	Demand	2	System Diurnal Curve	3	590	58
J-605	456.00	Zone-1	Demand	2	System Diurnal Curve	3	590	58
J-606	469.00	Upper Zone	Demand	0	Fixed	0	664	84
J-607	454.00	Zone-1	Demand	3	System Diurnal Curve	4	584	56
J-608	456.00	Zone-1	Demand	50	System Diurnal Curve	75	590	58
J-609	442.00	Zone-1	Demand	0	System Diurnal Curve	0	603	70
J-610	428.50	Zone-1	Demand	0	System Diurnal Curve	0	591	70
J-611	476.00	Upper Zone	Demand	0	Fixed	0	664	81
J-612	524.30	Upper Zone	Demand	0	System Diurnal Curve	0	666	61
J-613	527.00	Upper Zone	Demand	0	System Diurnal Curve	0	665	60

Scenario: PH
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-614	520.00	Upper Zone	Demand	3	System Diurnal Curve	4	666	63
J-615	524.60	Upper Zone	Demand	0	System Diurnal Curve	0	665	61
J-616	529.00	Upper Zone	Demand	0	System Diurnal Curve	0	665	59
J-617	474.00	Upper Zone	Demand	0	Fixed	0	664	82
J-618	472.00	Upper Zone	Demand	0	Fixed	0	664	83
J-619	470.00	Upper Zone	Demand	0	Fixed	0	664	84
J-620	456.30	Zone-1	Demand	6	System Diurnal Curve	9	590	58
J-621	483.20	Zone-1	Demand	12	System Diurnal Curve	18	590	46
J-622	470.00	Upper Zone	Demand	54	System Diurnal Curve	81	664	84
J-623	450.00	Zone-1	Demand	0	Fixed	0	586	59
J-624	441.80	Zone-1	Demand	2	System Diurnal Curve	3	596	67
J-625	454.00	Zone-1	Demand	0	System Diurnal Curve	0	589	58
J-626	449.00	Zone-1	Demand	0	Fixed	0	586	59
J-627	466.00	Upper Zone	Demand	0	Fixed	0	664	86
J-628	453.40	Zone-1	Demand	0	System Diurnal Curve	0	588	58
J-629	475.30	Zone-1	Demand	0	Fixed	0	589	49
J-630	455.00	Zone-1	Demand	3	System Diurnal Curve	4	587	57
J-631	557.00	Upper Zone	Demand	0	System Diurnal Curve	0	666	47
J-632	506.50	Zone-1	Demand	0	System Diurnal Curve	0	667	70
J-633	521.60	reservoir and pur	Demand	2	System Diurnal Curve	3	667	63
J-634	453.00	Zone-1	Demand	0	Fixed	0	589	59
J-635	436.00	reservoir and pur	Demand	0	System Diurnal Curve	0	476	17
J-636	483.20	Upper Zone	Demand	0	System Diurnal Curve	0	664	78
J-637	558.40	Upper Zone	Demand	0	System Diurnal Curve	0	666	47
J-638	448.70	Zone-1	Demand	0	System Diurnal Curve	0	588	60
J-639	449.10	Zone-1	Demand	0	System Diurnal Curve	0	588	60
J-640	436.00	Zone-1	Demand	3	System Diurnal Curve	4	585	65
J-641	446.00	Zone-1	Demand	0	Fixed	0	585	60
J-642	437.00	Zone-1	Demand	0	System Diurnal Curve	0	592	67
J-643	430.80	Zone-1	Demand	0	System Diurnal Curve	0	591	69
J-644	440.00	Zone-1	Demand	11	System Diurnal Curve	17	597	68
J-645	442.90	Zone-1	Demand	16	System Diurnal Curve	24	598	67
J-646	446.80	Zone-1	Demand	0	System Diurnal Curve	0	589	61
J-647	448.20	Zone-1	Demand	0	Fixed	0	598	65
J-648	0.00	Zone-1	Demand	0	Fixed	0	595	257
J-649	455.60	Zone-1	Demand	0	Fixed	0	589	58
J-650	451.00	Zone-1	Demand	0	System Diurnal Curve	0	587	59
J-651	480.00	Upper Zone	Demand	0	System Diurnal Curve	0	664	79
J-652	503.00	Upper Zone	Demand	0	System Diurnal Curve	0	663	69
J-653	506.00	Upper Zone	Demand	0	Fixed	0	666	69
J-654	460.80	Zone-1	Demand	0	System Diurnal Curve	0	590	56
J-655	480.30	Upper Zone	Demand	0	System Diurnal Curve	0	664	79
J-656	507.00	Upper Zone	Demand	0	System Diurnal Curve	0	666	69
J-657	532.00	Upper Zone	Demand	0	System Diurnal Curve	0	665	57
J-658	507.00	Zone-1	Demand	0	System Diurnal Curve	0	590	36
J-659	440.30	Zone-1	Demand	0	System Diurnal Curve	0	597	68
J-660	441.90	Zone-1	Demand	0	System Diurnal Curve	0	597	67
J-661	442.00	Zone-1	Demand	0	Fixed	0	595	66
J-669	443.00	Zone-1	Demand	0	Fixed	0	585	62
J-674	433.20	Zone-1	Demand	0	Fixed	0	586	66
J-680	469.00	Zone-1	Demand	0	Fixed	0	590	52
J-682	488.00	Zone-1	Demand	0	Fixed	0	590	44

Scenario: PH
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-687	450.00	Zone-1	Demand	0	Fixed	0	589	60
J-694	521.60	Zone-1	Demand	0	Fixed	0	590	29
J-699	0.00	Zone-1	Demand	0	Fixed	0	589	255

Scenario: AFF w/ Schedule M (Existing)
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-1	Zone-1	false	1,000	36	25	30	J-694
J-2	Zone-1	false	2,250	307	25	30	J-694
J-3	Zone-1	false	1,000	364	27	25	J-1
J-5	Zone-1	false	1,000	20	25	30	J-694
J-6	Zone-1	false	1,000	127	26	25	J-87
J-7	Zone-1	false	1,000	334	26	25	J-1
J-8	Zone-1	false	1,000	40	25	30	J-694
J-9	Zone-1	false	1,000	402	27	25	J-1
J-10	Zone-1	false	1,000	608	26	25	J-11
J-11	Zone-1	false	1,000	33	25	30	J-694
J-12	Zone-1	false	1,000	109	25	30	J-694
J-13	Zone-1	false	1,000	158	25	30	J-694
J-14	Zone-1	false	1,000	50	25	30	J-694
J-15	Zone-1	true	2,250	4,000	38	29	J-694
J-20	Zone-1	false	1,000	40	25	30	J-694
J-21	Zone-1	true	2,250	4,000	48	29	J-694
J-22	Zone-1	true	1,000	4,000	37	29	J-694
J-23	Zone-1	false	1,000	167	25	30	J-694
J-27	Zone-1	false	1,000	66	25	30	J-694
J-28	Zone-1	true	1,000	1,928	25	26	J-29
J-29	Zone-1	false	1,000	60	25	30	J-694
J-30	Zone-1	false	1,000	53	25	30	J-694
J-31	Zone-1	false	1,000	132	25	25	J-129
J-33	Zone-1	false	1,000	16	25	30	J-694
J-34	Zone-1	false	1,000	23	25	30	J-694
J-35	Zone-1	false	1,000	19	25	30	J-694
J-36	Zone-1	false	1,000	10	25	30	J-694
J-37	Zone-1	false	1,000	16	25	30	J-694
J-38	Zone-1	false	1,000	21	25	30	J-694
J-43	Zone-1	false	1,000	21	25	30	J-694
J-44	Zone-1	false	1,000	9	25	30	J-694
J-45	Zone-1	false	2,250	1,519	31	25	J-44
J-46	Zone-1	false	1,000	418	33	25	J-47
J-47	Zone-1	false	1,000	15	25	30	J-694
J-48	Upper Zone	false	1,000	23	25	65	J-432
J-49	Upper Zone	false	1,000	94	28	25	J-48
J-51	Zone-1	true	1,000	2,973	26	25	J-58
J-58	Zone-1	false	1,000	18	25	30	J-694
J-62	Zone-1	false	1,000	15	25	30	J-694
J-63	Zone-1	true	2,250	4,000	61	29	J-694
J-65	Zone-1	false	1,000	22	25	30	J-694
J-66	Zone-1	false	1,000	22	26	25	J-62
J-67	Zone-1	false	2,250	1,821	25	25	J-62
J-68	Zone-1	false	1,000	26	25	30	J-694
J-69	Zone-1	false	2,250	1,888	26	25	J-68
J-70	Zone-1	false	1,000	19	25	30	J-694
J-71	Zone-1	false	2,250	1,151	30	25	J-70
J-72	Zone-1	true	1,000	4,000	45	29	J-694
J-76	Zone-1	false	1,000	25	25	30	J-694
J-77	Zone-1	true	2,250	3,010	27	25	J-76

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-78	Zone-1	true	2,250	2,773	29	25	J-79
J-79	Zone-1	false	1,000	22	25	30	J-694
J-82	Zone-1	false	1,000	18	25	30	J-694
J-86	Zone-1	false	1,000	32	25	30	J-694
J-87	Zone-1	false	1,000	30	25	30	J-694
J-89	Zone-1	false	1,000	22	25	30	J-694
J-92	Zone-1	false	1,000	18	25	30	J-694
J-93	Zone-1	false	1,000	20	25	30	J-694
J-94	Upper Zone	false	1,000	826	25	26	J-98
J-98	Upper Zone	false	1,000	688	25	28	J-169
J-100	Upper Zone	true	1,000	1,107	25	25	J-101
J-101	Upper Zone	false	1,000	22	25	65	J-432
J-102	Zone-1	false	1,000	114	25	30	J-694
J-103	Zone-1	true	2,250	4,000	36	29	J-694
J-104	Zone-1	true	1,000	2,172	25	25	J-105
J-105	Zone-1	false	1,000	125	25	30	J-694
J-106	Zone-1	false	1,000	152	25	30	J-694
J-107	Zone-1	true	1,000	4,000	42	29	J-694
J-108	Zone-1	false	1,000	83	25	30	J-694
J-110	Zone-1	false	1,000	102	25	30	J-694
J-111	Zone-1	true	2,250	4,000	38	29	J-694
J-112	Upper Zone	true	1,000	2,194	27	25	J-275
J-113	Upper Zone	false	1,000	109	25	65	J-432
J-115	Zone-1	true	1,000	4,000	70	29	J-694
J-116	Zone-1	true	1,000	1,644	25	29	J-694
J-119	Zone-1	true	1,000	1,434	25	29	J-694
J-121	Zone-1	false	1,000	153	25	30	J-694
J-122	Zone-1	true	1,000	1,201	27	25	J-660
J-123	Zone-1	false	1,000	183	25	30	J-694
J-124	Zone-1	true	1,000	1,296	25	25	J-123
J-126	Zone-1	false	1,000	74	25	30	J-694
J-127	Zone-1	false	1,000	464	25	25	J-450
J-128	Zone-1	true	1,000	4,000	54	29	J-694
J-129	Zone-1	false	1,000	101	25	30	J-694
J-130	Zone-1	false	1,000	95	25	30	J-694
J-131	Zone-1	false	1,000	232	25	30	J-694
J-133	Zone-1	true	1,000	2,991	26	25	J-134
J-134	Zone-1	false	1,000	141	25	30	J-694
J-136	Zone-1	false	2,250	141	25	30	J-694
J-137	Zone-1	true	1,000	4,000	33	26	J-44
J-138	Upper Zone	true	1,000	2,260	25	44	J-481
J-140	Upper Zone	false	1,000	683	25	55	J-653
J-141	Zone-1	true	1,000	4,000	53	29	J-694
J-142	Upper Zone	true	1,000	1,657	27	25	J-143
J-143	Upper Zone	false	1,000	150	25	65	J-432
J-144	Upper Zone	false	1,000	248	25	65	J-432
J-145	Upper Zone	true	1,000	2,975	28	25	J-335
J-146	Zone-1	false	1,000	177	25	30	J-694
J-147	Zone-1	false	1,000	643	25	25	J-146
J-148	Zone-1	false	1,000	130	25	30	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-149	Zone-1	false	1,000	282	25	27	J-630
J-150	Zone-1	true	1,000	3,932	25	29	J-694
J-151	Zone-1	false	1,000	115	25	30	J-694
J-154	Zone-1	false	1,000	149	25	30	J-694
J-155	Zone-1	false	1,000	761	25	30	J-694
J-156	Zone-1	false	1,000	159	25	30	J-694
J-157	Zone-1	false	1,000	774	25	30	J-694
J-159	Zone-1	false	1,000	861	25	26	J-296
J-160	Zone-1	false	1,000	83	25	30	J-694
J-161	Zone-1	true	1,000	4,000	58	29	J-694
J-162	Zone-1	false	1,000	118	25	30	J-694
J-163	Zone-1	false	1,000	488	33	25	J-47
J-164	Zone-1	true	1,000	1,515	26	25	J-624
J-166	Zone-1	true	3,000	4,000	55	29	J-694
J-167	Zone-1	false	1,000	95	25	30	J-694
J-168	Zone-1	true	2,250	4,000	29	28	J-87
J-169	Upper Zone	false	1,000	483	25	59	J-481
J-170	Upper Zone	false	1,000	815	25	38	J-565
J-172	Upper Zone	true	1,000	1,794	25	34	J-481
J-173	Upper Zone	false	1,000	109	25	65	J-432
J-174	Upper Zone	false	1,000	563	34	25	J-48
J-175	Upper Zone	false	1,000	120	25	65	J-432
J-176	Zone-1	false	1,000	45	25	30	J-694
J-177	Zone-1	false	1,000	129	26	25	J-176
J-179	Zone-1	true	1,000	3,607	26	25	J-58
J-180	Zone-1	true	1,000	4,000	42	29	J-694
J-181	Zone-1	true	2,250	4,000	56	29	J-694
J-182	Zone-1	false	1,000	115	25	30	J-694
J-184	Zone-1	false	1,000	127	25	30	J-694
J-185	Zone-1	false	1,000	62	25	30	J-694
J-186	Zone-1	true	2,250	3,471	25	25	J-185
J-187	Zone-1	true	1,000	4,000	55	29	J-694
J-188	Zone-1	false	1,000	290	25	30	J-694
J-192	Upper Zone	true	1,000	2,544	25	27	J-194
J-193	Upper Zone	false	1,000	107	25	65	J-432
J-194	Upper Zone	true	1,000	2,525	25	28	J-192
J-195	Zone-1	false	1,000	139	25	30	J-694
J-197	Zone-1	true	3,000	3,527	25	25	J-198
J-198	Zone-1	false	1,000	425	25	30	J-694
J-199	Zone-1	true	1,000	3,375	25	25	J-146
J-200	Zone-1	false	1,000	330	25	30	J-694
J-202	Zone-1	false	1,000	375	25	30	J-694
J-203	Zone-1	true	1,000	2,184	25	25	J-202
J-204	Zone-1	false	2,250	228	25	27	J-205
J-205	Zone-1	false	1,000	187	25	30	J-694
J-206	Upper Zone	true	1,000	2,771	26	25	J-326
J-207	Upper Zone	true	1,000	2,774	26	25	J-326
J-208	Upper Zone	false	1,000	276	25	64	J-432
J-209	Zone-1	false	1,000	401	25	26	J-89
J-210	Zone-1	true	1,000	1,332	26	25	J-660

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-211	Zone-1	false	1,000	470	25	30	J-694
J-217	Upper Zone	false	1,000	903	25	52	J-481
J-219	Zone-1	true	1,000	1,435	25	25	J-251
J-220	Zone-1	true	1,000	4,000	39	29	J-694
J-221	Zone-1	false	1,000	706	25	30	J-694
J-222	Zone-1	true	1,000	2,464	25	25	J-221
J-223	Zone-1	false	1,000	745	25	30	J-694
J-224	Zone-1	true	1,000	2,577	25	25	J-223
J-225	Zone-1	false	1,000	732	25	30	J-694
J-226	Zone-1	true	1,000	2,754	25	25	J-225
J-227	Zone-1	false	1,000	939	25	29	J-694
J-228	Zone-1	true	1,000	4,000	40	29	J-694
J-229	Zone-1	true	1,000	2,904	25	25	J-230
J-230	Zone-1	false	1,000	855	25	30	J-694
J-231	Zone-1	false	1,000	728	25	30	J-694
J-232	Zone-1	false	1,000	623	25	30	J-694
J-234	Zone-1	false	1,000	728	25	30	J-694
J-235	Zone-1	false	1,000	732	25	30	J-694
J-236	Zone-1	false	1,000	688	25	30	J-694
J-237	Zone-1	true	1,000	4,000	34	29	J-694
J-238	Zone-1	false	1,000	756	25	30	J-694
J-239	Zone-1	false	1,000	688	25	30	J-694
J-240	Zone-1	true	1,000	1,712	25	25	J-239
J-241	Zone-1	true	1,000	1,136	25	29	J-694
J-242	Zone-1	true	1,000	4,000	38	29	J-694
J-243	Zone-1	true	1,000	4,000	37	29	J-694
J-244	Zone-1	false	1,000	721	25	30	J-694
J-245	Zone-1	true	1,000	4,000	38	29	J-694
J-246	Zone-1	true	1,000	1,084	25	29	J-694
J-247	Zone-1	false	1,000	919	25	29	J-694
J-248	Zone-1	true	1,000	1,725	25	25	J-247
J-249	Zone-1	true	1,000	2,491	26	25	J-250
J-250	Zone-1	true	1,000	1,017	25	29	J-694
J-251	Zone-1	false	1,000	701	25	30	J-694
J-252	Zone-1	false	2,250	384	25	30	J-694
J-253	Zone-1	true	1,000	1,663	25	25	J-641
J-254	Zone-1	false	1,000	364	25	30	J-694
J-255	Zone-1	true	2,250	3,703	25	29	J-186
J-256	Zone-1	false	1,000	415	25	25	J-27
J-257	Zone-1	false	1,000	695	28	25	J-27
J-258	Zone-1	true	2,250	3,358	28	25	J-27
J-262	Zone-1	true	1,000	4,000	30	29	J-694
J-263	Zone-1	false	2,250	1,370	25	25	J-182
J-265	Zone-1	true	2,250	4,000	56	29	J-694
J-268	Zone-1	true	1,000	2,554	25	29	J-694
J-269	Upper Zone	true	1,000	1,094	25	26	J-94
J-270	Upper Zone	true	1,000	2,983	28	25	J-611
J-273	Upper Zone	true	1,000	2,154	27	25	J-275
J-275	Upper Zone	false	1,000	523	25	57	J-481
J-276	Upper Zone	false	1,000	415	25	58	J-481

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-278	Upper Zone	true	1,000	2,301	39	25	J-276
J-280	Zone-1	true	1,000	4,000	48	29	J-694
J-281	Zone-1	true	1,000	2,186	25	25	J-200
J-286	Zone-1	false	1,000	589	25	30	J-694
J-287	Zone-1	false	1,000	689	25	30	J-694
J-289	Zone-1	true	2,250	4,000	49	29	J-694
J-290	Upper Zone	true	1,000	2,918	25	26	J-170
J-291	Zone-1	false	3,000	1,417	25	29	J-694
J-292	Zone-1	false	3,000	2,369	25	25	J-291
J-293	Zone-1	true	1,000	1,987	25	29	J-694
J-294	Zone-1	true	1,000	2,309	25	26	J-28
J-295	Zone-1	false	1,000	682	26	25	J-660
J-296	Zone-1	false	1,000	111	25	30	J-694
J-297	Zone-1	true	2,250	4,000	40	29	J-694
J-298	Zone-1	true	2,250	3,487	25	29	J-694
J-299	Zone-1	true	3,000	4,000	43	29	J-694
J-300	Zone-1	true	1,000	4,000	36	29	J-694
J-301	Zone-1	true	1,000	4,000	36	29	J-694
J-302	Zone-1	true	1,000	2,519	25	29	J-694
J-303	Zone-1	true	1,000	4,000	46	29	J-694
J-304	Zone-1	true	1,000	4,000	45	29	J-694
J-308	Zone-1	true	1,000	4,000	53	29	J-694
J-309	Zone-1	true	2,250	2,263	25	29	J-694
J-310	Zone-1	false	2,250	1,865	25	29	J-694
J-311	Zone-1	false	2,250	1,711	25	29	J-694
J-312	Zone-1	false	1,000	977	25	29	J-694
J-313	Zone-1	true	1,000	1,921	25	25	J-312
J-314	Zone-1	false	2,250	1,661	25	29	J-694
J-315	Zone-1	true	1,000	2,403	25	25	J-202
J-316	Zone-1	true	2,250	4,000	57	29	J-694
J-317	Zone-1	true	1,000	1,486	25	29	J-694
J-318	Upper Zone	true	1,000	1,676	25	50	J-481
J-319	Upper Zone	true	1,000	2,872	25	29	J-485
J-320	Upper Zone	true	1,000	1,326	25	55	J-481
J-321	Upper Zone	true	1,000	2,389	46	25	J-320
J-322	Upper Zone	true	1,000	3,326	28	25	J-485
J-324	Zone-1	true	1,000	4,000	43	29	J-694
J-325	Upper Zone	true	1,000	2,653	25	33	J-328
J-326	Upper Zone	true	1,000	2,709	25	28	J-328
J-327	Upper Zone	true	1,000	1,521	25	29	J-328
J-328	Upper Zone	true	1,000	1,593	25	26	J-327
J-329	Upper Zone	true	1,000	2,771	28	25	J-335
J-333	Upper Zone	true	1,000	1,751	31	25	J-590
J-334	Upper Zone	true	1,000	1,740	27	25	J-143
J-335	Upper Zone	true	1,000	1,564	25	36	J-477
J-336	Upper Zone	true	1,000	1,551	25	33	J-636
J-337	Upper Zone	true	1,000	1,683	27	25	J-636
J-339	Upper Zone	true	1,000	2,714	28	25	J-636
J-341	Upper Zone	true	1,000	2,248	28	25	J-276
J-342	Zone-1	true	1,000	1,990	25	29	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-343	Zone-1	true	1,000	2,783	25	25	J-605
J-346	Zone-1	true	1,000	2,171	25	29	J-694
J-349	Zone-1	true	1,000	2,086	25	29	J-694
J-351	Zone-1	true	2,250	2,587	25	25	J-353
J-353	Zone-1	false	2,250	1,434	25	29	J-694
J-356	Zone-1	true	3,000	4,000	55	29	J-694
J-358	Zone-1	false	2,250	1,940	27	25	J-353
J-359	Zone-1	true	2,250	4,000	68	29	J-694
J-360	Zone-1	true	2,250	4,000	62	29	J-694
J-362	Zone-1	true	1,000	1,429	26	25	J-124
J-364	Zone-1	true	3,000	4,000	60	29	J-694
J-365	Zone-1	true	1,000	2,585	25	29	J-694
J-367	Zone-1	false	2,250	265	25	26	J-204
J-368	Zone-1	false	1,000	283	25	25	J-369
J-369	Zone-1	false	2,250	283	25	25	J-367
J-370	Zone-1	true	1,000	2,770	25	26	J-293
J-371	Zone-1	true	2,250	3,470	25	29	J-694
J-372	Zone-1	true	2,250	3,620	25	29	J-375
J-374	Zone-1	true	2,250	4,000	45	29	J-694
J-375	Zone-1	true	2,250	3,622	25	25	J-412
J-376	Zone-1	true	1,000	4,000	70	29	J-694
J-378	Zone-1	true	2,250	4,000	69	29	J-694
J-379	Zone-1	true	1,000	2,102	25	25	J-412
J-380	Zone-1	true	3,000	4,000	58	29	J-694
J-387	reservoir an	false	1,000	0	20	17	J-635
J-388	Zone-1	true	1,000	3,355	25	29	J-694
J-389	Zone-1	true	1,000	3,323	25	29	J-694
J-390	Zone-1	true	1,000	3,922	25	28	J-501
J-391	Zone-1	true	1,000	3,888	25	28	J-504
J-392	Zone-1	true	1,000	4,000	32	29	J-694
J-393	Zone-1	true	1,000	1,453	25	29	J-694
J-394	Zone-1	true	2,250	3,323	25	28	J-538
J-395	Zone-1	true	2,250	4,000	41	29	J-694
J-396	Zone-1	false	2,250	1,518	25	29	J-694
J-398	Zone-1	true	2,250	4,000	39	29	J-694
J-399	Zone-1	true	2,250	4,000	39	29	J-694
J-400	Upper Zone	true	1,000	1,374	25	41	J-588
J-401	Zone-1	true	3,000	4,000	52	29	J-694
J-402	Zone-1	true	1,000	2,498	25	29	J-694
J-403	Zone-1	true	1,000	2,444	25	29	J-694
J-404	Zone-1	true	1,000	4,000	54	29	J-694
J-405	Zone-1	true	1,000	1,598	25	29	J-694
J-406	Zone-1	true	1,000	3,018	26	25	J-405
J-407	Zone-1	false	3,000	1,507	26	25	J-408
J-408	Zone-1	false	3,000	1,123	25	29	J-694
J-409	Zone-1	true	2,250	4,000	69	29	J-694
J-410	Zone-1	true	1,000	1,416	25	29	J-694
J-411	Zone-1	true	1,000	1,757	25	25	J-412
J-412	Zone-1	true	1,000	1,345	25	29	J-694
J-413	Zone-1	true	1,000	4,000	57	29	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-414	Zone-1	true	1,000	4,000	25	29	J-694
J-415	Zone-1	true	1,000	3,130	26	25	J-418
J-416	Zone-1	true	1,000	4,000	52	29	J-694
J-417	Zone-1	true	1,000	4,000	55	29	J-694
J-418	Zone-1	true	1,000	1,705	25	29	J-694
J-419	Zone-1	true	1,000	4,000	57	29	J-694
J-420	Zone-1	true	1,000	1,011	25	30	J-694
J-421	Zone-1	true	2,250	4,000	56	29	J-694
J-422	Zone-1	true	1,000	3,024	25	29	J-694
J-429	Zone-1	true	1,000	4,000	71	29	J-694
J-432	Upper Zone	true	1,000	3,663	25	63	J-208
J-433	Upper Zone	true	1,000	1,166	27	25	J-590
J-436	Upper Zone	true	1,000	2,028	36	25	J-335
J-437	Upper Zone	true	1,000	2,013	25	25	J-400
J-439	Upper Zone	true	1,000	2,053	33	25	J-335
J-440	Upper Zone	true	1,000	2,232	31	25	J-335
J-445	Zone-1	true	1,000	4,000	37	29	J-694
J-446	Zone-1	true	1,000	3,310	25	26	J-23
J-447	Zone-1	true	1,000	3,091	25	29	J-694
J-448	Zone-1	false	2,250	1,521	28	25	J-44
J-450	Zone-1	false	1,000	457	25	26	J-369
J-451	Zone-1	true	2,250	4,000	38	29	J-694
J-452	Zone-1	true	1,000	2,942	25	27	J-294
J-453	Zone-1	true	1,000	3,069	25	29	J-694
J-454	Zone-1	true	2,250	2,277	25	29	J-694
J-455	Zone-1	true	1,000	1,186	25	30	J-694
J-458	Zone-1	true	2,250	4,000	68	29	J-694
J-459	Zone-1	true	1,000	2,661	25	29	J-694
J-460	Zone-1	true	2,250	4,000	40	29	J-694
J-461	Zone-1	true	1,000	4,000	44	29	J-694
J-462	Zone-1	true	1,000	4,000	32	29	J-694
J-463	Zone-1	true	1,000	4,000	32	29	J-694
J-464	Zone-1	true	1,000	4,000	36	29	J-694
J-465	Zone-1	true	1,000	4,000	43	29	J-694
J-466	Zone-1	true	3,000	4,000	53	29	J-694
J-467	Zone-1	true	1,000	4,000	48	29	J-694
J-468	Zone-1	true	3,000	4,000	59	29	J-694
J-469	Zone-1	true	3,000	4,000	57	29	J-694
J-470	Zone-1	true	1,000	4,000	67	29	J-694
J-471	Zone-1	true	1,000	4,000	70	29	J-694
J-472	Zone-1	true	1,000	4,000	73	29	J-694
J-474	Zone-1	true	1,000	4,000	47	29	J-694
J-475	Upper Zone	true	1,000	2,262	29	25	J-335
J-476	Upper Zone	true	1,000	1,685	30	25	J-335
J-477	Upper Zone	true	1,000	1,606	25	30	J-335
J-478	Zone-1	true	1,000	4,000	44	29	J-694
J-480	Upper Zone	true	1,000	2,204	30	25	J-481
J-481	Upper Zone	true	1,000	1,089	25	26	J-483
J-483	Upper Zone	true	1,000	1,089	25	25	J-481
J-484	Upper Zone	true	1,000	2,745	40	25	J-320

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-485	Upper Zone	true	1,000	2,797	25	27	J-325
J-486	Zone-1	true	1,000	4,000	34	29	J-694
J-487	Zone-1	true	1,000	4,000	38	29	J-694
J-488	Zone-1	true	1,000	2,370	25	29	J-694
J-489	Upper Zone	true	1,000	4,000	44	44	J-481
J-490	Zone-1	true	1,000	4,000	45	29	J-694
J-491	Zone-1	true	1,000	4,000	41	29	J-694
J-492	Zone-1	true	1,000	4,000	33	29	J-694
J-493	Zone-1	true	1,000	4,000	41	29	J-694
J-494	Zone-1	true	1,000	4,000	39	29	J-694
J-495	Zone-1	true	1,000	4,000	40	29	J-694
J-496	Zone-1	true	1,000	3,014	25	29	J-694
J-497	Zone-1	true	1,000	4,000	29	29	J-694
J-498	Zone-1	true	1,000	4,000	37	29	J-694
J-499	Zone-1	true	1,000	4,000	43	29	J-694
J-500	Zone-1	true	1,000	2,486	25	29	J-694
J-501	Zone-1	true	1,000	3,553	25	25	J-500
J-502	Zone-1	true	1,000	3,414	26	25	J-504
J-503	Zone-1	true	2,250	4,000	41	29	J-694
J-504	Zone-1	true	1,000	2,297	25	29	J-694
J-505	Zone-1	true	1,000	4,000	42	29	J-694
J-507	Zone-1	true	1,000	2,313	25	27	J-639
J-508	Zone-1	true	1,000	2,203	25	25	J-515
J-509	Zone-1	true	1,000	2,460	25	25	J-638
J-510	Zone-1	true	1,000	2,444	25	26	J-507
J-511	Zone-1	true	1,000	2,781	26	25	J-639
J-512	Zone-1	true	1,000	2,492	25	27	J-510
J-515	Zone-1	true	1,000	1,999	25	29	J-694
J-516	Zone-1	true	1,000	4,000	47	29	J-694
J-517	Zone-1	true	1,000	4,000	54	29	J-694
J-519	Zone-1	true	1,000	4,000	29	28	J-629
J-520	Zone-1	true	1,000	3,970	26	25	J-184
J-521	Zone-1	true	1,000	3,737	32	25	J-44
J-523	Zone-1	true	1,000	4,000	37	29	J-694
J-526	Zone-1	true	2,250	4,000	60	29	J-694
J-527	Zone-1	true	3,000	4,000	59	29	J-694
J-529	Zone-1	true	3,000	4,000	58	29	J-694
J-530	Zone-1	true	3,000	4,000	52	29	J-694
J-531	Zone-1	true	1,000	4,000	58	29	J-694
J-532	Zone-1	true	3,000	4,000	63	29	J-694
J-533	Zone-1	true	2,250	4,000	68	29	J-694
J-534	Zone-1	true	3,000	4,000	58	29	J-694
J-536	Zone-1	true	2,250	4,000	62	29	J-694
J-538	Zone-1	true	2,250	3,393	25	25	J-394
J-540	Zone-1	false	2,250	478	25	25	J-252
J-541	Zone-1	true	2,250	4,000	41	29	J-694
J-542	Zone-1	true	2,250	4,000	43	29	J-694
J-543	Zone-1	true	2,250	4,000	36	29	J-694
J-544	Zone-1	true	2,250	4,000	37	29	J-694
J-545	Zone-1	true	2,250	4,000	44	29	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-546	Upper Zone	true	1,000	3,253	27	25	J-616
J-547	reservoir an	false	1,000	0	30	17	J-635
J-548	Zone-1	true	1,000	1,572	25	29	J-694
J-549	Zone-1	true	2,250	4,000	56	29	J-694
J-550	Zone-1	true	2,250	4,000	56	29	J-694
J-551	Zone-1	true	2,250	4,000	55	29	J-694
J-552	Zone-1	true	1,000	4,000	28	29	J-669
J-553	Zone-1	true	2,250	4,000	58	29	J-694
J-554	Zone-1	true	2,250	4,000	57	29	J-694
J-555	Upper Zone	true	1,000	1,605	25	48	J-335
J-556	Zone-1	true	1,000	4,000	55	29	J-694
J-557	Zone-1	true	3,000	4,000	51	29	J-694
J-558	Zone-1	true	2,250	3,635	25	26	J-134
J-559	Zone-1	true	2,250	4,000	57	29	J-694
J-560	Zone-1	true	2,250	4,000	58	29	J-694
J-561	Zone-1	true	1,000	4,000	54	29	J-694
J-562	Zone-1	true	2,250	4,000	57	29	J-694
J-563	Zone-1	true	1,000	1,367	26	25	J-408
J-564	Zone-1	true	1,000	4,000	43	29	J-694
J-565	Upper Zone	false	1,000	391	25	60	J-481
J-566	Upper Zone	true	1,000	1,698	28	25	J-636
J-567	Zone-1	true	1,000	4,000	48	29	J-694
J-568	Zone-1	true	1,000	4,000	31	29	J-694
J-569	Zone-1	true	1,000	4,000	47	29	J-694
J-570	Zone-1	true	1,000	1,130	25	29	J-694
J-571	Zone-1	true	1,000	4,000	71	29	J-694
J-572	Zone-1	true	1,000	2,812	25	29	J-694
J-573	Zone-1	true	1,000	1,859	25	29	J-694
J-574	Upper Zone	true	1,000	2,470	25	37	J-335
J-575	Zone-1	true	3,000	4,000	55	29	J-694
J-576	Zone-1	true	3,000	4,000	49	29	J-694
J-577	Zone-1	true	1,000	4,000	27	29	J-694
J-578	Zone-1	true	1,000	4,000	37	29	J-694
J-579	Zone-1	true	1,000	4,000	74	29	J-694
J-580	Upper Zone	true	1,000	1,114	28	25	J-593
J-581	Upper Zone	true	1,000	1,092	25	25	J-593
J-582	Upper Zone	true	1,000	1,082	26	25	J-593
J-583	Zone-1	true	3,000	4,000	62	29	J-694
J-584	Zone-1	true	3,000	4,000	63	29	J-694
J-585	Zone-1	true	2,250	4,000	59	29	J-694
J-586	Zone-1	true	1,000	4,000	49	29	J-694
J-587	Upper Zone	true	1,000	1,553	26	25	J-400
J-588	Upper Zone	true	1,000	1,553	25	25	J-400
J-589	Upper Zone	true	1,000	1,554	26	25	J-400
J-590	Upper Zone	true	1,000	1,164	25	26	J-593
J-591	Zone-1	true	1,000	4,000	76	29	J-694
J-592	Zone-1	true	1,000	4,000	77	29	J-694
J-593	Upper Zone	true	1,000	1,065	25	29	J-582
J-594	Zone-1	true	2,250	4,000	69	29	J-694
J-595	Zone-1	true	1,000	4,000	72	29	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-596	Zone-1	true	2,250	4,000	57	29	J-694
J-597	Zone-1	true	1,000	4,000	57	29	J-694
J-598	Zone-1	true	1,000	4,000	57	29	J-694
J-599	Zone-1	true	1,000	4,000	58	29	J-694
J-600	Zone-1	true	1,000	4,000	58	29	J-694
J-601	Zone-1	true	2,250	4,000	63	29	J-694
J-602	Upper Zone	true	1,000	1,097	27	25	J-593
J-603	Upper Zone	true	1,000	2,949	28	25	J-611
J-604	Zone-1	false	1,000	23	25	30	J-694
J-605	Zone-1	false	1,000	18	25	30	J-694
J-606	Upper Zone	true	1,000	2,522	28	25	J-611
J-607	Zone-1	false	1,000	14	25	30	J-694
J-608	Zone-1	true	1,000	3,214	26	25	J-607
J-609	Zone-1	true	1,000	4,000	72	29	J-694
J-610	Zone-1	true	3,000	4,000	41	29	J-694
J-611	Upper Zone	true	1,000	1,477	25	41	J-481
J-612	Upper Zone	true	1,000	2,985	25	26	J-616
J-613	Upper Zone	true	1,000	2,944	25	25	J-485
J-614	Upper Zone	true	1,000	2,730	25	34	J-612
J-615	Upper Zone	true	1,000	2,793	27	25	J-616
J-616	Upper Zone	true	1,000	2,472	25	38	J-615
J-617	Upper Zone	true	2,500	2,763	25	33	J-290
J-618	Upper Zone	true	1,000	2,954	26	25	J-617
J-619	Upper Zone	true	1,500	1,837	25	39	J-481
J-620	Zone-1	true	2,250	4,000	26	27	J-5
J-621	Zone-1	true	1,000	4,000	45	29	J-694
J-622	Upper Zone	true	1,000	2,953	27	25	J-617
J-623	Zone-1	true	1,000	3,409	25	25	J-626
J-624	Zone-1	false	1,000	131	25	28	J-126
J-625	Zone-1	true	1,000	4,000	53	29	J-694
J-626	Zone-1	false	2,250	1,387	25	29	J-694
J-627	Upper Zone	false	1,000	802	25	54	J-481
J-628	Zone-1	true	1,000	4,000	50	29	J-694
J-629	Zone-1	true	1,000	2,832	25	29	J-694
J-630	Zone-1	false	1,000	206	25	25	J-151
J-631	Upper Zone	true	1,000	2,273	31	25	J-481
J-632	Zone-1	true	1,000	2,129	25	29	J-694
J-633	reservoir an	false	1,000	0	90	17	J-635
J-634	Zone-1	true	1,000	2,910	25	29	J-694
J-635	reservoir an	false	1,000	0	17	20	J-387
J-636	Upper Zone	true	1,000	1,615	25	29	J-655
J-637	Upper Zone	true	1,000	2,281	30	25	J-481
J-638	Zone-1	true	1,000	2,299	25	26	J-508
J-639	Zone-1	true	1,000	2,168	25	27	J-508
J-640	Zone-1	true	1,000	4,000	33	29	J-694
J-641	Zone-1	false	1,000	690	25	26	J-540
J-642	Zone-1	true	3,000	4,000	65	29	J-694
J-643	Zone-1	true	3,000	4,000	55	29	J-694
J-644	Zone-1	true	1,000	1,785	26	25	J-624
J-645	Zone-1	true	1,000	4,000	71	29	J-694

Scenario: AFF w/ Schedule M
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Calculated Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction
J-646	Zone-1	true	1,000	4,000	42	29	J-694
J-647	Zone-1	true	1,000	4,000	63	29	J-694
J-648	Zone-1	true	1,000	4,000	264	29	J-694
J-649	Zone-1	true	1,000	4,000	50	29	J-694
J-650	Zone-1	true	1,000	1,734	25	29	J-694
J-651	Upper Zone	true	1,000	1,878	36	25	J-335
J-652	Upper Zone	true	1,000	1,785	26	25	J-335
J-653	Upper Zone	false	1,000	928	25	34	J-140
J-654	Zone-1	true	1,000	2,156	25	29	J-694
J-655	Upper Zone	true	1,000	1,660	26	25	J-636
J-656	Upper Zone	true	1,000	1,089	47	25	J-481
J-657	Upper Zone	false	1,000	802	25	54	J-481
J-658	Zone-1	true	1,000	2,400	25	29	J-694
J-659	Zone-1	false	1,000	468	25	30	J-694
J-660	Zone-1	false	1,000	489	25	30	J-694
J-661	Zone-1	true	1,000	4,000	73	29	J-694
J-669	Zone-1	true	1,000	3,644	25	28	J-394
J-674	Zone-1	true	1,000	4,000	45	29	J-694
J-680	Zone-1	true	1,000	4,000	52	29	J-694
J-682	Zone-1	true	1,000	2,705	33	25	J-658
J-687	Zone-1	true	1,000	4,000	29	29	J-694
J-694	Zone-1	true	1,000	4,000	29	37	J-195
J-699	Zone-1	true	1,000	4,000	247	29	J-694

Appendix E Cost Estimates

CITY OF STAYTON
Waterline Replacement Program

Estimated Replacement Cost

Size	Cost/Foot
8-inch	$ 105
10-inch	$ 110
12-inch	$ 130
16-inch	$ 155
24-inch	$ 195

Costs assume work is coordinated with street improvements and includes service repairs to meter, new valves, etc.

20-Year Replacement Buget

Assumptions:

Replace all Steel, Cast Iron, Galvanized Iron, and Galvanized Steel
% of Asbestos Cement Pipelines To Replace 25%

Replacement Costs:

Size	AC	CI	DI	GI	GST	PVC	Steel	Total
<4	$ 32,524	$ -	$ -	$ 659,190	$ 15,855	$ -	$ 529,620	1,237,189
4	$ 155,741	$ -	$ -	$ -	$ -	$ -	$ 279,300	435,041
6	$ 689,640	$ -	$ -	$ -	$ -	$ -	$ 398,160	1,087,800
8	$ 334,084	$ -	$ -	$ 130,200	$ -	$ -	$ 325,605	789,889
10	$ 634,370	$ 73,260	$ -	$ -	$ -	$ -	$ -	707,630
12	$ 231,140	$ 64,610	$ -	$ -	$ -	$ -	$ 297,050	592,800
14	$ 27,629	$ -	$ -	$ -	$ -	$ -	$ -	27,629
16	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
18	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-
24	$ -	$ -	$ -	$ -	$ -	$ -	$ 103,935	103,935
Total	2,105,128	137,870	-	789,390	15,855	-	1,933,670	**4,981,913**

Annual Cost (2005 dollars) = Total Cost Divided by 20-years **$ 249,000**
rounded

Notes:

The remaining life of the AC pipe is uncertain. There are only a few known problem areas, but much of the pipeline appears to be in fairly good conditions. The condition of the AC pipe should be reevulated periodically to fine-tune the replacement schedule.

The City should also use the results of the leak detection study to prioritize pipeline repair sections.

Water Lines to Be Replaced

Existing Pipelines

	Length of Pipe (ft)							
Size	**AC**	**CI**	**DI**	**GI**	**GST**	**PVC**	**Steel**	**Total**
<4	1,658	-	63	6,943	151	7,190	11,584	27,589
4	5,933	-	613	-	-	1,322	19,446	27,314
6	32,057	-	18,167	-	-	4,712	6,436	61,372
8	13,430	-	16,271	1,240	-	5,235	3,101	39,277
10	23,578	666	1,818	-	-	1,859	-	27,921
12	7,112	497	14,031	-	-	-	2,285	23,925
14	713	-	-	-	-	-	-	713
16	-	-	8,457	-	-	-	-	8,457
18	-	-	3,477	-	-	-	-	3,477
20	-	-	8,977	-	-	-	-	8,977
24	-	-	20	-	-	-	533	553
Total	84,481	1,163	71,894	8,183	151	20,318	43,385	229,575

Pipelines to be Replaced or Abandoned with Planned Improvements

	Length of Pipe (ft)							
Size	**AC**	**CI**	**DI**	**GI**	**GST**	**PVC**	**Steel**	**Total**
<4	419			665		12	6,540	7,636
4			335			1,322	16,786	18,443
6	5,785						2,644	8,429
8	703							703
10	510							510
12								-
14								-
16								-
18								-
20								-
24								
Total	7,417	-	335	665	-	1,334	25,970	35,721

Remaining Length of Pipeline to Be Replaced within next 20 to 40 years

Size	**AC**	**CI**	**DI**	**GI**	**GST**	**PVC**	**Steel**	**Total**
<4	1,239	-		6,278	151		5,044	19,953
4	5,933	-		-	-		2,660	8,871
6	26,272	-		-	-		3,792	52,943
8	12,727	-		1,240	-		3,101	38,574
10	23,068	666		-	-		-	27,411
12	7,112	497		-	-		2,285	23,925
14	713	-		-	-		-	713
16	-	-		-	-		-	8,457
18	-	-		-	-		-	3,477
20	-	-		-	-		-	8,977
24	-	-		-	-		533	553
Total	77,064	1,163	71,559	7,518	151	18,984	17,415	193,854

*No replacement of DI or PVC anticipated aside from that required for the planned improvements

NO.	ITEM	UNIT	Unit Price	Elwood Street ESTIMATED QUANTITY	Elwood Street CONTRACT TOTAL	Community Center ESTIMATED QUANTITY	Community Center CONTRACT TOTAL	Kathy Street ESTIMATED QUANTITY	Kathy Street CONTRACT TOTAL	Maple Ave Area ESTIMATED QUANTITY	Maple Ave Area CONTRACT TOTAL	2nd Ave ESTIMATED QUANTITY	2nd Ave CONTRACT TOTAL	Bowling Alley Area ESTIMATED QUANTITY	Bowling Alley Area CONTRACT TOTAL	Locust Road ESTIMATED QUANTITY	Locust Road CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)																
	a) 8-inch	LF	$80.00	2,250	$180,000	755	$60,400	600	$48,000	1,820	$145,600	510	$40,800	1,165	$93,200	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	d) 16-inch	LF	$125.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	New transmission pipes installed in undeveloped areas with no pavement repair																
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	PRV with Backflow Prevention	LF	$16,000.00	1	$16,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Reconnect Fire Hydrants to existing line	EA	$4,000.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	8	$32,000
	Install a new fire hydrant	EA	$2,800.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Replace water service	EA	$1,200.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Add 10-inch water valve	EA	$5,000.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Mobilization	LS	6%	1	$11,760	1	$3,624	1	$2,880	1	$8,736	1	$2,448	1	$5,592	1	$1,920
	Construction Cost				**$207,760**		**$64,024**		**$50,880**		**$154,336**		**$43,248**		**$98,792**		**$33,920**
	Contingency (20% of construction cost)		20%		$41,552		$12,805		$10,176		$30,867		$8,650		$19,758		$6,784
	Engineering (15% of construction cost)		15%		$31,164		$9,604		$7,632		$23,150		$6,487		$14,819		$5,088
	Total Project Cost (rounded)				**$280,000**		**$86,000**		**$69,000**		**$208,000**		**$58,000**		**$133,000**		**$46,000**

Stayton Water Master Plan
Priority 1 Improvement
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Florence Street ESTIMATED QUANTITY	Florence Street CONTRACT TOTAL	E. Santiam Street ESTIMATED QUANTITY	E. Santiam Street CONTRACT TOTAL	Pine Street ESTIMATED QUANTITY	Pine Street CONTRACT TOTAL	Highland Drive Area ESTIMATED QUANTITY	Highland Drive Area CONTRACT TOTAL	East Ida Street ESTIMATED QUANTITY	East Ida Street CONTRACT TOTAL	Cedar Street ESTIMATED QUANTITY	Cedar Street CONTRACT TOTAL	Safeway Complex ESTIMATED QUANTITY	Safeway Complex CONTRACT TOTAL
	Pipe replacement (installed in urban areas with paveme																
	a) 8-inch	LF	$80.00	834	$66,720	0	$0	0	$0	890	$71,200	525	$42,000	250	$20,000	640	$51,200
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	550	$46,750	1,875	$159,375	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	475	$47,500	1,400	$140,000	0	$0	0	$0	0	$0	0	$0
	d) 16-inch	LF	$125.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	New transmission pipes installed in undeveloped areas																
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	PRV with Backflow Prevention	LF	$16,000.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Reconnect Fire Hydrants to existing line	EA	$4,000.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Install a new fire hydrant	EA	$2,800.00	0	$0	1	$2,800	0	$0	0	$0	0	$0	0	$0	0	$0
	Replace water service	EA	$1,200.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Add 10-inch water valve	EA	$5,000.00	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
	Mobilization	LS	6%	1	$4,003	1	$3,018	1	$8,400	1	$7,077	1	$12,083	1	$1,200	1	$3,072
	Construction Cost				**$70,723**		**$53,318**		**$148,400**		**$125,027**		**$213,458**		**$21,200**		**$54,272**
	Contingency (20% of construction cost)		20%		$14,145		$10,664		$29,680		$25,005		$42,692		$4,240		$10,854
	Engineering (15% of construction cost)		15%		$10,608		$7,998		$22,260		$18,754		$32,019		$3,180		$8,141
	Total Project Cost (rounded)				**$95,000**		**$72,000**		**$200,000**		**$169,000**		**$288,000**		**$29,000**		**$73,000**

Stayton Water Master Plan

Priority 1 Improvement

Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Shaff Road ESTIMATED QUANTITY	Shaff Road CONTRACT TOTAL	Water Services for Northslope and Westown Subd ESTIMATED QUANTITY	Water Services for Northslope and Westown Subd CONTRACT TOTAL	Add Valves on Shaff Road ESTIMATED QUANTITY	Add Valves on Shaff Road CONTRACT TOTAL	10th Ave. ESTIMATED QUANTITY	10th Ave. CONTRACT TOTAL
	Pipe replacement (installed in urban areas with paveme										
	a) 8-inch	LF	$80.00	300	$24,000	0	$0	0	$0	135	$10,800
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0	0	$0	425	$42,500
	d) 16-inch	LF	$125.00	1,715	$214,375	0	$0	0	$0	0	$0
	New transmission pipes installed in undeveloped areas										
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0
	PRV with Backflow Prevention	LF	$16,000.00	0	$0	0	$0	0	$0	1	$16,000
	Reconnect Fire Hydrants to existing line	EA	$4,000.00	0	$0	0	$0	0	$0	0	$0
	Install a new fire hydrant	EA	$2,800.00	0	$0	0	$0	0	$0	0	$0
	Replace water service	EA	$1,200.00	0	$0	329	$394,800	0	$0	1	$1,200
	Add 10-inch water valve	EA	$5,000.00	0	$0	0	$0	2	$10,000	0	$0
	Mobilization	LS	6%	1	$14,303	1	$23,688	1	$600	1	$4,230
	Construction Cost				**$252,678**		**$418,488**		**$10,600**		**$74,730**
	Contingency (20% of construction cost)		20%		$50,536		$0		$0		$0
	Engineering (15% of construction cost)		15%		$37,902		$0		$0		$0
	Total Project Cost (rounded)				**$341,000**		**$418,000**		**$11,000**		**$75,000**

Stayton Water Master Plan

Priority 1 Improvement

Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Pine Steet Booster Station Improvements ESTIMATED QUANTITY	Pine Steet Booster Station Improvements CONTRACT TOTAL	Meter Unmetered Facilities ESTIMATED QUANTITY	Meter Unmetered Facilities CONTRACT TOTAL
	Pine Improvements						
	a) Upgrade pressure tank	LS	$5,000.00	1	$5,000	0	$0
	b) Change pumps to turbine	LS	$36,000.00	1	$36,000	0	$0
	c) SCADA	LS	$15,000.00	1	$15,000	0	$0
	d) Install new flow meter	LS	$12,000.00	1	$12,000	0	$0
	Install Meters						
	a) City Parks (5)	EA	$7,500.00	0	$0	5	$37,500
	b) WTP	EA	$1,200.00	0	$0	1	$1,200
	c) Cemetery	EA	$7,500.00	0	$0	1	$7,500
	d) City Shop	EA	$1,200.00	0	$0	1	$1,200
	Mobilization	LS	6%	1	$4,080	1	$2,844
	Construction Cost				**$72,080**		**$50,244**
	Contingency (20% of construction cost)		20%		$14,416		$10,049
	Engineering (15% of construction cost)		15%		$10,812		$7,537
	Total Project Cost				**$97,000**		**$68,000**

CITY OF STAYTON

PRIORITY 1 IMPROVEMENTS

Cost Opinion for Rehabilitation of the Regis Water Reservoir. To be use to refurbish the reservoir to obtain at least ten years of additional safe service from the reservoir.

Item	Description	Amount
1	Temporary Relocation of Cell Antenna Equipment	$8,500
2	Surface Preparation Inside and Out	$34,000
3	Replace corroded bottom plates	$22,000
4	Replace corroded anchor bolts	$9,500
5	Modify foundation to improve drainage away from base plate	$3,500
6	Paint inside and out	$38,000
7	Administration and engineering	$10,000
8	Contingency	$10,000
Total		$135,500

Stayton Water Master Plan
Priority 2 Improvement
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Water Street ESTIMATED QUANTITY	Water Street CONTRACT TOTAL	West Ida Road ESTIMATED QUANTITY	West Ida Road CONTRACT TOTAL	Marion Street Area ESTIMATED QUANTITY	Marion Street Area CONTRACT TOTAL	Washington Street ESTIMATED QUANTITY	Washington Street CONTRACT TOTAL	Robidoux Street Area ESTIMATED QUANTITY	Robidoux Street Area CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)												
	a) 8-inch	LF	$80.00	0	$0	2,050	$164,000	1,650	$132,000	550	$44,000	3,300	$264,000
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0	0	$0	0	$0	0	$0
	New transmission pipes installed in undeveloped areas with no pavement repair												
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0	0	$0
	Construct intertie with Salem Water Line			0	$0	0	$0	0	$0	0	$0	0	$0
	a) Water meter	EA	$16,800.00	0	$0	0	$0	0	$0	0	$0	0	$0
	b) Piping and Valving	EA	$24,000.00	0	$0	0	$0	0	$0	0	$0	0	$0
	Reconnect water service	EA	$700.00	25	$17,500	0	$0	0	$0	30	$21,000	0	$0
	Mobilization	LS	6%	1	$1,050	1	$9,840	1	$7,920	1	$3,900	1	$15,840
	Construction Cost				**$18,550**		**$173,840**		**$139,920**		**$68,900**		**$279,840**
	Contingency (20% of construction cost)		20%		$3,710		$34,768		$27,984		$13,780		$55,968
	Engineering (15% of construction cost)		15%		$2,783		$26,076		$20,988		$10,335		$41,976
	Total Project Cost (Rounded)				**$25,000**		**$235,000**		**$189,000**		**$93,000**		**$378,000**

Stayton Water Master Plan
Priority 2 Improvement
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Jefferson Street ESTIMATED QUANTITY	Jefferson Street CONTRACT TOTAL	Douglas Ave Area ESTIMATED QUANTITY	Douglas Ave Area CONTRACT TOTAL	Birch Ave Area ESTIMATED QUANTITY	Birch Ave Area CONTRACT TOTAL	Hollister Street Area ESTIMATED QUANTITY	Hollister Street Area CONTRACT TOTAL	Salem Inter-tie ESTIMATED QUANTITY	Salem Inter-tie CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavemen												
	a) 8-inch	LF	$80.00	2,610	$208,800	2,280	$182,400	800	$64,000	1,075	$86,000	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0	0	$0	0	$0	0	$0
	New transmission pipes installed in undeveloped areas												
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0	0	$0
	Construct intertie with Salem Water Line			0	$0	0	$0	0	$0	0	$0	0	$0
	a) Water meter	EA	$16,800.00	0	$0	0	$0	0	$0	0	$0	1	$16,800
	b) Piping and Valving	EA	$24,000.00	0	$0	0	$0	0	$0	0	$0	1	$24,000
	Reconnect water service	EA	$700.00	0	$0	0	$0	0	$0	0	$0	0	$0
	Mobilization	LS	6%	1	$12,528	1	$10,944	1	$3,840	1	$5,160	1	$2,448
	Construction Cost				**$221,328**		**$193,344**		**$67,840**		**$91,160**		**$43,248**
	Contingency (20% of construction cost)		20%		$44,266		$38,669		$13,568		$18,232		$8,650
	Engineering (15% of construction cost)		15%		$33,199		$29,002		$10,176		$13,674		$6,487
	Total Project Cost (Rounded)				**$299,000**		**$261,000**		**$92,000**		**$123,000**		**$58,000**

Stayton Water Master Plan
Priority 2 Improvement
Probable 2005 Cost Estimates

				Regis Improvements	
NO.	ITEM	UNIT	Unit Price	ESTIMATED QUANTITY	CONTRACT TOTAL
	Regis Improvements				
	a) Create single backup pump system (i.e. electrical, pump)	LS	$80,000.00	1	$80,000
	b) Building Upgrades	LS	$40,000.00	1	$40,000
	c) SCADA	LS	$10,000.00	1	$10,000
	Mobilization	LS	6%	1	$4,800
	Construction Cost				**$134,800**
	Contingency (20% of construction cost)		20%		$26,960
	Engineering (15% of construction cost)		15%		$20,220
	Total Project Cost (Rounded)				**$182,000**

Stayton Water Master Plan
Priority 3 Improvements
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Schedule "M" Booster Abandonment ESTIMATED QUANTITY	Schedule "M" Booster Abandonment CONTRACT TOTAL	Expand Pine Street Booster Capacity ESTIMATED QUANTITY	Expand Pine Street Booster Capacity CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)						
	a) 8-inch	LF	$80.00	0	$0	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0
	d) 16-inch	LF	$125.00	0	$0	0	$0
	d) Upsize costs for 16-inch over an 10-inch	LF	$20.00	0	$0	0	$0
	e) Upsize costs for 16-inch over a 12-inch	LF	$15.00	0	$0	0	$0
	f) Upsize costs for 12-inch over an 8-inch	LF	$10.00	0	$0	0	$0
	Add'l cost for construction in HWY -- Includes bore	LF	$50.00				
	New transmission pipes installed in undeveloped areas with no pavement repair						
	a) 8-inch	LF	$40.00	0	$0	0	$0
	b) 12-inch	LF	$60.00	0	$0	0	$0
	c) Upsize costs for 10-inch over an 8-inch	LF	$5.00	0	$0	0	$0
	d) Upsize costs for 12-inch over an 8-inch	LF	$20.00	0	$0	0	$0
	e) Upsize costs for 16-inch over an 8-inch	LF	$40.00	0	$0	0	$0
	PRV with Backflow Prevention	LS	$16,000.00	0	$0	0	$0
	Abandon Schedule "M" Booster Station	LS	$20,000.00	1	$20,000	0	$0
	Expand pumping capacity at Pine Street by 1325 GPM	LS	$40,000.00	0	$0	1	$40,000
	Abandon Regis Tank	LS	$40,000.00	0	$0	0	$0
	Add VFD at Pine Street Booster	LS	$12,000.00	0	$0	1	$12,000
	Construct New 5.0 MG Parallel Tank (Concrete)	LS	$2,000,000.00	0	$0	0	$0
	Mobilization	LS	6%	1	$1,200	1	$3,120
	Construction Cost				**$21,200**		**$55,120**
	Contingency (20% of construction cost)		20%		$4,240		$11,024
	Engineering (15% of construction cost)		15%		$3,180		$8,268
	Total Project Cost (Rounded)				**$29,000**		**$74,000**

Stayton Water Master Plan

Priority 4 Improvements

Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Pressure Unit Price	16-loop from Pine Street Reservoir To Fern Ridge ESTIMATED QUANTITY	CONTRACT TOTAL
	Transmission Pipelines				
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)				
	a) 8-inch	LF	$80.00	0	$0
	b) 10-inch	LF	$85.00	0	$0
	c) 12-inch	LF	$100.00	0	$0
	d) 14-inch	LF	$110.00	0	$0
	e) 16-inch	LF	$125.00	2,600	$325,000
	New transmission pipes installed in undeveloped areas with no pavement repair				
	a) 8-inch	LF	$40.00	0	$0
	b) 10-inch	LF	$45.00	0	$0
	c) 12-inch	LF	$60.00	0	$0
	d) 14-inch	LF	$70.00	0	$0
	e) 16-inch	LF	$80.00	3,000	$240,000
	Replace Regis Tank			0	$0
	a) 0.4 MG steel standpipe	EA	$310,000.00	0	$0
	b) check valve/alt. valve w/ house	EA	$50,000.00	0	$0
	c) yard piping	EA	$45,000.00	0	$0
	d) land and permitting	EA	$75,000.00	0	$0
	e) earthwork/landscape/fencing	EA	$18,000.00	0	$0
	Subtotal				$565,000
	Mobilization (6% of total)	LS	6%		$33,900
			Total Construction Cost		$598,900
			Engineering & Contingencies @ 30%		$179,670
			30%		
			Total Low Pressure Zone Alternative Cost	rounded	**$779,000**

Annualized Cost (assumes 4.5% interest, 60-year life) **$37,746**

O&M Cost (per Year) **$1,000**

Total Annualized Cost (rounded) **$ 38,700**

Stayton Water Master Plan
Priority 2 Improvements
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Fern Ridge Road ESTIMATED QUANTITY	Fern Ridge Road CONTRACT TOTAL	Abandon Regis Tank ESTIMATED QUANTITY	Abandon Regis Tank CONTRACT TOTAL	3rd Avenue Future Improvements ESTIMATED QUANTITY	3rd Avenue Future Improvements CONTRACT TOTAL	Construct New 5.0 MG Concrete Tank ESTIMATED QUANTITY	Construct New 5.0 MG Concrete Tank CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)										
	a) 8-inch	LF	$80.00	0	$0	0	$0	0	$0	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0	0	$0	0	$0
	c) 12-inch	LF	$100.00	1,225	$122,500	0	$0	0	$0	0	$0
	d) 16-inch	LF	$125.00	0	$0	0	$0	0	$0	0	$0
	d) Upsize costs for 16-inch over an 10-inch	LF	$20.00	0	$0	0	$0	520	$10,400	0	$0
	e) Upsize costs for 16-inch over a 12-inch	LF	$15.00	0	$0	0	$0	1,020	$15,300	0	$0
	f) Upsize costs for 12-inch over an 8-inch	LF	$10.00	0	$0	0	$0	0	$0	0	$0
	Add'l cost for construction in HWY -- Includes bore	LF	$50.00								
	New transmission pipes installed in undeveloped areas with no pavement repair										
	a) 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0
	b) 12-inch	LF	$60.00	0	$0	0	$0	0	$0	0	$0
	c) Upsize costs for 10-inch over an 8-inch	LF	$5.00	0	$0	0	$0	0	$0	0	$0
	d) Upsize costs for 12-inch over an 8-inch	LF	$20.00	0	$0	0	$0	0	$0	0	$0
	e) Upsize costs for 16-inch over an 8-inch	LF	$40.00	0	$0	0	$0	0	$0	0	$0
	PRV with Backflow Prevention	LS	$16,000.00	1	$16,000	0	$0	0	$0	0	$0
	Abandon Schedule "M" Booster Station	LS	$20,000.00	0	$0	0	$0	0	$0	0	$0
	Expand pumping capacity at Pine Street by 1325 GPM	LS	$40,000.00	0	$0	0	$0	0	$0	0	$0
	Abandon Regis Tank	LS	$40,000.00	0	$0	1	$40,000	0	$0	0	$0
	Add VFD at Pine Street Booster	LS	$12,000.00	0	$0	0	$0	0	$0	0	$0
	Construct New 5.0 MG Parallel Tank (Concrete)	LS	$2,000,000.00	0	$0	0	$0	0	$0	1	$2,000,000
	Mobilization	LS	6%	1	$8,310	1	$2,400	1	$1,542	1	$120,000
	Construction Cost				$146,810		$42,400		$27,242		$2,120,000
	Contingency (20% of construction cost)		20%		$29,362		$0		$5,448		$424,000
	Engineering (15% of construction cost)		15%		$22,022		$0		$4,086		$318,000
	Total Project Cost (Rounded)				**$198,000**		**$42,000**		**$37,000**		**$2,862,000**

Stayton Water Master Plan
Future Improvement
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Future Pipelines ESTIMATED QUANTITY	CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)				
	a) 8-inch	LF	$80.00	0	$0
	b) 10-inch	LF	$85.00	0	$0
	c) 12-inch	LF	$100.00	0	$0
	d) 16-inch	LF	$125.00	0	$0
	d) Upsize costs for 16-inch over an 10-inch	LF	$20.00	0	$0
	e) Upsize costs for 16-inch over a 12-inch	LF	$15.00	0	$0
	f) Upsize costs for 12-inch over an 8-inch	LF	$10.00	0	$0
	Add'l cost for construction in HWY -- Includes bore	LF	$50.00		
	New transmission pipes installed in undeveloped areas with no pavement repair				
	a) 8-inch	LF	$40.00	0	$0
	b) 12-inch	LF	$60.00	0	$0
	c) Upsize costs for 10-inch over an 8-inch	LF	$5.00	23,000	$115,000
	d) Upsize costs for 12-inch over an 8-inch	LF	$20.00	28,841	$576,820
	e) Upsize costs for 16-inch over an 8-inch	LF	$40.00	0	$0
	PRV with Backflow Prevention	LS	$16,000.00	0	$0
	Abandon Schedule "M" Booster Station	LS	$20,000.00	0	$0
	Expand pumping capacity at Pine Street by 1325 GPM	LS	$40,000.00	0	$0
	Abandon Regis Tank	LS	$40,000.00	0	$0
	Add VFD at Pine Street Booster	LS	$12,000.00	0	$0
	Construct New 5.0 MG Parallel Tank (Concrete)	LS	$2,000,000.00	0	$0
	Mobilization	LS	6%	1	$41,509
	Construction Cost				$733,329
	Contingency (20% of construction cost)		20%		$146,666
	Engineering (15% of construction cost)		15%		$109,999
	Total Project Cost (Rounded)				**$990,000**

Stayton Water Master Plan
Future Improvement
Probable 2005 Cost Estimates

NO.	ITEM	UNIT	Unit Price	Shaff Road Future Improvements ESTIMATED QUANTITY	Shaff Road Future Improvements CONTRACT TOTAL	Wilco Road Future Improvements ESTIMATED QUANTITY	Wilco Road Future Improvements CONTRACT TOTAL
	Pipe replacement (installed in urban areas with pavement repair and reco						
	a) 8-inch	LF	$80.00	0	$0	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0
	d) 16-inch	LF	$125.00	0	$0	0	$0
	d) Upsize costs for 16-inch over an 10-inch	LF	$20.00	3,150	$63,000	4,600	$92,000
	e) Upsize costs for 16-inch over a 12-inch	LF	$15.00	0	$0	0	$0
	f) Upsize costs for 12-inch over an 8-inch	LF	$10.00	0	$0	0	$0
	Add'l cost for construction in HWY -- Includes bore	LF	$50.00				
	New transmission pipes installed in undeveloped areas with no pavemen						
	a) 8-inch	LF	$40.00	0	$0	0	$0
	b) 12-inch	LF	$60.00	0	$0	0	$0
	c) Upsize costs for 10-inch over an 8-inch	LF	$5.00	0	$0	0	$0
	d) Upsize costs for 12-inch over an 8-inch	LF	$20.00	0	$0	0	$0
	e) Upsize costs for 16-inch over an 8-inch	LF	$40.00	0	$0	0	$0
	PRV with Backflow Prevention	LS	$16,000.00	0	$0	0	$0
	Abandon Schedule "M" Booster Station	LS	$20,000.00	0	$0	0	$0
	Expand pumping capacity at Pine Street by 1325 GPM	LS	$40,000.00	0	$0	0	$0
	Abandon Regis Tank	LS	$40,000.00	0	$0	0	$0
	Add VFD at Pine Street Booster	LS	$12,000.00	0	$0	0	$0
	Construct New 5.0 MG Parallel Tank (Concrete)	LS	$2,000,000.00	0	$0	0	$0
	Mobilization	LS	6%	1	$3,780	1	$5,520
	Construction Cost				**$66,780**		**$97,520**
	Contingency (20% of construction cost)		20%		$13,356		$19,504
	Engineering (15% of construction cost)		15%		$10,017		$14,628
	Total Project Cost (Rounded)				**$90,000**		**$132,000**

Stayton Water Master Plan

Preliminary Estimate of Probable 2005 Costs

Schedule "M" Alternatives

NO.	ITEM	UNIT	Unit Price	ALT A--Convert Schedule M to Clear Well Storage ESTIMATED QUANTITY	ALT A CONTRACT TOTAL	ALT B-- Relocate Schedule M to WTP ESTIMATED QUANTITY	ALT B CONTRACT TOTAL	ALT C--Keep Schedule "M" online and Expand Clear Well Storage at WTP ESTIMATED QUANTITY	ALT C CONTRACT TOTAL	ALT D--Abandon Schedule M and Expand Clear Well Storage at WTP ESTIMATED QUANTITY	ALT D CONTRACT TOTAL
	Transmission Pipelines										
	c) 16-inch Pressure Water	LF	$28.00	3,600	$100,800	0	$0	0	$0	0	$0
	Total Pipe Length			**3,600**		**0**		**0**		**0**	
	Pipeline Trench Excavation/Backfill										
	Excavation	LF	$35.00	3,600	$126,000	0	$0	0	$0	0	$0
	Total Excavation Length			**3,600**		**0**		**0**		**0**	
	Pipe Trenching Additions										
	b) groundwater dewatering--high water table (0'-6')	LF	$3.50	3,600	$12,600	0	$0	0	$0	0	$0
	c) Utilities--Urban	LF	$3.50	3,600	$12,600	0	$0	0	$0	0	$0
	Joint Easement with Salem	LF	$15.00	0	$0	0	$0	0	$0	0	$0
	16-inch Bend	EA	$1,800.00	13	$23,400	0	$0	0	$0	0	$0
	16-inch Valve	EA	$2,800.00	3	$8,400	0	$0	0	$0	0	$0
	Bore Highway	LF	$650.00	150	$97,500	0	$0	0	$0	0	$0
	Gravel Road Repair	LF	$8.00	600	$4,800	0	$0	0	$0	0	$0
	Traffic Control--Urban	LF	$5.00	1,000	$5,000	0	$0	0	$0	0	$0
	Canal Crossings--coordinate with Salem	EA	$15,000.00	2	$30,000	0	$0	0	$0	0	$0
	Yard piping at WTP for transmission line	EA	$30,000.00	1	$30,000	0	$0	0	$0	0	$0
	Yard piping at Schedule M for transmission line	EA	$35,000.00	1	$35,000	0	$0	0	$0	0	$0
	Pump system @ WTP for transmission line	EA	$20,000.00	1	$20,000	0	$0	0	$0	0	$0
	Repaint Shedule M (interior & exterior)	EA	$75,000.00	1	$75,000	1	$75,000	1	$75,000	0	$0
	Relocate Schedule M to WTP Site (move & reassemble)	EA	$135,000.00	0	$0	1	$135,000	0	$0	0	$0
	a) Yard piping and valving at WTP	EA	$25,000.00	0	$0	1	$25,000	0	$0	0	$0
	b) Pump modifications to pump to tanks with different HGL'	EA	$20,000.00	0	$0	0	$0	0	$0	0	$0
	Modify Schedule M to expand contact time (baffles)	EA	$65,000.00	1	$65,000	1	$65,000	0	$0	0	$0
	Abandon Schedule M Facilities	EA	$20,000.00	0	$0	1	$20,000	0	$0	1	$20,000
	Updgrade Schedule "M" Booster Station										
	a) SCADA	EA	$15,000.00	1	$15,000	0	$0	1	$15,000	0	$0
	b) Electrical	EA	$45,000.00	1	$45,000	0	$0	1	$45,000	0	$0
	c) Motors/Pumps	EA	$120,000.00	0	$0	0	$0	0	$0	0	$0
	Construct intertie with Salem Water Line										
	a) Water meter	EA	$30,000.00	0	$0	1	$30,000	0	$0	1	$30,000
	b) Piping and Valving	EA	$20,000.00	0	$0	1	$20,000	0	$0	1	$20,000
	c) Add standby power to WTP	EA	$130,000.00	0	$0	0	$0	0	$0	0	$0
	Expand Clear Well Storage at WTP										
	a) Contruct new 1.0 MG Tank and yard work	EA	$700,000.00	0	$0	0	$0	1	$700,000	1	$700,000
	Subtotal				$706,100		$370,000		$835,000		$770,000
	Mobilization (6% of total)	LS	6%		$42,366		$22,200		$50,100		$46,200
	Total Construction Cos				$748,466		$392,200		$885,100		$816,200
	Engineering & Contingencies @ 30%		30%		$224,540		$117,660		$265,530		$244,860
	Total Schedule "M" Alt. Cost (rounded)				**$973,000**		**$510,000**		**$1,151,000**		**$1,061,000**

Stayton Water Master Plan

Preliminary Estimate of Probable 2005 Costs

Upper Pressure Zone Alternatives

NO.	ITEM	UNIT	Pressure Unit Price	ALT A--Continuous Pumping from Pine & Regis (Status Quo) ESTIMATED QUANTITY	ALT A CONTRACT TOTAL	ALT B--Abandon Regis tank and booster station ESTIMATED QUANTITY	ALT B CONTRACT TOTAL	ALT C--Build Bench Reservoir & Transmission & Abandon Regis ESTIMATED QUANTITY	ALT C CONTRACT TOTAL	ALT D--Abandon Regis Tank but Upgrade Booster Station w/ Single Pump ESTIMATED QUANTITY	ALT D CONTRACT TOTAL
	Transmission Pipelines										
	c) 16-inch Pressure Water	LF	$28.00	0	$0	0	$0	5,500	$154,000	0	$0
	Total Pipe Length			**0**		**0**		**5,500**		**0**	
	Pipeline Trench Excavation/Backfill										
	Excavation	LF	$35.00	0	$0	0	$0	5,500	$192,500	0	$0
	Total Excavation Length			**0**		**0**		**5,500**		**0**	
	Pipe Trenching Additions										
	b) groundwater dewatering--high water table (0'-6')	LF	$3.50	0	$0	0	$0	5,500	$19,250	0	$0
	c) Utilities--Rural	LF	$1.50	0	$0	0	$0	4,000	$6,000	0	$0
	c) Utilities--Urban	LF	$5.00	0	$0	0	$0	1,500	$7,500	0	$0
	Easement--Rural	LF	$15.00	0	$0	0	$0	1,000	$15,000	0	$0
	16-inch Bend	EA	$1,800.00	0	$0	0	$0	10	$18,000	0	$0
	16-inch Valve	EA	$2,800.00	0	$0	0	$0	3	$8,400	0	$0
	Shoulder Repair	LF	$8.00	0	$0	0	$0	5,500	$44,000	0	$0
	Traffic Control--Urban	LF	$5.00	0	$0	0	$0	5,500	$27,500	0	$0
	Highway/Railroad Crossing--Bore	LF	$650.00	0	$0	0	$0	300	$195,000	0	$0
	Continuous O,M&R at Regis/Pine										
	a) Piping modifications that improve tank circulation	EA	$35,000.00	0	$0	0	$0	0	$0	0	$0
	b) Upgrade Regis Booster Station (motors, electrical, pumps)	EA	$120,000.00	1	$120,000	0	$0	0	$0	1	$80,000
	c) Building Upgrades	EA	$40,000.00	1	$40,000	0	$0	0	$0	1	$40,000
	d) SCADA @ Regis	EA	$10,000.00	1	$10,000	0	$0	0	$0	1	$10,000
	e) Pipe Improvements to improve fire protection	LF	$25.00	0	$0	1,050	$26,250	0	$0	0	$0
	Abandon Regis										
	a) Abandon Booster Station	EA	$40,000.00	0	$0	1	$40,000	1	$40,000	0	$0
	b) Abandon tank	EA	$40,000.00	0	$0	1	$40,000	1	$40,000	1	$20,000
	c) Construct backup power at Pine	EA	$65,000.00	0	$0	1	$65,000	0	$0	0	$0
	d) Add VFD at WTP to control system if Pine goes down	EA	$40,000.00	0	$0	0	$0	0	$0	0	$0
	Build 0.5 MG Bench Reservoir	EA	$325,000.00	0	$0	0	$0	1	$325,000	0	$0
	a) Site Purchase	EA	$60,000.00	0	$0	0	$0	1	$60,000	0	$0
	b) Site Work (Power, drainage, road access)	EA	$75,000.00	0	$0	0	$0	1	$75,000	0	$0
	c) Re-inject chlorine	EA	$30,000.00	0	$0	0	$0	1	$30,000	0	$0
	d) SCADA	EA	$10,000.00	0	$0	0	$0	1	$10,000	0	$0
	Subtotal				$170,000		$171,250		$1,267,150		$150,000
	Mobilization (6% of total)	LS	6%		$10,200		$10,275		$76,029		$9,000
	Total Construction Cost				$180,200		$181,525		$1,343,179		$159,000
	Engineering & Contingencies @ 30%		30%		$54,060		$54,458		$402,954		$47,700
	Total Upper Pressure Zone Alternative Cost (Rounded)				**$234,000**		**$236,000**		**$1,746,000**		**$207,000**

Stayton Water Master Plan

Preliminary Estimate of Probable 2005 Costs

Regis Tank versus Transmission Alternatives

NO.	ITEM	UNIT	Pressure Unit Price	ALT A--Replace Regis Tank ESTIMATED QUANTITY	ALT A--Replace Regis Tank CONTRACT TOTAL	ALT-B--16-loop from Pine Street Reservoir To Fern Ridge ESTIMATED QUANTITY	ALT-B--16-loop from Pine Street Reservoir To Fern Ridge CONTRACT TOTAL
	Transmission Pipelines						
	Pipe replacement (installed in urban areas with pavement repair and reconnect services)						
	a) 8-inch	LF	$80.00	0	$0	0	$0
	b) 10-inch	LF	$85.00	0	$0	0	$0
	c) 12-inch	LF	$100.00	0	$0	0	$0
	d) 14-inch	LF	$110.00	0	$0	0	$0
	e) 16-inch	LF	$125.00	0	$0	2,600	$325,000
	New transmission pipes installed in undeveloped areas with no pavement repair						
	a) 8-inch	LF	$40.00	0	$0	0	$0
	b) 10-inch	LF	$45.00	0	$0	0	$0
	c) 12-inch	LF	$60.00	0	$0	0	$0
	d) 14-inch	LF	$70.00	0	$0	0	$0
	e) 16-inch	LF	$80.00	0	$0	3,000	$240,000
	Replace Regis Tank			0	$0	0	$0
	a) 0.4 MG steel standpipe	EA	$310,000.00	1	$310,000	0	$0
	b) check valve/alt. valve w/ house	EA	$50,000.00	1	$50,000	0	$0
	c) yard piping	EA	$45,000.00	1	$45,000	0	$0
	d) land and permitting	EA	$75,000.00	1	$75,000	0	$0
	e) earthwork/landscape/fencing	EA	$18,000.00	1	$18,000	0	$0
	Subtotal				$498,000		$565,000
	Mobilization (6% of total)	LS	6%		$29,880		$33,900
	Total Construction Cost				$527,880		$598,900
	Engineering & Contingencies @ 30%		30%		$158,364		$179,670
	Total Low Pressure Zone Alternative Cost			rounded	**$686,000**	rounded	**$779,000**

	ALT A	ALT B
Annualized Cost (assumes 4.5% interest, 60-year life)	**$33,240**	**$37,746**
O&M Cost (per Year)	**$6,000**	**$1,000**
Total Annualized Cost (rounded)	**$ 39,200**	**$ 38,700**

Stayton Water Master Plan

Preliminary Estimate of Probable 2005 Costs

Mill Creek Upper Pressure Service Area Alternatives

				Serve from Existing High Pressure Zone -- Construct Pipeline		Construct New Booster Station	
NO.	ITEM	UNIT	Unit Price	ESTIMATED QUANTITY	CONTRACT TOTAL	ESTIMATED QUANTITY	CONTRACT TOTAL
	Pipline Construction						
	12-inch Transmission Pipeline -- Materials and Installation	LF	$50.00	4,100	$205,000	0	$0
	Natural Ground Restoration	LF	$5.00	700	$3,500		
	Asphalt Repair -- City Streets	LF	$30.00	2,000	$60,000	0	$0
	Asphalt Repair -- State HWY	LF	$50.00	1,350	$67,500	0	$0
	Cascade HWY Bore	LF	$650.00	80	$52,000	0	$0
	Mill Creek bore	LF	$675.00	60	$40,500		
	Booster Station and Valving						
	PRV with Backflow Prevention	LS	$16,000.00	1	$16,000	1	$16,000
	New Booster Station -- Sized for Fire Protection	LS	$300,000.00	0	$0	1	$300,000
	Construction Cost				**$444,500**		**$316,000**
	Contingency (20% of construction cost)		20%		$88,900		$63,200
	Engineering (15% of construction cost)		15%		$66,675		$47,400
	Total Project Cost (Rounded)				**$600,000**		**$427,000**
	Annualized Cost (assumes 4.5% interest, 30-year life)				**$36,835**		**$26,214**
	O&M Cost (per Year)				**$4,000**		**$6,000**
	Total Annualized Cost (rounded)				**$ 40,800**		**$ 32,200**

Appendix F Water Rate Analysis

City of Stayton

Financial Plan for the Water Utility

City of Stayton, Oregon

Financial Plan for the Water Utility

December 2005

Economic & Financial Analysis
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INTRODUCTION

Economic & Financial Analysis (EFA), a consulting firm, was retained under subcontract to Keller Associates, Inc. to prepare a water system capital improvements plan for the city of Stayton, Oregon. In this Appendix, EFA presents the financial plan and cash-flow forecast. The Improvement Plan identified $20.1 million of capital improvements needed over the next 20 years. These projects will be built to resolve existing deficiencies, replace facilities that are nearing the end of their useful life, and expand the system to accommodate growth within the City's urban growth boundary.

This report develops a financing plan for the next 8 years, forecasts total annual costs and revenue requirements from water rates, recommends a series of new debts and payoff of existing debts, and recommends periodic rate increases. Two other reports will be presented separately: a water rate analysis and a system development charge analysis.

This report contains 4 sections. Section 1 describes the schedule of construction for the most urgently needed capital improvements for the foreseeable future (8 years). Section 2 presents a least-cost financing plan for construction of urgently needed improvements, and a debt management plan to minimize future annual debt service payments. Section 3 is a forecast of cash flows for all water-related funds and a determination of revenue requirements from water rates. Section 4 presents recommendations for water rate increases.

SCHEDULE OF CAPITAL IMPROVEMENTS

Table 1 shows the schedule of capital improvements and specifies in which fiscal year each of the urgently needed capital improvements is to be constructed. Columns 1 and 2 describe the particular capital improvement and if it is eligible for funding from the *S*tate of Oregon *R*evolving Loan *F*und (SRF). These projects qualify for loans at interest rates that are below market rates, and SRF does not charge the City for any costs associated with securing the loan (i.e., no closing costs, which are typically between 1.5 percent and 3 percent of the loan amount). The City submitted the entire list of capital improvements to the SRF program, but only those identified in Column 2 qualified for SRF funding.

Column 3 shows the project cost as estimated by Keller Associates, Inc. in 2005 dollars. Columns 4 through 12 show the year in which the project is to be constructed and the cost escalated 4.5 percent per year to account for inflation. For example, improvement number 13, the Soda Ash Feed Modification project, is SRF eligible (column 2), is estimated to cost $39,500 (3) in 2005 dollars, and will be constructed in fiscal year 2009-10 at a cost of $49,200 (8). Project numbers 27, 29 and 32 through 50 will be funded after the forecast horizon (2013-14) of this financial plan.

The capital improvements planned between now and 2013-14 are beyond the City's ability to pay with cash. Based on the planned improvements two groupings of projects can be efficiently financed with an SRF loan from the state, two revenue bonds, and cash reserves. The first group of projects will be financed and constructed in the next 3 fiscal years, 2006-07 through 2008-09. The second group of projects will be financed and constructed in fiscal years 2010-11 through 2013-14. Projects not financed will be paid from cash reserves that are generated from water rate revenues after paying operating costs and debt service, and from the accumulation of system development charge revenues.

Table 1 Schedule of Capital Improvements

	(1)	(*) SRF Eligible (2)	Year 2005 $'s (3)	2005 2006 (4)	2006 2007 (5)	2007 2008 (6)	2008 2009 (7)	2009 2010 (8)	2010 2011 (9)	2011 2012 (10)	2012 2013 (11)	2013 2014 (12)
1	**Pipeline Replacements and Upsizing**		**$2,222,000**					**101,900**	**289,400**	**302,400**	**316,000**	**330,200**
2	Add Valves To Shaff Road		11,000		12,000							
3	Complete Leak Detection Study		25,000		27,300							
4	**Meter Unmetered Facilities**		**68,000**		**74,300**							
5	Repaint Interior & Exterior of Regis Tank		135,000		147,400							
6	Pine St. Booster Station		97,000		105,900							
7	**City Hall -- 11% of Total Cost**		**409,200**		**446,900**							
8	Raw Water Intake Maintenance		24,400		26,600							
9	Shallow Well Field	*	716,000			817,100						
10	**Raw Water Weir Box Modifications**		**5,800**			**6,600**						
11	Filter Turbidity Meters	*	56,000		61,200							
12	Replace Filter # 3 Liner	*	542,000		591,900							
13	**Soda Ash Feed Modifications**	*	**39,500**					**49,200**				
14	On-site hypochlorite generation	*	220,000					274,200				
15	Clearwell Maintenance -- interior/exterior		94,000		102,700							
16	**Finished Water Pumping Maintenance**	*	**6,700**			**7,600**						
17	Plant Maintenance Shop / Entrance		359,000						467,500			
18	Plant Automation / Instrumentation		300,800		328,500							
19	**Electrical Upgrade**		**116,000**		**126,700**							
20	Emergency Power System		169,000		184,600							
21	Pipeline / Distribution Improvements--Pipelines		1,695,000								241,000	251,900
22	**Replacement of Poor Water Services**		**418,000**						**272,150**	**284,400**		
23	Secure Land for Tank Site		150,000				178,900					
24	Regis Booster Station		182,000						237,000			
25	**Install Radio-read Meter System**		**50,000**						**65,100**			
26	Salem Inter-tie		58,000				69,200					
27	City Shop		410,000									
28	**Individual Raw Water Flow Meters**		**72,000**					**89,700**				
29	Security Upgrades		368,000									
30	Additional FW pump with VFD (200 hp)		170,000			194,000						
31	**Additional Clearwell Capacity**		**510,000**				**608,200**					
32	Abandon Schedule "M"		29,000									
33	Pine Street Add'l Capacity w/ VFDs		74,000									
34	**Shallow Well Field Expansion**		**79,000**									
35	Raw Water Weir Box Expansion		29,700									
36	Soda Ash System Expansion		29,000									

	(1)	(*) SRF Eligible (2)	Year 2005 $'s (3)	2005 2006 (4)	2006 2007 (5)	2007 2008 (6)	2008 2009 (7)	2009 2010 (8)	2010 2011 (9)	2011 2012 (10)	2012 2013 (11)	2013 2014 (12)
37	**New Filter**		**750,000**									
38	Fern Ridge Road		198,000									
39	16-inch Transmission Loop from Pine St.		779,000									
40	**Abandon Regis Tank (2025)**		**42,000**									
41	Construct New 5.0 MG Storage Reservoir		2,862,000									
42	3rd Avenue Future -- upsize cost		37,000									
43	**Upsize Costs for Future Pipeline**		**990,000**									
44	Shaff Road Pipeline		90,000									
45	Wilco Road Pipeline		132,000									
46	**East Pine Street Small Booster**		**130,000**									
47	Mill Creek Booster Station		427,000									
48	Construct Deep Well -- Backup Supply		1,333,000									
49	**Replace 100-hp pump with 200-hp pump**		**115,000**									
50	New Independent Intake Facility and Pipeline		2,250,000									
	Total Annual Capital Expenditures		20,075,100	0	2,236,000	1,025,300	856,300	515,000	1,331,150	586,800	557,000	582,100
	Qualified for SRF Funding		1,580,200	0	653,100	824,700	0	323,400	0	0	0	0

FINANCING PLAN

The financial plan will payoff one existing debt early, finish paying off the other existing debt on schedule, divides the list of capital improvements to be built in the next 8 years into two groups, and funds them from 3 new loans and cash reserves.

The water utility has two outstanding debts. One is a loan from the State of Oregon *S*pecial *P*ublic *W*orks *F*und (SPWF) that 12 years ago lent the City money for capital improvements. The City has 7 more years of payments owing on a balance of $253,466. This debt can be paid off early without prepayment penalties. The City issued General Obligation (GO) Bonds in 1993 and refinanced those bonds at a lower interest rate in 2001. While eligible to be repaid by assessing property taxes, the City pays annual debt service on these bonds from water rate and SDC revenues. These bonds have 4 years remaining on a balance of $620,000 and cannot be paid off early.

The capital improvements schedule shows the City will spend about $7.689 million on capital improvements over the next 8 years. The financial plan is to borrow approximately $5.699 million for two separate groups of projects. The remaining $1.99 million will be paid from accumulating cash reserves. The first group of projects to be financed will be those constructed over the next 4 years beginning in fiscal year 2006-07. The second group will be those projects constructed beginning in fiscal year 2010-11.

Group 1: FY 2006-7 through 2009-10

The first group of projects will cost $4.632 million. Table 2 shows both current debts and new debts for the proposed first group of projects. EFA assumes the *S*tate of Oregon *R*evolving Loan *F*und (SRF) will lend the City $1.0 million at 4 percent interest per annum over a 20-year term. This amount conservatively estimates how much the SRF may lead the City, as explained below. Also, the City will issue $2.718 million in revenue bonds with a term of 25 years at 4.75 percent interest. And the City will use about $915,000 in cash reserves to fund the rest of the first-group projects.

About $1.58 million (in 2005$) of projects in the first group of projects qualify for SRF financing. The SRF loan is less expensive than borrowing from the municipal bond market and, to be conservative, we assume that the SRF will lend the City only $1.0 million in fiscal year 2006-07. The state lends the SRF money on a priority basis by project. Cities and water districts apply for SRF funding and the state uses 6 criteria to rank projects for funding. The state receives more applications than it has money available to fund; therefore, at the actual time the City needs the money the state may not have sufficient money to fund all of Stayton's qualified projects. The criteria for funding are (a) risks to human health, (b) compliance with federal and state water quality regulations, (c) community affordability, (d) cost effectiveness of the project, (e) consolidation of two or more water supplies, and (f) readiness to proceed. After submitting all of the $20.1 million of planned capital improvements, Stayton was notified that $1.58 million of the projects qualified and may be funded beginning in fiscal year 2006-07. Approval and final loan documents need to be consummated between the state and City before these funds will be available to spend.

SRF has two loan programs, one for communities with high water rates relative to household income (criteria "c" above) and one for all other applicants. The interest rate on the first program is 1 percent and some of the loan may be forgiven (granted). The other program has an interest rate equal to 80 percent of the current municipal bond rate. Neither loan program charges closing or annual servicing fees. To be conservative, we assume Stayton will qualify for the second loan program and that only $1.0 million will be funded by SRF. The current interest rate for that program is approximately 4.0 percent and the term of the loan is a maximum of 20 years.

Table 2 Financing Assumptions--First Group of Capital Improvements (FY 2006-7 through 2009-10)

	Principal	Term	Rate	Avg. Annual Debt Service
Current Debts				
SPWF Loan (as of June 30, 2007)	$253,466	7	5.19%	$44,106
GO Bonds 1993 (as of June 30, 2007)	620,000	4	4.0%	170,099
Total Outstanding Debts	$873,466			$214,205
New Debts				
SRF Loan	$1,000,000	20	4.00%	$73,582
Revenue Bonds Series 2006	2,717,600	25	4.75%	188,017
Use of Cash Reserves	915,000			
Total Construction Costs	$4,632,600			$261,599
Total Principal Owing*	$4,591,066		4.51%	$475,804

Amounts are rounded to the nearest dollar.
* Excludes use of cash reserves

The City also will borrow from the municipal bond market by issuing $2.718 million in revenue bonds. Most municipalities use this publicly traded market to obtain financing for revenue-supported capital improvements. Stayton must follow the Uniform Revenue Bond Act of the State of Oregon to legally authorize the sale of revenue bonds on the open market. (The SRF program does not require conformity to the Bond Act.) The sale of revenue bonds requires an opinion from a certified Bond Counsel licensed to practice in Oregon, and it must produce an Official Statement (OS). The OS describes all of the pertinent details about the City, the use of the funds obtained, financial feasibility, legal authority, political stability, and repayment plan. We estimate these costs will be $100,000 (included in the amount of the Revenue Bonds Series 2006 on Table 2). The term of this bond will be 25 years at 4.75 percent interest cost per annum. Our assumed rate of interest, term and closing costs are subject to daily changes in the market and may differ when the bonds are actually issued.

The first group of projects will require the City to use about $915,000 of cash reserves over the next 4 years to complete all of the projects. The cash reserves as of June 30, 2005 amounted to $851,664. This amount coupled with net revenues resulting from future collection of system development charges and net operating revenues from rate increases will allow the City to maintain a cash balance of over $500,000 for unexpected costs.

The financing of the first group of projects will increase annual debt service from $214,205 to $475,804. Since the revenue to pay this annual debt service comes primarily from water rate revenues and secondarily from system development charge revenues, the City will have to increase water rates.

Between fiscal year 2007-08 and fiscal year 2010-11, the City will payoff the SPWF loan early, and the final payment on the General Obligation (GO) Bonds will be in fiscal year 2010-2011 (August 2010).

Group 2: FY 2010-11 through 2013-14

The second group of projects will be funded from a combination of loans and cash. We assume the SRF program will not fund any of these projects since they did not rank highly in the state's evaluation. All of the borrowing will come from issuing revenue bonds in fiscal year 2010-11. Table 3 shows the then current debts and the proposed $1.981 million in revenue bonds.

Table 3 Financing Assumptions--Second Group of Capital Improvements (FY 2010-11 through 2013-14)

	Principal	Term	Rate	Avg. Annual Debt Service
Current Debts				
SPWF Loan	$0	0	0%	$0
GO Bonds 1993	0	0	0%	
Revenue Bonds 2006 (as of June 30, 2011)	2,464,540	21	4.77%	197,857
SRF 2006 (as of June 30, 2011)	857,396	16	4.00%	73,582
Total Outstanding Debts	$3,321,937			$271,439
New Debts				
Revenue Bonds Series 2006	$1,980,950	25	5.00%	$140,553
Use of Cash Reserves	1,076,100			
Total Construction Costs	$3,057,050			$140,553
Total Principal Owing*	$5,302,887		4.73%	$411,992

Amounts are rounded to the nearest dollar.
*Excludes use of cash reserves.

Table 4 summarizes financing for the first and second groups of projects, and the changes in loans, bonds, and debt service. After the two groups of projects are financed or paid for with cash reserves, then the outstanding principal owing on all loans of the water utility will increase from $873,466 as of June 30, 2005 to $5.303 million as of June 30, 2011. Correspondingly, the annual debt service will increase from $214,205 to $411,992. In the process, the City will have purchased $7.689 million of capital improvements to the water system.

Table 4 Financing Assumptions Summary Groups 1 and 2

	First Group 2006-07 through 2008-09				Second Group 2010-11 through 2014			
	Principal	Term	Rate	Avg. Annual Debt Service	Principal	Term	Rate	Avg. Annual Debt Service
Current Debts								
SPWF Loan	$253,466	7	5.19%	$44,106	$0	0	0%	$0
GO Bonds 1993	620,000	4	4.0%	170,099	0	0	0%	
Revenue Bonds 2006					2,464,540	21	4.77%	197,857
SRF 2006					857,396	16	4.00%	73,582
Total Outstanding Debts	$873,466			$214,205	$3,321,937			$271,439
New Debts								
SRF Loan	$1,000,000	20	4.00%	$73,582				
Revenue Bonds Series 2006	2,717,600	25	4.75%	188,017	$1,980,950	25	5.00%	$140,553
Use of Cash Reserves	915,000				1,076,100			
Total Construction Costs	$4,632,600			$261,599	$3,057,050			$140,553
Total Principal Owing*	$4,591,066		4.51%	$475,804	$5,302,887		4.73%	$411,992

Amounts are rounded to the nearest dollar.
* Excludes cash used for capital improvements.

CASH FLOW

The above schedule of capital improvements and financing assumptions, coupled with annual operating and maintenance costs, determine the annual amount of cash needed from water rates and system development charges. Figure 1 illustrates some key financial measures of the water utility's financial history and forecast.

Figure 1 Cash Flow History and Forecast

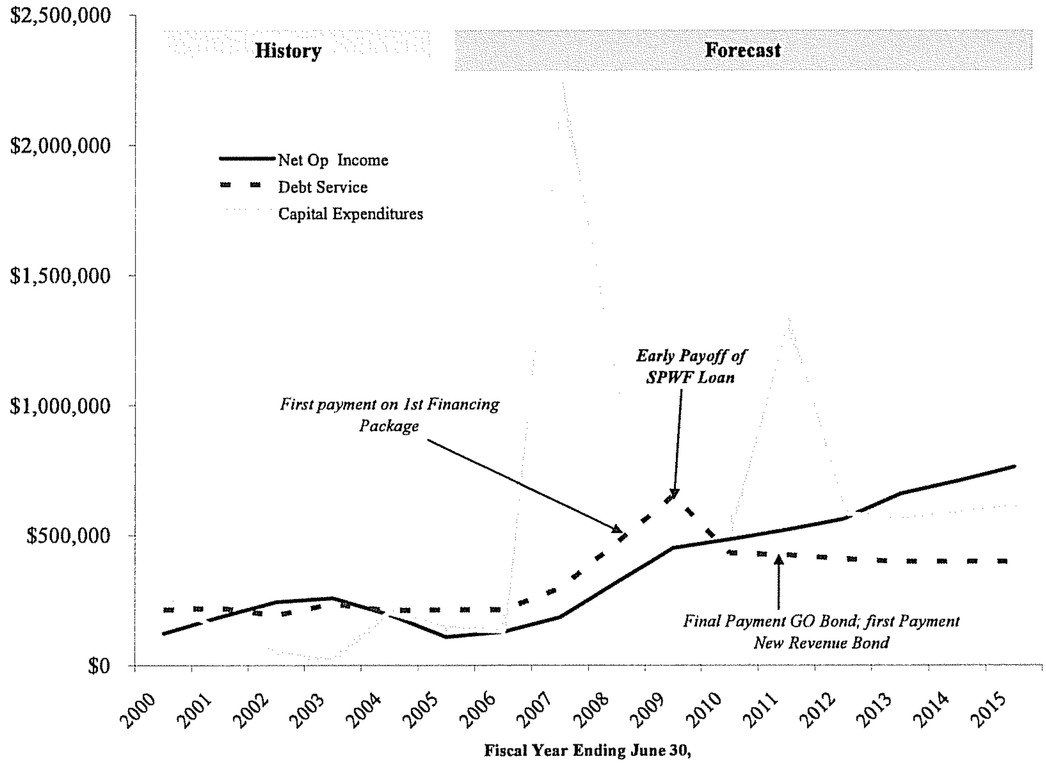

Figure 1 shows Net Operating Income (water rate revenues less operating costs) steadily increases to exceed annual debt service. Net operating income must increase to pay annual debt service on the new loans. Capital expenditures fluctuate as described in Table 1 above, and the peaks correspond with the new loans in 2006-07 and in 2010-11. Noted are the early payoff of the SPWF loan in 2008-09 and the final payment of the 1993 GO Bonds in 2009-10.

Table 5 shows a cash flow history of the water utility from 1996-97 through 2004-05.

Table 5 Cash Flow History

	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005	Avg. Ann. % Change
Cash Flows From Operating Activities										
Charges for Services	660,982	671,018	681,425	694,973	732,821	802,706	951,449	994,414	981,881	4.95%
Miscellaneous	24,175	28,813	27,153	21,091	24,277	33,447	37,450	43,969	29,147	
Total Operating Receipts	685,157	699,831	708,578	716,064	757,098	836,153	988,899	1,038,383	1,011,028	**4.86%**
Personnel Services	190,698	238,950	218,043	248,854	264,855	290,608	269,797	296,077	309,933	6.07%
Materials & Services	170,846	195,747	264,061	276,725	230,895	210,101	269,267	297,189	326,281	8.09%
Administration	48,997	50,000	61,200	67,250	75,185	92,710	191,058	249,780	265,350	21.12%
Total Operating Expenditures	410,541	484,697	543,304	592,829	570,935	593,419	730,122	843,046	901,564	**9.83%**
Net Cash Provided by Operating Activities	274,616	215,134	165,274	123,235	186,163	242,734	258,777	195,337	109,464	**-11.50%**
Cash Flows From Capital & Capital-Related Activities										
SDC Revenues	96,840	160,846	99,284	126,318	91,816	118,957	212,186	157,719	76,187	
Capital Outlays	(31,355)	(84,868)	(86,010)	(259,439)	(134,916)	(45,151)	(16,349)	(204,464)	(142,613)	
Bond Proceeds	72,190					7,108				
Bond Costs										
Debt Service	(224,086)	(153,516)	(215,648)	(214,920)	(220,122)	(192,858)	(235,728)	(210,331)	(213,936)	
Net Cash Provided by (Used In) Capital	(86,411)	(77,538)	(202,374)	(348,041)	(263,222)	(111,944)	(39,891)	(257,076)	(280,362)	
Cash Flows From Investing Activities										
Interest earnings	21,439	27,587	33,487	38,352	32,486	12,673	8,086	5,576	18,589	
Net Income	209,644	165,183	(3,613)	(186,454)	(44,573)	143,463	226,972	(56,163)	(152,309)	
Cash & Investments, July 1	549,514	759,158	924,341	920,728	734,274	689,701	833,164	1,060,136	1,003,973	
Cash & Investments, June 30	759,158	924,341	920,728	734,274	689,701	833,164	1,060,136	1,003,973	851,664	1.44%

Table 5 and the corresponding data represented in Figure 1 are compiled from audited financial statements and combine the water utility fund and the water SDC fund into the single cash flow statement shown as Table 5. Table 5 contains 4 major sections: *Cash flow from operating activities*, *Cash flows from capital and capital-related activities*, *Cash flow from investing activities*, and *Cash and investments* (beginning July 1 of one year and ending June 30 of the next year).

Cash flows from operating activities include all receipts collected from the sale of water to customers and miscellaneous revenues. It also includes all operating costs for personnel, materials and services, and administration. Overall, annual operating receipts have been increasing less rapidly (4.86 percent) than operating costs (9.83 percent). As a result, the net cash from operating activities has been decreasing at the rate of 11.5 percent per year since 1996-97. This figure is important because the City uses net cash from operations to pay debt service on its 2 existing debts and in the future on new debts. Past water rate increases and growth of the customer base and water sales has kept receipts above expenditures (but by a declining margin) since 2002-03.

Cash flows from capital and capital-related activities account for all capital related revenues and expenditures. It has two primary sources of revenue: receipts from system development charges (SDC), and loan and bond proceeds. The SDC receipts result from new building permits and fluctuate from year to year. Over the history, the City has experienced relatively steady growth. The City's only borrowing activity over this short history was to refinance the 1993 GO bonds. Expenditures include capital improvements and debt service on existing debts. Capital expenditures fluctuate markedly from year to year in response to the amount of cash available from loans, bonds, and cash reserves. Debt service varies annually, but only marginally. In every year the sum of debt service and capital expenditures exceeds SDC and bond receipts. In only 4 of the past 9 years, net cash from operating activities exceeded the debt service due in that year. To maintain financial security in the utility, net cash from operations should equal or exceed debt service in each year.

Cash flows from investing activities results from the City investing idle cash in interest bearing securities—primarily the Local Government Investment Pool operated by the Treasurer of the State of Oregon. The earnings vary with changes in interest rates and the amount of invested cash.

Net income is the sum of net cash flows from operations, capital-related and investing activities. In 5 of the past 9 years net income was negative—the utility spent more money in those years than it took in from all sources of revenue. In those years, the utility's cash and investments decreased.

Cash and investments is the accumulation of net income since the creation of the water utility funds. When net income is negative—ending cash and investments decrease; conversely, when net income is positive—ending cash and investments increase. Since 1996-97, ending cash and investments has increased an average of 1.44 percent per year.

The financial history indicates the utility needs to increase water rates to avoid running deficits in future years.

Forecast cash flows are presented in Table 6 and Figure 1. Figure 1 illustrates the steady increase in net operating income that until about 2010-11 is below annual debt service. Debt service fluctuates because of new loans and payoff of existing loans. Capital expenditures also fluctuate and coincide with revenues from new loans and bonds.

Table 6 shows Net Cash Flows from Operating Activities steadily increasing from 2005-06 through 2013-14. We assume that operating costs will increase 7.5 percent per year for personnel and 5.0 percent per year for materials and services. Historically, personnel increased about 6.0 percent per year and materials and services about 6.9 percent per year. Also, in personnel, a new public works position is included at a cost of $60,000 per year beginning in fiscal year 2007-08.

As explained in the next section, receipts from water rates increase due to growth at 2.4 percent per year and due to rate increases ranging from 5 percent to 15 percent per year. The increases in operating receipts exceed the increases in operating costs, so that net cash provided by operating activities steadily increases to levels that exceed annual debt service.

Cash Flows from Capital & Capital-Related Activities includes SDC revenues, bond and loan proceeds, capital expenditures, and annual debt service. Net cash from capital activities is negative except in years that loan and bond proceeds are received.

Cash Flows from Investing Activities are positive throughout the forecast and contribute to Net Income. Cash and Investments at the end of each year are above $500,000 in all but 3 years—fiscal years 2008-09, 2009-10, and 2013-14. In these years, cash is used to make capital improvements.

The bottom of Table 6 shows two other features of the proposed revenue bonds—a bond reserve and debt coverage ratio. The bond holders (lenders) usually require the City to keep a bond reserve equal to approximately one year of debt service. Additionally, the bond holders require a debt coverage ratio: net income from operating activities plus interest earnings must be equal to at least 1.25 of annual debt service. The amount of this ratio may vary by bond holder, but a general rule of thumb is that it should exceed 1.50; the higher the ratio, the less financial risk to the bond holder. In the forecast the ratio always exceeds 1.50 for revenue bonds issued to the municipal bond market except in 2008-09. In this year if the City is in danger of not meeting its minimum coverage ratio. To correct this potential problem, the City may delay some operating expense until the next fiscal year.

The forecast cash flows require careful annual management and decision making to avoid deficits and lack of cash for emergencies. Early payoff of the SPWF loan in 2008-09 (5 years early) and the final payment on the 1993 GO Bonds in 2010-11 will result in sufficient cash flows to pay debt service on the proposed 2011 revenue bonds.

In summary, this 8-year financial plan will result in the construction of $7.689 million of capital improvements to the water system and payoff the two existing debts. The City will incur new debts of $5.699 million and use about $1.99 million of accumulated cash. If revenues do not grow as expected or operating and capital expenditures are more than forecast, the City may have to either delay select capital improvements or increase water rates more than planned. As proposed, the City will have to increase water rates about 45 percent, as explained below.

Table 6 Cash Flow Forecast

Water Utility	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	2012 2013	2013 2014
Cash Flows From Operating Activities									
Charges for Services	1,051,600	1,233,500	1,436,800	1,643,700	1,760,400	1,885,400	2,019,300	2,214,200	2,371,400
Miscellaneous	38,400	41,600	44,800	45,900	46,100	47,400	49,400	53,600	54,100
Total Operating Receipts	1,090,000	1,275,100	1,481,600	1,689,600	1,806,500	1,932,800	2,068,700	2,267,800	2,425,500
Personnel Services	333,200	423,200	454,900	489,000	525,700	565,100	607,500	653,100	702,100
Materials & Services	342,600	359,700	377,700	396,600	416,400	437,200	459,100	482,100	506,200
Administration	285,300	306,700	329,700	354,400	381,000	409,600	440,300	473,300	508,800
Total Operating Expenditures	961,100	1,089,600	1,162,300	1,240,000	1,323,100	1,411,900	1,506,900	1,608,500	1,717,100
Net Cash Provided by Operating Activities	128,900	185,500	319,300	449,600	483,400	520,900	561,800	659,300	708,400
Cash Flows From Capital & Capital-Related Activities									
SDC Revenues	129,600	140,000	137,100	137,900	125,700	112,200	124,400	134,000	122,900
Capital Outlays	(131,200)	(2,236,000)	(1,025,300)	(856,300)	(515,000)	(1,331,150)	(586,800)	(557,000)	(582,100)
Bond Proceeds	0	3,717,600	0	0	0	1,980,950	0	0	0
Bond Costs	0	(100,000)	0	0	0	(63,000)	0	0	0
Debt Service	(213,636)	(297,679)	(474,035)	(656,289)	(435,519)	(428,639)	(411,992)	(402,153)	(402,153)
Net Cash Provided by (Used In) Capital	(215,236)	1,223,921	(1,362,235)	(1,374,689)	(824,819)	270,361	(874,392)	(825,153)	(861,353)
Cash Flows From Investing Activities									
Interest earnings	41,500	77,500	90,900	45,100	14,900	27,200	40,900	30,700	24,100
Net Income	(44,836)	1,486,921	(952,035)	(879,989)	(326,519)	818,461	(271,692)	(135,153)	(128,853)
Cash & Investments, July 1	851,664	806,828	2,293,749	1,341,714	461,725	135,205	953,666	681,974	546,821
Cash & Investments, June 30	806,828	2,293,749	1,341,714	461,725	135,205	953,666	681,974	546,821	417,969
Bond Reserve	0	188,017	188,017	188,017	188,017	328,571	328,571	328,571	328,571
Debt Coverage Ratio, Revenue Bonds w/o SDC	3.86	2.42	1.77	1.21	2.65	2.92	1.78	2.10	2.23

WATER RATE RECOMMENDATIONS

The planned rate increases are shown in Figure 2 and Table 7. The first and second rate increase of 15 percent and 12 percent, respectively, will provide the needed cash for operations and debt service on the proposed SRF $1.0 million loan, and the proposed $2.718 million revenue bonds. If the state approves more than $1.0 million from the SRF program, the municipal bond may be reduced and so may the second rate increase. Also, interest rates have begun to increase which, at the time of borrowing, may influence the schedule of capital improvements and the amount of money borrowed from the municipal bond market. And it could affect the second and third proposed rate increases.

The third and fourth rate increases of 10 percent and 5 percent respectively correspond to the second financing from the municipal bond market in fiscal year 2010-11, early payoff of the currently outstanding SPWF loan, and increasing operating costs. After the fourth increase, the next rate increases will be needed to keep revenues on pace with increasing operating costs, and to pay for cash acquisition of capital improvements. When the second financing becomes necessary, the City will have to reconsider the schedule of capital improvements again in light of then-current construction costs and the interest rate on municipal revenue bonds.

Since the water utility will have excess capacity to serve customers, growth has the effect of producing more revenue than cost. In the forecast we assume growth in the numbers of customers will average 2.4 percent per year over the 8-year forecast period. In recent history, annual growth has been in the range of 4 percent to 6 percent. If growth occurs more rapidly than forecast, smaller rate increases may be possible in the 2^{nd}, 3^{rd}, or 4^{th} years; conversely, slower growth will lead to higher rate increases.

Figure 2 Average Single-Family Residential Bill

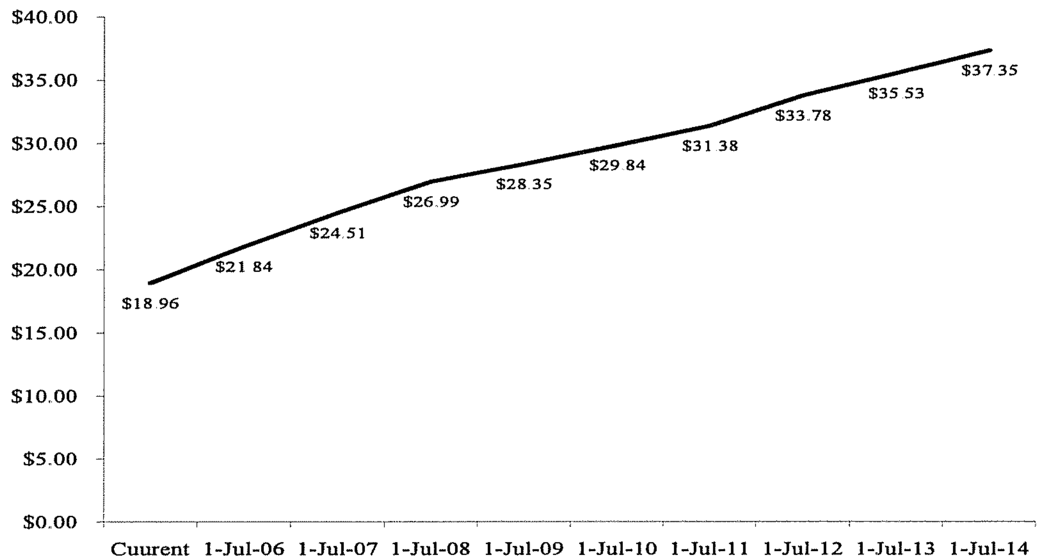

Table 7 Schedule of Water Rate Changes by Rate Code

	Meter				Proposed Increases								
					1-Jul-06	1-Jul-07	1-Jul-08	1-Jul-09	1-Jul-10	1-Jul-11	1-Jul-12	1-Jul-13	1-Jul-14
Code	Size	Use	Class	Current	15.0%	12.0%	10.0%	5.0%	5.0%	5.0%	7.5%	5.0%	5.0%
101	3/4	Residential	X	13.90	15.99	17.91	19.71	20.70	21.74	22.83	24.55	25.78	27.07
102	3/4	Residential	Y	23.10	26.57	29.76	32.74	34.38	36.10	37.91	40.76	42.80	44.94
103	3/4	Residential	1	13.90	15.99	17.91	19.71	20.70	21.74	22.83	24.55	25.78	27.07
104	1 1/2	Residential	Y	29.20	33.58	37.61	41.38	43.45	45.63	47.92	51.52	54.10	56.81
105	2	Residential	1	96.10	110.52	123.79	136.17	142.98	150.13	157.64	169.47	177.95	186.85
106	1	Residential	1	20.00	23.00	25.76	28.34	29.76	31.25	32.82	35.29	37.06	38.92
107	1 1/2	Residential	Y	39.25	45.14	50.56	55.62	58.41	61.34	64.41	69.25	72.72	76.36
108	1 1/2	Residential	Z	106.15	122.08	136.73	150.41	157.94	165.84	174.14	187.21	196.58	206.41
109	1 1/2	Residential	1	30.00	34.50	38.64	42.51	44.64	46.88	49.23	52.93	55.58	58.36
110	2	Residential	Z	118.20	135.93	152.25	167.48	175.86	184.66	193.90	208.45	218.88	229.83
111	2	Residential	1	42.10	48.42	54.24	59.67	62.66	65.80	69.09	74.28	78.00	81.90
121	3/4	Commercial	2	23.10	26.57	29.76	32.74	34.38	36.10	37.91	40.76	42.80	44.94
122	3/4	Commercial	3	90.00	103.50	115.92	127.52	133.90	140.60	147.63	158.71	166.65	174.99
123	3/4	Commercial	4	198.30	228.05	255.42	280.97	295.02	309.78	325.27	349.67	367.16	385.52
124	3/4	Commercial	5	377.05	433.61	485.65	534.22	560.94	588.99	618.44	664.83	698.08	732.99
125	1	Commercial	2	29.20	33.58	37.61	41.38	43.45	45.63	47.92	51.52	54.10	56.81
126	1	Commercial	3	96.10	110.52	123.79	136.17	142.98	150.13	157.64	169.47	177.95	186.85
127	1	Commercial	4	204.45	235.12	263.34	289.68	304.17	319.38	335.35	360.51	378.54	397.47
128	1 1/2	Commercial	2	39.25	45.14	50.56	55.62	58.41	61.34	64.41	69.25	72.72	76.36
129	1 1/2	Commercial	3	106.15	122.08	136.73	150.41	157.94	165.84	174.14	187.21	196.58	206.41
130	1 1/2	Commercial	4	214.50	246.68	276.29	303.92	319.12	335.08	351.84	378.23	397.15	417.01
131	1 1/2	Commercial	5	393.15	452.13	506.39	557.03	584.89	614.14	644.85	693.22	727.89	764.29
132	2	Commercial	2	50.35	57.91	64.86	71.35	74.92	78.67	82.61	88.81	93.26	97.93
133	2	Commercial	3	118.20	135.93	152.25	167.48	175.86	184.66	193.90	208.45	218.88	229.83
134	2	Commercial	4	226.55	260.54	291.81	321.00	337.05	353.91	371.61	399.49	419.47	440.45
135	2	Commercial	5	405.20	465.98	521.90	574.09	602.80	632.94	664.59	714.44	750.17	787.68
136	3	Commercial	3	146.40	168.36	188.57	207.43	217.81	228.71	240.15	258.17	271.08	284.64
137	3	Commercial	4	254.75	292.97	328.13	360.95	379.00	397.95	417.85	449.19	471.65	495.24
138	3	Commercial	5	433.40	498.41	558.22	614.05	644.76	677.00	710.85	764.17	802.38	842.50

	Meter				Proposed Increases								
					1-Jul-06	1-Jul-07	1-Jul-08	1-Jul-09	1-Jul-10	1-Jul-11	1-Jul-12	1-Jul-13	1-Jul-14
Code	Size	Use	Class	Current	15.0%	12.0%	10.0%	5.0%	5.0%	5.0%	7.5%	5.0%	5.0%
139	6	Commercial	3	287.30	330.40	370.05	407.06	427.42	448.80	471.24	506.59	531.92	558.52
140	6	Commercial	5	574.35	660.51	739.78	813.76	854.45	897.18	942.04	1,012.70	1,063.34	1,116.51
141	10	Commercial	5	836.10	961.52	1,076.91	1,184.61	1,243.85	1,306.05	1,371.36	1,474.22	1,547.94	1,625.34
142		Residential-duplex	1 meter	27.80	31.97	35.81	39.40	41.37	43.44	45.62	49.05	51.51	54.09
143	2	Commercial	Vault	226.55	260.54	291.81	321.00	337.05	353.91	371.61	399.49	419.47	440.45
198	NM	Flat rate		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
199	City	Irrigation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
201	3/4	Irrigation		10.95	12.60	14.12	15.54	16.32	17.14	18.00	19.35	20.32	21.34
202	1	Irrigation		17.05	19.61	21.97	24.17	25.38	26.65	27.99	30.09	31.60	33.18
203	1 1/4	Irrigation		22.05	25.36	28.41	31.26	32.83	34.48	36.21	38.93	40.88	42.93
204	1 1/2	Irrigation		27.10	31.17	34.92	38.42	40.35	42.37	44.49	47.83	50.23	52.75
205	2	Irrigation		39.15	45.03	50.44	55.49	58.27	61.19	64.25	69.07	72.53	76.16
206	3	Irrigation		67.35	77.46	86.76	95.44	100.22	105.24	110.51	118.80	124.74	130.98
207	8	Irrigation		329.10	378.47	423.89	466.28	489.60	514.08	539.79	580.28	609.30	639.77
208	10	Irrigation		470.05	540.56	605.43	665.98	699.28	734.25	770.97	828.80	870.24	913.76
301	3	Fire		8.35	9.61	10.77	11.85	12.45	13.08	13.74	14.78	15.52	16.30
302	4	Fire		9.40	10.81	12.11	13.33	14.00	14.70	15.44	16.60	17.43	18.31
303	6	Fire		18.30	21.05	23.58	25.94	27.24	28.61	30.05	32.31	33.93	35.63
304	8	Fire		29.80	34.27	38.39	42.23	44.35	46.57	48.90	52.57	55.20	57.96
399		Fire		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commodity Rate				$0.674	$0.780	$0.880	$0.970	$1.020	$1.080	$1.140	$1.230	$1.300	$1.370

Appendix G

SDCs (system Development Charges)

Water System Development Charge Update

Stayton, Oregon

Water System Development Charge Update

Stayton, Oregon

January 2006

Economic & Financial Analysis
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SUMMARY

The city of Stayton retained Keller Associates, Inc. an engineering consulting firm, to develop a Water System Master Plan. Keller Associates sub-contracted with Economic & Financial Analysis, a financial consulting firm, to update the City's water system development charge (SDC). The City's current schedule of SDCs was last updated in 2001 when it was adjusted for inflation. The City adopted its first water SDC in 1998 (Ordinance No. 691 and Resolution No. 624), and this report is the first full re-evaluation of it since then. Since then the City, through its contractor completed and the City has adopted the *Water Master Plan* (Keller Associates, January 2006). The Plan identifies $20.1 million in capital improvements, to replace existing facilities, and to expand facilities to build capacity for growth.

This report uses the capital improvements list and other data from the Master Plan to update the City's water system development charge.

The water system operates with some excess capacity which is valued at its original cost less accumulated depreciation to create a reimbursement fee. The majority of the SDC update is the improvement fee. Table 1 shows the current and updated water SDC. Overall, it increases 7 percent.

This update includes in it a revised credit policy that complies with ORS 223.297 through 223.314. It includes all mandated credits to developers who build a project(s) or portions of a project included as a statutorily defined qualified improvement on the capital improvements list.

Finally, a specific method to update the water SDC annually for inflation is recommended. These annual adjustments for inflation will not require a public hearing.

Table 1 Proposed Water System Development Charge

Meter Size	Current	Proposed Water SDC			Change	
		Reimbursement Fee	Improvement Fee	Total	$	%
3/4	$2,332	$821	$1,664	$2,485	$153	7%
1	3,895	1,371	2,779	$4,150	$255	7%
1 1/2	7,765	2,734	5,541	$8,275	$510	7%
2	12,428	4,376	8,869	$13,245	$817	7%
3	24,881	8,760	17,755	$26,515	$1,634	7%
4	38,872	13,686	27,739	$41,425	$2,553	7%
6	77,720	27,364	55,461	$82,825	$5,105	7%
8	124,357	43,784	88,741	$132,525	$8,168	7%
Multiple family	$1,866	$657	$1,331	$1,988	$122	7%

INTRODUCTION

The City of Stayton through its prime contractor Keller Associates retained Economic & Financial Analysis to update the water system development charge.

This report contains an overview of Oregon's SDC laws, three sections on the SDC update, a new credit policy, and a new annual SDC updating policy to index the SDC to construction cost inflation.

OVERVIEW OF OREGON'S SDC LAW

In 1989 the Oregon Legislature amended Oregon Revised Statutes Chapter 223 (ORS 223) which authorizes cities to assess Systems Development Charges (SDC) on new real estate developments for water, water, storm water, parks, and transportation. Since then, the statute has been amended by nearly every Legislature including the last Legislature.

The amended ORS defines the SDC as:

> "(4)(a) . . . 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. Systems Development Charge includes that portion of a ... water system connection charge that is greater than the amount necessary to reimburse the governmental unit for its average cost of inspecting and installing connections with water ... facilities.
>
> "(b) "Systems Development Charge does not include any fees assessed or collected as part of a local improvement district assessment or a charge in lieu of a local improvement district assessment, or the cost of complying with requirements or conditions imposed upon a land use decision or limited land use decision, expedited land division or limited land use decision."

The SDC may consist of a reimbursement fee, an improvement fee, or both.

The reimbursement fee is a capital charge for *existing excess capacity*. A reimbursement fee "...means a fee for costs associated with capital improvements already constructed or under construction." [ORS 223.314 (3)]. In general terms, this fee equals the capital value of those components of the water system that have excess capacity divided by their physical capacities.

The improvement fee is a capital charge for needed *future capacity* that the City must build to meet future demands. The planned improvements must be on a list of capital improvements that the City Council adopts and which the City Council by resolution may modify in the future. In general terms, this fee equals the expected cost of capital improvements needed to meet forecast demands divided by the capacity of the planned improvements. Notice that this fee cannot include capital improvements that repair existing problems. And if a specific capital improvement both fixes an existing problem and adds capacity, then the cost and capacity of the project is prorated so that the improvement fee includes only the capacity increasing portion.

The statute also establishes that certain system development charges and methodologies are prohibited (ORS 223.301). This section defines an employer as someone who hires employees and prohibits local governments from (a) charging its SDC on (a) the number of employees hired after a specified date, or (b) establishing a SDC ". . . methodology that assumes that costs are necessarily incurred from capital improvements when an employer hires an additional employee." The statute goes on to clarify than an SDC shall not be charges to ". . . include or incorporate any method or system under which the payment of the [reimbursement or improvement] fee or the amount of the fee is determined by the number of employees . . ."

Also, the SDC statutes require the city to have a credit policy for the improvement fee (but not for the reimbursement fee). Usually, when a developer builds an improvement on the list of capital improvements used to create the improvement fee, then the city must credit the developer for the cost of excess capacity of the improvement. The credit reduces the amount of the systems development charges owing on the development.

To qualify for a credit, a capital improvement must meet three conditions:

> First, the improvement must be on the list of capital improvements. If a project proposed for credit by a developer is not on the list then the project does NOT qualify for a credit. The City Council may amend the list of capital improvements by resolution.
>
> Second, the city must require the public improvement to be built as a condition of development approval. That is, the city must specifically state to the developer (preferably in writing) that unless the developer builds the improvement, the city will deny the proposed development permits to build.
>
> Third, the public improvement (or portions of it) must either be off-site of the proposed development or on-site and with more capacity than the development itself will utilize.

The City can use the SDC revenues only for capital improvements. The revenue from the reimbursement fee may be used on any water-related capital improvement, including replacing existing components. The statutes restrict the City's use of revenue from the improvement fee to those improvements on the capital improvements list that increase capacity. The City cannot use improvement-fee revenue simply to replace existing facilities such as a water line.

In the following analysis we develop the methodology for the water reimbursement and improvement fees and present the list of capital improvements that becomes the basis of charging the improvement fee, spending improvement fee revenues, and crediting developers for completed qualified public improvements.

METHODOLOGY WATER SDC

REIMBURSEMENT FEE

Table 2 shows the cost basis for the reimbursement fee. It is a summary compiled from the fixed asset records of the water system which are contained in the appendix to this report. The costs are based on the cost paid by the City for the improvement net of any federal or state grants. The depreciation period was determined by the City as a part of complying with Governmental Accounting Standard Board's rule No. 34 and it requires straight line annual depreciation methods. The expected life of most of these assets is 75 years but range as low as 20 years. For example, the water system has over the years of its existence invested $11,077,025.[1] This amount is the sum of all investments in water pipes, treatment plants, storage tanks, etc. The annual depreciation (consumption of capital) is $148,529, and over the life to date of the infrastructure $3,141,227 of the original assets has been depleted leaving a net book value of $7,967,204. Similarly, buildings and improvements are depreciated. Land does not depreciate therefore its net book value equals its original purchase price. In sum, the cost basis for the reimbursement fee is $7,967,204.

Table 2 Cost Basis for the Reimbursement Fee

Asset Group	Original Cost	Annual Depreciation	Net Book Value
Building	$44,660	$893	$21,043
Improvement	$33,316	1,666	-
Infrastructure	$11,077,025	148,529	7,935,798
Land	$10,364	-	10,364
Totals	$11,165,364	$151,088	$7,967,204

Source: City of Stayton Asset Records, See Appendix.

The current water system has a capacity to deliver 7 million gallons of water per day (mgd). This amount of water is the peak amount it can serve. Currently, the peak daily demand for water is approximately 6.5 mgd leaving 0.5 mgd for future development to use (see Table 3). It is this available excess capacity that the reimbursement fee is designed to recover from future developments.

The reimbursement fee is the cost of water assets divided by the capacity of the system. The cost is the net book value of the system, so the cost per gallon of capacity is $1.138 ($7,967,204 ÷ 7,000,000 gpd).

[1] In fiscal year 2003-04, the City contracted with an accounting firm to derive asset values and establish depreciation schedules for all of its physical assets to bring the City into compliance with GASB Rule 34. This report relies on those results.

Table 3 Current Water System Capacity

	Gallons per Day (Millions)
Current Capacity	7.00
Current Usage	6.50
Excess Capacity	0.50

Table 4 shows the calculation of the reimbursement fee for a single-family household on a ¾-inch water meter. On average a person uses 267 gallons of water per day (gpd)[2] on the peak days of water consumption (usually summer on hot days with outdoor watering). The average size household is 2.7 persons; therefore, the average peak-daily demand for a single family household is 721 gpd. The household's use of water multiplied by the cost of water assets per gallon is the cost of assets used by the household's connection to the water system, $821 ($1.138 x 721 gpd) rounded to the nearest dollar.

	Reimbursement Fee
Cost per gallon capacity	$1.138
Per capita daily consumption (gpd)	267
Average number of persons per household	2.70
ERU daily consumption (gpd)	721
Reimbursement fee per ERU	$821

To apply this rate to other water users besides a single family household on a ¾-inch water meter, the City uses a schedule of water meter sizes as a surrogate measure of peak daily demand and an average usage for multiple family housing units. Table 4 shows the schedule. For example, a 1½–inch water meter is capable of delivering as much water as 3⅓ 3/4–inch water meters; therefore, the reimbursement fee for the 1½–inch meter is 3⅓ times the amount for a ¾–inch meter. The ¾–inch water meter equivalencies are derived from standards set for water meters by the American Water Works Association, the industry organization that establishes quality and performance standards for the manufacture of domestic water meters.[3]

[2] Keller Associates determined this factor as average daily water use multiplied by a peaking factor of 2.4 multiplied by a water loss factor of 5%.

[3] American Water Works Association (AWWA) Standard for Cold-Water Meters Displacement Type, Bronze Main Case for meters up to 1½-inch, and Turbine Type Class I vertical-Shaft and Low-Velocity Horizontal Type meters for meters 2-inches and larger, publications C700-90 and C710-96, 1991 and 1996.

For multiple-family complexes, the meter size method does not apply equitably. Multiple family complexes may include any number of residential units in a single or multiple building complexes that results in 2 or more housing units sharing one or more meters. On average multiple family housing units use 80 percent as much water as a single-family household on a ¾-inch water meter. As a result, the reimbursement fee is based on the higher of two possible measures: (a) the number of housing units in the complex multiplied by 80 percent multiplied by the reimbursement fee for a ¾-inch meter, or (b) the reimbursement fee for the size meter(s) serving the development.

Table 4 Schedule of Reimbursement Fees by Meter Size and Multiple Family Units

Meter Size	¾" Meter Equivalents	Reimbursement Fee
3/4	1.0	$821
1	1.67	1,371
1 1/2	3.33	2,734
2	5.33	4,376
3	10.67	8,760
4	16.67	13,686
6	33.33	27,364
8	53.33	43,784
Multiple family	0.8	$657

IMPROVEMENT FEE

The improvement fee is based on capital improvements to be built to supply water to future developments.

Table 5 shows the list of capital improvements to be constructed over the next 20 years to 30 years, depending upon the rate of development. Table 5 lists the 50 proposed projects that sum to $20,075,100 in 2005 dollars. The 8 numbered columns of Table 5 show the derivation of the cost basis for the improvement fee. Only $13 million of the $20 million total cost of all projects is included in the improvement fee.

Columns 3 and 4 show the allocation of each project's cost to growth (and, implicitly to current users). Each project was evaluated for benefit to future development. For example, project No. 2, Add Valves to Shaff Road for $11,000 will benefit growth (32%) and current development (68%, which is not shown on Table 5); therefore, only 32% of the cost ($3,520) is carried forward to Column 4 and included in the improvement fee. Projects such as Nos. 3, 4, 5, 12, 15, 16, 19, 21, 22, 32, and 40 have no benefit to future development (0%) and are not included in Column 4. These projects must be built regardless of growth to resolve existing service problems. All of these costs will be born by rate payers (or tax payers, if the City issues general obligation bonds to pay for them). None of these projects' costs are included in the calculation of the improvement fee. Conversely, projects that will be built only if development occurs are allocated 100% to development and are included in the calculation of the improvement fee.

Projects that partially benefit current development and future development are pro-rated based on the benefit to current and future development. The percentages of projects that benefit development are 32%, 51%, or 62%. A special case is project No. 1, Pipeline Replacement and Upsizing at 41% benefit to future development.

Projects allocated 32% to the improvement fee are designed to accommodate growth through the year 2015. Population is expected to grow 32 percent in this period, and additional capacity is designed to meet this increased demand for water. Table 6 shows the correlation between population growth and water demand. Those projects (Nos. 2, 6, 9, 10, and 13) will increase capacity to provide for growth between now and about 2015. These projects will add approximately 1.75 mgd of capacity to the water system. In column 5, the cost per gallon of peak daily capacity is shown. For example, the Pine Street Booster Station (No. 6) along with the other projects 4 projects will increase capacity 1,750,000 gallons per day. The cost of this project ($97,000) that is allocated to growth ($31,040) is divided by the capacity it will provide (1,750,000 gpd) to derive the cost per gallon, $0.018 per gallon ($31,040 ÷ 1,750,000 gallons).

Projects allocated 51% to the improvement fee (Nos. 11, 14, 18, 20, 25, 28, 30, 34 through 36) are designed to accommodate growth between now and 2025, a 51 percent increase in population. Peak daily water use is expected to increase 3.85 mgd; therefore, the cost per gallon of capacity for these projects is the amount shown in Column 4 divided by 3,850,000 gallons.

Projects allocated 62% to the improvement fee (Nos. 1, 7, 17,23, 24, 26, 27, 29, 31, 33, and 37 through 50) are designed to accommodate growth between now and buildout of the City's urban growth boundary, a 62 percent increase in population. Peak day water use is expected to increase by 5.94 mgd; therefore, the cost per gallon for these projects is the amount in Column 4 divided by 5,940,000 gallons.

Table 5 CIP and Cost Basis for the Improvement Fee

No.	(1)	Year 2005 $'s (2)	Allocated to Growth % (3)	Allocated to Growth $ (4)	System Capacity (mgd) 1.75 2015 (5)	3.85 2025 (6)	5.94 Buildout (7)	Totals (8)
1	Pipeline Replacements and Upsizing	$2,222,000	41%	$911,020			$0.153	$0.153
2	Add Valves To Shaff Road	11,000	32%	3,520	$0.002			0.002
3	Complete Leak Detection Study	25,000	0%	0				0.000
4	Meter Unmetered Facilities	68,000	0%	0				0.000
5	Repaint Interior & Exterior of Regis Tank	135,000	0%	0				0.000
6	Pine St. Booster Station	97,000	32%	31,040	0.018			0.018
7	City Hall -- 11% of Total Cost	409,200	62%	253,704			0.043	0.043
	Sub total	$2,967,200	40%	$1,199,284	$0.020	$0.000	$0.196	$0.216
8	Raw Water Intake Maintenance	24,400	0%	0				0.000
9	Shallow Well Field	716,000	32%	229,120	0.131			0.131
10	Raw Water Weir Box Modifications	5,800	32%	1,856	0.001			0.001
11	Filter Turbidity meters	56,000	51%	28,560		0.007		0.007
12	Replace Filter # 3 Liner	542,000	0%	0				0.000
13	Soda Ash Feed Modifications	39,500	32%	12,640	0.007			0.007
14	On-site hypochlorite generation	220,000	51%	112,200		0.029		0.029
15	Clearwell Maintenance -- interior/exterior	94,000	0%	0				0.000
16	Finished Water Pumping Maintenance	6,700	0%	0				0.000
17	Plant Maintenance Shop / Entrance	359,000	62%	222,580			0.037	0.037
18	Plant Automation / Instrumentation	300,800	51%	153,408		0.040		0.040
19	Electrical Upgrade	116,000	0%	0				0.000
20	Emergency Power System	169,000	51%	86,190		0.022		0.022
	Sub total	$2,649,200	32%	$846,554	$0.139	$0.098	$0.037	$0.274
	Pipeline / Distribution Improvements--							
21	Pipelines	1,695,000	0%	0				0.000
22	Replacement of Poor Water Services	418,000	0%	0				0.000
23	Secure Land for Tank/Well Site	150,000	100%	150,000			0.025	0.025
24	Regis Booster Station	182,000	62%	112,840			0.019	0.019
25	Install Radio-read Meter System	50,000	51%	25,500		0.007		0.007
26	Salem Inter-tie	58,000	62%	35,960			0.006	0.006
27	City Shop--50 % of total cost	410,000	62%	254,200			0.043	0.043
	Sub total	$2,963,000	20%	$578,500	$0.000	$0.007	$0.093	$0.100
28	Individual Raw Water Flow Meters	72,000	51%	36,720		0.010		0.010
29	Security Upgrades	368,000	62%	228,160			0.038	0.038
30	Additional FW pump with VFD (200 hp)	170,000	100%	170,000		0.044		0.044

		Year	Allocated to Growth		System Capacity (mgd)			
					1.75	3.85	5.94	
		2005 $'s	%	$	2015	2025	Buildout	Totals
No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
31	Additional Clearwell Capacity	510,000	100%	510,000			0.086	0.086
	Sub total	$1,120,000	84%	$944,880	$0.000	$0.054	$0.124	$0.178
32	Abandon Schedule "M"	29,000	0%	0				0.000
33	Pine Street Add'l Capacity w/ VFDs	74,000	100%	74,000			0.012	0.012
	Sub total	$103,000	72%	$74,000	$0.000	$0.000	$0.012	$0.012
34	Shallow Well Field Expansion	79,000	100%	79,000		0.021		0.021
35	Raw Water Weir Box Expansion	29,700	100%	29,700		0.008		0.008
36	Soda Ash System Expansion	29,000	100%	29,000		0.008		0.008
37	New Filter	750,000	100%	750,000			0.126	0.126
	Sub total	$887,700	100%	$887,700	$0.000	$0.037	$0.126	$0.163
38	Fern Ridge Road	198,000	100%	198,000			0.033	0.033
39	16-inch Transmission Loop from Pine St.	779,000	100%	779,000			0.131	0.131
40	Abandon Regis Tank (2025)	42,000	0%	0			0.000	0.000
41	Construct New 5.0 MG Storage Reservoir	2,862,000	100%	2,862,000			0.482	0.482
42	3rd Avenue Future -- upsize cost	37,000	100%	37,000			0.006	0.006
	Sub total	$3,918,000	100%	$3,918,000	$0.000	$0.000	$0.652	$0.652
43	Upsize Costs for Future Pipeline	990,000	62%	613,800			0.103	0.103
44	Shaff Road Pipeline	90,000	100%	90,000			0.015	0.015
45	Wilco Road Pipeline	132,000	100%	132,000			0.022	0.022
46	East Pine Street Small Booster	130,000	100%	130,000			0.022	0.022
47	Mill Creek Booster Station	427,000	100%	427,000			0.072	0.072
	Sub total	$1,769,000	100%	$1,769,000	$0.000	$0.000	$0.234	$0.234
48	Construct Deep Well -- Backup Supply	1,333,000	100%	1,333,000			0.224	0.224
49	Replace 100-hp pump with 200-hp pump	115,000	100%	115,000			0.019	0.019
50	New Independent Intake Facility and Pipeline	2,250,000	62%	1,395,000			0.235	0.235
	Sub total	$3,698,000	77%	$2,843,000	$0.000	$0.000	$0.478	$0.478
	Total Annual Capital Expenditures	$20,075,100		$13,060,918	$0.159	$0.196	$1.952	$2.307
	% Total			65%				

Table 6 Growth of Population and Water Demand

	Population				Peak Million gallons per day (mgd)		
Year	Total	Increase	% Growth	% from 2003	Total	GPD	% Increase
Current	7,300				6.50		
2015	10,800	3,500	32.0%	32.0%	8.25	1.75	27%
2025	15,000	7,700	28.0%	51.0%	10.35	3.85	25%
Buildout	19,200	4,200	22.0%	62.0%	12.44	5.94	20%

Source: Population, Keller Associates, Section 2, Chart 2.2. Water use, Keller Associates, Tables 2.7 (Current) and 2.8 (Forecast). Keller Associates estimate current average peak day capacity of 7.0 mgd.

The sum of the costs per gallon in columns 5, 6, and 7 are shown in column 8, and the sum of the project costs per gallon in column 8 amounts to the improvement fee per gallon of capacity–$2.307. The costs per gallon are rounded to 3 places to the right of the decimal.

Using the same household water usage statistics as we used for the reimbursement fee, provides the improvement fee for a new single-family housing unit using a ¾ inch water meter, $1,664 ($2.307/gallon x 721gallons/peak day/household). Also, using the equivalent ¾-inch meter equivalents from Table 4 above and the ratio for multiple-family water usage; we derive the schedule of improvement fees by meter size and for multiple-family developments shown in Table 7.

Table 7 Water Improvement Fee by Meter Size and Multiple-Family Housing Unit

Meter Size	Improvement Fee
3/4	$1,664
1	2,779
1 1/2	5,541
2	8,869
3	17,755
4	27,739
6	55,461
8	88,741
Multiple family	$1,331

WATER SYSTEM DEVELOPMENT CHARGE

The water system development charge consists of reimbursement and an improvement fee as shown in Table 8. The total SDC is $2,485 for a ¾-inch water meter which is about 7 percent more than the current water SDC $2,332.

Table 8 Proposed Water System Development Charge

	Proposed Water SDC		
Meter Size	Reimbursement Fee	Improvement Fee	Total
3/4	$821	$1,664	$2,485
1	1,371	2,779	$4,150
1 1/2	2,734	5,541	$8,275
2	4,376	8,869	$13,245
3	8,760	17,755	$26,515
4	13,686	27,739	$41,425
6	27,364	55,461	$82,825
8	43,784	88,741	$132,525
Multiple family	$657	$1,331	$1,988

CREDIT POLICY

The City will provide a credit against the water improvement fee according to ORS 223.304(4)(a). The City also will extend a credit whenever the cost of constructing a qualified public improvement exceeds the credit for the improvement fee to future phases of the same development as provided in ORS 223.304 (4)(b). The City will not allow for transferability of credits nor will the City provide credits for public improvements not on the capital improvements list. The City's list of capital improvements, unless amended in the future, includes the projects on Table 5 whose costs are included in the calculation of the SDC.

Whenever an applicant for a development or building permit offers to build a water system improvement on the capital improvements list (those projects on Table 5 that are wholly or partially listed as eligible), the City must provide a credit for the value of the improvement. The credit may not exceed the value of the SDC improvement fee, and can be given only for the improvement fee portion of the SDC. No credit may be given for the reimbursement portion of the SDC. The City may credit up to 100 percent of the SDC under certain circumstances.

ORS 223.304 (3) and (4) define credits. A developer earns a credit by building a qualified public improvement (QPI). A QPI is a project that is (a) an improvement fee eligible on the water CIP list (Table 5), (b) required as a condition of development approval, and either (c) off-site of the proposed development, or (d) on-site but required to be built larger than would satisfy the water needs of just the proposed development (excess capacity).

The value of the credit is equal to (a) the cost of that portion of the improvement that exceeds the minimum standard facility size or capacity needed by the development, and (b) no more than the amount of the improvement fee. The portion of a water system improvement that would be excess to a development would equal the ratio of capacity of the improvement less expected water use in the proposed development divided by the capacity of the water improvement.

An example illustrates how the credit policy will work. If a developer proposes to build a 35 unit subdivision in phase I and another 35 housing units in phase II, and the City requires the developer to build project No. 46 East Pine Street Booster Station at a cost of $130,000 as a condition of development approval, then after the two phases of building are completed the developer will not have paid any water improvement fees. The pro rata amount of capacity to be used by a 70-unit housing development has to be subtracted from the total cost of the project to determine the qualified amount to be credited. The 70 housing units will use 0.36 percent of the system capacity, so only $129,526 of the $130,000 construction cost is creditable against the improvement fees owing. Table 9 illustrates the process.

In phase I the developer builds the East Pine Street Booster Station and 35 housing units. The pro rata share of the cost of the booster station ($129,526) exceeds the amount of improvement fees owing ($58,240) on phase I by $71,286. The $71,286 is the excess credit against the improvement fees owing. When the developer builds 35 more housing units in phase II, the excess credits from phase I ($71,286) still exceed the improvement fees owing ($58,240) on phase II by $13,046. These remaining excess credits are lost to the developer.

Table 9 Credit Policy Example

Phase	Housing units	Improvement Fee Owing	QPI construction cost Total Cost	Qualified Amount*	Credit Balance
I	35	$58,240	$130,000	$129,526	$71,286
II	35	$58,240			13,046
Total	70	$116,480	100%		
Remaining Excess Credits					$13,046

* Calculation of excess capacity:

	gpd	%
Total QPI capacity	13,843,200	100%
Used by phases 1 & 2 (721gpd x 50)	50,470	-0.36%
Excess capacity	13,893,670	99.64%

ANNUAL UPDATES FOR INFLATION

ORS 223.304 (7) provides that,

> "A change in the amount of a reimbursement fee or an improvement fee is not a modification of the system development charge if the change in amount is based on the periodic application of an adopted specific cost index or on a modification to any of the factors related to rate that are incorporated in the established methodology."

For the purposes of periodically adjusting the water SDC, the City will determine annually the increase in the 20-City Average Construction Cost Index (CCI) published in the weekly periodical *ENR* published by McGraw Hill, Inc. This publisher's construction (and building) cost index is widely accepted in the engineering and construction industry. *ENR* updates the CCI monthly and provides annual summaries in the July edition.

The formula for updating the SDC each year is as follows:

$$SDC_{current\ year} = SDC_{last\ year} \times (CCI_{current\ year} / CCI_{last\ year})$$

where:

$CCI_{current\ year}$ = Construction Cost Index for the current year
$CCI_{last\ year}$ = Construction Cost Index for the last year the SDCs were updated
$SDC_{current\ year}$ = the SDC updated by the CCI
$SDC_{last\ year}$ = the SDC to be updated

EFA recommends the City update the SDC annually and make the updated SDC effective January 1 of each year.

COMPARISON OF OTHER CITIES' SYSTEM DEVELOPMENT CHARGES

Figure 1 and Table 10 compare Stayton's systems development charges to 27 other cities in Oregon. The selected cities range in population from cities smaller to larger than Stayton. The SDCs are current as of February 2005 and includes Stayton's current and proposed SDC updates.

Table 10 is sorted by the total of all 5 possible SDCs. Figure 1 is sorted by the amount of the water SDC. The comparisons are based on a single-family house with 1,500 square feet of living area, 2,480 square feet of impervious surface, a 400 square foot garage, 11 plumbing fixtures, 3 bedrooms, 2 bathrooms, and the minimum size meter considered the standard size for each city (⅝-inch, ¾-inch, or ⅝ x ¾ inch diameter). Various communities use different criteria to calculate each of the 5 systems development charges.

Overall Stayton's total SDCs after increasing the water SDC will rank 11 of the 28 surveyed, excluding Stayton's existing water SDC (Stayton is counted twice in Table 10, once with the current SDCs and once with the proposed increase in the water SDC). Its water SDC will rank 8th among the 27 cities with water SDCs (McMinnville does not have a water SDC).

Figure 1 Comparison of Total Systems Development Charges

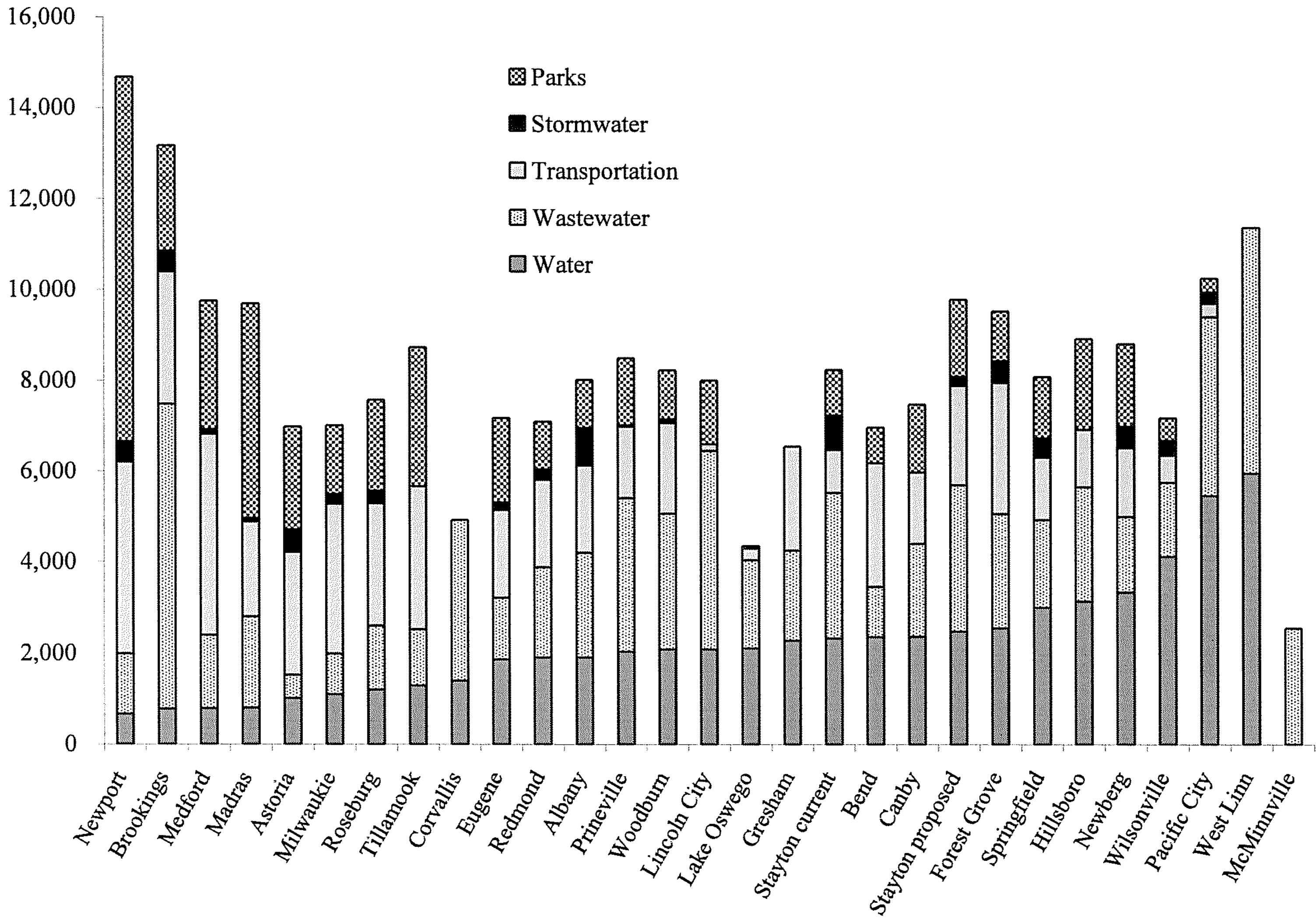

Table 10 Comparison of Total SDCs for Selected Cities

	Stormwater		Wastewater		Transportation		Parks		Water		Total SDC	
City	$	Rank	$	Rank	$	Rank	$	Rank	$	Rank	$	Rank
West Linn*	$455	7	$5,413	2	$4,217	2	$8,029	1	$5,946	1	$24,060	1
Wilsonville*	$456	6	1,628	21	2,917	5	2,320	5	4,111	3	11,432	2
Lake Oswego*	$112	16	1,921	18	4,420	1	2,825	4	2,108	13	11,386	3
Canby	$80	18	2,019	14	2,085	12	4,725	2	2,366	9	11,275	4
Hillsboro*	$500	3	2,500	11	2,690	8	2,276	6	3,141	5	11,107	5
Woodburn	$220	13	2,977	9	3,286	3	1,513	12	2,085	15	10,081	6
Forest Grove	$275	10	2,500	11	2,690	8	2,000	7	2,552	7	10,017	7
Bend*			1,098	27	3,145	4	3,064	3	2,356	10	9,663	8
Pacific City			3,942	4					5,452	2	9,394	9
Corvallis*	$168	15	3,528	5	1,924	16	1,870	9	1,395	20	8,885	10
Newberg	$223	12	1,656	20	1,583	18	1,471	14	3,331	4	8,264	13
Gresham	$823	1	1,963	17	1,997	13	1,073	18	2,273	12	8,129	14
Lincoln City	$35	19	4,355	3	150	26	1,408	15	2,086	14	8,034	15
Brookings	$88	17	6,700	1	258	25	57	25	776	27	7,879	16
Stayton current			3,197	7	1,936	14	1,062	19	2,323	11	8,518	12
Stayton proposed			3,197	7	1,936	14	1,062	19	***2,485***	8	8,680	11
Prineville			3,361	6	2,303	10			2,037	16	7,701	17
Springfield*	$769	2	1,921	18	948	22	1,000	21	3,000	6	7,638	18
Redmond			1,970	16	2,722	7	790	22	1,902	18	7,384	19
Albany*			2,284	13	1,584	17	1,500	13	1,903	17	7,271	20
Madras	$200	14	2,000	15	2,200	11	1,700	11	800	25	6,900	21
Medford	$486	4	1,612	22	2,896	6	1,086	17	783	26	6,863	22
Eugene*	$429	8	1,354	24	1,377	20	1,345	16	1,860	19	6,365	23
McMinnville*			2,550	10	1,273	21	2,000	7			5,823	24
Milwaukie	$473	5	893	28	1,527	19	1,817	10	1,095	23	5,805	25
Roseburg	$331	9	1,400	23	605	23	500	23	1,200	22	4,036	26
Newport	$248	11	1,320	25	300	24	300	24	660	28	2,828	27
Tillamook			1,225	26					1,290	21	2,515	28
Astoria			508	29					1,010	24	1,518	29
Number with SDC		*19*		*28*		*25*		*24*		*27*		*28*
Average, Excluding Stayton Proposed	$335		$2,448		$2,037		$1,872		$2,226		$8,257	
Stayton Proposed Over (Under) Average	($335)		$749		($101)		($810)		$259		$423	
% Over (-Below)	-100%		31%		-5%		-43%		12%		5%	

Sources: *City of Eugene, *2004 Oregon System Development Charge Survey*, November 2004. All others, EFA survey conducted January-February 2005.
Notes: averages exclude cities with zero SDCs.