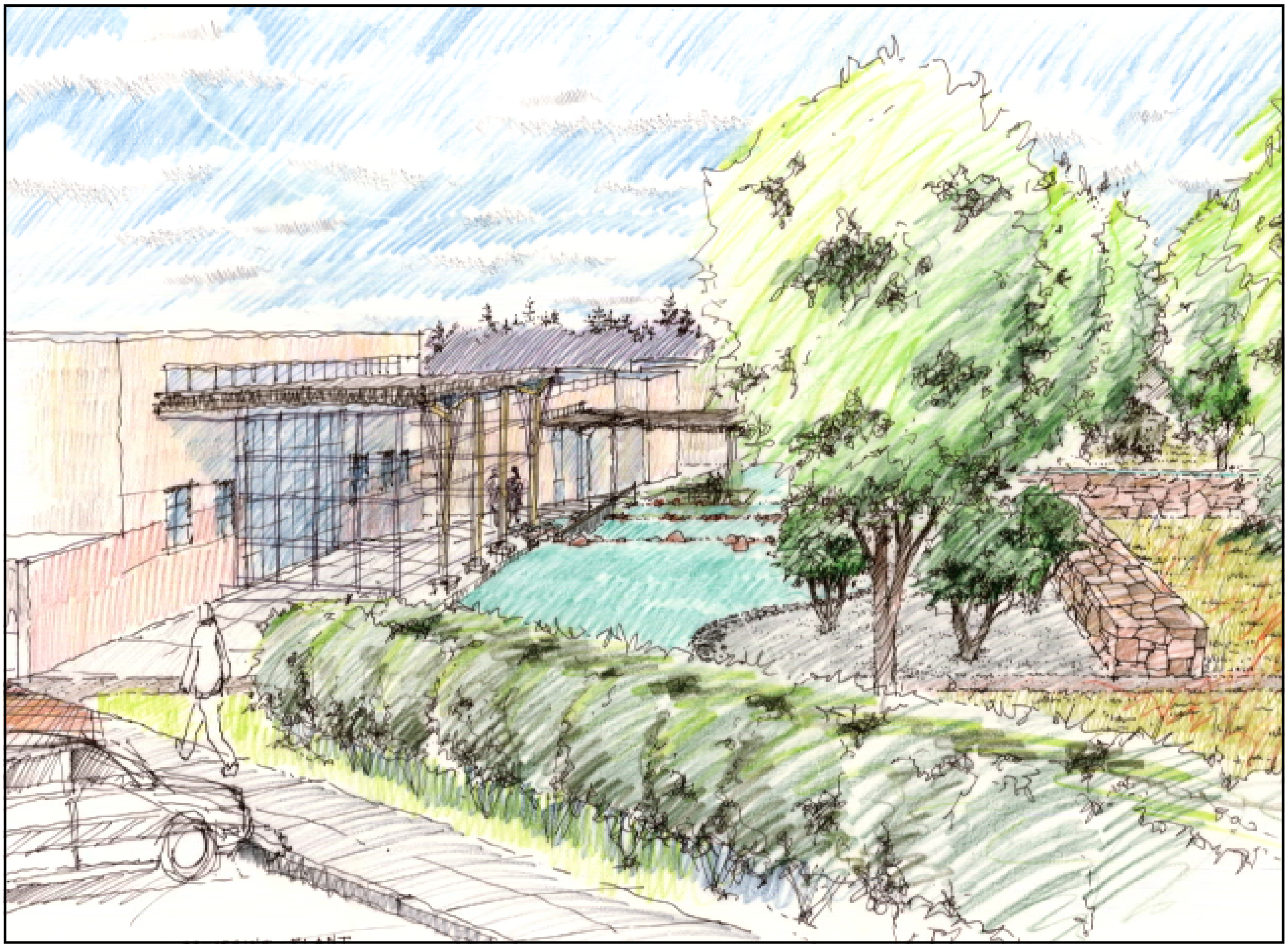

City of WILSONVILLE in Oregon

City of Wilsonville

Water System Master Plan - Ordinance No. 531

Adopted January 24, 2002

MWH MONTGOMERY WATSON HARZA

Read Me!

Final Report

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Water System Master Plan – Ordinance No. 531
For
City of Wilsonville, Oregon

Adopted January 24, 2002

Prepared by:
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CERTIFICATE OF ENGINEER

City of Wilsonville, Oregon
Water System Master Plan – Ordinance No. 531
Adopted January 24, 2002

The material and data contained in this report were prepared under the direction and supervision of the undersigned, whose seal as a professional engineer, licensed to practice in the State of Oregon, is affixed below.

David L. McPherson, P.E.
Oregon No. 58908PE

Montgomery Watson Harza, Inc.
Portland, Oregon

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Executive Summary

EXECUTIVE SUMMARY

INTRODUCTION

The City of Wilsonville currently obtains its water supply from eight groundwater wells in the Columbia River Aquifer scattered throughout the City. This aquifer has been classified as "groundwater limited" by the Oregon Water Resources Department (OWRD). As a consequence, development of new wells in the aquifer has been restricted and OWRD has requested that the City reduce its dependency on groundwater as soon as possible.

In addition to the wells, the City's facilities include:

- Approximately 66 miles of distribution and transmission pipelines,
- Four reservoirs totaling 7.95 million gallons in storage,
- Groundwater pumps and pump houses,
- Two booster pumping stations,
- Telemetry system,
- Four seismic isolation valves, and
- Three pressure reducing valves.

While the City has seen much growth in population and employment during the 1990's, the City's inability to develop new wells led, in January 1998, to imposition of a Moratorium on new construction because of the lack of sufficient long-term water supplies to serve new demand. Under State law, once a Moratorium was declared, the City had two years to find a solution to its water supply needs. This deadline was met when the voters of Wilsonville approved a revenue bond measure in September 1999 to fund construction of a new water treatment plant using the Willamette River as a water supply source. This new water treatment plant is currently under construction at a site along the Willamette River off of Industrial Way. The plant is on-schedule for completion by April 2002.

Approval of the Willamette Water Treatment Plant project was the culmination of a long process of investigating the Willamette River and other source supply options. This process began in 1973 when the City sought water rights to the Willamette River. The City obtained a 30 cfs (20 mgd) water right with a priority date of 1974. It continued in the 1986 Water System Master Plan (Westech Engineers), which also recommended that by 1995, the City should begin evaluating potential surface water sources to meet long-term needs, including the Willamette and Molalla Rivers. A series of studies by the metropolitan region and by the City of Wilsonville alone led to the specific decision to utilize the City's water rights on the Willamette by building a new water treatment plant.

The addition of the Willamette River as the primary water supply for the City will result in changes in the City's water system. Of primary importance is the fact that instead of flow entering the distribution system at multiple locations (the wells), all flow will now come from the site of the water treatment plant through a transmission line that runs up Kinsman Road. This Water Master Plan has been developed to evaluate these potential changes as well as to identify modifications to the system that are needed to meet the anticipated future growth in the community.

This Master Plan has developed a comprehensive water system Capital Improvement Program (CIP) for the City of Wilsonville. This Master Plan gives recommendations to guide the long-term development of the City's water system. It is not intended to be a specific list of required projects for specific years. While projects are listed in this Master Plan as being scheduled for construction in a given year, this is intended only to provide a general guideline of priorities, relationships between projects, ties to levels of growth, and understanding of maintenance priorities. Each year the City should review the Master Plan and adopt a specific Capital Improvement and Capital Maintenance Program which incorporates the general guidelines of the Master Plan into the specific activities for that year.

SCOPE OF WORK

The general scope of work for this project was to prepare a Water System Master Plan. The scope included tasks to:

- Review and develop forecasts of population and water demands,
- Develop planning criteria to be used in evaluating the existing system and future system expansions,
- Evaluate the existing system for deficiencies compared to the planning criteria,
- Develop a source of supply strategy;
- Identify the system improvements needed to support anticipated growth and development and provide means to anticipate system improvements before growth is constrained,
- Prepare a Capital Improvement Program based on the evaluation of existing and future facilities,

Determining water system rates or financing mechanisms was not a part of the Scope of Work for this Master Plan.

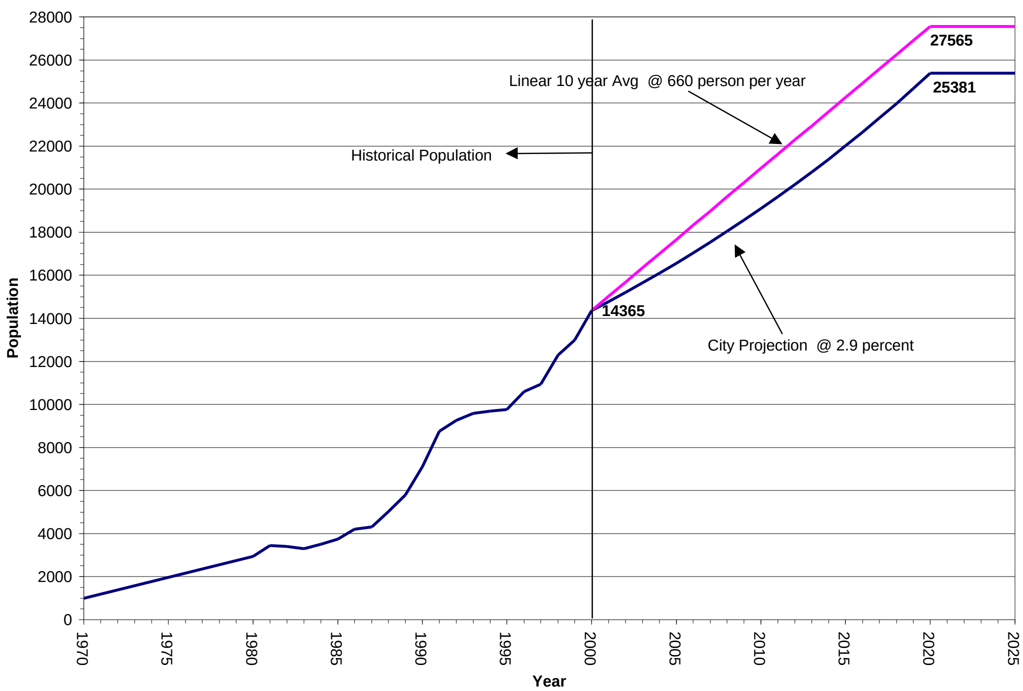
POPULATION FORECAST

It is recommended that the projection developed by the City of Wilsonville Community Development Department be used.

City Community Development Department Projections

While this Master Plan covers the twenty year planning period of 2002 to 2022, the City has estimated that the ultimate buildout population will be achieved in the year 2020. Projected populations to 2020 have been estimated by City staff based on the development capacity inside the current Urban Growth Boundary and estimates of future development in the unincorporated portions of the City's service area. Using the City's buildout population projections and current population data, a 2.9 percent average annual population growth rate has been developed from 2000 to 2020. Growth projections are depicted graphically in Figure ES-1. The ultimate year 2020 (buildout) population projection for the City is estimated to be 25,381.

Figure ES-1
Population Projections



This estimate represents the best available evaluation of existing development capacity within the current service area and adjacent future planning areas. The recommended population projection was used to develop a per capita water demand rate for residential services throughout the water system. Because of the influence of non-residential service in Wilsonville, water demand projections should not be solely based on a per capita water usage rate. Therefore, for non-residential services, a separate water demand was developed. The combination of the per capita demand rate and the per unit demand rate forms the basis of an evaluation of long-term water supply needs.

DEMAND FORECAST

Using the recommended population projection, and a non-residential development projection along with the historical water demand information provided by the City, a forecast of future water demands has been developed.

Because of historic limitations on available water from the existing well system, the City has implemented not only a stringent water conservation program, but also restrictions on water consumption for irrigation. This has included but has not been limited to every other day watering, maximum watering time limited to 20 minutes, voluntary on call 100% elimination of irrigation by 30 largest customers, and restrictions on landscape installation for developing properties. This program was initiated in 1994 when the actual realized peak day demand was 5.2 mgd. Since the restrictions on irrigation began, the City has not experienced a peak day demand in excess of 5.0 mgd. In fact, the actual peak day demand for year 2001 was 4.8 mgd. The demand forecast used in this Water System Master Plan assumes that the current restrictions on use of water for irrigation will no longer be in effect for the year 2002 and beyond. (For modeling purposes this removal of restrictions on water for irrigation has been included for the years 2000 and 2001 for consistency.) This has been assumed because once the Willamette Water Treatment Plant begins to produce water for City use, the City restrictions will be lifted although the City will continue to apply conservation efforts. As a result, this unrestricted water demand forecast will be utilized in the facilities planning for the Water System Master Plan.

The level of effort and sophistication that goes into estimating water demands can vary substantially. The demand projections in this Section rely upon historical information from the City and engineering judgment. In making a projection, it is important to understand the use of that projection. For this Water System Master Plan, the demand projections must be large enough so that the facilities that are planned will be adequate to meet future water needs in the community. At the same time, the demand forecast must not be too high, as then the planned facilities will be too large and have uncalled for impacts to water rates or funding mechanisms. The balance between these two concerns must be found. As a result, the sizing, capacity, and other planning and design criteria of recommended facilities should be reviewed during individual project predesign.

Historical Water Demands

Historical water production is shown in Table ES-1. This data was compiled from the supervisory control and data acquisition (SCADA) system and well logs for the years 1990 through 2000. From this information annual average, annual peak month, annual peak season, and annual non-peak season demand numbers have been calculated.

The impact of the City's curtailment program can be seen in Table ES-1. The City's annual per capita usage was highest in 1994, just prior to initiation of the curtailment program. The year 1994 was also a relatively hot one in the metropolitan region.

(The City of Portland, in its Infrastructure Master Plan, estimated that 1994 represents a year whose weather will be more severe only one year in ten on average).

Assuming that the City's usage in a hot year could return to the levels seen in 1994 prior to the curtailment program, an unrestrained annual average demand for the current population of 14,365 compared to a 1994 population of 9,680 would be 3.4 mgd. With a peak day to annual average peaking factor of 2.0, which is typical for unconstrained systems in the area, the estimated year 2000 unconstrained peak day demand under hot weather years would be 6.8 mgd. This is the estimate that is used in this Master Plan.

From the residential and employment information, and based on annual average and peak day demand production, a per unit demand has been developed for each landuse type. These per Equivalent Dwelling Unit (EDU) water usage rates will be used to forecast residential and non-residential water demand based on the City's landuse planning. Table ES-2 shows the per unit usage rates used for the water demand projections. Currently the Single Family Residential (SFR) population shows a population density of approximately 2.4 persons per household. As the population of the City of Wilsonville matures and maximum density is established, a reduction in persons per household is assumed at buildout. For year 2020 (buildout) a population density for single family residential landuse is assumed to be 2.1 person per household. However, it is assumed that the annual average water rate per household unit remains constant at 251 gpud. These per unit demand rates are based on year 2000 uncurtailed demand numbers. The City has been implementing an aggressive water curtailment and conservation plan on irrigation water usage throughout the City. This curtailment will depress the per unit usage rates. Therefore the City's Community Development department has used irrigation estimates based on landuse type from historical irrigation records in the 1980's. This estimate has been integrated into the current and projected water demands through the per unit demand rate.

Table ES-1
Historical Water Demands

	1990 (MG)	1991 (MG)	1992 (MG)	1993 (MG)	1994 (MG)	1995 (MG)	1996 (MG)	1997 (MG)	1998 (MG)	1999 (MG)	2000 (MG)
January	21.43	36.69	37.78	39.57	53.64	47.06	49.86	52.54	54.27	57.63	58.18
February	23.70	20.01	28.95	47.31	39.17	39.81	50.25	49.39	51.58	54.24	52.11
March	30.31	31.72	41.85	40.40	55.48	49.77	52.12	58.05	56.77	58.29	57.86
April	35.28	32.33	47.86	40.47	51.34	46.63	54.07	55.64	61.03	60.51	62.03
May	26.92	39.84	78.64	39.90	81.87	66.76	53.38	89.76	71.03	69.01	69.57
June	41.88	53.90	96.77	64.87	94.26	91.84	84.87	94.62	92.09	96.10	96.85
July	74.67	91.13	79.22	77.10	122.35	114.60	121.65	117.89	113.77	115.96	113.82
August	68.73	95.19	82.34	91.53	104.57	105.49	124.43	109.61	121.57	112.37	119.30
September	51.69	75.13	70.08	85.67	86.41	77.48	82.92	83.65	103.21	104.67	97.11
October	30.06	60.11	28.32	55.77	56.42	53.59	61.83	62.01	65.81	81.16	73.20
November	30.99	33.92	40.71	44.16	46.98	51.81	52.19	55.09	57.96	58.43	56.95
December	34.74	37.84	42.84	42.13	42.82	54.67	51.42	55.96	59.63	58.75	58.34
Annual Total	**470.40**	**607.82**	**675.34**	**668.88**	**835.29**	**799.52**	**839.01**	**884.19**	**908.72**	**927.12**	**915.33**
Annual Average Daily Demand (mgd)	1.29	1.67	1.85	1.83	2.29	2.19	2.30	2.42	2.49	2.54	2.51
Annual Average Monthly Demand (MG)	39.20	50.65	56.28	55.74	69.61	66.63	69.92	73.68	75.73	77.26	76.28
Annual Peak Day Demand (mgd)[1]					5.2	4.9	4.9	4.7	4.6	4.5	4.8
Annual Lowest Peak Month (MG)	21.43	20.01	28.32	39.57	39.17	39.81	49.86	49.39	51.58	54.24	52.11
Annual Highest Peak Month	July	August	June	August	July	July	August	July	August	July	August
Annual Average Peak Season (MG)	59.24	78.84	82.10	79.79	101.90	97.35	103.47	101.44	107.66	107.27	106.77
Annual Average Non-Peak Season (MG)	29.18	36.56	43.37	43.71	53.46	51.26	53.14	59.80	59.76	62.25	61.03

Notes: Peak Season is June through September, Non Peak Season is October through May.
1. Curtailed Peak Day

Table ES-2
Current Water Usage Rates Per Unit by Land Use Type

	Average Day (gal/landuse/day)	Peak Day (gal/landuse/day)
Single Family Residential [1]	251.00	866.00
Multi Family Residential	161.00	375.00
Commercial	236.00	670.00
Industrial	44.00	176.00

1. Assumes Persons Per Household decreases in the year 2020 from approximately 2.4 to 2.1

Recommended Demand Projection

The decision as to which population projection (See Figure ES-1), rate of growth of residential and commercial/industrial development, and water demand to use relates to the desired level of system reliability. There is often a relationship between the level of reliability and cost - higher levels of reliability result in higher costs. The reliability of local distribution system components, such as transmission and distribution pipelines and local pump stations and tanks, tend to be designed toward the upper end of a reliability range. Using a higher population and rate of growth value provides a higher degree of certainty that even in the most extreme weather conditions, adequate water will be available. This higher consumption value will result in more costly facilities, however. Other methods of dealing with extreme peaks in demand include reliance on temporary restrictions (e.g. voluntary or mandatory curtailments such as odd/even day watering) on water use or interties to other sources. Temporary restrictions on water for irrigation could include the restrictions that were used in the City of Wilsonville from 1994 through 2001.

For the purpose of this water system master plan it is recommended that a 3 percent rate of growth for residential and an initial 15 percent growth rate for commercial/industrial developments be used. It is also recommended that a 251 gpud average day demand (ADD) and an 866 gpud peak day demand (PDD) rate be used for single family residential development, and that a 161 gpud ADD and a 375 gpud PDD rate be used for multi-family residential. For non-residential land use a rate of 236 gpud for retail ADD and 670 gpud for retail PDD rate is recommended. It is recommended that an ADD industrial usage rate of 44 gpud and PDD rate of 176 gpud be used. The water demand forecast is obtained by multiplying the recommended per unit usage rate by the recommended projected rate of growth.

The City's Community Development department is forecasting that the equivalent of two 1.0 mgd ADD industrial users will be located within the City by 2020, either through the actual construction of such facilities or the conversion of existing warehouses to higher intensity water use. It has been assumed that the water demand associated with these two industrial user equivalents will be allocated throughout the planned industrial areas. Also the influence of these large facilities will be distributed over the entire 20 year planning period and not be isolated to one event.

It must be recognized that these estimates are predictions based on the best information available at this time, and should be subject to continuous updating and adjustment based on the actual water demand that the City experiences over time.

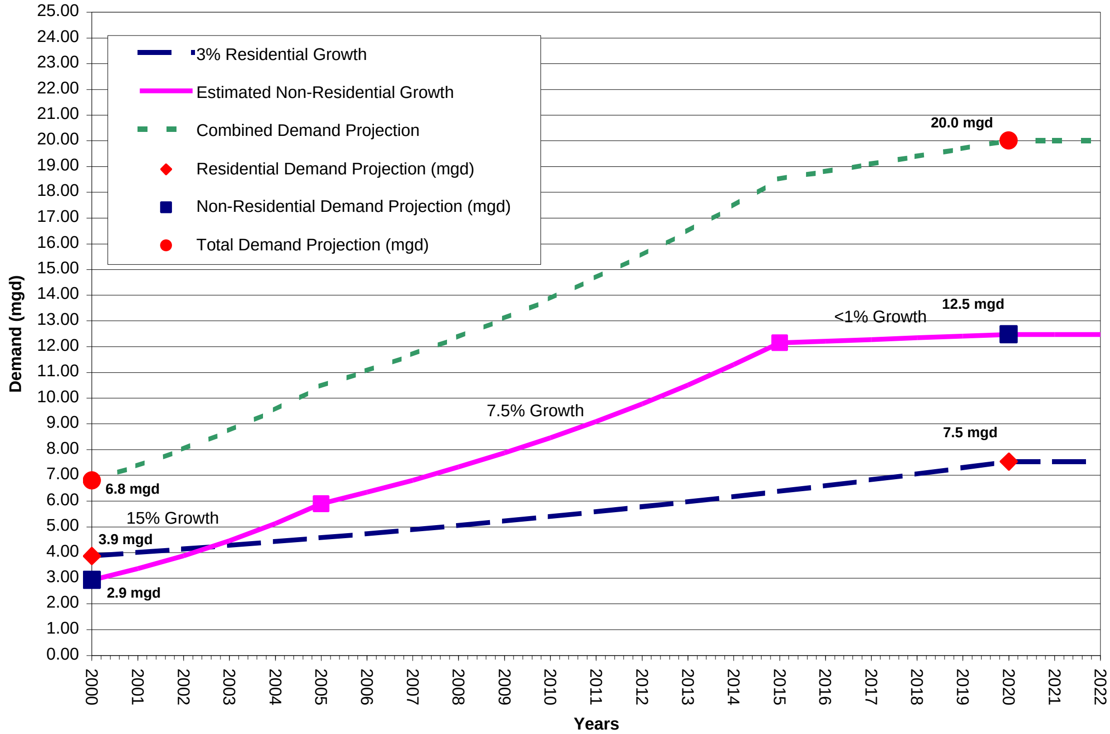
Table ES-3 provides a summary of the projected water demand, and Figure ES-2 shows the projection graphically.

Table ES-3
Maximum Day Water Demand by User Type

	2000 Unrestrained Peak Day Demand (mgd)	2020 Peak Day Demand (mgd)	Rate of Increase (%/yr)
Single Family Residential	2.56	5.24	3.6
Multi Family Residential	1.31	2.30	2.9
Commercial	1.36	2.13	2.3
Industrial	1.25	8.35	10.0
Special Use	0.32	2.00	9.6
Total	**6.80**	**20.02**	**5.5**
Total Residential	3.87	7.53	3.4
Total Non Residential	2.93	12.48	7.5

Note: Water demands based on City population and unrestrained water demand projections

Figure ES-2
Projected Unrestrained Peak Day Demand by Rate of Growth and User Type



CAPITAL IMPROVEMENT PROGRAM

Projects within the Capital Improvement Program (CIP) are listed in Table ES-4 and are show in Figure ES-3. Table ES-4 is separated into 6 major sections including:

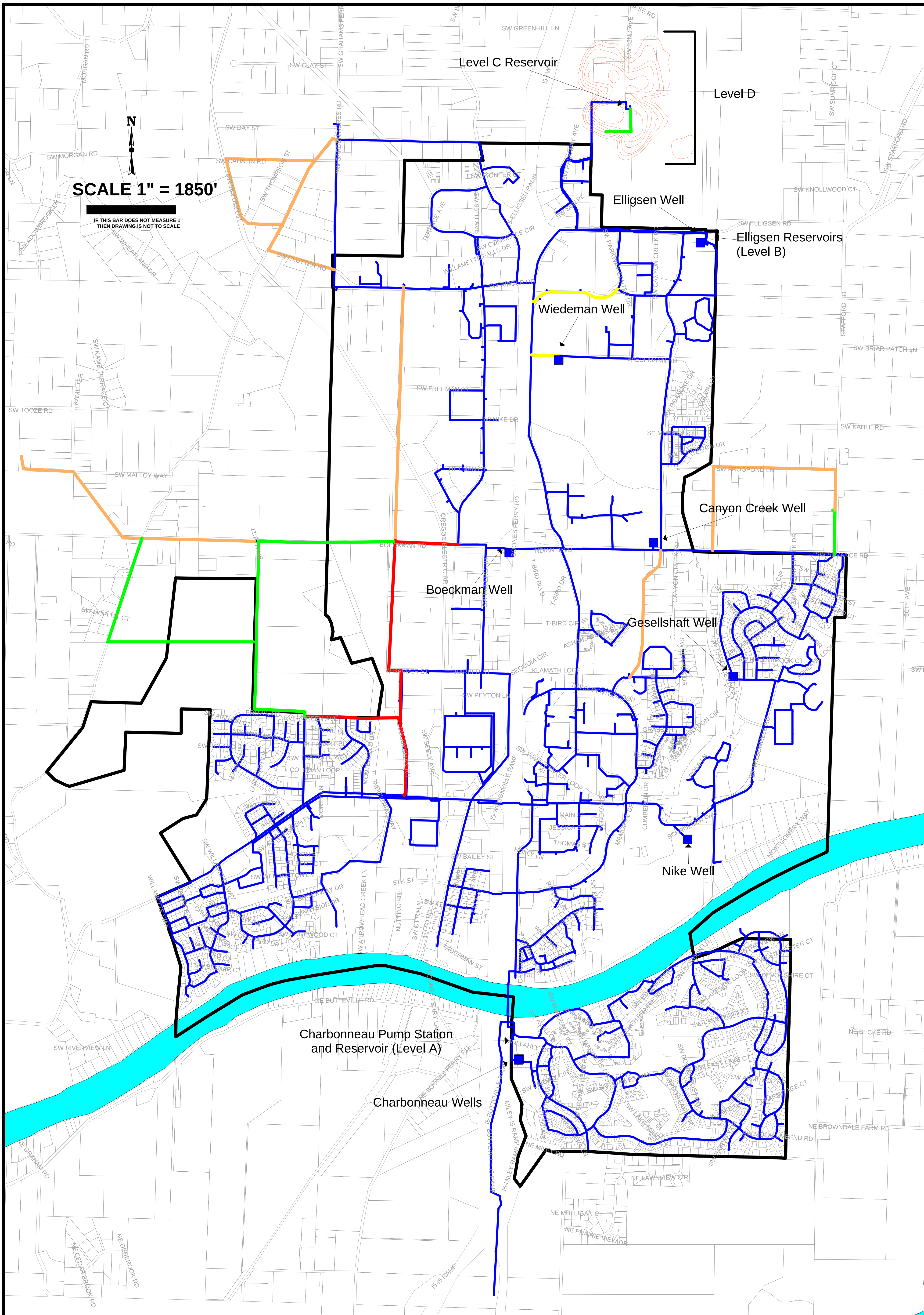
- Pipeline Projects,
- Source and Supply,
- Pump Station Projects,
- Control Valves,
- Reservoir Projects,
- Wells and Reservoir Rehabilitation Projects,
- Plans and Studies.

A total of about $26.6 M (in year 2001 dollars) in improvements is recommended between now and the year 2022. The majority of the recommended capital projects are needed by the year 2015. Financial impacts to existing water rates and System Development Charges (SDCs) have not been determined. The current rate structure is sufficient to cover the cost of projects planned in the first five years, but future

Table ES-4
Capital Improvement Program

Zone	Description	Peak Day Demand	Peak Hour Demand	Peak Day + Fire Flow Demand	Existing	2000	2005	2010	2015	2020	Project Diameter (inches)	Total Length (feet)	$/LF	Estimate of Cost[1]
Pipeline Projects														
B	Evergreen Road from Kinsman Road to Brown Road		x		N/A		18				18	2092	$171.00	$357,732
B	Boeckman Road from WTP Transmission to 95th Avenue	x		x	N/A		24				24	1290	$275.55	$355,460
B	WTP Transmission Barber Street to Boeckman[2]	x		x	N/A		24				48	2965	$576.00	$1,707,840
B	WTP Transmission Wilsonville Road to Barber Street[2]	x		x	N/A		30				48	2613	$576.00	$1,505,088
B	Boeckman Road from WTP Transmission to 110thAvenue (west)	x			N/A			24			24	2800	$275.55	$771,540
B	110th Avenue South from Boeckman Road to Intersection of Brown Road and Evergreen	x			N/A			18			18	4630	$171.00	$791,730
B	New School Pipeline north from Boeckman Road	x		x	N/A			12			12	1000	$109.65	$109,650
D	D Level Transmission from C Level Reservoir	x		x	N/A			12			12	1000	$109.65	$109,650
B	Dammasch Development to Grahams Ferry Road	x		x	N/A			18			18	3010	$171.00	$514,710
B	From Dammasch Development along Grahams Ferry Road to Boeckman Road	x		x	N/A			18			18	2270	$171.00	$388,170
B	Urban Service Area between Frog Pond Lane and Boeckman Road		x		N/A				12		12	5125	$109.65	$561,956
B	From Boeckman Road near Canyon Creek Well to Vlahos Drive		x		N/A				12		12	2850	$109.65	$312,503
B	Cahalin Road, Morton Street, and Elligsen Way		x		N/A				12		12	3980	$109.65	$436,407
B	Grahams Ferry to Ridder Road, Ridder Road to Garden Acres		x		N/A				12		12	4220	$109.65	$462,723
B	WTP Transmission Boeckman to Ridder[2]	x		x	N/A				18		48	5263	$576.00	$3,031,488
B	New Reservoir Transmission				N/A				30		30	6785	$360.00	$2,442,600
B	Weideman Road from Weideman PS to Parkway Ave		x		10					12	12	570	$109.65	$62,501
B	Parkway Center Drive from Burns Way to Parkway Ave		x		8					12	12	1900	$109.65	$208,335
Sub Total of Pipeline Cost Per Five Year Planning Horizon							**$3,926,120**	**$2,685,450**	**$7,247,677**	**$270,836**				**$14,130,082**
Source and Supply														
						2000	**2005**	**2010**	**2015**	**2020**				
B	5 mgd ASR Development						$1,000,000							$1,000,000
B	5mgd WTP Expansion								$3,750,000					$3,750,000
Sub Total						**$0**	**$1,000,000**	**$0**	**$3,750,000**	**$0**				**$4,750,000**
Pump Station Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Weideman Well Backup Generator							$100,000						$100,000
B	Canyon Creek Well Backup Generator							$100,000						$100,000
B	Gesellschaft Well Backup Generator							$100,000						$100,000
B	Charb Total Booster Flow Meter						$5,000							$5,000
A-B	Emergency Startup and Operation at Charb Booster PS						$50,000							$50,000
D	C Level Booster Pump Station							$225,000						$225,000
Sub Total						**$0**	**$55,000**	**$525,000**	**$0**	**$0**				**$580,000**
Control Valves														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Barber PRV Station						$55,000							$55,000
B	Boeckman PRV Station						$55,000							$55,000
B	Ridder PRV Station								$55,000					$55,000
A-B	PS Bypass at Charb Booster PS from Level B to Level A						$10,000							$10,000
Sub Total						**$0**	**$120,000**	**$0**	**$55,000**	**$0**				**175,000**
Reservoir Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
C	Level C Intertie					$50,000								$50,000
B	Reservoir Land Acquisition						$275,000							$275,000
B	Reservoir Storage Level B (2015 Required)								$1,940,000					$1,940,000
B	Reservoir Storage Level B (2020 Required)									$3,500,000				$3,500,000
Sub Total						**$50,000**	**$275,000**	**$0**	**$1,940,000**	**$3,500,000**				**$5,765,000**
Well and Reservoir Rehabilitation Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
A	Charb Res DeChlorination Facility for Reservoir Drainage					$10,000								$10,000
A	Charb Res Interior Inspection and Cleaning					$25,000		$25,000						$50,000
A	Charb Res Seismic Study					$25,000								$25,000
B	Elligsen Res 1 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 1 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
C	Level C External Painting						$75,000		$75,000					$150,000
C	Level C Internal Inspection and Cleaning						$25,000		$25,000					$50,000
B	Elligsen Res 2 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 2 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
Sub Total						**$110,000**	**$250,000**	**$75,000**	**$250,000**	**$0**				**$685,000**
Plans and Studies														
						2000	**2005**	**2010**	**2015**	**2020**				
	Water System Master Plan						$75,000	$75,000	$75,000	$75,000				$300,000
	Water Rate Study						$40,000	$40,000	$40,000	$40,000				$160,000
	ASR Feasibility Study						$100,000							$100,000
Sub Total						**$0**	**$215,000**	**$115,000**	**$115,000**	**$115,000**				**$560,000**
Total						**$160,000**	**$5,841,120**	**$3,400,450**	**$13,357,677**	**$3,885,836**				**$26,645,082**

1. Estimated Cost are based on Year 2000 Dollars
2. Project Diameter increased to provide potential supply flow to neighboring water providers.



Distribution Pipeline

2005 CIP

2010 CIP

2015 CIP

2020 CIP

City Boundary

Contour >= 415 feet (Level D)

MONTGOMERY WATSON

Figure ES-3
City of Wilsonville

Capital Improvement Program
Pipelines

City of WILSONVILLE in Oregon

implications will not be determined until after the water treatment plant is operational and a new rate study is conducted.

This Master Plan listing of CIP projects is intended to be a recommended plan and long-term guide for the development of the City's water system. While projects are shown in this CIP as being scheduled for construction in a given year, this is intended only to provide a general guideline of priorities, relationships between projects, ties to levels of growth, and understanding of maintenance priorities. Each year the City should review the Master Plan and adopt a specific Capital Improvement Program that incorporates the general guidelines of the Master Plan into the specific activities for that year.

CONCLUSIONS

The City of Wilsonville is currently constructing a new water treatment plant on the Willamette River in conjunction with the Tualatin Valley Water District and will have 10 mgd available by April 2002. Based on the growth projections developed as part of this Master Plan, this initial 10 mgd plant capacity, supplemented by the existing well system, will be adequate to meet the City's needs until the 2005 to 2009 timeframe. The City will need to develop additional supply capacity, ultimately reaching its projected buildout water demand of 20 mgd, by the year 2020.

It is recommended that the City study, plan, and if feasible, implement a 5 mgd Aquifer Storage and Recovery (ASR) system in that timeframe using its existing Columbia Aquifer wells. Under this approach, the City's 10 mgd water treatment plant capacity could be utilized in the winter to produce water and store it in its existing wells. This water would then be withdrawn in the summer peak season demand period. This would then reduce the size of the required long-term plant expansion by 5 mgd and would allow the plant expansion to be delayed several years. If ASR is successful, the plant expansion would only need to be 5 mgd to meet the projected 2020 demands. If ASR is not approved by OWRD or is not found to be feasible, the plant expansion would need to be 10 mgd.

The City should maintain its very successful water conservation program. In April 2002, once the Willamette WTP is providing the primary source, the need for mandatory water curtailment will be eliminated; however, it is recommended that the tools developed for the water conservation program continue. These tools would include, but not necessarily be limited to, an inverted block rate structure to charge higher amounts for increased irrigation consumption, continued emphasis on publicity for the water conservation program and assistance to customers in efficiently using their irrigation systems.

Along with source supply, emergency storage and emergency supply are critical to the City to improve its water system. The projected reservoir storage deficit for the City is 6.0 MG in year 2020 (buildout). It is recommended that the City obtain a storage reservoir site at the same elevation as the Elligsen Reservoirs (375 feet) for Zone B, and at that site develop 2.0 MGs of reservoir storage by year 2015. The remaining 4.0 MGs of storage should be constructed by the year 2020.

The City should continue to develop and maintain emergency supply and intertie options such as the one it recently concluded with the City of Tualatin. It is recommended that backup power is provided at Wiedeman, Canyon Creek, and Gesellshaft wells to provide a firm reliable secondary supply source for the City. All wells should be exercised (run) regularly to ensure their viability as a backup source. By establishing a firm reliable secondary supply from the wells and an emergency supply intertie with a total capacity equal to projected average day demand (7.1 mgd), the need for additional storage within the distribution system will be alleviated. This option should be reevaluated if the Willamette WTP develops into a regional water supplier with large transmission to adjacent water providers.

From the hydraulic analysis of the existing distribution system, presently there are no pipeline deficiencies in Wilsonville's water system. The pipeline component of the Capital Improvement Program (CIP) consists of pipeline that will be required by new development. Therefore, as the water system develops, adjustments should be made to the CIP estimated cost in consideration of changed alignments, looping and interconnections to the existing system.

Typically in water distribution systems, the fire flow analysis will result in a significant portion of the CIP being required for pump stations, storage reservoir volume, and pipeline projects to meet fire flows. The City has established the maximum fire flow to be 3000 gallons per minute for four (4) hours, resulting in a smaller portion of the CIP being required for fire flows than is determined in most systems. Therefore, it is recommended the City continue to require that the maximum available fire flow standard of 3000 gallons per minute for four (4) hours be maintained.

The water quality of the well supply and distribution system has historically been excellent. The system meets all current regulations. Some aesthetic measures have been taken in the well system to sequester iron and manganese precipitation in the distribution system and prevent brown water. These measures should continue as needed to maintain the usefulness of the ground water supply. Once the Willamette WTP is brought on line, comprehensive monitoring and analysis of mixing the surface water and well water should be made to confirm studies performed during WTP design. Consideration of taste and odor should be considered as well as the impacts of mixing the warmer Willamette supply with the well supply and the resultant effects on the iron and manganese sequestering program for the groundwater.

The City of Wilsonville has invested in the water system to be able to adequately supply a superior, abundant water source for projected growth and development. As development occurs there will be need to accurately estimate water demands and plan pipeline and facilities for the future growth. Therefore, it is recommended that the City establish reservoir, valve and pump station maintenance programs and periodically reevaluate the changing water system through water system master planning and rate studies.

WATER MASTER PLAN POLICIES AND IMPLEMENTATION MEASURES

The City's Comprehensive Plan provides a context within which this Master Plan has been developed. The primary goal of the Water Master Plan is derived from Wilsonville's Comprehensive Plan Goal 3.1 providing for infrastructure in general and is as follows:

"To assure that good quality public water supply and distribution facilities are available with adequate but not excessive capacity to meet community needs, while also assuring that growth does not exceed the community's commitment to provide adequate facilities and services."

The Comprehensive Plan also provides the following policies that were used to guide this master plan update:

Comprehensive Plan Policy 3.1.1. The City of Wilsonville shall provide public facilities and services to enhance the health, safety, educational and recreational aspects of urban living.

Comprehensive Plan Policy 3.1.2. The City of Wilsonville shall provide, or coordinate the provision of, facilities and services concurrent with need (created by new development, redevelopment, or upgrades of aging infrastructure.)

Comprehensive Plan Policy 3.1.3. The City of Wilsonville shall take steps to assure that the parties causing a need for expanded facilities and services, or those benefiting from such facilities and services, pay for them.

Comprehensive Plan Policy 3.1.5. The City of Wilsonville shall continue to develop, operate and maintain a water system, including wells, pumps, reservoirs, transmission mains and a surface water treatment plant capable of serving all urban development within the incorporated city limits, in conformance with federal, state, and regional water quality standards. The City shall also continue to maintain the lines of the distribution system once they have been installed and accepted by the City.

Additional policies, and the implementation measures necessary to carry out those policies, were developed specific to the water system and are listed below.

Policy 1. The City of Wilsonville shall continue a comprehensive water conservation program to make effective use of the water infrastructure, source water supply and treatment processes.

Implementation Measures:

> **1.1.** The City will track system water usage through production metering and service billing records and take appropriate actions to maintain an annual average unaccounted for water volume of less than 10% of total production volume.

1.2. The City will continue to make available brochures and instructional pamphlets describing the benefits and methods of water conservation.

1.3. The City will maintain a water rate structure that promotes water conservation through incentives.

1.4. The City will maintain other programs and activities as necessary to maintain effective conservation throughout the water system.

Policy 2. The City of Wilsonville shall make effective use of the existing water system facilities to reduce the need for improvements and extend the life of the existing system.

Implementation Measures:

2.1. The City will maintain water distribution hydraulic model to analyze each development opportunity and hydraulic impact to system.

2.2. The City will maintain facility sizing and capacity to meet OAR 333-061-0025 standards.

2.3. The City will install emergency power generators on all of its existing wells that do not have them so that they can provide water to meet fire flow requirements, thereby reducing required reservoir capacity. This will also provide an additional source of water if the new Willamette Water Treatment Plant is not available for any reason and commercial power is also not operating.

Policy 3. The City of Wilsonville shall provide adequate treated water supply and distribution system capacity for future growth to build-out development conditions.

Implementation Measures:

3.1. The City will use appropriate land use projections to determine future growth and water demand. These projections will be based on best available information provided by the Community Development Department. The future growth scenario will be that which is expected at ultimate build-out.

3.2. The City will expand its new Willamette Water Treatment Plant as needed to maintain an adequate supply of water.

3.3. The City will investigate the ability of an ASR system to reduce the size of future water treatment plant expansions.

3.4. The City will construct pipelines and reservoirs with adequate capacity to meet future projected demands.

Policy 4. The City of Wilsonville shall maintain an accurate user demand profile to account for actual and anticipated demand conditions in order to assure an adequately sized water system.

Implementation Measures:

4.1. The City will develop demand patterns based on land use and user type to accurately represent the current status of the water distribution system.

4.2. Using the historic information the City will maintain the proper demand planning for future water-intensive industrial and commercial enterprises that may locate to Wilsonville.

Policy 5. The City of Wilsonville shall fund the capital improvements with monies collected in accordance with existing laws, rules, and regulations.

Implementation Measures:

5.1. Water facilities serving the general City population shall be built and financed by the City. Financing may include revenue bonds, water utility fees, or the reimbursement component of system development charges. The improvement component of system development charges may be used to finance that portion of these projects that is used to provide increased capacity for future growth.

5.2. Where water transmission mains are built by the City but also provide water service to adjacent properties, said properties shall be assessed for the proportionate share of the water main construction costs when water is first used by each abutting property.

5.3. Water mains 12-inches in diameter and smaller extended to provide water service to properties not previously served shall be paid for in one of the following ways:

A. The landowner (developer) shall construct the mains at his cost and when completed and acceptable to the City, the pipeline shall be deeded to the City.

B. First, the landowner (developer) agrees with the City that as other lands adjacent to the proposed main connect to it within 10 years after its construction, a proportionate share of the constructed main's cost will be collected to reimburse the original landowner (developer). With this agreement the City then constructs the main at the landowner's (developer's) cost.

C. Where one or more property owners wish water service they may petition the City to form a local improvement district (LID). Once an LID is formed the facilities are built and costs are assessed in an equitable manner to the benefited property.

5.4. Where mains over 12-inches in diameter or mains extending beyond the distance necessary to serve the owners property are installed by others and the main is designed to serve as a City transmission pipeline, the City may reimburse the proportional share of the oversizing or extension cost either by direct payment or more likely, as a credit against system development charges.

Policy 6. The City of Wilsonville shall coordinate distribution system improvements with other CIP projects, such as roads, wastewater, storm sewer, to save construction costs and minimize public impacts during construction.

Policy 7. The City shall have a master plan that can be adjusted for changes in water requirements.

Implementation Measures:

7.1. Council may approve changes in planning areas and service areas provided changes are compatible with Metro urban planning decisions and that water is available.

7.2. The City Engineer can approve changes in distribution and transmission main sizes provided that the changes are compatible with the approved changes in land use and then current regulatory requirements.

Exhibit 7

Section 1 - Introduction

SECTION 1 - INTRODUCTION

The City of Wilsonville currently obtains its water supply from eight groundwater wells in the Columbia River Aquifer scattered throughout the City. This aquifer has been classified as "groundwater limited" by the Oregon Water Resources Department (OWRD). As a consequence, development of new wells in the aquifer has been restricted and OWRD has requested that the City reduce its dependency on groundwater as soon as possible.

In addition to the wells, the City's facilities include:

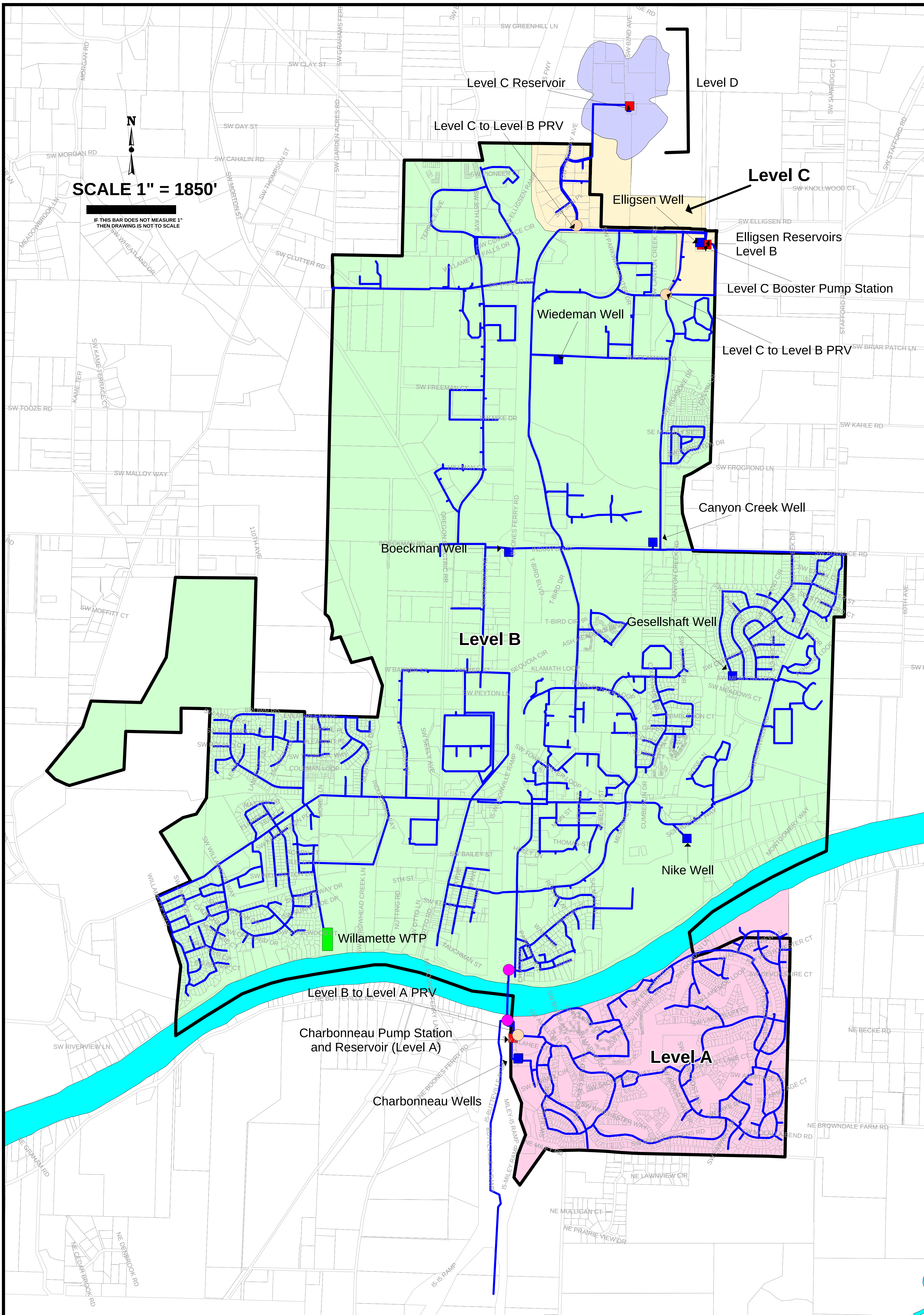
- Approximately 66 miles of distribution and transmission pipelines,
- Four reservoirs totaling 7.95 million gallons in storage,
- Groundwater pumps and pump houses,
- Two booster pumping stations,
- Telemetry system,
- Four seismic isolation valves, and
- Three pressure reducing valves.

The locations of these facilities are shown in Figure 1-1.

The last water system master plan for the City was developed by Westech Engineers in November 1986. As part of the 1986 Master Plan, additional groundwater development was recommended to meet the City's short-term water supply needs. This was done with construction of the Canyon Creek well in 1991 and the Boeckman well in 1997. But, the OWRD restrictions then limited the City's ability to continue adding new wells.

While the City has seen much growth in population and employment during the 1990's, the City's inability to develop new wells led, in January 1998, to imposition of a Moratorium on new construction because of the lack of sufficient long-term water supplies to serve new demand. Under State law, once a Moratorium was declared, the City had two years to find a solution to its water supply needs. This deadline was met when the voters of Wilsonville approved a revenue bond measure in September 1999 to fund construction of a new water treatment plant using the Willamette River as a water supply source. This new water treatment plant is currently under construction at a site along the Willamette River off of Industrial Way. The plant is on-schedule for completion by mid-April 2002.

Approval of the Willamette Water Treatment Plant project was the culmination of a long process of investigating the Willamette River and other source supply options. This process began in 1973 when the City sought water rights to the Willamette River. The City obtained a 30 cfs (20 mgd) water right with a priority date of 1974. It



Distribution Pipeline (> or = 4 inch)
Contour >= 415 feet (Level D)
City Boundary
Well
Reservoir
City Boundary
Seismic Isolation Valve
Pressure Regulating Valve

MONTGOMERY WATSON

Figure 1-1
City of Wilsonville

Service Area and Facilities

(As of May 2001)

City of WILSONVILLE in Oregon

continued in the 1986 Master Plan, which also recommended that by 1995, the City should begin evaluating potential surface water sources to meet long-term needs, including the Willamette and Molalla Rivers. A series of studies by the metropolitan region and by the City of Wilsonville alone led to the specific decision to utilize the City's water rights on the Willamette by building a new water treatment plant. The timeframe of these efforts is shown in Figure 1-1 and 1-2 and more detail on the studies that are represented in these Figures is provided in Section 7.

The addition of the Willamette River as the primary water supply for the City will result in changes in the City's water system. Of primary importance is the fact that instead of flow entering the distribution system at multiple locations (the wells), all flow will now come from the site of the water treatment plant through a transmission line that runs up Kinsman Road. This Water Master Plan has been developed to evaluate these potential changes as well as to identify modifications to the system that are needed to meet the anticipated future growth in the community.

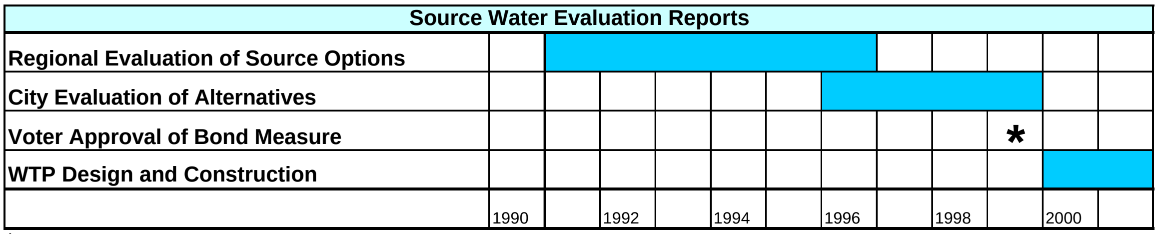
This Master Plan has developed a comprehensive water system Capital Improvement Program (CIP) for the City of Wilsonville. This Master Plan gives recommendations to guide the long-term development of the City's water system. It is not intended to be a specific list of required projects for specific years. While projects are listed in this Master Plan as being scheduled for construction in a given year, this is intended only to provide a general guideline of priorities, relationships between projects, ties to levels of growth, and understanding of maintenance priorities. Each year the City should review the Master Plan and adopt a specific Capital Improvement and Capital Maintenance Program which incorporates the general guidelines of the Master Plan into the specific activities for that year.

SCOPE OF WORK

The general scope of work for this project was to prepare a Water System Master Plan. The scope included tasks to:

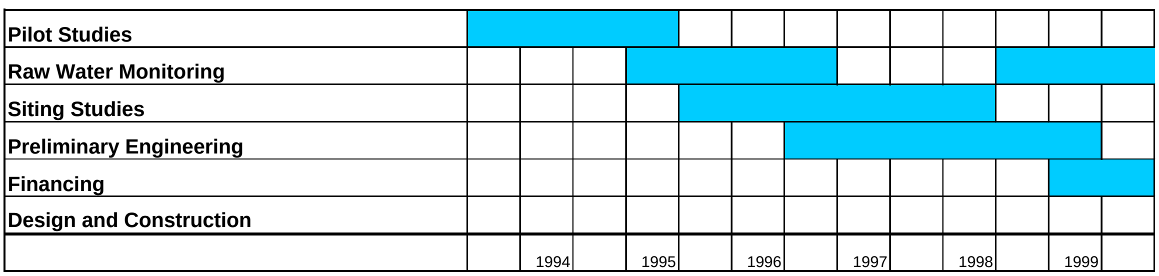
- Review and develop forecasts of population and water demands,
- Develop planning criteria to be used in evaluating the existing system and future system expansions,
- Evaluate the existing system for deficiencies compared to the planning criteria,
- Develop a source of supply strategy;
- Identify the system improvements needed to support anticipated growth and development and provide means to anticipate system improvements before growth is constrained,
- Prepare a Capital Improvement Program based on the evaluation of existing and future facilities,

Figure 1-2
History of Source Evaluation



* Master Plan Recommends Surface Source by 2000

Figure 1-3
History of Willamette WTP Development



Determining water system rates or financing mechanisms was not a part of the Scope of Work for this Master Plan.

AUTHORIZATION

Montgomery Watson was selected to prepare this Master Plan by the City. A contract authorizing the work was signed and dated October 19, 2000.

Exhibit 7

Section 2 - Population Projections

SECTION 2 - POPULATION PROJECTIONS

A forecast of water demands throughout a distribution system is dependent on an estimation of three key parameters – the number of water users, the type of water use, and the amount of water each member of a particular water user group is likely to consume. This section describes the projection of water user types and population projections that will become the basis for developing the water demand projection in Section 3 and ultimately the Capital Improvement Program in Section 10 for the Water System Master Plan.

CURRENT AND PLANNED WATER USE TYPES

Water use is often based on a per capita demand and a direct relationship to population is used. However, the City of Wilsonville's Comprehensive Plan (1990) has identified industrial development as the basic element of future economic growth. Industrial demand has very different usage patterns than residential demand; therefore, the demand projection presented in Section 3 will be based on a water user type. The City has actively managed growth to ensure economic stability. In fact since the development of the comprehensive plan, large industrial users have moved into the City. Today based on information provided by the City Community Development Department, approximately 18 percent of the annual average peak day water demand is from industrial use. In 2020 the City has projected that approximately 42 percent of the annual average peak day demand will be from industrial use. This rate of increase is approximately 10 percent per year.

Currently the City delivers 57 percent of its water supply to residential customers. This percentage will steadily decline as the City develops according to the comprehensive land use plan. Residential development is estimated to expand by only 3.4 percent while commercial / industrial development is estimated to expand at 15 percent in the first five years once water curtailment and development restrictions are lifted. Continued growth for commercial / industrial landuse after year 2005 is estimated to be 7.5 percent to year 2015 and less than 1 percent to year 2020. By the year 2003, the City of Wilsonville is projected to serve 49 percent residential and 51 percent commercial / industrial users. By the year 2020, commercial and industrial users will consume 62 percent of supplied water. To be consistent with the City of Wilsonville's Comprehensive Plan and to more accurately represent the projected water demand throughout the service area, two independent rates of growth have been established for the water demand projections for residential and commercial / industrial users. This will be discussed further in Section 3.

CURRENT POPULATION

The City's Community Development Department provided historical population estimates for the City of Wilsonville. Population estimates for the years between 1990 and 2000 were also obtained from the Center for Population Research and

Census, Portland State University (PSU). The PSU data represents estimates of population on July 1 each year within the Wilsonville City limits. Their estimates are based on census counts published by the U.S. Census Bureau every ten years. The PSU Annual estimates between census counts are derived by analyzing supplemental data, including economic changes, building permits, vehicle registrations, annexations, and other data. The U.S. Census Bureau data is utilized for 1990 and 2000.

The City of Wilsonville has experienced periods of high growth since being incorporated in 1969. The 1969 population was approximately 1,000. In the five year period from 1981 to 1986, the City's population grew 40 percent to approximately 4,100. This is considered significant growth because the State of Oregon was considered to be in an economic recession during this period. From 1986 to 1990 the population grew an additional 73 percent to a total population of 7,106. From 1990, the City of Wilsonville has grown approximately 92 percent to reach a current population of 14,365.

CITY COMMUNITY DEVELOPMENT DEPARTMENT PROJECTIONS

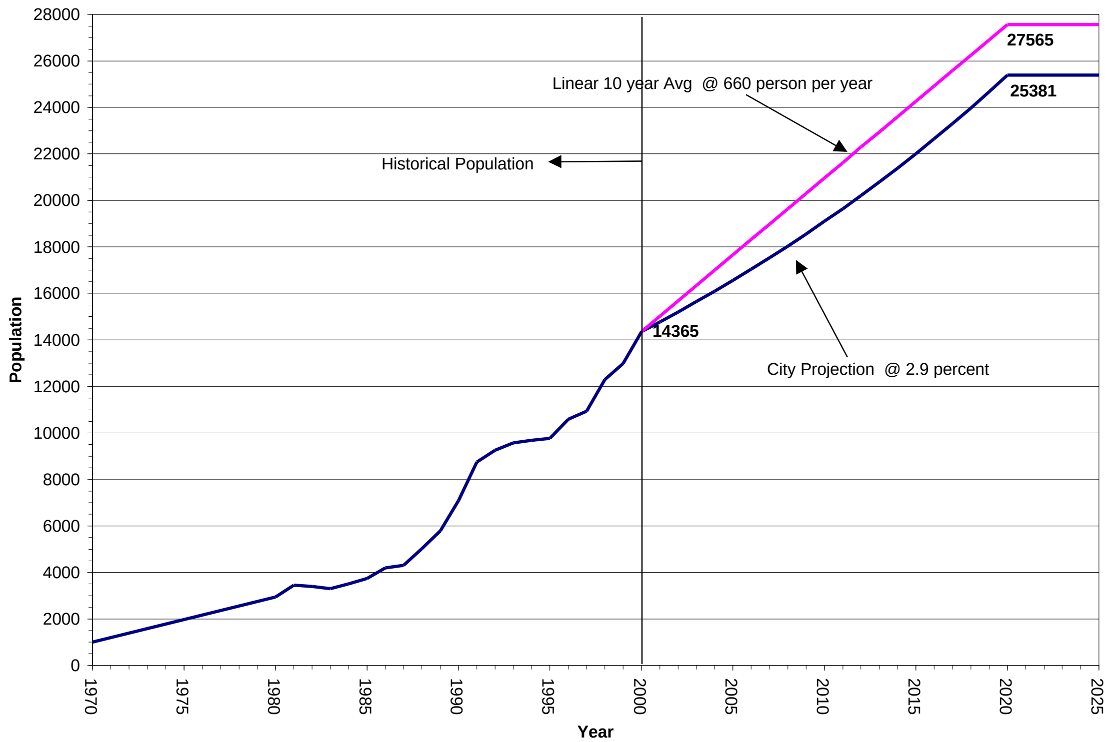
While this Master Plan covers the twenty year planning period of 2002 to 2022, the City has estimated that the ultimate buildout population will be achieved in the year 2020. Projected populations to 2020 have been estimated by City staff based on the development capacity inside the current Urban Growth Boundary and estimates of future development in the unincorporated portions of the City's service area. Using the City's buildout population projections and current population data, a 2.9 percent average annual population growth rate has been developed from 2000 to 2020. Growth projections are shown in Table 2-1, and depicted graphically in Figure 2-1. Straight line rate of growth projections do not account for potential growth spikes that may occur once the current building moratorium is lifted, nor do they consider the slowing growth patterns as stocks of available land within the service area are developed.

The 2020 (buildout) population is considered at maximum density including infill and redevelopment potential. The buildout population does include future annexation and service to development areas in unincorporated Clackamas and Washington Counties that have been identified as Urban Reserve Areas. The ultimate year 2020 (buildout) population projection for the City is estimated to be 25,381.

Table 2-1
City of Wilsonville Historical and Projected Population

Year	Historical and Projected Growth (2.9 Percent Growth)	% Annual Growth	Linear Ten Yr. (660 Persons Per Year)
1970	1001		
1980	2950	--	
1981	3450	16.9	
1982	3400	-1.4	
1983	3300	-2.9	
1984	3500	6.1	
1985	3750	7.1	
1986	4200	12.0	
1987	4300	2.4	
1988	5025	16.9	
1989	5800	15.4	
1990	7106	22.5	
1991	8755	23.2	
1992	9255	5.7	
1993	9580	3.5	
1994	9680	1.0	
1995	9765	0.9	
1996	10600	8.6	
1997	10940	3.1	
1998	12290	12.3	
1999	12985	5.7	
2000	14365	10.6	14365
2001	14780		15025
2002	15206		15685
2003	15645		16345
2004	16097		17005
2005	16562		17665
2006	17040		18325
2007	17532		18985
2008	18038		19645
2009	18559		20305
2010	19094	2.9	20965
2011	19646		21625
2012	20213		22285
2013	20796		22945
2014	21397		23605
2015	22014		24265
2016	22650		24925
2017	23304		25585
2018	23977		26245
2019	24669		26905
2020	25381		27565

Figure 2-1
City of Wilsonville Historical and Projected Population



1986 Water System Master Plan Projections

The 1986 Water System Master Plan provided a four year population projection of 5,885 in year 1990 for the existing service area. This is approximately 20 percent lower than the PSU population estimate of 7,106 for 1990, shown in Table 2-1. In the 1986 Master Plan, the year 2000 population projection was based on a 7.7 percent annual average growth rate and was 12,367. This population projection was approximately 16 percent lower than the PSU adjusted year 2000 census population of 14,365. The 1986 Master Plan continued the 7.7 percent increase into year 2006, for a total projected population of 19,311. This population of 19,311 is significantly higher than the City's estimate of 17,532. If that growth rate were to continue until the year 2020, the resultant population would be 54,554. These estimates illustrate that population forecasting is a blend of art and science, and that forecasts need to be updated regularly to take into account changing trends and conditions.

Linear Average Growth Projection

Another simplistic method of population forecasting is to assume that the future growth will be similar to past growth. Between 1990 and 2000, the population served by the City's water system grew from 7,106 to 14,365, for an average of 660 persons per year. If that same average were to continue to the year 2020 (buildout), then the 2020(buildout) population would be about 27,565. This is about 8 percent higher than the City's own projection to the year 2020 (buildout). This straight-line average growth projection is less sophisticated than the City's Community Development Department's analysis because it does not consider growth relative to land use type.

FUTURE PLANNING AREAS

METRO has identified seven areas bordering the City of Wilsonville's current Urban Growth Boundary (UGB) as areas of potential future urban growth. These future planning areas include Metro designated areas 35, 36, 37, 39, 41, and 42 as shown in Figure 2-2. Planning consultants in coordination with the City's Community Development Department have prepared Urban Reserve Plans for the North Wilsonville Industrial Area (Area 42) and the Dammasch Area (southern portion of Area 41). In addition to these planning studies, the City has developed a preliminary planning assessment based on projected land use for the remaining future planning areas and has included this assessment in their population and water demand projections. Area 39 and the southern portion of Area 41 have been recently approved for incorporation into the City UGB.

RECOMMENDED POPULATION FORECAST

The results of the various population forecasts are summarized in Table 2-2.

It is recommended that the projection developed by the City of Wilsonville Community Development Department be used.

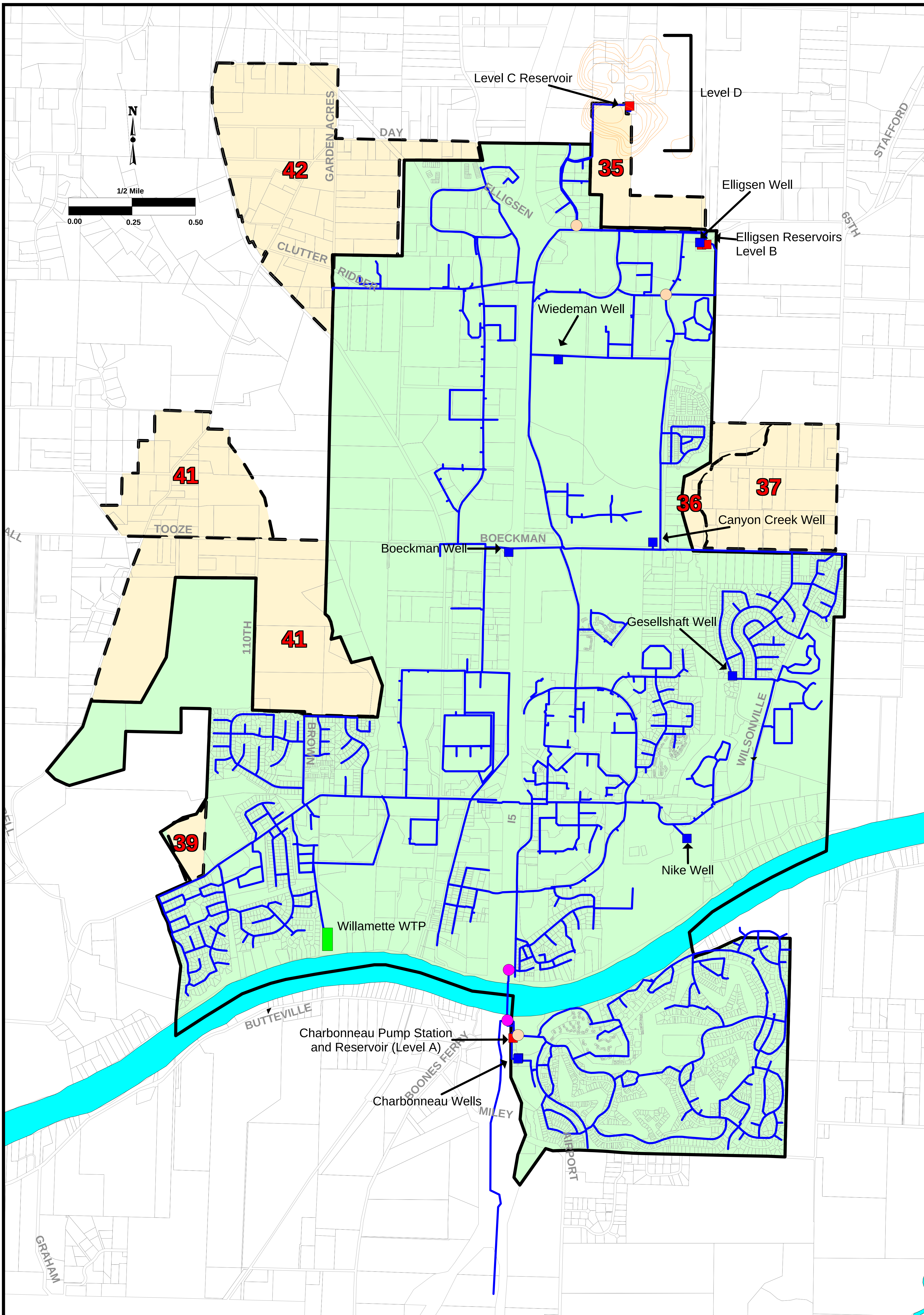
Table 2-2
Summary of Population Projections

	YR 2010	YR 2020 Buildout
City of Wilsonville Planning Department	19,094	25,831
Linear Average Growth Projection	20,965	27,565
1986 Master Plan[1]	25,981	54,554

1. Projection was made using 7.7% from last projection in 1986 Water Master Plan (YR 2006 = 19,311)

This estimate represents the best available evaluation of existing development capacity within the current service area and adjacent future planning areas. It must be recognized that these estimates should be subject to updating and adjustment, based on actual population growth and other factors. This Master Plan should be correspondingly updated and project sizing should be reviewed when projects are built.

The recommended population projection will be used to develop a per capita water demand rate for residential services throughout the water system. Because of the influence of non-residential service in Wilsonville, water demand projections should not be solely based on a per capita water usage rate. Therefore for non-residential services, a separate water demand will be developed. The combination of the per capita demand rate and the per unit demand rate will form the basis of an evaluation of long-term water supply needs.



Urban Planning Boundary

XX Urban Planning Area

METRO Designated Area Number

MONTGOMERY WATSON

Distribution Pipeline (> or = 4 inch)

Contour >= 415 ft (Level C)

City Boundary

Well

Reservoir

Seismic Isolation Valve

Pressure Regulating Valve

Figure 2-2
City of Wilsonville

Future Planning Areas

City of WILSONVILLE in Oregon

WILSONVILLE WATER TREATMENT PLANT
view from parking lot

Exhibit 7

Section 3 - Demand Projections

SECTION 3 - DEMAND PROJECTIONS

Using the recommended population projection, and a non-residential development projection along with the historical water demand information provided by the City, a forecast of future water demands has been developed. This Section provides that projection.

Because of historic limitations on available water from the existing well system, the City has implemented not only a stringent water conservation program, but also restrictions on water consumption for irrigation. This has included but has not been limited to every other day watering, maximum watering time limited to 20 minutes, voluntary on call 100% elimination of irrigation by 30 largest customers, and restrictions on landscape installation for developing properties. This program was initiated in 1994 when the actual realized peak day demand was 5.2 mgd. Since the restrictions on irrigation began, the City has not experienced a peak day demand in excess of 5.0 mgd. In fact, the actual peak day demand for year 2001 was 4.8 mgd. The demand forecast used in this Water System Master Plan assumes that the current restrictions on use of water for irrigation will no longer be in effect for the year 2002 and beyond. (For modeling purposes this removal of restrictions on water for irrigation has been included for the years 2000 and 2001 for consistency.) This has been assumed because once the Willamette Water Treatment Plant begins to produce water for City use, the City restrictions will be lifted although the City will continue to apply conservation efforts. As a result, this unrestricted water demand forecast will be utilized in the facilities planning for the Water System Master Plan.

The term "demand" refers to all the water requirements of a water system including domestic, commercial, municipal, irrigation, institutional and industrial as well as unbilled, unmetered and unaccounted-for water. Demands are discussed in terms of gallons per unit of time such as gallons per day (gpd), million gallons per day (mgd) or gallons per minute (gpm). Demands are also related to per capita use as gallons per capita per day (gpcd) or per land use type as gallons per unit per day (gpud).

The level of effort and sophistication that goes into estimating water demands can vary substantially. The demand projections in this Section rely upon historical information from the City and engineering judgment. In making a projection, it is important to understand the use of that projection. For this Water System Master Plan, the demand projections must be large enough so that the facilities that are planned will be adequate to meet future water needs in the community. At the same time, the demand forecast must not be too high, as then the planned facilities will be too large and have uncalled for impacts to water rates or funding mechanisms. The balance between these two concerns must be found. As a result, the sizing, capacity, and other planning and design criteria of recommended facilities should be reviewed during individual project predesign.

HISTORICAL WATER DEMANDS

Historical water production is shown in Table 3-1. This data was compiled from the supervisory control and data acquisition (SCADA) system and well logs for the years 1990 through 2000. From this information annual average, annual peak month, annual peak season, and annual non-peak season demand numbers have been calculated. The water demands shown in Table 3-2 have been developed from meter records for the average day consumption and the average gallons per unit per day and represent a very detailed annual average day water demand estimate for the year 2000. The maximum day consumption and the maximum gallon per unit per day are based on unrestricted peak day projections and represent a detailed annual peak day water demand estimate for the year 2000.

The impact of the City's curtailment program can be seen in the figures in Table 3-1. The City's annual per capita usage was highest in 1994, just prior to initiation of the curtailment program. The year 1994 was also a relatively hot one in the metropolitan region. (The City of Portland, in its Infrastructure Master Plan, estimated that 1994 represents a year whose weather will be more severe only one year in ten on average).

Assuming that the City's usage in a hot year could return to the levels seen in 1994 prior to the curtailment program, an unconstrained annual average demand for the current population of 14,365 compared to a 1994 population of 9,680 would be 3.4 mgd. With a peak day to annual average peaking factor of 2.0, which is typical for unconstrained systems in the area, the estimated year 2000 unconstrained peak day demand under hot weather years would be 6.8 mgd. This is the estimate that is used in this Master Plan.

These water demands were then allocated to the hydraulic model based on Traffic Analysis Zones (TAZ) and by user type. TAZ's are utilized in the analysis because the City allocates METRO dwelling unit and employment information to these zones. The TAZ allocation is shown in Table 3-2 along with dwelling units and employment information developed by the City Community Development Department and METRO.

From the residential and employment information, and based on annual average and peak day demand production, a per unit demand has been developed for each landuse type. These per Equivalent Dwelling Unit (EDU) water usage rates will be used to forecast residential and non-residential water demand based on the City's landuse planning. Table 3-3 shows the per unit usage rates used for the water demand projections. Currently the Single Family Residential (SFR) population shows a population density of approximately 2.4 persons per household. As the population of the City of Wilsonville matures and maximum density is established, a reduction in persons per household is assumed at buildout. For year 2020 (buildout) a population density for single family residential landuse is assumed to be 2.1 person per household. However, it is assumed that the annual average water rate per household unit remains constant at 251 gpud. These per unit demand rates are based on year 2000 uncurtailed demand numbers. The City has been implementing an aggressive water curtailment and conservation plan on irrigation water usage throughout the City. This curtailment has artificially depressed the per unit usage rates. Therefore, the City's Community Development department has used irrigation estimates based on landuse type from historical irrigation records in the 1980's. This estimate has been integrated into the current and projected water demands through the per unit demand rate.

Table 3-1
Historical Water Demands

	1990 (MG)	1991 (MG)	1992 (MG)	1993 (MG)	1994 (MG)	1995 (MG)	1996 (MG)	1997 (MG)	1998 (MG)	1999 (MG)	2000 (MG)
January	21.43	36.69	37.78	39.57	53.64	47.06	49.86	52.54	54.27	57.63	58.18
February	23.70	20.01	28.95	47.31	39.17	39.81	50.25	49.39	51.58	54.24	52.11
March	30.31	31.72	41.85	40.40	55.48	49.77	52.12	58.05	56.77	58.29	57.86
April	35.28	32.33	47.86	40.47	51.34	46.63	54.07	55.64	61.03	60.51	62.03
May	26.92	39.84	78.64	39.90	81.87	66.76	53.38	89.76	71.03	69.01	69.57
June	41.88	53.90	96.77	64.87	94.26	91.84	84.87	94.62	92.09	96.10	96.85
July	74.67	91.13	79.22	77.10	122.35	114.60	121.65	117.89	113.77	115.96	113.82
August	68.73	95.19	82.34	91.53	104.57	105.49	124.43	109.61	121.57	112.37	119.30
September	51.69	75.13	70.08	85.67	86.41	77.48	82.92	83.65	103.21	104.67	97.11
October	30.06	60.11	28.32	55.77	56.42	53.59	61.83	62.01	65.81	81.16	73.20
November	30.99	33.92	40.71	44.16	46.98	51.81	52.19	55.09	57.96	58.43	56.95
December	34.74	37.84	42.84	42.13	42.82	54.67	51.42	55.96	59.63	58.75	58.34
Annual Total	**470.40**	**607.82**	**675.34**	**668.88**	**835.29**	**799.52**	**839.01**	**884.19**	**908.72**	**927.12**	**915.33**
Annual Average Daily Demand (mgd)	1.29	1.67	1.85	1.83	2.29	2.19	2.30	2.42	2.49	2.54	2.51
Annual Average Monthly Demand (MG)	39.20	50.65	56.28	55.74	69.61	66.63	69.92	73.68	75.73	77.26	76.28
Annual Peak Day Demand (mgd)[1]					5.2	4.9	4.9	4.7	4.6	4.5	4.8
Annual Lowest Peak Month (MG)	21.43	20.01	28.32	39.57	39.17	39.81	49.86	49.39	51.58	54.24	52.11
Annual Highest Peak Month	July	August	June	August	July	July	August	July	August	July	August
Annual Average Peak Season (MG)	59.24	78.84	82.10	79.79	101.90	97.35	103.47	101.44	107.66	107.27	106.77
Annual Average Non-Peak Season (MG)	29.18	36.56	43.37	43.71	53.46	51.26	53.14	59.80	59.76	62.25	61.03

Notes: Peak Season is June through September, Non Peak Season is October through May.
1. Curtailed Peak Day

Unaccounted for Water

Unaccounted-for water is measured as the difference between water produced and water sold. Water loss is typically attributed to unmetered water delivery, inaccurate metering equipment or system leaks. A reasonable percentage of water loss for a system depends on the type of treatment required, the condition of the system, and how much of the water use is metered. The American Water Works Association recommends that the loss occurring after treatment be maintained at 10% or less.

The City of Wilsonville has been closely tracking water usage and loss due to the current shortage of peak season water supply and as part of an aggressive water conservation and curtailment effort. Using well production and water meter records the City has identified a water loss of approximately 8 percent. This water loss has been accounted for in the current (year 2000) water usage rates and weighted according to land use type. This figure is an estimate and inaccuracies may be introduced into the water loss calculation from sources such as meter inaccuracies.

Table 3-2
Current Water Use by Traffic Analysis Zone (TAZ)

TAZ	Dwelling Units		Employment		ADD Special Water Use (gpd)	PDD Special Water Use (gpd)	Notes
	SFR	MFR	Retail	Non-Retail			
384	0	0	131	624			
384A	0	0	0	0			
384B	0	0	0	0			
384C	0	0	0	136			
384D	0	0	4	176			
384E	0	0	0	15			
385	1	0	21	579			
385A	0	0	0	0			
385B	110	372	0	9			
385C	0	0	0	1343			
386	0	0	0	0			
386A	0	0	0	0			
386B	55	296	2	11			
386C	300	0	2	9			
386D	42	120	0	9			
386E	0	116	0	3			
386F	234	0	5	6			
386G	0	0	12	1525			
386H	5	0	0	2			
387	0	110	40	20			
387A	28	0	1	2			
387B	0	0	0	0			
387C	8	663	0	10			
387D	100	490	1	63			
387E	13	0	0	3			
387F	141	0	62	8			
387G	0	232	218	168			
387H	0	0	308	313			
387I	0	0	138	115			
387J	0	0	47	185			
387K	0	0	374	26			
388	399	248	2	21			
388A	0	0	0	0			
388B	192	0	0	10			
388C	44	0	1	2			
388D	180	207	1	19			
388E	0	0	0	104	175949	246653	Coca Cola process water
388F	2	0	8	417			
388G	0	0	0	63			
388H	0	0	14	1161			
388I	1	0	166	29			
388J	0	0	44	15			
388K	16	84	8	45			
388L	84	12	4	26			
388M	5	0	2	191			
388N	3	0	0	5			
389	54	0	1	141			
389A	0	0	182	0			
389B	0	0	0	0			
389C	0	0	2	903			
389D	0	0	80	268			
389E	0	0	0	0			
389F	0	0	0	0			
389G	0	0	0	186			
389H	0	0	0	47			
390	0	0	40	122			
390A	0	0	0	169			
390B	0	0	0	0			
390C	0	0	0	345			
391	0	0	0	0			
391A	0	0	16	200			
391B	0	0	70	98			
391C	0	0	24	1051	52175	73141	Fujimi process water
391D	0	0	0	0			
393	0	0	0	0			
393A	0	0	1	33			
393B	0	0	0	0			
398	0	0	0	0			
398A	0	0	0	0			
400	29	0	0	46			
400A	0	0	0	0			
400B	0	0	0	0			
400C	0	0	0	0			
400D	0	0	0	0			
400E	0	0	0	0			
401	0	0	0	0			
401A	0	0	0	0			
520	913	536	0	0			
Total	**2957**	**3486**	**2032**	**11155**			
			Retail	**Non-Retail**	**ADD Special Water Use (gpd)**	**PDD Special Water Use (gpd)**	**Total**
Average Day Consumption (gpd)	740,729	561,938	479,928	491,330	228124		2,502,049
Average gpud	251	161	236	44			
Maximum Day Consumption (gpd)	2,580,279	1,306,868	1,360,950	1,250,107		319796	6,799,999
Maximum gpcd or gpud	866	375	670	112			

Various authorized and unmetered water uses will also contribute to unaccounted-for water in the system. Unmetered water is used for fire fighting, fire fighting training and equipment testing, main flushing and hydrant testing. Construction, including the filling / testing / refilling of new water pipeline, is also a major source of unmetered water consumption.

Table 3-3
Current Water Usage Rates Per Unit by Land Use Type

	Average Day (gal/landuse/day)	Peak Day (gal/landuse/day)
Single Family Residential [1]	251.00	866.00
Multi Family Residential	161.00	375.00
Commercial	236.00	670.00
Industrial	44.00	176.00

1. Assumes Persons Per Household decreases in the year 2020 from approximately 2.4 to 2.1

Recommended Demand Projection

Forecasting water use has several inherent uncertainties. A two-step approach has been used for the City of Wilsonville because of the expected variance in growth between residential and commercial/industrial development. Strictly using a per capita consumption in a community with a large commercial/industry influence may lead to improperly identified or sized capital improvement facilities. Using a two-step approach may reduce the influence of factors such as the variability and relative mix between residential, commercial and industrial development; the amount and type of irrigation; and the difference in diurnal water use patterns. Per unit usage rates are shown in Table 3-3.

The decision as to which population projection (See Figure 2-1), rate of growth of residential and commercial/industrial development, and water demand to use relates to the desired level of system reliability. There is often a relationship between the level of reliability and cost - higher levels of reliability result in higher costs. The reliability of local distribution system components, such as transmission and distribution pipelines and local pump stations and tanks, tend to be designed toward the upper end of a reliability range. Using a higher population and rate of growth value provides a higher degree of certainty that even in the most extreme weather conditions, adequate water will be available. This higher consumption value will result in more costly facilities, however. Other methods of dealing with extreme peaks in demand include reliance on temporary restrictions (e.g. voluntary or mandatory curtailments such as odd/even day watering) on water use or interties to other sources. Temporary restrictions on water for irrigation could include the restrictions that were used in the City of Wilsonville from 1994 through 2001.

For the purpose of this water system master plan it is recommended that a 3 percent rate of growth for residential and an initial 15 percent growth rate for commercial/industrial developments be used. It is also recommended that a 251 gpud average day demand (ADD) and a 866 gpud peak day demand (PDD) rate be used for single family residential development, and that a 161 gpud ADD and a 375 gpud PDD rate be used for multi-family residential. For non-residential land use a rate of 236 gpud for retail ADD and 670 gpud for retail PDD rate is recommended. It is recommended that an ADD industrial usage rate of 44 gpud and PDD rate of 176 gpud be used. The water demand forecast is obtained by multiplying the recommended per unit usage rate by the recommended projected rate of growth. The results of this calculation are shown in Table 3-4 for the ultimate 2020 (buildout) condition. An annual projection is shown in Table 3-5 for intermediate years to year 2020.

The City's Community Development department is forecasting that the equivalent of two 1.0 mgd ADD industrial users will be located within the City by 2020, either through the actual construction of such facilities or the conversion of existing warehouses to higher intensity water use. It has been assumed that the water demand associated with these two industrial user equivalents will be allocated throughout the planned industrial areas. Also the influence of these large facilities will be distributed over the entire 20 year planning period and not be isolated to one event.

It must be recognized that these estimates are predictions based on the best information available at this time, and should be subject to continuous updating and adjustment based on the actual water demand that the City experiences over time.

Table 3-6 provides a summary of the projected water demand, and Figure 3-1 shows the projection graphically.

Table 3-4
2020 (buildout) Demand

TAZ	Dwelling Units		Employment		ADD Special Water Use (gpd)	PDD Special Water Use (gpd)	Notes
	SFR	MFR	Retail	Non-Retail			
384	0	0	131	831			
384A	78	0	0	391			
384B	0	0	0	0			
384C	0	360	0	136			
384D	0	126	4	175			
384E	0	0	0	1136			
385	1	0	21	1347			
385A	0	0	0	0			
385B	200	393	46	100			
385C	0	0	0	2432			
386	340	714	75	0	11606	108610	New elemtary school
386A	0	0	0	0			
386B	64	296	2	11	11606	108610	Boeckman Cr Gr School
386C	375	0	2	9			
386D	99	120	0	9			
386E	161	116	0	1963			
386F	274	0	5	6			
386G	0	0	27	2830			
386H	21	0	0	2			
387	0	110	57	1403			
387A	41	0	1	2	19341	181016	WV High School
387B	0	0	0	0			
387C	9	663	0	10			
387D	117	490	1	100			
387E	15	0	0	5	33848	316778	Mem Pk & Boozier
387F	192	89	62	20			
387G	32	326	218	542			
387H	0	0	365	313	4836	45254	Town Ctr Pk
387I	0	0	138	115			
387J	0	0	590	26			
387K	0	0	47	186			
388	496	248	23	21			
388A	138	0	0	0			
388B	227	0	0	10			
388C	53	0	1	2	13639	126711	Wood Middle School
388D	252	207	1	18			
388E	0	0	0	175	137077	171346	Coca Cola
388F	2	0	8	843			
388G	0	0	0	83			
388H	0	0	14	1264			
388I	1	0	166	29			
388J	0	0	44	15			
388K	20	139	315	53			
388L	135	12	8	40	10638	99559	Boones Ferry Park
388M	21	83	30	753			
388N	224	0	0	306			
389	63	0	1	349			
389A	0	0	182	515			
389B	0	0	0	16			
389C	0	0	2	1284			
389D	0	0	80	642			
389E	0	0	0	0			
389F	0	0	0	0			
389G	0	0	0	715			
389H	0	0	0	424			
390	0	0	40	244			
390A	0	0	0	2056			
390B	0	0	0	137			
390C	0	0	0	345			
391	0	0	0	0			
391A	0	0	16	376			
391B	0	0	75	151			
391C	0	0	24	1189	58936	72994	Fujimi
391D	0	0	69	261			
393	0	0	0	862	265000	660000	Prison
393A	0	0	51	444			
393B	0	0	0	700			
398	0	0	0	0			
398A	0	0	0	0			
400	34	0	0	46			
400A	976	1025	283	463			
400B	0	0	0	0			
400C	316	0	0	0			
400D	0	0	0	0			
400E	0	0	0	0			
401	0	0	0	0	11606	108610	New elementary school
401A	0	0	0	0			
520	1070	606	0	67			
Total	**6047**	**6123**	**3185**	**28987**			
	SFR	**MFR**	**Retail**	**Non-Retail**	**ADD Special Water Use (gpd)**	**PDD Special Water Use (gpd)**	**Total (gpd)**
Average Day Consumption (gpd)	1,514,775	967,018	752,249	3,276,856	578028		7,108,927
Average gpcd or gpud	251	161	236	44			
Adjust For Equivalent of 2 - 1.0 MGD ADD Industrial Users by 2020				69			
Maximum Day Consumption (gpd)	5,235,714	2,298,967	2,133,182	8,350,198		1999488	20,017,549
Maximum gpcd or gpud	866	375	670	112			
Adjust For Equivalent of 2 - 2.55 MGD PDD Industrial Users by 2020				176			

Table 3-5
Annual Peak Day Demand Projections to Year 2022

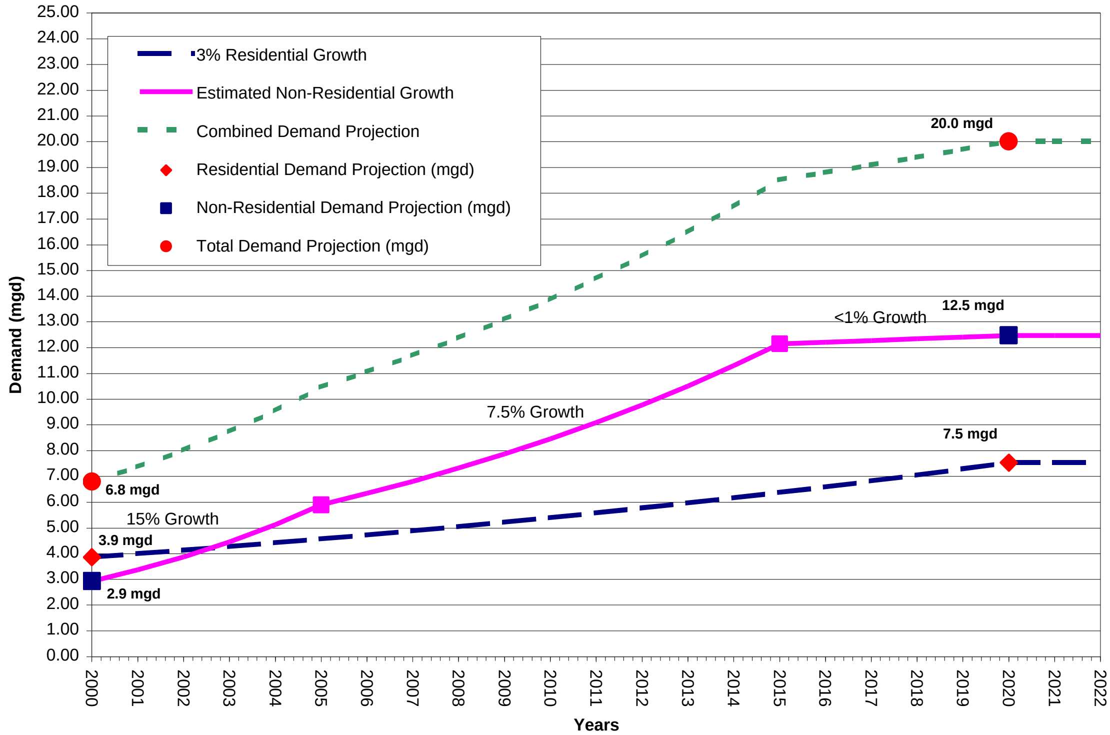
Projected Year	3% Residential Growth	Estimated Non-Residential Growth	Combined Demand Projection
2000	**3.87**	**2.93**	**6.80**
2001	4.00	3.37	7.37
2002	4.14	3.88	8.01
2003	4.28	4.46	8.73
2004	4.42	5.13	9.55
2005	4.57	5.89	10.47
2006	4.73	6.34	11.06
2007	4.89	6.81	11.70
2008	5.05	7.32	12.37
2009	5.22	7.87	13.10
2010	5.40	8.46	13.86
2011	5.58	9.10	14.68
2012	5.77	9.78	15.55
2013	5.97	10.51	16.48
2014	6.17	11.30	17.47
2015	6.38	12.15	18.53
2016	6.59	12.22	18.81
2017	6.82	12.28	19.10
2018	7.05	12.35	19.40
2019	7.29	12.41	19.70
2020	**7.54**	**12.48**	**20.02**
2021	**7.54**	**12.48**	**20.02**
2022	**7.54**	**12.48**	**20.02**

Table 3-6
Maximum Day Water Demand by User Type

	2000 Unrestrained Peak Day Demand (mgd)	2020 Peak Day Demand (mgd)	Rate of Increase (%/yr)
Single Family Residential	2.56	5.24	3.6
Multi Family Residential	1.31	2.30	2.9
Commercial	1.36	2.13	2.3
Industrial	1.25	8.35	10.0
Special Use	0.32	2.00	9.6
Total	**6.80**	**20.02**	**5.5**
Total Residential	3.87	7.53	3.4
Total Non Residential	2.93	12.48	7.5

Note: Water demands based on City population and unrestrained water demand projections

Figure 3-1
Projected Unrestrained Peak Day Demand by Rate of Growth and User Type



WILSONVILLE WATER TREATMENT PLANT
view from parking lot

Exhibit 7

Section 4 - Planning Criteria

SECTION 4 - PLANNING CRITERIA

This Section presents the planning and analysis criteria that are recommended for the evaluation of the existing facilities and in planning any new facilities for the City of Wilsonville. It must be recognized that these planning criteria are not precise rules but simply standards by which the water system can be rated for the purposes of planning capital improvement and capital maintenance projects under most circumstances. The City should review its Public Works Standards and determine whether changes are appropriate to it once this Water System Master Plan has been adopted.

PLANNING CONTEXT

The City's Comprehensive Plan provides a context within which this Master Plan has been developed. The primary goal of the Water Master Plan is derived from Wilsonville's Comprehensive Plan Goal 3.1 providing for infrastructure in general and is as follows:

"To assure that good quality public water supply and distribution facilities are available with adequate but not excessive capacity to meet community needs, while also assuring that growth does not exceed the community's commitment to provide adequate facilities and services."

The Comprehensive Plan also provides the following policies that were used to guide this master plan update:

Comprehensive Plan Policy 3.1.1. The City of Wilsonville shall provide public facilities and services to enhance the health, safety, educational and recreational aspects of urban living.

Comprehensive Plan Policy 3.1.2. The City of Wilsonville shall provide, or coordinate the provision of, facilities and services concurrent with need (created by new development, redevelopment, or upgrades of aging infrastructure.)

Comprehensive Plan Policy 3.1.3. The City of Wilsonville shall take steps to assure that the parties causing a need for expanded facilities and services, or those benefiting from such facilities and services, pay for them.

Comprehensive Plan Policy 3.1.5. The City of Wilsonville shall continue to develop, operate and maintain a water system, including wells, pumps, reservoirs, transmission mains and a surface water treatment plant capable of serving all urban development within the incorporated city limits, in conformance with federal, state, and regional water quality standards. The City shall also continue to maintain the lines of the distribution system once they have been installed and accepted by the City.

Additional policies, and the implementation measures necessary to carry out those policies, were developed specific to the water system and are listed in Section 10.

PLANNING PERIOD

This Water System Master Plan considers five planning horizons to the year 2020, which is the year of projected ultimate buildout for water use. This Master Plan has identified deficiencies of the existing water system as well as deficiencies that may occur during the City's growth. A detailed system evaluation has been conducted for the current and projected population and water use to the year 2020. A Capital Improvement Program (CIP) has been developed based on these growth projections, and appropriate staging of required system improvements corresponding to incremental levels of growth have been made. The impacts of growth and development relative to long-term water supply needs have been determined.

The population and water demand forecasts for 2001, 2005, 2010, 2015, and 2020 planning horizons are given in Sections 2 and 3, respectively. While the year 2020 is used throughout this Water System Master Plan in discussions of the planning period, the year should be viewed as a proxy for the population and water demand forecast that are associated with it. That is, improvements should be timed based on the actual population and water demand growth that occurs, as opposed to the specific years listed in the projections made in this Water System Master Plan.

PLANNING AREA

Service Area

Currently the City of Wilsonville's incorporated area includes approximately 4,365 acres located 18 miles south of Portland. This area includes the 512-acre Charbonneau District south of the Willamette River. The City water system currently serves two areas outside the current City UGB including the I-5 rest area south of the City, and the new State of Oregon Correctional Facility (currently undergoing annexation) in the northwest. By year 2020 it is assumed that all future planning areas will be annexed into the City and all developable land will be developed and included in the UGB.

Future Planning Areas

METRO previously identified seven areas bordering the City of Wilsonville's current UGB as areas of potential future urban growth. These future planning areas include METRO Areas **35** – 72.0 acres, **36** – 32.0 acres, **37** – 145.2 acres, **39** – 18.4 acres, **41** – southern 272.6 acres and northern 145.0 acres, and **42** – 326.4 acres as shown in Figure 2-3. The boundaries of these planning areas are subject to change, but the assumptions regarding acreage and land use have been utilized in this plan to reserve capacity for what is ultimately approved for annexation by the City Council. Some preliminary land use planning has been performed for the North Wilsonville

Industrial Area (Area 42) and the Dammasch Area (southern portion of Area 41). Area 39 and the southern portion of Area 41 have been recently approved for incorporation into the Wilsonville UGB.

PLANNING CRITERIA

The driving objective for the Willamette River water treatment plant is to produce the highest quality drinking water in the region. As such, stringent finished water quality goals are as follows:

A. Ensure the highest level of public health protection.
B. Ensure consistent compliance with drinking water regulations well into the future.
C. Provide aesthetically acceptable and palatable drinking water.
D. Provide a multi-barrier treatment process with the redundancy to provide consistent compliance with drinking water regulations under any potential adverse circumstances.

Similarly, the goals for the well system are as follows:

A. Ensure the highest level of public health protection.
B. Ensure consistent compliance with drinking water regulations well into the future.
C. Provide aesthetically acceptable and palatable drinking water that does not precipitate iron and manganese.
D. Provide water that is fully compatible with and mixes well with the water from the Willamette River water treatment plant.
E. Provide water that will immediately comply with drinking water regulations upon startup of the well.

Service Pressure

The minimum pressure that must be maintained in the system per State of Oregon Health Division (OHD) standards is 20 pounds per square inch (psi) (46 ft). This pressure must be maintained even during a fire flow event on a peak demand day. The existing system has been designed around tank and reservoir elevations that typically provide maximum and minimum service pressures between 100 psi (231 ft) and 40 psi (92 ft) respectively. The typical operating pressures obtained from the existing tanks and reservoirs should be maintained. Each of these pressure conditions will be evaluated with system reservoir/tank levels three-fourths full.

Source

The City is constructing a 15 mgd water treatment plant along the Willamette River for future supply as its primary source. This plant is being constructed in conjunction with the Tualatin Valley Water District. This source will be discussed in further detail in Section 7. The primary source(s) should be capable of supplying peak day demand at firm capacity without water demand curtailment. Firm capacity assumes that the largest component of the water treatment plant is out of service.

If the water treatment plant (primary supply) were to be unavailable, the water system should be able to meet a continuous average day demand from storage, redundant systems, and/or a secondary source or intertie.

Transmission Pipelines

Transmission pipelines are considered pipelines greater than or equal to 12-inches in diameter. Transmission pipeline flow velocities should be less than 5 feet per second (fps) under peak day demand conditions. All water transmission pipelines greater than or equal to 12-inches in diameter should be capable of providing peak day demands without violating this criteria.

Distribution Pipelines

For this master plan, distribution pipeline is considered all pipelines less than 12-inch but greater than or equal to 4-inch diameter. The rating of distribution pipeline is measured against (1) the pipeline's ability to pass the greater of peak hour demands or peak day demands plus fire flow with system reservoirs/tanks three-fourths full, and (2) flow velocity. Flow velocities for distribution pipeline should be below 10 fps under the higher demand conditions. Pressure headloss should be below 10 ft per 1000 ft of pipeline. Minimum pipeline diameter for new distribution pipes with fire hydrants will be 8-inches. Pipeline diameters smaller than 8-inches will be identified as inadequate for fire flow conditions. Any existing pipeline below 8-inches should be upgraded before being equipped with a fire hydrant.

Pressure Reducing Stations

Pressure reducing stations should meet the criteria of supplying the peak hour demand within the continuous flow rating of the valve. The fire flows through a pressure reducing station should be delivered within the intermittent flow rating of the valve.

Pump Stations

Pump stations should be sized for a firm capacity equal to the peak day demand. Firm capacity is defined as the capacity of the pump station with the largest pump out of service. The firm capacity for the well pumps is equal to the well pump capacity if the well has a full backup power supply. If the well does not have a backup power supply then the pump supply is not considered as adding to the firm supply capacity of the system.

For reliability, power supplies to pump stations should have either two sources of primary power feed, or one main source and standby or emergency power. The secondary power supply should be sized so that available pumping capacity is equal to average day demand, or fire flow, whichever is greater.

Storage

Storage facilities in water systems are generally provided for four purposes - equalization storage, operational storage, fire storage, and emergency storage. The total storage required in any tank or reservoir is the sum of these four components plus the dead storage (the volume of the tank that is unavailable to use due to physical constraints). The components of storage are described as follows:

Equalization Storage. This storage is needed in a water system to meet instantaneous water system demands in excess of the transmission/pumping delivery capacity from the supply source to the reservoir. The volume of equalization storage required is a function of supply system capacity, transmission piping capacity between reservoirs and pump stations, and system demand characteristics. Equalization storage is generally less expensive to provide than increased treatment and/or pumping, and/or transmission piping beyond that required to meet maximum day demands. Equalization storage volume should be sufficient to meet demands in excess of the maximum daily demand. Equalization storage volume in the amount of 20 to 30 percent of maximum daily demand is typical, and for this Master Plan, 25 percent of peak day demand is assumed for equalization storage.

Operational Storage. In the future, the City of Wilsonville may need to incorporate the second component of storage, operational storage. Typically operational storage is utilized to take advantage of lower power rates or for specific operational benefits by operating the primary source for part of the day to replenish the stored water and utilizing the operational storage component for source water while the primary source is rested. Currently Wilsonville does not utilize operational storage. If in the future the Wilsonville storage facilities are used with an operational storage component then this option should be included and the required storage should be re-assessed. (The water treatment plant clearwell, a storage reservoir built into the treatment process, supplies operational storage for the water treatment plant and is not included in the City's storage inventory.)

Fire Storage. Fire storage is provided to meet the single most severe fire flow demand within the system or pressure zone served by the storage facility. The fire storage volume required is determined by multiplying the fire flow rate by the duration of that flow.

Residential fire flows are 1,500 gpm for 4 hours and can be applied at any fire hydrant in the pressure zone. Commercial, industrial, and multi-family fire flows can be applied at any fire hydrant within areas that have appropriate land use zoning and is specific to the zoning and actual facilities in place. An ultimate fire flow of 3000 gpm for 4 hours will be used to size this component of storage for planning purposes.

Emergency Storage. This storage is provided to supply water from storage during emergencies such as power outages, equipment failures, pipeline failures or natural disasters. The amount of emergency storage provided can be highly variable and is dependent upon an assessment of risk and the desired degree of system reliability. Its primary function should be to provide water until the emergency supply can be activated. Detailed vulnerability analysis and risk assessments are not within the scope of this study. The City of Wilsonville currently utilizes emergency storage criteria equal to two days of average day demand, for each pressure zone.

It is highly desirable that storage be provided within at least two separate storage reservoirs to provide for continuing operations during maintenance, repairs or reconstruction or modifications to any single reservoir. Currently the City meets this criterion in the main Level B pressure zone, and can meet this in the newly established Level C zone through an intertie to the City of Tualatin. For this analysis, the multiple tank criteria has not been considered. This analysis concentrates more on the total storage volume and delivery capacity not on the number and location of storage facilities.

Summary of Storage. Based on the above storage criteria, the required storage in each pressure zone will consist of 25% of projected peak day demand for equalization plus the fire flow demand plus two average days demand for emergencies. A storage volume can be assigned to the wells that have backup power available. Currently the Charbonneau well system, Nike, Elligsen, and Boeckman wells have backup power and therefore provide a storage benefit to the year 2005. It is recommended that the City install backup power to the Wiedeman, Canyon Creek, and Gesellshaft wells by year 2005 in the Capital Improvement Program (see Section 9). Therefore, beyond the year 2005 all 8 wells are assumed to be able to provide a storage benefit.

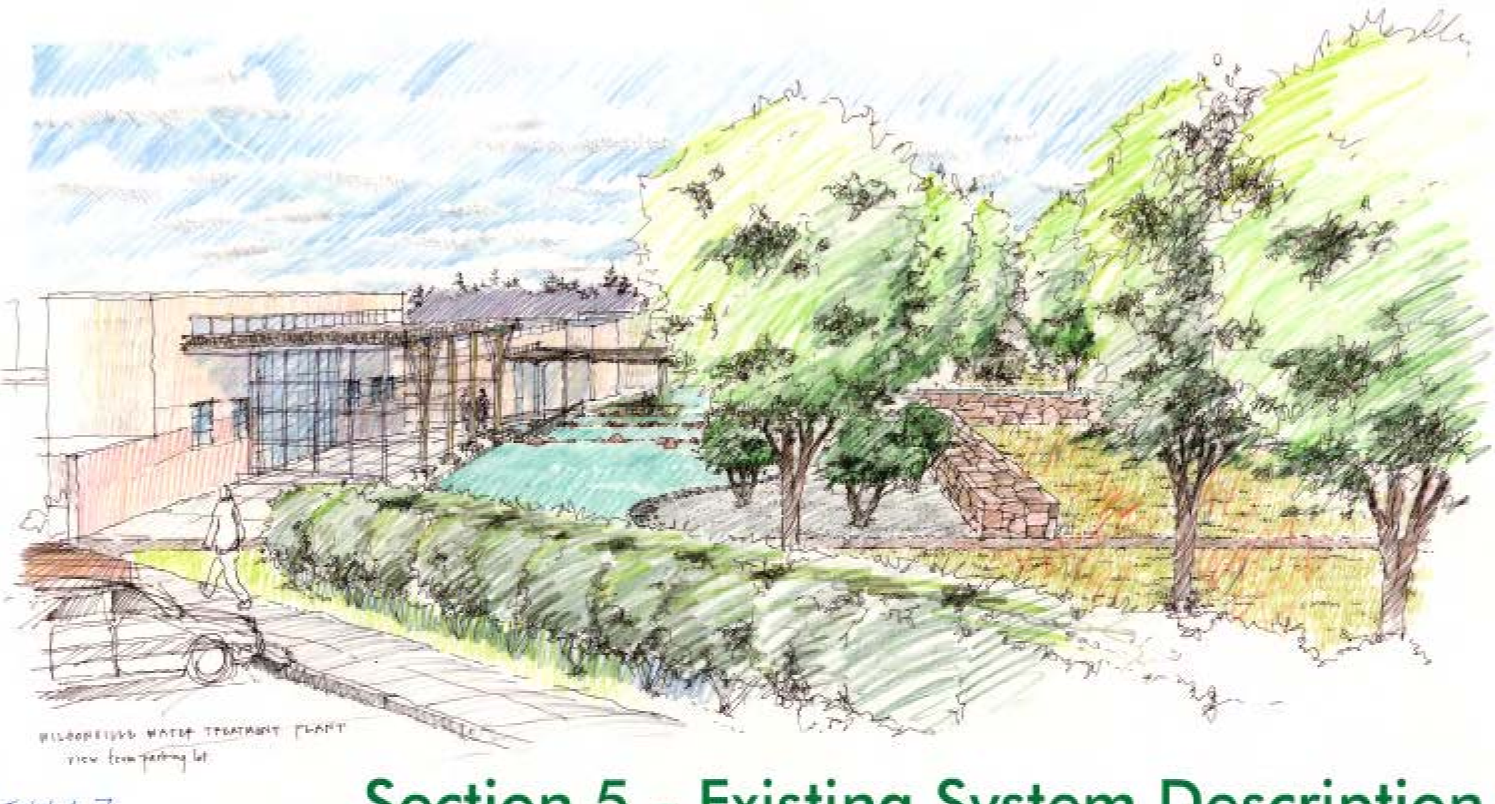


Exhibit 7

Section 5 - Existing System Description

SECTION 5 - EXISTING SYSTEM DESCRIPTION

Water for the City of Wilsonville is currently supplied by eight wells located throughout the City. These wells tap the Columbia River Basalt Aquifer that underlies the City. Typically, these basalt aquifers consist of fractured layers formed between numerous lava (basalt) flows that occurred many years ago. Evidence has shown that this aquifer recharges at a very slow rate by snowmelt and rain seeping through the ground eventually reaching the aquifer.

Wilsonville's water system includes the following main components:

- Eight groundwater production wells,
- Hypochlorite (disinfection) and polyphosphate (sequestering agent) injection at each of the wells,
- Approximately 66 miles of pipeline including 24 miles of transmission pipeline,
- Four reservoirs with a total storage capacity of 7.95 MG

Refer to Figure 5-1 for locations of the City's wells, booster pump stations, and reservoirs and Table 5-1 for address locations for each.

Table 5-1
Facility Locations

Facility Name	Location
Elligsen Well	7600 SW Elligsen Road
Elligsen Reservoir A (2.2 MG)	7600 SW Elligsen Road
Elligsen Reservoir B (3.0 MG)	7600 SW Elligsen Road
Weideman Well	26440 SW Parkway Avenue
Gesellschaft Well	29001 SW Meadows Parkway
Nike Well	7524 SW Kolbe Lane
Canyon Creek Well	7955 SW Boeckman Road
Charbonneau Booster Pump Station	8774 SW Illahee Court
Charbonneau Reservoir (0.75 MG)	8774 SW Illahee Court
Boeckman Well	28011 SW Boones Ferry Road
Level B Booster Pump Station	7610 SW Elligsen Road
Level B Reservoir (2.0 MG)	8249 SW Elligsen Road

SOURCE

The City of Wilsonville holds water right permits on eight groundwater wells and on the Willamette River at the Wilsonville diversion point. The priority date for the well water sources range from 1969 to 1988 and allow for a total combined withdraw of 6,010 gpm (13.4 cfs). The well with the highest permitted flow rate is the Gesellshaft well with a permitted rate of 1500 gpm (3.3 cfs). The Willamette River water right is for 13,500 gpm (30.0 cfs) with a priority date of 1974.

The drinking water supply wells for the City of Wilsonville were constructed between 1970 and 1997. The Elligsen Well was the first to be constructed. As the City has grown, additional wells have been constructed to meet the increasing water demand. The last well, Boeckman Well, was drilled in May of 1997. The current maximum realized pumping rate for the individual wells range from 78 gpm to 666 gpm. A summary of basic well information including date of construction, depth, maximum realized pumping rates and permitted pumping rates are summarized in Table 5-2.

Table 5-2
Summary of Groundwater Development

Well Name	Year Constructed	Permitted Pumping Rate (gpm)
Elligsen	1970	448.5
Charbonneau #2	1977	300.5
Charbonneau #3	1977	49.3
Weideman	1980	717.6
Gesellschaft	1984	1,498.00
Nike	1984	1,000.00
Canyon Creek	1991	995.7
Boeckman	1997	995.7

The combined permitted groundwater right and pumping rate for the eight wells is 8.65 mgd. The maximum realized total pumping capacity of all eight wells is approximately 5.5 mgd and the reliable pumping capacity is 4.6 mgd with one of the larger wells out of service.

The Oregon Water Resources Department (OWRD) has classified the portion of the Columbia River Basalt Aquifer that Wilsonville utilizes as “groundwater limited”. The aquifer recharges at a much slower rate than water is being pumped from it and as a result, the water level in the aquifer has continued to drop over the years. In issuing its permit to Wilsonville for the Canyon Creek / Boeckman wells, OWRD required the City to address conservation and growth management issues. OWRD also informed the City that reliance on this aquifer as a long-term water supply is unacceptable. Wilsonville pursued conservation and growth management efforts which are described in the Water Management and Conservation Plan that has been approved by OWRD. Wilsonville has restricted water usage and development of the distribution system while developing another source of water supply. This is discussed in more detail in Section 7.

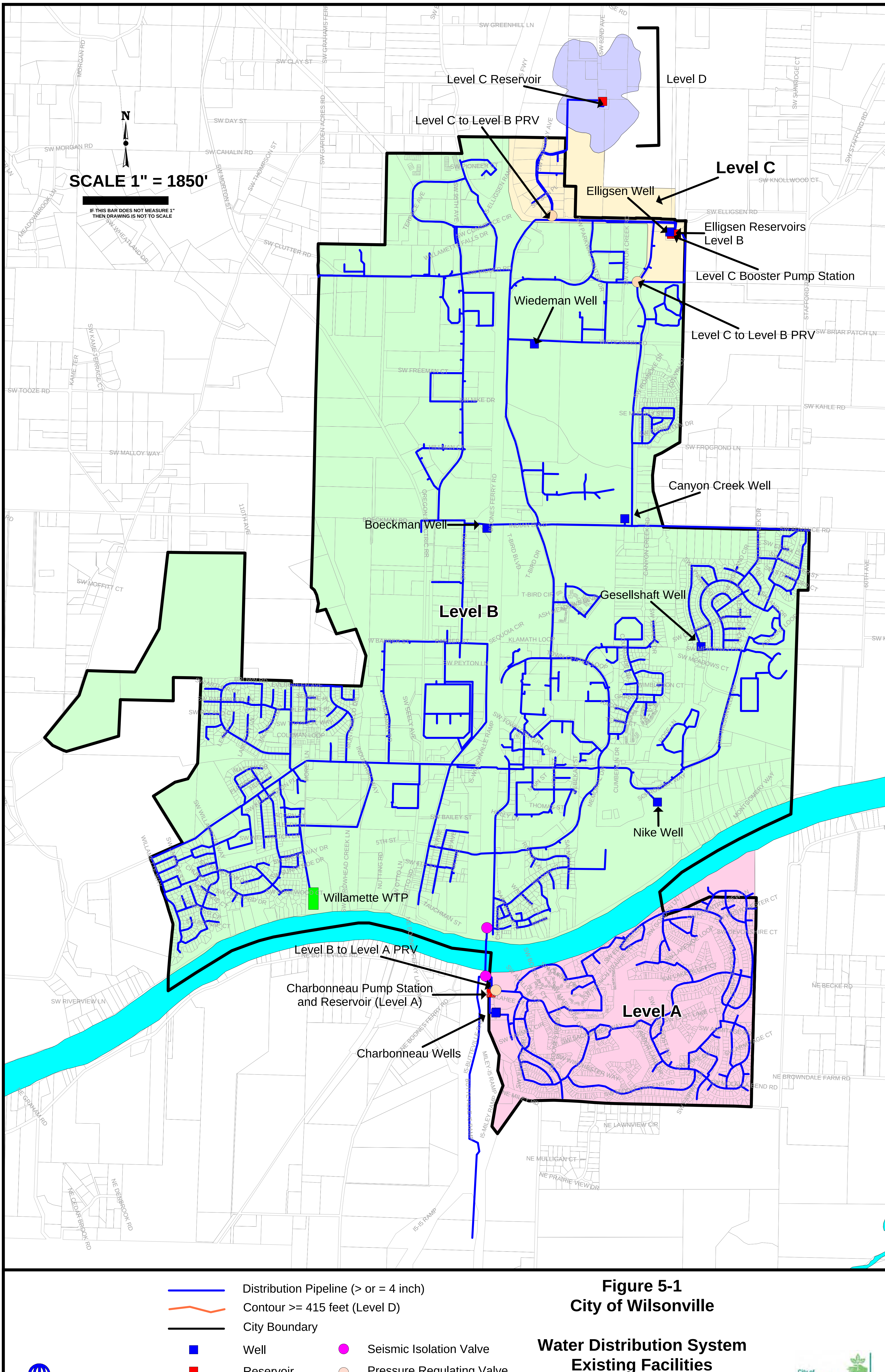


Figure 5-1
City of Wilsonville

Water Distribution System
Existing Facilities

(As of May 2001)

GROUNDWATER QUALITY

As a public water provider, the City of Wilsonville is required by the Oregon Health Division (OHD) to monitor and report the results for more than 100 regulated and unregulated inorganic and organic compounds. In addition, monitoring lead and copper, microbiological, and radiological parameters is also required.

Requirements for monitoring various constituents in the source water and the distribution system vary. The frequency for monitoring of most parameters in the source water is summarized in Table 5-3.

Table 5-3
Monitoring Frequency for Source Water

Source Water: Inorganic/Conventional Parameters	Testing Frequency
Nitrate	Annually
Synthetic Organic Compounds (SOC)	3-year cycle
Unregulated SOC	3-year cycle
Volatile Organic Compounds (VOC)	3-year cycle
Unregulated VOC	3-year cycle
Radiological	4-year cycle

In recent years, the City has met all drinking water standard requirements that the U.S. Environmental Protection Agency (EPA) has determined to establish the safety of drinking water supplies. For more complete information on the City's compliance with drinking water standards, see the Appendix for a copy of the City's *Annual Water Quality Reports*, starting with 1998 when these reports were first published. This report complies with a federal regulation requiring water utilities to provide water quality information annually to its customers. See Appendix A for more complete water quality information.

The City's wells can be characterized as relatively "hard" water from minerals in the water. The City has noticed an increased mineral content in the groundwater over time, likely a result from drawing the water level down in the aquifer.

Several future potential federal drinking water regulations must be considered in relation to the City's wells. Arsenic is currently regulated at 50 ug/L. However, EPA has been considering lowering this standard to between 2 and 10 ug/L. Historical data from the Charbonneau, Elligsen, Gesellshaft and Nike wells showed concentrations of 1.7, 1.6, 1.2 and 2 ug/L, which are at or below the lowest level that EPA is considering.

Radon levels in the City's wells have historically ranged from approximately 100 to 800 pCi/L. For a number of years, EPA has been considering establishing a radon regulation somewhere between 300 pCi/L and 4,000 pCi/L. Test results indicate that radon in the groundwater ranges from 110 pCi/L to 825 pCi/L. Proposals for regulating radon suggest MCLs ranging from 300 pCi/L to 4,000 pCi/L. If EPA were to regulate individual wells at the lower end of the range, the City may have to add treatment at one or more of its wells to remove the radon. Typical treatment for removing radon from groundwater includes aeration or the use of activated carbon.

EXISTING WATER DISTRIBUTION SYSTEM

The distribution system consists of approximately 65.6 miles of pipeline including 23.5 miles of transmission pipeline greater than 12-inch diameter. The City of Wilsonville's distribution system is a relative new system with the majority of the pipeline being ductile iron and installed within the last 20 years. Figure 5-1 shows the Well and Reservoir Locations and Table 5-4 shows the nominal diameters and lengths of the Wilsonville pipeline network.

Table 5-4
Distribution System Pipeline Length by Diameter

Nominal Pipeline Diameter	Length of Pipeline by Diameter	
(inches)	(LF)	(Miles)
<= 4	17,450.0	3.3
6	52,560.0	10.0
8	116,880.0	22.1
10	35,920.0	6.8
12	81,020.0	15.3
14	26,250.0	5.0
16	5,370.0	1.0
18	11,160.0	2.1
>18	0.0	0.0
Total	**346,610.0**	**65.6**

Currently, the City's water system is divided into three pressure zones. The Level C pressure zone is supplied water through a booster pump station located at the Elligsen Reservoir site. The C Level is located in the Northeast portion of the distribution system and is the smallest of the three pressure zones. The booster pump station to Level C draws water from Level B at approximately 400 ft and delivers water to the Level C Reservoir that has an overflow water surface elevation of 507.5 feet. The Reservoir volume, diameter, bottom elevation, over flow elevation, and type are shown in Table 5-5.

Table 5-5
Reservoir Information

	Volume (MG)	Diameter (ft)	Bottom Elevation	Overflow Elevation (ft)	Type
Elligsen B-1	2.2	83.2	345.7	399.7	At Grade Steel
Elligsen B-2	3.0	101.0	350.0	400.5	At Grade Steel
Charbonneau A-1	0.8	80.0	100.0	120.0	Buried Concrete
Elligsen C-1	2.0	87.5	463.0	507.5	At Grade Steel

The Level B pressure zone contains all the production wells for the City. Each well is equipped with a pump to boost flow to the Elligsen Reservoirs. However, the Charbonneau wells are pumped from the well to an intermediate reservoir with an over flow water surface level of 120 feet which is Level A. From this intermediate Level A reservoir the water is boosted into the Level B distribution system to the Elligsen Reservoirs. The Charbonneau district located south of the Willamette River is provided flow through a pressure reducing station from Level B.

A proposed Level D is recommended in Section 9 as part of the Capital Improvement Program. The proposed Level D pressure zone will be an "on demand" pumping system servicing development above elevation 415. Water will be boosted from the Level C reservoir into level D.

DISTRIBUTION SYSTEM QUALITY

As a public water supplier, the City of Wilsonville must comply with the drinking water regulations administered by OHD. The City completes all the distribution system monitoring required by OHD as well as additional tests that are needed to confirm adequate operation of the system. Monitoring requirements for the distribution system varies as shown in Table 5-6.

Table 5-6
Monitoring Frequency in the Distribution System

Parameter	Testing Frequency
Distribution System: Lead/Copper	3-year cycle
Routine Microbiological	Monthly
Trihalomethanes (THM)	Quarterly
Chlorine Residual	Daily/monthly

Since Wilsonville began monitoring for lead and copper in November 1992, all monitoring results have met the requirements of the Lead and Copper Rule. The lead and copper "Action Levels" established by the EPA are 0.015 mg/L for lead and 1.3 mg/L for copper for the 90th percentile of the samples taken. The Rule requires samples to be taken from customers' taps of a select pool of homes within the City that meet the requirements described in the Rule. Detected levels of lead and copper are generally from corrosion of household plumbing in the distribution system. These constituents are monitored on a three-year cycle.

Prior to 1996, the City of Wilsonville was not required to provide disinfection in the distribution system. However, bacteriological violations in 1994 and 1995 triggered the need to disinfect the groundwater. Bacteriological testing includes distribution coliform samples taken on a monthly basis. OHD requires ten bacteriological samples to be taken in the system. Wilsonville routinely collects sixteen samples monthly. Eight sites are sampled during the first part of the month and eight sites are sampled during the last part of the month. In 1994, the City had several positive coliform test results. Routine repeat samples were taken and again in 1995 test results indicated the presence of coliform bacteria. A sanitary survey conducted in mid-1995 indicated that bacteria were associated with the distribution system, not the groundwater supply. By 1996, the City had implemented a chlorination system at each well to provide the required disinfection in the distribution system. The City has been in compliance with the coliform rules since 1996 when sodium hypochlorite was added to the system.

With the addition of chlorine to the system, the City is required to monitor for trihalomethanes (THMs). Monitoring for THMs in the distribution system is conducted quarterly. The yearly average is used to determine compliance to the requirements. THMs are disinfection byproducts formed when chlorine is added to the water. The current MCL for total trihalomethanes (TTHMs) is 80 ug/L. Over the past three years, the average value for TTHMs has been 9 ug/L. The highest value recorded was 28.9 ug/L. New regulations will require localized averages rather than system wide averages.

The Stage 1 Disinfection Byproducts Rule also targets a group of five chemicals, Haloacetic acids (HAA5). The rule establishes an MCL of 60 ug/L that must be met by December 2001. Anticipating the new regulation, the City monitored HAA5s. This monitoring showed rare occurrence of detectable HAA5s. Of the 5 analyses with detectable levels, the highest HAA5 was 4 ug/L. OHD informed the City that they did not need to monitor HAA5s any more at this time.

Chlorine residual measurements are taken in the distribution system on a daily and monthly basis. Typically, chlorine residuals in the distribution range from 0.3 to 0.5 mg/L. This varies with the seasons and which wells are being used. Low chlorine residuals measured in the field are around 0.2 mg/L.

TREATMENT OF GROUNDWATER

As previously mentioned, prior to 1996 the City of Wilsonville was not required to treat the groundwater. But during the years 1994 and 1995, monthly bacterial monitoring results indicated violations that triggered the need to disinfect the water in the distribution system. In 1996, the City implemented the addition of chlorine at each of the wells. Chlorine is provided to the distribution system by liquid sodium hypochlorite. Field tested chlorine residual in the distribution system is generally between 0.3 and 0.8 mg/L.

While the addition of chlorine has addressed the bacteriological inadequacies in the distribution system, it has also triggered other events including the precipitation of iron and manganese in the system. The rust-colored sediments inside the pipes have resulted in many “brown water” complaints by customers. In addition to visual color complaints, the precipitated material can clog filters, and stain porcelain fixtures and laundry. Iron and manganese were always present in the water, but posed no aesthetic problem until chlorine was added. The addition of chlorine oxidized the iron and manganese in the distribution pipeline which formed iron and manganese particulate. The iron and manganese particulate were subsequently noted by customers at the tap as discolored water.

To address the color issues regarding iron and manganese, the City decided to add a sequestering agent to the water that would bind with the iron and manganese to keep it in solution, thus reducing the "brown water" effects. The sequestering agent is a polyphosphate product and is commonly used in water treatment systems for this purpose. The City started the addition of the polyphosphate in July 1999. Monitoring results following the addition of the polyphosphate indicated an immediate reduction in visible color (measured in color units). Prior to the addition of polyphosphate, color units in the distribution system ranged between 40 and 100. After the addition of the polyphosphate, the color units monitored in the system are typically around 10. Customer complaints have been reduced significantly as well. In addition, the Nike and Charbonneau wells had been experiencing sulfur odor problems. Since the addition of polyphosphate, the sulfur odor and discolored water problems have been significantly reduced.

WILSONVILLE WATER TREATMENT PLANT
view from parking lot

Exhibit 7

Section 6 - Facilities Evaluation

SECTION 6 - FACILITIES EVALUATION

The City of Wilsonville's water system has been described in Section 5. Several techniques were used to evaluate the water distribution system. These methodologies included field inspection of key facilities; a comparison of key facilities to the planning criteria; the utilization of a hydraulic model; and a review of previous studies and reports. The results of these evaluations are given in this section. Capital improvements and other recommendations based on this evaluation are given in Sections 9.

FIELD OBSERVATION OF KEY FACILITIES

As with any water system, on-going operations and maintenance efforts are required to keep the system functioning. As time goes by, elements such as motors and control systems, valves and coatings can wear out or become obsolete, thus reducing the effectiveness and overall efficiency of the distribution system. In order to evaluate the current condition of some of the key components of the City's water system, qualitative, field observations were conducted on key elements by Montgomery Watson Harza. Input was also obtained from the City water operations personnel who accompanied Montgomery Watson Harza on the field observations.

The purpose of the field observations were to observe the general condition of the facilities and to provide recommendations for potential improvements that should be included as part of the Capital Improvement Program. The observations reflect conditions as noted at the time of the fieldwork, March 2001. The observations are not intended to be a detailed evaluation, a safety inspection, or to serve any other purpose. The results of the field observations are summarized below.

PUMP STATIONS AND GROUNDWATER WELLS

Each well and pumping facility was evaluated for level of maintenance, functionality, safety, and operating efficiencies. Overall the wells and pump stations are currently in good working order and appear to be operating efficiently. Also, the proper facilities and signage for safety are present.

Several observations were made. The Boeckman Well was installed in 1996 and has not produced design flows. It is recommended that each pump and motor be evaluated and in-situ (in place) pump rating curves be developed for each well.

The emergency startup and shutdown of the Charbonneau booster pump station should be reevaluated for possible engineered improvements. The pump station improvements should allow the pumps to come on and off line without introducing significant pressure and/or surge conditions in the localized distribution pipeline, and should allow the fire flow pumps to operate in tandem with the existing service pumps.

Reservoirs

Each storage facility was evaluated for seismic restraint, condition of the coating system, structural integrity, access hatches, underdrain systems, and overflow drain systems.

Three of the four of the City's reservoirs have been evaluated for seismic stability. Recommendations for seismic restraints have or are scheduled to be implemented. They included seismic isolation valves and seismic restraints along the reservoir footing.

The external coating system for each reservoir appeared to be in good condition. It is recommended the Elligsen Reservoirs and Charbonneau Reservoir be internally inspected and cleaned. It is also recommended that a tank maintenance program be implemented that will include internal and external inspection, cleaning and re-coating if necessary every 10 years. All tanks appeared to be structurally sound and capable of supporting current loading conditions. The Charbonneau Reservoir did have some exterior cracking that should be watched and repaired when necessary to prevent potential leakage. For each reservoir, access hatches and ladder systems appear to be in good repair and meet current safety standards.

It is recommended that a permanent de-chlorination vault be installed at the Charbonneau Reservoir to treat flow before discharging to the local storm water drainage system. As the City begins to fluctuate the storage volume in the reservoirs after the WTP is brought on line, a measure of the chlorine residual at each storage facility will help fine tune the operational strategy.

RECOMMENDED IMPROVEMENTS

It is recommended that the following projects and evaluations be made to improve system reliability and efficiency:

- Evaluate booster pump stations and well head pumps for rated conditions and efficiency;
- Locate and install continuous monitoring of chlorine residual at each reservoir.
- Evaluate the emergency startup and shutdown of the Charbonneau Booster Pump Station;
- Develop a 10 year cyclical maintenance program for all reservoirs including internal and external inspection and re-coating ;
- Install a permanent de-chlorination vault at the Charbonneau reservoir.

COMPARISON OF KEY FACILITIES TO PLANNING CRITERIA

The City of Wilsonville's water system was evaluated with respect to the planning criteria described in Section 4 of this Master Plan. The results of this evaluation are presented in the following sections.

A COMPARISON OF SOURCE TO PLANNING CRITERIA

Peak Day Supply

The main source of supply for the City should be capable of providing the projected peak day demand. It should meet this demand with firm capacity - that is, with the largest component of the system out of service.

The current primary source of supply is groundwater. The ultimate capacity of the City's groundwater supply is 5.5 mgd. The largest single component of the groundwater system is the Weideman Well, with a capacity of 0.96 mgd. If the system were operated with its largest component (Weideman Well) out of service, the total supply would only be 4.6 mgd.

The estimated uncurtailed peak day demand in hot weather for the year 2000 population was 6.8 mgd (see Section 3). Therefore, the firm capacity of the existing supply is not capable of meeting peak day demand. The actual curtailed peak day demand in 2000 was 4.8 mgd, much lower than the planning estimated demand. A firm well capacity of 4.6 mgd still identifies a deficiency in pump station capacity. Projected peak day demand at 2020 is 20.0 mgd. To meet projected peak day demands by the year 2020, the City will need to develop an additional 15.4 mgd of firm source capacity. This would increase the City's firm capacity to 20.0 mgd.

The City of Wilsonville is currently constructing a water treatment facility on the Willamette River. The facility includes a raw water intake and pump station, treatment works and a finished water pipeline. The City currently holds an unperfected 20 mgd water right with a priority date of 1974 along the Willamette River at the Wilsonville diversion point. The City has recently been granted a 40 year water right extension for certification. The Willamette plant will have an initial capacity of 15 mgd and is anticipated to be operational by April of 2002. The City of Wilsonville's share of the initial 15 mgd capacity is 10 mgd. Five (5) mgd is allotted to Tualatin Valley Water District (TVWD). Based on the growth projections developed as part of this Master Plan, this initial 10 mgd plant capacity will be adequate to meet the City's needs until approximately 2005. After 2005, the City will need to develop additional supply capacity, ultimately reaching its projected buildout water demand of 20 mgd by 2020.

In order to meet long-term demands to 2020, it is recommended that the City expand the Wilsonville water treatment plant facility around 2015. In addition, it is recommended that the City explore Aquifer Storage and Recovery (ASR) as a means to reduce the size of the required plant expansion. Once the Willamette WTP comes on line and provides a source of off-peak season water, ASR may be possible to develop. A reasonable target for the ASR program would be to provide 5 mgd of peak season supply, or an amount equivalent to the City's current groundwater production. The ASR program would store more-plentiful winter water in the underground aquifer, and would withdraw this supply during the peak season. Source supply is discussed in more detail in Section 7.

EMERGENCY SUPPLY

It is recommended that the City maintain an emergency source of supply that is capable of providing average day demand for the length of time that the primary source of supply is out of service, such period lasting up to a week. Currently the primary source is the Well system; however in April 2002 the primary source will be the Willamette WTP. Therefore, this emergency source could be provided through a combination of wells, reservoir storage, or an intertie.

Current average day demand is approximately 2.5 mgd. By the year 2020 (buildout), average day demand is forecast to increase to 7.1 mgd, which is what the City's emergency supply should ultimately be able to deliver. The secondary source (Well System) is currently limited to a firm capacity of 4.6 mgd and a maximum realized capacity of 5.5 mgd. It is recommended that the City develop a one average day (7.1 mgd) emergency supply through a combination of interconnections with neighboring water providers, installation of emergency generators at Weideman, Canyon Creek, and Gesellshaft wells and upgrading the well system to utilize the full permitted groundwater right of 8.65 mgd.

In July 2001 the City installed an emergency supply interconnection with the City of Tualatin. This system intertie will allow either jurisdiction to supply the other up to 1 mgd for reservoir maintenance or emergency supply.

CHARBONNEAU SERVICE AREA

The Charbonneau service area is given special consideration relative to emergency supply. Charbonneau is located south of the Willamette River and is connected to the Level B pressure zone by a single 14-inch connection that crosses the Willamette River at the I-5 bridge. Therefore, this 14-inch connection to the primary elevated storage (Elligsen Reservoirs) and source water supply (WTP) in Level A puts the Charbonneau service area at a higher risk of losing its primary source.

The Charbonneau area is equipped with two wells, 0.75 MG of at grade storage, and a booster pump station. The wells have a realized firm capacity greater than 300 gpm and the booster pump station has a realized firm capacity of 1225 gpm. The 2020 Average Day Demand for the Charbonneau service area is 257 gpm. If the primary source supply were to be taken off line, the Charbonneau service area will be able to satisfy the two times projected average day demand emergency supply criterion from the well supply, at grade storage, and booster pump station for approximately 2.5

days. The Charbonneau service area can supply the projected average day demand indefinitely from the well supply.

COMPARISON OF STORAGE TO PLANNING CRITERIA

Based on the planning criteria presented in Section 4 of this Master Plan, the required storage will consist of 25% of projected peak day demand for equalization, plus the fire flow demand, plus two average day demand for emergency storage. For each well with emergency backup power, a storage volume equivalent to the realized maximum capacity for one day has been assumed.

Four alternatives have been considered in the storage evaluation. Using the four components of storage described in Section 4 each alternative is described in Table 6-1.

Table 6-1
Storage Alternatives

Alternative	Equalization Storage	Operational Storage	Emergency Storage	Fire Flow Storage
A	25% of Peak Day Demand	None	2 Average Day Demand minus 3 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
B	25% of Peak Day Demand	None	2 Average Day Demand minus 6 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
C	25% of Peak Day Demand	66% of Average Day Demand	2 Average Day Demand minus 3 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
D	25% of Peak Day Demand	66% of Average Day Demand	2 Average Day Demand minus 6 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours

Option B is the recommended criteria and considers all wells contributing to storage. Therefore, it is assumed that all wells will have backup power and be available under an emergency supply scenario. The Wiedeman, Gesellshaft, and Canyon Creek wells require backup power to satisfy this condition. The Charbonneau well system has been given special consideration in its contribution to storage. The Charbonneau Wells #2 and #3 supply the Charbonneau Reservoir. Water from the Charbonneau Reservoir is boosted into the distribution system. The Charbonneau Booster Pump Station has a higher firm capacity than the Charbonneau wells and therefore this Charbonneau system operating continuously at firm capacity would only be able to continuously supply water for approximately 13.5 hours before depleting the reservoir volume. To refill the Charbonneau Reservoir would take approximately 33 hours if only the wells were utilized. Recovery could happen much faster if flow were allowed to bypass the Charbonneau Booster Pump Station and fill the reservoir.

Option A is similar to Option B, but only considers the influence of the Boeckman, Elligsen, Charbonneau, and Nike wells on the required storage volume. These wells currently have backup power. Options C and D consider an additional storage component that relates to the operation of the water treatment plant, which is 2/3 of one average day equivalent storage in lieu of 8 hours of water treatment plant capacity. However, the initial capital cost of the additional storage volume required for option C or D would be difficult to justify relative to saving in plant operating cost.

Table 6-2 illustrates storage requirements under all four alternatives. The total system-wide storage deficit becomes 6 million gallons at 2020 with no intertie for Option B. There would not be a storage deficit if a one average day interconnection can be made to a neighboring water supplier. Additional Reservoir storage of approximately 6.0 MG has been included in the Capital Improvement Program. The estimated total cost of the storage tank(s), land, and pipelines associated with this additional storage will be approximately $8,157,600.

COMPARISON OF PUMPING FACILITIES TO PLANNING CRITERIA

The following planning criteria were used to identify deficiencies in pump stations:

- Sized for firm capacity equal to peak day demand;
- Two sources of power supply, or one main source and standby/emergency power; and
- Secondary source has enough capacity to pump average day demand or fire flow, whichever is greater.

A summary of the pumping facilities for the City of Wilsonville are presented in Table 6-3. The rated firm capacity indicated in the Table is the design capacity of the pump station with the largest pump out of service. The realized firm capacity is different from the nominal because pumps will be operated at different points on their operating curve. The Table also includes the rated ultimate capacity of each pump station.

Table 6-4 summarizes the ability of existing pumping facilities to meet projected peak day demands at buildout. The capacities of the existing wells do not meet the above criteria. When the new primary source comes on line, the WTP High Service Pump station along with well supply will meet the pumping criteria for the projected peak day water demand to the year 2020.

It is recommended that backup power be included at the Weideman, Canyon Creek, and Gesellshaft Wells to satisfy the backup power criterion and supplement the emergency storage volume.

COMPARISON OF PIPELINES TO PLANNING CRITERIA

Approximately 5% of the City's distribution system consists of pipeline less than 6 inches in diameter and 15% of the distribution system consist of pipeline equal to 6-inch diameter. These pipelines do not meet the planning criteria defined in Section 4 for fire flow service. These pipeline have not been included in the Capital Improvement program, but should be identified as fire flow restricted pipeline, and therefore, hydrants or fire service should not be permitted along these pipelines.

Table 6-2
Storage Analysis

	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)	Fire Flow Demand (gpm)	4 Wells (Measured) Operating (gpm)	8 Wells (Measured) Operating (gpm)	Required Storage (MG)	Storage Surplus / (Defecit) (MG)
2000	1736.0	4722.0	11806.0	3000.0	2834.0	4720.0		
Option A							4.1	3.8
Option B							1.4	6.6
Option C							5.8	2.2
Option D							3.1	4.9
2005	2567.0	7271.0	18177.0	3000.0	2834.0	4720.0		
Option A							7.4	0.5
Option B							4.7	3.2
Option C							9.9	(1.9)
Option D							7.2	0.8
2010	3187.0	9011.0	22528.0	3000.0	2834.0	4720.0		
Option A							9.8	(1.9)
Option B							7.1	0.8
Option C							12.9	(4.9)
Option D							10.2	(2.2)
2015	3964.0	11181.0	27951.0	3000.0	2834.0	4720.0		
Option A							12.9	(4.9)
Option B							10.1	(2.2)
Option C							16.7	(8.7)
Option D							13.9	(6.0)
2020 (Buildout)	4937.0	13903.0	34757.0	3000.0	2834.0	4720.0		
Option A							16.6	(8.7)
Option B							13.9	(6.0)
Option C							21.4	(13.4)
Option D							18.7	(10.7)

Option A = (2*ADD+ 0.25*PDD - (3 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option B = (2*ADD+ 0.25*PDD - (6 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option C = (2*ADD+0.25*PDD+2/3*ADD - (3 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option D = (2*ADD+0.25*PDD+2/3*ADD - (6 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours

Table 6-3
Pump Station Characteristics

	Realized Maximum Capacity (gpm)	Rated Ultimate Capacity (gpm)	Rated Firm Capacity (gpm)	Total Installed HP (HP)	Installed Pumps	Backup Generator	Comment
Elligsen Well	520	500	500	100	1 Pump Submersible	Yes	
Wiedeman Well	666	720	0	75	1 Pump Vertical Turbine	No	
Canyon Creek Well	596	700	0	125	1 Pump Submersible	No	
Boeckman Well	435	600	600	125	1 Pump Vertical Turbine	Yes	
Gesellschaft Well	624	700	0	125	1 Pump Vertical Turbine	No	
Nike Well	654	700	700	150	1 Pump Vertical Turbine	Yes	
Charbonneau Well #2	300	240	240	15	1 Pump Submersible	Yes	
Charbonneau Well #3	78	60	60	5	1 Pump Submersible	Yes	
Charbonneau Booster Pump Station	1225	2850	1600	190	1 - 40 HP End Suction Centrifugal 2 - 75 HP End Suction Centrifugal	Yes	Assumes 750,000 gallon tank can only supply for 10 hrs. This increases to 13.5 hrs if wells are also running.
Level B Booster	N/A	1650	850	107.5	1 - 7.5 HP End Suction Centrifugal 2 - 25 HP End Suction Centrifugal 1 - 50 HP End Suction Centrifugal	Yes	
WTP High Service Pump Station	N/A	18400	13200	1800	3 - 500 HP Vertical Turbine 1 - 300 HP Vertical Turbine All VFD	Yes	

Fire hydrants should only be installed on pipelines 8-inch diameter or larger. It is recommended that pipelines that service fire hydrants should be part of a looped system in order to deliver adequate fire flow.

Table 6-4
Pump Station Capacity Analysis

	Pressure Zone	Realized Maximum Firm Capacity (gpm)	Required Capacity 2020 Peak Day Demand (gpm)	Pump Station Suplus or (Deficit) (gpm)	Backup Generator
Elligsen Well	Level B	520.0			Yes
Wiedeman Well	Level B	0.0			No
Canyon Creek Well	Level B	0.0			No
Boeckman Well	Level B	435.0			Yes
Gesellschaft Well	Level B	0.0			No
Nike Well	Level B	654.0			Yes
Charbonneau Booster Pump Station	Level A-B	1225.0			Yes
WTP High Service Pump Station*	Level B	13200.0			Yes
Total w/o WTP	Level B	**2834.0**	**13888.9**	**(11054.9)**	
Total w/ WTP	Level B	**16034.0**	**13888.9**	**2145.1**	
Level C Booster*	**Level C**	**850.0**	**694.0**	**156.0**	Yes

* - Using Rated Firm Capacity due to lack of in-situ operating capacity.

SUMMARY AND CONCLUSIONS

Some deficiencies exist in the system under current and projected conditions.

- The firm capacity of the City's groundwater supply is not capable of meeting existing peak daily demand.
- Backup generators will be required at the Weideman, Canyon Creek, and Gesellshaft Wells.
- Current well system pumping facilities are not adequate to meet current and projected peak day demands at firm capacity
- Pipelines 6 inch in diameter and smaller should be identified as fire flow restrictive, and fire flow service should not be permitted off these pipelines. The City has not identified any existing pipeline that violates this criterion. However, if existing small diameter pipelines are found or new pipeline is placed for fire flow service, a minimum 8-inch diameter pipeline should be installed.

These findings form the basis of the capital improvement recommendations presented in Section 9 of this Master Plan. The results of the hydraulic model evaluation provide the basis for additional capital improvement projects, based on current and projected hydraulic deficiencies. The hydraulic modeling results are discussed below.

HYDRAULIC MODEL EVALUATION

The hydraulic model developed for this master plan utilizes the H_2ONET 3.1 software. The model was created and calibrated as part of a separate study and outlined in a report titled “Water System Hydraulic Model Final Report” in November 2000. A brief summary of the model development will be described herein. H_2ONET 3.1 is currently one of the leading commercially available hydraulic analysis tools and is supported by MW-Soft, Inc. The H_2ONET model is based on the Hybrid (or Gradient) method for network analysis. This method has two very attractive features. First, it combines the good convergence properties of Newton’s method, the better conditioning properties and starting values of the loop formulation, and the inherent scarcity of the nodal formulation. Second, the system of linear algebraic equations to be solved at each iteration is symmetric and positive definite. This allows for highly efficient matrix routines to be used for their solution. The system of equations to be solved is of dimension equal to the number of nodes. The model can accommodate any type of hydraulic device and computations may be carried out using both English and SI units. The model also implements advanced computational routines enabling the program to exhibit higher execution speed.

The H_2ONET software was programmed using the open architecture concept and consists of three modules, the core module of which is a relational database. The relational database stores and manages the network modeling data and allows the software to maintain a series of unique linkages between the modeling database and the other two modules: the graphical network map in AutoCAD and the network simulator. Through a specialized graphical interface developed for AutoCAD, the user populates the modeling database, runs the model, and views, queries, and displays modeling results. The relational database acts as the central storage location for all network modeling data. From this database, inputs to the hydraulic model are generated and model results are associated for display on the network map. The map acts as a graphical interface to these relational data. By combining all engineering applications into one central database, all system maps and facility data can be continuously and accurately maintained and updated.

H_2ONET provides great flexibility in file sharing capabilities with various popular Geographic Information System (GIS) software applications. The user can automatically import/export data files (both graphics and attributes) using the GENERATE (e.g., Arc/Info) and SHAPEFILE (e.g., ArcView) GIS formats. With complete CSV (comma-delimited text) data transferring capabilities, the user is able to directly share data with any other GIS software and standard database.

MODEL DEVELOPMENT

A complete hydraulic model was constructed with all the major facilities in the system, including pipes, pumps, reservoirs, sources, tanks, and valves. Once the system was laid out and all pertinent parameters were verified (such as pump curves, nodal elevations, demand allocations), the system was calibrated.

The H_2ONET software uses databases to store input and output for each facility. The input databases for nodes (locations where two pieces of pipeline in the model intersect) included elevation, demand, and pressure zone. Pipeline input databases included diameter, length, and roughness coefficient (based on material and age of pipeline). Storage tank databases included elevations and storage volumes; pump stations databases included pump curves; and pressure reducing valve (PRV) databases included pressure settings and valve diameter sizes.

Demand Allocation

Demand projections were based on population and land use projections, as presented in Section 3. The projections were developed using five planning horizons: existing and for the years 2005, 2010, 2015 and 2020 (buildout). Demands were developed based on land use and zoning. The ten largest users in the city were also identified.

Model Calibration

The initial model runs were made to determine if the model behaved as anticipated. These initial model runs provided a check for model stability. As part of this process, SCADA data was used along with field measurements taken by operators for 48-hours continuously to check pump station operation, reservoir status, demand allocations, and source contributions.

After the initial check for model stability, the calibration of a hydraulic model is relatively straightforward. The calibration of the model was a "steady-state" calibration. That is, the model was calibrated assuming that flows, reservoir levels, pumping rates, and other system conditions are occurring at a constant rate, or steady-state condition. Then, a dynamic calibration called an "extended period simulation" (EPS), was conducted to use the hydraulic model to assist in optimizing operations. The EPS model simulation considers the fluctuations of reservoir levels, pumping rates, and other system variables, which occur over the course of a day. The City's SCADA system aided in the collection of the data needed to develop the EPS model.

The hydraulic model calibration consisted of making a series of hydrant flow tests during peak season demands and recording all pertinent system parameters during the testing period. This allowed the system boundary conditions in the model to be set to an as is condition and use the pressure and flow parameters from the hydrant tests to provide a mark for system calibration. The water distribution system was calibrated (within 10% of field test) by adjusting pipeline roughness coefficients. The pump operating curves, pressure control settings, and location and setting of isolation valves were also checked and verified during the calibration effort.

The most common parameter, which prevents the calibration of the hydraulic model to real time data, is the setting of the isolation valves. Throughout a system network, there may be numerous valves (i.e. isolation valves) that are unaccounted for and/or misrepresented. The setting of a valve may be represented as fully opened when actually it is partially or fully closed. A partially closed valve can be very difficult to identify and a valve may result in extreme hydraulic variations in the network that is not accounted for in the model.

Pipeline Deficiencies Analysis

Each of the planning horizons were evaluated using the planning criteria presented in Section 4. Pump stations and storage tanks have defined design capacities, as presented in Section 5. Pipelines, however, function as part of a larger network and must be evaluated through modeling for various demand scenarios. Two demand scenarios were investigated:

- peak hour demands, and
- peak day demands plus fire flows.

For the second scenario, one fire flow at a time was applied to each pressure zone using a residential fire flow of 1,500 gpm during a projected peak day demand condition. The system was also evaluated for non-residential fires modeled in each zone using 3,000 gpm for industrial, commercial, and multi-family (i.e. apartment complexes) fires. Figure 6-1 shows the location of each node with an applied fire demand.

The following planning criteria were used to identify deficiencies in pipelines:

- Peak Hour Demand Scenarios
- Transmission pipelines (12-inch diameter and larger) with velocities greater than 5 fps on peak day demands;
- Distribution pipelines with velocities greater than 10 fps and/or pressure head loss greater than 10 ft per 1000 ft on peak hour demands; and
- Pressures less than 40 psi or greater than 100 psi.
- Maximum Day Demand Plus Fire Flow Scenarios
- Pressures less than 20 psi.

The system-wide peak day demand used in the existing analysis was 6.8 mgd as defined in Section 3. The system wide peak hour demand, which corresponds to a flow of 2.5 times the peak day demand, was 17.0 mgd. The future demand projections were applied using a multiplier derived from the existing and future demands defined in Section 3. All existing pumps, storage facilities, and operational settings were modeled to evaluate the existing system.

Capital Improvement Development

The analysis of the system and recommended improvements to correct deficiencies were developed in a step-by-step process. First, the existing system was evaluated for deficiencies under both the peak hour demand and the peak day demand plus fire flow scenarios. The improvements needed to remedy these existing deficiencies were then incorporated into the model. Improvements may include valve setting adjustments and new or parallel pipelines. The improved system became the basis for the next analysis of future planning horizons. This approach prevents redundant modeling of deficiencies of the existing system.

The demand projections were then applied in 5-year increments starting with 2005, as improved for existing deficiencies. Again, both the peak hour demand and the peak day demand plus fire flow demand scenarios were evaluated. Where deficiencies existed for the 2005 projection, improvements were identified by two methods. First, an attempt was made to expand an improvement that was already identified as needed to correct an existing system deficiency. Where this was not feasible, either hydraulically or economically, new improvements were identified to relieve 2005 projection deficiencies. The system as improved to meet the 2005 demand projections became the basis for the repeated analysis of the 2010 demand projection. The system as improved for the 2010 demand projection subsequently became the basis for the 2015 demand projection analysis and so on.

Identified System Deficiencies

Model analyses showed that there were no existing system pipeline deficiencies. Analysis of the 2005, 2010, 2015, and 2020 demands showed future system pipeline deficiencies, in the vicinity of Parkway Avenue and Parkway Center Drive. These two pipelines will need to be upsized to meet 2020 projected peak hourly demands. The remainder of the pipeline Capital Improvement Program is for projected growth in the Future Planning Areas. The Capital Improvement Program is described in greater detail in Section 9. A total of $14,130,082 in future pipeline system improvements is recommended.

REVIEW OF OTHER INFORMATION AND ISSUES

Service Replacement

An ongoing program of service renewal should be provided for in the Capital Maintenance Program. It is assumed that water services will be replaced on a 75-year cycle. With approximately 20,000 services in the system, this would require the replacement of 265 services a year.

Unaccounted for Water

In order to maintain or further reduce the amount of unaccounted-for water in the City of Wilsonville's system, and to develop a better understanding of water use, the following recommendations are proposed:

- Continue the leak detection program, with main replacement and repair based on program results;
- Examine production meter(s) for accuracy;
- All large meters (3-inch or greater) that are not already outfitted with test ports, should be outfitted and tested annually;
- Continue the current meter replacement program. Much of the development in Wilsonville is relatively new in terms of infrastructure. The City is replacing old water meters at the rate of approximately 60 per year. As the infrastructure ages, the goal should be to replace meters on a 20-year cycle.
- Maintain unmetered water use reports as part of the water department's monthly operating logs. Estimate water uses due to pump lubrication, main flushing, hydrant inspections, pipeline filling, tank cleaning, draining, and construction testing;
- Record the amount of water used for fire fighting, hydrant flushing and fire training;
- Continue to monitor construction use through issuance of hydrant meters and construction permits.

Water Conservation

Since 1994, Wilsonville has aggressively taken steps to conserve water. Initially, these efforts focused on (mandatory) restrictions during the summer season. As the water shortage became more acute, the City imposed a 2-year moratorium on the issuance of development approvals. More recently, the City has expanded its conservation efforts (through the "SWEEP" program) to include indoor water uses on a year-round basis. These and other conservation measures are briefly described below. Because of these activities, the Oregon Water Resources Department presented its first (annual) "Water Conservation Project of the Year" award to the City of Wilsonville in November 2000.

Mandatory Peak Season Restrictions. Since the mid-90s, Wilsonville has routinely imposed mandatory water restrictions during the months of June, July, August and September. The focus of these restrictions has been watering of lawns, yards and landscaped areas. Outdoor irrigation was only allowed every other day, with properties having addresses ending in an odd number allowed to irrigate on the 1st, 3rd, 5th, etc. of the month and properties having addresses ending in an even number allowed to irrigate on the 2nd, 4th, 6th, etc. To gain even further efficiencies, this program eventually shifted to an east-west concept whereby half the City was allowed to irrigate on Mondays, Thursdays and Saturdays. The other half of the City was allowed to irrigate on Tuesdays, Fridays and Sundays. No outdoor irrigation was allowed on Wednesdays (a day of rest for the City's wells, and a chance to replenish the water level in the City's reservoirs). Furthermore, watering was limited to 20 minutes per irrigation zone. And watering was prohibited between the hours of 9:00 a.m. and 5:00 p.m. in order to avoid wasting water due to evaporation during the heat of the day.

Eliminated Irrigation of Public Lands. For the past several years, the City has ceased watering its parks and the grounds around public buildings. Hand-watering from a truck-mounted tank is done for newly installed landscaping until the vegetation is well enough established to survive without irrigation.

"Phone Tree" of 30 Largest Users. The City maintains a list of its largest water users. During periods of peak demand (and/or mechanical problems at a well), City staff places direct phone calls to each of the 30 largest water users, requesting further reductions in water use for a period of days until the immediate problem has been abated. These large customers of the City's water system have been very cooperative in this regard.

Public Information. The City publishes and distributes conservation information via bill inserts to its customers regarding the environmental and economic benefits of conserving water, and providing water-saving tips. Conservation-related news is also provided in City newsletters sent to all residents and to members of the local Chamber of Commerce. The City provides literature on conservation published by the (Columbia-Willamette Conservation Coalition), of which the City is a member. The local (weekly) newspaper has also been very cooperative in publishing information about water conservation. The City also staffs a conservation booth at various community events. In addition to all this, the City Water Crew has a supply of door hangers that are distributed to properties where staff observes water being wasted and/or the mandatory water restrictions are being violated.

Financial Incentives. The City currently uses an inverted block rate structure to reward water conservation efforts. The City has also implemented a "prompt repair" policy which provides a financial credit on a customer's water bill if a leak is repaired within one month of detection. The City also sponsors a zero-down, low interest loan program for residents and/or local businesses that purchase water-efficient appliances.

Leak Detection. The City contracts with a leak detection service to inspect approximately 1/3 of the City's water distribution system annually. The goal is to fully inspect the system on a 3-year cycle. In addition, the utility billing system automatically identifies customers whose water usage is significantly higher than it was during the same billing period the prior year. In each such case, a work order is generated. The Water Crew then conducts an on-site inspection to help determine if there is a leak on the customer's side of the water meter. If so, the staff member advises the customer of the City's "prompt repair" policy. If not, the staff member encourages the customer to consider ways to use water more efficiently.

"SWEEP" Program. Twenty-five homes in Wilsonville were selected for a demonstration project to thoroughly measure the savings that can be achieved with high performance (i.e., water/energy efficient) appliances. This was a cooperative effort with the U.S. Department of Energy, the Oregon Office of Energy, Portland General Electric, Frigidaire, and others. Highly sophisticated metering of water and energy was conducted on each of the 25 sites to determine baseline usage levels for each household. Then all the washing machines, dryers, dish washers, shower heads, and toilets were replaced with high performance models. Based on before-after comparisons, the water and energy savings were shown to be very significant and highly cost-effective.

WaterWise Educational Program. For the past two years, the City has sponsored a very popular program at the local middle school. Every sixth grade student is supplied with a kit that includes a workbook with fun, multi-disciplinary information and activities regarding water and energy conservation. The kit also includes numerous "take-home" devices to measure (and to reduce) household water and energy use. Each student also receives a CD with an interactive computer game. Using the mouse on the computer, the student can wander through a "virtual house." Points are scored (and information is provided) each time the student correctly identifies opportunities to save water and energy. Rather than incorporate this into the daily curriculum in the classroom, the kit was used as the focal point at the week long "outdoor school" that is attended by all sixth graders in the spring. This project also included a poem/essay contest. Local businesses contributed 100 prizes (including T-shirts, movie tickets, free bowling, etc.) so that every middle student who submitted an entry received a prize. The theme of the poem/essay was: If you could tell your neighbor why it's important to conserve water and energy, what would you say? A group of senior citizens at the community center volunteered to judge the entries. The Mayor presented each of the three runner-up winners with a $50 gift certificate to a local store. The grand-prize winner also received a $50 gift certificate, plus a high performance washer/dryer set for their parents. The four top poems/essays were then published as an insert to the City's utility bill. So the students did indeed tell their neighbors why conservation is important.

Regional Water Providers Consortium (Columbia-Willamette Conservation Coalition). Since 1995, Wilsonville has been an active participant in the Coalition, which has subsequently merged with the Regional Water Providers Consortium. The Coalition publishes and distributes informative brochures, public service announcements for the broadcast media, sponsors water "audits" to help businesses identify ways to cost-effectively conserve water, and conducts workshops on topics such as tips on how to landscape with plants that need less water.

Demonstration Garden. The City has planted a drought-tolerant garden to demonstrate how plants can be selected and installed in a way that significantly reduces irrigation needs. The City has also published a reference manual entitled "Guidelines for a Water Wise Landscape."

Controls on New Development. Despite the successes associated with the conservation measures described above, the water shortage in Wilsonville has been so severe that limits have been imposed on development. For a 2-year period, the City Council adopted a moratorium on the issuance of approvals for new developments. Projects that had previously received planning approvals were allowed to proceed. But applications for new developments were put in abeyance while studies were completed to evaluate and select the City's long-term water supply. With the decision and voter approval to construct the Willamette water treatment plant, the development moratorium was replaced with a Public Facilities Strategy. This procedure regulates the timing of new development to correspond with availability of water between now and April 2002 when the new water treatment plant will be on line.

Exhibit 7

Section 7 - Source of Supply

SECTION 7 - SOURCE OF SUPPLY

DESCRIPTION OF CURRENT SOURCE

Wilsonville is currently supplied by a system of eight groundwater wells, which provide a total realized pumping capacity (that is, actual current capacity of well and pumps) of 5.5 mgd, with a firm capacity of 4.6 mgd. A more detailed description of the existing water system has been provided in Section 5 of this Master Plan. The source aquifer has been classified as "groundwater limited" by the OWRD because the water table is declining due to groundwater pumping. The OWRD has restricted Wilsonville's development of new wells, and has requested that the City reduce its dependency on the Columbia River Basalt Aquifer as soon as possible.

PROJECTED SUPPLY NEEDS TO 2022

Section 2 of this Master Plan has summarized population projections for the City of Wilsonville to the year 2022. The City's year 2000 population was 14,365 and has almost doubled over the past ten years. The City has estimated that buildout will be achieved by the year 2020, which reflects projected maximum density including infill and redevelopment. This buildout population includes future annexation and service to areas in unincorporated Clackamas and Washington Counties that have been identified as Urban Planning Areas. The ultimate year 2020 (buildout) population projection for the City is estimated to be 25,381.

Section 3 presented the water demand forecast. Total water demand for the City to buildout is projected to reach about 20 mgd. Although the City maintains 4.6 mgd of firm groundwater pumping capacity, the OWRD has required that the City reduce its reliance on this aquifer in the long term. Therefore, this Master Plan assumes the need for a long term supply capable of providing the full 20 mgd to meet 2020 needs.

SUMMARY OF PREVIOUS SUPPLY PLANNING EFFORTS

Over the last decade, the City has conducted and/or participated in numerous planning efforts related to the future of its water supply. This section summarizes the findings of those major plans and studies.

Wilsonville Water System Plan (Westech, November 1986)

Additional groundwater development was recommended to meet the City's short-term water supply needs. The Master Plan recommended that by 1995, the City should begin evaluating potential surface water sources to meet long-term needs, including the Willamette and Molalla Rivers.

WATER SOURCE OPTIONS STUDY, REGIONAL WATER SUPPLY PLAN - PHASE 1 (CH2M HILL, FEBRUARY 1992)

This study was authorized by the City of Portland in December of 1990. The study examined long-term water supply needs and evaluated future water supply options for the greater Portland-Vancouver metropolitan area. The plan included a sixty-year water demand forecast, a review of existing drinking water sources and the identification and ranking of twenty-nine specific source options. The source options included the surface and groundwater resources in a major portion of the Willamette Valley, all of the western drainages from Mt. Hood to the Lewis River in Washington, the coastal drainages of northwest Oregon and the Pacific Ocean for desalination. The water supply sources screened and recommended for the further study and refinement under Phase 2 of the Regional Water Supply Plan were:

- Clackamas River
- Columbia River
- Willamette River at Wilsonville
- Bull Run Watershed
- Lower Little Sandy River
- Regional Groundwater

With respect to supply options of relevance for the City of Wilsonville, the Willamette River diversion at Wilsonville was one of eight alternatives given a "High" ranking, out of a total of 27 water supply options considered. The ranking of source water options was accomplished by a team of scientists, environmental planners, policy specialists and engineers. Water source options were evaluated with respect to environmental, social, engineering and institutional/legal criteria. This study recommended that the Willamette River option be evaluated in more detail in Phase 2 of the study.

REGIONAL WATER SUPPLY PLAN, PHASE 2 FOR THE PORTLAND METROPOLITAN AREA (MONTGOMERY WATSON, OCTOBER 1996)

The long-term water supply options developed in Phase 1 of the Regional Water Supply Plan were further developed and refined as part of the Phase 2 Plan. Updated water demand estimates were developed, regional storage and transmission options were evaluated and estimated project costs and operation and maintenance costs were prepared. Source availability, water rights, permitting, environmental issues, and treatment and supply alternatives and concepts were also developed and analyzed. The Phase 2 Plan included a recommended strategy, to meet the region's long-term water needs. This strategy included:

- Water Conservation
- Aquifer Storage and Recovery (ASR)

- Development of future regional source increments, using the Clackamas River and the Willamette River.

This study identified Wilsonville as one of the localities where new resource capacity would be needed prior to the year 2000. The Regional Plan identified construction of first phase supply facilities on the Willamette River as a suitable option to meet Wilsonville's imminent needs.

Water Supply Study (Montgomery Watson, March 1997)

In 1996, the City of Wilsonville initiated a comprehensive supply study that evaluated seven different long-term supply scenarios. The components of long-term supply that were screened for potential use included:

- Clackamas River from the South Fork Water Board (SFWB);
- Clackamas River from Clackamas River Water (CRW), either directly or via the City of Portland;
- City of Portland (Bull Run and Columbia River Wellfield) direct supply from Portland;
- City of Portland (Bull Run and Columbia River Wellfield) supply via the City of Tualatin;
- City of Portland (Bull Run and Columbia River Wellfield) supply via the Tualatin Valley Water District;
- Tualatin River/Trask River from the Joint Water Commission (JWC); and
- Willamette River from a new treatment plant.

In addition to these sources, Aquifer Storage and Recovery (ASR) was evaluated in conjunction with the surface water sources listed above. Continued use of the City's wells as a peaking supply was also considered, as were non-potable dual water systems.

Three primary scenarios were evaluated in detail for long-term supply- these included Clackamas River supply from either the SFWB or CRW, development of the Willamette River, and wholesale contract with the City of Portland.

Eleven major criteria were selected for the evaluation of the major options described above. These included:

- Certainty of supply;
- Water rights;
- Treated Water quality;
- Environmental impact;

- Consistency with local and regional planning;
- Capital costs;
- Annualized costs;
- Timing;
- Opportunity for ownership;
- Water supply agreements and contracts; and
- Compatibility with short-term supply.

The lowest cost long-term option was found to be a jointly owned Willamette River water supply facility, with a treatment plant located in Wilsonville. Evaluation of most of the non-economic objectives for long-term supply also favored development of the Willamette River, using the City's existing water right permit on the River. ASR was found to be a potential peaking supply alternative that could reduce costs significantly, however the continued use of groundwater for peaking must be approved by the OWRD. Dual use non-potable supplies that provide irrigation water from reclaimed wastewater could reduce long-term demands, but would be more expensive to develop than ASR or groundwater, and face regulatory hurdles. The study also concluded that the City should consider the Clackamas River supply or the Portland option if the Willamette option proved to be cost prohibitive, or if sufficient incentives could be offered by the other providers to offset the increased cost of supply.

POTENTIAL SOURCE OPTIONS

From the planning efforts described above, and as a result of the public discussion taking place on source options, three major source of supply options emerged as candidates for long-term supply for the City of Wilsonville by 1997. These three options were:

- Development of the Troutdale Aquifer;
- Development of the Willamette River; and
- Purchase from the City of Portland.

Detailed evaluations of these options were carried out in the late 1990's. The results of these evaluations are summarized below.

SUPPLY OPTION 1: DEVELOPMENT OF THE TROUTDALE AQUIFER

The City currently relies on local groundwater for 100 percent of its water supply. The primary groundwater source is the Columbia River Basalt Aquifer, which underlies the City, and consists of fractured layers between lava formations. Historical information indicates that this aquifer is recharged at a relatively slow rate, and that continuous pumping of the aquifer by the City of Wilsonville has exceeded the aquifer's rate of recharge. The City of Wilsonville's primary source aquifer has been classified by the Oregon Water Resources Department (OWRD) as "groundwater limited". OWRD will not allow the City to develop any new wells within the aquifer, and has requested that the City reduce its dependency on the Columbia River Basalt Aquifer as soon as is practicable. As a result of severe groundwater shortages, the City had a moratorium on planning approvals for land development that began on January 5, 1998. The moratorium was replaced with a Public Facilities Strategy for Water in January 2000, which allowed planning approvals to proceed with restrictions while the City developed its new water supply. The City developed an OWRD approved conservation plan and also implemented stringent water curtailment measures during the peak season summer months.

In 1998, the City initiated an evaluation of additional groundwater development in the Troutdale Aquifer. The Troutdale Aquifer was selected for evaluation because of its relative proximity to the City and the speed with which additional supply could be brought on line, compared with other long-term supply options.

Troutdale Aquifer Wellfield Development Program Draft Report (CH2M Hill, March 1999)

This study evaluated the capability of the Troutdale Aquifer to produce up to 20 million gallons per day (mgd) while at the same time complying with land use regulations prohibiting municipal wells in areas designated for exclusive farm use if alternatives exist. The study was completed in May 1998, and indicated that the Aquifer could be developed to produce approximately 5.8 mgd of supply. Extraction of this amount of water would require eight new groundwater wells, pumping approximately 500 gallons per minute. In seeking to drill test wells, acquire sites for production wells, and secure water rights, the City encountered several impasses in securing test well locations and the necessary permits from Clackamas County. Even if all these obstacles could have been overcome, this option would not provide enough capacity to meet the City's projected water demand to 2020. The City Council, therefore, voted to terminate the project in December 1998.

SUPPLY OPTION 2: DEVELOPMENT OF THE WILLAMETTE RIVER

Willamette River Water Treatment Pilot Study (Montgomery Watson, July 1994)

The Tualatin Valley Water District in a cooperative study partly funded by the American Water Works Association Research Foundation conducted a five-month filtration pilot study at Wilsonville. The primary objective of the project was to identify an appropriate filtration process for Willamette River water. Stringent water treatment and operating goals were developed before beginning pilot plant operations. A multiple-barrier treatment process was selected for pilot testing, including pre-oxidation with ozone, coagulation/flocculation/sedimentation and filtration using granular activated carbon (GAC) media. A successful treatment process was developed which included the processes described above.

Water quality testing of the untreated supply indicated high-quality source water, with respect to organic material and turbidity. The multiple-barrier process was observed to successfully treat Willamette River water, and was able to meet the stringent water quality and operational goals that were significantly more stringent than federal standards.

Willamette River Raw Water Monitoring Program, Annual Reports for 1994-1996, 1998-1999, and 1999-2000. (Montgomery Watson, March 1997, August 1999, November 2000)

A series of extensive raw water monitoring programs were conducted at Wilsonville beginning in 1994. The program is ongoing and is currently sponsored by the Willamette Water Supply Agency and the City of Wilsonville. The sampling program is a continuation of the efforts to characterize the raw water quality of the River, which was begun in the pilot study described above. The programs maintain an emphasis on understanding the physical, chemical and biological parameters that are of interest for water treatment and public health. They include regularly scheduled sampling for a variety of drinking water parameters, microbiological contaminants, trace metals, inorganic chemicals and an exhaustive list of synthetic organic chemicals.

Sampling results have been consistent from year to year, and indicate that the Willamette River is a soft, generally low turbidity source with a low naturally occurring organic carbon content. Inorganic chemical and microbiological results are consistently within the range of acceptability for water treatment. Occasional detections of organic chemicals have been observed, in the part-per-billion range and well below drinking water standards. None of these detections pose a concern for the ability of the treatment process to surpass current or anticipated drinking water standards.

Willamette River Water Supply Study (Montgomery Watson, March 1996)

A group of six municipal water providers conducted this study in order to evaluate potential service areas and water demands; evaluate potential water treatment plant and intake sites; evaluate pipeline routings; prepare preliminary cost estimates and develop an implementation strategy. The participating entities included the Canby Utility Board, Clackamas River Water, the City of Sherwood, the City of Tigard, the Tualatin Valley Water District, and the City of Wilsonville.

This study concluded that locating the treatment plant in Wilsonville would be economically advantageous, given the location of the projected demands. The study also concluded that economies of scale could be achieved at higher plant capacities.

Willamette River Water Supply System, Preliminary Engineering Report (Murray Smith, December 1998)

This preliminary engineering effort was conducted by the Cities of Tigard, Wilsonville, Sherwood, Tualatin and the Tualatin Valley Water District. Preliminary design was conducted for a water treatment plant of an assumed initial capacity of 35 mgd, expandable to 120 mgd. The facility was assumed to be located on property owned by the City of Wilsonville, located along the River, 0.5 miles upstream of the I-5 bridge crossing in Wilsonville. The water supply facilities designed in this report included a river intake and raw water pump station; a water treatment plant; a high service pump station and a finished water transmission main.

Facility cost estimates including operating and maintenance costs were developed. Impacts to system operation, organization and governance were evaluated, and project procurement options were discussed. The report included a detailed evaluation of system costs, from an overall and an individual participant perspective. Potential financing structures and economic issues were evaluated in detail.

SUPPLY OPTION 3: CITY OF PORTLAND PURCHASE

Washington County Supply Line Capacity Analysis (Murray Smith, September 1997)

In September 1997, the Washington County Supply Line Capacity Analysis was completed for seven water providers from the southwestern and southern Portland metropolitan area. The analysis included evaluations of various transmission, pumping and intertie alternatives to meet the increasing water demand needs of the area. This study found that the Washington County Supply Line system, which presently supplies City of Portland water to Tualatin, could be used to meet some short-term water supply needs of the providers, including Wilsonville, Sherwood, Tualatin, Tigard, the Tualatin Valley Water District and the Raleigh Water District. Meeting these needs, however, required that a number of technical, operational, financial and legal conditions be met. This pipeline would not, however, be able to supply the needs of these communities in the long-term past year 2005.

Water System Plan for Expanded Southwest Service (City of Portland, Bureau of Water Works, December 1998)

The Portland Water Bureau developed a proposal for providing water service to Tigard, Wilsonville and Sherwood in late 1998 in response to inquiries from those cities concerning future water sales. The proposal indicated that service could be provided to these communities based on an expansion of the Portland system that would include:

- expansion of the Columbia South Shore wellfield,
- raising the existing dams in the Bull Run watershed,

- construction of a water filtration/treatment plant, and
- construction of new transmission pipelines from the Bureau's Powell Butte Reservoir to the Southwest service area.

As part of this proposal, 20 million gallons a day (MGD) of the capacity of these improvements was assumed for the City of Wilsonville out of a total of 60 MGD of new capacity need for this portion of Southwest Washington County. Others that would be served by these facilities were the Cities of Tigard, Sherwood, and Tualatin.

If all of the other cities that could be served under this proposal participated, a pipeline would also have to be constructed from Tualatin to serve Wilsonville as no other customers would take supply south of Tualatin. If no other cities participated, the pipeline to serve solely Wilsonville would have to originate in Tigard at the terminus of Portland's Washington County Supply Line. Transmission improvements from Powell Butte to Tigard and some supplementary supply increment would also be needed if no other cities participated.

CONCLUSIONS

In 1998 and 1999, the City of Wilsonville intensively evaluated the City of Portland and Willamette River options side-by-side. This 18-month evaluation process included public comment at regular and specially scheduled City Council meetings and public testimony received at special hearings devoted to the water supply issue. The evaluation process also included seeking expert advice from independent specialists, including academic experts in water treatment, toxicology and public health, and representatives from the Environmental Protection Agency and the Oregon Department of Environmental quality (DEQ).

Factors of primary importance to the City in their evaluation were:

- cost,
- the ability of the future water supply to protect public health and provide a high quality of treated water;
- reliability of the supply; and
- environmental impact.

Based on an evaluation of these and other factors, City staff recommended pursuing development of the Willamette River supply option. The Wilsonville City Council passed a resolution in June of 1999 to develop treatment and transmission facilities on the Willamette River. This option was deemed by the City to provide Wilsonville with a safe, reliable long-term water supply, while at the same time affording the City the greatest certainty and control over program implementation and costs. The City Council also referred this issue to the voters in a special election held in September 1999. As a result of the election, the voters approved revenue bonds to construct the Willamette River water treatment plant.

The City's conclusions with respect to the major decision criteria are summarized briefly below:

1. ***Water quality.*** A large database of Willamette River water quality data has been collected in the last decade by interested water providers, by the US Geological Survey and by the DEQ. All monitoring data indicates that the Willamette River is a suitable source for municipal supply. Pilot filtration testing of the supply adequately demonstrated that even under extreme conditions created by artificial loading of contaminants on the process, high quality drinking water is produced. The Willamette treatment process will use a state-of-the-art ozone/granular activated carbon treatment process that will provide the highest quality of treated water in the region. Independent experts convened by the City of Wilsonville examined historical water quality data and pilot treatment results and concurred with the City's conclusion that the Willamette River is a suitable supply that will provide high quality water. Other major sources in the region include the Clackamas and Trask/Tualatin Rivers, which are also treated by filtration and also receive most of their flow from unprotected watersheds under a variety of land uses.

2. ***Reliability.*** The Portland option continues to depend on the region's largest water supply, the Bull Run watershed/Columbia groundwater system. The Portland supply has historically been disrupted by winter storms and landslides, forcing wholesale customers off of the supply. The unfiltered Bull Run supply is vulnerable to a multitude of natural and man-made threats. A Willamette supply would diversify regional supplies, as was envisioned in the Regional Water Supply Plan. Other important aspects of reliability include Wilsonville's ability to perfect its 1974 water right on the Willamette River by development of the treatment plant project – water which will then be available in perpetuity to meet Wilsonville's long-term needs. Wilsonville would not be dependent on the major capital projects which must be completed by Portland over the next 40 years in order to receive adequate water, and the City would not need to be dependent on multi-agency agreements in order to assure supply or permits to construct the improvements.

3. ***Environmental Impact.*** The Willamette River option was judged by the City to have less overall environmental impact than the Portland option, which includes dam raises and fisheries impacts in the Bull Run, and also includes major regional pipeline construction. The Regional Water Supply Plan, Phase 2 (1996) also rated the Willamette option as preferable in terms of environmental goals.

4. ***Cost.*** The Portland option is substantially more expensive than is development of the Willamette River, even if Wilsonville was the sole developer of the Willamette River facility. Cost projections were developed by the City, based on the 1998 Preliminary Engineering Report and from the Portland proposal summarized above. Cost figures

were developed for a Wilsonville-only scenario (costs decrease for Wilsonville if partners contribute) and for a Portland with partners scenario (cost to Wilsonville increases if less than the assumed 22 wholesale customers participate). Overall, the Willamette option is about $20 million or 30 percent less expensive than the Portland option, based on capital costs alone, and about $30 million less considering capital costs plus interest to 2040. The cost implications to system development charges (SDC) were estimated for the Willamette River alone option ($3,834) and for the Portland with partners option ($4,585). This compares to then current SDCs of $2,681.

WILLAMETTE WATER TREATMENT PLANT

The City of Wilsonville is currently constructing a water treatment facility on the Willamette River at Wilsonville. The project is located at a site known as the Young property south of Wilsonville Road just off of Industrial Way in Wilsonville. The site consists of two major north and south parcels connected by a narrow strip of land and a twenty-foot strip along the western edge, north to Wilsonville Road. The treatment facility site plan is shown as Figure 7-1.

The project consists of three major components:

- Raw Water Intake
  - Screens,
  - Wetwell (Caisson) and
  - Raw water pump station.
- Water Treatment Plant (WTP)
  - Chemical addition with rapid mixing,
  - Actiflo clarification to reduce turbidity,
  - Ozone contact basin for disinfection,
  - Filtration for particle removal and taste and odor control,
  - Chlorine addition and
  - Clearwell reservoir.
- Finished water pump station and finished water pipeline (including access roadway)

The City of Wilsonville is the primary project participant and lead agency developing the project. The Tualatin Valley Water District (TVWD) is also participating in the project, paying for a portion of the land, the initial treatment capacity and for oversizing of the intake, raw water pumping and piping, and finished water pumping and piping.

The screening structure at the intake facility has been designed and is being constructed for a capacity of 70-mgd. The raw water pipeline and caisson have a

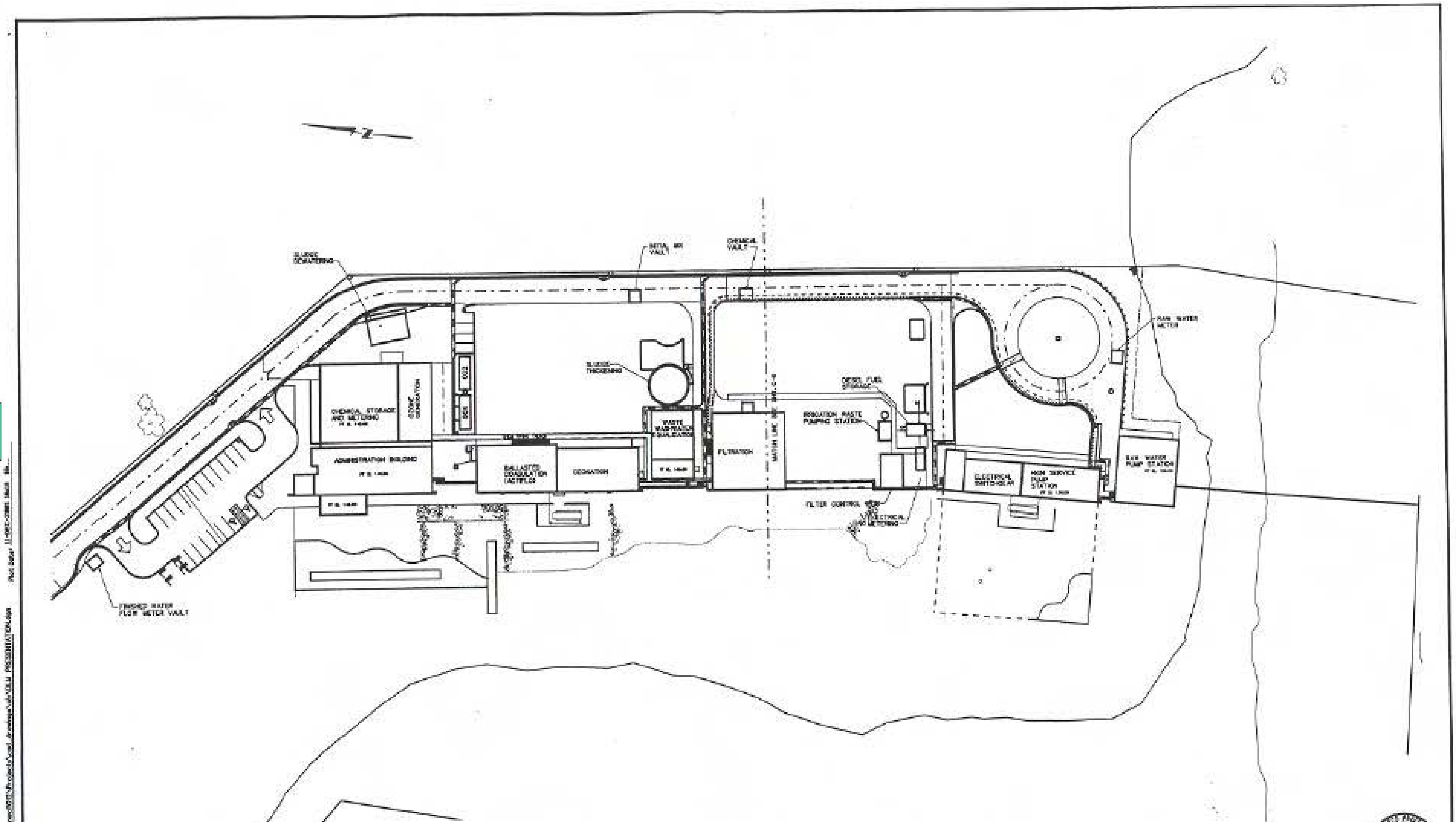


Figure 7-1: Willamette River Water Treatment Plant Site Plan

MONTGOMERY WATSON
Portland, Oregon

City of
WILSONVILLE
in OREGON

SITE PLAN

design capacity of 120 mgd. The raw water pump station has an initial installed capacity of 15- mgd with expansion capabilities to 120-mgd. Raw water piping to the WTP was sized for 70 mgd.

The water treatment plant is located on the south parcel of the property. It is sized at an initial capacity of 15 mgd, with Wilsonville taking 10 mgd and TVWD owning the remaining 5 mgd capacity. Based on the growth projections developed as part of this Master Plan, this initial 10 mgd plant capacity, supplemented by the existing well system, will be adequate to meet the City's needs until the 2005 to 2009 timeframe. The City will need to develop additional supply capacity, ultimately reaching its projected buildout water demand of 20 mgd, by the year 2020.

The water treatment plant on the south parcel is configured for an ultimate capacity of 70 mgd. Future expansion to 120 mgd will require construction of facilities in the northern parcel of the property. Pipe corridors from the intake have been identified and maintained for expansion to 120-mgd.

Finished water pumping is sized for the 15-mgd capacity, with expansion capability to 70- mgd. The finished water pipeline to the intersection of Wilsonville Road and Kinsman Road is also sized for a capacity of 70-mgd. At this point, the finished water pipeline connects to the City of Wilsonville's distribution system. It may also be available at that point for future connection by TVWD. If ultimate demands require 120-mgd, the additional 50-mgd increment would be delivered from another treatment plant and high service pump station.

As part of the project, the remainder of the south parcel of the site will be developed as a recreation park. It will include walking trails, picnic tables, a water feature, interpretive elements on water treatment, and a river overlook.

Construction began July 17, 2000. Initial water delivery from the new plant is scheduled for April, 2002, with final completion of all project elements by October, 2002.

The selected process included ozonation prior to the filters and the use of a deep bed granular activated carbon (GAC) over sand filter media in a ballasted coagulation (Actiflo) conventional treatment process. This process has been designed to control tastes and odors, address the risks of microbial contaminants, reduce disinfection byproducts and protect against the potential of organic contamination. The process layout also includes provision for future installation of ultraviolet light disinfection.

A 2.5 million-gallon rectangular clearwell has been provided. A diesel fuel standby power supply will be provided for a maximum of 4 mgd of total capacity including raw water pumping, treatment and high service pumping. An instrumentation and control system will be provided allowing remote monitoring and control of all processes. Monitoring of offsite turnouts and other offsite SCADA monitoring will also be provided. A sludge thickener will be provided to provide initial thickening of solids removed from the Actiflo process. Thickened sludge will be dewatered in centrifuges. The dewatered sludge will be hauled to a landfill for final disposal. An administration building will be provided for plant operations including control room, laboratory, office space, conference room, restrooms, dressing/shower facilities lunchroom, and instrument repair room.

To meet demands projected to occur beyond 2005, additional capacity beyond the City's 10 mgd initial treatment capacity will be required. There are several options for obtaining this capacity. The City could build another 5 – 10 mgd filtration capacity in the plant, or it may negotiate to utilize TVWD's share of the plant capacity.

Another option is to utilize the City's existing wells in an Aquifer Storage and Recovery (ASR) system. Under this approach, the City's 10 mgd capacity could be utilized in the winter to produce water and store it in its existing Columbia Aquifer wells. This water would then be withdrawn in the summer peak season demand period. Given the approximate 5 mgd capacity of the City's wells currently, it is assumed that the ASR system could be 5 mgd capacity. This would then reduce the size of the required long-term plant expansion by that amount and would allow the plant expansion to be delayed by several years. It is recommended that the City pursue this strategy for its long-term supply through pilot studies and testing of ASR. Then, a plant expansion could be installed in 2015. If ASR is successful, the plant expansion would only need to be 5 mgd to meet the projected 2020 demands. If not, the plant expansion would need to be 10 mgd with the first increment of expansion after 2005.

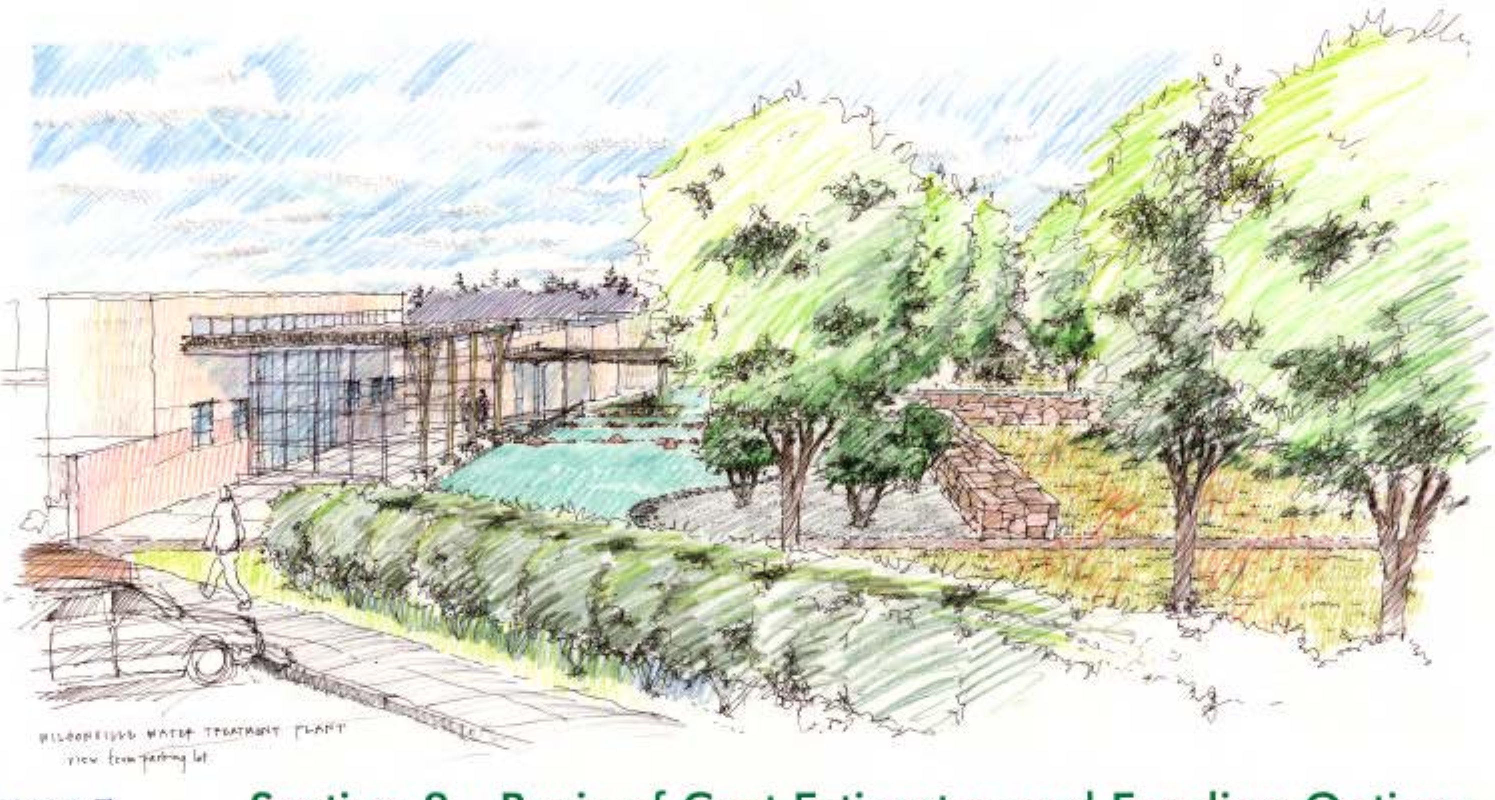


Exhibit 7

Section 8 - Basis of Cost Estimates and Funding Options

SECTION 8 - BASIS OF COST ESTIMATES AND FUNDING OPTIONS

BASIS OF COST ESTIMATES

Cost estimates prepared for this Water Master Plan are planning level opinions of project cost. These opinions of project costs are not definitive predictions of what the costs of any specific project will be when constructed. These estimates have been prepared from the information and data available at the time of this report. The final costs of any project, when constructed, will depend on the actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors at the time the project is actually built. As a result, the final actual project costs will vary from the estimates herein.

Costs of the projects are estimated assuming a traditional public works procurement process of design, bidding, award and construction by a licensed contractor using commonly accepted means and methods. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For future reference, the March 2001 ENR CCI of 7337 for the Seattle area construction market (the nearest market ENR monitors) was used as the benchmark for cost estimates in this study. The estimated cost of the facilities should be expected to change along with the accuracy of the estimate as a project proceeds into preliminary and final design. Planning level opinions of project cost are typically within the range of plus 50 percent to minus 30 percent of the average of the contractors bids after adjustments for changes in the ENR index and project scope.

Total capital costs for each project are comprised of several components. These components are the directly estimated construction cost, an allowance for contingencies, and an allowance for engineering, construction management, administrative and legal costs. The allowance for contingencies covers items such as variations in the project configuration that are developed during preliminary design and final design, unforeseen site conditions encountered during construction, and reasonable project changes during construction. The contingency allowance does not include major project scope additions or additional costs resulting from permit mitigation requirements such as wetlands enhancement.

The general basis of the cost estimates for new construction for each type of facility is given below. Any modifications to this general basis, where appropriate, are provided in Section 10, Summary of the Capital Improvement Program.

PIPELINES

The assumed costs per foot of installed pipe are shown in Table 8 -1.

Table 8-1
Assumed Basis of Pipeline Costs
($/ft of Installed Pipe)

Diameter (inches)	TOTAL $/ft	Material $/ft	Installation $/ft	Subtotal Const. Cost $/ft	Contingency (20%) $/ft	Engineering, Const. Management & Administrative (15%) $/ft
6	**$65.15**	$34.50	$13.80	$48.30	$9.60	$7.25
8	**$75.50**	$39.90	$16.00	$55.90	$11.20	$8.40
10	**$90.70**	$48.00	$19.20	$67.20	$13.40	$10.10
12	**$109.65**	$58.00	$23.20	$81.20	$16.25	$12.20
14	**$124.65**	$65.90	$26.40	$92.30	$18.50	$13.85
16	**$146.35**	$77.40	$31.00	$108.40	$21.70	$16.25
18	**$171.00**	$90.50	$36.20	$126.70	$25.30	$19.00
20	**$201.40**	$106.60	$42.60	$149.20	$29.80	$22.40
24	**$275.55**	$145.75	$58.30	$204.05	$40.90	$30.60
27	**$317.78**	$168.09	$67.20	$235.30	$47.20	$35.30
30	**$360.00**	$190.50	$76.20	$266.70	$53.30	$40.00

Estimates for pipelines are based on installation in typical urban street environments. Among the basic assumptions upon which the cost estimate is based, unless otherwise noted, are:

- Rights-of-way are in streets with asphalt paving to 4-inch depth. Pavement replacement is assumed to be required for the full project length.
- There are no significant utility relocations required for pipe installation.
- Trenching is in soil, with no rock encountered. Trench width is equal to the nominal pipe diameter plus 2 feet and trench depth assumes cover to top of pipe equal to 3 ½ feet.
- No trench dewatering is required.
- Unless specifically noted, joints are unrestrained.
- Pipe material is ductile iron, Class 52, cement lined and asphalt coated, in the size range of 6-inch to 30-inch diameter.
- Hydrant spacing is 400 feet for mains 18-inch and smaller.
- Two valves per 250 feet for 6-inch to 12-inch pipe, per 350 feet for 14-inch to 20-inch, per 500 feet for 24-inch and 30-inch. Valves are gate valves for 6-inch to 10-inch and butterfly valves for 12-inch to 30-inch piping.
- Projects are in the range of 100 feet to 5,000 feet in length.
- There are no costs for property or easement acquisition.

Use of restrained joints could add 10% to the construction costs. Installation in rock instead of soil could add 10-20% to project costs.

It is recommended that when pipelines are designed, consideration be given to the use of restrained joints on a case-by-case basis. Restrained joints should be used when pipelines cross unstable land, railroad tracks, freeways, or other locations which could either result in unusual ground movements or could result in significant damage to property or life should a leak occur.

STORAGE TANKS AND RESERVOIRS

The costs for various size ranges of tanks and reservoirs are shown in Table 8-2 and 8-3. Table 8-2 costs are for buried concrete reservoirs and Table 8-3 is for at-grade steel reservoirs.

Costs for storage tanks and reservoirs assume construction without any special site constraints or other requirements unless specifically noted. Among the basic assumptions upon which the cost estimates are based, unless otherwise noted, are:

- Reservoirs are constructed of poured-in-place concrete (buried concrete).
- Reservoirs are constructed of steel (at-grade steel).
- Reservoirs are buried with 2 feet of earth cover (buried concrete).
- Reservoirs are constructed on grade (at-grade steel)
- No rock is encountered for reservoir foundation excavation.
- Landscaping around the reservoir is grass.
- Seismic reinforcement is to Zone 3.
- Piping to bring water to and from the reservoir is located at the site.
- There are no costs for land acquisition or site demolition.
- There are no site or permit constraints which limit the use of the most economical height to diameter ratio for the desired reservoir volume.
- There are no special site environmental or community mitigation costs associated with the reservoir construction.

Table 8-2
Assumed Basis of Buried Concrete Reservoir Costs
($/gallon)

Size (Million Gallon)	Total Cost ($/gallon)	Construction ($/gallon)	Contingency ($/gallon)	Engineering Const. Management Administrative ($/gallon)
1.0	**$1.24**	$0.92	$0.18	$0.14
1.5	**$1.10**	$0.82	$0.16	$0.12
2.0	**$0.97**	$0.72	$0.14	$0.11
3.0	**$0.83**	$0.62	$0.12	$0.09
3.5	**$0.81**	$0.60	$0.12	$0.09
4.0	**$0.74**	$0.55	$0.11	$0.08
5.0	**$0.70**	$0.52	$0.10	$0.08

Seismic requirements for facilities in the Pacific Northwest have changed substantially over the last several years due to increased understanding of seismic risk in the region. It is likely that these requirements will continue to become more stringent. New facilities, which are considered "lifelines", are required to have a site specific seismic analysis. Such an analysis could lead to more stringent requirements than the Zone 3 reinforcement assumed in these cost estimates.

Special screening or landscape requirements that are specific to a site could add up to 30% to the costs of a reservoir. Another site consideration is the location of the site relative to existing piping to bring water to and from the reservoir. Sites that are far from existing adequately sized piping would incur additional costs to bring pipes to and from the site.

Wilsonville has recent reservoir construction experience that can be used to verify and adjust these unit costs. Level B reservoir was completed in 2000. This 2 MG at-grade steel reservoir was completed for a total project cost of $0.33/gal. These costs included engineering, administration, construction management and permitting. A competitive bidding environment and low cost of steel for this reservoir significantly reduced the cost of this reservoir. Relative to the cost table above, the Level B reservoir unit cost is 29-30 percent lower. Due to the inability to rely on a favorable bidding environment and cost of materials the higher, more conservative, estimated unit cost in Table 8-3 will be used for at-grade steel tanks in this master plan.

Table 8-3
Assumed Basis of At Grade Steel Reservoir Costs
($/gallon)

Size (Million Gallon)	Total Cost ($/gallon)	Construction ($/gallon)	Contingency ($/gallon)	Engineering Const. Management Administrative ($/gallon)
0.25	**$0.95**	$0.70	$0.14	$0.11
0.50	**$0.77**	$0.57	$0.11	$0.09
0.75	**$0.65**	$0.48	$0.10	$0.07
1.00	**$0.61**	$0.45	$0.09	$0.07
1.50	**$0.53**	$0.39	$0.08	$0.06
2.00	**$0.47**	$0.35	$0.07	$0.05
3.00	**$0.41**	$0.30	$0.06	$0.05

PUMP STATIONS

The costs for various size ranges of installed pump motor horsepower are shown in Table 8-4. Costs for pump stations assume construction without any special site constraints or other requirements unless otherwise noted. Among the basic assumptions upon which the cost estimate is based, unless otherwise noted, are:

- No rock is encountered during excavation.
- Landscaping around the site is grass.
- Seismic reinforcement is to Zone 3.
- There are no costs for land acquisition or site demolition.
- There are no special site environmental or community mitigation costs associated with the pump station construction.
- Buildings are of concrete masonry construction.
- Standby generator costs not included unless specifically noted.

Table 8-4
Assumed Basis of Pump Station Costs
($/HP)

Size Total Installed HP	Total Cost ($/HP)	Construction ($/HP)	Contingency ($/HP)	Engineering, Const. Management Administrative ($/HP)
50	$2,970	$2,200	$440	$330
75	$2,700	$2,000	$400	$300
100	$2,498	$1,850	$370	$278
200	$2,025	$1,500	$300	$225
300	$1,890	$1,400	$280	$210
500	$1,688	$1,250	$250	$188
1000	$1,350	$1,000	$200	$150

FINANCING OPTIONS

The options that are available to the City of Wilsonville to fund improvements to its water system are those established for municipal utility functions in general. The options include utility rate charges, general obligation and revenue bonds, system development charges, grants and loans, and plan review and other fees. The primary mechanism for funding the projects under this Master Plan will likely be SDCs for new development. System development charges will provide funding for capital expenditures. Revenue bonds will likely be the form of debt borrowing, with payment of the debt service from utility rates and system development charges. Grants and loans may provide funding for specific projects and programs and plan review fees will contribute small amounts of money to the funding program for this Master Plan. These options are discussed briefly below.

Utility Rate Charges

Water utility rate charges typically have two components. The first is often called the customer service charge and covers expenses that are uniform or do not vary across customers or customer classes. These expenses typically include such items as the cost of meter reading and billing. The second component of water utility rates is the commodity charge. This is a charge based upon the volume of water that is consumed. This amount covers items that vary with water consumption, such as power and chemical treatment costs. Commodity charge rate structures can be uniform, inclining or declining blocks. Inclining blocks, where costs are higher the more water that is consumed, generally promote conservation better than other rate structures.

General Obligation Bonds

The City can issue general obligation bonds for capital improvements and replacement subject to voter approval. General obligation bonds are debt instruments backed by the full faith and credit of the City. They are secured by an unconditional pledge of the City to levy assessments, charges or ad valorem taxes necessary to retire the bonds. General obligation bonds are the lowest-cost form of debt financing available to local governments. They can be combined with other revenue sources such as specific fees, or special assessment charges to form a dual security for debt that is issued. The City's total general obligation debt from all sources, (including water, wastewater, parks, transportation, etc.) is subject to State of Oregon statutory limits of three percent of the real market value for taxable property within the City. Typically, due to this limit, funding needs that have a potential revenue source associated with them, such as water, are not funded by cities through general obligation bonds. Cities typically save their general obligation bonding capacity for those funding needs that do not have revenue sources available to them.

Revenue Bonds

Unlike general obligation bonds, revenue bonds are not backed by the City as a whole, but constitute a lien against the revenues of the City's water operating fund. Revenue bonds present a greater comparative risk to the investor than do general obligation bonds, since repayment of debt depends on the City levying and collecting adequate water rates. Due to this increased risk, revenue bonds generally command a higher interest rate than do general obligation bonds. This type of debt also has very specific financial requirements concerning the amount of money that is left in reserve each year for annual debt payment. Voter approval is not typically required under state law when issuing revenue bonds. However, revenue bonds can be referred to the voters either by the City Council (as was done in the case of the revenue bonds for the Willamette Water Treatment Plant), or through the initiative process.

System Development Charges

System development charges (SDC) are fees designed to recover from new development, a proportionate share of the costs associated with providing existing and expanding future system capacity. The share that is to be recovered is proportionate to the capacity and capital needs created by the new development. SDCs are a one-time charge applied at the time of development approval. Because these fees are only collected when and if development occurs, they cannot be relied upon to fund facilities in any particular year. However, over the course of a period of time, SDCs will fund the proportionate share of facility improvement costs.

State/Federal Grants and Loans

Historically, unlike wastewater infrastructure needs which had a source of federal funds, water infrastructure had little federal or state grants or loans available. However, passage of the 1996 amendments to the Federal Safe Drinking Water Act brought both small amounts of federal loan and grant money to water system improvements. Funds for both grant and loan programs are administered through the State by the Oregon Economic Development Department. Interest rates for loans through this program are competitive with revenue bonds and have lower issuance costs associated with them. The Oregon Health Division maintains a drinking water funding needs inventory and prioritization process to rank projects around the state for funding. While these funds are available, and the City has indeed obtained funding for a portion of the Willamette Water Treatment Plant project currently under construction through these programs, these programs cannot be relied upon as a consistent element of on-going funding of the Master Plan. Having a stable rate program to repay any loans obtained through these programs is also a requirement for obtaining funding through them.

Plan Review and Other Fees

The City may also impose fees for various services and activities that can be applied toward water system costs. Among the typical fees that City's levy are building plan review fees, service charges for late bill payment, and fees for permits to use water for construction. These fees may typically cover some portion or all of the costs associated with a specific service or activity, but will not generate enough money to fund broad programs or projects.

Exhibit 7

Section 9 - Summary of the Capital Improvement Program

SECTION 9 - SUMMARY OF THE CAPITAL IMPROVEMENT PROGRAM

Based on the evaluation of the existing system presented in Section 6 and an evaluation of future supply options discussed in Section 8, this Section describes the recommended Capital Improvement Program (CIP). Projects within the CIP are listed in Table 9-1. The table is separated into 6 major sections including:

- Pipeline Projects,
- Source and Supply,
- Pump Station Projects,
- Control Valves,
- Reservoir Projects,
- Wells and Reservoir Rehabilitation Projects,
- Plans and Studies.

A total of about $26.6 M (in year 2001 dollars) in improvements is recommended between now and the year 2022. The majority of the recommended capital projects are needed by the year 2015. Financial impacts to existing water rates and System Development Charges (SDCs) have not been determined. The current rate structure is sufficient to cover the cost of projects planned in the first five years, but future implications will not be determined until after the water treatment plant is operational and a new rate study is conducted.

This Master Plan listing of CIP projects is intended to be a recommended plan and long-term guide for the development of the City's water system. While projects are shown in this CIP as being scheduled for construction in a given year, this is intended only to provide a general guideline of priorities, relationships between projects, ties to levels of growth, and understanding of maintenance priorities. Each year the City should review the Master Plan and adopt a specific Capital Improvement Program that incorporates the general guidelines of the Master Plan into the specific activities for that year.

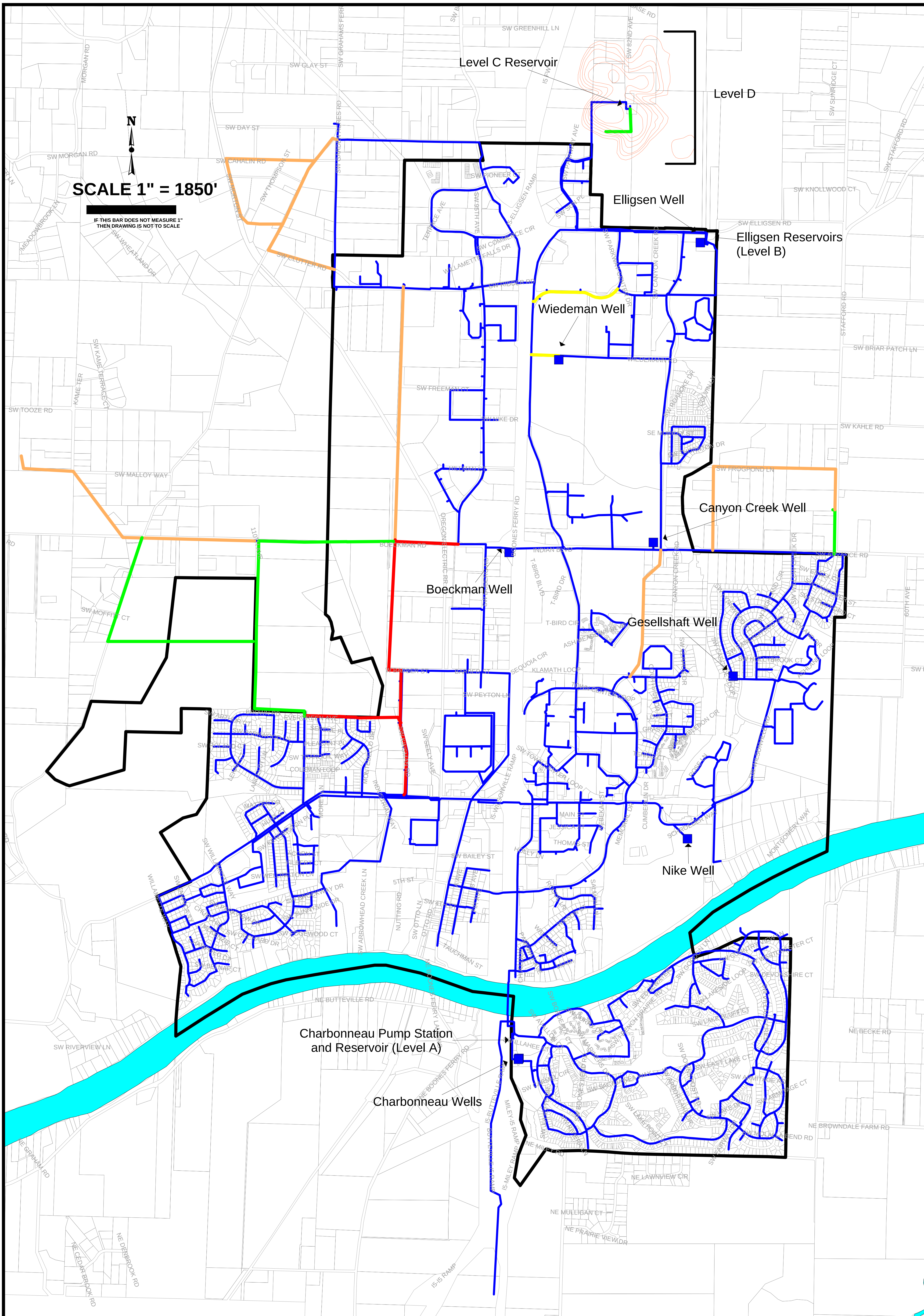
PIPELINE CIP

A total of about 10.3 miles of pipeline projects were identified to meet peak hour demands and peak day demands plus fire flow for existing and buildout conditions. Table 9-1 summarizes capital improvement projects for pipelines that cannot meet criteria established in Section 4. These projects are shown in Figure 9-1 and color coded by recommended year of improvement. The total pipeline improvement cost is approximately $14.1 M.

Table ES-4
Capital Improvement Program

Zone	Description	Peak Day Demand	Peak Hour Demand	Peak Day + Fire Flow Demand	Existing	2000	2005	2010	2015	2020	Project Diameter (inches)	Total Length (feet)	$/LF	Estimate of Cost[1]
Pipeline Projects														
B	Evergreen Road from Kinsman Road to Brown Road		x		N/A		18				18	2092	$171.00	$357,732
B	Boeckman Road from WTP Transmission to 95th Avenue	x		x	N/A		24				24	1290	$275.55	$355,460
B	WTP Transmission Barber Street to Boeckman[2]	x		x	N/A		24				48	2965	$576.00	$1,707,840
B	WTP Transmission Wilsonville Road to Barber Street[2]	x		x	N/A		30				48	2613	$576.00	$1,505,088
B	Boeckman Road from WTP Transmission to 110thAvenue (west)	x			N/A			24			24	2800	$275.55	$771,540
B	110th Avenue South from Boeckman Road to Intersection of Brown Road and Evergreen	x			N/A			18			18	4630	$171.00	$791,730
B	New School Pipeline north from Boeckman Road	x		x	N/A			12			12	1000	$109.65	$109,650
D	D Level Transmission from C Level Reservoir	x		x	N/A			12			12	1000	$109.65	$109,650
B	Dammasch Development to Grahams Ferry Road	x		x	N/A			18			18	3010	$171.00	$514,710
B	From Dammasch Development along Grahams Ferry Road to Boeckman Road	x		x	N/A			18			18	2270	$171.00	$388,170
B	Urban Service Area between Frog Pond Lane and Boeckman Road		x		N/A				12		12	5125	$109.65	$561,956
B	From Boeckman Road near Canyon Creek Well to Vlahos Drive		x		N/A				12		12	2850	$109.65	$312,503
B	Cahalin Road, Morton Street, and Elligsen Way		x		N/A				12		12	3980	$109.65	$436,407
B	Grahams Ferry to Ridder Road, Ridder Road to Garden Acres		x		N/A				12		12	4220	$109.65	$462,723
B	WTP Transmission Boeckman to Ridder[2]	x		x	N/A				18		48	5263	$576.00	$3,031,488
B	New Reservoir Transmission				N/A				30		30	6785	$360.00	$2,442,600
B	Weideman Road from Weideman PS to Parkway Ave		x		10					12	12	570	$109.65	$62,501
B	Parkway Center Drive from Burns Way to Parkway Ave		x		8					12	12	1900	$109.65	$208,335
Sub Total of Pipeline Cost Per Five Year Planning Horizon							**$3,926,120**	**$2,685,450**	**$7,247,677**	**$270,836**				**$14,130,082**
Source and Supply														
						2000	**2005**	**2010**	**2015**	**2020**				
B	5 mgd ASR Development						$1,000,000							$1,000,000
B	5mgd WTP Expansion								$3,750,000					$3,750,000
Sub Total						**$0**	**$1,000,000**	**$0**	**$3,750,000**	**$0**				**$4,750,000**
Pump Station Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Weideman Well Backup Generator							$100,000						$100,000
B	Canyon Creek Well Backup Generator							$100,000						$100,000
B	Gesellschaft Well Backup Generator							$100,000						$100,000
B	Charb Total Booster Flow Meter						$5,000							$5,000
A-B	Emergency Startup and Operation at Charb Booster PS						$50,000							$50,000
D	C Level Booster Pump Station							$225,000						$225,000
Sub Total						**$0**	**$55,000**	**$525,000**	**$0**	**$0**				**$580,000**
Control Valves														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Barber PRV Station						$55,000							$55,000
B	Boeckman PRV Station						$55,000							$55,000
B	Ridder PRV Station								$55,000					$55,000
A-B	PS Bypass at Charb Booster PS from Level B to Level A						$10,000							$10,000
Sub Total						**$0**	**$120,000**	**$0**	**$55,000**	**$0**				**175,000**
Reservoir Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
C	Level C Intertie					$50,000								$50,000
B	Reservoir Land Acquisition						$275,000							$275,000
B	Reservoir Storage Level B (2015 Required)								$1,940,000					$1,940,000
B	Reservoir Storage Level B (2020 Required)									$3,500,000				$3,500,000
Sub Total						**$50,000**	**$275,000**	**$0**	**$1,940,000**	**$3,500,000**				**$5,765,000**
Well and Reservoir Rehabilitation Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
A	Charb Res DeChlorination Facility for Reservoir Drainage					$10,000								$10,000
A	Charb Res Interior Inspection and Cleaning					$25,000		$25,000						$50,000
A	Charb Res Seismic Study					$25,000								$25,000
B	Elligsen Res 1 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 1 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
C	Level C External Painting						$75,000		$75,000					$150,000
C	Level C Internal Inspection and Cleaning						$25,000		$25,000					$50,000
B	Elligsen Res 2 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 2 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
Sub Total						**$110,000**	**$250,000**	**$75,000**	**$250,000**	**$0**				**$685,000**
Plans and Studies														
						2000	**2005**	**2010**	**2015**	**2020**				
	Water System Master Plan						$75,000	$75,000	$75,000	$75,000				$300,000
	Water Rate Study						$40,000	$40,000	$40,000	$40,000				$160,000
	ASR Feasibility Study						$100,000							$100,000
Sub Total						**$0**	**$215,000**	**$115,000**	**$115,000**	**$115,000**				**$560,000**
Total						**$160,000**	**$5,841,120**	**$3,400,450**	**$13,357,677**	**$3,885,836**				**$26,645,082**

1. Estimated Cost are based on Year 2000 Dollars
2. Project Diameter increased to provide potential supply flow to neighboring water providers.



Distribution Pipeline

2005 CIP

2010 CIP

2015 CIP

2020 CIP

City Boundary

Contour >= 415 feet (Level D)

MONTGOMERY WATSON

Figure 9-1
City of Wilsonville

Capital Improvement Program
Pipelines

City of WILSONVILLE in Oregon

The recommended transmission pipeline from Malloy Way to Boeckman Road, which is associated with the proposed reservoir storage, is approximately $2.4 M or 17% of the total pipeline CIP.

SOURCE AND SUPPLY PROJECTS

It is assumed the City will be able to utilize the ASR system to supplement peak day water demand. The total estimated cost of implementing ASR at the City's 8 existing wells is $1,000,000. The ASR system is expected to produce 5 mgd of peak day supply to meet demand beyond 2005. Both monitoring and well head retrofitting are assumed in this cost. By 2015 the City will require in excess of 15 mgd for peak day demand. The estimate for a 10 mgd WTP expansion will be approximately $7,000,000. However, it is recommended that the City only expand the plant by 5 mgd for a total of 15 mgd and continue to use the ASR system as a peaking source. Therefore, the estimated cost included in the CIP for a 5 mgd WTP expansion is $3,750,000.

PUMP STATION PROJECTS

Approximately $580,000 is needed for three pump station generators at Weideman, Canyon Creek, and Gesellshaft Wells to meet the emergency supply criteria and benefit the storage deficit. Included in the pump station capital improvement projects is a demand or pressure feed pump station for the proposed Level C service area. This pump station will provide service to development above the 415 ft elevation near the Level B Reservoir.

CONTROL VALVES

As the WTP transmission pipeline is installed to the north, it is proposed that the transmission pipeline be connected to the water distribution system at a total of 4 points. The initial intertie that will be installed with the WTP facilities will be along Wilsonville Road. In the future a pressure regulating station will be required at the Barber Street intertie, at the Boeckman Road intertie, and at the Ridder Road intertie. Also a bypass control valve at the Charbonneau Booster Pump Station is recommended. This bypass will allow Level B to fill the Level A (Charbonneau) Reservoir under emergency conditions. The total estimated cost for control valves is $175,000.

RESERVOIRS

Section 6 has discussed storage requirements to meet equalization, fire flow and emergency needs. A total of $5.8 M is recommended for storage improvements to buildout. These projects involve the construction of two separate reservoirs. One 2.0 MG reservoir will be required by 2015 and an additional 4.0 MG will be required by 2020 (buildout). Both of these Reservoir projects are for the Level B pressure zone.

WELL AND RESERVOIR MAINTENANCE

This section of the Capital improvement program recommends capital maintenance projects or projects that have cyclic patterns. These projects include the internal and external inspection, cleaning and recoating of the reservoirs. The total cost of the maintenance projects is approximately $685,000.

PLANS AND STUDIES

The following plan and studies are recommended. These studies will allow Wilsonville to investigate the potential for emergency source and peaking supply opportunities through ASR as well as update and maintain a current 5 year capital improvement program and rate study.

- ASR Feasibility Study
- Five year CIP updated every two to five years
- Water Rate Study update every five to ten years
- Water System Master Plan update every ten years.

Exhibit 7

Section 10 - Conclusions and Recommendations

SECTION 10 - CONCLUSIONS AND RECOMMENDATIONS

The City of Wilsonville is currently constructing a new water treatment plant on the Willamette River in conjunction with the Tualatin Valley Water District and will have 10 mgd available by April 2002. Based on the growth projections developed as part of this Master Plan, this initial 10 mgd plant capacity will be adequate to meet the City's needs until approximately 2005. After 2005, the City will need to develop additional supply capacity, ultimately reaching its projected buildout water demand of 20 mgd by 2020.

It is recommended that the City study, plan, and if feasible, implement a 5 mgd Aquifer Storage and Recovery (ASR) system in that timeframe using its existing Columbia Aquifer wells. Under this approach, the City's 10 mgd water treatment plant capacity could be utilized in the winter to produce water and store it in its existing wells. This water would then be withdrawn in the summer peak season demand period. This would then reduce the size of the required long-term plant expansion by 5 mgd. If ASR is successful, the plant expansion would only need to be 5 mgd to meet the projected 2020 demands. If ASR is not approved by OWRD or is not found to be feasible, the plant expansion would need to be 10 mgd..

The City should maintain its very successful water conservation program. In April 2002, once the Willamette WTP is providing the primary source, the need for mandatory water curtailment will be eliminated; however, it is recommended that the tools developed for the water conservation program continue.

Along with source supply, emergency storage and emergency supply are critical to the City to improve its water system. The projected reservoir storage deficit for the City is 6.0 MG in year 2020 (buildout). It is recommended that the City obtain a storage reservoir site at the same elevation as the Elligsen Reservoirs (375 feet) for Zone B, and at that site develop 2.0 MGs of reservoir storage by year 2015. The remaining 4.0 MGs of storage should be constructed by the year 2020.

The City should continue to develop and maintain emergency supply and intertie options such as the one it recently concluded with the City of Tualatin. It is recommended that backup power is provided at Wiedeman, Canyon Creek, and Gesellshaft wells to provide a firm reliable secondary supply source for the City. All wells should be exercised (run) regularly to ensure their viability as a backup source. By establishing a firm reliable secondary supply from the wells and an emergency supply intertie with a total capacity equal to projected average day demand (7.1 mgd), the need for additional storage within the distribution system will be alleviated. This option should be reevaluated if the Willamette WTP develops into a regional water supplier with large transmission to adjacent water providers.

From the hydraulic analysis of the existing distribution system, presently there are no pipeline deficiencies in Wilsonville's water system. The pipeline component of the Capital Improvement Program (CIP) consists of pipeline that will be required by new development. Therefore, as the water system develops, adjustments should be made to the CIP estimated cost in consideration of changed alignments, looping and interconnections to the existing system.

Typically in water distribution systems, the fire flow analysis will result in a significant portion of the CIP being required for pump stations, storage reservoir volume, and pipeline projects to meet fire flows. The City has established the maximum fire flow to be 3000 gallons per minute for four (4) hours, resulting in a smaller portion of the CIP being required for fire flows than is determined in most systems. Therefore, it is recommended the City continue to require that the maximum available fire flow standard of 3000 gallons per minute for four (4) hours be maintained.

The water quality of the well supply and distribution system has historically been excellent. The system meets all current regulations. Some aesthetic measures have been taken in the well system to sequester iron and manganese precipitation in the distribution system and prevent brown water. These measures should continue as needed to maintain the usefulness of the ground water supply. Once the Willamette WTP is brought on line, comprehensive monitoring and analysis of mixing the surface water and well water should be made to confirm studies performed during WTP design. Consideration of taste and odor should be considered as well as the impacts of mixing the warmer Willamette supply with the well supply and the resultant effects on the iron and manganese sequestering program for the groundwater.

The City of Wilsonville has invested in the water system to be able to adequately supply a superior, abundant water source for projected growth and development. As development occurs there will be need to accurately estimate water demands and plan pipeline and facilities for the future growth. Therefore, it is recommended that the City establishes reservoir, valve and pump station maintenance programs and periodically reevaluate the changing water system through water system master planning and rate studies.

WATER MASTER PLAN POLICIES AND IMPLEMENTATION MEASURES

The City's Comprehensive Plan provides a context within which this Master Plan has been developed. The primary goal of the Water Master Plan is derived from Wilsonville's Comprehensive Plan Goal 3.1 providing for infrastructure in general and is as follows:

"To assure that good quality public water supply and distribution facilities are available with adequate but not excessive capacity to meet community needs, while also assuring that growth does not exceed the community's commitment to provide adequate facilities and services."

The Comprehensive Plan also provides the following policies that were used to guide this master plan update:

Comprehensive Plan Policy 3.1.1. The City of Wilsonville shall provide public facilities and services to enhance the health, safety, educational and recreational aspects of urban living.

Comprehensive Plan Policy 3.1.2. The City of Wilsonville shall provide, or coordinate the provision of, facilities and services concurrent with need (created by new development, redevelopment, or upgrades of aging infrastructure.)

Comprehensive Plan Policy 3.1.3. The City of Wilsonville shall take steps to assure that the parties causing a need for expanded facilities and services, or those benefiting from such facilities and services, pay for them.

Comprehensive Plan Policy 3.1.5. The City of Wilsonville shall continue to develop, operate and maintain a water system, including wells, pumps, reservoirs, transmission mains and a surface water treatment plant capable of serving all urban development within the incorporated city limits, in conformance with federal, state, and regional water quality standards. The City shall also continue to maintain the lines of the distribution system once they have been installed and accepted by the City.

Additional policies, and the implementation measures necessary to carry out those policies, were developed specific to the water system and are listed below.

Policy 1. The City of Wilsonville shall continue a comprehensive water conservation program to make effective use of the water infrastructure, source water supply and treatment processes.

Implementation Measures:

1.1. The City will track system water usage through production metering and service billing records and take appropriate actions to maintain an annual average unaccounted for water volume of less than 10% of total production volume.

1.2. The City will continue to make available brochures and instructional pamphlets describing the benefits and methods of water conservation.

1.3. The City will maintain a water rate structure that promotes water conservation through incentives.

1.4. The City will maintain other programs and activities as necessary to maintain effective conservation throughout the water system.

Policy 2. The City of Wilsonville shall make effective use of the existing water system facilities to reduce the need for improvements and extend the life of the existing system.

Implementation Measures:

2.1. The City will maintain water distribution hydraulic model to analyze each development opportunity and hydraulic impact to system.

2.2. The City will maintain facility sizing and capacity to meet OAR 333-061-0025 standards.

2.3. The City will install emergency power generators on all of its existing wells that do not have them so that they can provide water to meet fire flow requirements, thereby reducing required reservoir capacity. This will also provide an additional source of water if the new Willamette Water Treatment Plant is not available for any reason and commercial power is also not operating.

Policy 3. The City of Wilsonville shall provide adequate treated water supply and distribution system capacity for future growth to build-out development conditions.

Implementation Measures:

3.1. The City will use appropriate land use projections to determine future growth and water demand. These projections will be based on best available information provided by the Community Development Department. The future growth scenario will be that which is expected at ultimate build-out.

3.2. The City will expand its new Willamette Water Treatment Plant as needed to maintain an adequate supply of water.

3.3. The City will investigate the ability of an ASR system to reduce the size of future water treatment plant expansions.

3.4. The City will construct pipelines and reservoirs with adequate capacity to meet future projected demands.

Policy 4. The City of Wilsonville shall maintain an accurate user demand profile to account for actual and anticipated demand conditions in order to assure an adequately sized water system.

Implementation Measures:

4.1. The City will develop demand patterns based on land use and user type to accurately represent the current status of the water distribution system.

4.2. Using the historic information the City will maintain the proper demand planning for future water-intensive industrial and commercial enterprises that may locate to Wilsonville.

Policy 5. The City of Wilsonville shall fund the capital improvements with monies collected in accordance with existing laws, rules, and regulations.

Implementation Measures:

5.1. Water facilities serving the general City population shall be built and financed by the City. Financing may include revenue bonds, water utility fees, or the reimbursement component of system development charges. The improvement component of system development charges may be used to finance that portion of these projects that is used to provide increased capacity for future growth.

5.2. Where water transmission mains are built by the City but also provide water service to adjacent properties, said properties shall be assessed for the proportionate share of the water main construction costs when water is first used by each abutting property.

5.3. Water mains 12-inches in diameter and smaller extended to provide water service to properties not previously served shall be paid for in one of following ways:

A. The landowner (developer) shall construct the mains at his cost and when completed and acceptable to the City, the pipeline shall be deeded to the City.

B. First, the landowner (developer) agrees with the City that as other lands adjacent to the proposed main connect to it within 10 years after its construction, a proportionate share of the constructed main's cost will be collected to reimburse the original landowner (developer). With this agreement the City then constructs the main at the landowner's (developer's) cost.

C. Where one or more property owners wish water service they may petition the City to form a local improvement district (LID). Once an LID is formed the facilities are built and costs are assessed in an equitable manner to the benefited property.

5.4. Where mains over 12-inches in diameter or mains extending beyond the distance necessary to serve the owners property are installed by others and the main is designed to serve as a City transmission pipeline, the City may reimburse the proportional share of the oversizing or extension cost either by direct payment or more likely, as a credit against system development charges.

Policy 6. The City of Wilsonville shall coordinate distribution system improvements with other CIP projects, such as roads, wastewater, storm sewer, to save construction costs and minimize public impacts during construction.

Policy 7. The City shall have a master plan that can be adjusted for changes in water requirements.

Implementation Measures:

7.1. Council may approve changes in planning areas and service areas provided changes are compatible with Metro urban planning decisions and that water is available.

7.2. The City Engineer can approve changes in distribution and transmission main sizes provided that the changes are compatible with the approved changes in land use and then current regulatory requirements.

Exhibit 7

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LIST OF ABBREVIATIONS

ADD - Average Day Demand
ASR – Aquifer Storage and Recovery
AWWA- American Water Works Association
^{o}C – Degrees Celsius
ccf – 100 Cubic Feet
CCI – Construction Cost Index
cfs – cubic foot per second
CIP – Capital Improvement Program
CRW - Clackamas River Water
ENR – Engineering News Record
EPA – U.S. Environmental Protection Agency
ft - feet
fps – foot per second
gal - gallon
GIS - Geographic Information System
gpcd – gallons per capital per day
gpd – gallons per day
gpm – gallons per minute
HAA5 – Haloacetic Acids – a class of organic chemicals
HP, hp – Horse Power
Hr - hour
in - inch
MCL – Maximum Contaminant Level
Metro - Metropolitan Service District
MDD - Maximum Day Demand (PDD)
MFR – Multi Family Residential
MG – million gallons
mg/L – milligrams per liter
mgd – million gallons per day
mL – Milliliters
NA - Not Applicable
ND – Non Detect
NR - Not Recorded
NTU – Nepthelometric Turbidity Units, a Measure of Water Clarity
ODEQ – Oregon Department of Environmental Quality
ODOT - Oregon Department of Transportation
OHD – Oregon Health Division
ORS – Oregon Revised Statutes

LIST OF ABBREVIATIONS (continued)

OWRD – Oregon Water Resources Department
pCi/L – Pico Curies per Liter
PDD - Peak Day Demand (MDD)
pH – a measure of acidity or alkalinity of water
psi - pounds per square inch (gage)
PRV's - Pressure Reducing Valves
PSU – Portland State University
SCADA – System Control and Data Acquisition
SDC – System Development Charge
sf – square foot
SFR – Single Family Residential
TAZ – Traffic Analysis Zone
THM - Trihalomethanes
TTHM – Total Trihalomethanes
TVWD – Tualatin Valley Water District
UFC – Uniform Fire Code
UGB – Urban Growth Boundary
ug/l – microgram per liter
UV - Ultraviolet
WTP – Water Treatment Plant

GLOSSARY OF TERMINOLOGY

Aquifer — (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply.

Best Management Practices (BMP) — Water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice that provides for the more efficient use of existing water supplies or contributes towards the conservation of water; or (2) Practices which provide sufficient data to clearly indicate their value, are technically and economically reasonable, are environmentally and socially acceptable, are reasonably capable of being implemented by water purveyors and users, and for which significant conservation or conservation-related benefits can be achieved.

Clean Water Act (CWA) [Public Law 92–500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and "fishable" and "swimmable" surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Commercial Water Use (Withdrawals) — Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows.

Conjunctive (Water) Use — (1) The operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use by intentionally recharging the basin during years of above-average water supply. (2) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (3) The integrated use and management of hydrologically connected groundwater and surface water.

Consumptive (Water) Use — (1) A use which lessens the amount of water available for another use (e.g., water that is used for development and growth of plant tissue or consumed by humans or renders it no longer available because it has been evaporated, transpired by plants, incorporated into products or corps, consumed by people or livestock, or otherwise removed from water supplies. (3) The portion of water withdrawn from a surface or groundwater source that is consumed for a particular use (e.g., irrigation, domestic needs, and industry), and does not return to its original source or another body of water. The terms *Consumptive Use* and *Nonconsumptive Use* are traditionally associated with water rights and water use studies, but they are not completely definitive. No typical consumptive use is 100 percent efficient; there is always some return flow associated with such use either in the form of a return to surface flows or as a ground water recharge. Nor are typically nonconsumptive uses of water entirely nonconsumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydropower, and there are conveyance losses associated with maintaining a minimum streamflow in a river, diversion canal, or irrigation ditch.

Cubic Feet Per Second (CFS) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic foot per second is equal to the discharge of a stream having a cross section of 1 square foot and flowing at an average velocity of 1 foot per second. It also equals a rate of approximately 7.48 gallons per second, 448.83 gallons per minute. 1.9835 acre-feet per day, or 723.97 acre-feet per year.

Curtailment Program. – A system of incentives or mandatory restrictions intended to encourage conservation and/or forcibly restrict water use as a means of reducing the peak day demand. Also called *Water Restrictions.*

Domestic Water Use (Withdrawals) — Water used normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained From a public supply or may be self supplied. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also referred to as *Residential Water Use.*

Domestic Well — A water well used solely for domestic, i.e., residential or household purposes to include both indoor and outdoor water uses. Such wells are generally not required to be permitted; however, they may have restrictions in terms of daily pumping amounts, for example, 1,800 gallons per day.

Gage, or Gauge — (1) An instrument used to measure magnitude or position; gages may be used to measure the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, the depth of snowfall, etc. (2) The act or operation of registering or measuring magnitude or position. (3) The operation, including both field and office work, of measuring the discharge of a stream of water in a waterway.

Gallons per Capita (Person) per Day (GPCD) — An expression of the average rate of domestic and commercial water demand, usually computed for public water supply systems. Depending on the size of the system, the climate, whether the system is metered, the cost of water, and other factors, *Public Water Supply Systems (PWSS)* in the United States experience a demand rate of approximately 60 to 150 gallons per capita per day.

Ground Water, also Groundwater — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Industrial Water Use (Withdrawals) — Industrial water use includes water used for processing activities, washing, and cooling. Major water-using manufacturing industries include food processing, textile and apparel products, lumber, furniture and wood products, paper production, printing and publishing, chemicals, petroleum, rubber products, stone, clay, glass and concrete products, primary and fabricated metal industries, industrial and commercial equipment and electrical, electronic and measuring equipment and transportation equipment. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Commercial Water Use (Withdrawals).*

Instream Flow or Instream Use — (1) The amount of water remaining in a stream, without diversions, that is required to satisfy a particular aquatic environment or water use. (2) Nonconsumptive water requirements which do not reduce the water supply; water flows for uses within a defined stream channel. Examples of instream flows include:

[1] ***Aesthetics*** — Water required for maintaining flowing steams, lakes, and bodies of water for visual enjoyment;

[2] ***Fish and Wildlife*** — Water required for fish and wildlife;

[3] ***Navigation*** — Water required to maintain minimum flow for waterborne commerce;

[4] ***Quality Dilution*** — Water required for diluting salt and pollution loading to acceptable concentrations; and

[5] ***Recreation*** — Water required for outdoor water recreation such as fishing, boating, water skiing, and swimming.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports.*

Intrabasin Transfer (of Water) — Transfers of water within the same water basin or hydrographic area.

Irrigation Water Use (Withdrawals) — Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands, such as parks and golf courses. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows.

Municipal and Industrial (M & I) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system for rural domestic use, stock water, steam electric powerplants, and water used in industry and commerce.

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial* (or *Induced*) *Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Planning — A comprehensive study of present trends and of probable future developments, together with recommendations of policies to be pursued. Planning embraces such subjects as population growth and distribution; social forces; availability of land, water, minerals, and other natural resources; technological progress; and probable future revenues, expenditures, and financial policies. Planning must be responsive to rapidly changing conditions.

Planning Horizon — The overall time period considered in the planning process that spans all activities covered in or associated with the analysis or plan and all future conditions and effects or proposed actions which would influence the planning decisions.

Priority — The concept that the person first using water has a better right to it than those commencing their use later. An appropriator is usually assigned a "priority date". However, the date is not significant in and of itself, but only in relation to the dates assigned other water users from the same source of water. Priority is only important when the quantity of available water is insufficient to meet the needs of all those having a right to use water.

Public Supply Water — (1) Water withdrawn for all users by public and private water suppliers and delivered to users that do not supply their own water. (2) Water withdrawn by and delivered to a public water system regardless of the use made of the water. Includes water supplied both by large municipal systems and by smaller quasi-municipal or privately-owned water companies. Water suppliers provide water for a variety of uses, such as *Domestic Water Use* (also referred to as *Residential Water Use*), *Commercial Water Use*, *Industrial Water Use*, *Thermoelectric Power Water Use* (domestic and cooling purposes), and *Public Water Use*.

Public Water Use — Water supplied from a *Public Water Supply System (PWSS)* and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Public water use also includes system water losses (water lost to leakage) and brine water discharged from desalination facilities. Also referred to as *Utility Water Use*.

Rate. - A unit of measure or reference of quantity. These terms are used frequently throughout the document, and may typically mean either the amount charged for the provision of water, or the amount of water that is treated of consumed. As an example, the "going rate" for water might be about $1.50 per one hundred cubit feet. The rate of production may be expressed as 300 gallons per minute and the rate of demand or consumption might be 251 gallons per household per day. Carefully note the context the term is used in.

Residential Water Use — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*.

Safe Drinking Water Act [SDWA] (Public Law 93–523) — An amendment to the *Public Health Service Act* which established primary and secondary quality standards for drinking water. The SDWA was passed in 1976 to protect public health by establishing uniform drinking water standards for the nation. In 1986 SDWA Amendments were passed that mandated the *U.S. Environmental Protection Agency (EPA)* to establish standards for 83 drinking water contaminants by 1992 and identify an additional 25 contaminants for regulation every 3 years thereafter.

Surface Water — (1) An open body of water such as a stream, lake, or reservoir. (2) Water that remains on the earth's surface; all waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water. (3) A source of drinking water that originates in rivers, lakes and run-off from melting snow. It is either drawn directly from a river or captured behind dams and stored in reservoirs.

Thermoelectric (Power) Water Use — Water used in the process of the generation of *Thermoelectric Power*. The water may be obtained from a *Public Water Supply System* or may be self supplied.

Total Dissolved Solids (TDS) — (Water Quality) A measure of the amount of material dissolved in water (mostly inorganic salts). Typically aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. The common and synonymously used term for TDS is “salt”. Usually expressed in milligrams per liter.

Turbidity — A measure of the reduced transparency of water due to suspended material which carries water quality implications. The term “turbid” is applied to waters containing suspended matter that interferes with the passage of light through the water or in which visual depth is restricted. The turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton and other microscopic organisms and similar substances.

Water Administration (and Management) — A broad term referring to the collective role of defined state agencies to implement state and federal water laws, commonly through the development and implementation of appropriate statutes and regulations. This role can include oversight, approval, and enforcement responsibilities.

Water Conservation — The physical control, protection, management, and use of water resources in such a way as to maintain crop, grazing, and forest lands, vegetative cover, wildlife, and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy. The extent to which these actions actually create a savings in water supply depends on how they affect new water use and depletion.

Water Master Plan — A document of issues, policies, strategies and action plans intended to effectively and economically execute a *Water Planning* process.

Water Planning — Water planning is an analytical planning process developed and continually modified to address the physical, economic, and sociological dimensions of water use. As a planning process it must assess and quantify the available supply of water resources and the future demands anticipated to be levied upon those resources. Based upon this continuous supply and demand evaluation, water planning must also give direction for moving water supplies to points of use while encouraging users to be good and effective stewards of available water resources. The water planning process requires constant re-evaluation and updating to address changing social, political, economic, and environmental parameters. While the ultimate objective of such efforts is typically the development of a comprehensive, publicly-supported *Water Master Plan*, it is also critical to develop and maintain a comprehensive and viable water planning process that covers various aspects of water resource development, transport, water treatment, allocation among various competing uses, conservation, waste-water treatment, re-use, and disposal.

Water Right — (1) The legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose. (2) A legally-protected right, granted by law, to take possession of water occurring in a water supply and to put it to *Beneficial Use*. (3) A legal right to divert state waters for a beneficial purpose.

Watershed — (1) An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. (2) All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water. Also referred to as *Water Basin* or *Drainage Basin*. (3) A ridge of relatively high land dividing two areas that are drained by different river systems. Also referred to as *Water Parting.*

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount.

Xeriscape™ — Landscaping with native and naturalized plant species that are adapted to survive in areas of low precipitation. [*Trademark Note:* The term "Xeriscape" is a trademark of the National Xeriscape Council, Inc., and accordingly must always be capitalized, must always be used the first time with a "™" symbol, and can only be used as an adjective, e.g., Xeriscape landscaping, a Xeriscape garden, etc.]

Exhibit 7

Appendix A - Exhibit T

Exhibit T

CITY OF WILSONVILLE
1998 ANNUAL WATER QUALITY REPORT *

SUMMARY: *This report describes Wilsonville's current water source and its quality. We are pleased to report that the water delivered to you - - our customers - - is safe and meets all federal and state drinking water requirements. We nonetheless have other water supply problems. The City is in the midst of a water shortage. Also, there are harmless but annoying sediments that occasionally discolor the tap water. As noted in this report, steps are being taken to resolve the water shortage, and to eliminate the "brown water" problem.*

WHERE OUR WATER COMES FROM

Currently, the City obtains all its water from 8 local wells that tap a large groundwater formation called the Columbia River Basalt Aquifer. This water comes from snow and rain seeping into the basalt rock in the foothills miles away from Wilsonville. It takes decades (perhaps centuries) for this water to slowly percolate through the aquifer. The good news is: the water is highly filtered by the time it reaches Wilsonville. There are no harmful contaminants in the water pumped from the City's wells. The bad news is: we are currently pumping water out of this aquifer faster than it is being replenished. As the water table declines, so does the productivity of the City's wells.

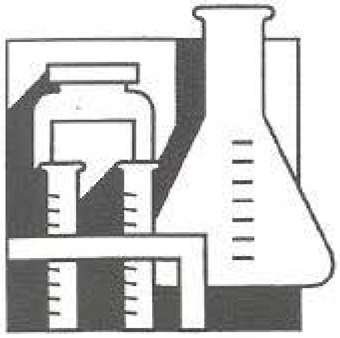
The Oregon Water Resources Department (OWRD) has classified this portion of the aquifer as "groundwater limited." According to OWRD, Wilsonville's reliance on this source for long-term water supply is unacceptable. By January 1998 the water shortage became so critical the Wilsonville City Council declared a moratorium on approvals for new development. State law requires the City to resolve this water shortage and lift the moratorium within two years. Following years of study and public discussion, the Wilsonville City Council has voted to construct a water treatment plant on the Willamette River (utilizing the City's long-standing water rights to this source). The existing wells would be maintained and used for supplemental supply and emergency backup.

Another problem with the declining water table is its relatively high mineral content. The longer the groundwater is in contact with surrounding rock, the more minerals leach into the water. The dissolved minerals are colorless and harmless. In fact, minerals such as iron are part of a well balanced diet. But as these dissolved minerals (particularly iron and manganese) flow through the water lines, they are converted to rust-colored sediments inside the pipes. These sediments cause the "brown water" many of our customers have experienced. While not a health concern, it can be a severe aesthetic problem. It can also clog water filters, stain porcelain fixtures, and stain laundry. The City's new water supply will have a lower mineral content, and the "brown water" problems will become a thing of the past. In the meantime, the City will be adding a substance called polyphosphate to the well water in order to keep the minerals in their colorless, dissolved state. Polyphosphate is widely used in this way, and is approved by regulatory agencies to be safe for this purpose.

* This document complies with the new federal law requiring water utilities to provide water quality information to customers every year.

THINGS WE LOOKED FOR - - BUT WERE NOT DETECTABLE

Wilsonville routinely monitors for constituents in your drinking water according to federal and state laws. We are pleased to report that none of the following were detected in the water supply:



Microbes

(indicators of potential disease-causing contaminants)

e-coli
fecal coliform
total coliform
Giardia
Cryptosporidium

Inorganic Contaminants

(chemicals that occur naturally and may be in water by means of erosion and leaching of mineral deposits)

antimony
asbestos
beryllium
cadmium
cyanide
fluoride
mercury
nitrate
nitrite
selenium
thallium

Volatile Organics

(chemical compounds such as cleaning fluids, degreasers and plastics)

benzene
carbon tetrachloride
chlorobenzene
o-dichlorobenzene
p-dichlorobenzene
1,2-dichloroethane
1,1-dichloroethylene
cis-1,2-dichloroethylene
trans-1,2-dichloroethylene
dichloromethane
1,2-dichloropropane
ethylbenzene
styrene
tetrachloroethylene
1,2,4-trichlorobenzene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethylene
toluene
vinyl chloride
xylenes

Synthetic Organics

(chemical compounds that include insecticides and herbicides)

2,4-D
2,4,5-TP
alachlor
atrazine
benzo(a)pyrene
carbofuran
chlordane
dalapon
di(2-ethylhexyl) adipate
di(2-ethylhexyl) phthalate
dibromochloropropane
dinoseb
diquat
endothall
endrin
ethylene dibromide
glyphosate
heptachlor
heptachlor epoxide
hexachlorobenzene
hexachlorocyclopentadiene
lindane
methoxychlor
oxamyl
PCBs
pentachlorophenol
picloram
simazine
toxaphene

THING WE LOOKED FOR - - AND FOUND

The following table displays results of further water quality monitoring. **As you can see, our system had no violations. The U. S. Environmental Protection Agency (EPA) has determined that your water is safe at these levels**. In reading the table, please note the following definitions:

Maximum contaminant level goal (MCLG). The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum contaminant level (MCL). The highest level of a contaminant that is allowed in drinking water. MCL's are set as close to the MCLG's as feasible using the best available treatment technology. MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

n/a = not applicable

ppm = parts per million (or milligrams per liter)

ppb = parts per billion (or micrograms per liter)

pCi/l = picocuries per liter (a measure of radioactivity)

AL = action level. The concentration of a contaminant which, if exceeded, triggers a treatment or other requirement which a water system must follow.

Contaminant	Date Tested	Unit	Maximum Amount Detected	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Goal (MCLG)	Potential Source(s) of Contamination	Violation?
Inorganic Contaminants							
arsenic	4/22/96	ppb	1.7	50	n/a	erosion of natural deposits; runoff from orchards; runoff from glass and electronics production wastes	NO
barium	4/22/96	ppm	0.02	2	2	discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	NO
chromium	4/22/96	ppb	2	100	100	discharge from steel and pulp mills; erosion of natural deposits	NO
Volatile Organic Contaminants							
total trihalomethanes	11/25/98	ppb	9.8	100	0	by-product of drinking water chlorination	NO
Radioactive Contaminants							
alpha emitters	11/98	pCi/l	2	15	0	erosion of natural deposits	NO
Lead and Copper Corrosion							
lead	summer 1997	ppb	4	AL=15	0	corrosion of household plumbing systems; erosion of natural deposits	NO
(Note: The 90th percentile lead level was 3 ppb. All levels detected were below the action level of 15 ppb.)							
copper	summer 1997	ppm	0.2	AL=1.3	1.3	corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives	NO
(Note: The 90th percentile copper level was 0.2 ppm. All levels detected were below the action level of 1.3 ppm.)							

OTHER WATER QUALITY TESTING

Beyond health and safety issues, we also monitor various aesthetic properties of the water. The results listed here show the range of measurements from all eight well sites.

Analysis	Unit	Range of Amount Detected
pH	pH units	6.25 to 8.01
iron	ppm	ND* to 1.6
manganese	ppm	ND* to 0.09
sodium	ppm	8.2 to 37
calcium	ppm	20 to 62
hardness	grains per gallon	5.3 to 15.2

* ND = none detected

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessariiy indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

FOR FURTHER INFORMATION . . .

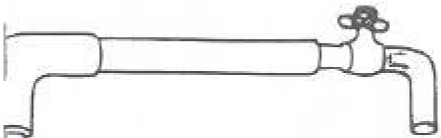
If you have any questions about this report or would like additional information please contact Jeff Bauman, Wilsonville's Public Works Director, at (503) 682-4092. You may also learn more by attending any of the regularly scheduled meetings of the Wilsonville City Council. These meetings are held at 7:00 p.m. on the first and third Monday of each month. The Council currently meets at 8445 S.W. Elligsen Road. However, the Council meetings will move to the expanded Community Center located behind City Hall at 30000 S.W. Town Center Loop E. when renovations there are completed.

City of
WILSONVILLE
in OREGON
)000 SW Town Center Loop E.
Wilsonville, OR 97070

CITY OF WILSONVILLE 1999 ANNUAL WATER QUALITY REPORT *

City of Wilsonville
30000 SW Town Center Loop E.
Wilsonville, OR 97070
503-682-1011

SUMMARY: This report describes Wilsonville's current water source and its quality. We are pleased to report that the water delivered to you - - our customers - - is safe and meets all federal and state drinking water requirements. We nonetheless remain in the midst of a water shortage. This report provides a brief update on the steps being taken to resolve the water shortage.



Where Does Our Water Come From?

Currently, the City obtains all its water from 8 local wells that tap a large groundwater formation called the Columbia River Basalt Aquifer. This water comes from snow and rain seeping into the basalt rock in the foothills miles away from Wilsonville. It takes decades (perhaps centuries) for this water to slowly percolate through the aquifer. The good news is: the water is highly filtered by the time it reaches Wilsonville. There are no harmful contaminants in the water pumped from the City's wells. The bad news is: we are currently pumping water out of this aquifer faster than it is being replenished. As the water table declines, so does the productivity of the City's wells.

Another problem with the declining water table is its relatively high mineral content. The longer the groundwater is in contact with surrounding rock, the more minerals leach into the water. While not a health concern, this can be a severe aesthetic problem. It can also clog water filters, stain porcelain fixtures, and stain laundry. The City's new water supply (see paragraphs below) will have a lower mineral content, and these problems will become a thing of the past. In the meantime, the City is adding a substance called polyphosphate to the well water in order to keep the minerals in a colorless, dissolved state. Polyphosphate is widely used in this way, and is approved by regulatory agencies to be safe for this purpose.

The Oregon Water Resources Department (OWRD) has classified this portion of the aquifer as "groundwater limited." According to OWRD, Wilsonville's reliance on this source for long-term water supply is unacceptable. After years of study and public discussion, the Wilsonville City Council voted in June 1999 to construct a state-of-the-art water treatment plant on the Willamette River (utilizing the City's long-standing water rights to this source). The existing wells would be maintained and used for supplemental supply and emergency backup. The Council placed this matter on the ballot for a special election in September 1999, at which time voters approved the funding for the Willamette River water treatment plant.

The City has hired a multi-disciplinary team to design and construct this project. The team includes engineers, architects, landscape specialists, public involvement personnel, and a general contractor. The water treatment plant is scheduled to be on line by April 2002. In the meantime, water in Wilsonville remains in short supply - - particularly during the summer months. Numerous conservation efforts are underway to assure available water is used efficiently.

** This document complies with federal law requiring water utilities to provide water quality information to customers annually.*

THINGS WE LOOKED FOR -- BUT WERE NOT DETECTABLE

Wilsonville routinely monitors for constituents in your drinking water according to federal and state laws. We are pleased to report that none of the following were detected in the water supply:

Microbes

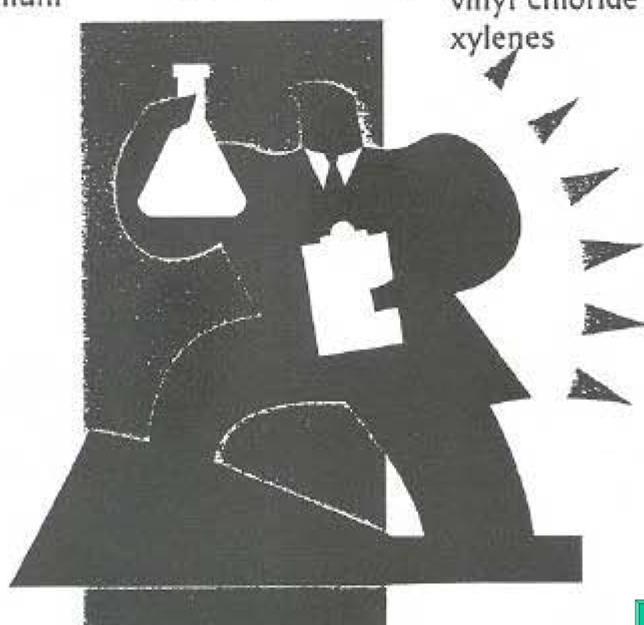
(indicators of potential disease-causing contaminants)

- *e-coli*
- fecal coliform
- total coliform
- *Giardia*
- *Cryptosporidium*

Inorganic Contaminants

(chemicals that occur naturally and may be in water by means of erosion and leaching of mineral deposits)

- antimony
- arsenic
- barium
- beryllium
- cadmium
- chromium
- cyanide
- fluoride
- mercury
- nitrite
- selenium
- thallium



Volatile Organics

(chemical compounds such as cleaning fluids, degreasers and plastics)

- benzene
- carbon tetrachloride
- chlorobenzene
- o-dichlorobenzene
- p-dichlorobenzene
- 1,2-dichloroethane
- 1,1-dichloroethylene
- cis-1,2-dichloroethylene
- trans-1,2-dichloroethylene
- dichloromethane
- 1,2-dichloropropane
- ethylbenzene
- styrene
- tetrachloroethylene
- 1,2,4-trichlorobenzene
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- trichloroethylene
- toluene
- vinyl chloride
- xylenes

Synthetic Organics

(chemical compounds that include insecticides and herbicides)

- 2,4-D
- 2,4,5-TP
- alachlor
- atrazine
- benzo(a)pyrene
- carbofuran
- chlordane
- dalapon
- di(2-ethylhexyl) adipate
- di(2-ethylhexyl) phthalate
- dibromochloropropane
- dinoseb
- diquat
- endothall
- endrin
- ethylene dibromide
- glyphosate
- heptachlor
- heptachlor epoxide
- hexachlorobenzene
- hexachlorocyclopentadiene
- lindane
- methoxychlor
- oxamyl
- PCBs
- pentachlorophenol
- picloram
- simazine
- toxaphene

THINGS WE LOOKED FOR - - AND FOUND

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AL = action level. The concentration of a contaminant which, if exceeded, triggers a treatment or other requirement which a water system must follow.

Contaminant	Date Tested	Unit	Maximum Amount Detected	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Goal (MCLG)	Potential Source(s) of Contamination	Violation?
Inorganic Contaminants							
nitrate	6/28/99	ppm	0.8	10	10	runoff from fertilizer use; leaching from septic tanks; erosion of natural deposits	NO
Volatile Organic Contaminants							
total trihalomethanes	9/3/99	ppb	28.9	100	0	by-product of drinking water chlorination	NO
Radioactive Contaminants							
alpha emitters	11/98	pCi/l	2	15	0	erosion of natural deposits	NO
Lead and Copper Corrosion							
lead	summer 1997	ppb	4	AL = 15	0	corrosion of household plumbing systems; erosion of natural deposits	NO
(Note: The 90th percentile lead level was 3 ppb. All levels detected were below the action level of 15 ppb.)							
copper	summer 1997	ppm	0.2	AL = 1.3	1.3	corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives	NO
(Note: The 90th percentile copper level was 0.2 ppm. All levels detected were below the action level of 1.3 ppm.)							

OTHER WATER QUALITY TESTING

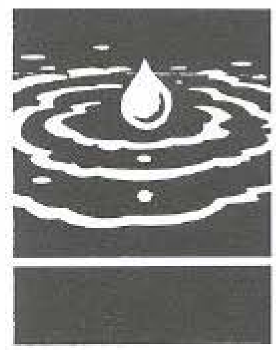
Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

The Environmental Protection Agency is considering regulations for radon in water supplies. Proposed standards range from 300 pCi/l to 4,000 pCi/l. Radon levels in water from Wilsonville's wells range between 110 pCi/l and 825 pCi/l.

We also monitor various aesthetic properties of the water. The results listed here show the range of measurements from all eight well sites.

Analysis	Unit	Range of Amount Detected
pH	pH units	7.26 to 7.69
iron	ppm	ND* to 3.37
manganese	ppm	ND* to 0.1
sodium	ppm	7.5 to 37.3
calcium	ppm	19.5 to 65
hardness	grains per gallon	5.2 to 14.3

* ND = none detected



Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

FOR FURTHER INFORMATION . . .

If you have any questions about this report or would like additional information please contact Jeff Bauman, Wilsonville's Public Works Director, at (503) 682-4092. You may also learn more by attending meetings of the Wilsonville City Council. These meetings regularly occur at 7:00 p.m. on the first and third Monday of each month. The Council meets at the Community Center (located behind City Hall) at 7965 SW Wilsonville Rd.

City of WILSONVILLE in OREGON

30000 SW Town Center Loop E.
Wilsonville, OR 97070

CITY OF WILSONVILLE
2000 ANNUAL WATER QUALITY REPORT *

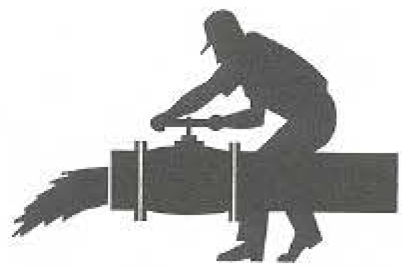
SUMMARY: This report describes Wilsonville's current water source and its quality. We are pleased to report that the water delivered to you - - our customers - - is safe and meets all federal and state drinking water requirements. We nonetheless remain in the midst of a water shortage until the new water treatment plant comes on line in the spring of 2002.

Where Does Our Water Come From?

Currently, the City obtains all its water from 8 local wells that tap a large groundwater formation called the Columbia River Basalt Aquifer. This water comes from snow and rain seeping into the basalt rock in the foothills miles away from Wilsonville. It takes decades (perhaps centuries) for this water to slowly percolate through the aquifer. The good news is: the water is highly filtered by the time it reaches Wilsonville. There are no harmful contaminants in the water pumped from the City's wells. The bad news is: we are currently pumping water out of this aquifer faster than it is being replenished. As the water table declines, so does the productivity of the City's wells.

Another problem with the declining water table is its relatively high mineral content. The longer the groundwater is in contact with surrounding rock, the more minerals leach into the water. While not a health concern, this can be a severe aesthetic problem. It can also clog water filters, stain porcelain fixtures, and stain laundry. The City's new water supply (see paragraphs below) will have a lower mineral content, and these problems will become a thing of the past. In the meantime, the City is adding a substance called polyphosphate to the well water in order to keep the minerals in a colorless, dissolved state. Polyphosphate is widely used in this way, and is approved by regulatory agencies to be safe for this purpose.

The Oregon Water Resources Department (OWRD) has classified this portion of the aquifer as "groundwater limited." According to OWRD, Wilsonville's reliance on this source for long-term water supply is unacceptable. After years of study and public discussion, the Wilsonville City Council voted in June 1999 to construct a state-of-the-art water treatment plant on the Willamette River (utilizing the City's long-standing water rights to this source). The existing wells would be maintained and used for supplemental supply and emergency backup. The Council placed this matter on the ballot for a special election in September 1999, at which time voters approved the funding for the Willamette River water treatment plant.



The City has hired a multi-disciplinary team to design, construct, and operate this facility. The project is on budget and is scheduled to be on line by April 2002. In the meantime, water in Wilsonville remains in short supply - - particularly during the summer months. Numerous conservation efforts are underway to assure available water is used efficiently.

* This document complies with federal law requiring water utilities to provide water quality information to customers annually.

THINGS WE LOOKED FOR -- BUT WERE NOT DETECTABLE

Wilsonville routinely monitors for constituents in your drinking water according to federal and state laws. We are pleased to report that none of the following were detected in the water supply:

Microbes

(indicators of potential disease-causing contaminants)

e-coli
fecal coliform
total coliform
Giardia
Cryptosporidium

Inorganic Contaminants

(chemicals that occur naturally and may be in water by means of erosion and leaching of mineral deposits)

antimony
arsenic
barium
beryllium
cadmium
chromium
cyanide
fluoride
mercury
nitrite
selenium
thallium

Volatile Organics

(chemical compounds such as cleaning fluids, degreasers and plastics)

benzene
carbon tetrachloride
chlorobenzene
o-dichlorobenzene
p-dichlorobenzene
1,2-dichloroethane
1,1-dichloroethylene
cis-1,2-dichloroethylene
trans-1,2-dichloroethylene
dichloromethane
1,2-dichloropropane
ethylbenzene
MTBE
styrene
tetrachloroethylene
1,2,4-trichlorobenzene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethylene
toluene
vinyl chloride
xylenes

Synthetic Organics

(chemical compounds that include insecticides and herbicides)

2,4-D
2,4,5-TP
alachlor
atrazine
benzo(a)pyrene
carbofuran
chlordane
dalapon
di(2-ethylhexyl) adipate
di(2-ethylhexyl) phthalate
dibromochloropropane
dinoseb
diquat
endothall
endrin
ethylene dibromide
glyphosate
heptachlor
heptachlor epoxide
hexachlorobenzene
hexachlorocyclopentadiene
lindane
methoxychlor
oxamyl
PCBs
pentachlorophenol
picloram
simazine
toxaphene

THINGS WE LOOKED FOR - - AND FOUND

The following table displays results of further water quality monitoring. **<u>As you can see, our system had no violations. The U. S. Environmental Protection Agency (EPA) has determined that your water is safe at these levels</u>**. In reading the table, please note the following definitions:

Maximum contaminant level goal (MCLG). The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum contaminant level (MCL). The highest level of a contaminant that is allowed in drinking water. MCL's are set as close to the MCLG's as feasible using the best available treatment technology. MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

n/a = not applicable
ppm = parts per million (or milligrams per liter)
ppb = parts per billion (or micrograms per liter)
pCi/l = picocuries per liter (a measure of radioactivity)
AL = action level. The concentration of a contaminant which, if exceeded, triggers a treatment or other requirement which a water system must follow. For lead and copper, a water supply is in compliance with the drinking water standards if 90% of the samples are less than or equal to the "action level."

Contaminant	Date Tested	Unit	Maximum Amount Detected	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Goal (MCLG)	Potential Source(s) of Contamination	Violation?
Inorganic Contaminants							
nitrate	6/28/99	ppm	0.8	10	10	runoff from fertilizer use; leaching from septic tanks; erosion of natural deposits	NO
Volatile Organic Contaminants							
total trihalomethanes	9/13/00	ppb	8.5	100	0	by-product of drinking water chlorination	NO
Radioactive Contaminants							
alpha emitters	10/2/00	pCi/l	7.86	15	0	erosion of natural deposits	NO
Lead and Copper Corrosion							
lead	summer 2000	ppb	28	AL=15	0	corrosion of household plumbing systems; erosion of natural deposits	NO
(Note: The 90th percentile lead level was 3 ppb. All levels detected were below the action level of 15 ppb except one sample at 28ppb.)							
copper	summer 2000	ppm	0.26	AL=1.3	1.3	corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives	NO
(Note: The 90th percentile copper level was 0.21 ppm. All levels detected were below the action level of 1.3 ppm.)							

OTHER WATER QUALITY TESTING

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

The Environmental Protection Agency is considering regulations for radon in water supplies. Proposed standards range from 300 pCi/l to 4,000 pCi/l. Radon levels in water from Wilsonville's wells range between 105 pCi/l and 695 pCi/l.

We also monitor various aesthetic properties of the water. The results listed here show the range of measurements from all eight well sites.

Analysis	Unit	Range of Amount Detected
pH	pH units	7.26 to 7.69
iron	ppm	ND* to 3.37
manganese	ppm	ND* to 0.1
sodium	ppm	7.5 to 37.3
calcium	ppm	19.5 to 65
hardness	grains per gallon	5.2 to 14.3

* ND = none detected

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

FOR FURTHER INFORMATION . . .

If you have any questions about this report or would like additional information please contact Jeff Bauman, Wilsonville's Public Works Director, at (503) 682-4092. You may also learn more by attending meetings of the Wilsonville City Council. These meetings regularly occur at 7:00 p.m. on the first and third Monday of each month. The Council meets at the Community Center (located behind City Hall) at 7965 SW Wilsonville Rd.

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Table 3-2
Willamette River Raw Water Quality Monitoring Results 2000-2001
EPA PRIMARY DRINKING WATER STANDARD CONTAMINANTS

EPA Primary Drinking Water Standards	Max. Contaminant Level	Max. Contam. Level Goal	Method Detection Limit	Method of Measurement	Units of Measure	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Inorganic Constituents									
Antimony	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Arsenic	50 ug/l		1 ug/l	EPA/ML 200.8	ug/l	1.8	ND	1.3	ND
Barium	2000 ug/l	2000 ug/l	[illegible]	EPA/ML 200.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Beryllium	4 ug/l	4.4 ug/l	1 ug/l	EPA/ML 200.8	ug/l	ND	ND	ND	ND
Cadmium	5 ug/l	5 ug/l	[illegible]	EPA/ML 200.8	[illegible]	ND	ND	ND	ND
Chromium (Total)	100 ug/l	100 ug/l	2 ug/l	EPA/ML 200.8	ug/l	3.2	ND	ND	2.5
Copper	[illegible]	1300 ug/l	[illegible]	EPA/ML 200.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead	regulated by treatment technique	zero	0.50 ug/l	EPA/ ML 200.8	ug/l	0.82	ND	ND	6.63
Mercury (Inorganic)	2 ug/l	2 ug/l	[illegible]	[illegible]	[illegible]	ND	ND	ND	ND
Selenium	50 ug/l	50 ug/l	5 ug/l	S3113B/EPA200.9	ug/l	ND	ND	ND	ND
Thallium	2 ug/l	0.5 ug/l	[illegible]	EPA/ML 200.8	ug/l	ND	[illegible]	ND	ND
Organic Constituents									
Alachlor	2 ug/l	zero	[illegible]	EPA 525.2, 507, 508	[illegible]	ND	ND	ND	[illegible]
Atrazine	3 ug/l	3 ug/l	0.05, 0.1, 1.0 ug/l	EPA 525.2, 507, (ML614,619,8141)	ug/l	ND	ND	ND	ND
Benzo(a)pyrene (PAHs)	0.2 ug/l	zero	[illegible]	ML/EPA 525.2	ug/l	ND	ND	ND	ND
Di(2-Ethylhexyl)Adipate	400 ug/l	400 ug/l	0.60 ug/l	ML/EPA 525.2	ug/l	ND	ND	ND	ND
Di(2-Ethylhexyl)Phthalate	6 ug/l	zero	0.60 ug/l	ML/EPA 525.2	ug/l	ND	ND	ND	ND
Endothall	100 ug/l	100 ug/l	20 ug/l	ML/EPA 548.1	ug/l	ND	ND	ND	ND
Endrin	2 ug/l	2 ug/l	[illegible]	ML/EPA 525.2, 508	[illegible]	ND	ND	ND	ND
Heptachlor	0.4 ug/l	zero	0.04, 0.01 ug/l	ML/ EPA 525.2, 508	ug/l	ND	ND	ND	ND
Heptachlor Epoxide	0.2 ug/l	zero	[illegible]	ML/EPA 525.2, 508	[illegible]	ND	ND	ND	ND
Hexachlorobenzene	1 ug/l	zero	0.65 ug/l	ML/ EPA 525.2	ug/l	ND	ND	ND	ND
Hexachlorocyclopentadiene	50 ug/l	50 ug/l	[illegible]	ML/ EPA 525.2	[illegible]	ND	ND	ND	ND
Lindane	0.2 ug/l	0.2 ug/l	0.02, 0.01 ug/l	ML/ EPA 525.2, 508	ug/l	ND	ND	ND	ND
Methoxychlor	40 ug/l	40 ug/l	[illegible]	ML/ EPA 525.2, 508	[illegible]	ND	ND	ND	ND
Pentachlorophenol	1 ug/l	zero	1, 20, 0.04 ug/l	ML/ EPA 525.2, SW 8270, 515.1	ug/l	ND	ND	ND	ND
Simazine	4 ug/l	4 ug/l	[illegible]	EPA 525.2, 507, [illegible]	ug/l	ND	ND	ND	ND
Carbofuran	40 ug/l	40 ug/l	0.9 ug/l	ML/EPA 531.1	ug/l	ND	ND	ND	ND
Oxamyl (Vydate)	200 ug/l	200 ug/l	[illegible]	ML/EPA 531.1	[illegible]	ND	ND	ND	ND
1,2,4-Trichlorobenzene	70 ug/l	70 ug/l	5 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
o-Dichlorobenzene (1,2-DCB)	600 ug/l	600 ug/l	[illegible]	ML/EPA 524.2	[illegible]	ND	ND	ND	ND
p-Dichlorobenzene (1,4 DCB)	75 ug/l	75 ug/l	5 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Dibromochloropropane (DBCP)	0.2 ug/l	zero	0.010 ug/l	ML/EPA 504.1	[illegible]	ND	ND	ND	ND
2,4,5-TP (Silvex)	50 ug/l	50 ug/l	0.20 ug/l	ML/ EPA 515.1	ug/l	ND	ND	ND	ND
2,4-D	70 ug/l	70 ug/l	[illegible]	ML/EPA 515.1	[illegible]	ND	ND	ND	ND
Dalapon	200 ug/l	200 ug/l	1 ug/l	ML/EPA 515.1	ug/l	ND	ND	ND	ND
Dinoseb	7 ug/l	7 ug/l	[illegible]	ML/EPA 515.1	[illegible]	ND	ND	ND	ND
Dioxin (2,3,7,8-TCDD)	0.00003 ug/l	zero	0.72 pg/l	EPA 1613	pg/l	ND	ND	ND	ND
Ethylene Dibromide (EDB)	0.05 ug/l	zero	[illegible]	ML/EPA 504.1	[illegible]	ND	ND	ND	ND
Picloram	500 ug/l	500 ug/l	0.10 ug/l	ML/ EPA 515.1	ug/l	ND	ND	ND	ND
1,1,1-Trichloroethane	200 ug/l	200 ug/l	[illegible]	ML/EPA 524.2	[illegible]	ND	ND	ND	ND
1,1,2-Trichloroethane	5 ug/l	3 ug/l	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,1-Dichloroethylene	7 ug/l	7 ug/l	0.50 ug/l	ML/EPA 524.2	[illegible]	ND	ND	ND	ND
1,2-Dichloroethane	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
1,2-Dichloropropane	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Benzene	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Carbon Tetrachloride	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Chlorobenzene	100 ug/l	100 ug/l	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
cis-1,2-Dichloroethylene	70 ug/l	70 ug/l	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Dichloromethane	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Ethyl Benzene	700 ug/l	700 ug/l	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Styrene	100 ug/l	100 ug/l	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
Tetrachloroethylene (PCE)	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Toluene	1000 ug/l	1000 ug/l	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
trans-1,2-Dichloroethylene	100 ug/l	100 ug/l	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Trichloroethylene (TCE)	5 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Vinyl Chloride	2 ug/l	zero	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
PCBs									
1016 Aroclor	0.5 ug/l	zero	0.07 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1221 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1232 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1242 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1248 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1254 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
1260 Aroclor	0.5 ug/l	zero	0.10 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND
Chlordane (Alpha)	0.2 ug/l	zero	0.05, 0.10 ug/l	ML/EPA 525.2,508	ug/l	ND	ND	ND	ND
Toxaphene	3 ug/l	zero	0.50 ug/l	ML/ EPA 508	ug/l	ND	ND	ND	ND

Ml - moved by lab

55 of 65 ug/l = part per billion ND = not detected

Table 3-11
Willamette River Raw Water Quality Monitoring Results 2000-2001
Additional Analytes Tested by Montgomery Watson Labs

11/29/00

Analyte	Units of Measure	MDL	Method of Measurement	8/29/00	11/29/01	2/28/01	5/30/01
Ametryn	ug/l	0.30	EPA 507	ND	ND	ND	ND
Atraton	ug/l	0.30	EPA 507	ND	ND	ND	ND
Butylate	ug/l	1.0	EPA 507	ND	ND	ND	ND
Carboxin	ug/l	1.0	EPA 507	ND	ND	ND	ND
Chlorpropham	ug/l	0.7	EPA 507	ND	ND	ND	ND
Dichlorvos	ug/l	0.2	EPA 507	ND	ND	ND	ND
Diphenamide	ug/l	0.4	EPA 507	ND	ND	ND	ND
Fenamiphos	ug/l	0.3	EPA 507	ND	ND	ND	ND
Fluridone	ug/l	1.8	EPA 507	ND	ND	ND	ND
Merphos	ug/l	0.4	EPA 507	ND	ND	ND	ND
Mevinphos	ug/l	0.3	EPA 507	ND	ND	ND	ND
MGK264	ug/l	2.0	EPA 507	ND	ND	ND	ND
Pebulate	ug/l	0.4	EPA 507	ND	ND	ND	ND
Propazine	ug/l	0.2	EPA 507	ND	ND	ND	ND
Stirofos	ug/l	0.4	EPA 507	ND	M	ND	ND
Terbutryn	ug/l	0.3	EPA 507	ND	ND	ND	ND
Triademefon	ug/l	0.3	EPA 507	ND	ND	ND	ND
Tricyclazoles	ug/l	1.2	EPA 507	ND	ND	ND	ND
Vernolate	ug/l	0.4	EPA 507	ND	ND	ND	ND
2,6 Dinitrotoluene	ug/L	0.1	ML/ EPA 525.2	ND	ND	ND	ND
Alpha-Chlordane	ug/l	0.05	ML/ EPA 525.2, 508	ND	ND	ND	ND
Acenaphthene	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Acenaphthylene	ug/l	0.20	ML/ EPA 525.2	ND	ND	ND	ND
Anthracene	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Benz (a) Anthracene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Benzo (b) Fluoranthene	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Benzo (g,h,i) Perylene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Benzo (k) Fluoranthene	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Butylbenzylphthalate	ug/l	1.0	ML/ EPA 525.2	ND	ND	ND	ND
Butachlor	ug/l	1.5, 0.10	EPA 507, 525.2	ND	ND	ND	ND
Caffeine	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Chrysene	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Chlorobenzilate	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Chloroneb	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Dibenz(a,h)Anthracene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
4,4-DDD	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
4,4-DDE	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
4,4-DDT	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Diethylphthalate	ug/l	1.0	ML/ EPA 525.2	ND	ND	ND	ND
Dimethylphthalate	ug/l	1.0	ML/ EPA 525.2	ND	ND	ND	ND
Dimethoate	ug/l	20	ML/ EPA 525.2	ND	ND	ND	ND
Di-N-Butylphthalate	ug/l	1.0	ML/ EPA 525.2	ND	ND	ND	ND
Di-N-Octylphthalate	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Fluoranthene	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Fluorene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Gamma-Chlordane	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Hexachloroethane	ug/l	10	ML/EPA 625/8270	ND	ND	ND	ND
Indeno (1,2,3,c-d)Pyrene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Isophorone	ug/l	1.0	ML/ EPA 525.2	ND	ND	ND	ND
N-Nitrosodimethylamine	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
N-Nitrosodiphenylamine	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
Trans-Nonachlor	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
p-Chloro-m-cresol	ug/l	10.00	ML/EPA 625/8270	ND	ND	ND	ND
Permethrin (Mixed Isomers)	ug/l	10	ML/ EPA 525.2	ND	ND	ND	ND
Prometryn	ug/l	0.5, 1.0	EPA 507, 525.2	ND	ND	ND	ND
Phenanthrene	ug/l	0.040	ML/ EPA 525.2	ND	ND	ND	ND
Phenol	ug/l	5.0	ML/SW 8270	ND	ND	ND	ND
Parathion, Methyl	ug/l	1.0	ML614, 619, 8141	ND	ND	ND	ND
Pyrene	ug/l	0.10	ML/ EPA 525.2	ND	ND	ND	ND
Thiobencarb	ug/l	0.40	ML/ EPA 525.2	ND	ND	ND	ND
2,4,5-Trichorophenol	ug/l	5.0	ML/ EPA 625	ND	ND	ND	ND
2,4-Dimethylphenol	ug/l	5.0	ML/SW 8270	ND	ND	ND	ND
2-Choronaphthalane	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
2-Chlorophenol	ug/l	5.0	ML/SW 8270	ND	ND	ND	ND
2-Nitroaniline	ug/l	20.0	ML/EPA 625/8270	ND	ND	ND	ND
2-Nitrophenol	ug/l	5.0	ML/SW 8270	ND	ND	ND	ND
3,3'-Dicholorbenzidine	ug/l	100.0	ML/EPA 625/8270	ND	ND	ND	ND
3-Nitroaniline	ug/l	40.0	ML/EPA 625/8270	ND	ND	ND	ND
4,6'-Dinitro-o-cresol	ug/l	100.0	ML/EPA 625/8270	ND	ND	ND	ND
4-Bromophenylphenylether	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
4-Chloroaniline	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
4-Chlorophenylphenylether	ug/l	10.0	ML/EPA 625/8270	ND	ND	ND	ND
4-Methyphenol	ug/l	5.0	ML/ EPA 625	ND	ND	ND	ND
4-Nitroaniline	ug/l	40.0	ML/EPA 625/8270	ND	ND	ND	ND
4-Nitrophenol	ug/l	10, 5.0	ML/ SW 8270, EPA 515.1	ND	ND	ND	ND
Aniline	ug/l	10	ML/EPA 625/8270	ND	ND	ND	ND
Benzoic Acid	ug/l	50	ML/ EPA 625	ND	ND	ND	ND
Benzo (a) pyrene	ug/l	10	ML/EPA 625/8270	ND	ND	ND	ND
bis (2-Chloroethyl) ether	ug/l	20	ML/EPA 625/8270	ND	ND	ND	ND
bis (2-Chloroethoxy) methane	ug/l	20	ML/EPA 625/8270	ND	ND	ND	ND
bis (2-Chloroisopropyl) ether	ug/l	20	ML/EPA 625/8270	ND	ND	ND	ND
Benzidine	ug/l	100	ML/EPA 625/8270	ND	ND	ND	ND

ug/l = part per billion

ND [illegible] dete[illegible]

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Table 3-11 (continued)
Willamette River Raw Water Quality Monitoring Results 2000-2001
Additional Analytes Tested by Montgomery Watson Labs

11/29/00

Analyte	Units of Measure	MDL	Method of Measurement	8/29/00	11/29/01	2/28/01	5/30/01
Benzyl Alcohol	ug/l	10	ML/EPA 625/8270	ND	ND	ND	ND
Dibenzofuran	ug/l	10	ML/EPA 625/8270	ND	ND	ND	ND
3-Hydroxycarbofuran	ug/l	2.0	ML/ EPA 531.1	ND	ND	ND	ND
Aldicarb (Temik)	ug/l	0.50	ML/EPA 531.1	ND	ND	ND	ND
Aldicarb Sulfone	ug/l	0.80	ML/EPA 531.1	ND	ND	ND	ND
Aldcarb Sulfoxide	ug/l	0.50	ML/EPA 531.1	ND	ND	ND	ND
Baygon	ug/l	2.0	ML/EPA 531.1	ND	ND	ND	ND
Methiocarb	ug/l	2.0	ML/EPA 531.1	ND	ND	ND	ND
Methomyl	ug/l	1.0	ML/EPA 531.1	ND	ND	ND	ND
2,4,5-T	ug/l	0.20	ML/ EPA 515.1	ND	ND	ND	ND
2,4-DB	ug/l	2.0	ML/ EPA 515.1	ND	ND	ND	ND
Dichlorprop	ug/l	0.50	ML/ EPA 515.1	ND	ND	ND	ND
Acifluorfen	ug/l	0.20	ML/ EPA 515.1	ND	ND	ND	ND
3,5-Dichlorobenzoic Acid	ug/l	0.60	ML/ EPA 515.1	ND	ND	ND	ND
Azinphos Methyl	ug/l	1.0	ML614, 619, 8141	ND	ND	ND	ND
Demeton	ug/l	1.0	ML614, 619, 8141	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
1,2,3-Trichlorobenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
1,2,3-Trichloropropane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
2-Butanone (MEK)	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
m-Dichlorobenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
o-Dichlorobenzene (1,2 DCB)	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
o-Chlorotoluene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
p-Chlorotoluene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
4-Methyl-2-Pentanone	ug/l	5.0	ML/ EPA 524.2	ND	ND	ND	ND
Bromoform	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Chloroform	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Bromochloromethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Chloroethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Chloromethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Chlorodibromomethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Dibromomethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Bromodichloromethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Di-Isopropyl Ether	ug/l	5.0	ML/ EPA 524.2	ND	ND	ND	ND
Dichlordifluoromethane	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Fluorotrichloromethane-Freon 11	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Isopropylbenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
m-Dichlorobenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
m,p-Xylenes	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
n-Butylbenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
o-Xylene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
sec-Butylbenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
tert-Amil Methyl Ether	ug/l	5.0	ML/ EPA 524.2	ND	ND	ND	ND
tert-Butyl Ethyl Ether	ug/l	5.0	ML/ EPA 524.2	ND	ND	ND	ND
tert-Butylbenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Trichlorotrifluoroethane (Freon)	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Alpha-BHC	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Beta-BHC	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Chlorthalonil	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Delta-BHC	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
p,p' DDD	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
p,p' DDE	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
p,p' DDT	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Endrin Aldehyde	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Endosulfan I (Alpha)	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Endosulfan II (Beta)	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Endosulfan Sulfate	ug/l	0.010	ML/ EPA 508	ND	ND	ND	ND
Ethion	ug/l	1.0	ML614, 619, 8141	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ug/l	0.50	ML/ EPA 524.2	ND	ND	ND	ND
Fenarimol	ug/l	0.4	ML/ EPA 507	ND	ND	ND	ND
Methyl Paraoxon	ug/l	1.0	ML/ EPA 507	ND	ND	ND	ND
Simetryn	ug/l	0.1	ML/ EPA 507	ND	ND	ND	ND
Nickel	ug/l	5.0	EPA/ ML 200.8	ND	ND	ND	ND

ug/l = part per billion

ND = not detected

Table 3-6

Willamette River Raw Water Quality Monitoring Results 2000-2001

RESEARCH PRIORITIES OF THE CONTAMINANT CANDIDATE LIST

Analyte	Research Priority	Method Detection Limit	Method of Measurement	Units of Measure	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Inorganic Constituents								
Aluminum	priority for treatment research	0.025 mg/L	EPA/ML 200.8	mg/L	0.12	0.14	2.00	0.14
Organic Constituents								
Acetochlor	priority for analytical methods research	0.1 ug/l	ML/EPA 525.2	ug/l	ND	ND	ND	ND
DCPA	priority for health research	0.1 ug/l	ML/ EPA 515.1	ug/l	ND	ND	ND	ND
EPTC	priority for occurrence research	0.3, 0.1 ug/l	EPA 507, 525.2	ug/l	ND	ND	ND	ND
Molinate	priority for occurrence research	0.4, 0.2 ug/l	EPA 507, 525.2	ug/l	ND	ND	ND	ND
Nitrobenzene	priority for occurrence research	0.05 ug/l	EPA 525.2	ug/l	ND	ND	ND	ND
Terbacil	priority for occurrence research	3.5, 0.1 ug/l	EPA 507, 525.2	ug/l	ND	ND	ND	ND
Diazinon	priority for occurrence research	0.10, 1.0 ug/l	EPA 507, (ML614, 619, 8141)	ug/l	ND	ND	ND	ND
Disulfoton	priority for occurrence research	1 ug/l	ML 614, 619, 8141	ug/l	ND	ND	ND	ND
Prometon	priority for occurrence research	0.3, 1.0 ug/l	EPA 507, (ML614, 619, 8141)	ug/l	ND	ND	ND	ND
Methyl Bromide (Bromomethane)	priority for health research	0.5 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
MTBE (Methyl Tert-Butyl Ether)	priority for occurrence and analytical methods research	3 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
1,1-Dichloropropene	priority for health research	0.5 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,2-Diphenylhydrazine	prioity for analytical methods research	20 ug/l	ML/EPA 625/8270	ug/l	ND	ND	ND	ND
1,3-Dichloropropene	priority for health research	0.5 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,3-Dichloropropene (cis- And trans-)	priority for regulatory determination	0.5 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
2,4,6-Trichlorophenol	priority for analytical methods research	10 ug/l	ML/ SW8270	ug/l	ND	ND	ND	ND
2,4-Dichlorophenol	priority for analytical methods research	10 ug/l	ML/ SW8270	ug/l	ND	ND	ND	ND
2,4-Dinitrophenol	priority for analytical methods research	100 ug/l	ML/ SW8270	ug/l	ND	ND	ND	ND
2,4-Dinitrotoluene	priority for occurrence research	1, 10 ug/l	ML/ EPA 525	ug/l	ND	ND	ND	ND
2,6-Dinitrotoluene	priority for occurrence research and analytical methods	0.1, 10 ug/l	ML/ EPA 525	ug/l	ND	ND	ND	ND
2-Methylphenol	priority for analytical methods research	10 ug/l	ML/ EPA 625	ug/l	ND	ND	ND	ND
4,4-DDE	priority for occurrence research	10 ug/L	ML/EPA 525.5	ug/L	ND	ND	ND	ND

ug/l = part per billion

ND = not detected

Table 3-7
Willamette River Raw Water Quality Monitoring Results 2000-2001
USGS STUDY OF DISSOLVED PESTICIDES

Analyte	MCL/status	MCLG	Units of Measure	Method Detection Limit	Analytical Method	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Atrazine	3 ug/l	3 ug/l	ug/l	0.1, 0.05, 1.0 ug/l	EPA 507, 525.2, (ML614, 619, 8141)	ND	ND	ND	ND
Simazine	4 ug/l	4 ug/l	ug/l	0.07, 0.05, 1.0 ug/l	EPA 507, 525.2, (ML614, 619, 8141)	ND	ND	ND	ND
Metolachlor	priority for regulatory determination		ug/l	1.5, 0.05 ug/l	EPA 507, 525.2	ND	ND	ND	ND
Tebuthiuron			ug/l	0.4 ug/l	EPA 507	ND	ND	ND	ND
Prometon	priority for occurrence research		ug/l	0.3, 1.0 ug/l	EPA 507, (ML614, 619, 8141)	ND	ND	ND	ND
Metribuzin	priority for regulatory determination		ug/l	0.4, 0.05 ug/l	EPA 507, 525.2	ND	ND	ND	ND
Diazinon	priority for occurrence research		ug/l	0.10, 1.0 ug/l	EPA 507, (ML614, 619, 8141)	ND	ND	ND	ND
EPTC	priority for occurrence research		ug/l	0.3, 0.10 ug/l	EPA 507, 525.2	ND	ND	ND	ND
Ethoprop			ug/l	0.1 ug/l	EPA 507	ND	ND	ND	ND
2,4-D	70 ug/l	70 ug/l	ug/l	0.07 ug/l	ML/ EPA 515.1	ND	ND	ND	ND
Terbacil	prioity for occurrence research		ug/l	3.5, 0.10 ug/l	EPA 507, 525.2	ND	ND	ND	ND
Bromacil			ug/l	2.2, 0.2 ug/l	EPA 507,525.2	ND	ND	ND	ND
Chloropyrifos (dursban)			ug/l	0.05 ug/l	ML/EPA 531.0	ND	ND	ND	ND
Carbaryl			ug/l	2 ug/l	EPA 8151	ND	ND	ND	ND
Trifluralin			ug/l	0.1 ug/l	ML/ EPA 525.2	ND	ND	ND	ND
Dicamba			ug/l	0.08 ug/l	EPA 515.1	ND	ND	ND	ND
Carbofuran	40 ug/l	40 ug/l	ug/l	0.9 ug/l	ML/ EPA 531.1	ND	ND	ND	ND
DCPA	priority for health research		ug/l	0.10 ug/l	ML/ EPA 515.1	ND	ND	ND	ND
Napropamide			ug/l	0.5 ug/l	EPA 507	ND	ND	ND	ND
Propachlor			ug/l	0.05 ug/l	ML/EPA 525.2	ND	ND	ND	ND
Bentazon			ug/l	0.5 ug/l	ML/ EPA 525.2	ND	M	ND	ND
Malathion			ug/l	0.10, 1.0 ug/l	ML/ EPA 525.2, ML614, 619, 8141	ND	ND	ND	ND
Alachlor	2 ug/l	zero	ug/l	0.20, 0.10, .05 ug/l	EPA 507, 525.2, 508	ND	ND	ND	ND
Norflurazon			ug/l	0.4 ug/l	EPA 507	ND	ND	ND	ND
Dinoseb	7 ug/l	7 ug/l	ug/l	0.20 ug/l	ML/EPA 515.1	ND	ND	ND	ND

M - missed by lab

ug/l = part per billion

ND = not detected

Table 3-8

Willamette River Raw Water Quality Monitoring Results 2000-2001

SUSPECTED ENDOCRINE DISRUPTORS IN THE WILLAMETTE RIVER BASIN

Suspected Endocrine Disruptor	MCL	MCLG	Units of Measure	Method Detection Limit	Analytical Method	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Diazinon	None		ug/l	0.1, 1 ug/l	EPA 507, (ML 614, 619, 8141)	ND	ND	ND	ND
Prometon	None		ug/l	0.3, 1 ug/l	EPA 507, (ML 614, 619, 8141)	ND	ND	ND	ND
Chlorpyrifos (1)	None		ug/l	1 ug/l	ML 614, 619, 8141	ND	ND	ND	ND
Carbaryl	None		ug/l	2 ug/l	ML/ EPA 531.1	ND	ND	ND	ND
Carbofuran	40 ug/l	40 ug/l	ug/l	0.9 ug/l	ML/ EPA 531.1	ND	ND	ND	ND
Metribuzin	None		ug/l	0.4, 0.05 ug/l	EPA 507, 525.2	ND	ND	ND	ND
Trifluralin	None		ug/l	10 ug/l	ML/ EPA 525.2	ND	ND	ND	ND
2,4-D	70 ug/L	70 ug/l	ug/l	0.1 ug/l	ML/ EPA 515.1	ND	ND	ND	ND

ug/l = part per billion

ND = not detected

Table 3-5
Willamette River Raw Water Quality Monitoring Results 2000-2001
REGULATORY DETERMINATION PRIORITIES PORTION OF THE CCL

Analyte	Method Detection Limit	Method of Measurement	Units of Measure	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Inorganic Constituents							
Boron	0.05 mg/l	ML/ EPA 200.7	mg/l	ND	M	ND	ND
Manganese	2 ug/l	EPA/ ML 200.8	ug/l	ND	25	22	23
Sulfate	2 mg/l	ML/ EPA 300	mg/l	4.88	3.64	6.38	3.40
Vanadium	0.02 mg/l	ML/6010-200.7	mg/l	ND	M	ND	ND
Organic Constituents							
Aldrin	0.05, 0.01 ug/l	ML/ EPA 525.2, 508	ug/l	ND	ND	ND	ND
Dieldrin	0.20, 0.01 ug/l	ML/ EPA 525.2, 508	ug/l	ND	ND	ND	ND
Hexachlorobutadiene	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
p-Isopropyltoluene	0.50 ug/l	ML/EPA 524.2	ug/l	ND	ND	ND	ND
Metolachlor	1.5, 0.05 ug/l	EPA 507, 525.2	ug/l	ND	ND	ND	ND
Metribuzin	0.40, 0.05 ug/l	EPA 507, 525.2	ug/l	ND	ND	ND	ND
Naphthalene	0.10, 0.50 ug/l	ML/EPA 525.2, 524.2	ug/l	ND	ND	ND	ND
Bromobenzene	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,2,4-Trimethylbenzene	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,1-Dichloroethane	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
1,3-Dichloropropene (cis- and trans-)	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
2,2-Dichloropropane	0.50 ug/l	ML/ EPA 524.2	ug/l	ND	ND	ND	ND
Triazines: atrazine & simazine	0.05 ug/L	ML/EPA 525.2	ug/L	ND	ND	ND	ND

M - missed by lab

ug/l = part per billion   ND = not detected

Exhibit 7

Tables

Table ES-1
Historical Water Demands

	1990 (MG)	1991 (MG)	1992 (MG)	1993 (MG)	1994 (MG)	1995 (MG)	1996 (MG)	1997 (MG)	1998 (MG)	1999 (MG)	2000 (MG)
January	21.43	36.69	37.78	39.57	53.64	47.06	49.86	52.54	54.27	57.63	58.18
February	23.70	20.01	28.95	47.31	39.17	39.81	50.25	49.39	51.58	54.24	52.11
March	30.31	31.72	41.85	40.40	55.48	49.77	52.12	58.05	56.77	58.29	57.86
April	35.28	32.33	47.86	40.47	51.34	46.63	54.07	55.64	61.03	60.51	62.03
May	26.92	39.84	78.64	39.90	81.87	66.76	53.38	89.76	71.03	69.01	69.57
June	41.88	53.90	96.77	64.87	94.26	91.84	84.87	94.62	92.09	96.10	96.85
July	74.67	91.13	79.22	77.10	122.35	114.60	121.65	117.89	113.77	115.96	113.82
August	68.73	95.19	82.34	91.53	104.57	105.49	124.43	109.61	121.57	112.37	119.30
September	51.69	75.13	70.08	85.67	86.41	77.48	82.92	83.65	103.21	104.67	97.11
October	30.06	60.11	28.32	55.77	56.42	53.59	61.83	62.01	65.81	81.16	73.20
November	30.99	33.92	40.71	44.16	46.98	51.81	52.19	55.09	57.96	58.43	56.95
December	34.74	37.84	42.84	42.13	42.82	54.67	51.42	55.96	59.63	58.75	58.34
Annual Total	**470.40**	**607.82**	**675.34**	**668.88**	**835.29**	**799.52**	**839.01**	**884.19**	**908.72**	**927.12**	**915.33**
Annual Average Daily Demand (mgd)	1.29	1.67	1.85	1.83	2.29	2.19	2.30	2.42	2.49	2.54	2.51
Annual Average Monthly Demand (MG)	39.20	50.65	56.28	55.74	69.61	66.63	69.92	73.68	75.73	77.26	76.28
Annual Peak Day Demand (mgd)[1]					5.2	4.9	4.9	4.7	4.6	4.5	4.8
Annual Lowest Peak Month (MG)	21.43	20.01	28.32	39.57	39.17	39.81	49.86	49.39	51.58	54.24	52.11
Annual Highest Peak Month	July	August	June	August	July	July	August	July	August	July	August
Annual Average Peak Season (MG)	59.24	78.84	82.10	79.79	101.90	97.35	103.47	101.44	107.66	107.27	106.77
Annual Average Non-Peak Season (MG)	29.18	36.56	43.37	43.71	53.46	51.26	53.14	59.80	59.76	62.25	61.03

Notes: Peak Season is June through September, Non Peak Season is October through May.
1. Curtailed Peak Day

Table ES-2
Current Water Usage Rates Per Unit by Land Use Type

	Average Day (gal/landuse/day)	Peak Day (gal/landuse/day)
Single Family Residential [1]	251.00	866.00
Multi Family Residential	161.00	375.00
Commercial	236.00	670.00
Industrial	44.00	176.00

1. Assumes Persons Per Household decreases in the year 2020 from approximately 2.4 to 2.1

Recommended Demand Projection

The decision as to which population projection (See Figure ES-1), rate of growth of residential and commercial/industrial development, and water demand to use relates to the desired level of system reliability. There is often a relationship between the level of reliability and cost - higher levels of reliability result in higher costs. The reliability of local distribution system components, such as transmission and distribution pipelines and local pump stations and tanks, tend to be designed toward the upper end of a reliability range. Using a higher population and rate of growth value provides a higher degree of certainty that even in the most extreme weather conditions, adequate water will be available. This higher consumption value will result in more costly facilities, however. Other methods of dealing with extreme peaks in demand include reliance on temporary restrictions (e.g. voluntary or mandatory curtailments such as odd/even day watering) on water use or interties to other sources. Temporary restrictions on water for irrigation could include the restrictions that were used in the City of Wilsonville from 1994 through 2001.

For the purpose of this water system master plan it is recommended that a 3 percent rate of growth for residential and an initial 15 percent growth rate for commercial/industrial developments be used. It is also recommended that a 251 gpud average day demand (ADD) and an 866 gpud peak day demand (PDD) rate be used for single family residential development, and that a 161 gpud ADD and a 375 gpud PDD rate be used for multi-family residential. For non-residential land use a rate of 236 gpud for retail ADD and 670 gpud for retail PDD rate is recommended. It is recommended that an ADD industrial usage rate of 44 gpud and PDD rate of 176 gpud be used. The water demand forecast is obtained by multiplying the recommended per unit usage rate by the recommended projected rate of growth.

The City's Community Development department is forecasting that the equivalent of two 1.0 mgd ADD industrial users will be located within the City by 2020, either through the actual construction of such facilities or the conversion of existing warehouses to higher intensity water use. It has been assumed that the water demand associated with these two industrial user equivalents will be allocated throughout the planned industrial areas. Also the influence of these large facilities will be distributed over the entire 20 year planning period and not be isolated to one event.

It must be recognized that these estimates are predictions based on the best information available at this time, and should be subject to continuous updating and adjustment based on the actual water demand that the City experiences over time.

Table ES-3 provides a summary of the projected water demand, and Figure ES-2 shows the projection graphically.

Table ES-3
Maximum Day Water Demand by User Type

	2000 Unrestrained Peak Day Demand (mgd)	2020 Peak Day Demand (mgd)	Rate of Increase (%/yr)
Single Family Residential	2.56	5.24	3.6
Multi Family Residential	1.31	2.30	2.9
Commercial	1.36	2.13	2.3
Industrial	1.25	8.35	10.0
Special Use	0.32	2.00	9.6
Total	**6.80**	**20.02**	**5.5**
Total Residential	3.87	7.53	3.4
Total Non Residential	2.93	12.48	7.5

Note: Water demands based on City population and unrestrained water demand projections

Table ES-4
Capital Improvement Program

Zone	Description	Peak Day Demand	Peak Hour Demand	Peak Day + Fire Flow Demand	Existing	2000	2005	2010	2015	2020	Project Diameter (inches)	Total Length (feet)	$/LF	Estimate of Cost[1]
Pipeline Projects														
B	Evergreen Road from Kinsman Road to Brown Road		x		N/A		18				18	2092	$171.00	$357,732
B	Boeckman Road from WTP Transmission to 95th Avenue	x		x	N/A		24				24	1290	$275.55	$355,460
B	WTP Transmission Barber Street to Boeckman[2]	x		x	N/A		24				48	2965	$576.00	$1,707,840
B	WTP Transmission Wilsonville Road to Barber Street[2]	x		x	N/A		30				48	2613	$576.00	$1,505,088
B	Boeckman Road from WTP Transmission to 110thAvenue (west)	x			N/A			24			24	2800	$275.55	$771,540
B	110th Avenue South from Boeckman Road to Intersection of Brown Road and Evergreen	x			N/A			18			18	4630	$171.00	$791,730
B	New School Pipeline north from Boeckman Road	x		x	N/A			12			12	1000	$109.65	$109,650
D	D Level Transmission from C Level Reservoir	x		x	N/A			12			12	1000	$109.65	$109,650
B	Dammasch Development to Grahams Ferry Road	x		x	N/A			18			18	3010	$171.00	$514,710
B	From Dammasch Development along Grahams Ferry Road to Boeckman Road	x		x	N/A			18			18	2270	$171.00	$388,170
B	Urban Service Area between Frog Pond Lane and Boeckman Road		x		N/A				12		12	5125	$109.65	$561,956
B	From Boeckman Road near Canyon Creek Well to Vlahos Drive		x		N/A				12		12	2850	$109.65	$312,503
B	Cahalin Road, Morton Street, and Elligsen Way		x		N/A				12		12	3980	$109.65	$436,407
B	Grahams Ferry to Ridder Road, Ridder Road to Garden Acres		x		N/A				12		12	4220	$109.65	$462,723
B	WTP Transmission Boeckman to Ridder[2]	x		x	N/A				18		48	5263	$576.00	$3,031,488
B	New Reservoir Transmission				N/A				30		30	6785	$360.00	$2,442,600
B	Weideman Road from Weideman PS to Parkway Ave		x		10					12	12	570	$109.65	$62,501
B	Parkway Center Drive from Burns Way to Parkway Ave		x		8					12	12	1900	$109.65	$208,335
Sub Total of Pipeline Cost Per Five Year Planning Horizon							**$3,926,120**	**$2,685,450**	**$7,247,677**	**$270,836**				**$14,130,082**
Source and Supply						**2000**	**2005**	**2010**	**2015**	**2020**				
B	5 mgd ASR Development						$1,000,000							$1,000,000
B	5mgd WTP Expansion								$3,750,000					$3,750,000
Sub Total						**$0**	**$1,000,000**	**$0**	**$3,750,000**	**$0**				**$4,750,000**
Pump Station Projects						**2000**	**2005**	**2010**	**2015**	**2020**				
B	Weideman Well Backup Generator							$100,000						$100,000
B	Canyon Creek Well Backup Generator							$100,000						$100,000
B	Gesellschaft Well Backup Generator							$100,000						$100,000
B	Charb Total Booster Flow Meter						$5,000							$5,000
A-B	Emergency Startup and Operation at Charb Booster PS						$50,000							$50,000
D	C Level Booster Pump Station							$225,000						$225,000
Sub Total						**$0**	**$55,000**	**$525,000**	**$0**	**$0**				**$580,000**
Control Valves						**2000**	**2005**	**2010**	**2015**	**2020**				
B	Barber PRV Station						$55,000							$55,000
B	Boeckman PRV Station						$55,000							$55,000
B	Ridder PRV Station								$55,000					$55,000
A-B	PS Bypass at Charb Booster PS from Level B to Level A						$10,000							$10,000
Sub Total						**$0**	**$120,000**	**$0**	**$55,000**	**$0**				**175,000**
Reservoir Projects						**2000**	**2005**	**2010**	**2015**	**2020**				
C	Level C Intertie					$50,000								$50,000
B	Reservoir Land Acquisition						$275,000							$275,000
B	Reservoir Storage Level B (2015 Required)								$1,940,000					$1,940,000
B	Reservoir Storage Level B (2020 Required)									$3,500,000				$3,500,000
Sub Total						**$50,000**	**$275,000**	**$0**	**$1,940,000**	**$3,500,000**				**$5,765,000**
Well and Reservoir Rehabilitation Projects						**2000**	**2005**	**2010**	**2015**	**2020**				
A	Charb Res DeChlorination Facility for Reservoir Drainage					$10,000								$10,000
A	Charb Res Interior Inspection and Cleaning					$25,000		$25,000						$50,000
A	Charb Res Seismic Study					$25,000								$25,000
B	Elligsen Res 1 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 1 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
C	Level C External Painting						$75,000		$75,000					$150,000
C	Level C Internal Inspection and Cleaning						$25,000		$25,000					$50,000
B	Elligsen Res 2 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 2 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
Sub Total						**$110,000**	**$250,000**	**$75,000**	**$250,000**	**$0**				**$685,000**
Plans and Studies						**2000**	**2005**	**2010**	**2015**	**2020**				
	Water System Master Plan						$75,000	$75,000	$75,000	$75,000				$300,000
	Water Rate Study						$40,000	$40,000	$40,000	$40,000				$160,000
	ASR Feasibility Study						$100,000							$100,000
Sub Total						**$0**	**$215,000**	**$115,000**	**$115,000**	**$115,000**				**$560,000**
Total						**$160,000**	**$5,841,120**	**$3,400,450**	**$13,357,677**	**$3,885,836**				**$26,645,082**

1. Estimated Cost are based on Year 2000 Dollars
2. Project Diameter increased to provide potential supply flow to neighboring water providers.

Table 2-1
City of Wilsonville Historical and Projected Population

Year	Historical and Projected Growth (2.9 Percent Growth)	% Annual Growth	Linear Ten Yr. (660 Persons Per Year)
1970	1001		
1980	2950	--	
1981	3450	16.9	
1982	3400	-1.4	
1983	3300	-2.9	
1984	3500	6.1	
1985	3750	7.1	
1986	4200	12.0	
1987	4300	2.4	
1988	5025	16.9	
1989	5800	15.4	
1990	7106	22.5	
1991	8755	23.2	
1992	9255	5.7	
1993	9580	3.5	
1994	9680	1.0	
1995	9765	0.9	
1996	10600	8.6	
1997	10940	3.1	
1998	12290	12.3	
1999	12985	5.7	
2000	14365	10.6	14365
2001	14780		15025
2002	15206		15685
2003	15645		16345
2004	16097		17005
2005	16562		17665
2006	17040		18325
2007	17532		18985
2008	18038		19645
2009	18559		20305
2010	19094	2.9	20965
2011	19646		21625
2012	20213		22285
2013	20796		22945
2014	21397		23605
2015	22014		24265
2016	22650		24925
2017	23304		25585
2018	23977		26245
2019	24669		26905
2020	25381		27565

than the City's own projection to the year 2020 (buildout). This straight-line average growth projection is less sophisticated than the City's Community Development Department's analysis because it does not consider growth relative to land use type.

FUTURE PLANNING AREAS

METRO has identified seven areas bordering the City of Wilsonville's current Urban Growth Boundary (UGB) as areas of potential future urban growth. These future planning areas include Metro designated areas 35, 36, 37, 39, 41, and 42 as shown in Figure 2-2. Planning consultants in coordination with the City's Community Development Department have prepared Urban Reserve Plans for the North Wilsonville Industrial Area (Area 42) and the Dammasch Area (southern portion of Area 41). In addition to these planning studies, the City has developed a preliminary planning assessment based on projected land use for the remaining future planning areas and has included this assessment in their population and water demand projections. Area 39 and the southern portion of Area 41 have been recently approved for incorporation into the City UGB.

RECOMMENDED POPULATION FORECAST

The results of the various population forecasts are summarized in Table 2-2.

It is recommended that the projection developed by the City of Wilsonville Community Development Department be used.

Table 2-2
Summary of Population Projections

	YR 2010	YR 2020 Buildout
City of Wilsonville Planning Department	19,094	25,831
Linear Average Growth Projection	20,965	27,565
1986 Master Plan[1]	25,981	54,554

1. Projection was made using 7.7% from last projection in 1986 Water Master Plan (YR 2006 = 19,311)

This estimate represents the best available evaluation of existing development capacity within the current service area and adjacent future planning areas. It must be recognized that these estimates should be subject to updating and adjustment, based on actual population growth and other factors. This Master Plan should be correspondingly updated and project sizing should be reviewed when projects are built.

The recommended population projection will be used to develop a per capita water demand rate for residential services throughout the water system. Because of the influence of non-residential service in Wilsonville, water demand projections should not be solely based on a per capita water usage rate. Therefore for non-residential services, a separate water demand will be developed. The combination of the per throughout the City. This curtailment has artificially depressed the per unit usage rates. Therefore, the City's Community Development department has used irrigation estimates based on landuse type from historical irrigation records in the 1980's. This estimate has been integrated into the current and projected water demands through the per unit demand rate.

Table 3-1
Historical Water Demands

	1990 (MG)	1991 (MG)	1992 (MG)	1993 (MG)	1994 (MG)	1995 (MG)	1996 (MG)	1997 (MG)	1998 (MG)	1999 (MG)	2000 (MG)
January	21.43	36.69	37.78	39.57	53.64	47.06	49.86	52.54	54.27	57.63	58.18
February	23.70	20.01	28.95	47.31	39.17	39.81	50.25	49.39	51.58	54.24	52.11
March	30.31	31.72	41.85	40.40	55.48	49.77	52.12	58.05	56.77	58.29	57.86
April	35.28	32.33	47.86	40.47	51.34	46.63	54.07	55.64	61.03	60.51	62.03
May	26.92	39.84	78.64	39.90	81.87	66.76	53.38	89.76	71.03	69.01	69.57
June	41.88	53.90	96.77	64.87	94.26	91.84	84.87	94.62	92.09	96.10	96.85
July	74.67	91.13	79.22	77.10	122.35	114.60	121.65	117.89	113.77	115.96	113.82
August	68.73	95.19	82.34	91.53	104.57	105.49	124.43	109.61	121.57	112.37	119.30
September	51.69	75.13	70.08	85.67	86.41	77.48	82.92	83.65	103.21	104.67	97.11
October	30.06	60.11	28.32	55.77	56.42	53.59	61.83	62.01	65.81	81.16	73.20
November	30.99	33.92	40.71	44.16	46.98	51.81	52.19	55.09	57.96	58.43	56.95
December	34.74	37.84	42.84	42.13	42.82	54.67	51.42	55.96	59.63	58.75	58.34
Annual Total	**470.40**	**607.82**	**675.34**	**668.88**	**835.29**	**799.52**	**839.01**	**884.19**	**908.72**	**927.12**	**915.33**
Annual Average Daily Demand (mgd)	1.29	1.67	1.85	1.83	2.29	2.19	2.30	2.42	2.49	2.54	2.51
Annual Average Monthly Demand (MG)	39.20	50.65	56.28	55.74	69.61	66.63	69.92	73.68	75.73	77.26	76.28
Annual Peak Day Demand (mgd)[1]					5.2	4.9	4.9	4.7	4.6	4.5	4.8
Annual Lowest Peak Month (MG)	21.43	20.01	28.32	39.57	39.17	39.81	49.86	49.39	51.58	54.24	52.11
Annual Highest Peak Month	July	August	June	August	July	July	August	July	August	July	August
Annual Average Peak Season (MG)	59.24	78.84	82.10	79.79	101.90	97.35	103.47	101.44	107.66	107.27	106.77
Annual Average Non-Peak Season (MG)	29.18	36.56	43.37	43.71	53.46	51.26	53.14	59.80	59.76	62.25	61.03

Notes: Peak Season is June through September, Non Peak Season is October through May.
1. Curtailed Peak Day

Unaccounted for Water

Unaccounted-for water is measured as the difference between water produced and water sold. Water loss is typically attributed to unmetered water delivery, inaccurate metering equipment or system leaks. A reasonable percentage of water loss for a system depends on the type of treatment required, the condition of the system, and how much of the water use is metered. The American Water Works Association recommends that the loss occurring after treatment be maintained at 10% or less.

The City of Wilsonville has been closely tracking water usage and loss due to the current shortage of peak season water supply and as part of an aggressive water conservation and curtailment effort. Using well production and water meter records the City has identified a water loss of approximately 8 percent. This water loss has been accounted for in the current (year 2000) water usage rates and weighted according to land use type. This figure is an estimate and inaccuracies may be introduced into the water loss calculation from sources such as meter inaccuracies.

Table 3-2
Current Water Use by Traffic Analysis Zone (TAZ)

TAZ	Dwelling Units SFR	Dwelling Units MFR	Employment Retail	Employment Non-Retail	ADD Special Water Use (gpd)	PDD Special Water Use (gpd)	Notes
384	0	0	131	624			
384A	0	0	0	0			
384B	0	0	0	0			
384C	0	0	0	136			
384D	0	0	4	176			
384E	0	0	0	15			
385	1	0	21	579			
385A	0	0	0	0			
385B	110	372	0	9			
385C	0	0	0	1343			
386	0	0	0	0			
386A	0	0	0	0			
386B	55	296	2	11			
386C	300	0	2	9			
386D	42	120	0	9			
386E	0	116	0	3			
386F	234	0	5	6			
386G	0	0	12	1525			
386H	5	0	0	2			
387	0	110	40	20			
387A	28	0	1	2			
387B	0	0	0	0			
387C	8	663	0	10			
387D	100	490	1	83			
387E	13	0	0	3			
387F	141	0	62	8			
387G	0	232	218	168			
387H	0	0	308	313			
387I	0	0	138	115			
387J	0	0	47	185			
387K	0	0	374	26			
388	399	248	2	21			
388A	0	0	0	0			
388B	192	0	0	10			
388C	44	0	1	2			
388D	180	207	1	19			
388E	0	0	0	104	175949	246653	Coca Cola process water
388F	2	0	8	417			
388G	0	0	0	83			
388H	0	0	14	1181			
388I	1	0	166	29			
388J	0	0	44	15			
388K	16	84	8	45			
388L	64	12	4	26			
388M	5	0	2	191			
388N	3	0	0	5			
389	54	0	1	141			
389A	0	0	182	0			
389B	0	0	0	0			
389C	0	0	2	903			
389D	0	0	80	268			
389E	0	0	0	0			
389F	0	0	0	0			
389G	0	0	0	186			
389H	0	0	0	47			
390	0	0	40	122			
390A	0	0	0	169			
390B	0	0	0	0			
390C	0	0	0	345			
391	0	0	0	0			
391A	0	0	16	200			
391B	0	0	70	98			
391C	0	0	24	1051	52175	73141	Fujimi process water
391D	0	0	0	0			
393	0	0	0	0			
393A	0	0	1	33			
393B	0	0	0	0			
398	0	0	0	0			
398A	0	0	0	0			
400	29	0	0	46			
400A	0	0	0	0			
400B	0	0	0	0			
400C	0	0	0	0			
400D	0	0	0	0			
400E	0	0	0	0			
401	0	0	0	0			
401A	0	0	0	0			
520	913	536	0	0			
Total	**2957**	**3486**	**2032**	**11155**			
			Retail	**Non-Retail**	**ADD Special Water Use (gpd)**	**PDD Special Water Use (gpd)**	**Total**
Average Day Consumption (gpd)	740,729	561,938	479,928	491,330	228124		2,502,049
Average gpud	251	161	236	44			
Maximum Day Consumption (gpd)	2,560,279	1,306,868	1,360,950	1,250,107		319796	6,799,999
Maximum gpcd or gpud	866	375	670	112			

Various authorized and unmetered water uses will also contribute to unaccounted-for water in the system. Unmetered water is used for fire fighting, fire fighting training and equipment testing, main flushing and hydrant testing. Construction, including the filling / testing / refilling of new water pipeline, is also a major source of unmetered water consumption.

Table 3-3
Current Water Usage Rates Per Unit by Land Use Type

	Average Day (gal/landuse/day)	Peak Day (gal/landuse/day)
Single Family Residential [1]	251.00	866.00
Multi Family Residential	161.00	375.00
Commercial	236.00	670.00
Industrial	44.00	176.00

1. Assumes Persons Per Household decreases in the year 2020 from approximately 2.4 to 2.1

Recommended Demand Projection

Forecasting water use has several inherent uncertainties. A two-step approach has been used for the City of Wilsonville because of the expected variance in growth between residential and commercial/industrial development. Strictly using a per capita consumption in a community with a large commercial/industry influence may lead to improperly identified or sized capital improvement facilities. Using a two-step approach may reduce the influence of factors such as the variability and relative mix between residential, commercial and industrial development; the amount and type of irrigation; and the difference in diurnal water use patterns. Per unit usage rates are shown in Table 3-3.

The decision as to which population projection (See Figure 2-1), rate of growth of residential and commercial/industrial development, and water demand to use relates to the desired level of system reliability. There is often a relationship between the level of reliability and cost - higher levels of reliability result in higher costs. The reliability of local distribution system components, such as transmission and distribution pipelines and local pump stations and tanks, tend to be designed toward the upper end of a reliability range. Using a higher population and rate of growth value provides a higher degree of certainty that even in the most extreme weather conditions, adequate water will be available. This higher consumption value will result in more costly facilities, however. Other methods of dealing with extreme peaks in demand include reliance on temporary restrictions (e.g. voluntary or mandatory curtailments such as odd/even day watering) on water use or interties to other sources. Temporary restrictions on water for irrigation could include the restrictions that were used in the City of Wilsonville from 1994 through 2001.

For the purpose of this water system master plan it is recommended that a 3 percent rate of growth for residential and an initial 15 percent growth rate for

Table 3-4
2020 (buildout) Demand

TAZ	Dwelling Units		Employment		ADD Special Water Use (gpd)	PDD Special Water Use (gpd)	Notes
	SFR	MFR	Retail	Non-Retail			
384	0	0	131	831			
384A	78	0	0	391			
384B	0	0	0	0			
384C	0	360	0	136			
384D	0	126	4	176			
384E	0	0	0	1136			
385	1	0	21	1347			
385A	0	0	0	0			
385B	200	393	46	100			
385C	0	0	0	2432			
386	340	714	75	0	11605	108610	New elemtary school
386A	0	0	0	0			
386B	64	296	2	11	11605	108610	Boeckman Cr Gr School
386C	375	0	2	9			
386D	99	120	0	9			
386E	161	116	0	1963			
386F	274	0	5	6			
386G	0	0	27	2830			
386H	21	0	0	2			
387	0	110	57	1403			
387A	41	0	1	2	19341	181016	WV High School
387B	0	0	0	0			
387C	9	663	0	10			
387D	117	490	1	100			
387E	15	0	0	5	33848	316778	Mem Pk & Boozier
387F	192	89	62	20			
387G	32	326	218	542			
387H	0	0	365	313	4835	45254	Town Ctr Pk
387I	0	0	138	115			
387J	0	0	560	26			
387K	0	0	47	186			
388	496	248	23	21			
388A	138	0	0	0			
388B	227	0	0	10			
388C	53	0	1	2	13539	126711	Wood Middle School
388D	252	207	1	18			
388E	0	0	0	175	137077	171346	Coca Cola
388F	2	0	8	843			
388G	0	0	0	83			
388H	0	0	14	1264			
388I	1	0	166	29			
388J	0	0	44	15			
388K	20	139	315	53			
388L	135	12	8	40	10638	99559	Boones Ferry Park
388M	21	83	30	753			
388N	224	0	0	306			
389	63	0	1	349			
389A	0	0	182	515			
389B	0	0	0	16			
389C	0	0	2	1284			
389D	0	0	80	642			
389E	0	0	0	0			
389F	0	0	0	0			
389G	0	0	0	715			
389H	0	0	0	424			
390	0	0	40	244			
390A	0	0	0	2056			
390B	0	0	0	137			
390C	0	0	0	345			
391	0	0	0	0			
391A	0	0	16	376			
391B	0	0	75	151			
391C	0	0	24	1189	58935	72994	Fujimi
391D	0	0	69	261			
393	0	0	0	862	265000	660000	Prison
393A	0	0	51	444			
393B	0	0	0	700			
398	0	0	0	0			
398A	0	0	0	0			
400	34	0	0	46			
400A	976	1025	283	463			
400B	0	0	0	0			
400C	316	0	0	0			
400D	0	0	0	0			
400E	0	0	0	0			
401	0	0	0	0	11605	108610	New elementary school
401A	0	0	0	0			
520	1070	606	0	67			
Total	**6047**	**6123**	**3185**	**28987**			
	SFR	**MFR**	**Retail**	**Non-Retail**	**ADD Special Water Use (gpd)**	**PDD Special Water Use (gpd)**	**Total (gpd)**
Average Day Consumption (gpd)	1,514,775	967,018	752,249	3,276,858	578028		7,108,927
Average gpcd or gpud	251	161	236	44			
Adjust For Equivalent of 2 - 1.0 MGD ADD Industrial Users by 2020				69			
Maximum Day Consumption (gpd)	5,235,714	2,298,967	2,133,182	8,350,198		1999488	20,017,549
Maximum gpcd or gpud	866	375	670	112			
Adjust For Equivalent of 2 - 2.55 MGD PDD Industrial Users by 2020				176			

Table 3-5
Annual Peak Day Demand Projections to Year 2022

Projected Year	3% Residential Growth	Estimated Non-Residential Growth	Combined Demand Projection
2000	**3.87**	**2.93**	**6.80**
2001	4.00	3.37	7.37
2002	4.14	3.88	8.01
2003	4.28	4.46	8.73
2004	4.42	5.13	9.55
2005	4.57	5.89	10.47
2006	4.73	6.34	11.06
2007	4.89	6.81	11.70
2008	5.05	7.32	12.37
2009	5.22	7.87	13.10
2010	5.40	8.46	13.86
2011	5.58	9.10	14.68
2012	5.77	9.78	15.55
2013	5.97	10.51	16.48
2014	6.17	11.30	17.47
2015	6.38	12.15	18.53
2016	6.59	12.22	18.81
2017	6.82	12.28	19.10
2018	7.05	12.35	19.40
2019	7.29	12.41	19.70
2020	**7.54**	**12.48**	**20.02**
2021	**7.54**	**12.48**	**20.02**
2022	**7.54**	**12.48**	**20.02**

Table 3-6
Maximum Day Water Demand by User Type

	2000 Unrestrained Peak Day Demand (mgd)	2020 Peak Day Demand (mgd)	Rate of Increase (%/yr)
Single Family Residential	2.56	5.24	3.6
Multi Family Residential	1.31	2.30	2.9
Commercial	1.36	2.13	2.3
Industrial	1.25	8.35	10.0
Special Use	0.32	2.00	9.6
Total	**6.80**	**20.02**	**5.5**
Total Residential	3.87	7.53	3.4
Total Non Residential	2.93	12.48	7.5

Note: Water demands based on City population and unrestrained water demand projections

Section 5 - Existing System Description

Water for the City of Wilsonville is currently supplied by eight wells located throughout the City. These wells tap the Columbia River Basalt Aquifer that underlies the City. Typically, these basalt aquifers consist of fractured layers formed between numerous lava (basalt) flows that occurred many years ago. Evidence has shown that this aquifer recharges at a very slow rate by snowmelt and rain seeping through the ground eventually reaching the aquifer.

Wilsonville's water system includes the following main components:

- Eight groundwater production wells,
- Hypochlorite (disinfection) and polyphosphate (sequestering agent) injection at each of the wells,
- Approximately 66 miles of pipeline including 24 miles of transmission pipeline,
- Four reservoirs with a total storage capacity of 7.95 MG

Refer to Figure 5-1 for locations of the City's wells, booster pump stations, and reservoirs and Table 5-1 for address locations for each.

Table 5-1
Facility Locations

Facility Name	Location
Elligsen Well	7600 SW Elligsen Road
Elligsen Reservoir A (2.2 MG)	7600 SW Elligsen Road
Elligsen Reservoir B (3.0 MG)	7600 SW Elligsen Road
Weideman Well	26440 SW Parkway Avenue
Gesellschaft Well	29001 SW Meadows Parkway
Nike Well	7524 SW Kolbe Lane
Canyon Creek Well	7955 SW Boeckman Road
Charbonneau Booster Pump Station	8774 SW Illahee Court
Charbonneau Reservoir (0.75 MG)	8774 SW Illahee Court
Boeckman Well	28011 SW Boones Ferry Road
Level B Booster Pump Station	7610 SW Elligsen Road
Level B Reservoir (2.0 MG)	8249 SW Elligsen Road

Source

The City of Wilsonville holds water right permits on eight groundwater wells and on the Willamette River at the Wilsonville diversion point. The priority date for the well water sources range from 1969 to 1988 and allow for a total combined withdraw of 6,010 gpm (13.4 cfs). The well with the highest permitted flow rate is the Gesellshaft well with a permitted rate of 1500 gpm (3.3 cfs). The Willamette River water right is for 13,500 gpm (30.0 cfs) with a priority date of 1974.

The drinking water supply wells for the City of Wilsonville were constructed between 1970 and 1997. The Elligsen Well was the first to be constructed. As the City has grown, additional wells have been constructed to meet the increasing water demand. The last well, Boeckman Well, was drilled in May of 1997. The current maximum realized pumping rate for the individual wells range from 78 gpm to 666 gpm. A summary of basic well information including date of construction, depth, maximum realized pumping rates and permitted pumping rates are summarized in Table 5-2.

Table 5-2
Summary of Groundwater Development

Well Name	Year Constructed	Permitted Pumping Rate (gpm)
Elligsen	1970	448.5
Charbonneau #2	1977	300.5
Charbonneau #3	1977	49.3
Weideman	1980	717.6
Gesellschaft	1984	1,498.00
Nike	1984	1,000.00
Canyon Creek	1991	995.7
Boeckman	1997	995.7

The combined permitted groundwater right and pumping rate for the eight wells is 8.65 mgd. The maximum realized total pumping capacity of all eight wells is approximately 5.5 mgd and the reliable pumping capacity is 4.6 mgd with one of the larger wells out of service.

The Oregon Water Resources Department (OWRD) has classified the portion of the Columbia River Basalt Aquifer that Wilsonville utilizes as “groundwater limited”. The aquifer recharges at a much slower rate than water is being pumped from it and as a result, the water level in the aquifer has continued to drop over the years. In issuing its permit to Wilsonville for the Canyon Creek / Boeckman wells, OWRD required the City to address conservation and growth management issues. OWRD also informed the City that reliance on this aquifer as a long-term water supply is unacceptable. Wilsonville pursued conservation and growth management efforts which are described in the Water Management and Conservation Plan that has been approved by OWRD. Wilsonville has restricted water usage and development of the distribution system while developing another source of water supply. This is discussed in more detail in Section 7.

GROUNDWATER QUALITY

As a public water provider, the City of Wilsonville is required by the Oregon Health Division (OHD) to monitor and report the results for more than 100 regulated and unregulated inorganic and organic compounds. In addition, monitoring lead and copper, microbiological, and radiological parameters is also required.

Requirements for monitoring various constituents in the source water and the distribution system vary. The frequency for monitoring of most parameters in the source water is summarized in Table 5-3.

Table 5-3
Monitoring Frequency for Source Water

Source Water: Inorganic/Conventional Parameters	Testing Frequency
Nitrate	Annually
Synthetic Organic Compounds (SOC)	3-year cycle
Unregulated SOC	3-year cycle
Volatile Organic Compounds (VOC)	3-year cycle
Unregulated VOC	3-year cycle
Radiological	4-year cycle

In recent years, the City has met all drinking water standard requirements that the U.S. Environmental Protection Agency (EPA) has determined to establish the safety of drinking water supplies. For more complete information on the City's compliance with drinking water standards, see the Appendix for a copy of the City's *Annual Water Quality Reports*, starting with 1998 when these reports were first published. This report complies with a federal regulation requiring water utilities to provide water quality information annually to its customers. See Appendix A for more complete water quality information.

The City's wells can be characterized as relatively "hard" water from minerals in the water. The City has noticed an increased mineral content in the groundwater over time, likely a result from drawing the water level down in the aquifer.

Several future potential federal drinking water regulations must be considered in relation to the City's wells. Arsenic is currently regulated at 50 ug/L. However, EPA has been considering lowering this standard to between 2 and 10 ug/L. Historical data from the Charbonneau, Elligsen, Gesellshaft and Nike wells showed concentrations of 1.7, 1.6, 1.2 and 2 ug/L, which are at or below the lowest level that EPA is considering.

Radon levels in the City's wells have historically ranged from approximately 100 to 800 pCi/L. For a number of years, EPA has been considering establishing a radon regulation somewhere between 300 pCi/L and 4,000 pCi/L. Test results indicate that radon in the groundwater ranges from 110 pCi/L to 825 pCi/L. Proposals for regulating radon suggest MCLs ranging from 300 pCi/L to 4,000 pCi/L. If EPA were to regulate individual wells at the lower end of the range, the City may have to add treatment at one or more of its wells to remove the radon. Typical treatment for removing radon from groundwater includes aeration or the use of activated carbon.

EXISTING WATER DISTRIBUTION SYSTEM

The distribution system consists of approximately 65.6 miles of pipeline including 23.5 miles of transmission pipeline greater than 12-inch diameter. The City of Wilsonville's distribution system is a relative new system with the majority of the pipeline being ductile iron and installed within the last 20 years. Figure 5-1 shows the Well and Reservoir Locations and Table 5-4 shows the nominal diameters and lengths of the Wilsonville pipeline network.

Table 5-4
Distribution System Pipeline Length by Diameter

Nominal Pipeline Diameter	Length of Pipeline by Diameter	
(inches)	(LF)	(Miles)
<= 4	17,450.0	3.3
6	52,560.0	10.0
8	116,880.0	22.1
10	35,920.0	6.8
12	81,020.0	15.3
14	26,250.0	5.0
16	5,370.0	1.0
18	11,160.0	2.1
>18	0.0	0.0
Total	**346,610.0**	**65.6**

Currently, the City's water system is divided into three pressure zones. The Level C pressure zone is supplied water through a booster pump station located at the Elligsen Reservoir site. The C Level is located in the Northeast portion of the distribution system and is the smallest of the three pressure zones. The booster pump station to Level C draws water from Level B at approximately 400 ft and delivers water to the Level C Reservoir that has an overflow water surface elevation of 507.5 feet. The Reservoir volume, diameter, bottom elevation, over flow elevation, and type are shown in Table 5-5.

Table 5-5
Reservoir Information

	Volume (MG)	Diameter (ft)	Bottom Elevation	Overflow Elevation (ft)	Type
Elligsen B-1	2.2	83.2	345.7	399.7	At Grade Steel
Elligsen B-2	3.0	101.0	350.0	400.5	At Grade Steel
Charbonneau A-1	0.8	80.0	100.0	120.0	Buried Concrete
Elligsen C-1	2.0	87.5	463.0	507.5	At Grade Steel

The Level B pressure zone contains all the production wells for the City. Each well is equipped with a pump to boost flow to the Elligsen Reservoirs. However, the Charbonneau wells are pumped from the well to an intermediate reservoir with an over flow water surface level of 120 feet which is Level A. From this intermediate Level A reservoir the water is boosted into the Level B distribution system to the Elligsen Reservoirs. The Charbonneau district located south of the Willamette River is provided flow through a pressure reducing station from Level B.

A proposed Level D is recommended in Section 9 as part of the Capital Improvement Program. The proposed Level D pressure zone will be an "on demand" pumping system servicing development above elevation 415. Water will be boosted from the Level C reservoir into level D.

DISTRIBUTION SYSTEM QUALITY

As a public water supplier, the City of Wilsonville must comply with the drinking water regulations administered by OHD. The City completes all the distribution system monitoring required by OHD as well as additional tests that are needed to confirm adequate operation of the system. Monitoring requirements for the distribution system varies as shown in Table 5-6.

Table 5-6
Monitoring Frequency in the Distribution System

Parameter	Testing Frequency
Distribution System: Lead/Copper	3-year cycle
Routine Microbiological	Monthly
Trihalomethanes (THM)	Quarterly
Chlorine Residual	Daily/monthly

Since Wilsonville began monitoring for lead and copper in November 1992, all monitoring results have met the requirements of the Lead and Copper Rule. The lead and copper "Action Levels" established by the EPA are 0.015 mg/L for lead and 1.3 mg/L for copper for the 90th percentile of the samples taken. The Rule requires samples to be taken from customers' taps of a select pool of homes within the City that meet the requirements described in the Rule. Detected levels of lead and copper are generally from corrosion of household plumbing in the distribution system. These constituents are monitored on a three-year cycle.

Prior to 1996, the City of Wilsonville was not required to provide disinfection in the distribution system. However, bacteriological violations in 1994 and 1995 triggered the need to disinfect the groundwater. Bacteriological testing includes distribution coliform samples taken on a monthly basis. OHD requires ten bacteriological samples to be taken in the system. Wilsonville routinely collects sixteen samples monthly. Eight sites are sampled during the first part of the month and eight sites are sampled during the last part of the month. In 1994, the City had several positive coliform test results. Routine repeat samples were taken and again in 1995 test days. The Charbonneau service area can supply the projected average day demand indefinitely from the well supply.

COMPARISON OF STORAGE TO PLANNING CRITERIA

Based on the planning criteria presented in Section 4 of this Master Plan, the required storage will consist of 25% of projected peak day demand for equalization, plus the fire flow demand, plus two average day demand for emergency storage. For each well with emergency backup power, a storage volume equivalent to the realized maximum capacity for one day has been assumed.

Four alternatives have been considered in the storage evaluation. Using the four components of storage described in Section 4 each alternative is described in Table 6-1.

Table 6-1
Storage Alternatives

Alternative	Equalization Storage	Operational Storage	Emergency Storage	Fire Flow Storage
A	25% of Peak Day Demand	None	2 Average Day Demand minus 3 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
B	25% of Peak Day Demand	None	2 Average Day Demand minus 6 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
C	25% of Peak Day Demand	66% of Average Day Demand	2 Average Day Demand minus 3 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours
D	25% of Peak Day Demand	66% of Average Day Demand	2 Average Day Demand minus 6 Wells and 13.5 hours of Charbonneau Booster PS firm capacity	3000 gpm for 4 hours

Option B is the recommended criteria and considers all wells contributing to storage. Therefore, it is assumed that all wells will have backup power and be available under an emergency supply scenario. The Wiedeman, Gesellshaft, and Canyon Creek wells require backup power to satisfy this condition. The Charbonneau well system has been given special consideration in its contribution to storage. The Charbonneau Wells #2 and #3 supply the Charbonneau Reservoir. Water from the Charbonneau Reservoir is boosted into the distribution system. The Charbonneau Booster Pump Station has a higher firm capacity than the Charbonneau wells and therefore this Charbonneau system operating continuously at firm capacity would only be able to continuously supply water for approximately 13.5 hours before depleting the reservoir volume. To refill the Charbonneau Reservoir would take approximately 33 hours if only the wells were utilized. Recovery could happen much faster if flow were allowed to bypass the Charbonneau Booster Pump Station and fill the reservoir.

Option A is similar to Option B, but only considers the influence of the Boeckman, Elligsen, Charbonneau, and Nike wells on the required storage volume. These wells currently have backup power. Options C and D consider an additional storage component that relates to the operation of the water treatment plant, which is 2/3 of one average day equivalent storage in lieu of 8 hours of water treatment plant capacity. However, the initial capital cost of the additional storage volume required

Table 6-2
Storage Analysis

	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)	Fire Flow Demand (gpm)	4 Wells (Measured) Operating (gpm)	8 Wells (Measured) Operating (gpm)	Required Storage (MG)	Storage Surplus / (Defecit) (MG)
2000	1736.0	4722.0	11806.0	3000.0	2834.0	4720.0		
Option A							4.1	3.8
Option B							1.4	6.6
Option C							5.8	2.2
Option D							3.1	4.9
2005	2567.0	7271.0	18177.0	3000.0	2834.0	4720.0		
Option A							7.4	0.5
Option B							4.7	3.2
Option C							9.9	(1.9)
Option D							7.2	0.8
2010	3187.0	9011.0	22528.0	3000.0	2834.0	4720.0		
Option A							9.8	(1.9)
Option B							7.1	0.8
Option C							12.9	(4.9)
Option D							10.2	(2.2)
2015	3964.0	11181.0	27951.0	3000.0	2834.0	4720.0		
Option A							12.9	(4.9)
Option B							10.1	(2.2)
Option C							16.7	(8.7)
Option D							13.9	(6.0)
2020 (Buildout)	4937.0	13903.0	34757.0	3000.0	2834.0	4720.0		
Option A							16.6	(8.7)
Option B							13.9	(6.0)
Option C							21.4	(13.4)
Option D							18.7	(10.7)

Option A = (2*ADD+ 0.25*PDD - (3 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option B = (2*ADD+ 0.25*PDD - (6 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option C = (2*ADD+0.25*PDD+2/3*ADD - (3 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours
Option D = (2*ADD+0.25*PDD+2/3*ADD - (6 Wells and Charb. For 13.5 hrs)) for a day + FF for 4 hours

Table 6-3
Pump Station Characteristics

	Realized Maximum Capacity (gpm)	Rated Ultimate Capacity (gpm)	Rated Firm Capacity (gpm)	Total Installed HP (HP)	Installed Pumps	Backup Generator	Comment
Elligsen Well	520	500	500	100	1 Pump Submersible	Yes	
Wiedeman Well	666	720	0	75	1 Pump Vertical Turbine	No	
Canyon Creek Well	596	700	0	125	1 Pump Submersible	No	
Boeckman Well	435	600	600	125	1 Pump Vertical Turbine	Yes	
Gesellschaft Well	624	700	0	125	1 Pump Vertical Turbine	No	
Nike Well	654	700	700	150	1 Pump Vertical Turbine	Yes	
Charbonneau Well #2	300	240	240	15	1 Pump Submersible	Yes	
Charbonneau Well #3	78	60	60	5	1 Pump Submersible	Yes	
Charbonneau Booster Pump Station	1225	2850	1600	190	1 - 40 HP End Suction Centrifugal 2 - 75 HP End Suction Centrifugal	Yes	Assumes 750,000 gallon tank can only supply for 10 hrs. This increases to 13.5 hrs if wells are also running.
Level B Booster	N/A	1650	850	107.5	1 - 7.5 HP End Suction Centrifugal 2 - 25 HP End Suction Centrifugal 1 - 50 HP End Suction Centrifugal	Yes	
WTP High Service Pump Station	N/A	18400	13200	1800	3 - 500 HP Vertical Turbine 1 - 300 HP Vertical Turbine All VFD	Yes	

Fire hydrants should only be installed on pipelines 8-inch diameter or larger. It is recommended that pipelines that service fire hydrants should be part of a looped system in order to deliver adequate fire flow.

Table 6-4
Pump Station Capacity Analysis

	Pressure Zone	Realized Maximum Firm Capacity	Required Capacity 2020 Peak Day Demand	Pump Station Suplus or (Deficit)	Backup Generator
		(gpm)	(gpm)	(gpm)	
Elligsen Well	Level B	520.0			Yes
Wiedeman Well	Level B	0.0			No
Canyon Creek Well	Level B	0.0			No
Boeckman Well	Level B	435.0			Yes
Gesellschaft Well	Level B	0.0			No
Nike Well	Level B	654.0			Yes
Charbonneau Booster Pump Station	Level A-B	1225.0			Yes
WTP High Service Pump Station*	Level B	13200.0			Yes
Total w/o WTP	Level B	**2834.0**	**13888.9**	**(11054.9)**	
Total w/ WTP	Level B	**16034.0**	**13888.9**	**2145.1**	
Level C Booster*	**Level C**	**850.0**	**694.0**	**156.0**	Yes

* - Using Rated Firm Capacity due to lack of in-situ operating capacity.

SUMMARY AND CONCLUSIONS

Some deficiencies exist in the system under current and projected conditions.

- The firm capacity of the City's groundwater supply is not capable of meeting existing peak daily demand.
- Backup generators will be required at the Weideman, Canyon Creek, and Gesellshaft Wells.
- Current well system pumping facilities are not adequate to meet current and projected peak day demands at firm capacity
- Pipelines 6 inch in diameter and smaller should be identified as fire flow restrictive, and fire flow service should not be permitted off these pipelines. The City has not identified any existing pipeline that violates this criterion. However, if existing small diameter pipelines are found or new pipeline is placed for fire flow service, a minimum 8-inch diameter pipeline should be installed.

These findings form the basis of the capital improvement recommendations presented in Section 9 of this Master Plan. The results of the hydraulic model evaluation provide the basis for additional capital improvement projects, based on current and projected hydraulic deficiencies. The hydraulic modeling results are discussed below.

PIPELINES

The assumed costs per foot of installed pipe are shown in Table 8 -1.

Table 8-1
Assumed Basis of Pipeline Costs
($/ft of Installed Pipe)

Diameter (inches)	TOTAL $/ft	Material $/ft	Installation $/ft	Subtotal Const. Cost $/ft	Contingency (20%) $/ft	Engineering, Const. Management & Administrative (15%) $/ft
6	**$65.15**	$34.50	$13.80	$48.30	$9.60	$7.25
8	**$75.50**	$39.90	$16.00	$55.90	$11.20	$8.40
10	**$90.70**	$48.00	$19.20	$67.20	$13.40	$10.10
12	**$109.65**	$58.00	$23.20	$81.20	$16.25	$12.20
14	**$124.65**	$65.90	$26.40	$92.30	$18.50	$13.85
16	**$146.35**	$77.40	$31.00	$108.40	$21.70	$16.25
18	**$171.00**	$90.50	$36.20	$126.70	$25.30	$19.00
20	**$201.40**	$106.60	$42.60	$149.20	$29.80	$22.40
24	**$275.55**	$145.75	$58.30	$204.05	$40.90	$30.60
27	**$317.78**	$168.09	$67.20	$235.30	$47.20	$35.30
30	**$360.00**	$190.50	$76.20	$266.70	$53.30	$40.00

Estimates for pipelines are based on installation in typical urban street environments. Among the basic assumptions upon which the cost estimate is based, unless otherwise noted, are:

- Rights-of-way are in streets with asphalt paving to 4-inch depth. Pavement replacement is assumed to be required for the full project length.
- There are no significant utility relocations required for pipe installation.
- Trenching is in soil, with no rock encountered. Trench width is equal to the nominal pipe diameter plus 2 feet and trench depth assumes cover to top of pipe equal to 3 ½ feet.
- No trench dewatering is required.
- Unless specifically noted, joints are unrestrained.
- Pipe material is ductile iron, Class 52, cement lined and asphalt coated, in the size range of 6-inch to 30-inch diameter.
- Hydrant spacing is 400 feet for mains 18-inch and smaller.
- Two valves per 250 feet for 6-inch to 12-inch pipe, per 350 feet for 14-inch to 20-inch, per 500 feet for 24-inch and 30-inch. Valves are gate valves for 6-inch to 10-inch and butterfly valves for 12-inch to 30-inch piping.
- Projects are in the range of 100 feet to 5,000 feet in length.
- There are no costs for property or easement acquisition.

Table 8-2
Assumed Basis of Buried Concrete Reservoir Costs
($/gallon)

Size (Million Gallon)	Total Cost ($/gallon)	Construction ($/gallon)	Contingency ($/gallon)	Engineering Const. Management Administrative ($/gallon)
1.0	**$1.24**	$0.92	$0.18	$0.14
1.5	**$1.10**	$0.82	$0.16	$0.12
2.0	**$0.97**	$0.72	$0.14	$0.11
3.0	**$0.83**	$0.62	$0.12	$0.09
3.5	**$0.81**	$0.60	$0.12	$0.09
4.0	**$0.74**	$0.55	$0.11	$0.08
5.0	**$0.70**	$0.52	$0.10	$0.08

Seismic requirements for facilities in the Pacific Northwest have changed substantially over the last several years due to increased understanding of seismic risk in the region. It is likely that these requirements will continue to become more stringent. New facilities, which are considered "lifelines", are required to have a site specific seismic analysis. Such an analysis could lead to more stringent requirements than the Zone 3 reinforcement assumed in these cost estimates.

Special screening or landscape requirements that are specific to a site could add up to 30% to the costs of a reservoir. Another site consideration is the location of the site relative to existing piping to bring water to and from the reservoir. Sites that are far from existing adequately sized piping would incur additional costs to bring pipes to and from the site.

Wilsonville has recent reservoir construction experience that can be used to verify and adjust these unit costs. Level B reservoir was completed in 2000. This 2 MG at-grade steel reservoir was completed for a total project cost of $0.33/gal. These costs included engineering, administration, construction management and permitting. A competitive bidding environment and low cost of steel for this reservoir significantly reduced the cost of this reservoir. Relative to the cost table above, the Level B reservoir unit cost is 29-30 percent lower. Due to the inability to rely on a favorable bidding environment and cost of materials the higher, more conservative, estimated unit cost in Table 8-3 will be used for at-grade steel tanks in this master plan.

Table 8-3
Assumed Basis of At Grade Steel Reservoir Costs
($/gallon)

Size (Million Gallon)	Total Cost ($/gallon)	Construction ($/gallon)	Contingency ($/gallon)	Engineering Const. Management Administrative ($/gallon)
0.25	**$0.95**	$0.70	$0.14	$0.11
0.50	**$0.77**	$0.57	$0.11	$0.09
0.75	**$0.65**	$0.48	$0.10	$0.07
1.00	**$0.61**	$0.45	$0.09	$0.07
1.50	**$0.53**	$0.39	$0.08	$0.06
2.00	**$0.47**	$0.35	$0.07	$0.05
3.00	**$0.41**	$0.30	$0.06	$0.05

PUMP STATIONS

The costs for various size ranges of installed pump motor horsepower are shown in Table 8-4. Costs for pump stations assume construction without any special site constraints or other requirements unless otherwise noted. Among the basic assumptions upon which the cost estimate is based, unless otherwise noted, are:

- No rock is encountered during excavation.
- Landscaping around the site is grass.
- Seismic reinforcement is to Zone 3.
- There are no costs for land acquisition or site demolition.
- There are no special site environmental or community mitigation costs associated with the pump station construction.
- Buildings are of concrete masonry construction.
- Standby generator costs not included unless specifically noted.

Table 8-4
Assumed Basis of Pump Station Costs
($/HP)

Size Total Installed HP	Total Cost ($/HP)	Construction ($/HP)	Contingency ($/HP)	Engineering, Const. Management Administrative ($/HP)
50	$2,970	$2,200	$440	$330
75	$2,700	$2,000	$400	$300
100	$2,498	$1,850	$370	$278
200	$2,025	$1,500	$300	$225
300	$1,890	$1,400	$280	$210
500	$1,688	$1,250	$250	$188
1000	$1,350	$1,000	$200	$150

FINANCING OPTIONS

The options that are available to the City of Wilsonville to fund improvements to its water system are those established for municipal utility functions in general. The options include utility rate charges, general obligation and revenue bonds, system development charges, grants and loans, and plan review and other fees. The primary mechanism for funding the projects under this Master Plan will likely be SDCs for new development. System development charges will provide funding for capital expenditures. Revenue bonds will likely be the form of debt borrowing, with payment of the debt service from utility rates and system development charges. Grants and loans may provide funding for specific projects and programs and plan review fees will contribute small amounts of money to the funding program for this Master Plan. These options are discussed briefly below.

Utility Rate Charges

Water utility rate charges typically have two components. The first is often called the customer service charge and covers expenses that are uniform or do not vary across customers or customer classes. These expenses typically include such items as the cost of meter reading and billing. The second component of water utility rates is the commodity charge. This is a charge based upon the volume of water that is consumed. This amount covers items that vary with water consumption, such as power and chemical treatment costs. Commodity charge rate structures can be uniform, inclining or declining blocks. Inclining blocks, where costs are higher the more water that is consumed, generally promote conservation better than other rate structures.

General Obligation Bonds

The City can issue general obligation bonds for capital improvements and replacement subject to voter approval. General obligation bonds are debt

Table 9-1
Capital Improvement Program

Zone	Description	Peak Day Demand	Peak Hour Demand	Peak Day + Fire Flow Demand	Existing	2000	2005	2010	2015	2020	Project Diameter (inches)	Total Length (feet)	$/LF	Estimate of Cost[1]
Pipeline Projects														
B	Evergreen Road from Kinsman Road to Brown Road		x		N/A		18				18	2092	$171.00	$357,732
B	Boeckman Road from WTP Transmission to 95th Avenue	x		x	N/A		24				24	1290	$275.55	$355,460
B	WTP Transmission Barber Street to Boeckman[2]	x		x	N/A		24				48	2965	$576.00	$1,707,840
B	WTP Transmission Wilsonville Road to Barber Street[2]	x		x	N/A		30				48	2613	$576.00	$1,505,088
B	Boeckman Road from WTP Transmission to 110thAvenue (west)	x			N/A			24			24	2800	$275.55	$771,540
B	110th Avenue South from Boeckman Road to Intersection of Brown Road and Evergreen	x			N/A			18			18	4630	$171.00	$791,730
B	New School Pipeline north from Boeckman Road	x		x	N/A			12			12	1000	$109.65	$109,650
D	D Level Transmission from C Level Reservoir	x		x	N/A			12			12	1000	$109.65	$109,650
B	Dammasch Development to Grahams Ferry Road	x		x	N/A			18			18	3010	$171.00	$514,710
B	From Dammasch Development along Grahams Ferry Road to Boeckman Road	x		x	N/A			18			18	2270	$171.00	$388,170
B	Urban Service Area between Frog Pond Lane and Boeckman Road		x		N/A				12		12	5125	$109.65	$561,956
B	From Boeckman Road near Canyon Creek Well to Vlahos Drive		x		N/A				12		12	2850	$109.65	$312,503
B	Cahalin Road, Morton Street, and Elligsen Way		x		N/A				12		12	3980	$109.65	$436,407
B	Grahams Ferry to Ridder Road, Ridder Road to Garden Acres		x		N/A				12		12	4220	$109.65	$462,723
B	WTP Transmission Boeckman to Ridder[2]	x		x	N/A				18		48	5263	$576.00	$3,031,488
B	New Reservoir Transmission				N/A				30		30	6785	$360.00	$2,442,600
B	Weideman Road from Weideman PS to Parkway Ave		x		10					12	12	570	$109.65	$62,501
B	Parkway Center Drive from Burns Way to Parkway Ave		x		8					12	12	1900	$109.65	$208,335
Sub Total of Pipeline Cost Per Five Year Planning Horizon							**$3,926,120**	**$2,685,450**	**$7,247,677**	**$270,836**				**$14,130,082**
Source and Supply														
						2000	**2005**	**2010**	**2015**	**2020**				
B	5 mgd ASR Development						$1,000,000							$1,000,000
B	5mgd WTP Expansion								$3,750,000					$3,750,000
Sub Total						**$0**	**$1,000,000**	**$0**	**$3,750,000**	**$0**				**$4,750,000**
Pump Station Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Weideman Well Backup Generator							$100,000						$100,000
B	Canyon Creek Well Backup Generator							$100,000						$100,000
B	Gesellschaft Well Backup Generator							$100,000						$100,000
B	Charb Total Booster Flow Meter						$5,000							$5,000
A-B	Emergency Startup and Operation at Charb Booster PS						$50,000							$50,000
D	C Level Booster Pump Station							$225,000						$225,000
Sub Total						**$0**	**$55,000**	**$525,000**	**$0**	**$0**				**$580,000**
Control Valves														
						2000	**2005**	**2010**	**2015**	**2020**				
B	Barber PRV Station						$55,000							$55,000
B	Boeckman PRV Station						$55,000							$55,000
B	Ridder PRV Station								$55,000					$55,000
A-B	PS Bypass at Charb Booster PS from Level B to Level A						$10,000							$10,000
Sub Total						**$0**	**$120,000**	**$0**	**$55,000**	**$0**				**175,000**
Reservoir Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
C	Level C Intertie					$50,000								$50,000
B	Reservoir Land Acquisition						$275,000							$275,000
B	Reservoir Storage Level B (2015 Required)								$1,940,000					$1,940,000
B	Reservoir Storage Level B (2020 Required)									$3,500,000				$3,500,000
Sub Total						**$50,000**	**$275,000**	**$0**	**$1,940,000**	**$3,500,000**				**$5,765,000**
Well and Reservoir Rehabilitation Projects														
						2000	**2005**	**2010**	**2015**	**2020**				
A	Charb Res DeChlorination Facility for Reservoir Drainage					$10,000								$10,000
A	Charb Res Interior Inspection and Cleaning					$25,000		$25,000						$50,000
A	Charb Res Seismic Study					$25,000								$25,000
B	Elligsen Res 1 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 1 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
C	Level C External Painting						$75,000		$75,000					$150,000
C	Level C Internal Inspection and Cleaning						$25,000		$25,000					$50,000
B	Elligsen Res 2 External Painting						$75,000		$75,000					$150,000
B	Elligsen Res 2 Interior Inspection and Cleaning					$25,000		$25,000						$50,000
Sub Total						**$110,000**	**$250,000**	**$75,000**	**$250,000**	**$0**				**$685,000**
Plans and Studies														
						2000	**2005**	**2010**	**2015**	**2020**				
	Water System Master Plan						$75,000	$75,000	$75,000	$75,000				$300,000
	Water Rate Study						$40,000	$40,000	$40,000	$40,000				$160,000
	ASR Feasibility Study						$100,000							$100,000
Sub Total						**$0**	**$215,000**	**$115,000**	**$115,000**	**$115,000**				**$560,000**
Total						**$160,000**	**$5,841,120**	**$3,400,450**	**$13,357,677**	**$3,885,836**				**$26,645,082**

1. Estimated Cost are based on Year 2000 Dollars
2. Project Diameter increased to provide potential supply flow to neighboring water providers.

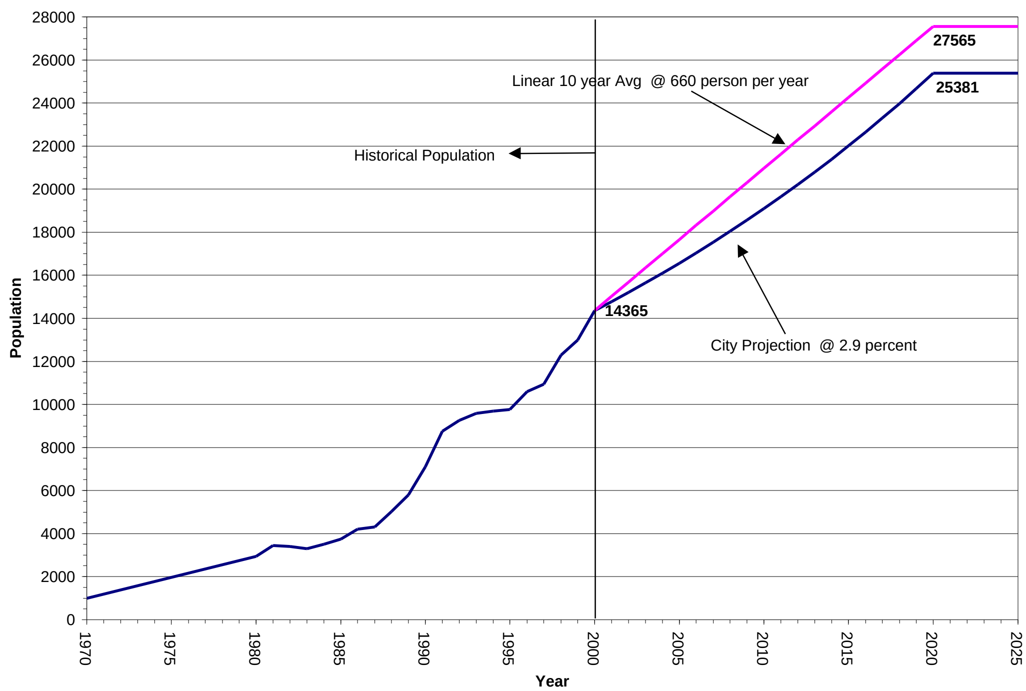
Exhibit 7

Figures

City Community Development Department Projections

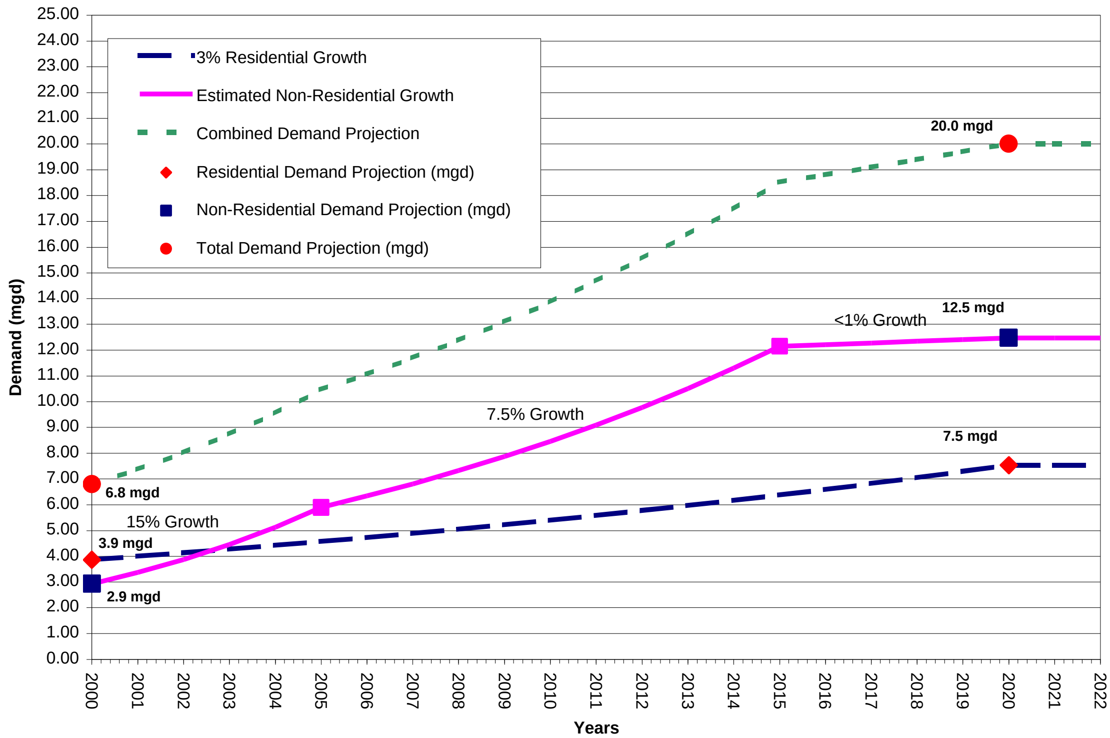
While this Master Plan covers the twenty year planning period of 2002 to 2022, the City has estimated that the ultimate buildout population will be achieved in the year 2020. Projected populations to 2020 have been estimated by City staff based on the development capacity inside the current Urban Growth Boundary and estimates of future development in the unincorporated portions of the City's service area. Using the City's buildout population projections and current population data, a 2.9 percent average annual population growth rate has been developed from 2000 to 2020. Growth projections are depicted graphically in Figure ES-1. The ultimate year 2020 (buildout) population projection for the City is estimated to be 25,381.

Figure ES-1
Population Projections



This estimate represents the best available evaluation of existing development capacity within the current service area and adjacent future planning areas. The recommended population projection was used to develop a per capita water demand rate for residential services throughout the water system. Because of the influence of non-residential service in Wilsonville, water demand projections should not be solely based on a per capita water usage rate. Therefore, for non-residential services, a separate water demand was developed. The combination of the per capita demand rate and the per unit demand rate forms the basis of an evaluation of long-term water supply needs.

Figure ES-2
Projected Unrestrained Peak Day Demand by Rate of Growth and User Type

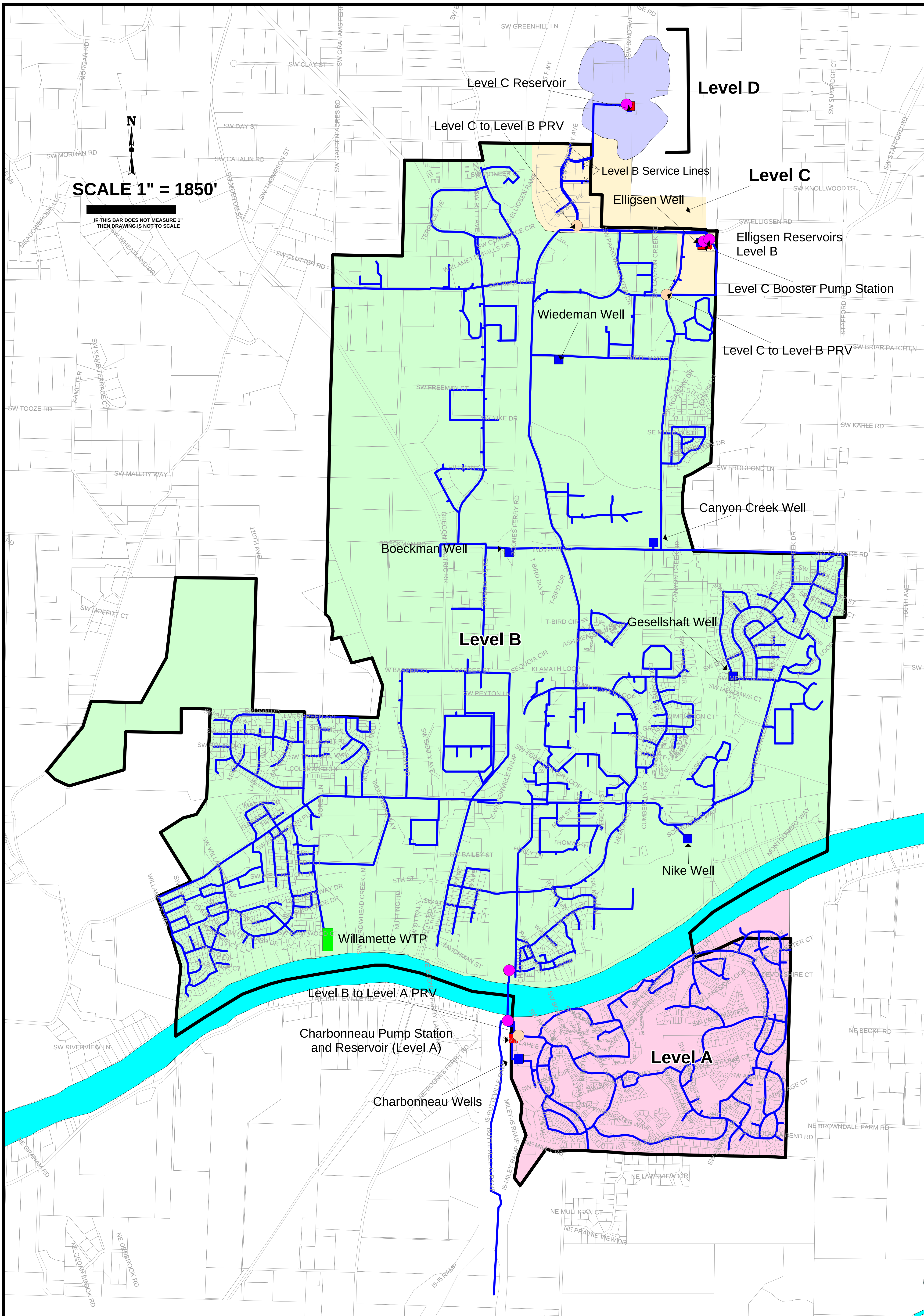


CAPITAL IMPROVEMENT PROGRAM

Projects within the Capital Improvement Program (CIP) are listed in Table ES-4 and are show in Figure ES-3. Table ES-4 is separated into 6 major sections including:

- Pipeline Projects,
- Source and Supply,
- Pump Station Projects,
- Control Valves,
- Reservoir Projects,
- Wells and Reservoir Rehabilitation Projects,
- Plans and Studies.

A total of about $26.6 M (in year 2001 dollars) in improvements is recommended between now and the year 2022. The majority of the recommended capital projects are needed by the year 2015. Financial impacts to existing water rates and System Development Charges (SDCs) have not been determined. The current rate structure is sufficient to cover the cost of projects planned in the first five years, but future



Distribution Pipeline (> or = 4 inch)

Contour >= 415 feet (Level D)

City Boundary

Well

Reservoir

City Boundary

Seismic Isolation Valve

Pressure Regulating Valve

MONTGOMERY WATSON

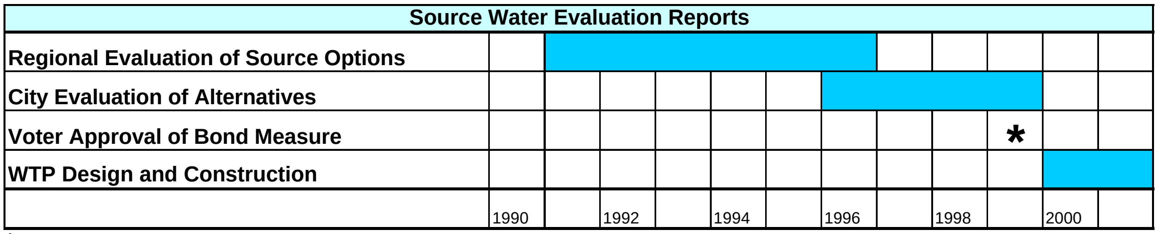
Figure 1-1
City of Wilsonville

Service Area and Facilities

(As of May 2001)

City of WILSONVILLE in Oregon

Figure 1-2
History of Source Evaluation



* Master Plan Recommends Surface Source by 2000

Figure 1-3
History of Willamette WTP Development

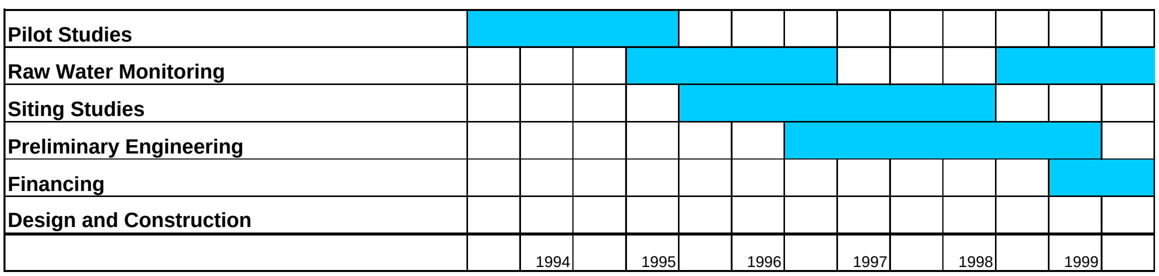
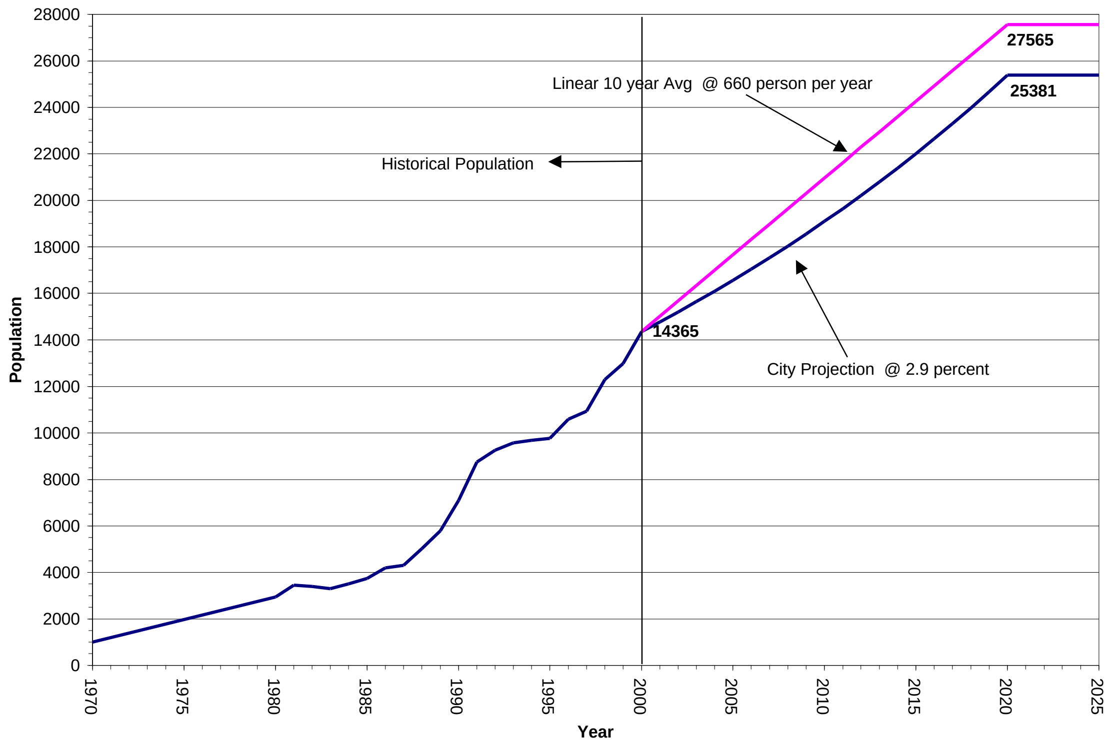


Figure 2-1
City of Wilsonville Historical and Projected Population

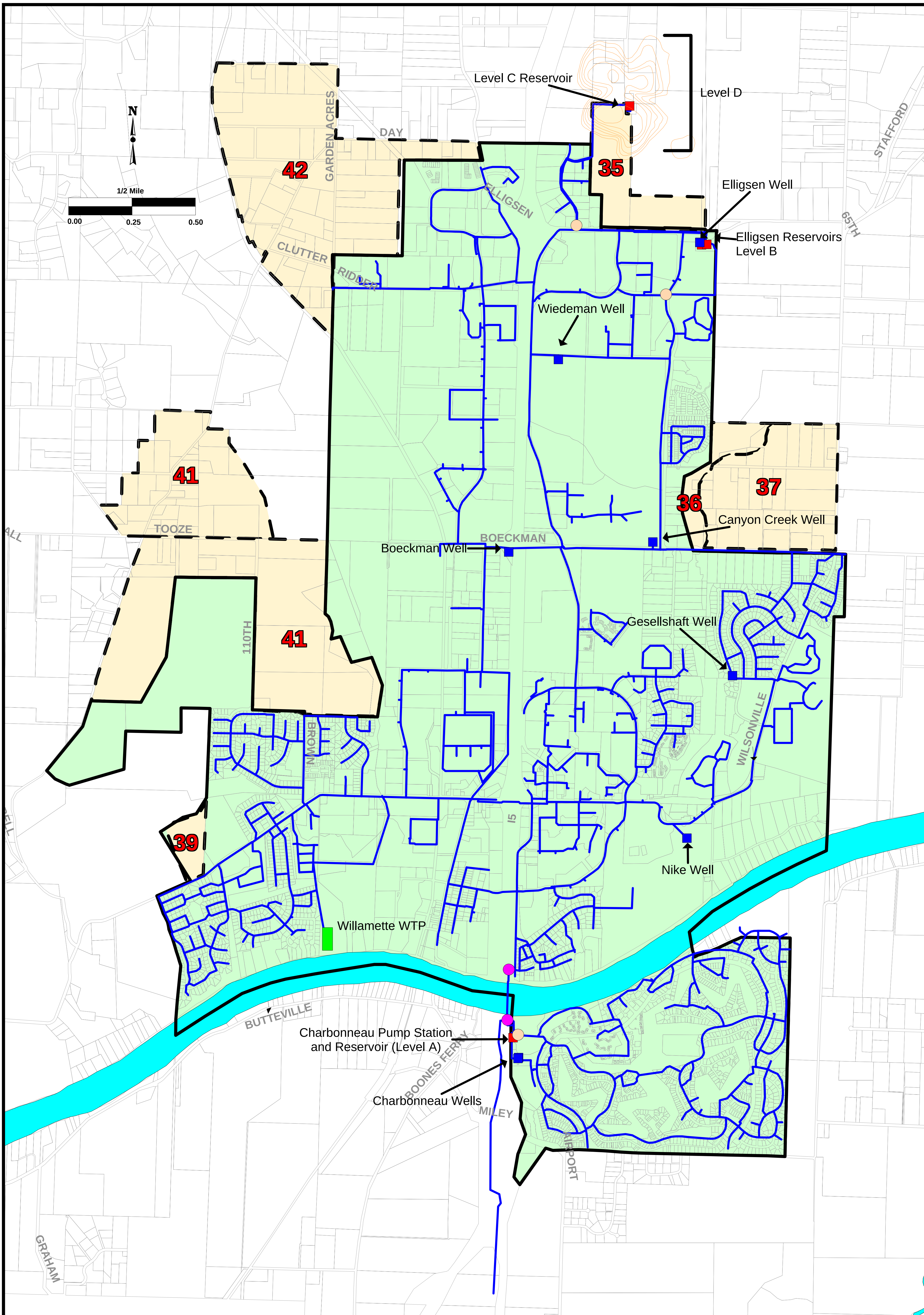


1986 Water System Master Plan Projections

The 1986 Water System Master Plan provided a four year population projection of 5,885 in year 1990 for the existing service area. This is approximately 20 percent lower than the PSU population estimate of 7,106 for 1990, shown in Table 2-1. In the 1986 Master Plan, the year 2000 population projection was based on a 7.7 percent annual average growth rate and was 12,367. This population projection was approximately 16 percent lower than the PSU adjusted year 2000 census population of 14,365. The 1986 Master Plan continued the 7.7 percent increase into year 2006, for a total projected population of 19,311. This population of 19,311 is significantly higher than the City's estimate of 17,532. If that growth rate were to continue until the year 2020, the resultant population would be 54,554. These estimates illustrate that population forecasting is a blend of art and science, and that forecasts need to be updated regularly to take into account changing trends and conditions.

Linear Average Growth Projection

Another simplistic method of population forecasting is to assume that the future growth will be similar to past growth. Between 1990 and 2000, the population served by the City's water system grew from 7,106 to 14,365, for an average of 660 persons per year. If that same average were to continue to the year 2020 (buildout), then the 2020(buildout) population would be about 27,565. This is about 8 percent higher



Urban Planning Boundary

XX Urban Planning Area

METRO Designated Area Number

Distribution Pipeline (> or = 4 inch)

Contour >= 415 ft (Level C)

City Boundary

Well

Reservoir

Seismic Isolation Valve

Pressure Regulating Valve

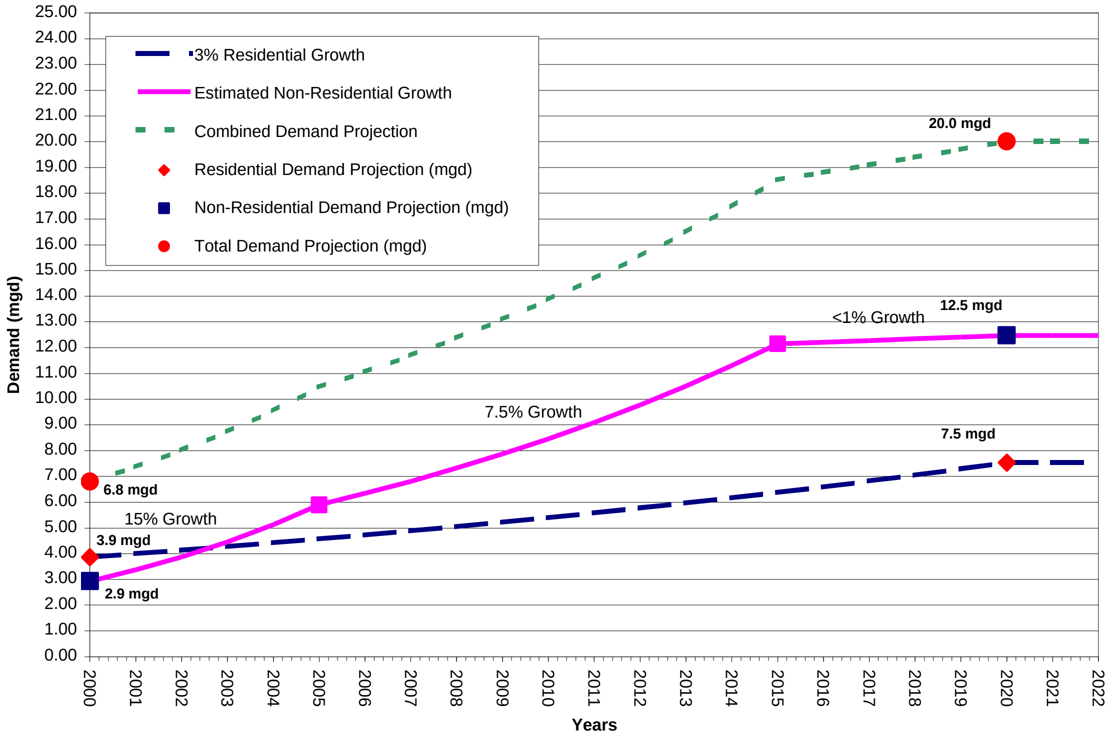
MONTGOMERY WATSON

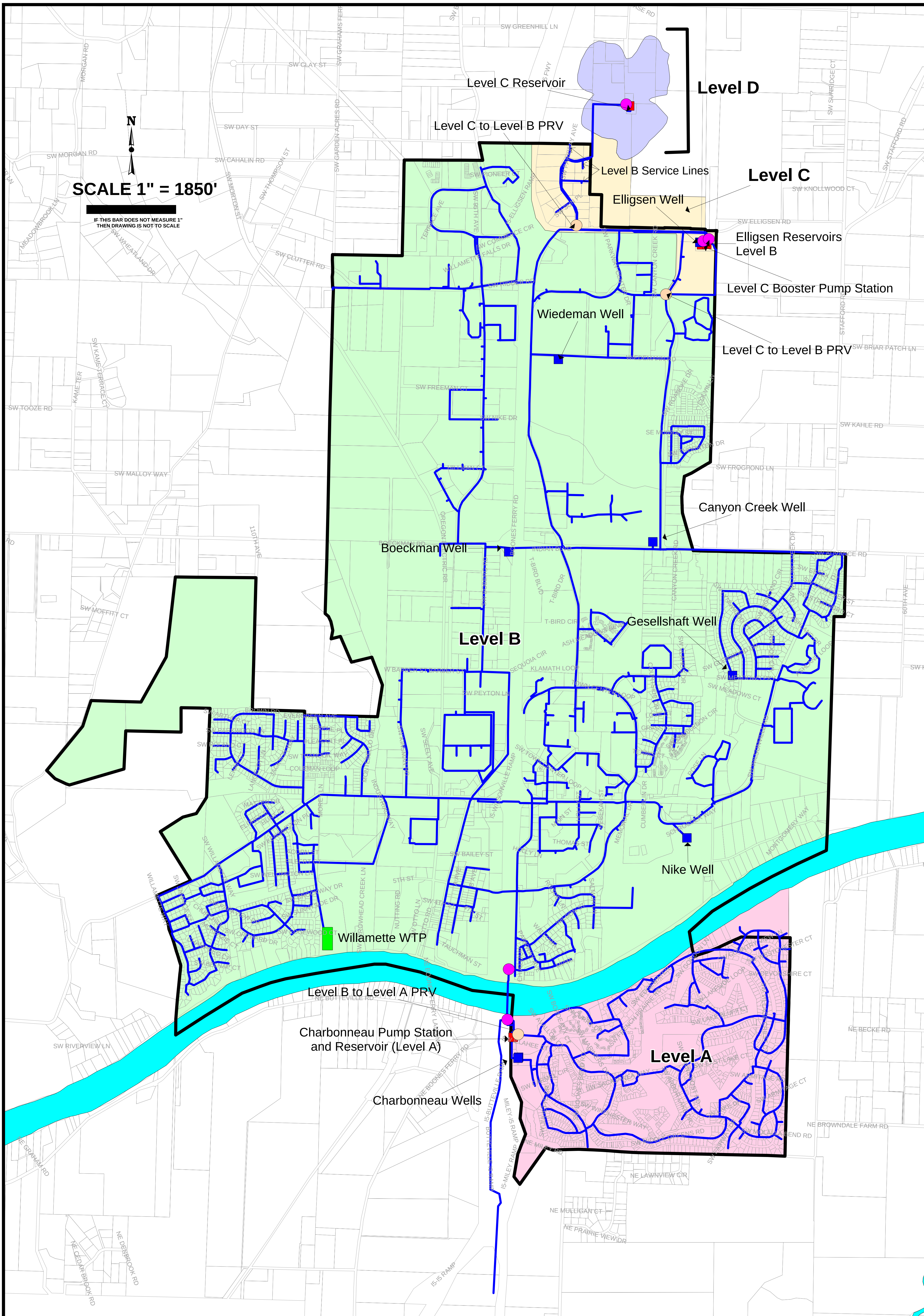
Figure 2-2
City of Wilsonville

Future Planning Areas

City of WILSONVILLE in Oregon

Figure 3-1
Projected Unrestrained Peak Day Demand by Rate of Growth and User Type





Distribution Pipeline (> or = 4 inch)

Contour >= 415 feet (Level D)

City Boundary

Well

Reservoir

Seismic Isolation Valve

Pressure Regulating Valve

City Boundary

MONTGOMERY WATSON

Figure 5-1
City of Wilsonville

Water Distribution System
Existing Facilities

(As of May 2001)

City of WILSONVILLE in Oregon

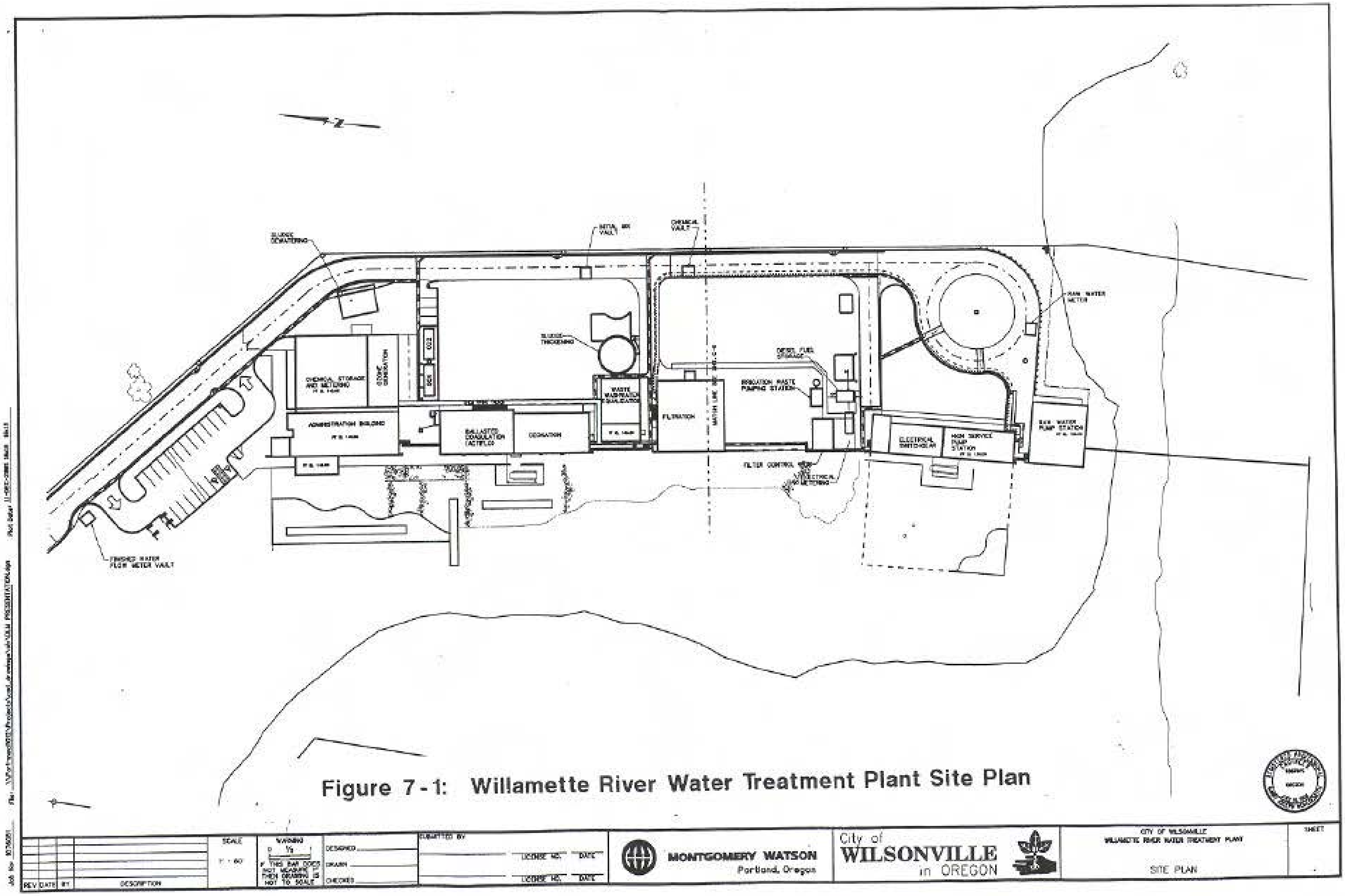
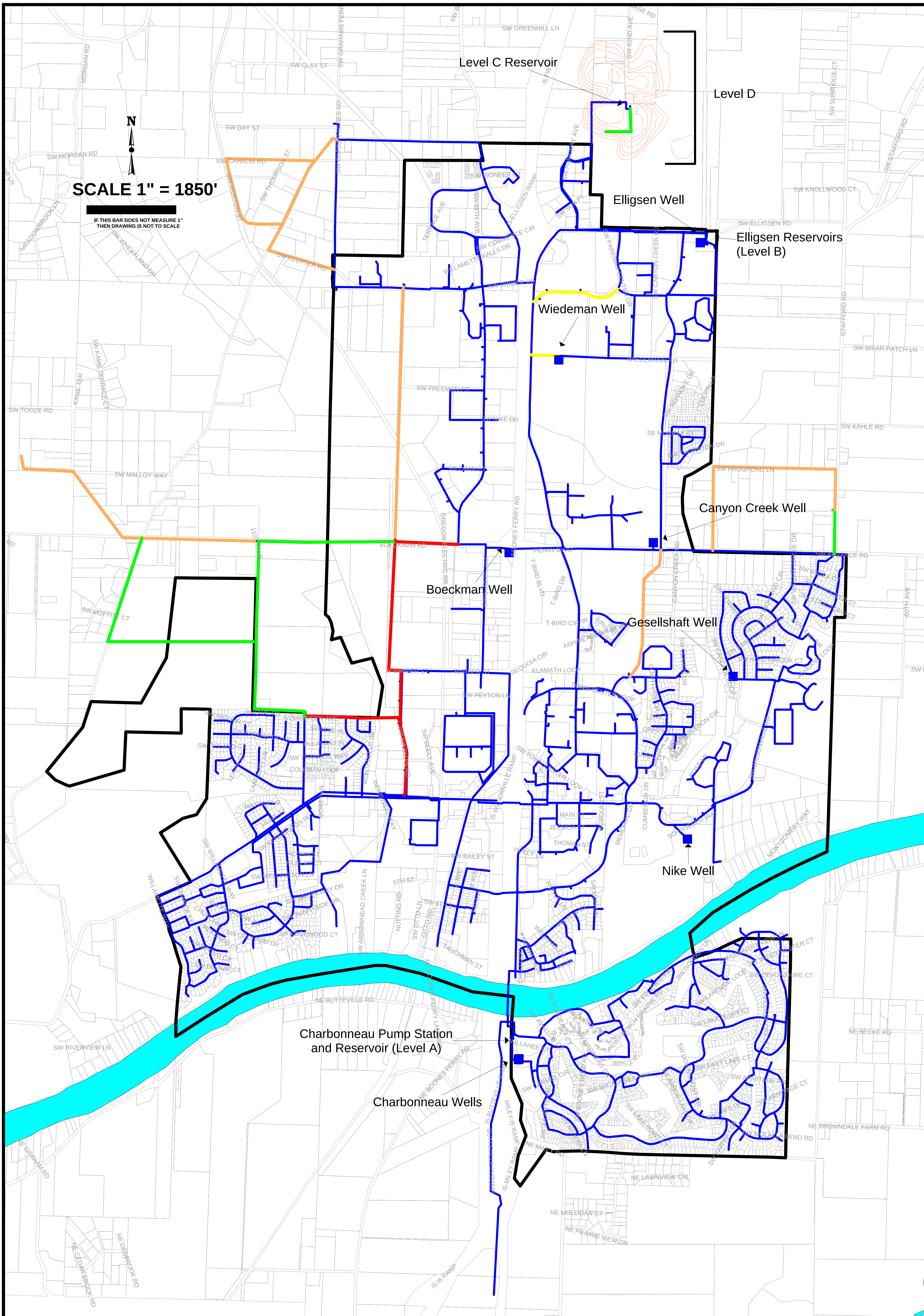


Figure 7-1: Willamette River Water Treatment Plant Site Plan



Distribution Pipeline

2005 CIP

2010 CIP

2015 CIP

2020 CIP

City Boundary

Contour >= 415 feet (Level D)

MONTGOMERY WATSON

Figure 9-1
City of Wilsonville

Capital Improvement Program Pipelines

City of WILSONVILLE in Oregon

How to Navigate the Wilsonville Master Plan.

Return to beginning of section.

Back one page.

Return Home.

Forward one page.

Go to end of section.

Live link to City of Wilsonville's website.

Live link to MWH's website.

Section Titles	Click on section titles to move forward one page.
Read Me!	Click to reach this information sheet.
Final Report	Click to get to the report.
Table	Click to get to the Tables Section.
Figures	Click to get to the Figures Section.