City of Yakima

System Number 991509

Yakima County

Washington

Water System Plan Update

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Table of Contents

1	**Description of Water System**	
1.1	Ownership and Management	1-1
1.2	System Background	1-3
1.3	Inventory of Existing Facilities	1-3
1.4	Related Plans	1-19
1.5	Existing Service Area Characteristics	1-28
1.6	Future Service Area	1-32
1.7	Service Area Agreements	1-35
1.8	Service Area Policies	1-35
1.9	Satellite Management Agencies	1-37
1.10	Conditions of Service	1-37
1.11	Complaints	1-38
2	**Basic Planning Data and Water Demand Forecasting**	
2.1	Current Population, Service Connections, Water Use, and Equivalent Residential Units	2-1
2.2	Water Use and Equivalent Residential Units	2-6
2.3	Projected Land Use, Future Population, and Water Demand	2-25
3	**System Analysis**	
3.1	System Design Standards	3-1
3.2	Water Quality Analysis	3-18
3.3	System Description and Analysis	3-30
3.3.1	Objectives	3-30
3.3.2	Source	3-30
3.3.3	Water Treatment	3-33
3.3.4	Storage	3-42
3.3.5	Distribution System	3-59
3.3.6	Summary of System Deficiencies	3-75
3.3.7	Selection and Justification of Proposed Improvement Projects	3-80
4	**Conservation Program, Water Right Analysis, System Reliability, and Interties**	
4.1	Conservation Program Development and Implementation	4-1
4.1.1	Introduction	4-1
4.1.2	Required Measures for All Systems	4-2
4.1.3	Water Use Efficiency Goals	4-2
4.1.4	Water Use Efficiency Measures	4-3
4.1.5	Conservation Program and Program History	4-4
4.1.6	Evaluation of Water Use Efficiency Program	4-7
4.1.7	Consumer Education Program	4-9
4.1.8	Water Loss Control Action Plan	4-9
4.1.9	Water Reuse	4-10
4.2	Source of Supply Analysis	4-14
4.2.1	General	4-14
4.2.2	Aquifer Storage and Recovery (ASR)	4-14
4.3	Water Right Evaluation	4-17
4.3.1	Permits, Certificates, Claims, and Applications	4-17

4.4	Water System Reliability Analysis	4-43
4.5	Interties	4-49
5	**Source Water Protection**	
5.1	Source Water Protection Overview	5-1
5.2	Wellhead Protection Program	5-1
5.3	Watershed Control Program	5-2
5.3.1	Regulatory Requirements/Program Overview	5-2
5.3.2	Watershed Description/Characteristics	5-3
5.3.3	Identification of Activities/Land Uses Detrimental to Water Quality	5-9
5.3.4	Watershed Management and Control Measures	5-18
5.3.5	Recommended Specific Actions for Watershed Monitoring and Control	5-32
5.3.6	Monitoring Program	5-36
6	**Operation and Maintenance Program**	
6.1	Water System Management and Personnel	6-1
6.2	Operator Certification	6-3
6.3	System Operation and Control	6-6
6.4	Water Monitoring and Sampling	6-26
6.5	Emergency Response Program	6-32
6.6	Safety Procedures	6-36
6.7	Cross-Connection Control Program	6-37
6.8	Customer Complaint Response Program	6-37
6.9	Recordkeeping and Reporting	6-38
6.10	O & M Manual	6-39
7	**Distribution Facilities Design and Construction Standards**	
7.1	General	7-1
7.2	Project Review Procedures	7-2
7.3	Policies and Requirements for Outside Parties	7-2
7.4	Design Standards, (Performance Standards and Sizing Criteria)	7-3
7.5	Construction Standards, (Materials and Methods)	7-5
7.6	Construction Certification and Follow-up Procedures	7-6
8	**Improvement Program**	
8.1	Objective	8-1
8.2	Descriptions of Recommended Improvements	8-2
8.3	Improvement Schedule	8-6
9	**Financial Program**	
9.1	Objective and Plan Content	9-1
9.2	Past and Present Financial Status	9-3
9.3	Available Revenue Sources	9-5
9.4	Allocation of Revenue Sources	9-5
9.5	Program Justification	9-8
9.6	Assessment of Rates	9-9
10	**Appendices (Separate Volume)**	- -

List of Tables

No.	Table Description/Title	page
	Tables in Chapter 1 - Description of Water System	
1-1	Groundwater Supply Facilities	1-8
1-2	Pump Stations	1-15
1-3	Pressure Reducing Valves	1-16
1-4	Distribution Storage Reservoirs	1-17
1-5	Interties	1-18
1-6	Yakima Wastewater Service and Planning Area Population Projections	1-21
	Tables in Chapter 2 - Basic Planning Data and Water Demand Forecasting	
2-1	Current Population for the City of Yakima and Yakima County	2-1
2-2	Current Population for the City of Yakima Water Service Area and Zones	2-2
2-3	Number of Service Connections by Billing Code (2002 to 2009)	2-3
2-4	Monthly Water Supply Data (WTP Effluent plus Well production)	2-6
2-5	Use by Pressure Zone calculated from water supplied by zone data.	2-7
2-6	Metered Water Use by Billing Code	2-8
2-7	Summary of Metered Water Use by Billing Code	2-10
2-8	Other Authorized Use and Estimated Distribution System Leakage (DSL)	2-11
2-9	Water Use by Customer Class adjusted by adding a prorated share of the DSL	2-14
2-10	Land Area and Population by Land Use Zoning Code	2-16
2-11	Distribution of Land Use Classification Areas among the Pressure Zones	2-17
2-12	Population Summary by Pressure Zone (from Table 2-11)	2-18
2-13	Estimated Level 3 Single Family residential use in gallons per capita per day	2-19
2-14	Estimate Usage for residential customer classes in gpcd for Level 1 and Level 2	2-20
2-15	Estimate Usage for residential customer classes in gpcd for Level 2	2-21
2-16	Estimate Usage for Level 1 Single Family residential customer class in gpcd	2-22
2-17	Estimated Usage for Level 1 Multi Family residential class in gpcd	2-23
2-18	Estimated Usage for Level 1 combined Single and Multi Family classes in gpcd	2-23
2-19	Estimated per capita use by pressure zone (gal/capita/day)	2-24
2-20	Estimated number of residents per single family connection	2-24
2-21	ERU calculation by pressure zone	2-24
2-22	Future Land Use Inventory	2-26
2-23	Projections of the Yakima County Resident Population for GMA	2-31
2-24	Yakima Water Service Area Population Projections by Pressure Zone (Low series)	2-32
2-25	Yakima Water Service Area Population Projections by Pressure Zone (Int. series)	2-32
2-26	Yakima Water Service Area Population Projections by Pressure Zone (High series)	2-32
2-27	City of Yakima Water Service Area Population Projections by Pressure Zone	2-34
2-28	Residential Water Demand Projections	2-34
2-29	Forecast Commercial use average day demand based	2-35
2-30	Forecast Industrial use average day demand based	2-35
2-31	Forecast average day demand for Governmental and other minor Customer Classes	2-36
2-32	Forecast total average day demand (ADD) 2010 through 2030	2-36
2-33	Maximum Day Demands from 1994 through 2009 and MDD/ADD Ratios	2-42
2-34	Forecast total Maximum Day Demand (MDD) 2010 through 2030	2-43

List of Tables (continued)

No.	Table Description/Title	page
2-35	Observed PHDs and PHD to MDD Ratios for highest PHDs from 2002 to 2009	2-43
2-36	Factors and Coefficients for Equation 5-3 from DOH #331-123	2-44
2-37	Forecast total Peak Hour Demand (PHD) 2010 through 2030	2-45
	Tables in Chapter 3 - System Analysis	
3-1	National Primary Drinking Water Standards for Microbial Contaminants	3-2
3-2	National Primary Drinking Water Standards for Disinfection By-products	3-3
3-3	National Primary Drinking Water Standards for Disinfection Residuals	3-3
3-4	Inorganic Chemical Primary MCLs and MCLGs	3-5
3-5	Volatile and Synthetic Organic Chemical Primary MCLGs and MCLs	3-6
3-6	Volatile and Synthetic Organic Chemical Primary MCLGs and MCLs (cont.)	3-7
3-7	Current Radionuclide MCLs from WAC 246-290	3-8
3-8	Radionuclide MCLGs and MCLs from EPA Radionuclide Rule	3-8
3-9	National Secondary Drinking Water Contaminants	3-9
3-10	Projected 6 year and 20 year Average Daily Demands in MGD	3-10
3-11	Projected 6 year and 20 year Maximum Daily Demands in MGD	3-10
3-12	Projected 6 year and 20 year Peak Hour Demands in MGD	3-13
3-13	Summary of Naches River Raw Water Quality (1994 to 2000)	3-18
3-14	Table 3-14 Primary IOCs, MCLs and MCLGs	3-25
3-15	Secondary IOCs, MCLs and MCLGs	3-25
3-16	EPA Regulated Inorganic Chemical Primary MCLs	3-26
3-17	EPA Regulated Inorganic Chemical Secondary MCLs	3-26
3-18	Parameters Tested for, but NOT Regulated	3-27
3-19	Other Finished Water Quality Data	3-27
3-20	Stage 1 Disinfection By-product Rule monitoring	3-28
3-21	Seasonal/Emergency Wells Regulated Inorganic Chemical Primary MCLs	3-29
3-22	Source Capacity Analysis for Years 2010 through 2030 in MGD	3-32
3-23	Existing Design Criteria Naches River Water Treatment Plant	3-35
3-24	Long Term 2 Enhanced Surface Water Treatment Rule Monitoring Results	3-40
3-25	Distribution Storage Reservoirs	3-42
3-26	Assumed Peak-Week Demand Conditions used to estimate the OS +ES Requirements	3-44
3-27	Assumed Peak-Week Supply Conditions used to estimate the OS +ES Requirements	3-44
3-28	Recommended OS + ES (Level 1 plus Level 2)	3-48
3-29	Actual Drawdown (OS+ES) during Max Day Demand Period (2002 to 2009)	3-50
3-30	Level 2 and Level 3 Equalization Storage Requirements	3-51
3-31	Projected Supply for Years 2010 through 2030 in MGD	3-55
3-32	Projected 6 and 20 year Standby (SB) Storage Requirements	3-56
3-33	Required Fire Flow Storage (FSS) by Pressure Zone	3-57
3-34	Summary of Storage Analysis	3-57
3-35	Comparison of the Projected Storage Requirements with the Current Storage Facilities	3-58
3-36	Water Distribution System Pipe Diameters and Lengths	3-59

List of Tables - continued

No.	Table Description/Title	page
3-37	Summary of Pressure Zone Operating Conditions	3-63
3-38	Comparative Pipe Roughness Coefficients for Yakima Water System Hydraulic Model	3-65
3-39	Recommended Hazen-Williams Roughness Coefficients for Hydraulic Model	3-66
3-40	Daily Diurnal Demand Patterns for City of Yakima Water System Hydraulic Model	3-68
3-41	Extended Period Simulation (EPS) Hydraulic Model Calibration Summary of Results	3-71
3-42	Hydraulic Analysis under Fire Flow Conditions at Selected Nodes	3-72
3-43	New Source of Supply to Meet Future MDD	3-80
	Tables in Chapter 4 - Conservation Program, Water Right Analysis, System Reliability, and Interties	
4-1	Summary of Water Use Efficiency (WUE) Program Requirements	4-2
4-2	Recommended Water Use Efficiency Measures	4-3
4-3	Estimated Distribution System Leakage (2002 through 2009)	4-8
4-4	Potential Reclaimed Water Users Within 2 Miles of the WWTP	4-13
4-5	Existing Water Right Status	4-34
4-6	Forecasted Six-Year Water Right Status	4-37
4-7	Forecasted 20-Year Water Right Status	4-40
4-8	Suggested Public Information Demand Reduction Actions	4-45
4-9	Suggested Government Demand Reduction Actions	4-46
4-10	Suggested User Restrictions Demand Reduction Actions	4-47
4-11	Suggested User Penalties Demand Reduction Actions	4-47
4-12	Suggested Pricing Demand Reduction Actions	4-48
	Tables in Chapter 5 - Source Water Protection	
5-1	US Bureau of Reclamation Stream Flow Data Naches River at Naches, WA	5-5
5-2	Naches River Near Naches River Flow Statistics	5-5
5-3	Naches Watershed Land Ownership	5-9
5-4	Naches Watershed Land Uses Within National Forest Boundary	5-14
5-5	Land-Use Pollutant Analysis Matrix	5-17
5-6	City of Yakima Watershed Protection Plan Partial List of Contacts	5-35
	Tables in Chapter 6 - Operation and Maintenance Program	
6-1	Responsibility/Authority for Key Functions	6-3
6-2	Washington DOH Water System Classification Guide	6-4
6-3	Education and Operating Experience Requirements Yakima Naches River WTP	6-5
6-4	City of Yakima Sources of Water Supply	6-7
6-5	Raw Water Intake Facilities Components and Function	6-9
6-6	Flash Mix Components and Function	6-10
6-7	Contact Basin Components and Function	6-11
6-8	Filter Component Function and Failure Criteria	6-12
6-9	Residuals Handling Facilities Components and Function	6-14
6-10	Chemical Systems, Treatment Goals, and Failure Criteria	6-15
6-11	Distribution Storage Reservoirs	6-17
6-12	Booster Pump Stations	6-19

List of Tables - continued

No.	Table Description/Title	page
6-13	Water Division Equipment Listing	6-23
6-14	Materials on Hand	6-24
6-15	Support agencies/organizations for Materials and Services	6-25
6-16	Automated Water Sampling and Monitoring for the Naches River WTP	6-27
6-17	Finished Water Quality Monitoring for the Naches River WTP	6-28
6-18	Water /Irrigation Division Employees Emergency Call Out List	6-33
	Tables in Chapter 7 - Distribution Facilities Design and Construction Standards	
	None	
	Tables in Chapter 8 - Improvement Program	
8-1	Summary of Recommended Capital Improvements 2003 to 2008	8-6
8-2	Capital Improvement Schedule 2003 to 2022	8-7
	Tables in Chapter 9 - Improvement Program	
9-1	Summary of Income and Expenses 2003 to 2009	9-4
9-2	Summary of current and projected income and expense for capital through 2011	9-6
9-3	Summary of Current and Projected Income and Expenses for Operating Fund through 2011	9-7
9-4	Ready-to-Serve Charges per Two-Month Period (7.68.250)	9-9
9-5	Charge for Water Consumed per UOC (7.68.250)	9-10
9-6	Fire service charges (7.68.282)	9-11

List of Figures

No.	Figure Description/Title	Page
	Figures in Chapter 1 - Description of Water System	
1-1	City of Yakima Water Division Organizational Structure	1-2
1-2	City of Yakima Water System Map	1-5
1-3	City of Yakima Water System Hydraulic Profile	1-10
1.4	Distribution System Piping Map (including valves and hydrants)	1-13
1-5	Regional Sewer Service Boundaries	1-23
1-6	Adjacent Purveyor Service Areas	1-29
1-7	Urban Area Boundary map	1-30
	Figures in Chapter 2 - Basic Planning Data and Water Demand Forecasting	
2-1	Number of Single Family Residential Services	2-4
2-2	Numbers of Multi Residential, Commercial, and Industrial Services	2-5
2-3	Metered Use for the Four Major Customer Classes	2-9
2-4	Future Land Use Map	2-27
2-5	Current Zoning Map	2-28
2-6	ADD 1977 to 2009 and Forecast ADD to 2030	2-38
2-7	Comparison of ADD forecasts based on GMA to Linear Regression	2-39
2-5	ADD Forecasts by Zone	2-41
	Figures in Chapter 3 - System Analysis	
3-1	Projected Average Day Demand through 2030	3-11
3-2	Projected Maximum Day Demand through 2030	3-12
3-3	Projected Peak Hour Demand through 2030	3-14
3-4	Daily Raw Water Turbidity 2001 to 2009	3-20
3-5	Frequency distribution of Daily Avg. Raw Water Turbidity	3-21
3-6	Finished Water Turbidity 2001 to 2009	3-23
3-7	Finished Water Turbidity Frequency Distribution Curve	3-24
3-8	Water Treatment Plant Process Schematic	3-37
3-9	Water Treatment Plant Plan View	3-38
3-10	Hydraulic Profile and Storage Reservoir Operating Diagram	3-45
3-11	Estimated OS + ES for 2016 based on Supply/Demand simulation	3-46
3-12	Estimated OS + ES for 2030 based on Supply/Demand simulation	3-47
3-13	Level 1 Reservoir Elevations 7-25-03 through 7-26-03	3-49
3-14	Level 2 Reservoir Elevations 7-25-03 through 7-26-03	3-49
3-15	Level 3 Reservoir Elevations 7-25-03 through 7-26-03	3-50
3-16	2016 Peak-Week Maximum Daily Equalization Requirement	3-52
3-17	2030 Peak-Week Maximum Daily Equalization Requirement	3-53
3-18	Water System Distribution Piping Map	3-61
3-19	Water System Pressure Zone Map	3-62

List of Figures - continued

No.	Figure Description/Title	Page
4-1	Place of Use Map	4-23
5-1	Location of watershed and WTP map	5-7
5-2	Watershed Topographic Map	5-8
5-3	Watershed land ownership map	5-11
5-4	Watershed land use map	5-12
6-1	City of Yakima Water Division Organizational Structure	6-2

Chapter 1

Description of Water System

1 Description of Water System

1.1 Ownership and Management

The name of this water system, as officially listed in the Washington State Department of Health (DOH) records, is the City of Yakima Water Division. The DOH System Identification number is 991509.

The City of Yakima, which owns the system, is a municipal corporation. Yakima is a first class city as defined in Chapter 35.01.010 RCW.

Yakima has a Council-Manager type of municipal government as defined under Chapter 35.18 RCW. An organizational chart of the Water Division is shown in Figure 1-1. The Water/Irrigation Division Manager is directly responsible to the City Manager and the Assistant City Manager.

A copy of the current Water Facilities Inventory (WFI) form is included in Appendix C of this water system plan.

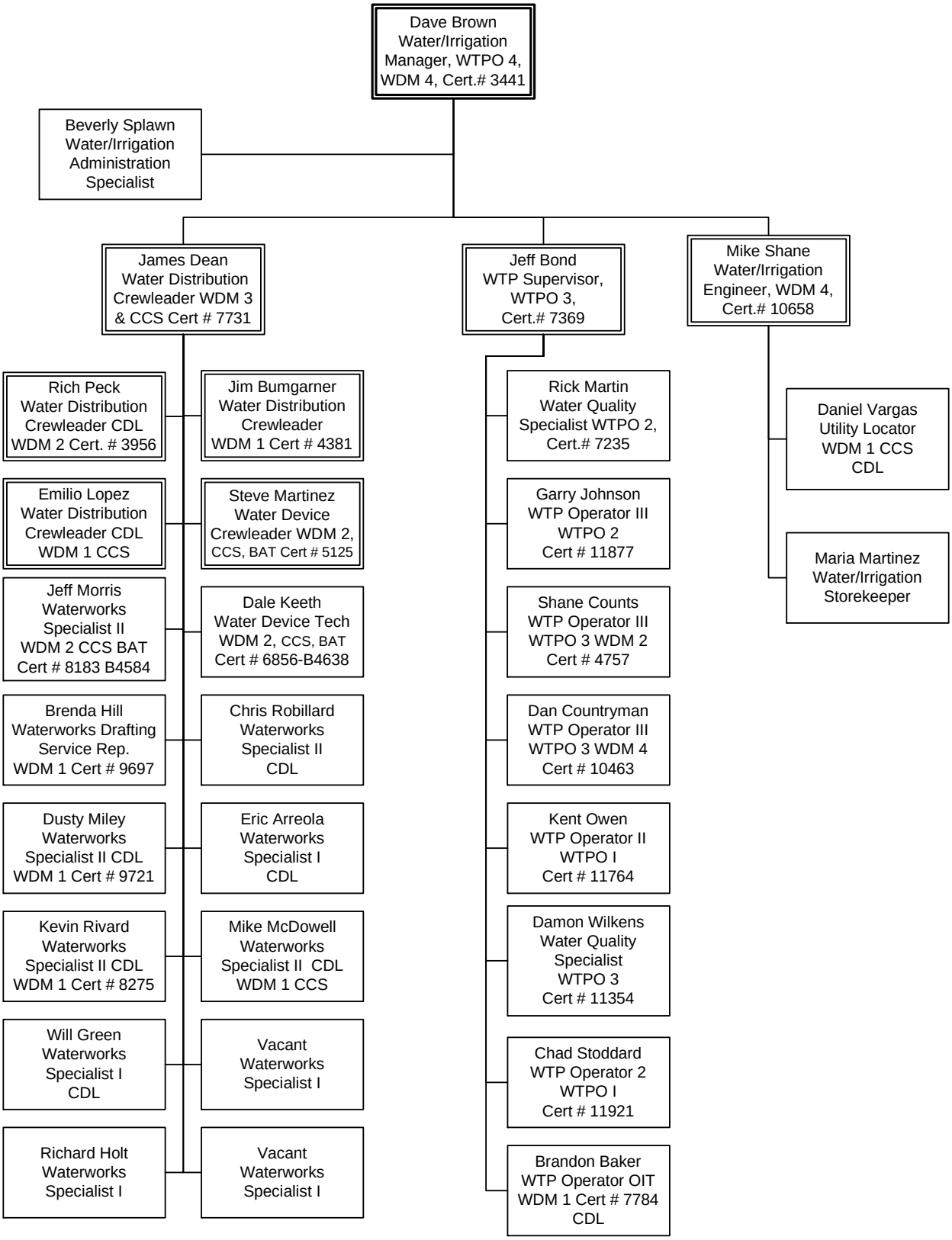


Figure 1-1 City of Yakima Water/Irrigation Division - Water Organizational Structure

1.2 System Background

The original City of Yakima water system was developed by the Pacific Power and Light Company (PP&L) in the early 1900s. The City of Yakima purchased the system on July 1, 1926. At that time, the supply consisted of a diversion from the PP&L power canal.

In an effort to expand the water supply, the City purchased 343 acres of land at Oak Flats to develop a source on the Naches River. A 14-mile, 24-inch wood stave transmission main was constructed to transport the supply to twin concrete reservoirs with a combined 24-MG capacity.

Three shallow wells, including a Ranney collector were later developed in 1948 and 1950 to supplement the Oak Flats supply. The first well developed was the Wright Avenue Well. (The water right for the Wright well was later transfer to the Kissel Park well.) The second well developed was located near 16th Avenue and what is now Highway 12. This well was abandoned in 1969 when this section of Highway 12 was expanded to four lanes. It was not being used at the time it was abandoned because of high coliform levels. A portion of the Ranney collector well has also been transferred to the Kissel Park well.

Two deep wells were developed in 1962 and 1965 to further supplement the Oak Flats supply. The first of these was the Kiwanis Park Well (1962) and the second was the Airport Well (1965). Both of these wells are in service today as seasonal/emergency sources of supply.

A water treatment plant near Rowe Hill on the Naches River and a 48-inch transmission pipeline to the City were constructed during the period from 1969 to 1971 to replace the Oak Flats supply. The water treatment plant is discussed in detail in Chapter 3 of this plan.

In 1993 the Kissel Park Well was added to the City's system. This well is also used for seasonal/ emergency purposes and to help meet peak demands.

In recent years, the City has not found it necessary to make any major expansions to the water system facilities, in part because of the high level of service that the system is already capable of providing, and also because expansion of the City's water service area is limited by the surrounding water association and municipal water purveyors. Potential for expansion is also limited by the “place of use” conditions of the surface water rights in accordance with the 2002 water rights settlement agreement. (City of Yakima Water Rights Settlement Agreement with the United States and the State of Washington Department of Ecology regarding the City’s Naches River Water Rights in connection with the Acquavella case.)

1.3 Inventory of Existing Facilities

This section describes the major components of the City's water system including: supply and treatment, the distribution system, and storage. The physical facilities as well as the operation of each of these components are summarized here.

More detailed evaluations and analyses of the water system components are discussed in subsequent chapters:

Water Supply - Chapters 3 and 4

Storage - Chapter 3, Section 3.3.4
Distribution System - Chapter 3, Section 3.3.5
Water System Operation - Chapter 6

A map of the water system is presented in Figure 1-2. The ordinance for the City's water system is City Code Chapter 7.68, which is contained in Appendix D.

Supply Facilities

The supply system consists of a surface water treatment plant (WTP) on the Naches River and three active wells. A fourth well was a Ranney collector which was located adjacent to the Naches River near the Nelson Bridges. A portion of the Ranney well water right has been transferred to the Kissel Park well. The balance of the Ranney well water right has been transferred for use with a new groundwater supply well which is being constructed in Gardner Park with completion scheduled in 2011.

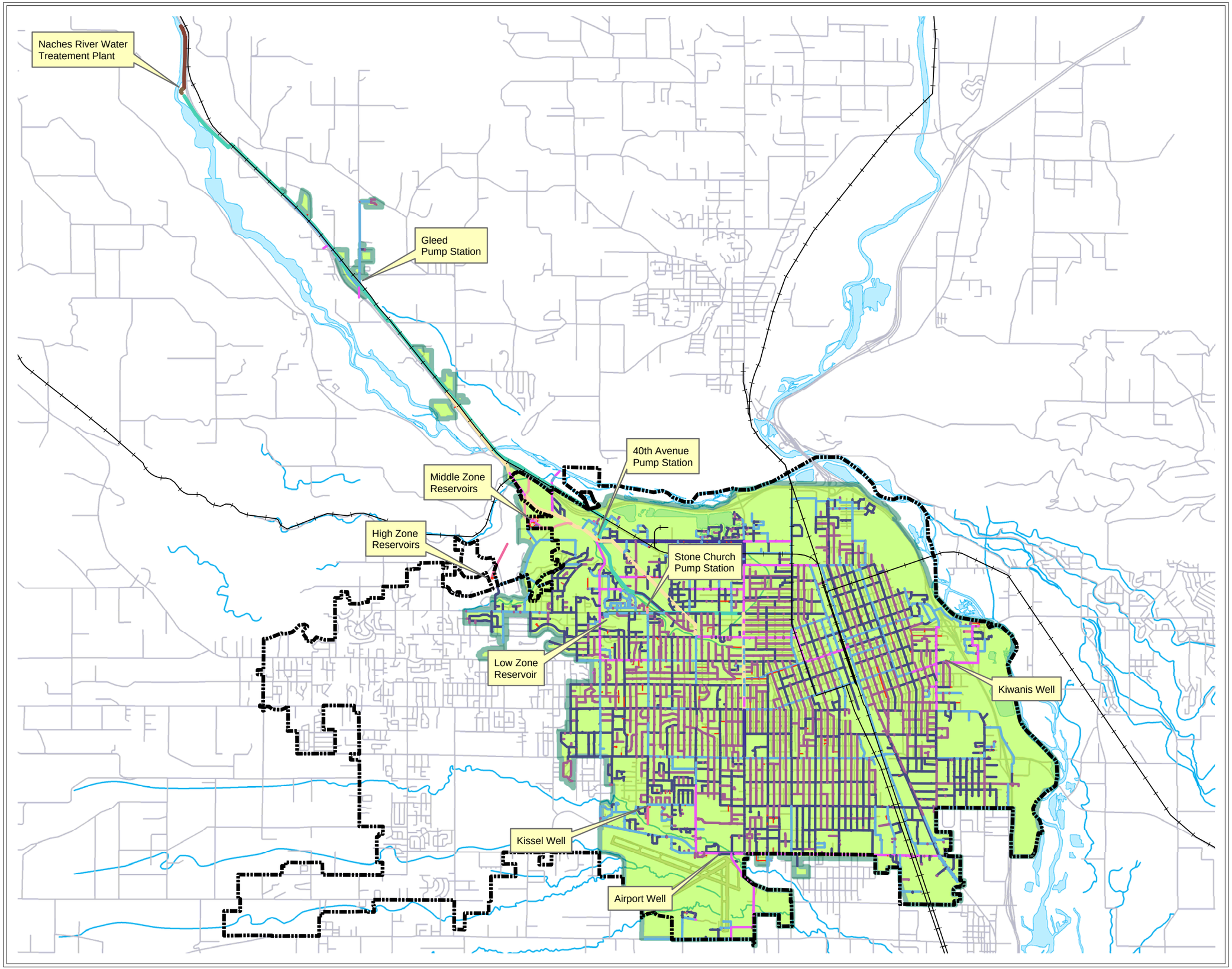
The Naches River Water Treatment Plant (WTP) was constructed at Rowe Hill between 1969 and 1971 to replace the Oak Flats supply. The original capacity of the WTP was 20 MGD. The plant was laid out to allow space for expansion to 60 MGD capacity if and when demand warrants increased supply capacity and subject to the availability of the necessary water right. Treated water from the plant flows over a weir into a 48-inch transmission main and to the City by gravity.

In 1990, a filter media pilot study was conducted. This study indicated that a modification of the media would increase the WTP capacity to approximately 25 MGD. In 1991, the four filters were rehabilitated in accordance with that study by drilling out plugged orifices in the underdrains, regrouting the underdrains, replacing of gravel support layers, and replacing the original filter media with a new multi-media design.

In 1993, a new supervisory control and data acquisition (SCADA) system was installed at the WTP to provide improved monitoring and control of the treatment processes including a new filter control algorithm to maintain constant filtration flow rates during filter backwash cycles, improved coagulation and chemical feed systems controls, and improved capacity for collection and storage of water quality data. The SCADA system also upgraded each of the remote telemetry installations for improved monitoring and control of the wells, reservoirs, and booster pump stations from the WTP.

In 1997, the City completed installation of a bulk soda ash storage and feed system. These improvements were needed to comply with the Lead and Copper Rule guidelines and are used to increase the pH of the filtered water to 7.4. The copper action level of 1.3 mg/l was exceeded in monitoring which had been initiated in 1993.

In 2002, a fluoridation system was installed including a new chemical storage building and the associated chemical feed equipment. Also in 2002, new fish barrier screens were installed at the Water Treatment Plant river intake structure.



Legend

City Limits Boundary

Waterlines

DIAMETER (in Inches)

- 0 - 3
- 4
- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 36
- 48
- 54

Place of use, Existing, Retail and Future Service Area

Water System Plan Update
Figure 1-2

Yakima Water System

N
W E
S

0 0.25 0.5 1 1.5 2 Miles

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New chemical storage, chemical feed, and containment facilities were constructed for the Water Treatment Plant in 2004. These improvements included the replacement of the chlorine gas disinfection facilities with an on-site hypochlorite generation system. Switched to Caustic Soda for pH adjustment and corrosion control

In 2005, major improvements to the Water Treatment Plant filter pipe gallery were constructed. These improvements replaced the old deteriorating piping and modified the filter-to-waste and filter effluent metering systems. Filter media, underdrains and surface wash replaced

The City of Yakima water system currently has three wells that are used for seasonal emergency purposes and to help meet peak demands. The wells are located at the Airport, at Kiwanis Park, and at Kissel Park. The Kissel Park well was constructed in 1993 partially replaced the Ranney collector, which was located on the Naches River and was previously used to supplement the City's water supply. Table 1-1 shows the capacity, zone served, and other pertinent information about the wells. A discussion of the hydrogeology of the aquifers from which these wells withdraw water is presented in Chapter 4.

Table 1-1 Groundwater Supply Facilities								
Designation	**Capacity (MGD/gpm)**	**Pump Depth (feet)**	**Well Depth (feet)**	**Casing Diameter (inches)**	**Ground Surface Elevation (ft)**	**Pump Type and Manufacturer**	**Pump HP**	**Remarks[b]**
Kiwanis Park	3.3 / 2,300	330	850	20	1,037	Vertical turbine U.S. Pump	300	Located in lower Ellensburg aquifer
Airport	4.0 / 2,800	310	1,100	16	1,056	Vertical turbine Peabody Floway	300	Located in lower Ellensburg aquifer
Kissel Park	4.2 / 2,900	300	1,171	20 (first 472 feet) and 16	1,112	Submersible Peabody Floway	300	Located in lower Ellensburg aquifer
Gardner Park (future)	4.3 / 3,000	400	900	24 & 16	1,170	Vertical turbine To be determined	--	Located in lower Ellensburg aquifer

Pressure Zones

The City of Yakima water system has three major pressure zones, designated as the Low, Middle, and High zones, plus a separate pressure zone for Gleed. A water system hydraulic profile is shown in Figure 1-3. The relationship between the pressure zones is discussed in this section.

Low Pressure Zone

The gravity supply from the 48-inch-diameter transmission main flows to a 6-MG reservoir located at North 40th Avenue and Englewood Avenue. This reservoir supplies water to the Low zone. Flows from the WTP are manually adjusted to maintain a nominal hydraulic elevation of 1,264 feet, resulting in a static pressure range in the Low zone of approximately 54 to 110 psi.

During emergencies, the Low zone can also be served from the three wells. In extreme emergencies, such as fire-flow conditions, the Low zone can also be served by the 12 pressure-reducing valves which allow water to flow from the Middle zone.

Middle Pressure Zone

The Middle pressure zone is served by the 40th Avenue Pump Station and the Stone Church Pump Station. The 40th Avenue Pump Station draws from the 48-inch supply transmission main and pump operation is controlled by the WTP operators based on the water level in the zone's two 12-MG reservoirs. The nominal hydraulic elevation is 1,380 feet, which results in a static pressure range of 43 to 105 psi. The Stone Church booster pump station was installed in 2000 near the intersection of North 32nd Avenue and Englewood Avenue. This second pump station and provides another alternative for supply the Middle zone to improve reliability and the ability to satisfy emergency demands. The Stone Church pump station is equipped with a 250 KW emergency generator to allow for operation during electrical power outages.

During emergencies, the Middle zone can be supplied by two pressure-reducing valves from the High zone or, in case of emergency, by opening the valve that controls the intertie from the Nob Hill Water Association. During extreme emergencies, the High zone can supply some of the Middle zone's needs for approximately one day of average water use.

High Pressure Zone

The High pressure zone is served from the Middle zone by the Reservoir Road Booster Pump Station located at the site of the Middle zone's twin 12-MG reservoirs. The booster pump station includes a new 250-kilowatt (kW) generator to provide emergency power. The booster pump station operation is controlled by two I-MG reservoirs located in the High zone. The nominal hydraulic elevation is 1,531 feet, resulting in a static pressure range of 70 to 115 psi .

During emergencies, the High zone can be supplemented by opening the valve that controls the intertie from the Nob Hill Water Association. During fire demand periods, water can be supplied to the High pressure zone from the Middle pressure zone through the two 2-way PRVs which connect the two zones.

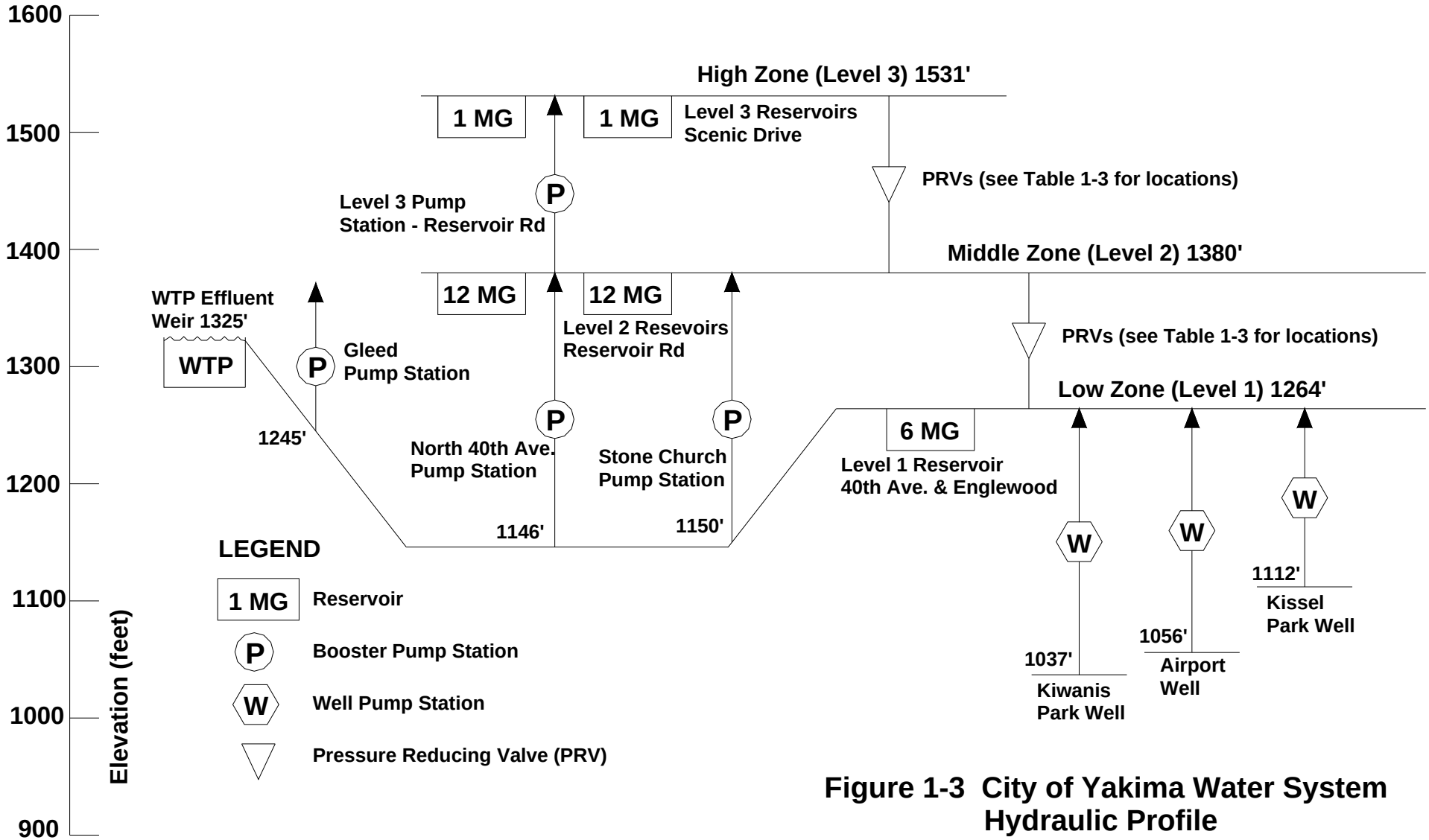


Figure 1-3 City of Yakima Water System Hydraulic Profile

Gleed Pressure Zone
The Gleed area, with a service capacity of 100 residential units, is served from the 48-inch transmission main through a booster pump station. Two 80-gpm pumps provide the average and maximum day demands, with a 2,000-gpm pump reserved for fire flow. No storage facilities are located in Gleed.

Distribution System

The pipelines in the distribution system range from 4 to 24 inches in diameter. The distribution system piping (6 inches and greater in diameter), the pressure-reducing valves, fire hydrants, and blow-offs are shown in Figure 1-4. The pipe materials are mainly cast iron, with ductile iron being used since the early 1970s. There are several steel pipelines and many unlined cast-iron pipelines remaining from the portions of the system that were privately owned before being acquired by the City. Since the steel and unlined cast-iron pipelines are more vulnerable to corrosion and leakage, the City is developing a program to replace these pipes during the next several years.

The steel main replacement program includes the replacement of steel, galvanized iron, and unlined cast-iron pipelines 4 inches in diameter or less. These pipes are located mainly in the business district and in portions of the older residential districts. The pipelines are replaced with 6-inch (minimum) ductile iron pipe. Two to three areas are targeted for replacement each year, with 500 to 2,000 linear feet of pipeline replaced each year.

Booster Pump Stations
The booster pump stations provide water to the Middle and High zones and to Gleed, as shown in the hydraulic profile in Figure 1-3. The pump station location, the supply location, the zone that is served, the number of pumps in each station, pump capacity, and other characteristics are listed in Table 1-2.

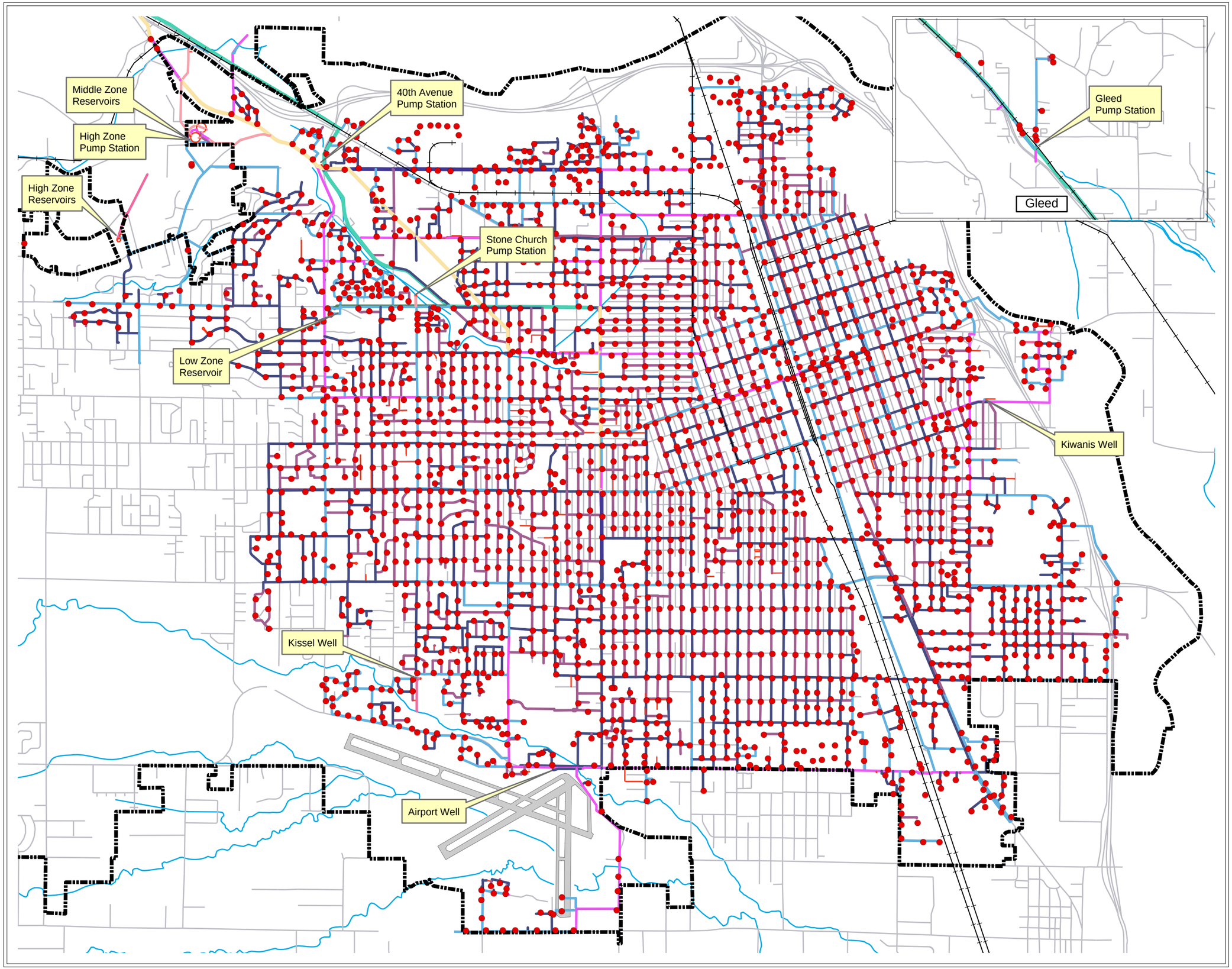
Pressure-Reducing Valves
Emergency supply from the High to the Middle zone and from the Middle to the Low zone is provided by 14 pressure-reducing valves (PRVs) located throughout the water system, as shown schematically in the hydraulic profile in Figure 1-3. The PRVs are set to open and close at various hydraulic elevations. Table 1-3 shows the location, size, inlet and outlet pressures, and other characteristics of each PRV.

The purpose of the PRVs is to provide additional flow for emergency purposes. The reduction of pressure in a zone under emergency conditions because of a fire flow or other large water need causes the hydraulic elevation to decrease. Reduction in hydraulic elevation will cause the normally closed, hydraulically activated valves to open and provide additional flow into the zone. In addition to the 14 PRVs, there are three additional connections between the High and Middle zones:

> Check valve at Lincoln Avenue and North 40th Avenue to allow water to flow from the Middle zone to the High zone under emergency conditions (very low High zone pressure)

Closed valve with a 2-inch-diameter bypass for winter operation at Westpark Alley and North 40th Avenue

Closed valve at Summitview Avenue and North 44th Avenue



Legend

- Fire Hydrant
- City Limits

Waterlines

DIAMETER (in Inches)

- 0 - 3
- 4
- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 36
- 48
- 54

Water System Plan Update
Figure 1-4

Yakima Water System

N
W E
S

0 0.125 0.25 0.5 0.75 1 Miles

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Table 1-2 Pump Stations

Station Name	Location	Zone Supply	Zone Service	Pump No.	Pump HP	TDH (ft.) Operating	TDH (ft.) Shut Off	Pumping Rate (gpm)	Local Elev. (ft.)	Pump Manufacturer
High Zone, Third Level[a,b]	Reservoir Road	Middle	High	1 2 3	125 125 30	203.5 203.5 203.5	315 315 315	1,700 1,700 400	1372	Byron-Jackson Byron-Jackson Simons
North 40th Avenue[b]	River Road & Powerhouse Road	Low	Middle	2 3 4	 40 60 100	126 125 130	182 176 240	 1,000 1,500 2,500	1,146	 Peerless Peerless Peabody Floway
Gleed[c]	Gleed	Low	Gleed	1 2 3 4	5 5 [d] 125	135 135 --- 300	212 212 --- 350	80 80 --- 2,000	1,245	Aurora Aurora --- Aurora
Stone Church	Englewood Ave. & 32nd Ave.	Low	Middle	1 2 3	125 100 50	172 172 172	221 221 235	2,500 1,500 700	1,150	PACO PACO PACO

[a] Only one large pump at a time, in conjunction with the 40-hp pump, is operated in the High zone under the present power source. The High zone pump station includes a 250 kW standby generator.
[b] Controlled from reservoir level transmitters for pump start and stop.
[c] Controlled by pressure activated controls.
[d] Not installed at the present time.

Table 1-3 Pressure Reducing Valves

No.	WA #	Size	Location	Approx. Ground Elevation	Service Levels	High Side PSI	Low Side PSI	Downstream PSI Setting	NOTES
1	WA5065	4"	N. 41st Ave. & Snowmountain Rd.	1266'	3rd to 2nd	118	44	20	could not lower psi to 20, counted turns
		2"						45	
2	WA5021	6"	N. 40th Ave. & Richey Rd.	1254'	3rd to 2nd	118	60	20	could not lower psi to 20, counted turns
		2"						51	
3	WA5020	8"	506 N. 40th Ave. (btwn Richey and Englewood)	1264'	3rd to 2nd				No gauges, 8" prv, don't adjust per James Dean
4	WA5009	6"	S. 32nd Ave. & W. Viola Ave.	1122'	2nd to 1st	95	49	20	could not lower psi to 20, counted turns
		2"						45	
5	WA5011	4"	S. 31st Ave & Clinton Wy	1124'	2nd to 1st	110	55	20	could not lower psi to 20, counted turns
		2"						50	
6	WA5012	8"	S. 30th Ave. & W. Nob Hill Blvd.	1132'	2nd to 1st	95	45	20	Actual Set Point
		2"						30	
7	WA5018	4"	S. 27th Ave. & Fraser Wy.	1144'	2nd to 1st	103	35	20	Actual Set Point
		2"						35	
8	WA5013	6"	S. 20th Ave. N. of Bonnie Doone	1140'	2nd to 1st	110	55	20	Actual Set Point
		2"						48	
9	WA5010	6"	S. 19th Ave. & W. Chestnut Ave.	1160'	2nd to 1st	80	30	15	Actual Set Point
		2"						25	
10	WA5016	6"	Park Ave. & Summitview Ave.	1135'	2nd to 1st	100	35	20	could not lower psi to 20, counted turns
		2"						38	
11	WA5015	12"	40th Ave. Pump Station	1144'	2nd to 1st	102	51	30	Soleniod not wired. Valve in manual mode.

Distribution Storage Reservoirs

Each pressure zone has an established hydraulic elevation. This elevation is maintained by the distribution reservoir located in each of the pressure zones. The reservoirs shown in the hydraulic profile in Figure 1-3 are listed in Table 1-4.

Table 1-4 Distribution Storage Reservoirs

Zone Designation	Location	Volume MG	Max. Elevation	Min. Elevation	Zone Served	Construction Material
Low Zone	40th Ave. & Englewood	6	1,264 ft	1,234 ft	Low	Reinforced Concrete
Middle Zone	Reservoir Road	24 (two at 12 MG ea.)	1,380 ft	1,356 ft	Middle	Reinforced Concrete
High Zone	Scenic Drive	2 (two at 1 MG ea.)	1,531 ft	1,511 ft	High	(1) concrete (1) steel

Supervisory Control and Data Acquisition System

In 1993, the City installed a new supervisory control and data acquisition (SCADA) system. The new system is a persona1computer based system served by programmable logic controllers (PLC) that performs the following functions:

Monitors WTP operations

Continually records water quality

Records storage reservoir levels continually

Records pump station flow rates continually

Actuates booster pumps from reservoir levels through local PLCs

Sequences Pump operation through local PLCs

The main control panel for the SCADA system is located at the Naches River WTP. Radio communications are used to transmit data between the main control panel and the remote sites (reservoirs, pump stations, and supply wells).

Interties with Adjacent Water Systems

As discussed previously, the City has common boundaries with, or is approximately adjacent to, four other water purveyors:

Nob Hill Water Association

City of Union Gap

Terrace Heights area (Yakima County)

City of Selah

The City has three interties with the Nob Hill Water Association. A summary of the interties, including location, size, hydraulic grade line (HGL), adjacent purveyor, and other data, are included in Table 1-5. The 32nd and Ahtanum intertie is automatically activated during certain types of fire flow events. The other two interties are activated manually. The city of Yakima hydraulic grade line elevations shown in the table are base on the hydraulic grade line at the storage reservoir when full and under static conditions.

Table 1-5 Interties

Pressure Zone	Location	Adjacent Purveyor	HGL (ft.) City of Yakima	HGL (ft.) Adjacent Purveyor	Main Size City of Yakima	Main Size Adjacent Purveyor	Intertie Metered	Intertie Agreement
Low	32nd Ave. & Ahtanum	Nob Hill Water	1,199	1,415	12	12	No	Yes
Middle	45th Ave. & Tieton Drive	Nob Hill Water	1,380	1,394	8	6	No	Yes
High	56th Ave. & Lincoln Ave.	Nob Hill Water	1,531	1,521	12	12	No	Yes

1.4 Related Plans

Yakima Urban Area Comprehensive Plan

The Yakima Urban Area Comprehensive Plan was adopted in April 1997 and amended in 1998, 2000, 2001, 2002, 2006, and 2010 in compliance with the Washington State Growth Management Act (Chapter 36.70A RCW). Compliance with the Growth Management Act (GMA) was also dependant on the adoption of the implementing regulations as defined in Chapter 36.70A.040 RCW including:

1. Zoning map amendments;
2. Zoning ordinance amendments;
3. Development standards;
4. Critical area ordinance;
5. New subdivision ordinance;
6. Transportation capacity management ordinance;
7. Regulatory reform procedure;
8. Future land use map;
9. Comprehensive plan text changes;
10. Revised transportation plan.

Yakima Urban Area Zoning Ordinance

The Yakima Urban Area Zoning Ordinance (Yakima Municipal Code Title 15) was revised December 28, 1998 to comply with the requirements of the Growth Management Act as discussed above. The Yakima Urban Area Zoning Ordinance was most recently updated in 2010.

Plan 2015 – A Blueprint for Yakima County Progress

Plan 2015 is the Yakima County Comprehensive Plan. This planning document provides the policy framework for how the County will develop in the years preceding 2015. It contains a land use map as well as the other planning elements required by the Growth Management Act. Volume 1 of Plan 2015 consists of three Chapters: the Policy Plan, Plan Development, and the Environmental Analysis. The Policy Plan is the key document in the series. Volumes II and III provide background materials and support for the Policy Plan.

Also an integral part of the long range plan for Yakima County, are the plans of the individual cities. Although not technically part of Plan 2015, each city in the county has adopted a comprehensive plan that defines their vision of the future. Yakima County is a partner with the City of Yakima in the adoption of the Yakima Urban Area Comprehensive Plan which includes separately adopted neighborhood plans. The Terrace Heights Neighborhood Plan was adopted in 1999.

West Valley Neighborhood Plan

The West Valley Neighborhood Plan and Area-Wide Rezone were adopted on February 15, 2011. They became effective on February 28, 2011 in the unincorporated area, and on March 20, 2011 inside the Yakima City Limits. The West Valley Neighborhood lies outside of the Yakima Water System Service Area and is served by the Nob Hill Water Association

City of Yakima Stormwater Management Plan

In 1987, congress changed the federal Clean Water Act by declaring the discharge of stormwater (traditionally considered a nonpoint source) from certain industries and municipalities to be a point source of pollution requiring National Pollutant Discharge Elimination System (NPDES) permits or water-quality discharge permits. The Washington Department of Ecology (Ecology) is delegated authority by the U.S. Environmental Protection Agency (EPA) to implement the water-quality permit.

The EPA stormwater regulations establish two phases for the stormwater permit program. Stormwater NPDES permits under Phase I have been issued to cover stormwater discharges from certain industries, construction sites involving five or more acres, and municipalities with a population of more than 100,000.

In 1999, the final Phase II stormwater regulations were signed into rule by EPA. The phase II regulations expand the requirements for stormwater permits to all municipalities located in urbanized areas, and to construction sites between one and five acres. The new rule requires operators of regulated small municipal storm sewer systems (MS4s) to obtain coverage under the permit and develop a stormwater management program designed to prevent harmful pollutants from being washed by stormwater runoff into the MS4 (or from being dumped directly into the MS4) and then discharged from the MS4 into local waterbodies. Under the new rule, up to 90 additional municipalities in Washington may need municipal stormwater permits, including the cities of Selah, Sunnyside, Yakima, and Union Gap and Yakima County.

EPA rules require local governments to develop stormwater programs that address the following six minimum control measures:

- Public Education and Outreach
- Public Participation/Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention/Good Housekeeping

Department of Ecology rules require local governments to address two additional elements:

- Compliance with Total Maximum Daily Load Allocations
- Monitoring, Reporting, and Record Keeping Requirements

The City of Yakima, Yakima County, and the City of Union Gap have developed a joint plan to fund and implement a regional stormwater management plan intended to achieve compliance with these requirements.

City of Yakima Wastewater Facilities Plan

The Yakima Regional Waste Water Treatment Plant (WWTP) owned and operated by the City of Yakima provides treatment services for the City of Yakima, the City of Union Gap, the City of Moxee, unincorporated lands to the east of Yakima referred to as Terrace Heights, and several other unincorporated areas under the jurisdiction of Yakima County including the area to the west of Yakima known as West Valley. The Yakima Regional WWTP may eventually provide service to the community of Gleed, located five miles northwest of the current City limits. The regional sewer service boundaries are shown in Figure 1-5. The City of Yakima provides sewer service to these areas based upon an inter-local agreement known as the "Four Party Agreement (4PA)" which was agreed upon and entered into by the City of Yakima, Yakima County, the City of Union Gap and the Terrace Heights Sewer District to allocate capacities and service areas on February 23, 1976.

Since the regional wastewater treatment facilities are intended to serve the entire urban area, the service area boundaries and the associated population projections are considerably larger than those of the City of Yakima Water System. The urban areas not served by the City of Yakima Water System are served by the adjacent water purveyors which include the City of Union Gap, the Nob Hill Water Association, and Yakima County (Terrace Heights).

Table 1-6, Wastewater Treatment Plant Capacity Allocation, shows the percentage of capacity allocated to each entity.

Table 1-6
Wastewater Treatment Plant Capacity Allocation

Service Area	% of Capacity Allocation
City of Yakima & Urban Service Area	87.9%
City of Union Gap	8.1%
Terrace Heights Sewer District	4.0%
Total	100.0%

The most recent Wastewater Treatment Facilities Plan was completed in 2004. It was adopted by the Yakima City Council in October 2004, and it was approved by the Department of Ecology in October of 2005.

The current treatment capacity of the Yakima Regional WWTP is 53,400 pounds per day influent corresponding to flows of 14.0 million gallons a day (MGD) during peak loading conditions.

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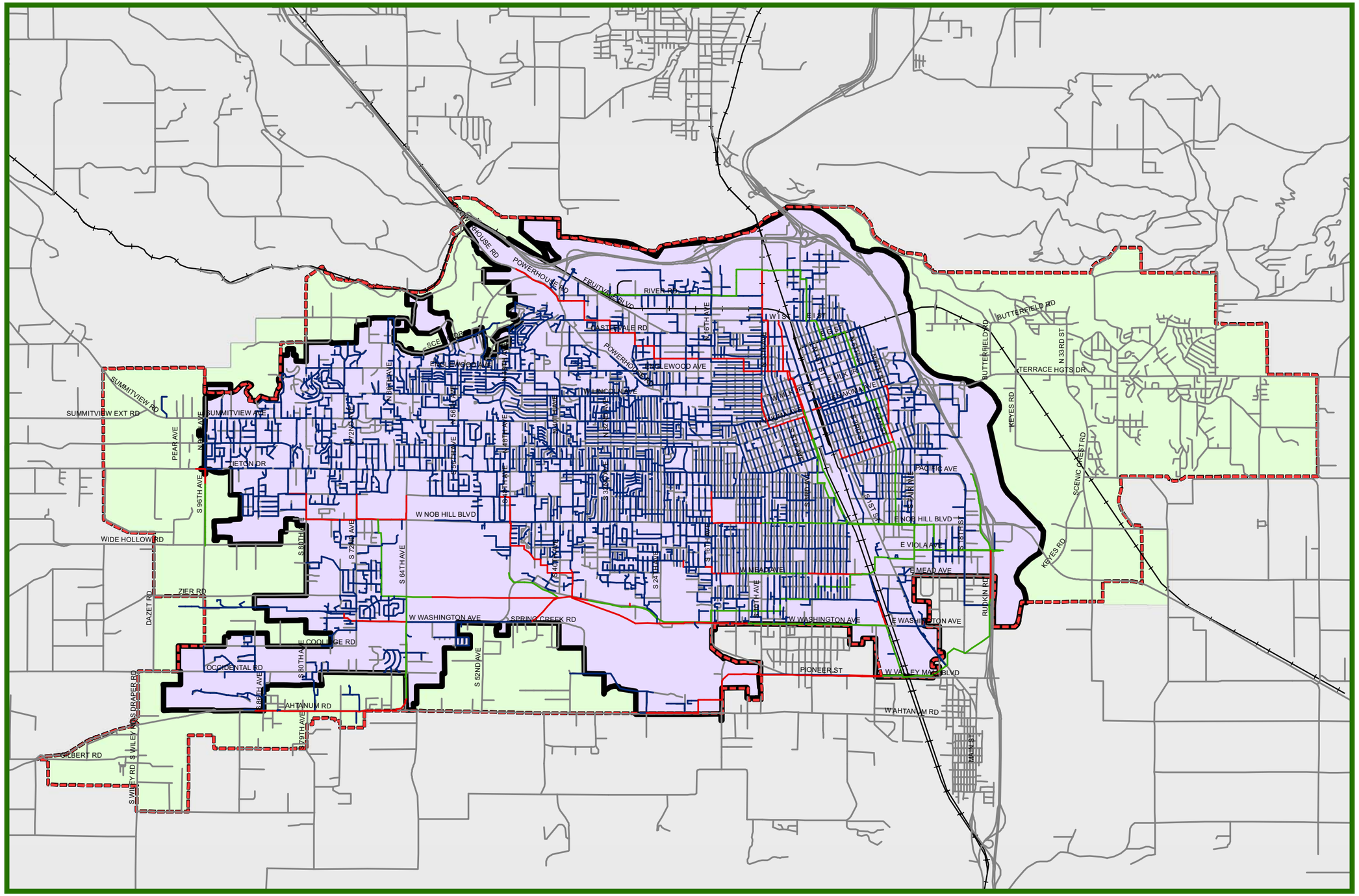

0 1,600 3,200 6,400 9,600 12,800 Feet

6" to 12" Pipe
13" to 18" Pipe
18" Pipe and Larger

Yakima City Limits
Yakima Urban Growth Area
Four Party Sewer Agreement

City of Yakima
Yakima Urban Growth Area
Outside Urban Growth Area

Yakima Urban Area Comprehensive Plan

Figure 1-5
Waste Water Service

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On-site sewage disposal regulations

Chapter 7.65.030 of the City of Yakima Municipal Code requires the use of public sewers wherever the sewer is within 200 feet of the property line. Chapter 7.65.040 requires that before commencement of construction of a private wastewater disposal system, the owner shall first obtain a written permit from the Yakima Health District as set forth in chapter 10, as now or as hereafter may be amended, of the district's "Rules and Regulations Providing for the Regulation of On-site Sewage Disposal Systems."

Chapter 12.05 of the Yakima County Code permits the installation of on-site sewerage disposal systems only when a public sewer is not available.

Wellhead protection programs

The Upper Yakima Valley Regional Wellhead Protection Plan (WHPP) was completed in October 2000. The purpose of this plan is to identify potential sources of contamination near the member purveyors' groundwater supplies, implement management strategies to prevent contamination of those supplies, and develop a contingency plan for the contamination mitigation in the event that groundwater does become contaminated. In this Regional WHPP, each member community in the Upper Yakima Valley plays a role in protecting the groundwater supplies of the entire area by pooling resources and management efforts to target an audience beyond that which could be reached at a local level.

The member purveyors participating in this wellhead protection plan include:

Yakima County
City of Yakima
Town of Naches
City of Moxee
Town of Tieton
City of Union Gap
City of Selah
Nob Hill Water Association

Regional management efforts adopted by the eight purveyors forming the Regional Wellhead Protection Committee include:

Development of a Geographical Information System (GIS) database of the wellhead protection areas, potential contamination sources, and water quality data in order to monitor and track sources and receptors.

Development of a planning trigger to distribute wellhead protection notification letters for development changes (i.e. building permits, zoning changes, SEPA, etc.) within wellhead protection areas.

Coordination with Ecology to prioritize their Hazmat Technical Assistance Sweep within wellhead protection areas.

Coordination with the State Health Department's Sanitary Surveys to ensure up-to-date information is maintained in the regional GIS potential contamination source inventory.

Coordination with County Health District to identify septic tanks and private wells with Global Positioning System (GPS) units.

Coordination with the Washington Association of Realtors to adopt a Property Disclosure Addendum that will help identify private and abandoned well locations during property transfers.

Designation of the 6-Month wellhead protection area as a critical "Red Zone" by County Emergency Management (LEPC) in order to prioritize wellhead protection during emergencies (i.e. hazardous material spills) Public education efforts including literature distribution.

Coordination with Education Services District (ESD) which provides continuing education to area teachers in order to better integrate wellhead protection and water issues into school curriculum.

Development of a regional website to increase public awareness on the need to protect groundwater.

Development of a logo for wellhead protection area signs.

Development of an interlocal agreement among the eight purveyors to make sure that wellhead protection is given a high priority in the Upper Yakima Valley.

County water and sewer general plans

The *Yakima County Rural Water & Sewerage General Plan* was adopted by Yakima County in May 1988. This plan was subsequently amended by the *Yakima County Water System Satellite Management Plan* which was completed in December 1996. This satellite management plan, prepared in accordance with the requirements of WAC 246-295, was approved by DOH thereby authorizing the county to become a satellite management agency (SMA). An SMA is an individual, purveyor, or entity approved by DOH to own or operate more than one public water system on a regional or county-wide basis.

The County’s SMA includes all of Yakima County except the incorporated area, the Yakima Training Center, and certain areas of the Yakama Indian Nation. Under its satellite management plan, the County will acknowledge the service area boundary of any existing water system that has a DOH approved water system plan. Developments located within a defined service area

boundary will be referred to that water purveyor for service, thus allowing the existing water purveyor the first right for providing water service.

Yakima County currently operates 25 satellite water systems. Two of these systems are within the City of Yakima UGA. These are:

Terrace Heights Water System, and

Star Crest Water System

The County does not currently operate any water systems which it does not own.

Groundwater management plans

In 1999, United States Bureau of Reclamation (USBR), Department of Ecology (Ecology), and the Yakama Nation signed a Memorandum of Agreement (MOA) to fund and oversee a study of the ground water resources of the Yakima River Basin. The U.S. Geological Survey (USGS) has been contracted to perform the lead role in conducting the study which will be provide more detailed information with respect to ground water resources of the Yakima River Basin. This extensive study has been completed and study results should be available sometime in the spring of 2011. Detailed analysis of existing data combined with analysis of the data collected during this study should provide the information needed to provide reasonable estimates of the availability of groundwater resources and of the interaction or "continuity" between groundwater and surface water in the Yakima River Basin which will provide the information necessary to manage the groundwater in the Yakima Basin.

Basin plans

In 1998, the Washington State Legislature passed the Watershed Management Act (RCW 90.82, [ESHB 2514]) (WMA). The WMA identifies the "initiating governments" that select a lead agency, apply for grant funding, determine the scope of planning, and convene a "Planning Unit." In the Yakima Basin, the Tri-County Water Resource Agency (TCWRA) represents the initiating governments under WMA. Representation on the TCWRA includes Benton, Kittitas, and Yakima Counties; the Cities of Yakima and Ellensburg; Sunnyside Valley Irrigation District, Roza Irrigation District, and Yakima-Tieton Irrigation District.

The Yakima Basin Water Resources Agency (YBWRA)was form to replace the TCWRA when the members in Kittitas County dropped out of the program. In 2003 the Watershed Management Plan, Yakima River Basin was adopted by Yakima and Benton Counties. The Detailed Implementation Plan (DIP) was developed and adopted in 2007. The DIP was being administered though the YBWRA until Ecology stopped funding local Watershed Agencies in 2010.

Water system plans for adjacent purveyors

City of Union Gap

The City of Union Gap's most recent water system plan update was completed in 2004. The area presently served by the Union Gap water system is shown in Figure 1-6.

Nob Hill Water Association

Nob Hill Water Association Water System Plan Update was completed in 2010. The area presently served by the Nob Hill Water Association water system is shown in Figure 1-6.

Yakima County

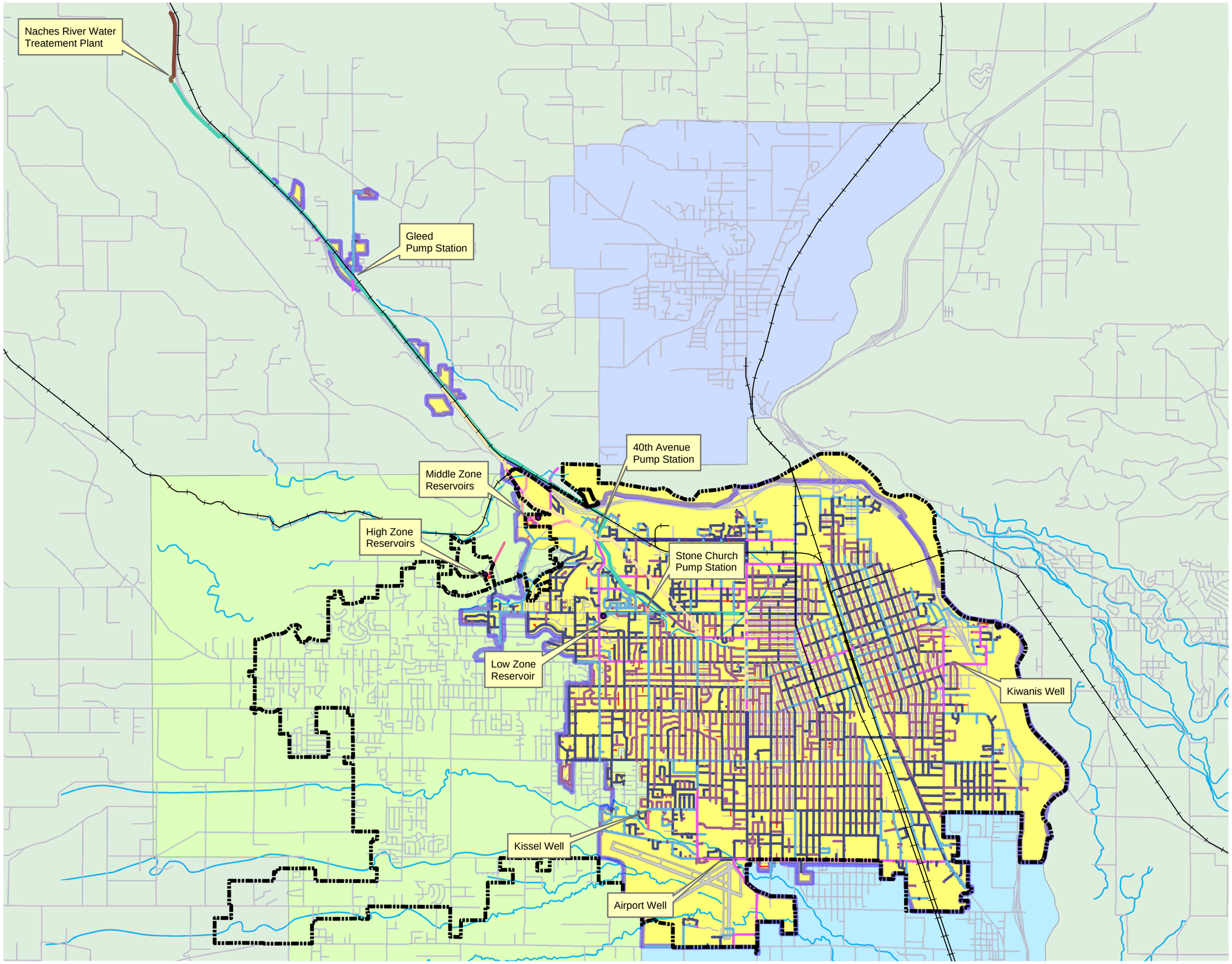
Yakima County's Water System Plan update was completed in 2009. The area served by Yakima County water system is shown in Figure 1-6.

City of Selah

The City of Selah's most recent Water System Plan update was adopted in December 8, 2008. The area presently served by the Selah water system is shown in Figure 1-6.

1.5 Existing Service Area Characteristics

The City's water system is within the Yakima Urban Area, as defined in the *Yakima Urban Area Comprehensive Plan*, which was adopted in April 1997 and amended in 1998, 2000, 2001, 2002, 2006, and 2010. The Urban Area, city limits, and the Four Party Urban Area are shown in Figure 1-7. The Washington State Growth Management Act (GMA) passed in 1990, requires municipalities to establish boundaries within which "urban services" such as water supply will be provided.



Legend

City Limits

Service Area

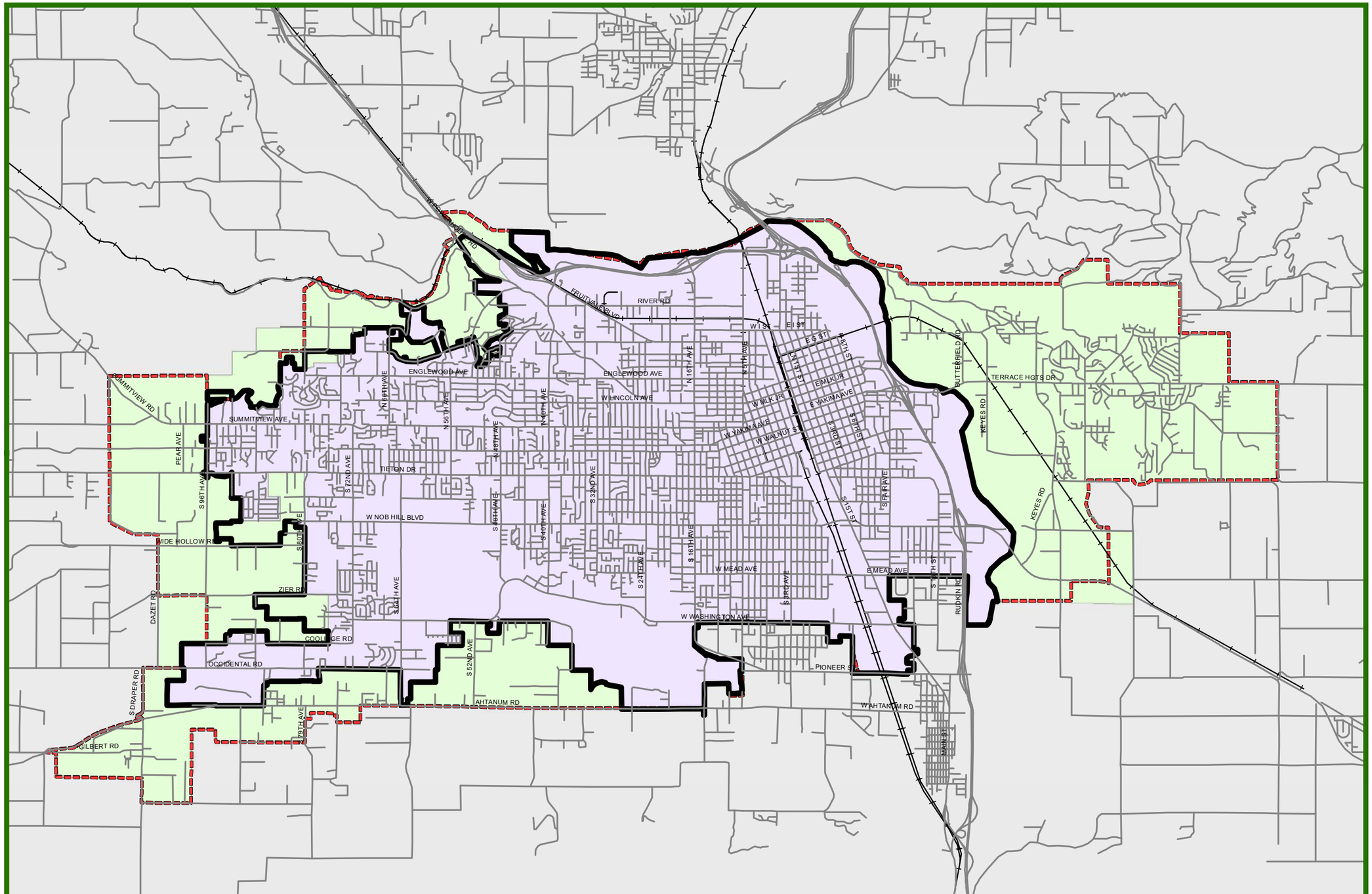
- Yakima
- Nob Hill
- Selah
- Union Gap
- Yakima County

Water System Plan Update
Figure 1-6

Adjacent Purveyor Service Areas

N
W E
S

0 0.25 0.5 1 1.5 2 Miles



0 1,625 3,250 6,500 9,750 13,000 Feet

Yakima City Limits

Yakima Urban Growth Area

Sewer Service inside City Limits

Sewer Service Outside City Limits

Outside Urban Growth Area

Yakima Urban Area Comprehensive Plan

Figure 1-7
Yakima Four Party Sewer Service Agreement

The areas that are not inside the water service boundary as shown in Figure 1-6, could be considered to be potential wholesale water supply users. However, no water demands for these possible future users have been included in the demand forecast, because the City has decided not to pursue regionalization at this time. It should also be noted that these areas are also outside of the "place of use" boundaries which are reference in the City's surface water rights. For the purpose of this plan, the existing and future water service areas are essentially the same.

The City of Yakima's existing water service area shown in Figure 1-6 is delineated by the boundary of plats currently served by mains and service connections. The existing service area extends beyond other boundaries such as city limits, urban boundary, and future service boundary. For example, City service is provided to county areas, such as the Gleed area. If the existing service area extends into an adjacent purveyor's future service area, it is by mutual verbal or written agreement until the adjacent purveyor's system is extended.

Adjacent Purveyors

Four water purveyors supply water to areas adjacent to or within the City of Yakima: Noh Hill Water Association, the City of Union Gap, Yakima County in the Terrace Heights area, and the City of Selah. The existing service areas of these purveyors are shown in Figure 1-6.

Nob Hill Water Association

The Nob Hill Water Association serves the West Valley area west of Yakima. A significant portion of the system is located within the City's corporate limits and the remainder is located in unincorporated Yakima County. The system is operated as an association with a board of directors. In 2010, the Association had approximately 9,419 services, serving a population of 27,610. Nob Hill Association's 2009 Water System Plan Update projected an average growth rate of 2.43 percent through the year 2026. The systems's five active wells have a capacity of 8,550 GPM. The distribution storage consists of five reservoirs with a total capacity of 3.6 MG.

The City has three interties with the Nob Hill Water Association. The three interties are located at West Lincoln Avenue and North 56th Avenue, Tieton Drive and South 45th Avenue, and South 32nd Avenue and Ahtanum. These interties are for emergency purposes only and are covered in a Memorandum of Understanding between the City and the Association dated September 6, 2000, a copy of which is included in Appendix E. These interties are not designed for normal operation of either system and are not considered as a source of supply in the storage and supply analyses presented in Chapter 3 of this plan. In the past, whenever an intertie has been activated, it has been a joint effort. Crews from Nob Hill and the City have been present to open the two valves (each with a locking cap) and to check system pressure. The interties are not metered. Instead, supply has been estimated by comparing the current pump records to the previous year's pump records during the same time period.

City of Union Gap

The City of Union Gap is located in the southeast corner of the urban area. Union Gap's water system supplies approximately 1,100 services. The source of supply is three wells with a combined capacity of approximately 1,600 gpm and a reservoir capacity of 1.6 MG. The water system growth rate is projected at approximately one percent per year.

The City does not have any interties with Union Gap. However some water could be delivered to Union Gap in an emergency through a connection between fire hydrants near Washington Ave.

Terrace Heights Area (Yakima County)

Until recently, the Terrace Heights area consisted of four water systems with greater than 100 services and approximately 20 water systems that served between 10 and 99 customers. The major systems were the Country Club District, Terrace Estates, Sun Country Mobile Estates, and Skyline Mobile Estates. There were also a number of systems that served mainly commercial establishments or had fewer than 10 connections.

The County's existing service area is entirely east of its western future service boundary that is coincident with the City of Yakima's east boundary. Overlaps and islands of service do not exist and are not anticipated. The county utility is expected to grow into a major purveyor within the urban boundary and may soon be providing service adjacent to the City of Yakima service area.

City of Selah

Selah is located east of the Gleed area and North of the City of Yakima (see Figure 1.61). Because Selah is located across the Naches River and is outside the current water service area and urban area, it is not expected that the City will provide water service to this area.

1.6 Future Service Area

The areas currently designated or planned to be included in Yakima's future water service area are discussed in this Section and are shown in Figure 1-6.

Potential Service Area

The future service boundary describes the specific area for which water service is planned by a public water system (WAC 246-293). The future service boundary is important to meet the requirements of the GMA, and it is critical to the efficient and cost-effective development of the water system. Annexations by the City of Yakima or its neighboring cities will not affect that water service area, because the water service boundaries are established by separate agreements.

From a technical viewpoint, the area that could reasonably be served by the City of Yakima is a gentle slope confined on two sides by natural barriers consisting of:

Selah Heights on the north

Ahtanum Ridge on the south

On the west and east sides, the size and increasing elevation of the potential area could be a practical limitation. It is possible to extend the system beyond these natural barriers, but to do so would be a significant undertaking. The Yakima River is a natural barrier, but it could be crossed with an acceptable cost-benefit ratio.

However, as described in the previous section, four other utilities provide service within or near the urban boundary. Service agreements have been or are being developed among the utilities to determine which utility will serve new areas of growth.

A 1993 study for Terrace Heights and Yakima County (January 1993, CH2M HILL) suggested a long-term combined supply from both the City's surface supply and groundwater in the Terrace Heights area. Since that time, Yakima County has developed a well in the Terrace Heights area, purchased two systems, and intends to serve the area within the urban boundary east of the Yakima River.

The criteria used to determine the City of Yakima's future service boundary include:

Place of Use - The “place of use” boundary (see Figure 4-2 in Chapter 4) defines the specific area within which the City is allowed to utilize its surface water supply.

Physical features - Boundaries formed by physical features are usually expensive and often impractical to cross.

Adjacent jurisdictional boundaries - Jurisdictional boundaries include other city limits and adjacent purveyor future service areas. It is inefficient and perhaps impossible politically to serve in areas already planned for service by adjacent purveyors.

Urban Growth Boundary - The GMA requires that the water utilities establish common future service boundaries within the growth management planning area designated by the Urban Growth Boundary.

Policy - The City's current policy is to provide service outside the existing service area only where it is economical and practical. Resolution No. D- 1250, adopted March 29, 1965, describes the City policy regarding service outside the existing city limits (Appendix C).

The alignment of different sections of the City's future service boundary is based on different combinations of these criteria. The main sections of the City's future service boundary in terms of these criteria are discussed below.

Northwest Boundary (Gleed)
The final urban growth boundary and policy criteria influence the alignment of this section. The Gleed area has historically been served by the City from the City's 48-inch diameter transmission main, which conveys treated water from the treatment plant to the low-level reservoir. The existing service area is shown in Figure 1-6 and extends north of Maple Way Road. The urban boundary shown in Figure 1-5 coincides with Maple Way Road. It is the City's policy to continue serving the existing customers north of Maple Way Road, but to provide service for new customers only within the water right "place of use" boundary. It is expected that customers currently served by the privately owned community water systems in the Gleed area will continue to be served by those systems.

North Boundary
The Naches River, the urban boundary, the adopted urban area of the City of Selah, and the City of Yakima boundary define the north section of the future service boundary.

East Boundary
The east boundary is defined by the Yakima River and the City of Yakima boundary.
This boundary is coincident with Yakima County's future service boundary for Terrace Heights.

South Boundary
The south boundary primarily depends on adjacent jurisdictional boundaries and policy. The Water Service Agreement between the City of Yakima and the City of Union Gap dated April 21, 1987 (Appendix F), did not completely define the service areas of Yakima and Union Gap. As a result, some disagreement arose over which purveyor would provide service to some areas. These disagreements are described in the following sections. Although Union Gap recently annexed all of the land south of Washington Avenue, water service is still provided to some areas by the City of Yakima.

On South Side or Washington Avenue, the current service area of the City of Yakima extends into the Union Gap service area as defined by the agreement (as shown in Figure 1-6). By verbal agreement, the City of Yakima serves all parcels abutting the south side of Washington Avenue east of South 16th Avenue and west of Voelker Avenue. Thus, the necessity for both cities to install a main in Washington Avenue is avoided.

Some parcels south of, but not adjacent to, Washington Avenue are served by the City of Yakima by verbal agreement between the two cities. It is understood that, when the City of Union Gap system is extended to these areas, the ownership of the mains and services will be transferred from Yakima to Union Gap.

West Boundary
The Nob Hill Water Association operates and maintains a water system in the western part of the City of Yakima under a 25-year franchise agreement {City of Yakima Ordinance No.93-86, December 1, 1993, Appendix E). The association's service area also extends well beyond city limits.

Generally, as shown in Figure 1-6, the City's future service boundary is the same as the existing boundary. There are several areas that can be served by either utility. Some of these areas are "islands" completely surrounded by the other utility's service area. Other parcels abutting the future service area boundary may be served by either utility, creating an erratic boundary. In this case, the boundary might alternate from a street centerline to the back property line on either side of the same street. Nob Hill Water Association and the City of Yakima have verbally agreed to maintain the status quo. Most of the parcels currently receive water service, and the distribution grid is well established. Where in- fill services are requested, the customer is given the choice of utility where both utilities have water mains in the same street.

1.7 Service Area Agreements

The City of Yakima currently has written service area agreements with the Nob Hill Water Association and with the City of Union Gap. Copies of these agreements are included in Appendix E and Appendix F, respectively.

There are currently no comprehensive service area agreements between the City of Yakima and the other two adjacent purveyors, the City of Selah and Yakima County.

1.8 Service Area Policies

The City of Yakima's service area policies are applicable to various sections of this water system plan update and may also be referenced and discussed in more detail elsewhere in this document. However, the policies are presented together here in one location in a summary form with reference made, where applicable, to other documents which the City provides for distribution to persons interested in developing within the water service area.

A brief summary of each applicable service area policy is included below.

Wholesaling Water: The City of Yakima Water Division does not currently provide water to any other utilities on a wholesale basis, and does not anticipate doing so in the future.

Wheeling Water: The City of Yakima Water Division currently does not allow the system’s mains to be used to wheel water to another water system. A need to consider any wheeling arrangements with adjacent purveyors is not anticipated during the planning period.

Annexation: It is City policy that before utility service is provided to a contiguous, unincorporated property annexation is required. For noncontiguous properties the City would require an outside utility agreement (OUA). . However, the City does not provide water service outside of the defined service area (see Figure 1-2) and, with only a few exceptions, the Yakima Water Service Area lie entirely within the City limits. Significant areas in the western portion of Yakima are actually served by the Nob Hill Water Association. The only significant area outside the Yakima City limits served by the Yakima water system is the unincorporated community of Gleed.

Direct Connection and Satellite/Remote Systems : Section 12.04.010 of the Yakima Municipal Code requires that;

> *All new lots and development shall be served by a public water supply line maintained by the City of Yakima, Nob Hill Water Company, or other water purveyor, and located adjacent to the lot or development site.*

Yakima Municipal Code does not prohibit satellite water systems within the City limits or water service area. The City has, however, elected not to become a satellite management agency. The only approved satellite management agency in the area in Yakima County.

Design and Performance Standards: The water system minimum design and performance standards for new development have been developed by the City of Yakima Engineering Department. The standards are available to the public upon request in a document titled *WATER Specification and Details (1999)*. This document can be obtained from the engineering department at the following address:

City of Yakima – Engineering
129 North Second Street
Yakima, WA 98901
Phone (509) 575-6111
Fax (509) 576-6305

Title 12 of the Yakima Municipal Code also establishes development standards for water service extensions. Copies Title 12 – Development Standards are also available from Yakima City Engineering. Chapter 12.04 covers water system development standards. Section 12.04.030 requires that all water lines shall be looped. Section 12.04.040 requires that all new water lines within the City of Yakima water service area shall be constructed of Class 52 ductile iron and shall be a minimum of eight inches in diameter, and that improvements and additions to the Nob Hill Water Company system shall conform to the requirements of Nob Hill Water Company. (Ord. 98-64 § 1 (part), 1998).

Surcharge for Outside Customers : The City imposes a surcharge of 1.5 × the volume rate for customers outside of the service. There is no surcharge on the connection fee. Due to the limitations of the water rights "place of use" boundary and agreements with adjacent purveyors, the circumstances in which the City might provide service to outside customers would be very limited.

UGA: The City's service area and water rights "place of use" boundaries are entirely within and significantly smaller that the Urban Growth Area (except for Gleed which was included in the interim UGA, but not in the final UGA). Because of this the growth which occurs within the City's service area will be primarily through in-fill, and the need to proactively finance extensions in anticipation of growth is not expected to be necessary.

Late-Comer Agreements: The City has a policy allowing late-comer agreements for applicants or developers who propose water system extensions. The latecomer agreements are developed

by project proponents and reviewed and administered by the City Engineering Department. The maximum duration allowed for latecomer agreements is 15 years.

Cross-Connection Control Program: Cross Connection control is covered in Chapter 7.68 of the Yakima Municipal Code under Article 7.68.070. The Water Division currently has two full time Water Device Technicians who are dedicated to the inspection of cross connection control devices and enforcement of this ordinance.

Extension: Water line extensions within the City of Yakima water service area are governed by Chapter 12.04.020 of the Yakima Municipal Code which states that;

> *Water lines shall be extended to the point where the adjoining property owner's responsibility for further extension begins. This typically requires extension across the street or easement frontage of the developing property. In some cases it will require dedication of an easement and a line extension across the property or extension along two or more sides of the developing property. Extensions will be consistent with and implement the city's adopted water comprehensive plan. (Ordinance. 98-64 § 1 (part), 1998).*

1.9 Satellite Management Agencies

The City of Yakima Water/Irrigation Division is not now and is not currently considering becoming a Department of Health approved Satellite Management Agency (SMA). The currently approved SMA in the area are Nob Hill Water Association and Yakima County. It will be the City's intent to refer any existing or propose satellite systems within its service area boundaries to Nob Hill Water Association or Yakima County as the approved SMA.

1.10 Conditions of Service

Municipal water suppliers have a duty to provide service to all new connections within their retail service area when the circumstances meet four threshold factors: (RCW 43.20.260 *Review of water system plan, requirements – Municipal water suppliers, retail service*)

1. The municipal water supplier has sufficient **capacity** to serve water in a safe and reliable manner.
2. The service request is **consistent** with adopted local plans and development regulations.
3. The municipal water supplier has sufficient **water rights** to provide service.
4. The municipal water supplier can provide service in a **timely and reasonable** manner.

For the City of Yakima Water System a primary condition of service is that the customer be within the boundaries of the "place of use" area which is a condition of the City's surface water rights. (See Figure 1-2.)

The other conditions of service are that the customer pays all applicable connection and user costs. All water system extensions required to serve a customer must conform to the City design standards and developer standards.

1.11 Complaints

All water service related complaints are handled through the Water/Irrigation Division office which can be reached at (509) 575-6154. This number also serves as the Nights and Weekend Emergency telephone number to report problems and complaints after normal working hours.

All water quality complaints are referred to the Water Quality Specialist at the Water Treatment Plant. The Water Quality Specialist investigates the complaints and maintains records describing the nature of the complaint and the steps taken to resolve it. All complaints are assigned a work order number which can then be tracked in the Automated Inventory and Maintenance Management Systems (AIMMS). AIMMS is a City wide program which tracks information about all of the City's facilities and equipment. Additional information on AIMMS is included in Chapter 6 of this Water System Plan Update.

All low pressure and other distribution system related complaints are referred to the Distribution Supervisor who investigates and takes corrective actions as necessary. As with the water quality complaints, the distribution system related complaints are assigned a work order number and tracked in AIMMS.

Chapter 2

Basic Planning Data and Water Demand Forecasting

2 Basic Planning Data and Water Demand Forecasting

2.1 Current Population, Service Connections, Water Use, and Equivalent Residential Units

Current Population

The Washington State Office of Financial Management (OFM) official 2000 Census population figures and April 1, 2010 population estimates for Yakima County and the City of Yakima are listed in Table 2-1.

Table 2-1 Current Population for the City of Yakima and Yakima County

Municipality	2000 Census Population	April 1, 2010 OFM Estimate
Yakima County	222,581	239,100
Unincorporated	93,192	89,300
Incorporated	129,389	149,800
City of Yakima	71,845	85,040

As discussed in Section 1.5, Existing Service Area Characteristics, the City of Yakima water system does serve some small areas outside the current municipal boundaries (including Gleed and a small portion of Union Gap) however, it does not serve significant areas in the western portions of Yakima which do lie within the city limits and are served by the Nob Hill Water Association. The net result is that the actual population served by the City of Yakima water system is significantly less than the OFM population figures for the corporate limits as indicated in Table 2-1, above.

The current population within the City of Yakima water service area was estimated using the City's geographical information system (GIS). The GIS database includes the 2000 Census population figures for each of the census blocks within the city limits. By overlapping (intersecting) the water service area boundaries with the census block boundaries and population data, the GIS can be used to calculate the population within the service area as well as the population within the individual pressure zones. Where the service area lines cut through a census block the amount of population assigned to each area or zone was interpolated based on the relative areas of the resulting census block segments.

The populations of the individual pressure zones and the total service area population as calculated from 2000 census block data in the GIS coverages, as described above, are listed in Table 2-2. The 2010 Census data will not be available until sometime in 2011. As will be discussed later in this section, there does not appear that any significant growth has occurred in the Yakima Water System Service Area since the 2000 Census data was analyzed. Therefore, for the current water system plan update the same historic population data will be used.

Table 2-2 Current Population for the City of Yakima Water Service Area and Zones		
Service Area	**2000 Census Population**	**April 1, 2010 Estimate[a]**
Level 1 (Low) pressure zone	50,962	50,962
Level 2 (Middle) pressure zone	12,024	12,024
Level 3 (High) pressure zone	2,052	2,052
Total for Water Service Area	65,038	65,038
[a] unchanged for 2000 Census Population based on customer connections, metered consumption, and water supply data for the period from 2002 to 2009		

Total Service Connections

The number of service connections for each customer class from 2002 to 2009, are presented in Table 2-3. These customer classes are derived from the billing codes for the various classes of use which have been established in the City of Yakima utility billing system.

The numbers of single family residential service connections from 2002 to 2009 are showed graphically in Figure 2-1. The numbers of multi-family (W10), commercial (W12), and industrial (W13) service connections are shown in Figure 2-2.

Table 2-3 Number of Services by Billing Code

Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
W10	Multi Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	1,606	1,622	1,619	1,642	1,633	1,638	1,636	1,642
W11	Residential Water Inside (Single family residences)	14,764	14,771	14,803	14,818	14,851	14,813	14,826	14,835
W12	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	2,001	2,010	1,882	1,905	1,921	1,919	1,931	1,938
W13	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	86	107	108	106	105	103	102	100
W14	*Discontinued in 2009*	2	1						1
W15	All city owned accounts inside except Irrigation	66	63	23	27	33	36	36	36
W20	Multi Family Residential Outside (any residence with more than one unit, duplexes, apartment building, etc.)	9	9	9	9	9	8	8	8
W21	Residential Water Outside (Single family residences)	121	105	105	104	103	102	97	97
W22	Commercial Water Outside (services for commercial, not residential or industrial)	33	32	28	30	25	23	22	22
W23	Industrial Water Outside (services where manufacturing takes place, including fruit processing)		2	2	2	3	2	2	2
W24	*Discontinued in 2003*	2							
W25	All city owned accounts outside / B&O tax exempt								
W31	Fire Service/Inside (All fire services except city owned)	335	339	349	357	372	380	379	389
W32	*Discontinued in 2004*	7							
W35	All city owned Fire Service accounts inside / B&O tax exempt	2					3	3	3
W41	Fire Service Outside (All fire services)	11	9	9	11	11	8	8	8
W42	*Discontinued in 2006*		1	1	1				
W43	*Discontinued in 2003*	1							
W44	All city owned Fire Service accounts outside								
W51	Deduct meters only	137	189	226	386	355	368	373	
W52	Irrigation Only Inside (All Irrigation Only services)	166	196	270	330	174	180	188	190
W55	All city owned Irrigation Only accounts inside tax	40	44	78	79	84	98	100	102
W61	Irrigation Only Outside)	3			1	1		1	

Figure 2-1 Number of Single Family Residential (Billing Code W11) Services from 2002 to 2009

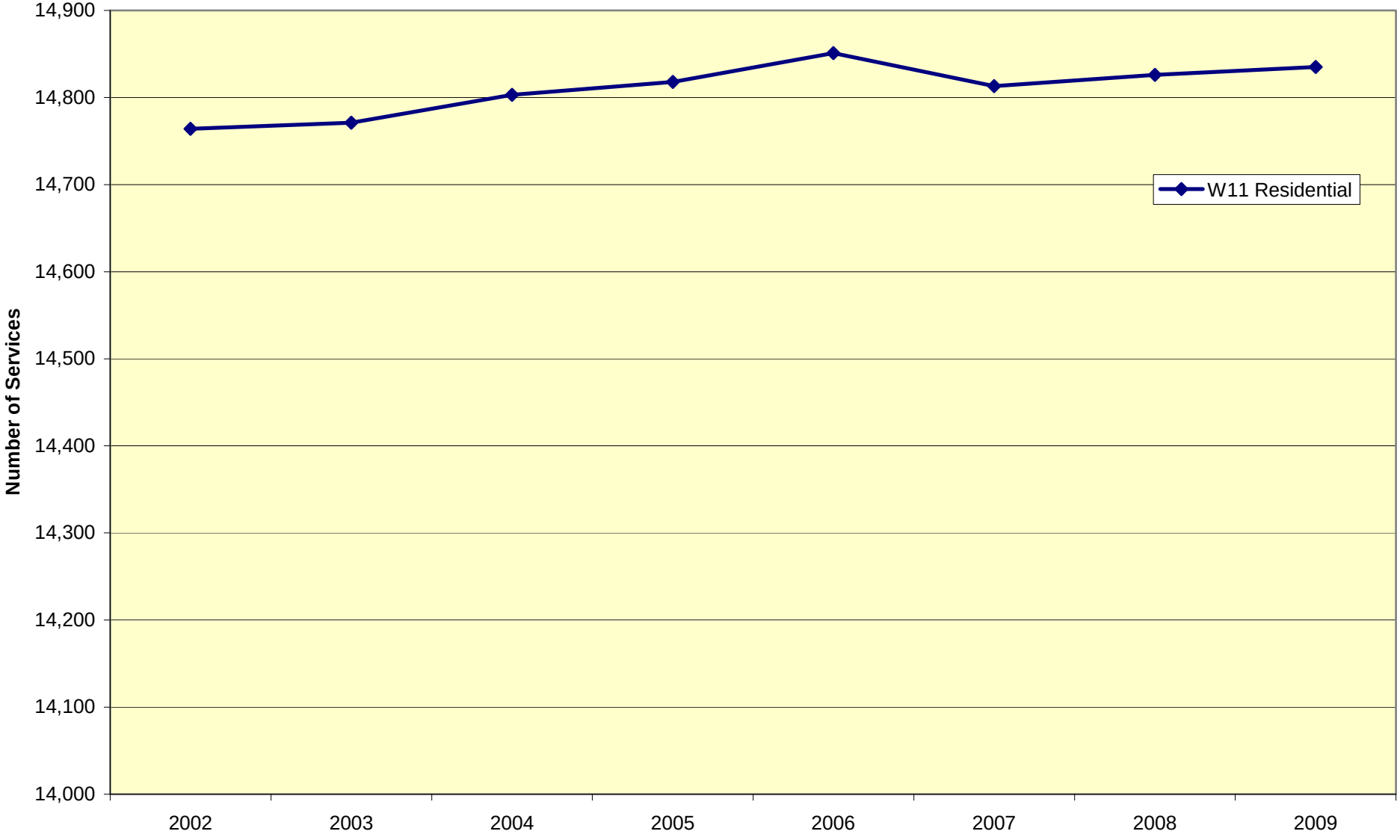
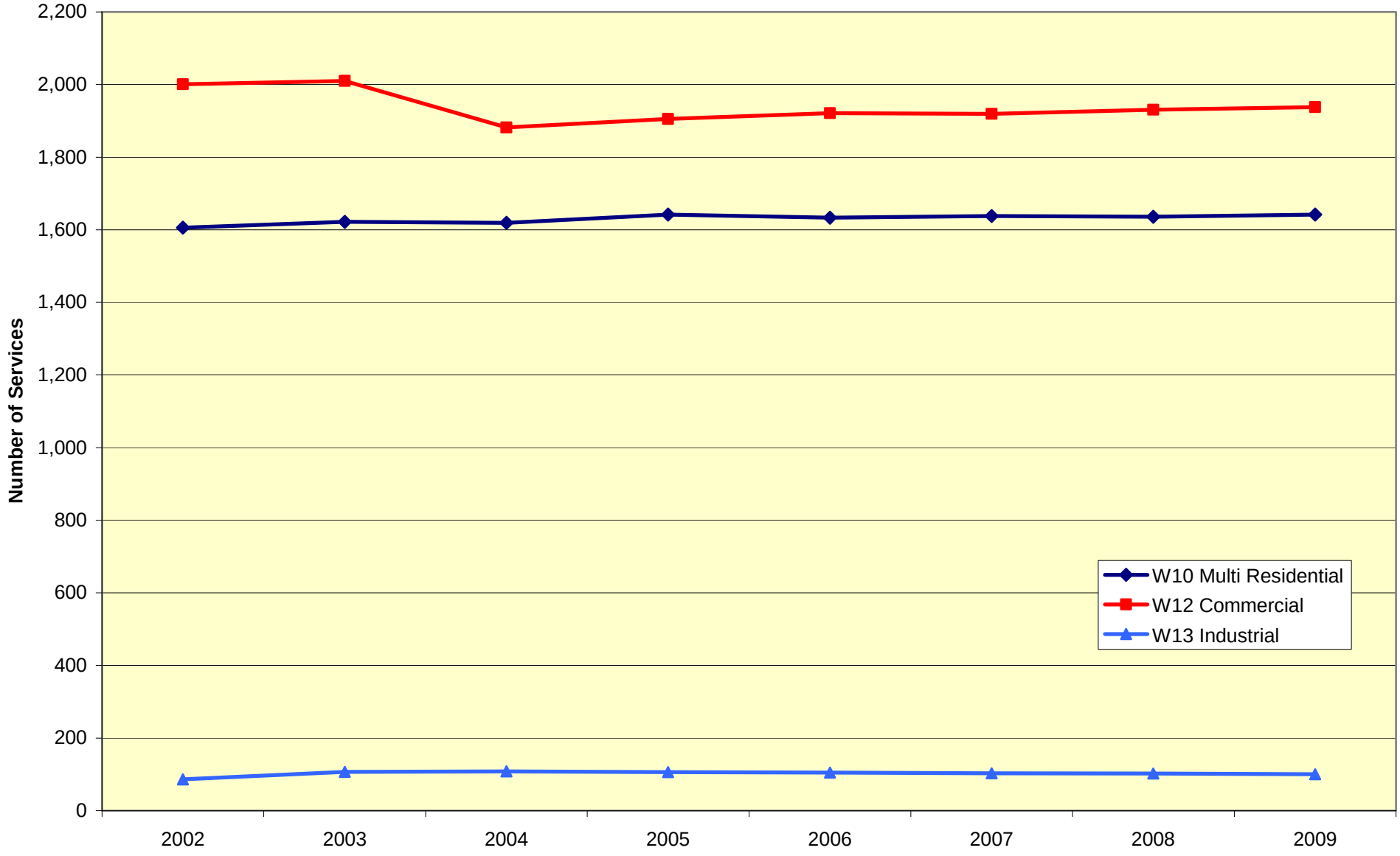


Figure 2-2 Numbers of Multi Residential (W10), Commercial (W12), and Industrial (W13) Services from 2002 to 2009



2.2 Water Use and Equivalent Residential Units

Water Supply Data

The water use data as determined by measurement of the water supply sources is summarized in Table 2-4. The Naches River Water Treatment Plant (WTP) production is measured by the filter effluent flow meters. Each of the wells which are currently available for use (Kiwanis Park, Airport and Kissel Park) is equipped with a flow meter. The sum of the WTP production and the output of the well pumps represents the total water supplied for a given period.

Table 2-4 Monthly Water Supply Data (WTP Effluent plus Well production)

Month	Monthly Averages (MGD)								Averages by Month (MGD)
	2002	2003	2004	2005	2006	2007	2008	2009	
Jan	9.28	10.33	10.45	9.65	10.37	9.68	9.25	9.80	9.85
Feb	9.22	8.92	9.47	10.17	10.12	9.32	9.72	9.41	9.55
Mar	9.57	9.16	9.04	10.07	10.10	10.30	9.98	9.63	9.73
Apr	11.62	10.72	10.53	11.67	11.73	11.55	11.23	12.19	11.41
May	12.66	12.13	10.19	12.65	14.18	13.79	14.58	13.77	12.99
Jun	15.11	16.44	13.50	15.95	15.55	16.04	14.80	15.03	15.30
Jul	17.06	19.62	17.71	17.87	15.00	17.51	16.88	16.31	17.24
Aug	17.47	17.32	14.43	17.09	14.24	17.59	15.76	16.01	16.24
Sep	14.93	14.45	11.75	14.02	13.97	15.20	14.33	13.23	13.98
Oct	12.19	10.75	10.74	10.52	10.66	10.88	10.84	9.41	10.75
Nov	9.45	8.04	7.93	9.10	9.53	8.63	8.93	7.58	8.65
Dec	9.99	8.14	8.41	9.91	9.58	8.83	9.32	8.09	9.03
Annual Averages	12.38	12.17	11.18	12.39	12.09	12.90	12.14	11.70	12.10

In addition to the flow meter at the water treatment plant and the wells, there are flow meters at each of the booster pump stations. The data from these flowmeters together with the continuously recorded reservoir level data make it possible to estimate the water use in each pressure zone. Because the “by-zone” use estimates are derived from additional flow meter and level measurement devices which each are subject to some inherent variation, the total water use

estimates obtained by adding the use in each pressure zone will be close to but not exactly the same as the total water supplied estimates in Table 2-4, above. The "by-zone" estimates are presented in Table 2-5, below.

Table 2-5 Use by Pressure Zone calculated from water supplied by zone data.

Zone	Parameter	2002	2003	2004	2005	2006	2007	2008	2009	Avg.
Level 1 Low	Total (MG)	3644	3535	3137	3671	3567	3733	3312	3440	3,505
	Avg. Day (MGD)	9.983	9.684	8.572	10.057	9.771	10.228	9.049	9.425	9.596
	% of Total Use	80.4%	79.9%	76.6%	81.1%	80.1%	79.3%	75.1%	80.9%	79.2%
Level 2 Middle	Total (MG)	701	700	792	682	705	798	919	665	745
	Avg. Day (MGD)	1.920	1.919	2.164	1.869	1.933	2.188	2.510	1.823	2.041
	% of Total Use	15.5%	15.8%	19.3%	15.1%	15.9%	17.0%	20.8%	15.6%	16.9%
Level 3 High	Total (MG)	184	186	161	168	173	172	171	142	170
	Avg. Day (MGD)	0.504	0.510	0.440	0.461	0.474	0.471	0.468	0.389	0.465
	% of Total Use	4.1%	4.2%	3.9%	3.7%	3.9%	3.6%	3.9%	3.3%	3.8%
Gleed	Total (MG)	3.989	4.941	5.019	4.959	5.192	6.106	7.101	5.016	5.290
	Avg. Day (MGD)	0.0109	0.0135	0.0137	0.0136	0.0142	0.0167	0.0194	0.0137	0.0145
	% of Total Use	0.09%	0.11%	0.12%	0.11%	0.12%	0.13%	0.16%	0.12%	0.1%
Total	Total (MG)	4,533	4,426	4,096	4,526	4,450	4,710	4,409	4,252	4,425
	Avg. Day (MGD)	12.419	12.126	11.221	12.400	12.192	12.903	12.081	11.651	12.124

Water Use Data

Water use by customer class can be estimated by the City's utility billing records. By comparing the water consumption data generated from the billing records to the water supply data in Table 2-4 it is also possible to estimate the amount of water which is either non-revenue producing (fire, flushing mains, etc.) or unaccounted for water (leaks, under reporting meters, etc.) A summary of the water consumption by customer class is presented in Table 2-7 below. Metered use for the four major user classifications is shown graphically in Figure 2-3. Authorized non-revenue water use and unaccounted for water estimates are presented in Table 2-8.

Table 2-6 Metered Use by Billing Code (Customer Class) in 100 ft^3 (CCF)

Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
W10	Multi Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	731,053	731,411	804,322	744,928	778,704	744,667	724,482	822,171
W11	Residential Water Inside (Single family residences)	1,674,343	1,694,759	1,681,582	1,593,651	1,586,657	1,550,561	1,480,027	1,569,639
W12	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	1,500,725	1,338,118	1,285,634	1,114,080	1,177,707	1,154,983	1,108,174	1,267,050
W13	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	280,122	382,964	446,158	356,828	365,398	282,749	132,856	240,005
W14	*Discontinued in 2009*	210	54						77
W15	All city owned accounts inside except Irrigation	119,673	103,794	47,118	39,902	54,314	41,441	43,892	43,339
W20	Multi Family Residential Outside (any residence with more than one unit, duplexes, apartment building, etc.)	2,258	2,401	1,971	1,734	2,144	1,311	1,194	1,332
W21	Residential Water Outside (Single family residences)	11,874	14,367	13,468	13,275	12,997	10,889	10,711	11,687
W22	Commercial Water Outside (services for commercial, not residential or industrial)	34,843	32,273	35,002	27,993	10,981	5,493	6,137	5,992
W23	Industrial Water Outside (services where manufacturing takes place, including fruit processing)		626	1,275	1,391	1,378	1,485	2,638	1,815
W24	*Discontinued in 2003*	39							
W25	All city owned accounts outside / B&O tax exempt								
W31	Fire Service/Inside (All fire services except city owned)	2,375	5,584	4,864	7,575	3,331	18,320	8,344	2,999
W32	*Discontinued in 2004*	0							
W35	All city owned Fire Service accounts inside / B&O tax exempt	0					13	173	1,704
W41	Fire Service Outside (All fire services)	219	762	827	213	73	8	-9,999	45
W42	*Discontinued in 2006*		0	0	0				
W43	*Discontinued in 2003*	0							
W44	All city owned Fire Service accounts outside								
W51	Deduct meters only	45,735	167,225	272,121	159,885	158,262	162,015	168,430	
W52	Irrigation Only Inside (All Irrigation Only services)	106,265	104,049	171,685	265,526	280,276	324,250	307,916	309,307
W55	All city owned Irrigation Only accounts inside tax	79,518	78,546	183,810	141,090	114,535	159,974	151,977	157,593
W61	Irrigation Only Outside)	0			73	0		0	
	Totals (CCF)	**4,543,517**	**4,489,708**	**4,677,716**	**4,308,259**	**4,388,495**	**4,296,144**	**3,968,522**	**4,434,755**

Figure 2-3 Metered Use for the Four Major Customer Classes in 100 ft^3 (CCF)

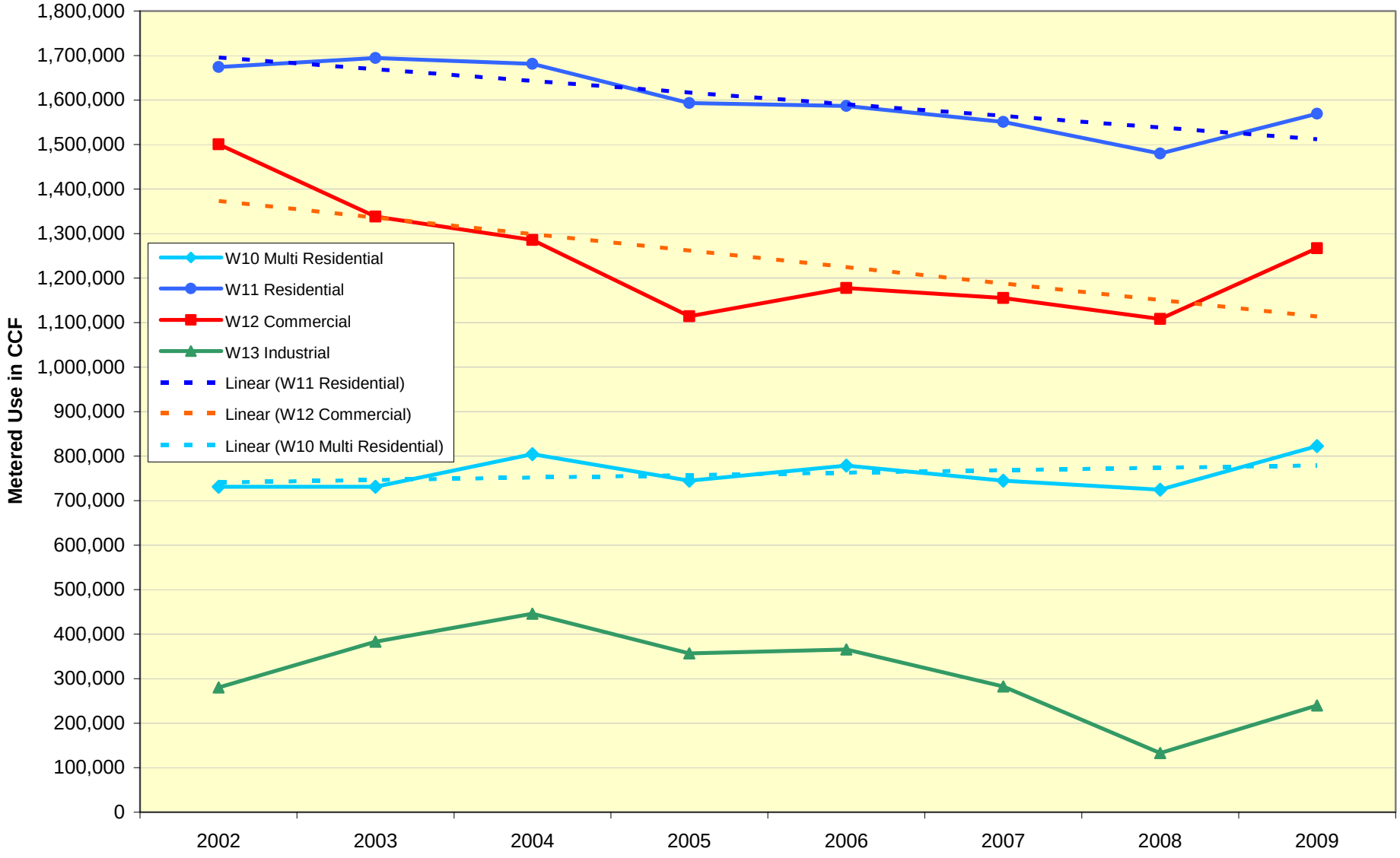


Table 2-7 Summary of Metered Water Use by Billing Code or Customer Class

Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
W10	Multi Family Residential Inside (e.g. any residence with more than one unit, duplexes, apartments, etc.)	731,053	731,411	804,322	744,928	778,704	744,667	724,482	822,171
	Multi Family Residential (W10) % of total	16%	16%	17%	17%	18%	17%	18%	19%
W11	Residential Water Inside (Single family residences)	1,674,343	1,694,759	1,681,582	1,593,651	1,586,657	1,550,561	1,480,027	1,569,639
	Residential (W11) % of total	37%	38%	36%	37%	36%	36%	37%	35%
W12	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	1,500,725	1,338,118	1,285,634	1,114,080	1,177,707	1,154,983	1,108,174	1,267,050
	Commercial (W12) % of total	33%	30%	27%	26%	27%	27%	28%	29%
W13	Industrial Water Inside (services to manufacturing facilities, including fruit processing)	280,122	382,964	446,158	356,828	365,398	282,749	132,856	240,005
	Industrial (W13) % of total	6.2%	8.5%	9.5%	8.3%	8.3%	6.6%	3.3%	5.4%
	Governmental	122,267	110,140	52,809	47,690	57,718	59,782	42,410	48,087
	Governmental % of total	2.7%	2.5%	1.1%	1.1%	1.3%	1.4%	1.1%	1.1%
	Irrigation Only	185,783	182,595	355,495	406,689	394,811	484,224	459,893	466,900
	Irrigation Only % of total	4.1%	4.1%	7.6%	9.4%	9.0%	11.3%	11.6%	10.5%
	Other	49,224	49,721	51,716	44,393	27,500	19,178	20,680	20,903
	Other % of total	1.1%	1.1%	1.1%	1.0%	0.6%	0.4%	0.5%	0.5%
	Totals (CCF)	**4,543,518**	**4,489,709**	**4,677,717**	**4,308,260**	**4,388,496**	**4,296,145**	**3,968,523**	**4,434,756**

Table 2-8 Other Authorized Use and Estimated Distribution System Leakage (DSL)								
Type of Use	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Water Treatment Plant (incl. backwash, surface wash, and service water) MG	186.06	169.88	136.66	186.95	234.95	263.05	186.75	181.82
Subtotal Water Treatment Plant use (100 ft^3)	**248,743**	**227,112**	**182,701**	**249,933**	**314,104**	**351,671**	**249,667**	**243,075**
Use for Street Flushing (100 ft^3)	2,033	2,033	2,215	1,688	2,467	1,943	**1,803**	2,080
Estimated Use for Fire (100 ft^3)	9,506	9,506	9,506	9,506	9,506	3,479	1,368	23,670
Estimated Water System Flushing Use (100 ft^3)	1,483	1,483	1,483	1,483	1,483	1,500	1,596	1,352
Metered through Fire Hydrants (100 ft^3)	6,443	6,443	6,443	6,443	6,443	6,332	4,663	8,335
Reservoir maintenance, irrigation diversions and other use (100 ft3)	23,411	23,411	23,411	23,411	434,492	468,467	15,352	31,470
Wastewater Collection System Flushing Use (100 ft^3)	1,379	1,379	824	1,267	1,264	1,337	1,994	1,585
Subtotal of Other Estimated Water Uses (100 ft^3)	**44,253**	**44,253**	**43,881**	**43,797**	**455,654**	**483,058**	**26,775**	**68,491**
Total of WTP Use plus Other Estimated Water Use (100 ft^3)	**292,997**	**271,366**	**226,582**	**293,730**	**769,759**	**834,730**	**276,442**	**311,566**
Total metered water use from Table 2-6 (100 ft^3)	4,543,517	4,489,708	4,677,716	4,308,259	4,388,495	4,296,144	3,968,522	4,434,755
Total Water Accounted for; metered use, WTP use, & other uses (100 ft^3)	**4,836,514**	**4,761,074**	**4,904,298**	**4,601,989**	**5,158,254**	**5,130,874**	**4,244,964**	**4,746,321**
Total Water Produced (WTP effluent plus wells) (100 ft^3)	6,062,834	5,949,198	5,475,557	6,052,444	6,336,210	6,066,990	6,215,560	5,718,243
Distribution System Leakage (100 ft^3)	1,226,320	1,188,124	571,259	1,450,455	1,177,956	936,117	1,970,596	971,922
Unaccounted for Water (DSL) as % of Water Produced	**20.2%**	**20.0%**	**10.4%**	**24.0%**	**18.6%**	**15.4%**	**31.7%**	**17.0%**

In order to estimate the total usage by each customer class it is necessary to add an appropriate percentage of the unaccounted for water into the metered usage for that customer class. A proportionate fraction of the estimated unaccounted for water amounts for each year (as shown in Table 2-8) are added to the usage by each customer class to result in the Adjusted Use by Customer Class estimates presented in Table 2-9. For example, the adjusted single family residential use for 2002 includes 20.2% of the unaccounted for water estimate corresponding to that year since the single family use in that year was 37% of the total metered use.

It should be noted that inaccuracies in the billing system which was in place until 2010 is one of the factors in the variability of the unaccounted for water. This system did not allow for separate tracking of revenue and consumption. A new billing system was placed into service in 2010 but data from this system was not available for incorporation into this water system plan update.

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Table 2-9 Water Use by Customer Class adjusted by adding a prorated share of the DSL

Code	Description	2002	2003	2004	2005	2006	2007	2008	2009
W10	Multi Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	928,368	924,966	902,549	995,722	987,723	906,928	1,084,228	1,002,358
	W10 % of total	16%	17%	17%	18%	18%	18%	19%	19%
W11	Residential Water Inside (Single family residences)	2,126,257	2,143,248	1,886,943	2,130,183	2,012,546	1,888,423	2,214,944	1,913,642
	W11 % of total	37%	38%	36%	38%	37%	37%	39%	36%
W12	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	1,905,779	1,692,228	1,442,640	1,489,156	1,493,826	1,406,650	1,658,445	1,544,737
	W12 % of total	34%	30%	28%	27%	27%	28%	29%	29%
W13	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	355,728	484,309	500,644	476,961	463,478	344,359	198,827	292,605
	W13 % of total	6.3%	8.7%	9.6%	8.5%	8.5%	6.7%	3.5%	5.5%
	Governmental	155,268	139,287	59,258	63,746	73,211	72,808	63,469	58,626
	Governmental % of total	2.7%	2.5%	1.1%	1.1%	1.3%	1.4%	1.1%	1.1%
	Irrigation Only	235,927	230,916	398,909	543,608	500,786	589,735	688,256	569,226
	Irrigation Only % of total	4.2%	4.1%	7.7%	9.7%	9.2%	11.5%	12.1%	10.8%
	Other	62,460	62,879	58,032	59,339	34,882	23,357	30,949	25,484
	Other % of total	1.1%	1.1%	1.1%	1.1%	0.6%	0.5%	0.5%	0.5%
	Totals	5,673,408	5,587,208	5,192,797	5,590,794	5,437,603	5,109,545	5,679,428	5,289,232

Equivalent Residential Units

To further analyze the water use patterns within the different customer classifications and pressure zones, the areas and populations of each zoning code classification were determined for each pressure zone using the 2000 census block data in the GIS coverages for the zoning code areas and pressure zones. These areas and populations are shown in Table 2-10.

The land use zoning code classifications in Table 2-10 are grouped to correspond to the billing code classifications which as previously noted are as follows:

Single Family Residential

Multi Family Residential

Commercial

Industrial

The Commercial Irrigation Only billing code water consumption is assumed to occur primarily within zoning areas that are grouped under the Commercial category in Table 2-10.

It should also be noted that the current billing system does not in all cases enable the residences in the R2 zoning classification to be identified as to whether they are treated as single family or multifamily in the billing records. For example, a duplex that has individual water meters on each unit would be treated as single family while a duplex with a single meter would typically be treated as multi family in the billing system. For the purpose of correlating the customer class usage data with the current population and zoning it is assumed that 40% of the R2 population and area is in the Single Family category and 60% of the R2 population and area is in the Multi Family category.

Table 2-10 Land Area and Population by Land Use Zoning Code

User Class	Land Use Code	Level 1				Level 2				Level 3				Totals	
		Acres	% Total Area[a]	Popu-lation	% Total Pop.	Acres	% Total Area[a]	Popu-lation	% Total Pop.	Acres	% Total Area[a]	Popu-lation	% Total Pop.	Acres	Popu-lation
Single Family	R-1	1266.91	45.5%	16,525	61.9%	1151.39	41.3%	8,531	31.9%	369.07	13.2%	1,648	6.17%	2,787.37	26,704
	R-2	1611.65	89.4%	15,248	92.0%	172.35	9.6%	1,197	7.2%	18.57	1.03%	132	0.80%	1,802.58	16,577
	SR	857.46	95.4%	18	47.4%	4.01	0.4%	2	5.3%	37.41	4.16%	18	47.4%	898.88	38
	Outside	266.15	97.9%	499	100.0%	5.62	2.1%							271.77	499
	Subtotal	3035.18	64.9%	23,141	68.3%	1230.97	26.3%	9,012	26.6%	413.91	8.85%	1,719	5.1%	4,679.06	33,872
Multi Family	R-3	592.89	77.4%	7,061	80.0%	157.32	20.5%	1,578	17.9%	15.80	2.06%	189	2.14%	766.02	8,828
	Subtotal	1559.89	84.4%	16,210	86.3%	260.73	14.1%	2,296	12.2%	26.94	1.46%	268	1.43%	1847.56	18,774
Commercial	B-1	263.93	79.1%	1,312	76.4%	64.42	19.3%	389	22.7%	5.36	1.61%	16	0.93%	333.71	1,717
	B-2	90.04	77.6%	605	79.6%	25.96	22.4%	155	20.4%	0.01	0.01%			116.01	760
	CBD	215.75	100.0%	1,168	100.0%									215.75	1,168
	CBDS	1667.75	100.0%	4,860	100.0%									1667.75	4,860
	HB	3.24	100.0%	57	100.0%									3.24	57
	LCC	57.15	77.3%	74	73.3%					16.77	22.7%	27	26.7%	73.92	101
	SCC	109.35	12.6%	466	72.2%	754.01	86.7%	157	24.3%	5.99	0.69%	22	3.41%	869.34	645
	Subtotal	2407.21	73.4%	8,542	91.8%	844.38	25.7%	701	7.5%	28.12	0.86%	65	0.70%	3279.71	9,308
Industrial	M-1	2223.66	99.2%	2,725	99.5%	17.68	0.8%	15	0.5%					2,241.34	2,740
	M-2	359.00	100.0%	344	100.0%									359.00	344
	Subtotal	2582.66	99.3%	3,069	99.5%	17.68	0.7%	15	0.5%					2600.34	3,084
	Totals	**9584.93**	**77.3%**	**50,962**	**78.4%**	**2352.76**	**19.0%**	**12,024**	**18.5%**	**468.98**	**3.78%**	**2,052**	**3.2%**	**12,406.7**	**65,038**

[a] percent of the total area of the listed zoning code classification which lies within the respective pressure zone level.

[b] assumes 40% of R2 population and area is in the Single Family category and 60% of R2 population and area is in the Multi Family category.

The distribution of the land use zoning classification areas among the pressure zones is shown in Table 2-11. The land use classifications are grouped according to the water use customer classifications as represented by the subtotal area figures in the table above.

Table 2-11 Distribution of Land Use Classification Areas among the Pressure Zones[a]

Customer Class	Level 1 Low Zone	Level 2 Middle Zone	Level 3 High Zone	Sum
Single Family	65.8%	25.7%	8.6%	100.0%
Multi Family	83.9%	14.6%	1.5%	100.0%
Commercial	73.4%	25.7%	0.9%	100.0%
Industrial	99.3%	0.7%	0.0%	100.0%

[a] This analysis of land use zoning distribution does not include Gleed since it is not within the City's GIS coverage and since the water use in Gleed is insignificant with respect to total use.

The total use in each customer class including an allowance for unaccounted for water was estimated previously in Table 2-8, above. A portion of the total unaccounted for water in each year is added into the use in each customer class in proportion to the percentage of the total use which is attributable to that customer class.

The current utility billing system is not capable of correlating the water usage to the location of use. It only differentiates the water use by customer class. However, based on the GIS analysis of the land use zoning classifications with respect to the pressure zones (see Tables 2-10 and 2-11) it can be seen that nearly all of the industrial categories and 73% of the commercial categories are located in the Level 1 pressure zone. A large majority (approximately 84%) of the multi family zoned area is also located in Level 1.

The estimated single family and multi family residential population is presented in Table 2-12. The population not residing within either the single family or multi family land use zoning classifications is included in the "Other" category in this table. The total single family and multi family residential population columns each include a prorated share of the "Other" population.

Table 2-12 Population Summary by Pressure Zone (from Table 2-11)

Pressure Zone/ Population	SF Subtotal	MF Subtotal	Subtotal SF + MF	Other	Total in Zone	Est. SF Total in Zone[a]	Est. MF Total in Zone[b]
Level 1	23,141	16,210	39,351	11,612	50,962	29,969	20,993
Level 2	9,012	2,296	11,308	717	12,024	9,582	2,442
Level 3	1,719	268	1,987	66	2052	1,775	277
Totals	33,872	18,774	52,646	12,395	65,038	41,327	23,711

[a] includes proportionate fraction of population in "Other" category $(\text{Total} \div \text{Subtotal}_{SF+MF}) \times \text{SF}$
[b] includes proportionate fraction of population in "Other" category $(\text{Total} \div \text{Subtotal}_{SF+MF}) \times \text{MF}$

Since Level 3 is almost entirely residential and most of that single family residential, the per capita usage can be estimated directly from the total amount of water supplied to that zone. The per capita use estimates for Level 3 are presented in Table 2-13.

The combined per capita residential usage in Level 1 and Level 2 can be estimated by first subtracting the Level 3 usage from the total residential use (including the allowance made for DSL). The Level 1 and Level 2 per capita use estimates are presented in Table 2-14.

Estimate Usage for residential customer classes in gallons per capita per day for Level 2 based on adjusted consumption volume data prorated by land use areas by zone is shown in Table 2-15 (land use areas as tabulated in Table 2-11 and population data from Table 2-12).

Estimated usage for Level 1 Single Family, Multi-family, and combined Single Family and Multi-Family residential customer classes in gallons per capita per day are shown in Table 2-16, Table 2-17, and Table 2-18, respectively.

Table 2-13 Estimated Level 3 Single Family residential use in gallons per capita per day (gpcd) based on estimated volumes of water supplied to this zone (as tabulated in Table 2-5)

Level 3 Supply	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Averages**
Avg. Day (mgd)	0.504	0.510	0.440	0.461	0.474	0.471	0.468	0.389	**0.465**
Avg. Day (CCF)	674.36	681.19	588.79	616.83	633.09	629.17	626.04	520.52	**621**
Avg. Day (gpd)	504,420	509,528	440,415	461,389	473,549	470,621	468,274	389,349	**464,693**
Annual CCF	246,141	248,634	214,909	225,143	231,077	229,648	228,503	189,990	**226,755**
Population	2052	2052	2052	2052	2052	2052	2052	2052	
gal/capita/day	245.82	248.31	214.63	224.85	230.77	229.35	228.20	189.74	**226.46**

Table 2-14 Estimate Usage for residential customer classes in gallons per capita per day for Level 1 and Level 2 combined

Use Category and units		2002	2003	2004	2005	2006	2007	2008	2009	Averages
Annual Average Consumption in CCF (adjusted to include DSL estimate)	Single Family (SF)	2,126,257	2,143,248	1,886,943	2,130,183	2,012,546	1,888,423	2,214,944	1,913,642	**2,039,523**
	Multi-Family (MF)	928,368	924,966	902,549	995,722	987,723	906,928	1,084,228	1,002,358	**966,605**
	Total Use SF + MF	3,054,625	3,068,214	2,789,492	3,125,905	3,000,269	2,795,351	3,299,172	2,916,000	**3,006,129**
Annual Level 3 use in CCF[1]		246,141	248,634	214,909	225,143	231,077	229,648	228,503	189,990	**226,755**
Net Levels 1 + 2 Use, CCF		1,880,116	1,894,614	1,672,034	1,905,040	1,781,469	1,658,775	1,986,441	1,723,652	**1,812,768**
Level 1+2 SF population		32,153	32,153	32,153	32,153	32,153	32,153	32,153	32,153	**32,153**
Level 1+2 MF population		18,506	18,506	18,506	18,506	18,506	18,506	18,506	18,506	**18,506**
Level 1+2 *Other* population		12,329	12,329	12,329	12,329	12,329	12,329	12,329	12,329	**12,329**
Level 1+2 total population		62,988	62,988	62,988	62,988	62,988	62,988	62,988	62,988	**62,988**
Level 1+2 SF population including prorated *Other*		39,978	39,978	39,978	39,978	39,978	39,978	39,978	39,978	**39,978**
Level 1+2 MF population including prorated *Other*		23,010	23,010	23,010	23,010	23,010	23,010	23,010	23,010	**23,010**
SF use in gallons/capita/day		96	97	86	98	91	85	102	88	**93**
MF use in gallons/capita/day		83	82	80	89	88	81	97	89	**86**

Table 2-15 Estimate Usage for residential customer classes in gallons per capita per day for Level 2 based on adjusted consumption volume data prorated by land use areas by zone as tabulated in Table 2-11 and population data from Table 2-12

Use Category and units	2002	2003	2004	2005	2006	2007	2008	2009	Averages
SF use prorated by land use distribution in CCF	546,448	550,815	484,944	547,457	517,224	485,325	569,241	491,806	**524,157**
MF use prorated by land use distribution in CCF	135,542	135,045	131,772	145,375	144,208	132,411	158,297	146,344	**141,124**
Commercial use prorated by land use distribution in CCF	489,785	434,903	370,758	382,713	383,913	361,509	426,220	396,997	**405,850**
Level 2 total in CCF	1,171,775	1,120,762	987,475	1,075,546	1,045,345	979,245	1,153,758	1,035,148	**1,071,132**
Level 2 total in gallons/day	2,401,336	2,296,795	2,023,647	2,204,132	2,142,242	2,006,782	2,364,414	2,121,344	**2,195,086**
Level 2 total in MGD	2.401	2.297	2.024	2.204	2.142	2.007	2.364	2.121	**2.195**
Compare Level 2 supply data from Table 2-__	1.920	1.919	2.164	1.869	1.933	2.188	2.510	1.823	**2.041**
Level 2 population in areas zoned Single Family (SF)	39,978	39,978	39,978	39,978	39,978	39,978	39,978	39,978	**39,978**
Level 2 population in areas zoned Multi Family (MF)	23,010	23,010	23,010	23,010	23,010	23,010	23,010	23,010	**23,010**
SF use in gallons/capita/day	116.9	117.8	103.7	117.1	110.6	103.8	121.7	105.2	**112.1**
MF use in gallons/capita/day	113.8	113.4	110.6	122.1	121.1	111.2	132.9	122.9	**118.5**
Combined SF & MF gpcd	116.2	116.9	105.1	118.1	112.7	105.3	124.0	108.8	**113.4**

Table 2-16 Estimate Usage for Level 1 Single Family residential customer class in gallons per capita per day

Use Category and units	2002	2003	2004	2005	2006	2007	2008	2009	Averages
Total adjusted SF use from Table 2-14 in CCF	2,126,257	2,143,248	1,886,943	2,130,183	2,012,546	1,888,423	2,214,944	1,913,642	**2,039,523**
Level 2 adjusted SF use from Table 2-15 in CCF	546,448	550,815	484,944	547,457	517,224	485,325	569,241	491,806	**524,157**
Level 3 water supplied from Table 2-13 in CCF	246,141	248,634	214,909	225,143	231,077	229,648	228,503	189,990	**226,755**
Net adjusted SF use in Level 1 in CCF	1,333,668	1,343,800	1,187,090	1,357,583	1,264,245	1,173,450	1,417,201	,231,846	**1,288,610**
Level 1 SF population from Table 2-12	29,969	29,969	29,969	29,969	29,969	29,969	29,969	29,969	29,969
Level 1 SF use in gallons/capita/day	91.2	91.9	81.2	92.8	86.5	80.2	96.9	84.2	**88.1**

Table 2-17 Estimated Usage for Level 1 Multi Family residential customer class in gallons per capita per day (gpcd)

Use Category and units	2002	2003	2004	2005	2006	2007	2008	2009	Averages
Total adjusted MF use from Table 2-14 in CCF	928,368	924,966	902,549	995,722	987,723	906,928	1,084,228	1,002,358	**966,605**
Level 2 adjusted MF use from Table 2-15 in CCF	135,542	135,045	131,772	145,375	144,208	132,411	158,297	146,344	**141,124**
Level 3 adjusted MF use in CCF	--	--	--	--	--	--	--	--	--
Net adjusted MF use in Level 1 in CCF	792,826	789,921	770,777	850,347	843,515	774,517	925,931	856,014	**825,481**
Level 1 MF population from Table 2-12	20,993	20,993	20,993	20,993	20,993	20,993	20,993	20,993	20,993
Level 1 MF use in gallons/capita/day	77.4	77.1	75.2	83.0	82.3	75.6	90.4	83.6	**80.6**

Table 2-18 Estimated Usage for Level 1 combined Single and Multi Family residential customer classes in gpcd

Use Category and units	2002	2003	2004	2005	2006	2007	2008	2009	Averages
Total adjusted Level 1 use for SF and MF in gpd	4,065,629	4,306,427	3,955,032	4,464,763	4,257,903	3,930,817	4,740,939	4,228,068	**4,243,697**
Level 1 total population from Table 2-12	50,962	50,962	50,962	50,962	50,962	50,962	50,962	50,962	**50,962**
Level 1 combined SF and MF use in gpcd	79.8	84.5	77.6	87.6	83.6	77.1	93.0	83.0	**83.3**

Based on the per capita usage estimates presented in Table 2-13 through 2-18, the per capita consumption by zone for both single family and multi family residential users is summarized in Table 2-19.

Table 2-19 Estimated per capita use by pressure zone (gal/capita/day)[1]			
Pressure Zone	**SF gpcd**	**MF gpcd**	**gpcd for combined SF + MF use in zone**
Level 1	88.1	80.6	83.3
Level 2	112.1	118.5	113.4
Level 3	226.5	--	226.5
[1] based on average usage estimates from 2002 through 2009			

Using the total single family residential population estimate from Table 2-12, and the current (2009) number of single family connections, the number of residents per connection is estimated in Table 2-20, below.

Table 2-20 Estimated number of residents per single family connection		
Number of SF connections (year 2009)	**Estimated Single Family Population**	**Estimated SF Population per connection**
14,835	41,327	2.79

Using 2.79 residents per single family connection from Table 2-20, the ERU value for each pressure zone is calculated in Table 2-21 using the gallons per capita per day estimates in Table 2-19.

Table 2-21 ERU calculation by pressure zone (gal//day)[a]			
Pressure Zone	**SF gpcd**	**Residents per ERU[b]**	**ERU by Pressure Zone (gal/day)**
Level 1	88.1	2.79	183
Level 2	112.1	2.79	201
Level 3	226.5	2.79	848
[a] based on average usage estimates from 2002 through 2009. [b] the same number of residents per connection is used in each zone since insufficient data is available to differentiate among the zone with regard to this parameter.			

2.3 Projected Land Use, Future Population, and Water Demand

Projected Land Use

The Yakima Urban Area Comprehensive Plan was adopted in April 1997 and amended in 1998, 2000, 2001, 2002, and 2006 in compliance with the Washington State Growth Management Act (Chapter 36.70A RCW). The 2006 Yakima Urban Area Comprehensive Plan 2025, was adopted on December 16, 2006 by Ordinance 2006-62. The West Valley Neighborhood Plan and Area-Wide Rezone were adopted on February 15, 2011. They became effective on February 28, 2011 in the unincorporated area, and on March 20, 2011 inside the Yakima City Limits. The West Valley Neighborhood lies outside of the Yakima Water System Service Area and is served by the Nob Hill Water Association

The Future Land Use Map (Figure 2-4) shows the proposed general distribution and general location of various land uses anticipated during the next twenty year planning period. The Map provides a graphic display of where development is expected to occur, and serves as a guide for development and land use planning. The Future Land Use Map represents a mixture of land uses which are necessary for the future of the community, including provisions for various residential densities located throughout the Urban Service Area, and appropriate commercial service centers located to serve neighborhoods. The current City of Yakima Water Service Area is also shown on Figure 1-6. The Yakima Water Service Area is less than the area within the Yakima City limits, and is substantially less that the Urban Service Area. The potential for expansion of the geographic boundaries of the Yakima Water Service Area is very limited. It is anticipated that residential, commercial, and industrial growth will occur within the water service area primarily through infill on vacant land and increases in population density.

Future Land Use designations indicate the preferred use of lands within a particular area. Along with these land use designations, the comprehensive plan includes facility planning for the necessary urban services within this Urban Service Area. In the future, land use designations will be assigned to the Urban Reserve, as facility planning is conducted. GMA requires development regulations to implement the comprehensive plan.

The Future Land Use Map is a generalized proposal for where development is expected to occur, and is not the official zoning map for the City. The Future Land Use Map acts as a guide to evaluate development proposals for consistency with the Plan, along with applicable goals and policies. The City of Yakima Zoning Map, not the Future Land Use Map, continues to be the basis for land use project permit decisions. The current zoning map is presented in Figure 2-5.

The City of Yakima's current zoning map can only be modified through the public hearing process. Changes from the current zoning map will include an evaluation process with criteria established to determine when and if rezoning of land will be necessary. The evaluation criteria includes: existing residential densities; water / sewer availability; street capacity; neighborhood characteristics; vacant land; and existing institutions (schools, hospitals, etc.)

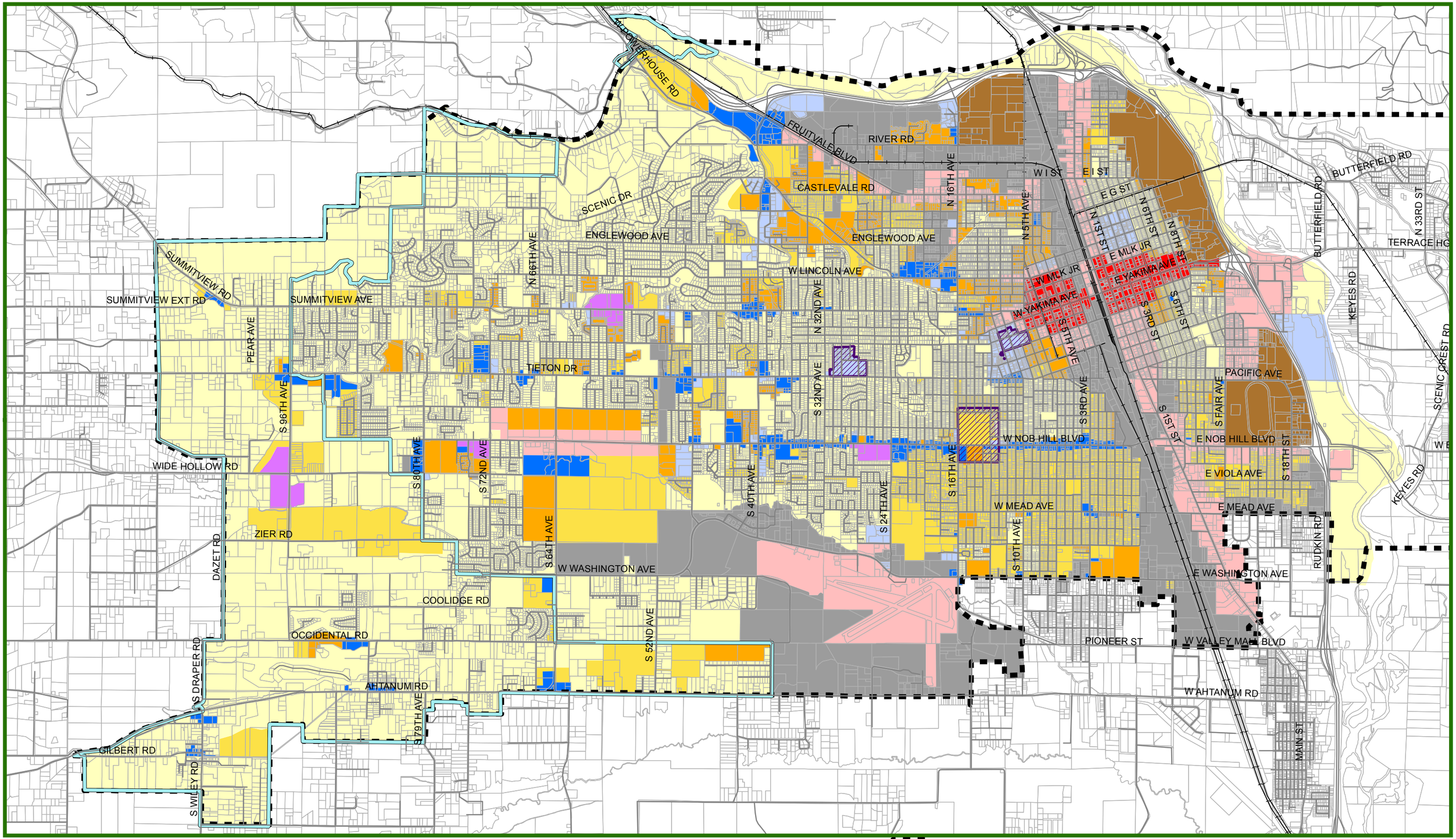
There may be more than one appropriate zoning category within any future land use designation to suit a particular proposal. If the Future Land Use Map supports a proposed development, but current zoning does not relate to the proposal, a rezone maybe considered appropriate, depending upon the results of the evaluation process described above.

The Future Land Use Map for the Yakima Urban Service Area identifies the land use preferences of the community as a result of citizen participation. The Map was presented to the community and analyzed as a series of future land use alternatives. The inventory and composition of land use designations included in the Future Land Use Map is summarized on Table 2-22. Development opportunities for additional residential units of all densities are identified by the Future Land Use Map. A community preference for low density housing is evident. Infill of existing vacant lots within neighborhoods is a high priority for implementing affordable housing and efficient use of existing infrastructure. However, significant increases in opportunities for medium and high density land are also identified by the Future Land Use Map.

A variety of commercial and industrial development land use opportunities are identified within the Urban Service Area, consistent with the past development patterns of the community and the future needs of a growing and changing community. The majority of the areas designated for multifamily residential, commercial, and industrial land uses lie within the Yakima city limits and within the Yakima Water Service Area.

Table 2-22 Future Land Use Inventory

Future Land Use	Parcel Acres	Land Use%	Percent Vacant
Low Density Residential	6,768	45%	21%
Medium Density Residential	1,320	9%	36%
High Density Residential	581	4%	33%
Professional Office	415	3%	39%
Neighborhood Commercial	180	1%	19%
Large Convenience Center	116	1%	23%
Arterial Commercial	1,187	8%	25%
CBD Core	121	1%	14%
Warehouse/Wholesale	1,278	8%	48%
Industrial	1,235	8%	47%
Institutional	1,073	6%	26%
Parks and Open Space	845	6%	65%
Subtotal Urban Service Area	15,119	100%	21%



1 inch = 3,500 feet

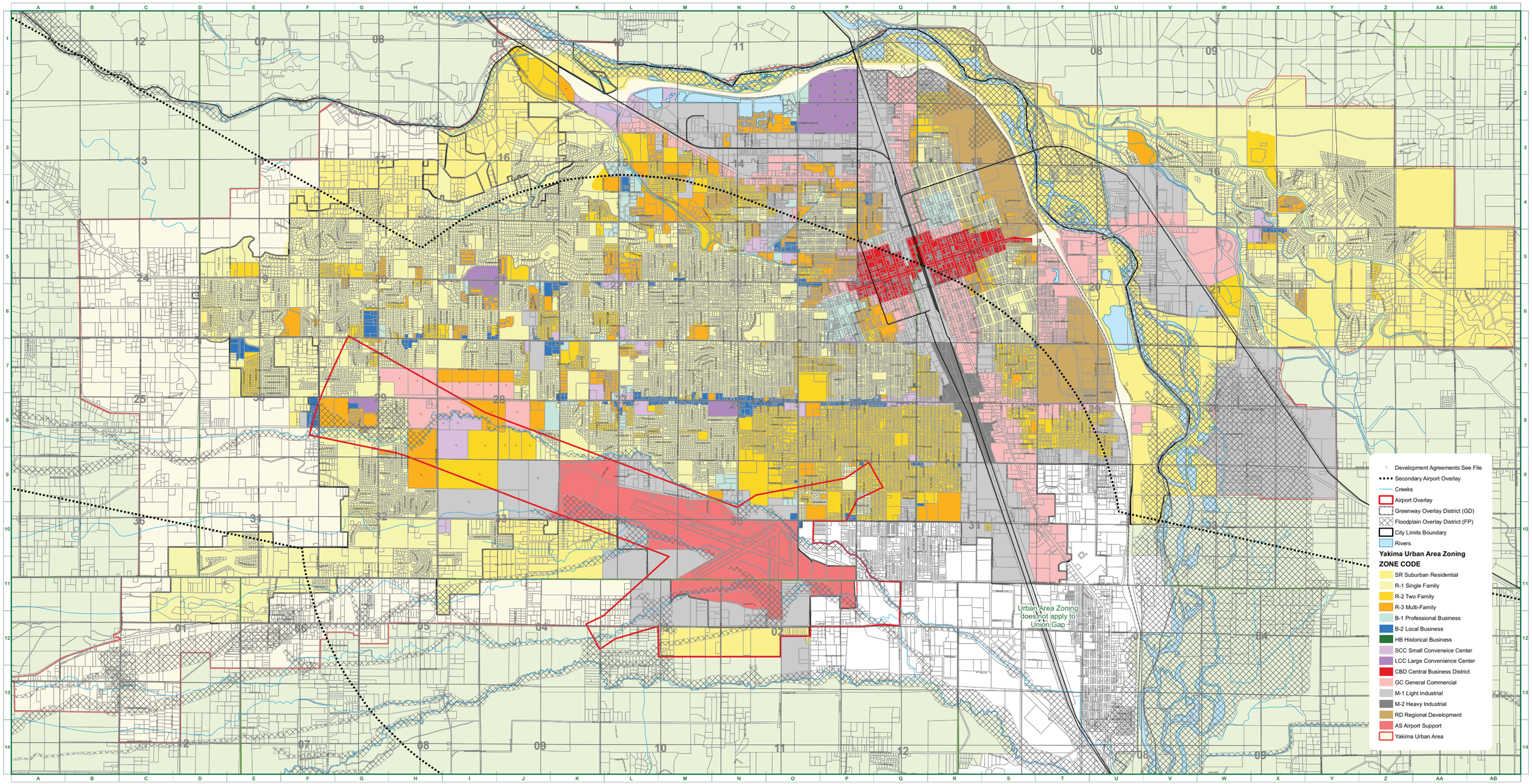
Date: 6/1/2011

Future Land Use

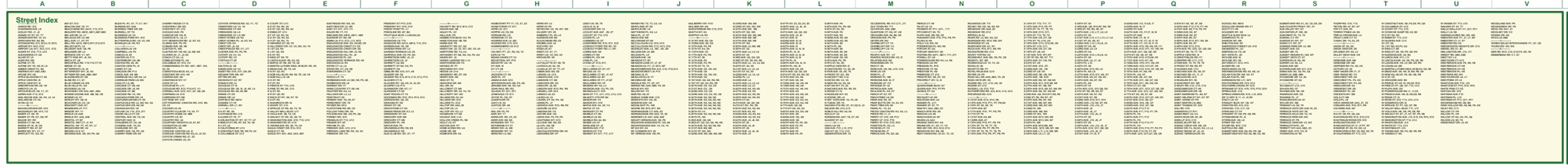
- Low Density Residential
- Medium Density Residential
- High Density residential
- Professional Office
- Neighborhood Commercial
- Community Commercial
- General Commercial
- CBD Core Commercial
- Regional Commercial
- Industrial
- Institutional
- Yakima Urban Area
- West Valley Neighborhood Plan
- Yakima City Limits

Yakima Urban Area Comprehensive Plan

Figure 2-4
Future Land Use



Street Index



Water System Plan Update
Figure 2-5
Yakima Urban Area Zoning

Parks & Recreation	575-6020
Planning & Zoning	575-6183
Police (not emergency)	575-6200
Refuse & Recycling	575-6080
Streets & Traffic	575-6005
Transit	575-6175
Cable Communications	575-6092

Emergency Police, Fire, Rescue:
DIAL 911

1 inch = 1,000 feet

MISSION
The mission of the City of Yakima is to
provide superior services and public facilities for the people, businesses and institutions within the city boundaries, or where appropriate to provide urban services, in order to enhance quality of life and economic
environment, within the community's willingness and ability to pay.

RESIDENTIAL LAND USE

The Future Land Use Map designates residential lands into three basic categories, which vary by density and permitted land uses. These include the following:

Low Density Residential - Primarily single family, detached residences. Net residential density before considering roads and right of ways is less than 7.0 dwelling units per acre, which is considered the lowest residential density to efficiently support public services.

Medium Density Residential - Characterized by a mixture of single family detached residences and duplexes, with a variety of other housing types at a residential density ranging between 7.0 and 11 dwelling units per acre.

High Density Residential - Apartments and densely developed planned residential developments ranging from 12 and above dwelling units per acre. A limited range of other land uses may be permitted, such as some professional offices and community services.

An adequate and affordable supply of housing for all income levels within the community is a major goal of the Yakima Urban Area Comprehensive Plan. To accomplish this goal, opportunities must be available for new development, but must also be balanced by the preservation of existing neighborhoods and the need to infill or redevelop some areas. As noted previously, infill will be a major factor with respect to growth occurring within the Yakima Water Service Area.

In the western portion of the Urban Service Area, residential densities are lower with scattered regions of high or medium density zoning. Currently, there is a definite lack of vacant land zoned for medium or high density residential development. It should be noted that much of the western portion of the Urban Service Area lies outside of the Yakima Water Service Area.

The Future Land Use Map identifies some new areas for high densities. A stated goal of the comprehensive plan is that housing opportunities for all income levels and housing types should be distributed throughout the Urban Service Area to balance the community needs.

COMMERCIAL LAND USE

The Future Land Use Map includes four categories of Commercial uses, which vary intensity by function and location.

Professional Office - Includes financial institutions, real estate, insurance, engineer, legal, medical offices and other similar business uses.

Neighborhood Commercial - Small scale shopping centers, with shared parking and access, usually located on arterial streets. Neighborhood commercial centers are dispersed throughout the Urban Service Area to provide convenience shopping to the residential population.

Large Convenience Center - Provides areas for commercial activities to meet retail shopping and service needs of the community and accommodates clusters of retail, financial, professional

service business and entertainment activities that attract shoppers from an area significantly larger than a neighborhood. Regional centers may be considered appropriate when they demonstrate that they will complement, and not have a detrimental impact on existing commercial areas or surrounding land uses.

Arterial Commercial - Land uses which require high auto visibility such as restaurants, service stations, car washes, as well as wholesale and retail activities.

CBD Core Commercial - The Yakima Downtown area is the regional center for commerce, cultural and governmental land uses. This area provides for a wide variety of intense retail, office, institutional, and high density residential land uses.

INDUSTRIAL DEVELOPMENT PATTERNS

The Future Land Use Map includes two categories of industrial uses, which are closely related and supportive of each other. Most of the land designated for industrial land use lies within the Yakima Water Service Area.

Wholesale /Warehouse - Quasi-industrial areas which provide for a mixture of wholesale and warehousing activities, as well as some limited office and retail land uses.

Industrial - Mixture of land uses which provide a range of activities, including construction businesses, manufacturing, transportation, communication and utilities. This zone is not appropriate for residential or high traffic generating retail land uses, which would introduce conflicting vehicular traffic into industrial areas.

Industrial development is concentrated along 1-82, Fruitvale Boulevard, North 6th Avenue and the Burlington Northern Railroad tracks, making for convenient transportation of products. The Boise Cascade plant and storage area, highly visible from the Interstate 82 system has been located at that site since the turn of the century. The Airport region continues to provide industrial opportunities for warehouse and light industrial activities.

Within the Yakima Urban Service Area there exist large areas already zoned for industrial use which have not been developed. Many of the areas currently zoned for industrial development are not desirable for immediate development, including such problems as small parcels and multiple ownerships; location in the flood plain; or remoteness from utilities and major transportation corridors. These multiple problems indicate that some of those areas should be reexamined for more suitable land uses.

Another unusual feature of the Yakima Urban Service Area is the amount of land which surrounds the railroad corridor. The railroad corridor creates a large linear pattern which bisects the entire city and limits access to adjoining land uses. Due to this fact, is difficult to maximize the development potential of much of the vacant land near the railroad corridor.

Projected Population

RCW 43.62.35 directs the Washington State Office of Financial Management (OFM) to prepare 20 year Growth Management Act (GMA) planning projections. Updates are required every five years. Each county's GMA projection is expressed as a range within a reasonable "High" & "Low" projection. Counties select a GMA planning population within the range released by OFM. This provides counties with reasonable discretion in determining a GMA planning target. Typically, ranges provided by OFM are as much as 15% higher than the middle projection on the high side, and 14% lower on the low side. County projections are developed within the state "high, "intermediate," and "low" projection series. That is, the sum of the counties in each projections series (high, intermediate, and low) needs to add to the state total. It is the responsibility of county and city governments in each county to allocate the projected planning population to the cities and unincorporated area in their county. The Low, Intermediate, and High series OFM GMA projections for Yakima County through 2030 are shown in Table 2-23, below.

Table 2-23 Projections of the Yakima County Resident Population for the Growth Management Act (Source: OFM/Forecasting 2010)

	2010	2015	2020	2025	2030
Low Series	224,303	233,240	240,233	245,929	249,601
Intermediate Series	241,446	257,867	272,992	287,468	300,362
High Series	259,917	283,847	307,116	330,373	352,476

As discussed in Section 2.1, above, the population of the City of Yakima water service area was estimated using the City's GIS and the 2000 Census population figures for each of the census blocks by overlapping the water service area boundaries with the census block boundaries and population data. The population within the entire service area, as well as the populations within the individual pressure zones, was estimated in this manner. As indicated by the number of connections in each customer class, the volume of metered use, and the total amount of water supplied, it does not appear that any significant growth has occurred in the Yakima Water System service area since the 2004 Water System Plan Update was completed. For the purpose of this water system plan update, the population data developed from the 2000 Census information will be used. The 2010 Census data will not be available until sometime in 2011 and it appears from the water system supply and use data that little or no growth has occurred within the water service area between 2000 and 2010. The distribution of use among the individual pressure zones also appears to be little changed. In the previous plan it was assumed that growth within the water system service area would occur at the same rate as the growth within the entire county. This was considered to be a reasonable approach because the OFM projections are not formulated below the countywide level, and because even though the water service area is not expanding significantly, the implementation of GMA should encourage greater in-fill and population growth within the existing service area boundaries.

The projected populations within the service area under the Low, Intermediate, and High GMA projections are presented in Tables 2-24, 2-25, and 2-26, respectively.

Table 2-24 City of Yakima Water Service Area Population Projections by Pressure Zone based on the OFM GMA Low Series Projections for Yakima County

	2010	2015	2020	2025	2030
Level 1	**50,962**	**52,993**	**54,581**	**55,875**	**56,710**
Level 2	**12,024**	**12,503**	**12,878**	**13,183**	**13,380**
Level 3	**2,052**	**2,134**	**2,198**	**2,250**	**2,283**
Totals	**65,038**	**67,629**	**69,657**	**71,309**	**72,373**

Table 2-25 City of Yakima Water Service Area Population Projections by Pressure Zone based on the OFM GMA Intermediate Series Projections for Yakima County

	2010	2015	2020	2025	2030
Level 1	**50,962**	**54,428**	**57,620**	**60,676**	**63,397**
Level 2	**12,024**	**12,842**	**13,595**	**14,316**	**14,958**
Level 3	**2,052**	**2,192**	**2,320**	**2,443**	**2,553**
Totals	**65,038**	**69,461**	**73,536**	**77,435**	**80,908**

Table 2-26 City of Yakima Water Service Area Population Projections by Pressure Zone based on the OFM GMA High Series Projections for Yakima County

	2010	2015	2020	2025	2030
Level 1	**50,962**	**55,654**	**60,216**	**64,776**	**69,110**
Level 2	**12,024**	**13,131**	**14,207**	**15,283**	**16,306**
Level 3	**2,052**	**2,241**	**2,425**	**2,608**	**2,783**
Totals	**65,038**	**71,026**	**76,848**	**82,668**	**88,199**

Projected Water Demands

To adequately serve customers throughout the planning period, population and water demand forecasts of future needs should be conservative enough to ensure that sufficient water will be

available to meet those needs as growth occurs. In the previous water system plan update, only the Intermediate and High OFM population projections were be considered in estimating future water demands. This assumption clearly overestimated the growth in water demand within the service area. However, it is still reasonable to assume that GMA and other factors will lead to increased in-fill and development with the Yakima Water System Service Area.

For the current Water System Plan Update, future water demands will be projected based on the following assumptions:

Level 1 and Level 2 - Residential population growth in these two pressure zones will be projected at the **Low** OFM GMA Projections for Yakima County.

Level 3 - Residential population growth in this pressure zone will be projected at the **Intermediate** OFM GMA Projections for Yakima County. The slightly higher growth rate in this zone reflects the fact that it covers a newer portion of the City with more developable land than is available in Level 1 and Level 2.

Commercial and Industrial – The water demands in the Commercial and Industrial Customer Classes will be projected to grow at the **Intermediate** OFM GMA Projections for Yakima County. The commercial and industrial land use zones serve the entire urban area and the County population as a whole so it is reasonable to assume that the growth in demand in these categories will reflect the countywide population increase which is projected by OFM.

Governmental and other minor customer classes – The water demands in the Governmental and other minor customer classes will be projected to grow at the Intermedia**te** OFM GMA Projections for Yakima County. Like the commercial and industrial customer classes, these functions serve the entire urban area and the County population as a whole so it is reasonable to assume that the growth in demand in these categories will reflect the countywide population increase which is projected by OFM.

Based on the assumptions outlined above, the projected populations in each pressure zone which will be used to estimate water demand through the planning period are summarized in Table 2-27.

Table 2-27 City of Yakima Water Service Area Population Projections by Pressure Zone based on the OFM GMA Projections for Yakima County					
	2010	**2015**	**2020**	**2025**	**2030**
Level 1 (Low GMA)	**50,962**	**52,993**	**54,581**	**55,875**	**56,710**
Level 2 (Low GMA)	**12,024**	**12,503**	**12,878**	**13,183**	**13,380**
Level 3 (Intermediate GMA)	**2,052**	**2,192**	**2,320**	**2,443**	**2,553**
Totals	**65,038**	**67,688**	**69,779**	**71,501**	**72,643**

Residential water demand forecasts have been calculated for each zone based on the per capita consumption estimates presented in Table 2-19. For the purpose of these projections, the combined single family and multifamily per capita use figures from Table 2-19 are used. This assumes that the relative proportion of single family and multi family residential population and the per capita usages by zone will not change significantly over the planning period. Commercial and industrial water demand projections are based on historic usage data and growth rates proportional to the OFM Intermediate Series population projections.

Estimated residential, commercial, industrial, governmental and other minor user classes average day demands based on the applicable OFM population projections are presented in Tables 2-28 through 2-31, respectively, and summarized in Table 2-32.

Table 2-28 Residential Water Demand Projections

Level 1 and Level 2 water demand projections based on the OFM GMA Low Series Population Projections for Yakima County (ADD in gpd)					
	2010	**2015**	**2020**	**2025**	**2030**
Level 1	4,245,135	4,414,317	4,546,597	4,654,388	4,723,943
Level 2	1,363,522	1,417,840	1,460,365	1,494,952	1,517,292
Residential Water Demand Projections for Level 3 based on the OFM GMA Intermediate Series Population Projections for Yakima County (ADD in gpd)					
Level 3	464,778	496,488	525,480	553,340	578,255
Totals	6,073,434	6,328,645	6,532,443	6,702,679	6,819,490

Table 2-29 Forecast Commercial use average day demand based on <u>Intermediate Series</u> OFM population forecast (includes Commercial Irrigation demands).					
	2010	**2015**	**2020**	**2025**	**2030**
Forecast annual Commercial use (100 ft^3)	1,579,183	1,686,924	1,785,431	1,880,089	1,964,743
Avg. Annual Commercial Irrigation use (100 ft^3)	469,670	501,714	531,011	559,164	584,341
Total forecast annual Commercial use (gpd)	2,048,853	2,188,638	2,316,442	2,439,253	2,549,085
Level 1 commercial use forecast (gpd) [1]	4,198,745	4,485,209	4,747,119	4,998,799	5,223,878
Level 2 commercial use forecast (gpd) [1]	3,149,059	3,363,907	3,560,340	3,749,099	3,917,908
Level 3 commercial use forecast (gpd) [1]	1,049,686	1,121,302	1,186,780	1,249,700	1,305,969
[1]Commercial use prorated among pressure zones based on percentages in Table 2-11.					

Table 2-30 Forecast Industrial use average day demand based on <u>Intermediate Series</u> OFM population forecast.					
	2010	**2015**	**2020**	**2025**	**2030**
Total forecast annual Industrial use (100 ft^3)	389,614	416,196	440,499	463,853	484,739
Total forecast annual Industrial use (gal/day)	798,442	852,916	902,721	950,581	993,383
Level 1 Industrial use forecast gal/day [1]	798,442	852,916	902,721	950,581	993,383
Level 2 Industrial use forecast gal/day [1]	—	—	—	—	—
Level 3 Industrial use forecast gal/day [1]	—	—	—	—	—
[1] Industrial use prorated among pressure zones based on percentages in Table 2-11.					

Table 2-31 Forecast average day demand for Governmental and other minor Customer Classes based on Intermediate Series OFM population forecast .					
	2010	**2015**	**2020**	**2025**	**2030**
Forecast annual Governmental use (100 ft^3)	85,709	91,557	96,903	102,041	106,635
Forecast Other minor user classes (100 ft^3)	44,673	47,721	50,507	53,185	55,580
Estimated other authorized use, street flushing, fire, etc. (100ft^3)	311,566	332,823	352,258	370,934	387,635
Totals (100 ft^3)	441,948	472,100	499,668	526,159	549,850
Forecast of other use (gpd)	905,690	967,482	1,023,977	1,078,266	1,126,817
Level 1 Government and other use forecast (gpd) [1]	679,268	725,612	767,983	808,699	845,112
Level 2 Government and other use forecast (gpd) [2]	226,423	241,871	255,994	269,566	281,704
Level 3 Government and other use forecast (gpd) [3]	—	—	—	—	—

[1] Assumes 75% of Government and other use will be in Level 1
[2] Assumes 25% of Government and other use will be in Level 2
[3] No Government and other use occurs in Level 3

Table 2-32 Forecast total average day demand (ADD) 2010 through 2030					
	2010	**2015**	**2020**	**2025**	**2030**
Level 1 Forecast Average Day Demand Use (gpd) *	8,871,903	9,356,752	9,777,642	10,162,767	10,480,346
Level 2 Forecast Average Day Demand Use (gpd) *	3,438,072	3,633,929	3,805,861	3,964,800	4,098,348
Level 3 Forecast Average Day Demand Use (gpd) *	464,778	496,488	525,480	553,340	578,255
Total Forecast Average Day Demand Use (gpd) *	12,774,753	13,487,169	14,108,982	14,680,906	15,156,949

For the purpose of comparison to the demand projections based on the Intermediate and High Series OFM population projections, a linear regression analysis of the historic water usage data from 1977 to 2000 was also carried out and the results shown graphically in Figure 2-6. The linear regression projection and the demand projections from the OFM population data are presented together for comparison in Figure 2-7.

Figure 2-6 Average Day Demand (MGD) 1977 to 2009 and Forecast Average Day Demand to 2030

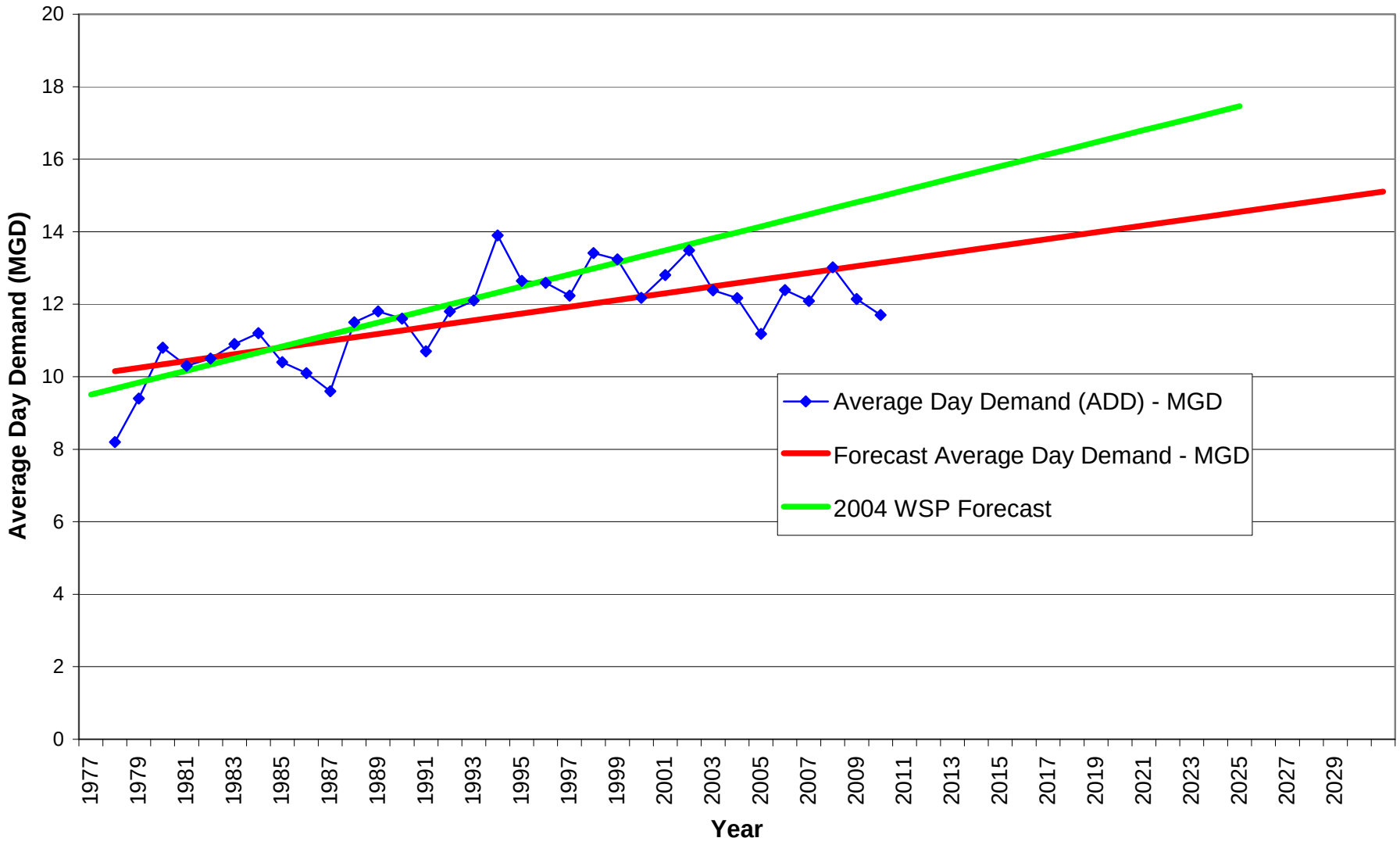
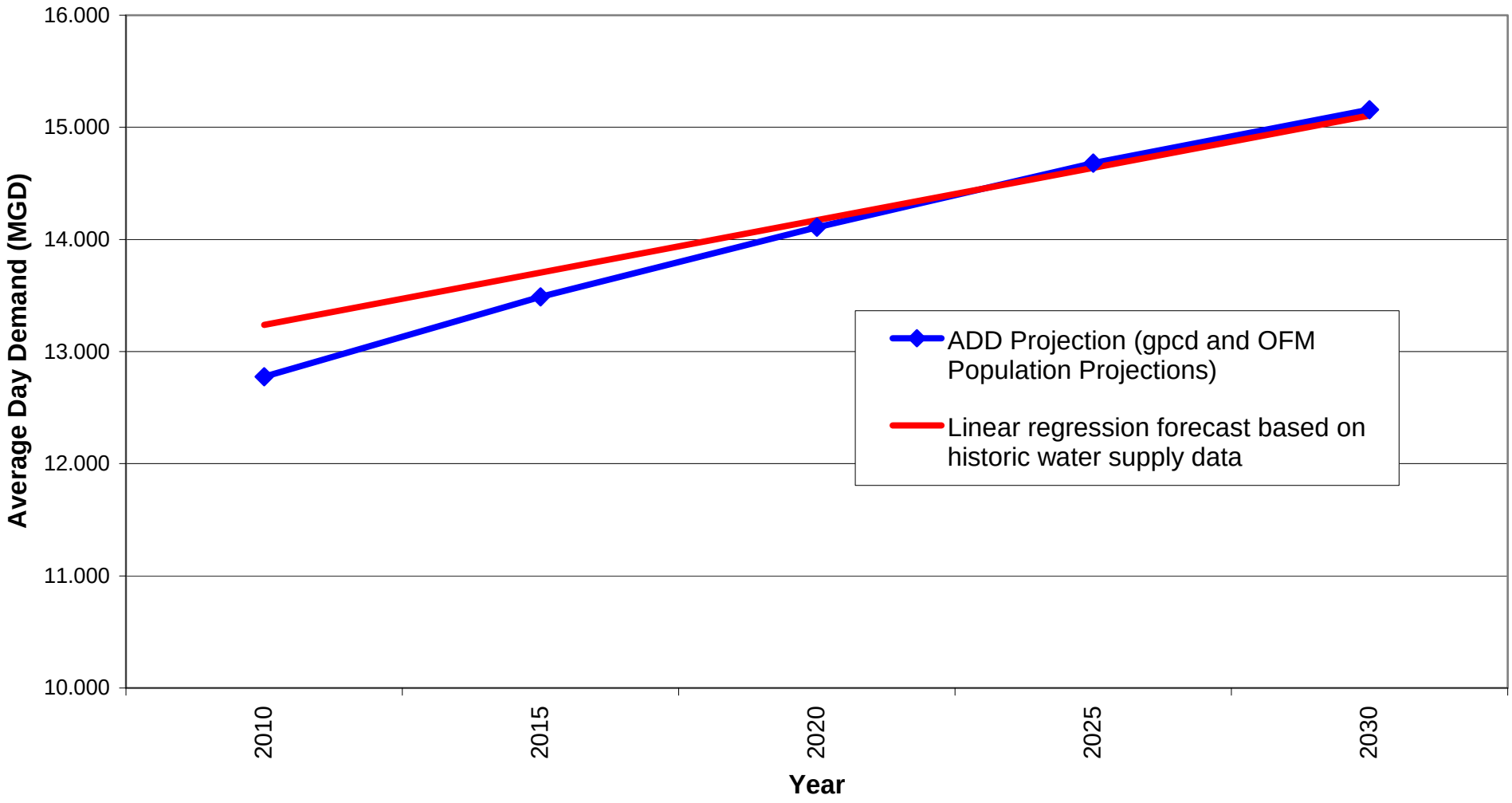
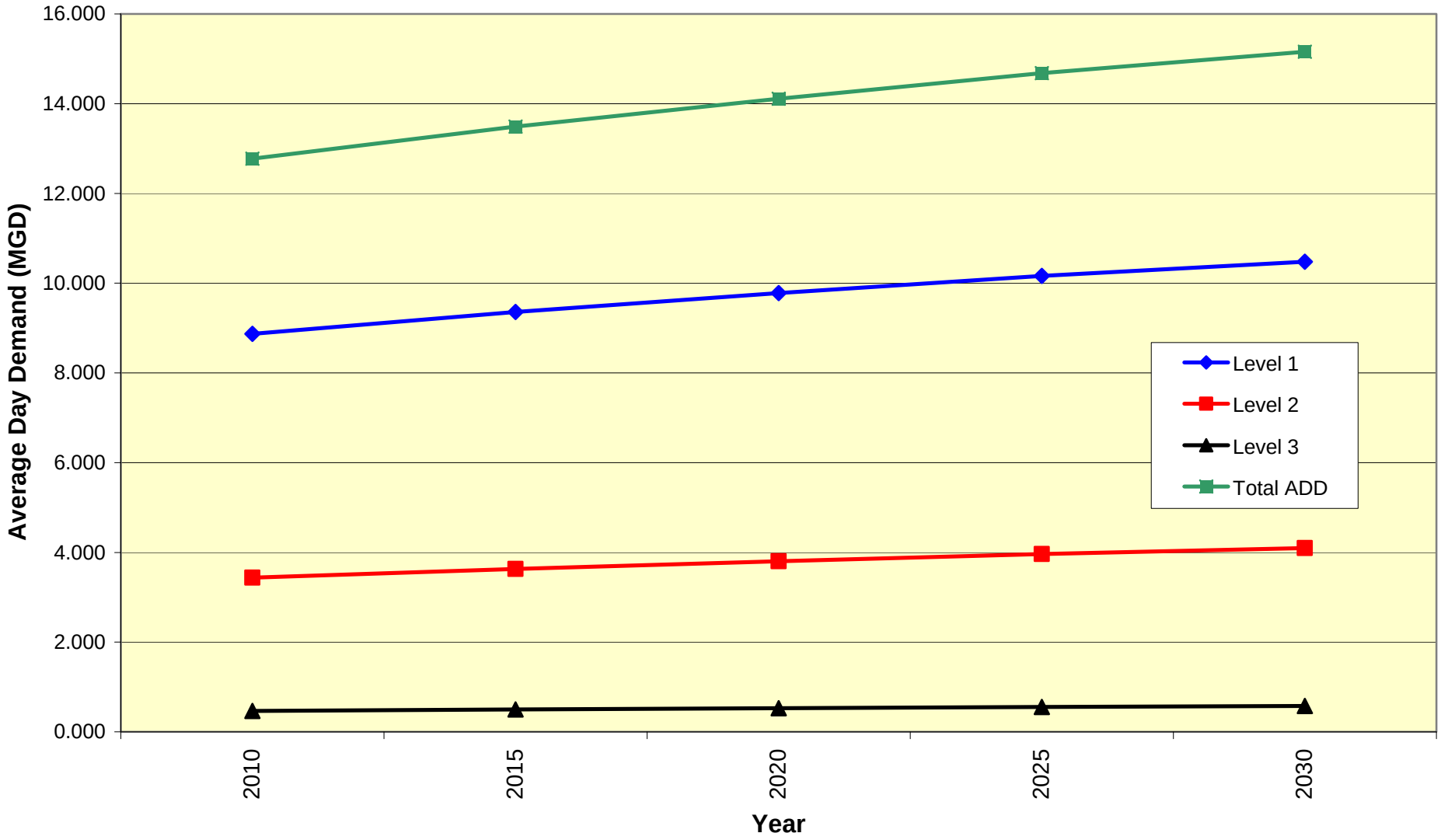


Figure 2-7 Comparison of ADD forecasts based on GMA population projection to linear regression forecast from 1977 to 2009 water supply data



As can be seen in Figure 2-7, the linear regression plot projecting future demand from the historical water use data from 1977 to 2009 most closely matches the demand estimates generated from the OFM population estimates using the assumptions for the different customer classes which were described above.

Figure 2-8 ADD Forecasts by Zone based on Table 2--32



Maximum Day and Peak Hour Water Demands

The maximum day demand (MDD) for each year from 1994 through 2000 is shown in Table 2-33. Also shown in this table are the ADDs for each year and the ratio of the MDD to ADD.

Table 2-33 Maximum Day Demands from 1994 through 2009 and MDD/ADD Ratios

Year	MDD (MGD)	Date of MDD	ADD (MGD)	MDD/ADD ratio
1994	20.777	7/23/1994	12.62	1.646
1995	19.895	7/31/1995	12.57	1.583
1996	21.860	7/16/1996	12.23	1.787
1997	23.033	5/19/1997	13.84	1.664
1998	26.176	7/28/1998	13.27	1.973
1999	21.517	6/17/1999	12.37	1.739
2000	22.854	8/2/2000	13.06	1.750
2001	21.128	8/16/2001	12.906	1.64
2002	20.410	7/19/2002	12.400	1.65
2003	24.386	7/26/2003	12.192	2.00
2004	23.924	7/15/2004	11.190	2.14
2005	19.862	7/27/2005	12.403	1.60
2006	21.014	8/9/2006	12.095	1.74
2007	22.998	8/2/2007	13.051	1.76
2008	20.300	8/7/2008	12.147	1.67
2009	20.420	8/1/2009	11.720	1.74
Average				**1.75**

The average of the MDD to ADD ratio is 1.75. For the purpose of projecting maximum day demands through the planning period, the MDD/ADD ratio will assumed to be 1.75. The projected maximum day demands through the planning period are shown in Table 2-34.

Table 2-34 Forecast total Maximum Day Demand (MDD) 2010 through 2030					
	2010	**2015**	**2020**	**2025**	**2030**
Level 1 Forecast Maximum Day Demand Use (gpd)	15,525,830	16,374,316	17,110,873	17,784,843	18,340,606
Level 2 Forecast Maximum Day Demand Use (gpd)	6,016,626	6,359,376	6,660,257	6,938,399	7,172,109
Level 3 Forecast Maximum Day Demand Use (gpd)	813,362	868,854	919,590	968,344	1,011,945
Total Forecast Maximum Day Demand Use (gpd)	22,355,818	23,602,546	24,690,719	25,691,586	26,524,661

The peak hour demands (PHDs) corresponding to the maximum demand days in the years 2002 to 2009 were estimated by graphing the moving average the instantaneous demands observed on those days. The instantaneous demands were calculated from the water treatment plant supply and well pumping data together with the reservoir level data for each zone. This data is available from the WTP SCADA system archive records at approximately 3 minute increments. Moving averages of the calculated instantaneous demands were taken to account for the inherent inaccuracies in the instantaneous reservoir data readings which results in excessive fluctuations in single point calculations. The highest observed peak hour demands and the corresponding PHD to MDD ratios are summarized in Table 2-35, below.

Table 2-35 Observed PHDs and PHD to MDD Ratios for highest PHDs from 2002 to 2009			
Date	**MDD (MGD)**	**PHD (MGD)**	**PHD/MDD ratio**
7/25/2003	24.259	34.18	1.41
7/26/2003	24.386	32.96	1.35
7/28/2003	23.776	32.39	1.36
7/26/2006	21.494	32.25	1.50
8/9/2006	22.733	32.58	1.43
8/3/2007	22.428	33.45	1.49
		Average	1.42

In the previous water system plan update (2004) the observed average PHD/MDD ratio was approximately 1.6. Data for the current planning period show PHD/MDD ratios in the 1.4 to 1.5 range. The DOH formula, as presented below, also results in an estimated PHD to MDD ratio

of 1.6 consistent with the earlier historical data. The ratio of 1.6 is, therefore, a conservative estimate and will be used for planning projections in the current Water System Plan Update.

The generalized equation for PHD determinations from the Washington State Department of Health *Water System Design Manual* (DOH #331-123) is:

$$PHD = (MDD/1440) \times [(C) \times (N) + F] + 18 \text{ (Equation 5-3 from DOH \#331-123)}$$

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

Table 2-36 (Table 5-1 from DOH #331-123) identifies the appropriate coefficients and factors to substitute into Equation 5-3 for the ranges of ERUs:

Table 2-36 Factors and Coefficients for Equation 5-3 from DOH #331-123

Range of N (ERUs)	C	F
15 - 50	3.0	0
51 - 100	2.5	25
101 - 250	2.0	75
251 - 500	1.8	125
> 500	1.6	225

From examination of DOH Equation 5-3 it is apparent that as the number of ERUs in the system becomes large with respect to 500 (as is the case with the City of Yakima water system which has in excess of 50,000 ERUs) the equation can be approximated by:

$$PHD = 1.6 \times MDD$$

The use of a PHD to MDD ratio of 1.6 for the projection of future peak hour demands as suggested by the DOH design manual is entirely consistent with historical data for the Yakima water system as shown in Table 2-36. This ratio has, therefore, been used to project the peak hour demands through the year 2025 as presented in Table 2-37, below.

Table 2-37 Forecast total Peak Hour Demand (PHD) 2010 through 2030					
	2010	**2015**	**2020**	**2025**	**2030**
Level 1 Peak Hour Demand (gpd)	24,841,328	26,198,905	27,377,396	28,455,748	29,344,970
Level 2 Peak Hour Demand (gpd)	9,626,602	10,175,002	10,656,411	11,101,439	11,475,375
Level 3 Peak Hour Demand (gpd)	1,301,378	1,390,166	1,471,344	1,549,351	1,619,113
Total Peak Hour Demand (gpd)	35,769,309	37,764,073	39,505,151	41,106,538	42,439,458

Chapter 3

System Analysis

3 System Analysis

3.1 System Design Standards

The purpose of this section is to identify and describe the design standards which apply to the City of Yakima Water System. Standards which are incorporated by reference include the Washington State Department of Health *Water System Design Manual* (DOH #331-123, December 2009, or latest edition) and Chapter 246-290 WAC Group A *Public Water Supplies* (January 4, 2010 update, or latest revision).

Specific design standards applicable to the City of Yakima Water System established and listed in this Water System Plan Update include:

- Water Quality Standards;
- Average and Maximum Daily Demands;
- Peak Hour Demand;
- Storage Requirements;
- Fire Flow Rate and Duration;
- Minimum System Pressure;
- Minimum Pipe Sizes;
- Telemetry Systems;
- Backup Power Requirements;
- Valve and Hydrant Spacing; and
- Other System Policies and Design Standards (e.g. Looping).

Water Quality Standards

The 1974 Safe Drinking Water Act (SDWA) and its 1986 and 1996 amendments established specific legislation for regulation of public water systems by federal and state governments. The US Environmental Protection Agency (EPA), is authorized to develop national drinking water regulations and oversee the implementation of the SDWA. Once federal regulations become effective, the states may adopt the federal law as state law and accept the primary responsibility for implementation and enforcement of the law.

The State of Washington has adopted as state law all of the SDWA regulations promulgated by the EPA. The State has delegated the authority to oversee drinking water regulations to the State Department of Health (DOH). State drinking water regulations are published in WAC 246-290, which establishes monitoring requirements, maximum contaminant levels, and requirements for follow-up actions.

Minimum standards for water quality are often specified in terms of Maximum Contaminant Levels (MCLs). Primary MCLs are based on chronic and/or acute human health effects. Secondary MCLs are based on factors other than health effects, such as the aesthetic quality of the water. Maximum Contaminant Level Goals (MCLGs) are based on 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 and are non-enforceable public health goals. Public water purveyors have the responsibility of meeting the requirements of the regulations on a day-to-day basis. Monitoring requirements are often established for regulated contaminants to ensure that water systems demonstrate compliance with MCLs or treatment technique requirements. Public water suppliers are also required to retain certain records and submit reports to the DOH.

Microorganisms - Indicator organisms are often used to test for bacterial and other microbial contamination in drinking water. Total coliform, fecal coliform, and *E. Coli* are typical indicator organisms. The absence of coliform bacteria generally assures the water purveyor that pathogenic bacteria are not present. WAC 246-290 establishes bacteriological requirements for public water systems. Compliance with this rule is based on the presence/absence of total coliforms. Monitoring requirements and schedules are provided in the City's Coliform Monitoring Plan. A copy of the Coliform Monitoring Plan is included in Appendix H. Samples are collected to cover each pressure zone, reservoir outfall, and source distribution area. The monitoring program specifies the collection of samples on a rotating basis, such that the sites are re-sampled each quarter.

The current MCLs and MCLGs pertaining to microbiological water quality standards are summarized in Table 3-1, below.

Table 3-1 National Primary Drinking Water Standards for Microbial Contaminants

Microorganisms	**MCLG**	**MCL or Treatment Technique (TT)**
Cryptosporidium	zero	99% removal (as of1/1/02 for systems serving >10,000 and 1/14/05 for systems serving<10,000).
Giardia lamblia	zero	99.9% removal/inactivation
Heterotrophic plate count (HPC)	n/a	No more than 500 bacterial colonies per milliliter.
Legionella	zero	No limit, but EPA believes that if Giardia and viruses are removed/inactivated, Legionella will also be controlled.
Total Coliforms (including fecal coliform and E. Coli)	zero	No more than 5.0% samples total coliform-positive in a month. Every sample that has total coliform must be analyzed for either fecal coliforms or E. coli if two consecutive TC-positive samples, and one is also positive for E.coli fecal coliforms, system has an acute MCL violation.
Turbidity	n/a	As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
Viruses (enteric)	zero	99.99% removal/inactivation

Disinfection By-products (DBPs) – DBPs, including trihalomethanes (THMs) and haloacetic acids (HAA5) are a group of organic compounds that can be formed as a result of drinking water disinfection by oxidants such as chlorine, chlorine dioxide and ozone.

The current MCLGs and MCLs for disinfection by-products are summarized in Table 3-2, below.

Table 3-2 National Primary Drinking Water Standards for Disinfection By-products

Disinfection Byproducts	MCLG (mg/L)	MCL (mg/L)
Bromate	zero	0.010
Chlorite	0.8	1.0
Haloacetic acids (HAA5)	bromoform (zero); dibromochloromethane (0.06 mg/L)	0.060
Total Trihalomethanes (TTHMs)	dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)	0.080

Residual Disinfectants - Water in the distribution system must maintain a residual disinfectant concentration of total free chlorine of at least 0.2 mg/L. Distribution system residual disinfectant Concentrations, measured as total free chlorine, must be detectable in at least 95 percent of the samples taken each calendar month. For groundwater systems that are required to disinfect, systems are required to have a CT (concentration of chlorine (mg/l) multiplied by contact time (min)) of 6 in accordance with WAC 246-260-451. Residual disinfectant concentration within the distribution system is measured at the same time and location that routine coliform samples are collected.

The current Maximum Residual Disinfectant Level Goals (MRDLGs) and Maximum Residual Disinfectant Levels (MRDLs) for disinfection by-products are summarized in Table 3-3, below.

Table 3-3 National Primary Drinking Water Standards for Disinfection Residuals

Disinfectant	MRDLG (mg/L)	MRDL (mg/L)
Chloramines (as Cl2)	4	4
Chlorine (as Cl2)	4	4
Chlorine dioxide (as ClO2)	0.8	0.8

Lead And Copper - The EPA published the final regulations for the Lead and Copper Rule (LCR) in 1991 as part of the 1986 Safe Drinking Water Amendments. LCR is intended to reduce tap water concentrations of lead and copper. LCR requires an initial monitoring phase in which two rounds of water sampling for lead and copper are conducted. Lead samples, collected according to 40 CFR, must have concentrations below the 'Action Level' of 0.015 mg/L in the 90th percentile. Similarly, copper samples must have concentrations less than 1.3 mg/L in the 90th percentile. Systems exceeding the action levels are required to implement corrosion control measures. The MCLG for lead is zero and, the MCLG for copper is 1.3 mg/L.

IOCs, VOCs and SOCs- The State of Washington has adopted Federal MCLs and monitoring regulations for inorganic chemicals and physical parameters (IOCs), volatile organic compounds (VOCs), and synthetic organic compounds (SOCs). The Federal standards were originally promulgated in the Phase I Rule and updated in the Phase II and Phase V rules.

The current MCLGs and MCLs for IOCs, VOCs and SOCs are presented in Tables 3-4, 3-5, and 3-6, below.

The City of Yakima's monitoring plans for inorganic chemicals, organic chemicals, radionuclides, disinfection/disinfection by-products, and turbidity/free chlorine residual/pH are included in this plan as Appendices I, J, K, L, and M.

Table 3-4 Inorganic Chemical Primary MCLs and MCLGs		
Substance	**MCLG (mg/L)**	**MCL (mg/L)**
Antimony (Sb)	0.006	0.006
Arsenic (As)	zero	0.01 (as of 1/23/06)
Asbestos (fiber >10 μm long)	7 million fibers/liter	7 million fibers/liter
Barium (Ba)	2.0	2.0
Beryllium (Be)	0.004	0.004
Cadmium (Cd)	0.005	0.005
Chromium -Total (Cr)	0.1	0.1
Copper (Cu)	1.3	1.3 (note 1)
Cyanide (HCN)	0.2	0.2
Fluoride (F)	4.0	4.0
Lead (Pb)	zero	0.015 (note 1)
Mercury (Hg)	0.002	0.002
Nickel (Ni)	0.1	0.1
Nitrate (as N)	10.0	10.0
Nitrite (as N)	1.0	1.0
Selenium (Se)	0.05	0.05
Sodium (Na)	n/a	20 (note 2)
Thallium (Tl)	0.0005	0.002

Note 1 – MCL not established, however lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.
Note 2 – MCL not established, however EPA has also established a recommended level of twenty mg/L for sodium as a level of concern for those consumers that may be restricted for daily sodium intake.

Table 3-5 Volatile and Synthetic Organic Chemical Primary MCLGs and MCLs		
Substance	**MCLG (mg/L)**	**MCL (mg/L)**
Acrylamide	zero	TT [1]
Alachlor	zero	0.002
Atrazine	0.003	0.003
Benzene	zero	0.005
Benzo(a)pyrene (PAHs)	zero	0.0002
Carbofuran	0.04	0.04
Carbon tetrachloride	zero	0.005
Chlordane	zero	0.002
Chlorobenzene	0.1	0.1
2,4-D	0.7	0.7
Dalapon	0.2	0.2
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002
o-Dichlorobenzene	0.6	0.6
p-Dichlorobenzene	0.075	0.075
1,2-Dichloroethane	zero	0.005
1,1-Dichloroethylene	0.007	0.007
cis-1,2-Dichloroethylene	0.07	0.07
trans-1,2-Dichloroethylene	0.1	0.1
Dichloromethane.	Zero	0.005
1,2-Dichloropropane	zero	0.005
Di(2-ethylhexyl) adipate	0.4	0.4
Di(2-ethylhexyl) phthalate	zero	0.006
Dinoseb	0.007	0.007
Dioxin (2,3,7,8-TCDD)	zero	0.00000003
Diquat	0.02	0.02
Endothall	0.1	0.1
Endrin	0.002	0.002

Table 3-6 Volatile and Synthetic Organic Chemical Primary MCLGs and MCLs (cont.)		
Substance	**MCLG (mg/L)**	**MCL (mg/L)**
Epichlorohydrin	zero	TT [1]
Ethylbenzene	0.7	0.7
Ethylene dibromide	zero	0.00005
Glyphosate	0.7	0.7
Heptachlor	zero	0.0004
Heptachlor epoxide	zero	0.0002
Hexachlorobenzene	zero	0.001
Hexachlorocyclopentadiene	0.05	0.05
Lindane	0.0002	0.0002
Methoxychlor	0.04	0.04
Oxamyl (Vydate)	0.2	0.2
Polychlorinated biphenyls(PCBs)	zero	0.0005
Pentachlorophenol	zero	0.001
Picloram	0.5	0.5
Simazine	0.004	0.004
Styrene	0.1	0.1
Tetrachloroethylene	zero	0.005
Toluene	1	1
Toxaphene	zero	0.003
2,4,5-TP (Silvex)	0.05	0.05
1,2,4-Trichlorobenzene	0.07	0.07
1,1,1-Trichloroethane	0.2	0.2
1,1,2-Trichloroethane	0.003	0.005
Trichloroethylene	zero	0.005
Vinyl chloride	zero	0.002
Xylenes (total)	10	10

[1] When acrylamide and epichlorohydrin are used in drinking water systems, the combination of dose and monomer level shall not exceed: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

Radionuclides - The current radionuclide MCLs as defined be WAC 246-290 are shown in Table 3-7. EPA published the final version of the Radionuclide Rule on December 7, 2000 which revised the radionuclide MCLs. The radionuclide MCLs which will be in place after the new rule becomes effective are shown in Table 3-8. The effective date of the final Radionuclide Rule is December 8, 2003 for systems that have begun initial monitoring under state-specified monitoring plan, unless the state permits the use of grandfathered data, and December 31, 2007 for all systems, including those using grandfathered data.

Table 3-7 Current Radionuclide MCLs from WAC 246-290

Radionuclide	**MCLG (pCi/L)[1]**	**MCL (pCi/L)[1]**
Radium-226	n/a	3
Combined Radium-226 and Radium-228	n/a	5
Gross alpha particle activity excluding Uranium	n/a	15
Beta particle and photon radioactivity from man made radionulclides	n/a	4 millirem/year

[1] pCi/L = picocuries per liter

Table 3-8 Radionuclide MCLGs and MCLs from EPA Radionuclide Rule

Radionuclide	**MCLG**	**MCL**
Beta/photon emitters [2]	zero	4 millirem/year
Gross alpha particle	zero	15 pCi/L [1]
Combined Radium-226 and Radium-228	zero	5 pCi/L [1]
Uranium	zero	30 µg/L

[1] pCi/L = picocuries per liter
[2] A total of 168 individual beta particle and photon emitters may be used to calculate compliance with the MCL.

Secondary Drinking Water Contaminants - National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. The secondary standards as established by EPA and adopted by the Washington State DOH are presented in Table 3-9.

Table 3-9 National Secondary Drinking Water Contaminants

Contaminant	**Secondary MCL**
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Average and Maximum Daily Demands

The average daily demand (ADD) and the maximum daily demand (MDD) projections based on the basic planning data presented in Chapter 2 are shown in Figures 3-1 and 3-2, respectively. The MDD is estimated as 1.75 times the ADD based on historical data. The 2016 (6 year) and 2030 (20 year) ADD and MDD projections for each pressure zone were determined graphically from the demand projection curves in these figures. These ADD and MDD projections are summarized in Table 3-10 and Table 3-11, respectively.

Table 3-10 Projected 6 year and 20 year Average Daily Demands in MGD

Pressure Zone	2016 (6 year) projection	2030 (20 year) projection
Level 1	9.44	10.48
Level 2	3.67	4.10
Level 3	0.50	0.58
Total	13.61	15.16

Table 3-11 Projected 6 year and 20 year Maximum Daily Demands in MGD

Pressure Zone	2016 (6 year) projection	2030 (20 year) projection
Level 1	16.52	18.34
Level 2	6.42	7.17
Level 3	0.88	1.01
Total	23.82	26.52

Figure 3-1 Projected Average Day Demand through 2030

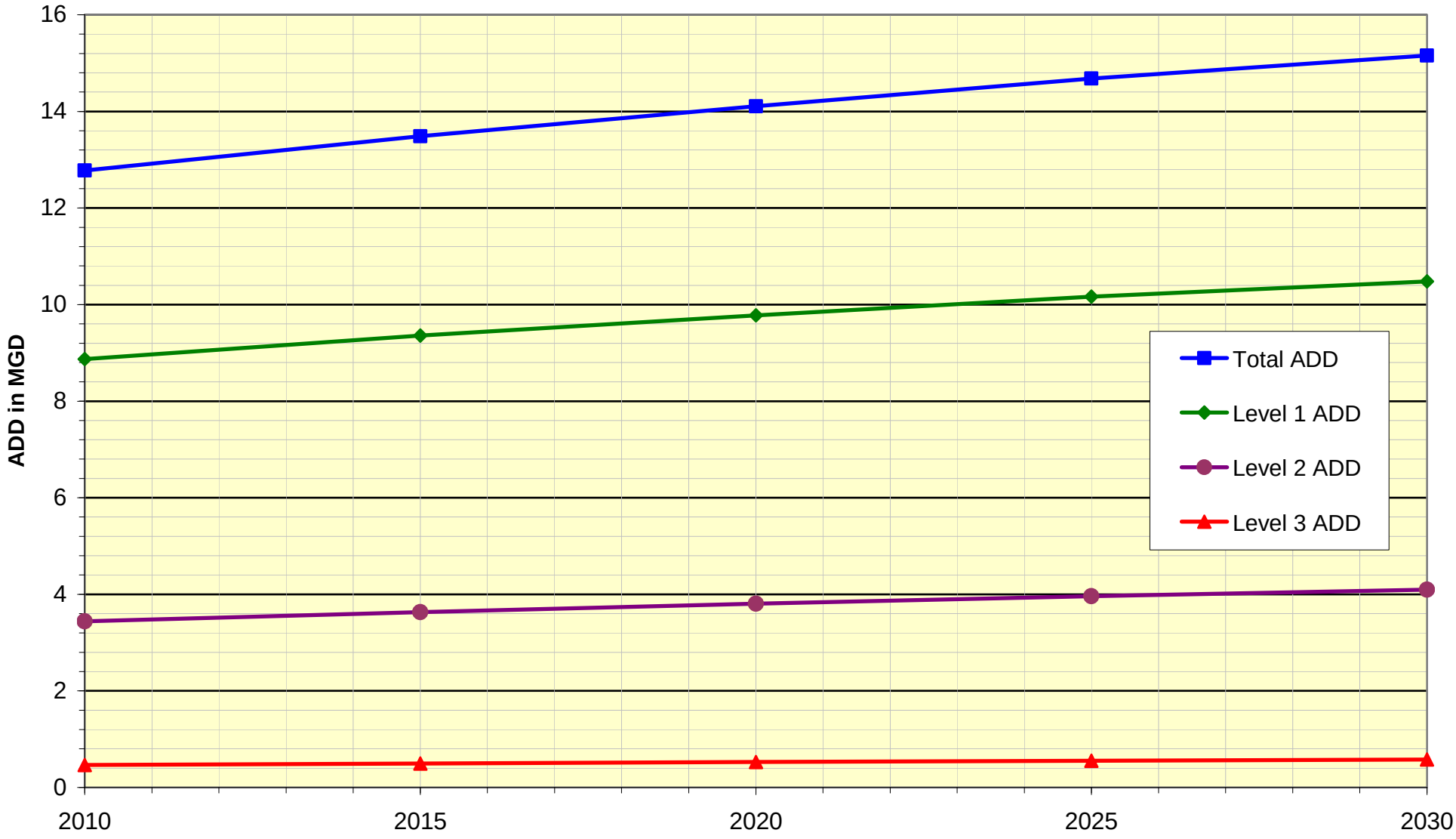
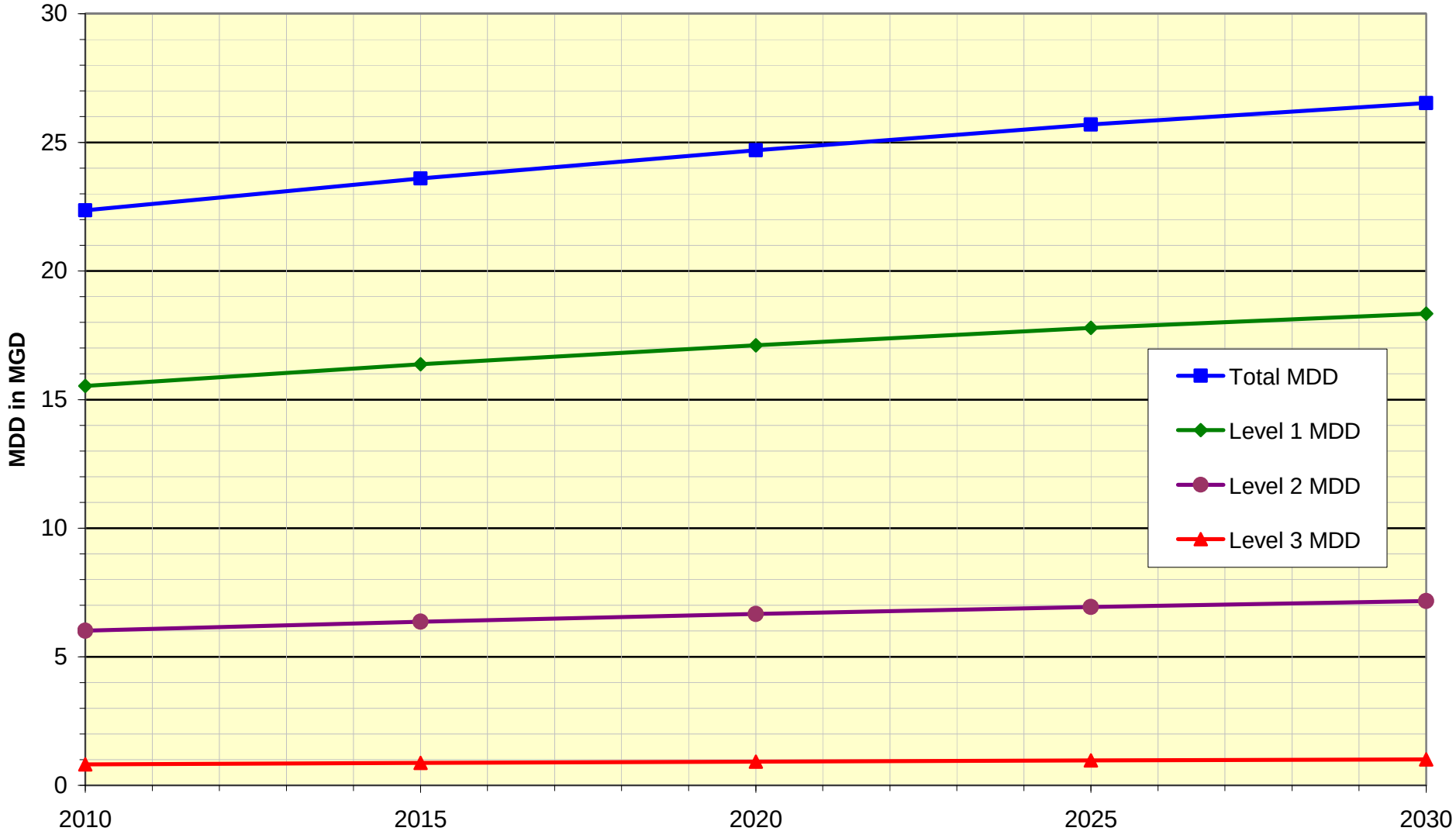


Figure 3-2 Projected Maximum Day Demand through 2030



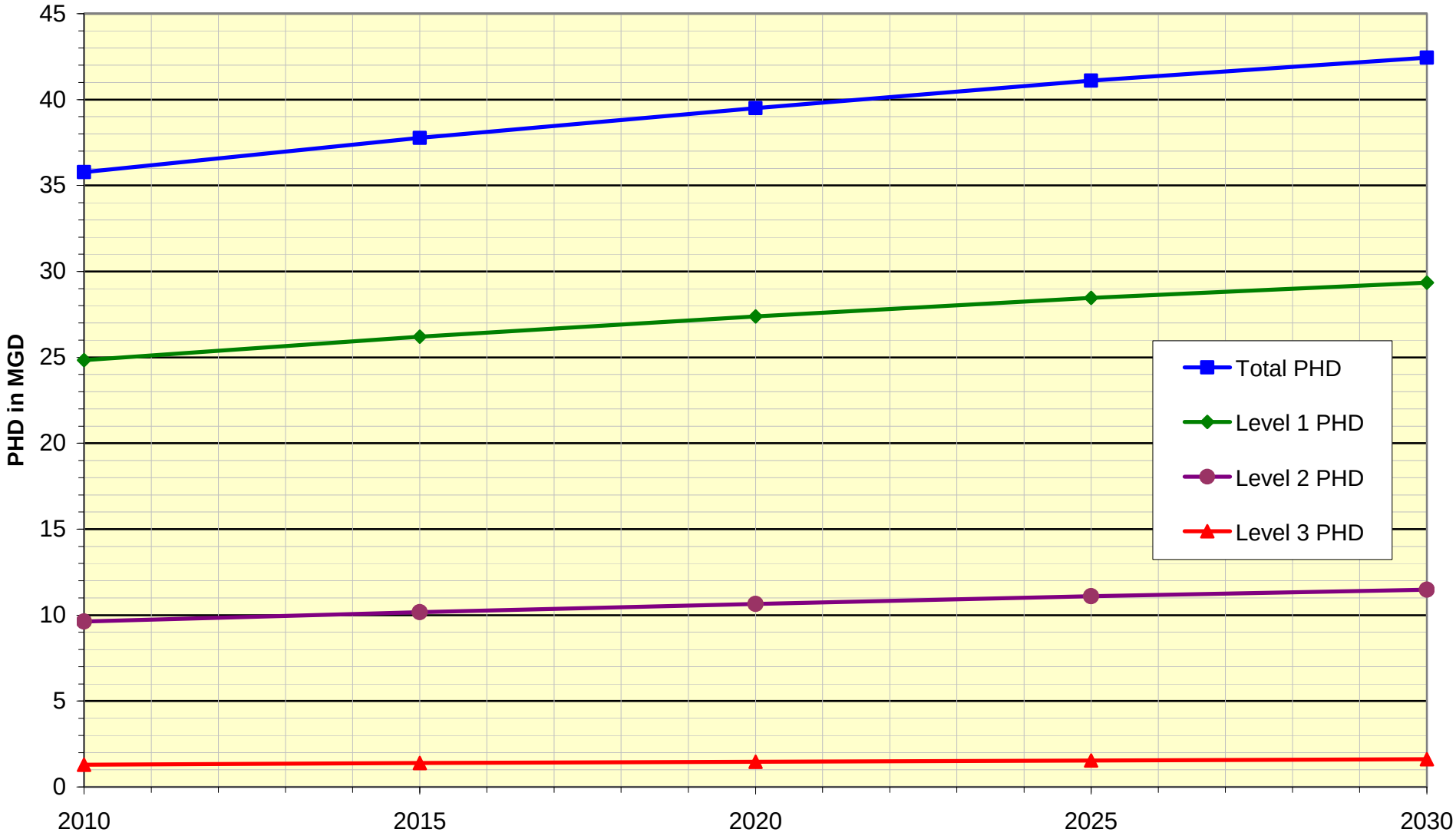
Peak Hour Demands

The peak hour demand (PHD) projections based on the basic planning data presented in Chapter 2 are shown in Figure 3-3. The PHD is estimated as 1.6 times the ADD based on historical data and DOH guidelines. The 2016 (6 year) and 2030 (20 year) PHD projections for each pressure zone were determined graphically from the demand projection curves in Figure 3-3. The PHD projections are summarized in Table 3-12.

Table 3-12 Projected 6 year and 20 year Peak Hour Demands in MGD

Pressure Zone	2016 (6 year) projection	2030 (20 year) projection
Level 1	26.43	29.34
Level 2	10.27	11.48
Level 3	1.41	1.62
Total	38.11	42.44

Figure 3-3 Projected Peak Hour Demand through 2030



Storage Requirements

The design of storage requirements must consider each of the five (5) storage component listed below (reference WAC 246-290-235(3)):

1. Operational storage (OS);
2. Equalizing storage (ES);
3. Standby storage (SB),
4. Fire suppression storage (FSS); and
5. Dead storage (DS), if any.

1. Operational storage (OS)

As defined in WAC 246-290-010, operational storage is the volume of the reservoir devoted to supplying the water system while under normal operating conditions when the source(s) of supply are "off". This volume will vary according to two main factors: (1) the sensitivity of the water level sensors controlling the source pumps, and (2) the configuration of the tank designed to provide the volume required to prevent excessive cycling (starting and stopping) of the pump motor(s). The definition specifies that OS is an additive quantity to the other components of storage. This provides an additional factor of safety to the ES, SB, and FSS components if the reservoir is full when that component of storage would be needed.

According to the DOH guidelines, operational storage may not apply to systems operating under a continuous pumping mode or a gravity fed supply such as from a water treatment plant (see discussion below under equalizing storage).

2. Equalizing storage (ES)

When the source pumping capacity cannot meet the periodic daily (or longer) peak demands placed on the water system, Equalizing Storage (ES) must be provided (reference WAC 246-290-235(2)) as a part of the total storage for the system and must be available at 30 psi to all service connections. The volume of ES depends upon several factors, including peak diurnal variations in system demand, source production capacity, and the mode of operation. If pumping is to be continuous or if the system is supplied by gravity, it is necessary to prepare a mass analysis by either graphical or tabular methods, or a computer simulation in order to determine the OS and ES requirements. According to the DOH Design Manual, ES should be calculated using the following equation:

$$\mathbf{ES} = \mathbf{(PHD - Q_S) \times (150\ min.)}, \text{ but in no case less than zero.}$$

Where: **ES** = Equalizing storage component, in gallons.

PHD = Peak hourly demand, in gpm,

$\mathbf{Q_S}$ = Sum of all installed and active source of supply capacities, except emergency sources of supply in gpm..

3. Standby storage (SB)

The purpose of SB is to provide a measure of reliability should sources fail or when unusual conditions impose higher demands than anticipated. The SB volume recommended for systems served by one source may be different than for systems served by multiple sources as indicated in the following equations.

Water Systems With A Single Source

The recommended SB volume for systems served by a single source of supply is two (2) times the system's *average day demand* (ADD) for the design year to be available to all service connections at 20 psi.

$$\mathbf{SB_{TSS} = (2\ days) \times (ADD)}$$

Where: $\mathbf{SB_{TSS}}$ = Total standby storage component for a single source system, in gallons;

ADD = Average day demand for the design year, in gpd

Water Systems With Multiple Sources

The recommended SB volume for systems served by multiple sources should be based upon the following equation:

$$\mathbf{SB_{TMS} = (2\ days) \times (ADD) - t_m \times (Q_S - Q_L)}$$

Where: $\mathbf{SB_{TMS}}$ = Total standby storage component for a multiple source system; in gallons

ADD = Average day demand for the system, in gpd;

$\mathbf{Q_S}$ = Sum of all installed and continuously available source of supply capacities, except emergency sources, in gpm.

$\mathbf{Q_L}$ = The largest capacity source available to the system, in gpm.

$\mathbf{t_m}$ = Time that remaining sources are pumped on the day when the largest source is not available, in minutes. (Unless restricted otherwise, this is generally assumed to be 1440 minutes.)

4. Fire Flow Rate and Duration

Public water systems are required to construct and maintain facilities, including storage reservoirs, capable of delivering fire flows in accordance with the *determination of fire flow requirement* made by the local fire protection authority or County Fire Marshal while maintaining 20 psi pressure throughout the distribution system (WAC 246-290-221(5)). The magnitude of fire suppression storage (FSS) is the product of the maximum flow *rate* and *duration* established by the local fire protection authority or County Fire Marshal. For water systems located in areas governed under the Public Water System Coordination Act of 1977 (PWSCA), Chapter 70.116 RCW, minimum flow rates and durations that must apply for residential, commercial, and industrial developments are

specified in the Water System Coordination Act regulations, WAC 246-293-640. Greater FSS requirements may be specified by the local fire protection authority, County Fire Marshal, and/or locally adopted Coordinated Water System Plan. Fire-flow volumes are typically calculated based on the largest fire flow occurring in each pressure zone.

5. Dead storage (DS), if any.

Dead storage (effective only to provide adequate pressure) is the volume of stored water not available to all consumers at the minimum design pressure in accordance with WAC 246-290-230(5) and (6). DS volume is excluded from the volumes provided to meet OS, ES, and/or FSS.

Minimum System Pressure

The minimum system pressure design standard which has been established by the City of Yakima provides that during peak-hour demands, the distribution system should provide a minimum service pressure of 30 psi to all customers. Under fire-flow conditions, service pressures across the City should not drop below 20 psi. These design standards are consistent with the DOH Design Manual requirements and the applicable portions of WAC 246-290-230.

Minimum Pipe Size

Title 12 of the Yakima Municipal Code establishes development standards for water service extensions. Chapter 12.04 covers water system development standards. Article 12.04.030 requires that all water lines shall be looped. Article 12.04.040 requires that all new water lines within the City of Yakima water service area shall be a minimum of eight inches in diameter and be constructed of Class 52 ductile iron.

Telemetry Systems

The existing telemetry system provides for monitoring and control of booster pumps, reservoir levels, the water treatment plant, and each of the wells. Each telemetry location can communicate with the water treatment plant and with each of the other telemetry locations. Each telemetry unit consists of a programmable logic controller (PLC) and a VHF radio transmitter which communicates via a digital packet burst protocol. Any new telemetry points must be compatible with the existing system.

Backup Power

Backup power shall be provided for the various components of the water system in accordance with the DOH Design Manual and applicable regulations.

Valve and Hydrant Spacing

Fire hydrant location and number requirements are stipulated in Article 10.10.070 of the Yakima Municipal Code. The maximum distance between fire hydrants in single-family zones shall be 600 feet. In all other areas, including areas of single-family zones impressed with public buildings, and/or schools, the maximum distance between fire hydrants in single-family zones shall be 400 feet.

With regard to valve spacing, each project is reviewed to determine valve spacing based on main isolation for minimal disruption in service. In addition, valves are required at each intersections.

Other Requirements

Section 12.04.030 of the Yakima Municipal Code requires that all water lines shall be looped. Temporary dead-end lines may be permitted based on an agreement between the developer and the City with provisions for timely completion of looping.

Copies of the City's Development Standards and Water System Specification and Details are included in Appendix O and Appendix P, respectively.

3.2 Water Quality Analysis

Raw Water Quality

The normal water supply source for the City of Yakima is the Naches River Water Treatment Plant located approximately 8 miles west of Yakima on Highway 12. Like many surface waters in the Pacific Northwest, the Naches River can be categorized by its low hardness and low alkalinity. However, its water quality can vary significantly throughout the year. Storm events and spring snowmelt in the mountains to the west can increase turbidity and color rapidly. A summary of the raw water quality data for the time period 2001 through 2009 in presented in Table 3-13.

Table 3-13 Summary of Naches River Raw Water Quality (2001 to 2009)

Parameter	Units	Average	Minimum	Maximum
Turbidity	NTU	6.7	0.30	136.8
pH	--	7.4 (median)	5.7	8.3
Alkalinity	mg/L as $CaCO_3$	26.46	18	35
Temperature	°C	10.6	1.4	24.5
Calcium	mg/L	23	13	40
Hardness	mg/L as $CaCO_3$	19[a]	--	--
Color - Apparent	ACU	58[a]	--	--
Color - True	TCU	0[a]	--	--
UV_{254}	cm^{-1}	0.04[a]	--	--
Total Organic Carbon	mg/L	2.0	1.2	5.1

[a] Data collected between May 12 and May 15, 1998 (Carollo Engineers, *Naches River Water Treatment Plant Evaluation Final Report*, August 1998)

The raw water turbidities ranged during the period from 0.30 NTU to 137 NTU with an average of 6.76 NTU. The daily raw water turbidity values from 2001 to 2009 are shown in Figure 3-4. A frequency distribution curve of the same influent turbidity data is shown in Figure 3-5. The direct filtration criterion for raw water turbidity is 15 NTU. As indicated in Figure 3-5, this raw water turbidity value is exceeded approximately 6 % of the time (i.e. 94 % of the raw water turbidity values do not exceed 15 NTU). The implications of the raw water quality with respect to turbidity are discussed below in Section 3.3, System Description and Analysis.

Figure 3-4 Daily Raw Water Turbidity 2001 to 2009

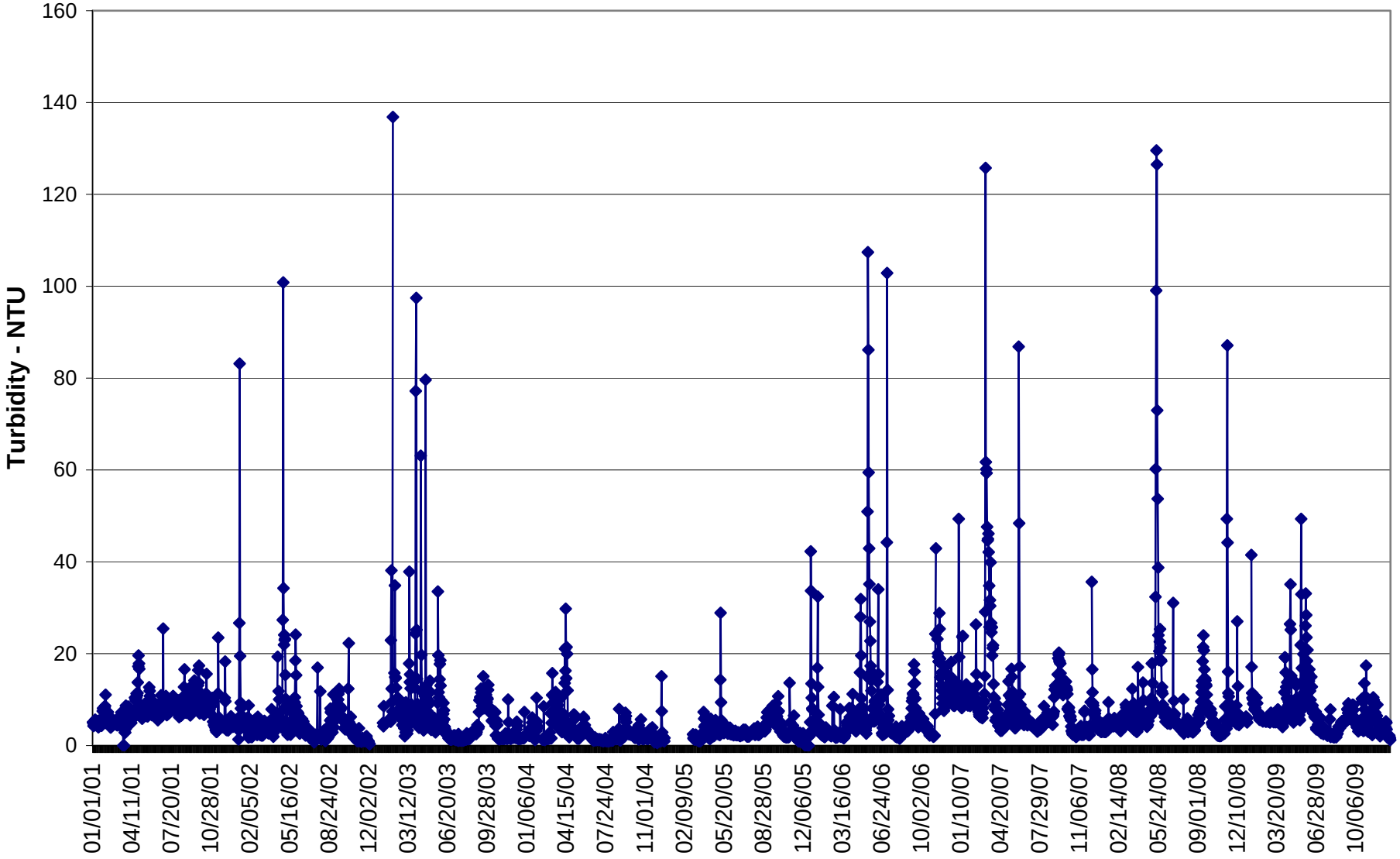
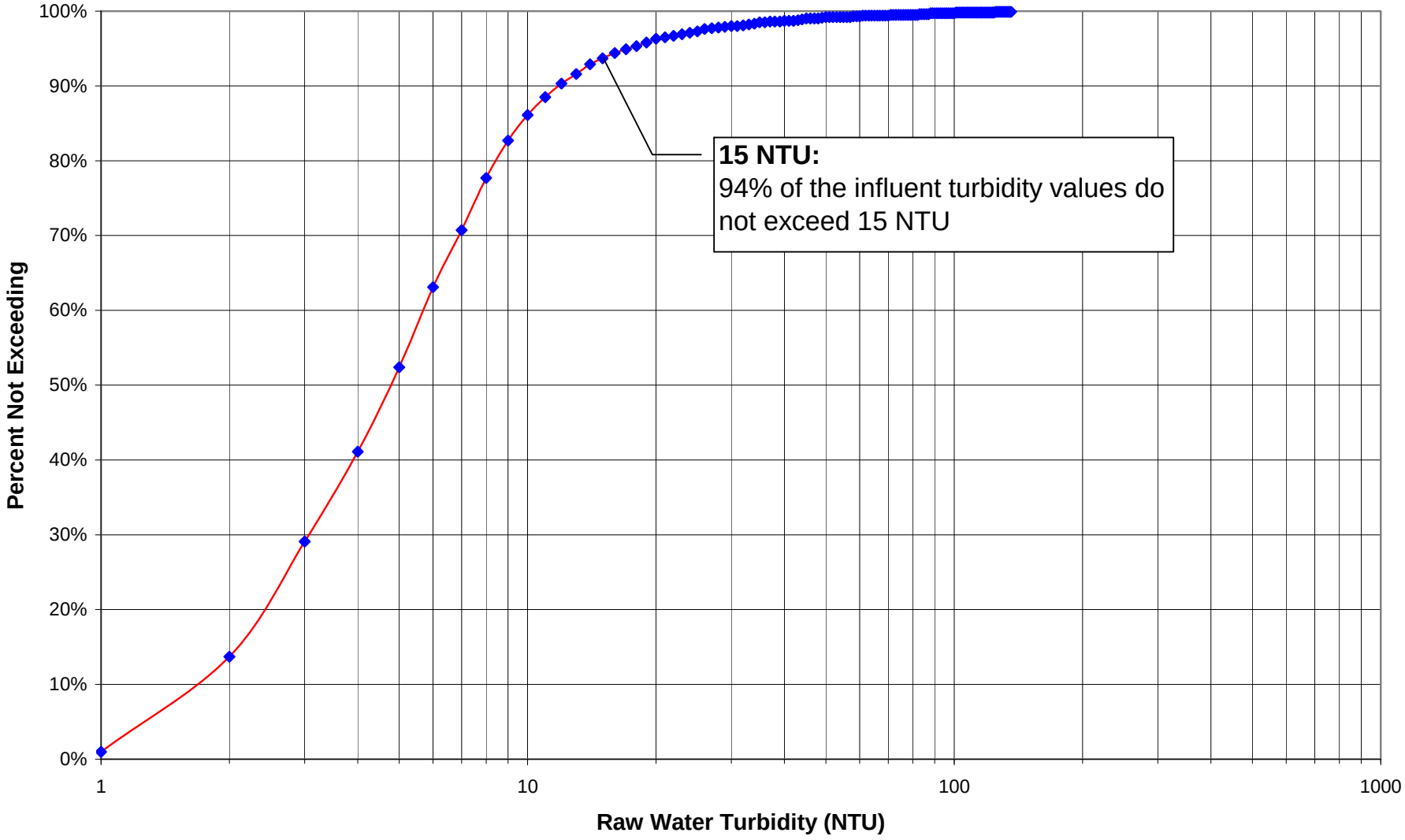


Figure 3-5 Frequency distribution of Daily Average Raw Water Turbidity Values 2001 to 2009



Finished Water Quality

A time series chart of finished water turbidity for the WTP from 2001 through 2009 is shown in Figure 3-6. The current MCL for finished water turbidity is 0.3 NTU for 95 percent of the samples in any month. On January 1, 2002, the Interim Enhanced Surface Water Treatment Rule (IESWTR) lowered the turbidity MCL to 0.3 NTU for the 95th percentile. The WTP has not violated the monthly 95 percent turbidity standard since the effective date of the original regulation (June 29, 1993), nor has it violated the more stringent MCL in the IESTWR. A frequency distribution curve of the same finished water turbidity data is shown in Figure 3-7.

EPA Regulated inorganic chemicals (IOCs) for which Primary and Secondary MCLs have been established are tested annually in the WTP finished water. The results of the finished water IOC testing from 2002 through 2009 are summarized in Tables 3-14 and 3-15.

Parameters which are tested for but not regulated are summarized in Table 3-16.

Other parameters including total coliform, volatile organic compounds, and lead and copper are summarized in Table 3-17.

During this period there have been no violations with respect to meeting the applicable standards for safe, clean water as delivered into the city's water distribution system. In all categories, the levels of regulated chemical species are substantially below acceptable contamination levels set by EPA.

In addition, the City has routinely tested for another 53 compounds including the regulated and unregulated volatile and synthetic organic compounds. In all cases no detectible levels of these compounds were found.

Seasonal/Emergency Well Water Quality Monitoring

The three wells (Airport Well, Kissel Well, and Kiwanis Well) are currently classified as seasonal/emergency sources of supply and, as such, are not subject to annual monitoring. The City has, however conducted periodic monitoring. Recent IOC testing results for the wells are summarized in Table 3-18. In addition, the Maximum Total Trihalomethane Potential (MTTHP) has been tested annually for emergency well supplies since 1996. The results of these MTTHP tests are summarized in Table 3-19. The City has also tested the well supplies for the regulated and unregulated volatile and synthetic organic compounds. The results of these tests are summarized in Tables 3-20 and 3-21. As with the WTP finished water, no detectible levels of these compounds were found in the well water tests.

Figure 3-6 Finished Water Turbidity 2001 to 2009

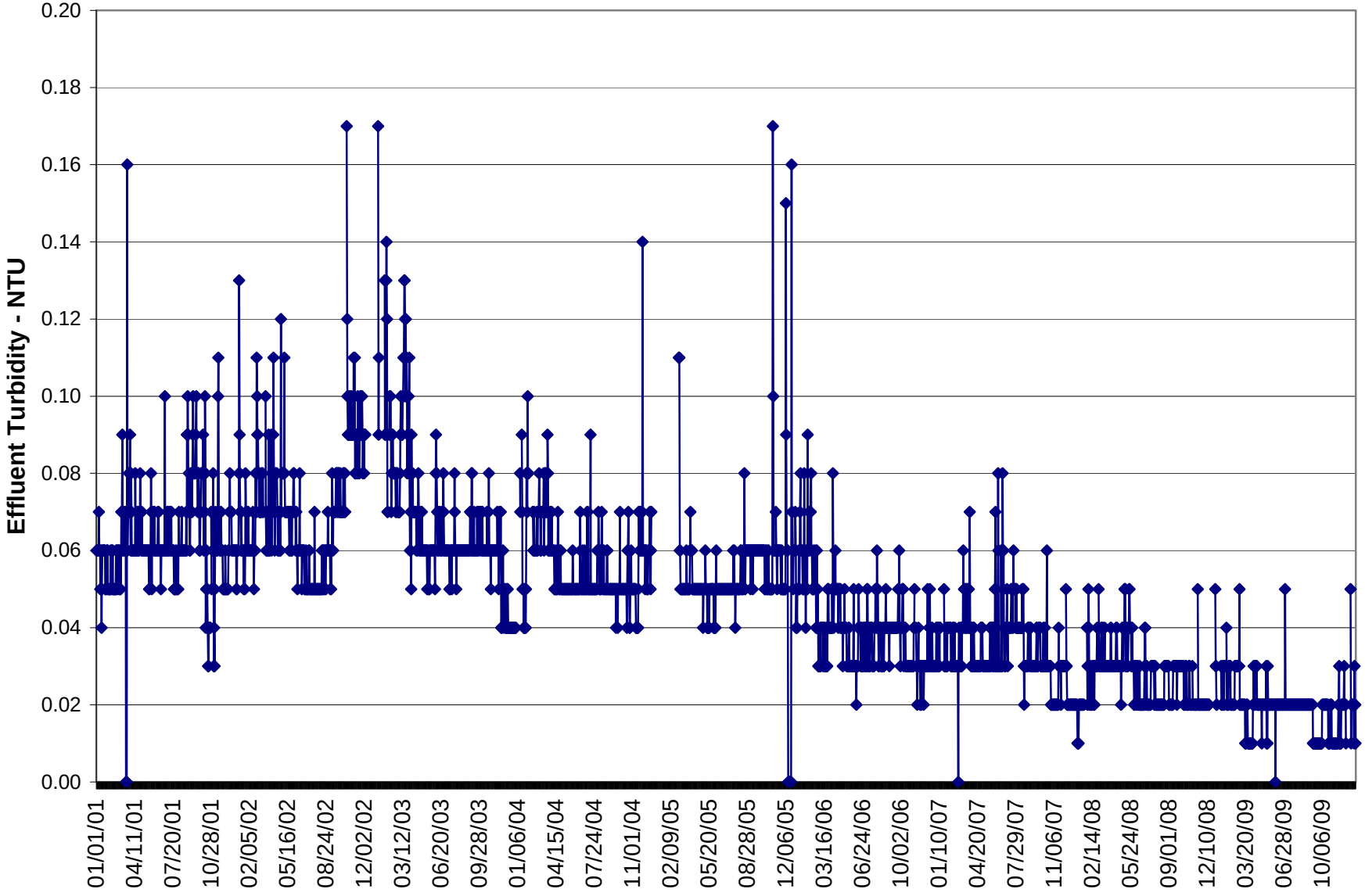


Figure 3-7 Finished Water Turbidity Frequency Distribution Curve

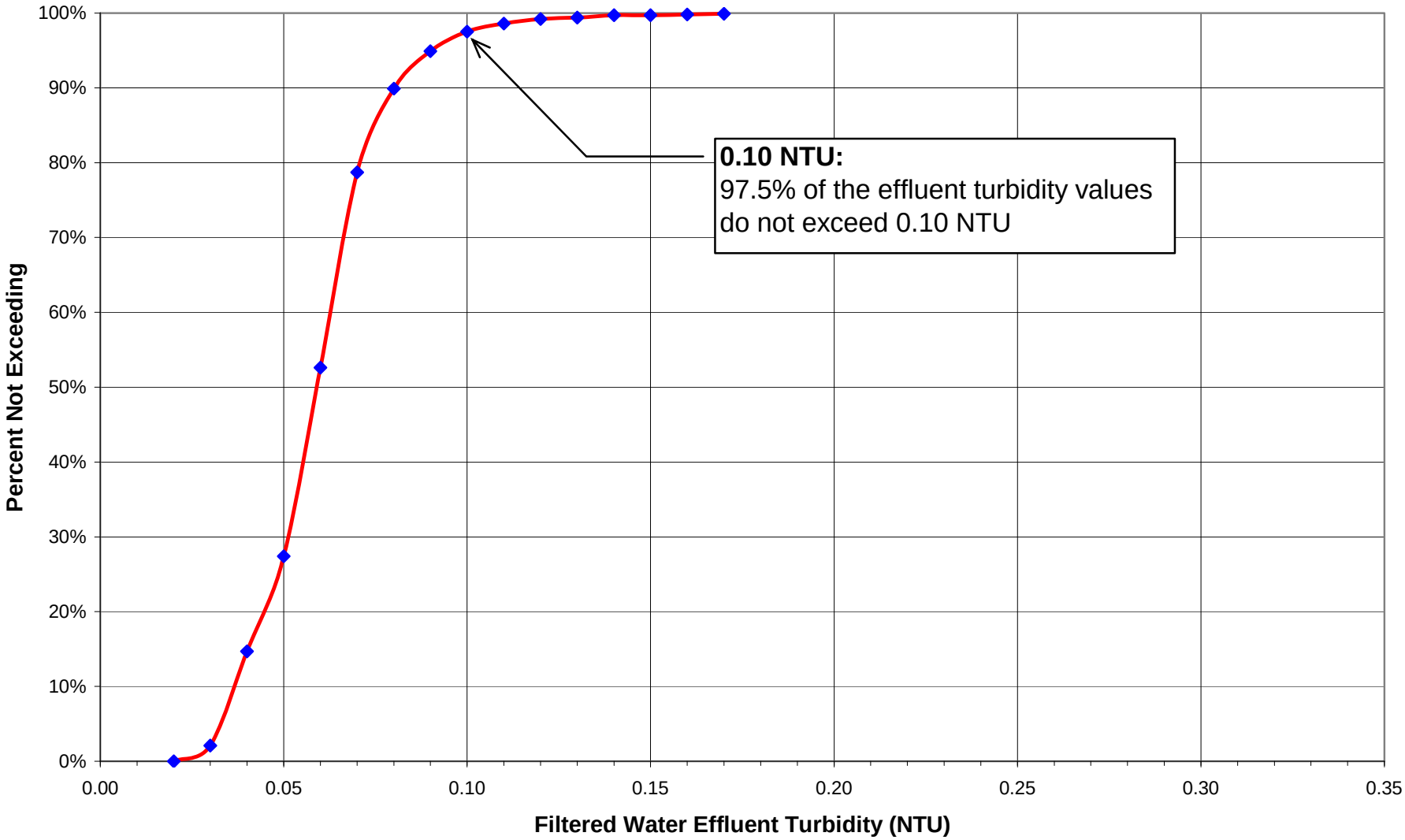


Table 3-14 Primary IOCs, MCLs and MCLGs		
Chemical	**MCL**	**MCLG**
Concentrations in parts per billion		
Arsenic	50	n/a
Cadmium	5	5
Chromium	100	100
Mercury	2	2
Selenium	50	50
Beryllium	4	4
Nickel	100	100
Antimony	6	6
Thallium	2	0.5
Cyanide	200	200
Concentrations in parts per million		
Lead	0.015	0
Copper	1.3	1.3
Fluoride	4	4
Nitrite –N	1	1
Nitrate –N	10	10
Barium	2	2

Table 3-15 Secondary IOCs, MCLs and MCLGs		
Chemical	**MCL**	**MCLG**
Concentrations in parts per billion		
Iron	300	300
Manganese	50	50
Silver	100	100
Concentrations in parts per million		
Chloride	250	250
Sulfate	250	250
Zinc	5	5

Table 3-16 EPA Regulated Inorganic Chemical Primary MCLs								
	Concentrations in parts per billion							
Chemical	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Arsenic	<5*	<1*	<2*	<2*	<2*	<2*	<2*	<2*
Cadmium	<1*	<1*	<0.3*	<0.3*	<0.3*	<2*	<0.3*	<0.3*
Chromium	<10*	<2*	<5*	<4.7*	<4.7*	<4.7*	<4.7*	<4.7*
Mercury	<0.5*	<0.5*	<0.3*	<0.3*	<0.3*	<0.3*	<0.3*	<0.3*
Selenium	<5*	<5*	<5*	<5*	<5*	<5*	<5*	<5*
Beryllium	<3*	<2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
Nickel	<20*	<2*	<10*	<10*	<10*	<10*	<10*	<10*
Antimony	<2*	<2*	<5*	<5*	<5*	<5*	<5*	<5*
Thallium	<1*	<1*	<1*	<1*	<1*	<1*	<1*	<1*
Cyanide	<50*	<50*	<10*	<10*	<10*	<10*	<10*	<10*
	Concentrations in parts per million							
Fluoride	<0.2*							
Nitrite –N	<0.05*	<0.05*	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate –N	<0.2*	<0.2*	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	<0.1*	<0.05*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
***** Denotes that the detected value is below the minimum reporting level required by the Washington Department of Health.								

Table 3-17 EPA Regulated Inorganic Chemical Secondary MCLs								
	Concentrations in parts per billion							
Chemical	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Iron	<100*	<100*	<100*	<100*	<100*	<100*	<100*	<100*
Manganese	<10*	<5*	<10*	<10*	<10*	<10*	<10*	<10*
Silver	<10*	<5*	<10*	<10*	<10*	<10*	<10*	<10*
	Concentrations in parts per million							
Chloride	2.40*	3.00*	5*	<5*	5*	<5*	<5*	3*
Sulfate	-	-	13	11	8*	<5*	<5*	6*
Zinc	<0.2*	<0.01	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
***** Denotes that the detected value is below the minimum reporting level required by the Washington Department of Health.								

Table 3-18 Parameters Tested for, but NOT Regulated									
	Concentrations in parts per million								
Parameter	**MCL**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Sodium[1]		6	10	9.0	7.03	7.94	9.3	8.4	6.35
Hardness		23	30	28.0	27.4	29.0	30.3	27.5	27.3
	Value in color units								
Color	15	5	5	<4	<4	<4	<4	5	<4
	Value in Micromhos at 25 degrees Celsius								
Conductivity[2]	700	80	90	86	94	94	113	98	99

[1] The EPA has established a recommended level of 20 ppm for sodium as a level of concern for those customers that may be restricted for daily sodium intake.

[2] Conductivity testing is done in lieu of the more expensive test for Total Dissolved Solids (TDS). Exceeding the conductivity MCL would require that the City perform the test for TDS.

Table 3-19 Other Finished Water Quality Data									
	Concentrations in parts per million								
Parameter	**MCL**	**2002**	**2003[2]**	**2004**	**2005**	**2006[2]**	**2007**	**2008**	**2009**
Lead[1]	0.015		0.0061			0.0060			0 0019
Copper[1]	1.3		0.71			0.255			0.0684
	Value in color units								
Total Coliform[1]	<5%			1.4%	1.4%	1.4%	0.12%	0.12%	0%

[1] Average of samples taken unless otherwise noted

[2] Maximum annual values for lead and copper

Table 3-20 Stage 1 Disinfection By-product Rule monitoring								
DBP	HAA5				TTHM			
Site	Reservoir	Kissel	City Hall	WWTP	Reservoir	Kissel	City Hall	WWTP
2002	27.9	27.2	20.6	30.1				20.4
	21.6	25.6	29.4	34.4				32.6
	18.7	18.5	20.6	22.6				30.3
	16.6	5.4	ND	ND				1.1
2003	ND	ND	23.8	33.8				2.9
	32.5	45.6	31.1	37.7				27.9
	15.2	ND	18.8	ND				1.7
	28.2	30.2	16.5	25.2				27.2
2004	16.5	13.4	13.2	14				8.7
	42.6	27.5	22.2	28.6	28.1	23.9	18.4	22.4
	24.4	15.7	21	ND	34.5	38.6	33.1	1.5
	25.1	ND	ND	ND	18	0.3J	2.4	2.1
2005	8	2.5	21.4	22.7	16.2	4	16.9	19.5
	23	2	34	37	25.5	1.5	20.1	25
	23.8	ND	0.7	ND	35.7	ND	23.1	4
	16.9	20.7	18.5	19.9	29.8	23.9	17.3	24.1
	16.5	0.9	25.6	0.7	29.3	3.9	22.3	3
	ND	ND	ND	ND	19	ND	0.3	2
2006	27.9	26.9	24.4	26.9	26.5	15.5	12.8	16.2
	27.3	0	41.4	13.1	30.7	0	26.6	10.9
	27.1	36.5	33.3	13.9	35.9	25.7	24.5	13.4
	22.6	27.9	22.8	26.9	44.4	33.7	28.2	27.8
	25.8	27.8	24	26.3	36.4	28.2	22.5	25.6
	33.5	37.6	35.2	34.4	22.5	26.3	20.1	23.5
2007	41	30.5	33.9	35.5	36	25	25.3	25.4
	43.3	0	27.9	29.6	30.4	0	17.8	26.4
	25.4	0	26.4	41.2	29.7	0	26.9	42.1
	13.8	0	3.3	0	39.7	0	6.1	0.8
	14.2	22	14.1	12.3	42.8	29.5	24	29.5
	17.3	17.3	17.6	20	21.6	22.4	15.6	22.4
2008	16.4	19.7	14.9	19.8	15.5	22.8	13.4	17.9
	28.2	28.5	25.6	30.9	25.8	27.4	20.2	26.5
	47.3	31.2	29.2	31.6	45.8	29	24	31
	53	38.1	28.5	31.9	66.9	40.5	37.4	40.2
	36.8	34.9	25.1	28.5	52.8	49.5	33.8	40.6
	22.2	28.2	22.4	23.3	46.5	25.6	19.3	27.5
2009	15.3	31.4	26.7	30.9	35.4	29	23.7	31.8
	36.3	34.8	32.5	0	46.5	55.4	37.2	1.6
	50.3	0	37.1	1.7	62.3	0	47	35.9
	24.1	18	21.9	23.1	55.8	34.7	35.8	39.1
	19.2	0	20.6	0	58.5	0	39.6	3.3
	19	0	23.5	1.8	47.1	0	31.9	28.5
	13.3	0	0	0	38.3	0	0	1.6

Table 3-21 Seasonal/Emergency Wells Regulated Inorganic Chemical Primary MCLs
all units in mg/L unless otherwise noted

IOC's	Kissel		Airport		Kiwanis	
	2004	**2007**	**2004**	**2007**	**2004**	**2007**
Arsenic	0.0027	0.0023	0.0031	0.0031	0.0049	0.0041
Barium	0.0080	0.0090	0.0640	0.0360	0.0090	0.0100
Cadmium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Chromium	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Mercury	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Beryllium	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	0.2800	0.3100	0.2500	0.2800	0.2200	0.2400
Nitrite-N	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrate-N	0.3800	0.3500	0.2800	0.2600	0.2600	0.2400
Total NOx	0.3800	0.3500	0.2800	0.2600	0.2600	0.2400
Iron	0.0148	<0.0097	0.0368	0.0102	<0.0097	0.0220
Manganese	<0.002	<0.002	<0.002	<0.002	<0.002	0.0020
Silver	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Chloride	1.75	1.68	1.56	1.42	2.34	2.02
Sulfate	3.96	3.78	3.27	3.09	4.85	4.61
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sodium	18.4	18.4	19.9	23.6	19.2	18.9
Hardness	40.6	42.3	39.2	36.7	37.8	37.0
Conductivity[1]	166.0	171.0	165.0	168.0	157.0	156.0
Turbidity[2]	<0.02	<0.2	<0.5	<0.2	<0.5	0.2000
Color[3]	<4	<4	<4	<4	<4	<4
TDS	172.0	138.0	144.0	138.0	162.0	126.0
Lead	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Copper	<0.002	<0.002	0.0058	0.0022	<0.002	<0.002
Magnesium	3.36	3.54	2.78	2.61	0.82	0.86
Calcium	10.70	11.10	11.10	10.40	13.80	13.40

[1] Conductivity in umhos/cm
[2] Turbidity in NTU
[3] Color in color units
SOC's were all non detect
VOC's were all non detect

3.3 System Description and Analysis

3.3.1 Objectives

With reference to the system performance design standards described in Section 3.1, this section includes a description of the general condition of each system facility as well as an analysis of the physical capacity of each facility. These analyses consider each facility individually, and as a functional component group, (i.e., source, treatment, storage, and distribution). The description of the general condition of system facilities includes a summary of the physical condition of the facility as well as the facility's anticipated remaining life expectancy. The overall system analysis also includes a comparison of the existing facility capacity with the existing and projected water demands identified in Chapter 2 and in Section 3.1.

The objective of the system description and analysis presented in this section is the identification of the extent and timing of any individual facility and/or functional group deficiencies. Deficiencies identified in the first 6 years of the planning period are addressed and remedied by a specific project or action, including a project schedule. Deficiencies identified in years 7 through 20 are, in most cases, placed in the capital improvement program without identifying a specific schedule for implementation.

3.3.2 Source

General Description and Condition

The current supply sources consist of a surface water treatment plant (WTP) on the Naches River and three wells. A fourth well is currently under construction and is scheduled to be operational by the end of 2011.

The Naches River Water Treatment Plant (WTP) was constructed at Rowe Hill between 1967 and 1970 to replace the Oak Flats supply. Treated water from the plant flows over a weir into a 48-inch transmission main and to the City by gravity. The condition and performance characteristics of the water treatment plant along with recommended capital improvements are described in detail below in Section 3.3.3, Water Treatment.

The City of Yakima water system currently has three wells that are used for seasonal/emergency purposes. The wells are located at the Airport, at Kiwanis Park, and at Kissel Park. The Airport and Kiwanis wells were developed in 1962 and 1965 to further supplement the Oak Flats supply. The first of these was the Kiwanis Park Well (1962) and the second was the Airport Well (1965). Both of these wells are in service today for seasonal/emergency purposes. The Kissel Park well was constructed in 1993. The Kissel Park well partially replaced the Ranney collector, which was located on the Naches River and was previously used to supplement the City's water supply. Table 1-1 in Chapter 1 shows the capacity, zone served, and other pertinent information about the wells. A discussion of the hydrogeology of the aquifers from which these wells withdraw water is presented in Chapter 4 of the plan. The static water levels in the Kiwanis and Airport wells have declined over the years due to increased water withdrawals from the aquifer.

Source Capacity Analysis

The City of Yakima holds a number of water rights that supply the City's domestic and municipal irrigation distribution systems. All of these water rights are described in Chapter 4 of this plan and in Tables 4-5 and 4-6 (see Section 4.3). The City holds several other water rights that are not considered in this source capacity analysis, because they are not part of the City's municipal water distribution systems and are not used for domestic purposes.

As described above, the City's domestic water distribution system is primarily supplied by surface water, with diversions occurring at the City's Naches River Water Treatment Plant. The City currently uses its groundwater supply system as a seasonal or emergency backup supply. The City also has three interties with the Nob Hill Water Association for emergency supply purposes.

A source capacity analysis for the years 2010 through 2030 is presented in Table 3-22. This analysis is based on the following assumptions:

The existing water treatment plant is rated at 25 MGD (17,400 gpm) in normal water supply years consistent with the DOH Water Facilities Inventory (WFI).

Existing groundwater wells (Kiwanis, Airport, and Kissel Park Wells) are designated for seasonal/emergency use only. Since the existing groundwater wells are for emergency use, they are excluded from the Non-Drought year (Normal) supply.

During 2001, and due to drought conditions, the USBR reduced the storage control capacity of the WTP to 29%. This was the most severe reduction in storage control capacity since the Naches River Water Treatment Plant was placed into service and is therefore assumed to be a worst case scenario for the purpose of this source capacity analysis. The 2001 drought was considered to be an emergency condition, and therefore, the Groundwater Wells were utilized.

A new well is nearing completion at Gardner Park. This new well will use the remaining 3000 gpm of the Ranney Well water right. (The other 2000 gpm of the original 5000 gpm Ranney Well water right had been previously transferred to the Kissel Park Well.) Installation of the new Gardner Park began in 2010 and will be completed in 2012. The new well will also be designated as seasonal/emergency, initially.

Two future 2,500 gpm (3.6 MGD) Aquifer Storage and Recovery (ASR) wells are proposed. A discussion of the 2002 ASR Study is included in Chapter 4 of this plan. A summary report of the ASR project is included in Appendix S. The entire ASR project reports are to be incorporated into the Water System Plan Update by reference. Installations of the proposed ASR wells are currently planned for 2020 and 2025.

Table 3-22 Source Capacity Analysis for Years 2010 through 2030 in MGD

Projected Demands	**2010**	**2015**	**2020**	**2025**	**2030**
Average Day Demand	12.8	13.5	14.1	14.7	15.2
Maximum Day Demand	22.4	23.6	24.7	25.7	26.5
Peak Hour Demand	35.8	37.8	39.5	41.1	42.4
Existing Supply Capacity					
Existing Water Treatment Plant [1]	25.0	25.0	25.0	25.0	25.0
Existing Wells – Seasonal Only					
Kiwanis Well (3.4 MGD / 2,350 gpm)	3.4	3.4	3.4	3.4	3.4
Airport Well (4.0 MGD / 2,800 gpm)	4.0	4.0	4.0	4.0	4.0
Kissel Well (4.2 MGD / 2,900 gpm)	4.2	4.2	4.2	4.2	4.2
Gardner Well (4.3 MGD / 3,000 gpm)	4.3	4.3	4.3	4.3	4.3
Total Seasonal Well Capacity	15.9	15.9	15.9	15.9	15.9
Supply Capacity - Non-Drought Years					
Existing Water Treatment Plant	25.0	25.0	25.0	25.0	25.0
Existing Seasonal Supply Wells [2, 3]	0.0	0.0	0.0	0.0	0.0
Total Capacity	25.0	25.0	25.0	25.0	25.0
Supply Capacity - Drought Years					
Existing WTP (10 cfs + 29% of 29 cfs) [4]	11.9	11.9	11.9	11.9	11.9
Existing Wells (Seasonal Use) [2, 5]	15.9	15.9	15.9	15.9	15.9
Total Capacity	27.8	27.8	27.8	27.8	27.8
Supply Requirements					
Required Supply to meet MDD	22.4	23.6	24.7	25.7	26.5
Projected Deficiency (w/o adding supply)	--	--	--	0.7	1.5
Future New Supply Sources (Proposed)					
ASR Groundwater Wells [7]	0.0	0.0	3.6	7.2	7.2
Total Additional Supply from New Sources	0.0	0.0	3.6	7.2	7.2
Projected Supply					
Existing Water Treatment Plant (non-drought)	25.0	25.0	25.0	25.0	25.0
Existing Water Treatment Plant (drought) [4]	11.9	11.9	11.9	11.9	11.9
Existing Groundwater Wells [2, 3]	15.9	15.9	15.9	15.9	15.9
Future ASR Groundwater Wells [7]	0.0	0.0	3.6	7.2	7.2
Total Capacity – Non-Drought Year [3]	25.0	25.0	28.6	28.6	28.6
Total Capacity – Drought Year [3, 4, 5, 7]	27.8	27.8	27.8	31.4	31.4

1. The existing water treatment plant is rated at 25 MGD (17,400 gpm) consistent with the DOH Water Facilities Inventory (WFI)
2. Existing groundwater wells are designated for seasonal use.
3. Since the existing groundwater wells are for seasonal use when needed, they are excluded from the Non-Drought year supply.
4. During 2001, and due to drought conditions, the USBR reduced the storage control capacity of the WTP to 29%.
5. During 2001 drought conditions, the Groundwater Wells were activated.
6. The Gardner Park Well would use 3000 gpm of the Ranney Well water right. Installation to be complete 2020.
7. Two future 2,500 gpm (3.6 MGD) ASR wells are proposed. Installations are estimated for 2015 and 2008. Initially both ASR wells will be designated as emergency sources. In 2015 one ASR well will be changed to a normal source.

3.3.3 Water Treatment

Background and General Information

The City of Yakima Naches River WTP was built between 1967 and 1970 with a design capacity of 20 MGD). The nominal capacity was increased to 25 MGD by filter upgrades in 1991.

Since original construction, the City has made process renovations to the plant in 1991, 1993, 1997, 2001, 2003, 2004, and 2005.

In 1991, the four filters were rehabilitated. Components of that project were as follows:

- Drilled out plugged orifices in the Leopold block underdrains.
- Replaced gravel support layers.
- Replace original filter media with new multi-media design.

As part of the filter rehabilitation project, the State of Washington increased the rated capacity of the WTP from 20 to 25 MGD based on results of a concurrent pilot filter demonstration study.

In 1993, a new supervisory control and data acquisition (SCADA) system was installed, and it included the following items:

- Continuous individual filter monitoring
- Greater capacity to gather water quality data
- Change in flow control to reduce influent flow rate during a filter backwash cycle to prevent a sudden flow increase to the remaining filters in service.

In 1997, the City completed installation of a bulk soda ash storage and feed system. This was in response to exceeding the copper action level of 1.3 mg/L in 1993. To achieve compliance with Lead and Copper Rule guidelines, the soda ash feed system is used to increase filtered water pH to 7.4.

A new fluoridation facility was constructed in 2001 and placed into service during the spring of 2002. The facility includes a new building containing hydrofluosilicic acid storage tanks and chemical feed equipment. The fluoridation equipment also includes fluoride monitoring instrumentation and a containment tank to prevent the release of hydrofluosilicic acid in the event of an accidental spill.

A 1998 report by Carollo Engineers titled *Evaluation of the Naches River Water Treatment Plant* (Carollo Engineers, August 1998) provided an assessment of the existing treatment plant components. This report identified deficiencies and recommended improvements to the WTP as needed to meet current and anticipated performance requirements. Many of the recommendations in this report were implemented in projects that were implemented in 2003, 2004, and 2005.

In 2003, a major upgrade to the raw water intake facility was completed. The improvements included the installation of flat panel screen with continuous backwash and a continuous air curtain to mitigate the build-up of ice in winter months.

In 2004, the then existing rapid mix coagulation system was replaced with a new pump diffusion flash mix system. The new rapid mix/coagulation system, together with related piping modifications enabled the WTP to achieve compliance with the Filter Backwash Recycling Rule which went into effect on June 8, 2004.

In 2004, the existing gas chlorination system was replaced with an on-site sodium hypochlorite generator system. Chlorine is used for both primary disinfection (CT compliance) and as a secondary disinfectant (distribution system residual). Chlorine is added upstream of the contact basins (prechlorination) and downstream of the filters (post chlorination). The primary deficiency with the gas chlorination system was related to safety due to the lack of a chlorine scrubber system. The hypochlorite system had been recommended in the 1998 and 2004 planning documents as the preferred alternative to adding a scrubber and the other safety equipment which would be required if a gas chlorination system were to be maintained.

The on-site sodium hypochlorite generator system was installed in a new Chemical Handling Building. The chemical storage and handling facilities for aluminum chlorohydrate, alum, and filter aid polymer, were also relocated to the new building in the 2004 project. The new building includes spill containment for all of the bulk chemical storage facilities, and corrected the other chemical handling facilities deficiencies which had been identified in the above-referenced planning documents.

In 2005, a major upgrade to the filters was completed to address the deficiencies which were identified in the 1998 Carollo report and in the 2004 Water System Plan Update. The filter upgrade included: replacing the clay block underdrains with a nozzle type underdrain and the elimination of the gravel support system; replacing the multimedia filter media configuration with a dual media design; modifications to the surface wash system.

The 2005 filter system upgrade also included the recommended upgrades to the Filter-to-waste facilities, thereby correcting the deficiencies which had also been identified in the 1998 report and the 2004 WSP Update

The design criteria for existing WTP unit processes are shown in Table 3-23.

A process flow schematic of the existing WTP is shown in Figure 3-8. A site plan is shown in Figure 3-9.

Table 3-23 Existing Design Criteria Naches River Water Treatment Plant		
Description	**Units**	**Criteria**
Plant Capacity		
Plant Capacity - Nominal	MGD (gpm)	25 (17,400)
Raw Water Supply		
Source: Diversion Structure on the Naches River		
Screens: Mechanical		
Raw Water Pipeline		
Diameter	in	54
Length (approximate)	ft	4,000
Velocity @ 25 MGD	ft/sec	2.4
Contact Time @ 25 MGD	min	28
Rapid Mix		
Type: Pump diffusion		
Number of units	--	1
Mixing Energy (G-Value)	$seconds^{-1}$	750
Pump Capacity	gpm	869
Pump Power	HP	5
Contact Basins		
Type: Rectangular, inlet orifices, outlet ports, inlet and outlet submerged gates		
Number of Basins	--	2
Dimensions per Basin	ft x ft	36 x 131
Water Depth (varies due to sloped bottom)	ft	15.0
Volume per Basin	ft^3 (gal)	71,000 (530,000)
Total Volume	ft^3 (gal)	140,000 (1,100,000)
Detention Time @ 25 MGD (based on tracer study)	min	60
Surface Loading Rate @ 25 MGD	gpm/ft^2	1.8
Filters		
Type: Gravity, dual-media, rate of flow control, gravity backwash, Leopold Plastic Tri-Lateral Block Underdrains		
Number of Filters	--	4
Dimensions per Filter	ft x ft	26 x 24
Surface Area Per Filter (Total Surface Area)	ft^2	624 (2,496)
Filter Box Depth	ft	13.5
Filtration Rate @ 25 MGD	gpm/ft^2	7.0
Depth of Water Above Media	ft	5.3
Headloss Available for Solids [a]	ft	9.9
Filter Media		
Anthracite Coal		
Depth	in	30
Effective Size	mm	1.0 - 1.1
Uniformity Coefficient	--	1.4
Specific Gravity	--	1.6 – 1.7
Sand		

Depth	in	12
Effective Size	mm	0.55 - 0.65
Uniformity Coefficient	--	1.4
Specific Gravity	--	2.6
Total L/d Media Ratio	--	1,230
Distance from Media to Top of Backwash Trough[b]	in	51
Distance from Media to Bottom of Backwash Trough[b]	in	26
Distance from Media to Surface Wash[b]	in	2 to 4
Filter Backwash		
Type: Gravity, elevated storage tank		
Backwash Rate (and Duration[c])	gpm/ft^2 (min)	17 (5.0)
Backwash Storage Tank		
Type: steel, cylindrical, above grade	--	--
Diameter	ft	40
Height	ft	80
Volume	ft^3 (gal)	100,000 (750,000)
Number of Supply Pumps	--	2
Pump Capacity	gpm (hp)	1,725 (40)
Surface Wash		
Type: Rotating arms		
Wash Rate	gpm/ft^2	0.8
Duration	min	3
Number of pumps	--	1
Pump Capacity	gpm (hp)	520 (50)
Filter Waste Washwater and Solids Handling		
Type: Earthen pond, trapezoidal		
Dimensions (approximate)	--	--
Top	ft x ft	450 x 60
Bottom	ft x ft	450 x 12
Depth (approximate)	ft	7
Volume	ft^3 (gal)	110,000 (850,000)
Recycle Pipeline Diameter (Length)	in (ft)	8 (250)
Recycle Pump Capacity	gpm (hp)	400-700 (5)
Filtered Water Clearwell		
Type: Buried concrete, rectangular, 2 compartments)		
Dimensions (of both West and East compartments)	ft x ft	13 x 19.3
Water Depth @ 25 MGD Minimum (Maximum)	ft	8.9 (9.8)
Volume @ Minimum Water Depth	ft^3 (gal)	2,200 (17,000)

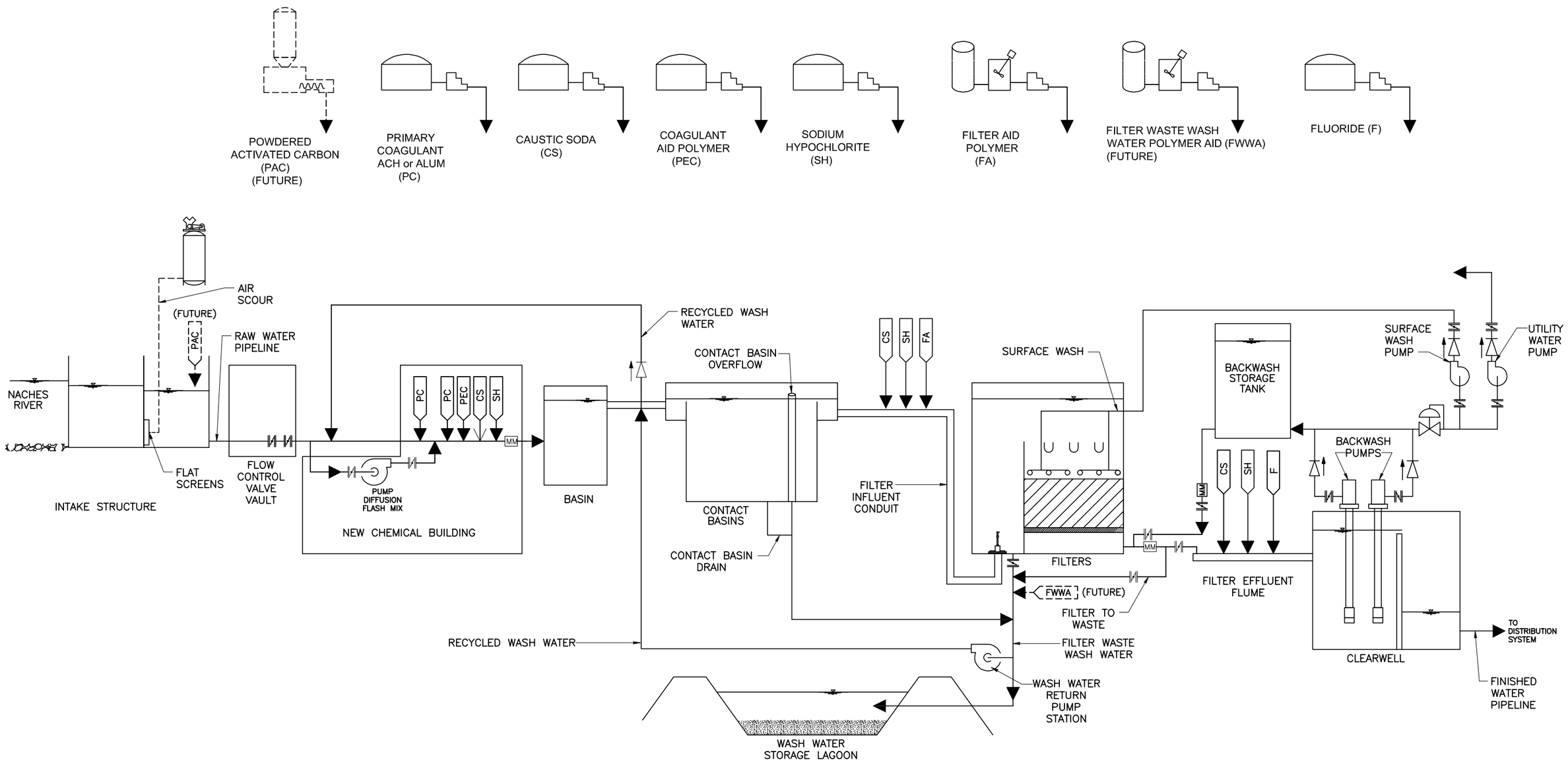


Figure 3-8
Process Flow Diagram
City of Yakima Naches River
Water Treatment Plant

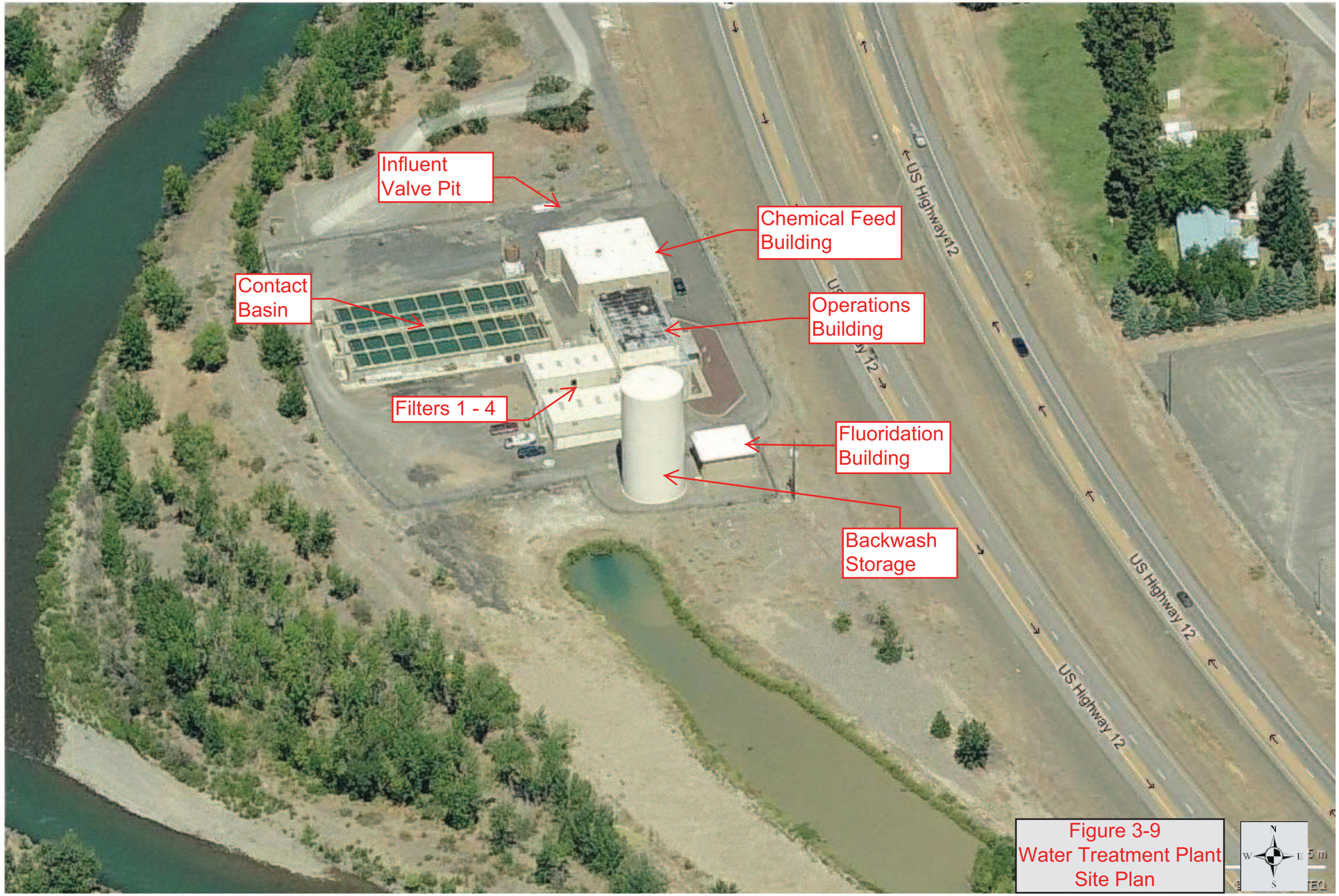


Figure 3-9
Water Treatment Plant
Site Plan

Existing Water Treatment Plant – Analysis and Discussion

The Naches River Water Treatment Plant has contact basins upstream of the filters and it meets the EPA definition of "direct filtration" because it does not include a sedimentation step prior to filtration. This distinction is important because a "direct filtration" plant must provide a higher level of disinfection than a conventional water treatment plant. The applicability of direct filtration is generally limited to facilities which have high quality source water (< 15 NTU turbidity). As shown in Figure 3-7, the raw water quality is 15 NTU or less about 94% of the time and it is 10 NTU or less about 86% of the time. Actual operating experience has shown that the plant can handle intermittent periods of higher raw water turbidity. Sustained periods of high turbidity are rare. When they do occur they are typically due to rain on snow flooding during the winter months or from Spring snowmelt. During periods went it is not feasible or not economical to treat the Naches River water, the WTP can be shut down and the seasonal/emergency wells activated until the raw water turbidity levels return to normal levels.

Contact Basins

Existing Conditions - Two rectangular contact basins are located between the rapid mix basin and the filters. Coagulated water must flow through them before it goes onto the filters. No mechanical sludge removal equipment exists in the basins, and plant staff does not currently have the capability to add chemicals to the basins.

Disinfection Facilities

Existing Conditions - Chlorine is used for both primary disinfection (CT compliance) and as a secondary disinfectant (distribution system residual). Chlorine is added upstream of the contact basins (prechlorination) and downstream of the filters (post chlorination).

The 1998 Carollo WTP evaluation report identified two issues with regard to the then existing disinfection facilities. Safety was the primary issue, since at that time the WTP used a gas chlorination system. The other issue was that of future regulatory requirements. (See discussion of the LT2 rule, below.) As noted above an on-site hypochlorite generation system was installed in 2004 to replace the gas chlorination system. The conversion from gas chlorination to hypochlorite disinfection address the safety issues which had been identified as a deficiency in the 1998 Carollo report and the 2004 Water System Plan update

Long Term 2 Enhanced Surface Water Treatment Rule

EPA has developed the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 rule) to improve your drinking water quality and provide additional protection from disease-causing microorganisms and contaminants in drinking water.

Pathogens, such as *Giardia* and *Cryptosporidium*, are often found in water, and can cause gastrointestinal illness (e.g., diarrhea, vomiting, cramps) and other health risks. In many cases, this water needs to be disinfected through the use of additives such as chlorine to inactivate (or kill) microbial pathogens.

Cryptosporidium is a significant concern in drinking water because it contaminates surface waters used as drinking water sources, it is resistant to chlorine and other disinfectants, and it has caused waterborne disease outbreaks. Consuming water with *Cryptosporidium*, a contaminant in drinking water sources, can cause gastrointestinal illness, which may be severe in people with weakened immune systems (e.g., infants and the elderly) and sometimes fatal in people with severely compromised immune systems (e.g., cancer and AIDS patients).

The purpose of the LT2 rule is to reduce disease incidence associated with *Cryptosporidium* and other pathogenic microorganisms in your drinking water. The rule applies to all public water systems that use surface water or ground water that is under the direct influence of surface water.

Water systems must initially monitor their water sources to determine treatment requirements. This monitoring involves two years of monthly sampling for *Cryptosporidium*. Based on monitoring results, filtered water systems are classified in one of four treatment categories (bins) based on their monitoring results. The LT2 monitoring for the City of Yakima source water is presented in Table 3-24. Based on these monitoring results, the system is classified in the lowest bin and no further treatment steps are required to achieve compliance with the rule.

Table 3-24 Long Term 2 Enhanced Surface Water Treatment Rule Monitoring Results

Date	Turbidity	Cryptosporidium oocysts	Giardia oocysts	Total Coliform	E. coli
4/18/2007	3.2	0.0	5	56.1	1.0
5/9/2007	14.0	0.0	0	272.3	32.3
6/13/2007	4.0	0.0	4	220.9	6.3
7/12/2007	4.5	1.0	4	1486.3	30.9
8/8/2007	4.7	0.0	2	228.2	50.4
9/11/2007	12.5	0.0	0	1989.0	30.0
10/9/2007	9.0	1.0	7	579.0	0.0
11/6/2007	1.1	0.0	0	327.0	10.0
12/12/2007	4.5	0.0	9	52.0	>10.0
1/8/2008	2.3	0.0	1	52.0	<10
2/6/2008	2.8	0.0	0	<10	<10
3/11/2008	5.1	0.0	2	8.5	3.1
4/9/2008	3.3	0.0	1	35.5	1.0
5/15/2008	26.1	1.0	26	579.4	27.9
6/11/2008	4.5	0.0	0	68.9	12.1
7/9/08	2.4	0.0	0	410.6	27.9
8/13/08	1.9	1.0	5	686.7	9.7
9/10/08	9.1	0.0	8	1046.2	14.6
10/8/08	2.8	0.0	19	488.4	3.1
11/12/2008	3.1	0.0	36	770.1	1.0
12/10/2008	4.0	0.0	51	140.5	4.9
1/14/2009	11.3	0.0	1	384.5	6.5
2/12/2009	4.5	0.0	15	29.38	5.13
3/11/2009	3.9	0.0	4	142.13	6.50

The next round of LT2 sampling begins October 1, 2015.

Residuals Handling

Existing Conditions - An earthen lined sludge lagoon with a capacity of about 850,000 gallons is used to handle residuals (sludge) generated at the plant. Filter waste washwater streams and settled solids from the contact basins are directed to the sludge lagoon. Decanted water is recycled back to the plant downstream of the rapid mix basin. The recycle rate is about 600 gpm and is operated based on water level within the lagoon. Settled sludge is pumped out of the lagoon on an intermittent basis

Recommended Improvements

A Backwash Settling Basin Project Report was prepared in April 2010 by Huibregtse, Louman Associates (HLA). The report recommended the construction of four (4) new common wall concrete settling basins of 400,000 gallons each for a total settling basin volume of 1,600.000 gallons. The The recommendations are based on an average daily backwash and filter-to-waste discharge of 778,100 gallons. The new settling basins would provide adequate settling time for particles in the filter backwash stream. A new pump station would be constructed to recycle the settling backwash and filter-to-waste water back to the WTP influent. The average recycle return rate would be 750 gpm with a maximum return rate of 1300 gpm. The estimated annual volume of dried solids to be removed from the settling basins would be 350 cubic yards. The existing settling basin does not allow for drying of the solids which must be pumped out wet.

The proposed project would also include a new auxiliary power generator and a new electrical service to the WTP.The estimated costs for the new backwash basin and electrical service are as follows (HLA 2010:

Structural Concrete Backwash Settling Basins	$2,349,300
Recycle Water Pump Station	$ 333,600
Water Treatment Facility Electrical Service Upgrades	$1,073,000
Total Estimated Cost	$3,755,900

The recommended improvements to the residuals handling facilities are scheduled for installation in 2012 or later.

3.3.4 Storage

General Description and Condition

The City of Yakima water systems currently has three storage locations, one in each of the three pressure zones. The distribution storage reservoir information is summarized in Table 3-25, below.

Table 3-25 Distribution Storage Reservoirs

Location	Total Volume MG	Usable Volume MG	Turnover at 2016 ADD	Year constructed	Zone Served	Construction Material
40th Ave. & Englewood	6	6	0.64 days	1970	Low	Reinforced Concrete
Reservoir Road	24 (two at 12 MG ea.)	24	6.5 days	1920s	Middle	Reinforced Concrete
Scenic Drive	One of two at 1 MG ea.	1	4.0 days	1920s	High	concrete
Scenic Drive	One of two at 1 MG ea.	1		1980	High	steel

Based on recent inspections and cleaning, all of the reservoirs are in good condition. The one million gallon steel Level 3 reservoir was last coated October 1995. The steel reservoir is typically recoated every 25 years or as dictated by conditions at time of inspection.

Vent and overflow screens are inspected 2 times per year, repairs made as necessary.

All four reservoir access hatch covers have been replaced, two in May 2002 and two in March 2003.

Storage Capacity Analysis

The storage capacity analysis must consider each of the five (5) storage component listed below (reference WAC 246-290-235(3)):

- Operational storage (OS);
- Equalizing storage (ES);
- Standby storage (SB),
- Fire suppression storage (FSS); and
- Dead storage (DS), if any.

Operational storage (OS)

Operational storage is normally defined as the volume of the reservoir devoted to supplying the water system while under normal operating conditions when the source(s) of supply are "off". The requirement specifies that OS is an additive quantity to the other components of storage. This provides an additional factor of safety to the ES, SB, and FSS components if the reservoir is full when that component of storage would be needed.

According to the DOH guidelines, the above definition of operational storage does not apply to some systems such as those operating under a continuous pumping mode or a gravity fed supply such as from a water treatment plant as is the case in Yakima. In these cases, it is necessary to prepare a mass analysis by either graphical or tabular methods, or a computer simulation in order to determine the OS and ES requirements. (see also discussion below under equalizing storage, below).

Figure 3-10 shows the City of Yakima Water System hydraulic profile and storage reservoir operating diagram. All of the supply sources feed Level 1. Level 2 is supplied from Level 1 by the North 40th Avenue Pump Station and the Stone Church Pump Station. Level 3 is supplied from Level 2 by the Level 3 Pump Station on Reservoir Road. The Level 3 Pump Station is controlled based on level transmitters in the Level 3 Reservoirs. The levels in the Level 1 and Level 2 reservoirs are controlled manually by the water treatment plant operators. The Level 1 reservoir water elevation is controlled by regulating the water treatment plant output and, secondarily, by setting the pumping rate from Level 1 to Level 2. The Level 2 reservoir water elevation is controlled by regulating the pumping output of the North 40th Avenue and Stone Church Pump Stations which can be done from the Water Treatment Plant via telemetry.

For historical reasons the largest volume of reservoir storage is in Level 2 even though the highest percentage of usage is in Level 1. What are now the Level 2 reservoirs were originally served by gravity when the source of the surface water supply was at Oak Flats. At that time Level 1 was served entirely through the PRV connections between Level 1 and Level 2. The Level 1 reservoir was installed in the early 1970s in conjunction with the construction of the Naches River Water Treatment Plant at Rowe Hill and the North 40th Avenue Pump Station. However, the operation of the Level 2 reservoirs is still closely linked to the water supply requirements of Level 1 and the entire volume of the Level 2 reservoirs would be available to the Level 1 distribution system if needed. Increased Level 1 demand would be met first by shutting

off the North 40th Avenue and Stone Church booster pumps allowing the Level 2 reservoirs to draw down to meet Level 2 demand. If the Level 1 demands could still not be met then the PRVs would begin to open to maintain pressure in Level 1. In order to provide the operators with even greater flexibility and control over the use of the Level 2 reservoir storage capacity in Level 1, a new automated control valve is proposed for installation at the North 40th Avenue Pump Station as shown in Figure 3-10. This will also enable the operators to periodically increase the turnover rate in the Level 2 reservoirs.

Because the Level 1 and Level 2 pressure zones each have a continuous source of supply which is manually controlled by the treatment plant operators, and because the Level 1 and Level 2 supply, demand, and reservoir storage factors are interrelated as described above, it is necessary to analyze the storage capacity requirements for both of these pressure zones together in a single computer simulation. The results of the simulation can be compared to historical Level 1 and Level 2 reservoir operating levels during peak demand periods in order to confirm the estimates of the OS plus ES requirements.

The procedure used to calculate the needed equalization and operational storage (OS + ES) volume involved the use of the water system hydraulic model algorithm to simulate a period of operation representing a typical peak demand week. The demand condition during a typical peak week was assumed to contain one maximum day with the balance of the week days representing near peak days as shown in Table 3-26, below:

Table 3-26 Assumed Peak-Week Demand Conditions used for Computer Simulation to estimate the OS +ES Requirements. The Daily Demands are expressed as a percentage of the Maximum Day Demand (MDD)

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
85%	95%	100%	95%	85%	85%	85%

For purposes of simulating a reasonable lag in supply rate and to account for other operational limitations (such as filter backwash periods at the Water Treatment Plant), the following peak-week supply rate assumptions as shown in Table 3-27 were used:

Table 3-27 Assumed Peak-Week Supply Conditions used for Computer Simulation to estimate the OS +ES Requirements. The Daily Supply rates are expressed as a percentage of the Maximum Day Demand (MDD)

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
82%	93%	95%	95%	95%	95%	95%

The estimated OS + ES for the year 2008 can be determined graphically from the output of the simulation as shown in Figure 3-11. The corresponding estimated OS + ES for the year 2022 is shown in Figure 3-12.

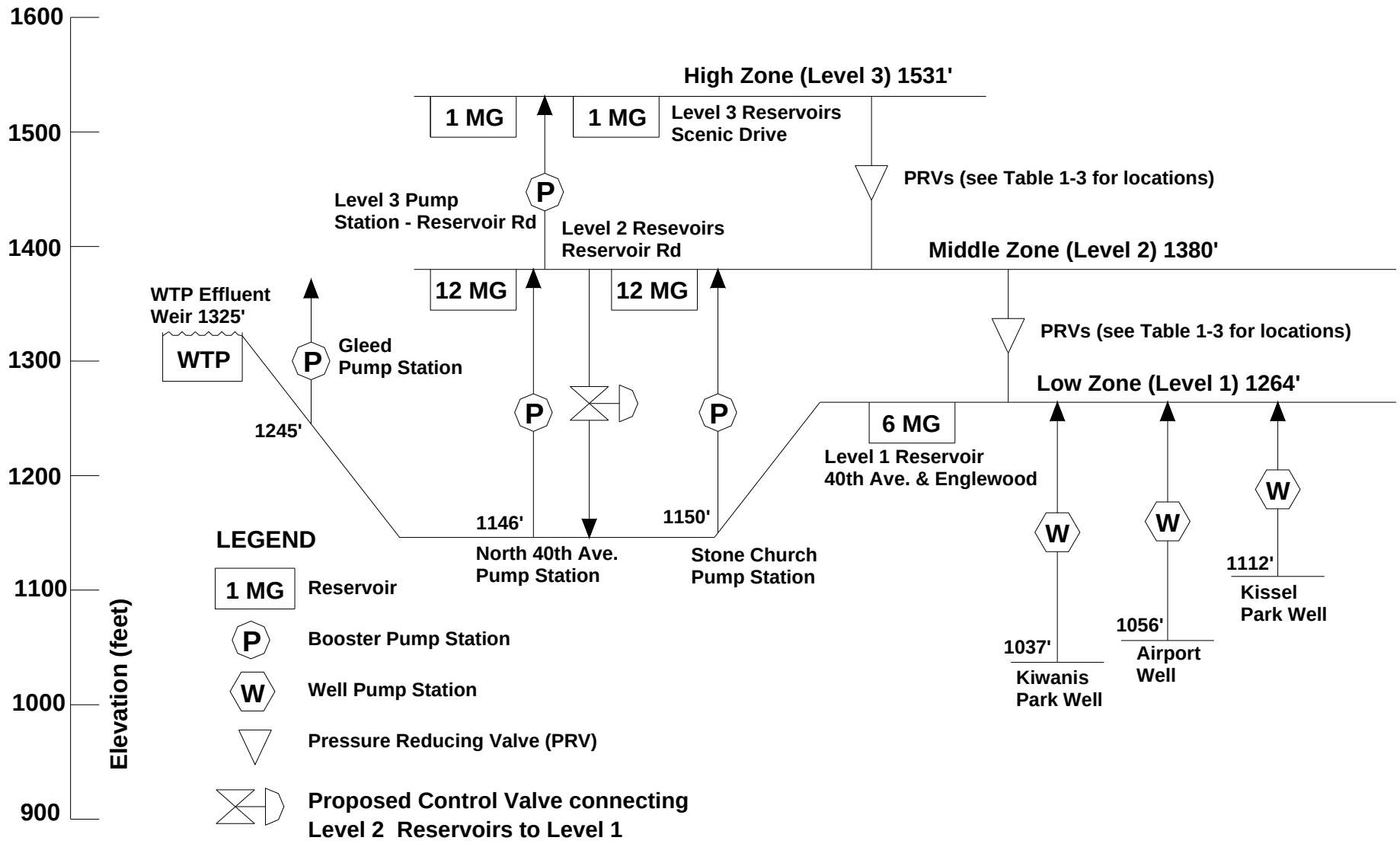


Figure 3-10 City of Yakima Water System Hydraulic Profile and Storage Reservoir Operating Diagram

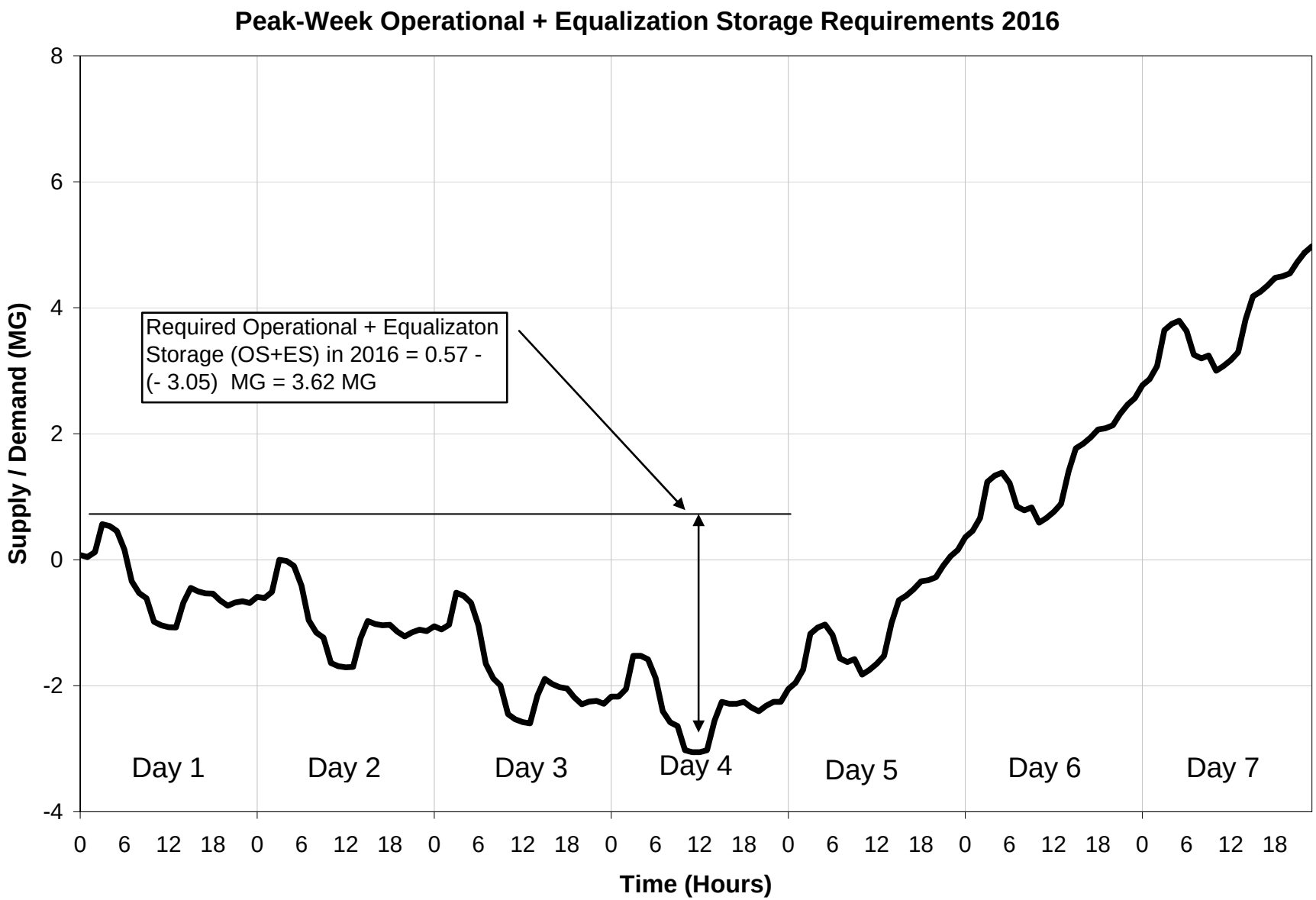


Figure 3-11 Estimated OS + ES for 2016 based on Supply/Demand simulation

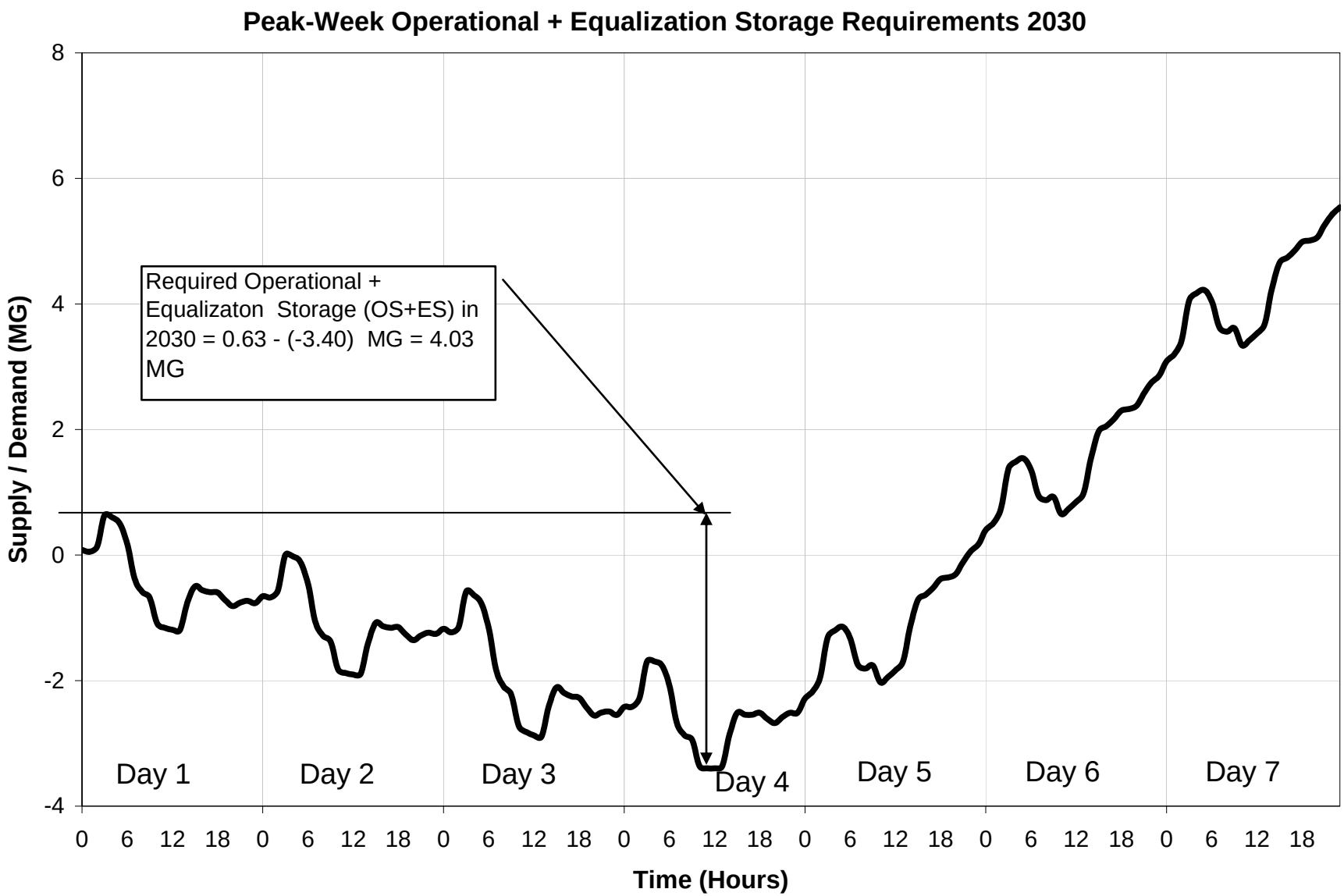


Figure 3-12 Estimated OS + ES for 2030 based on Supply/Demand simulation

The supply/demand simulations presented graphically in Figures 3-11 and 3-12 are for the entire water system including all of the pressure zones. However, as discussed below, the OS + ES for Level 3 is a very small percentage of the total OS + ES, and therefore, the results of the simulations can be considered the approximate combined OS + ES requirements for Level 1 and Level 2 together. Since, as noted previously, the Level 2 storage is available to Level 1, it is necessary to consider these two pressure zones together in the storage analysis for OS + ES. Based on the simulation the recommended OS + ES volumes for 2016 and 2030 would be as shown in Table 3-28, below:

Table 3-28 Recommended OS + ES (Level 1 plus Level 2)	
Year	**Recommended OS + ES (MG)**
2016	3.62
2030	4.03

The actual water elevations for the Level 1, Level 2 and Level 3 reservoirs July 25 through July 26, 2003 (which includes the maximum day demand for the period from 2002 through 2009) are shown in Figures 3-13, 3-14, and 3-15.

These operating levels are summarized in Table 3-29. The variations in the Level 1 and Level 2 reservoir elevations represent OS + ES. Level transmitters in the Level 3 reservoirs are used to control the Level 3 Pump Station within a narrow operating range between 17 and 18 feet. As can be seen in Figure 3-15, the Level 3 reservoir level variations are all operational storage.

As shown in Table 3-29, the observed combined volume for OS + ES during the peak demand periods was 1.71 MG. This data indicates that the recommended OS + ES volumes determined from the simulated supply/demand analysis are conservative. These more conservative OS + ES volumes summarized in Table 3-29, above will be used for the purpose of determining the total storage requirements for this Water System Plan Update planning period.

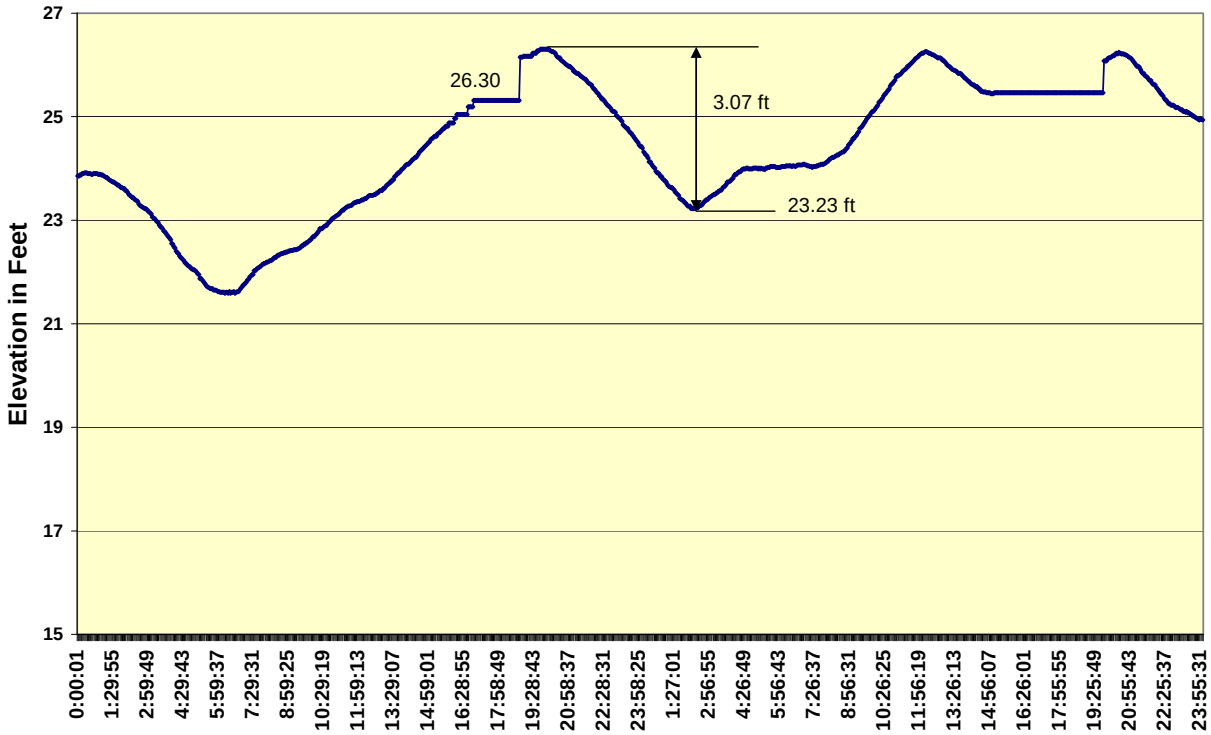


Figure 3-13 Level 1 Reservoir Elevations 7-25-03 through 7-26-03

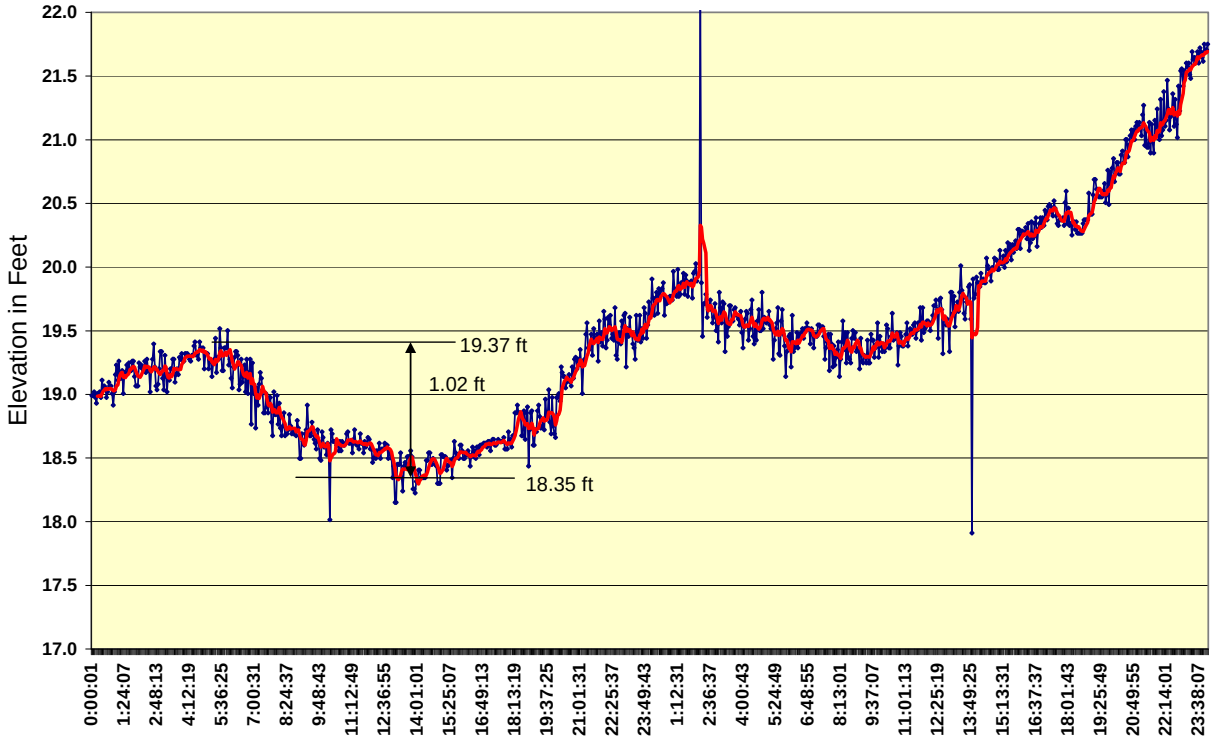


Figure 3-14 Level 2 Reservoir Elevations 7-25-03 through 7-26-03

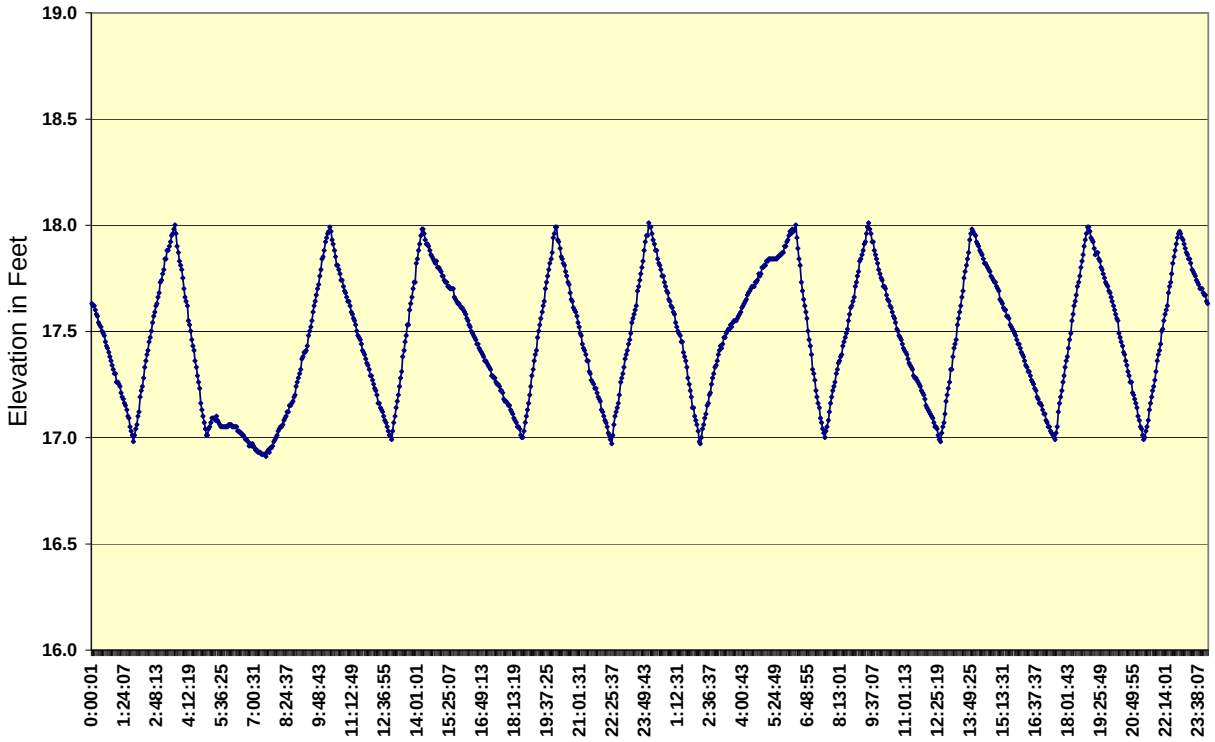


Figure 3-15 Level 3 Reservoir Elevations 7-25-03 through 7-26-03

Table 3-29 Actual Drawdown (OS+ES) during Max Day Demand Period (2002 to 2009)			
Level 1 Reservoir: Volume - 6.0 MG; Volume per foot – 200,000 gallons			
Reservoir/time period	**Volume/ft**	**Maximum drawdown**	**OS+ES (MG)**
Level 1 / July 25 through 26, 2003	200,000 gallons	3.07	0.614
Level 2 / July 25 through 26, 2003	980,000 gallons	1.02	1.000
Level 3 / July 25 through 26, 2003	100,000 gallons	1.00	0.100
Total OS + ES July 25 to July 26, 2003			**1.714**

Equalizing storage (ES)

When the source capacity cannot meet the periodic daily (or longer) peak demands placed on the water system, Equalizing Storage (ES) must be provided (reference WAC 246-290-235(2)) as a part of the total storage for the system and must be available at 30 psi to all service connections. The volume of ES depends upon several factors, including peak diurnal variations in system demand, source production capacity, and the mode of operation. According to the DOH Design Manual, ES would normally be calculated using the following equation:

ES = **(PHD - Q_S) x (150 min.)**, but in no case less than zero.

Where: **ES** = Equalizing storage component, in gallons.

PHD = Peak hourly demand, in gpm,

Q_S = Sum of all installed and active source of supply

As noted above, if pumping is to be continuous or if the system is supplied by gravity, it is necessary to prepare a mass analysis by either graphical or tabular methods, or a computer simulation in order to determine the combined OS and ES requirements. A simulation can also be done to estimate ES alone. The OS could then be estimated as the difference between OS + ES and the ES estimates as determined by the simulation. For the purpose of this storage analysis, it would normally be sufficient to estimate OS + ES. However, it might also be useful to estimate ES alone, since OS could possibly be reduced by future changes in operational control while ES will remain a function of available supply sources and system demands. The results of simulations estimating the ES for the system as a whole for 2016 and 2030 are shown in Figures 3-16 and 3-17, respectively. The ES requirement for Level 2 and Level 3 can be estimated using the equation above from the DOH Design Manual by considering QS to be the capacity of the booster pumps supplying the respective pressure zone as shown in Table 3-30. Since the pump station capacities (Q_S) exceed the PHDs, no additional ES is required to meet demands within the Level 2 and Level 3 pressure zones.

Table 3-30 Level 2 and Level 3 Equalization Storage Requirements

	Projected 2016 PHD		**Projected 2030 PHD**	
Pressure Zone	**MGD**	**gpm**	**MGD**	**gpm**
Level 2	10.3	7,150	11.5	7,990
Level 3	1.4	972	1.6	1,110
Level 2 plus Level 3	11.7	8,120	13.1	9,100
Pump Stations	**Q_S gpm**	**ES = (PHD - Q_S) x (150 min.)**	**Q_S gpm**	**ES = (PHD - Q_S) x (150 min.)**
North 40th Avenue	5,760		5,760	
Stone Church	4,700		4,700	
Total Level 2 pumps	10,460	<0	10,460	<0
Level 3 Pump Station	3,800	<0	3,800	<0

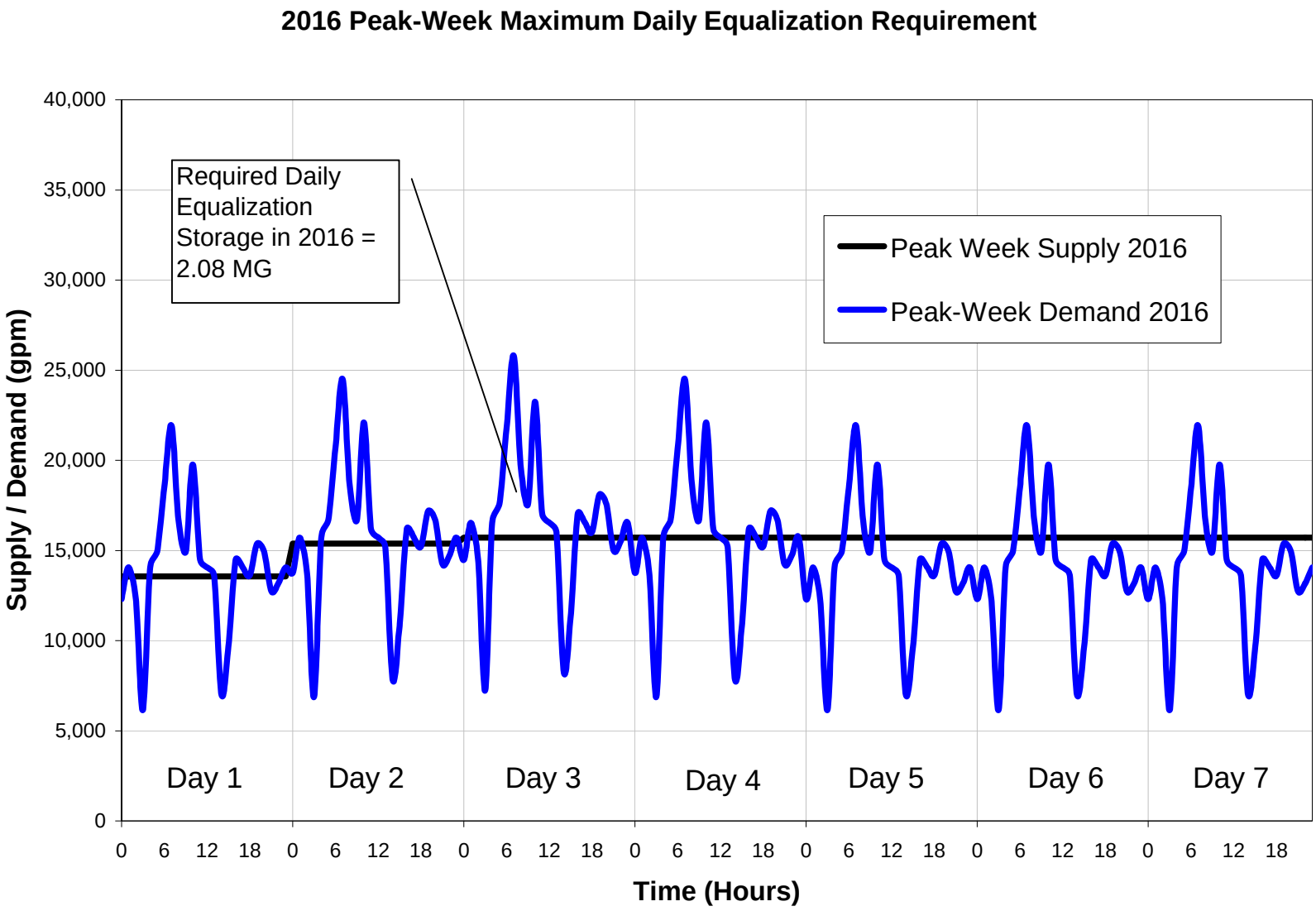


Figure 3-16 2016 Peak-Week Maximum Daily Equalization Requirement

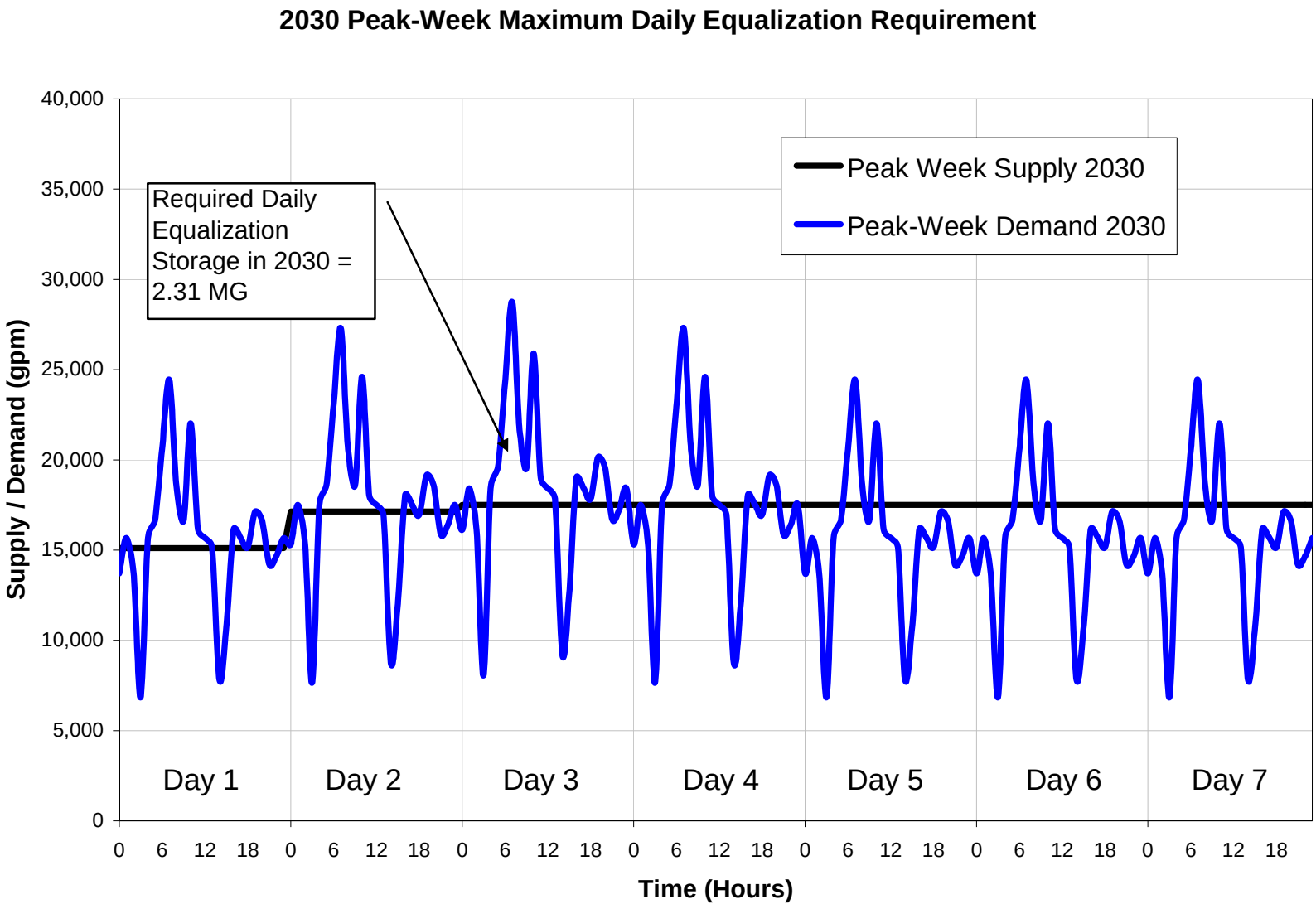


Figure 3-17 2030 Peak-Week Maximum Daily Equalization Requirement

Standby storage (SB)

The purpose of SB is to provide a measure of reliability should sources fail or when unusual conditions impose higher demands than anticipated. The SB volume recommended for systems served by one source may be different than for systems served by multiple sources as indicated in the following equations.

The recommended SB volume for systems served by a single source of supply is two (2) times the system's *average day demand* (ADD) for the design year to be available to all service connections at 20 psi.

$$\mathbf{SB_{TSS}} = \mathbf{(2\ days)} \times \mathbf{(ADD)}$$

Where: $\mathbf{SB_{TSS}}$ = Total standby storage component for a single source system; in million gallons MG).

ADD = Average day demand for the system, in MGD;

The recommended SB volume for systems served by multiple sources can be calculated based upon the following equation:

$$\mathbf{SB_{TMS}} = \mathbf{(2\ days)} \times \mathbf{(ADD)} - \mathbf{t_m} \times \mathbf{(Q_S - Q_L)}$$

Where: $\mathbf{SB_{TMS}}$ = Total standby storage component for a multiple source system; in million gallons (MG)

ADD = Average day demand for the system, in MGD;

$\mathbf{Q_S}$ = Sum of all installed and continuously available source of supply capacities, except emergency sources, in MGD.

$\mathbf{Q_L}$ = The largest capacity source available to the system, in MGD.

$\mathbf{t_m}$ = Time that remaining sources are used on the day when the largest source is not available, in days. (Unless restricted otherwise, this is generally assumed to be one (1) day.)

The projected supply quantities for 2016 and 2030 to be used to estimate the Standby (SB) Storage requirements in those years are presented in Table 3-31.

Table 3-31 Projected Supply for Years 2010 through 2030 in MGD					
Source of Supply	**2010**	**2015**	**2020**	**2025**	**2030**
Existing Water Treatment Plant (non-drought)[1]	25.0	25.0	25.0	25.0	25.0
Existing Water Treatment Plant (drought) [4]	11.9	11.9	11.9	11.9	11.9
Existing Groundwater Wells [2, 3]	11.6	11.6	11.6	11.6	11.6
Future Gardner Park Well [6]	0.0	4.3	4.3	4.3	4.3
Future ASR Groundwater Wells [7]	0.0	0.0	3.6	7.2	7.2
Total Capacity – Non-Drought Year [3]	25.0	25.0	28.6	32.2	32.2
Total Capacity – Drought Year [3, 4, 5, 7]	23.5	28.8	28.8	28.8	28.8
Non-Drought Year Q_S - Q_L	0	0	3.6	7.2	7.2

1. The existing water treatment plant is rated at 25 MGD (17,400 gpm) consistent with the DOH Water Facilities Inventory (WFI).
2. Existing groundwater wells are designated for seasonal/emergency use only.
3. Since the existing groundwater wells are for seasonal/emergency use, they are excluded from the Non-Drought year supply.
4. During 2001, and due to drought conditions, the USBR reduced the storage control capacity of the WTP to 29%.
5. During 2001 drought conditions, the Groundwater Wells were activated.
6. The proposed Gardner Park Well would use 3000 gpm of the Ranney Well water right. Installation to be completed in 2011.
7. Two future 2,500 gpm (3.6 MGD) ASR wells are proposed. Installations are estimated for 2020 and 2025. The ASR wells would be designated as a normal sources.

The calculated Standby Storage requirements for 2016 and 2030 are presented in Table 3-32.

Table 3-32 Projected 6 and 20 year Standby (SB) Storage Requirements

	2016 ADD	2016 SB[1]	2030 ADD	2030 SB[2]
Pressure Zone	**MGD**	**MG**	**MGD**	**MG**
Level 1	9.44	18.88	10.48	13.76
Level 2	3.67	7.34	4.10	8.20
Level 3	0.50	1.00	0.58	1.18
Total	13.61	27.2	15.16	23.1

1. In 2016 there will be one normal supply sources; the WTP at 25 MGD; and SB = 2 days × ADD.
2. In 2030 there will be three normal supply sources; the WTP at 25 MGD; and one ASR wells at 3.6 MGD each. $Q_S – Q_L$ = (32.2 MGD – 25 MGD) = 7.2 MGD. Since all three of the supply sources will be in Level 1, SB_{TMS} is calculated for Level 1 and for the total system as SB_{TMS} = [(2 days) × (ADD)] – [(1 day) × (Q_S - Q_L)]. SB for Level 2 and Level 3 are calculated as SB = 2 days × ADD.

Fire Flow Rate and Duration

Public water systems are required to construct and maintain facilities, including storage reservoirs, capable of delivering fire flows in accordance with the *determination of fire flow requirement* made by the local Fire Marshal while maintaining 20 psi pressure throughout the distribution system (WAC 246-290-221(5)). The magnitude of fire suppression storage (FSS) is the product of the maximum flow *rate* and *duration* established by the local fire Fire Marshal. Fire-flow volumes are typically calculated based on the largest fire flow occurring in each pressure zone. The maximum flow rates and durations which have been established for the City of Yakima for each pressure zone are summarized in Table 3-33.

FSS can be nested within the standby storage (SB) provided as long as SB exceeds the FSS.

Table 3-33 Required Fire Flow Storage (FSS) by Pressure Zone			
Pressure Zone	**Largest Required Fire Flow in (gpm)**	**Duration (hours)**	**Required Fire Flow Volume (MG)**
Level 1	6,000	6	2.2
Level 2	5,000	5	1.5
Level 3	5,000	5	1.5

Dead storage (DS)

Dead storage (effective only to provide adequate pressure) is the volume of stored water not available to all consumers at the minimum design pressure in accordance with WAC 246-290-230(5) and (6). DS volume is excluded from the volumes provided to meet OS, ES, and/or FSS. The entire volume of each of the reservoirs in the City of Yakima Water System is available to meet minimum design pressures. Therefore DS does not need to be added in the determination of the total storage requirements.

Storage Analysis Summary

A summary of the storage analysis prepared for this Water System Plan Update is presented in Table 3-34, below.

Table 3-34 Summary of Storage Analysis						
Year/ Level	**Type of Storage**					
2016	**Operational (OS)**	**Equalization (ES)**	**Standby (SB)**	**Fire Suppres-sion (FSS)**	**Dead (DS)**	**Total Storage**
Level 1	3.62		18.88	2.2	0	22.5
Level 2	included in Level 1	0	7.34	1.5	0	7.34
Level 3	0.15	0	1.00	1.5	0	1.65
Totals	3.77		27.2	5.2	0	31.5
2030	**Operational (OS)**	**Equalization (ES)**	**Standby (SB)**	**Fire Suppres-sion (FSS)**	**Dead (DS)**	**Total Storage**
Level 1	4.03		13.76	2.2	0	17.8
Level 2	included in Level 1	0	8.06	1.5	0	8.06
Level 3	0.15	0	1.18	1.5	0	1.65
Totals	4.18		23.1	5.2	0	27.5

A comparison of the projected storage requirements with the current storage facilities is presented in Table 3-35.

Table 3-35 Comparison of the Projected Storage Requirements with the Current Storage Facilities

Pressure Zone	Current Storage MG	2016 Storage Required MG	2016 Storage Surplus (Deficit) MG	2030 Storage Required MG	2030 Storage Surplus (Deficit) MG
Level 1	6.0	22.5	N/A	17.8	N/A
Level 2	24	7.34	N/A	8.06	N/A
Level 1 + Level 2	30	29.8	0.2	25.9	4.1
Level 3	2.0	1.65	0.35	1.65	0.35
Total Storage	32	31.4	0.6	27.5	4.5

As can been seen in Table 3-35, the currently available storage is adequate through 2030.

3.3.5 Distribution System

General Description and Condition

A map of the City of Yakima water distribution system piping is shown in Figure 3-18. A summary of the pipe diameters and the respective lengths of each diameter in the system is shown in Table 3-36. Since the last WSP update in 2004, approximately 5000 feet of asbestos cement (AC) pipe has been replaced. There is no AC pipe left in the distribution system. The pipe material in the system is either ductile iron or cast iron (about 50% of each). All new water mains are constructed using ductile iron pipe in accordance with the City standards (refer to Chapter 7 of this plan for additional information regarding construction standards).

Table 3-36 Water Distribution System Pipe Diameters and Lengths

Pipe Diameter	Length in Feet	Length in Miles
2.00	12,809	2.43
4.00	6,115	1.16
6.00	540,661	102.40
8.00	550,559	104.27
10.00	3,807	0.72
12.00	261,957	49.61
16.00	75,899	14.37
18.00	5,542	1.05
20.00	15,421	2.92
24.00	20,653	3.91
30.00	3,320	0.63
48.00	44,995	8.52
Totals	**1,541,738**	**292**

The pressure zones which make up the distribution system are shown in Figure 3-19. The City of Yakima water system has three major pressure zones, designated as the Low, Middle, and High zones, plus a separate pressure zone for Gleed. A water system hydraulic profile was shown in Figure 3-10. The relationship between the pressure zones is discussed in this section.

Low Pressure Zone (Level 1)

The gravity supply from the 48-inch-diarneter transmission main flows to a 6-MG reservoir located at North 40th Avenue and Englewood Avenue. This reservoir supplies water to the Low zone. Flows from the WTP are manually adjusted to maintain a nominal hydraulic elevation of 1,264 feet, resulting in a static pressure range in the Low zone of approximately 54 to 110 psi.

During emergencies, the Low zone can also be served from the three wells, in addition to eight (8) pressure reducing valves that allow water to flow from the Middle zone.

Middle Pressure Zone (Level 2)
The Middle pressure zone is served by the River Road and Powerhouse Road Booster Pump Station from the 48-inch supply transmission main. The booster pump operation is controlled from the zone's two 12-MG reservoirs. The nominal hydraulic elevation is 1,380 feet, which results in a static pressure range of 43 to 105 psi.

During emergencies, the Middle zone can be supplied by three (3) pressure-reducing valves from the High zone or, by opening the valve that controls the intertie from the Nob Hill Water Association. During an emergency, the High zone can supply some of the Middle zone's needs for approximately one day of average water use.

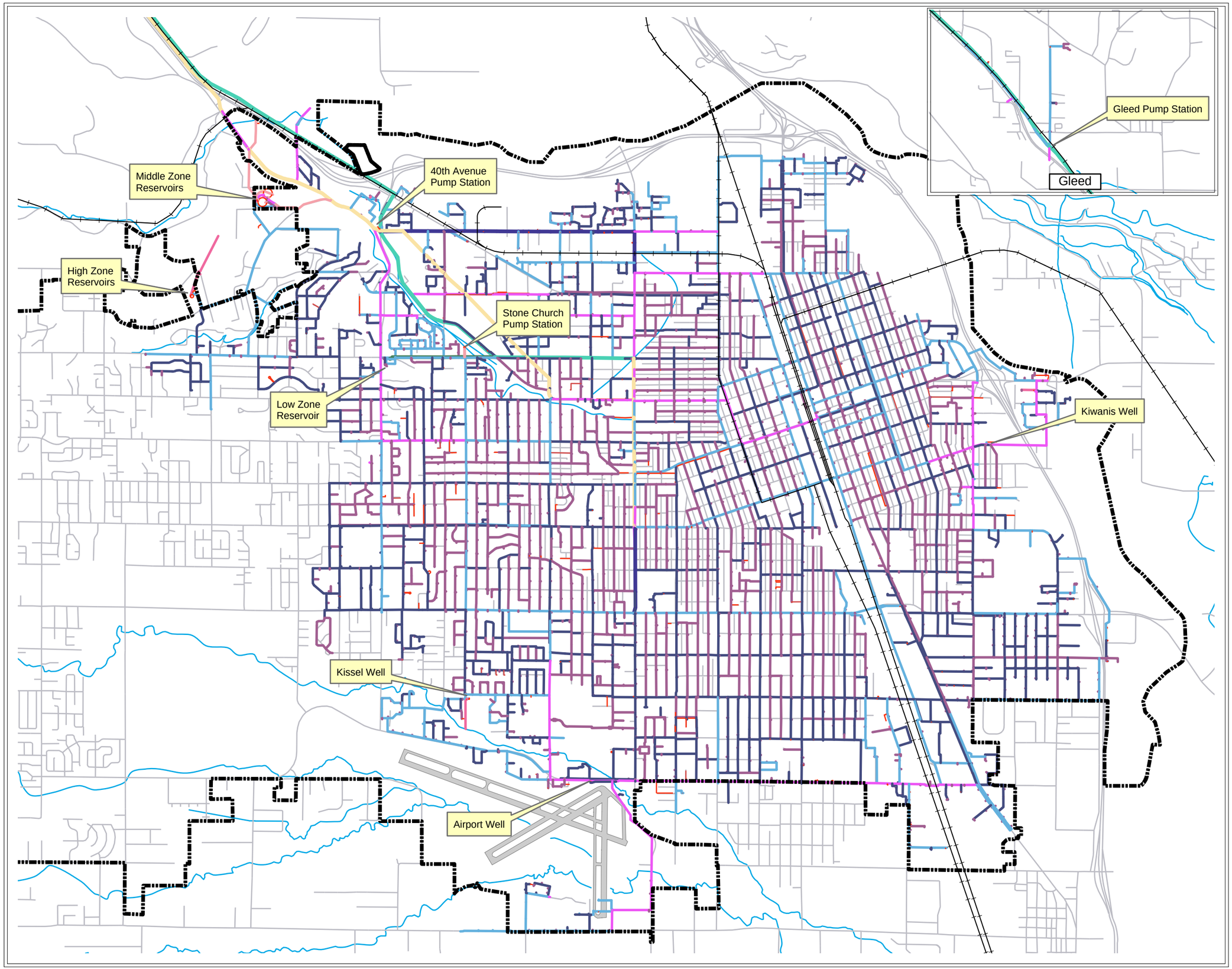
In 2000, a new booster pump station was installed near the intersection of North 32nd Avenue and Englewood Avenue. This has been designated the Stone Church booster pump station and provides another alternative for supply to the Middle zone to improve reliability and the ability to satisfy emergency demands.

From 2006 to 2009, improvements were made to the Middle zone by replacing the existing steel transmission main that filled the reservoirs with ductile iron pipe. Improvements also included installation of fill lines to the two 12-MG reservoirs separate from the discharge lines, providing for improved mixing and water quality within the reservoirs; replacement of all transmission valves associated with the isolation of the reservoirs; replacement of the access ladders and overflow standpipes within the reservoirs and installation of intrusion alarms on the reservoir access hatches.

High Pressure Zone (Level 3)
The High pressure zone is served from the Middle zone by the Reservoir Road Booster Pump Station (also referred to as the Level 3 Pumps Station) located at the site of the Middle zone's twin 12-MG reservoirs. The booster pump station includes a new 250-kilowatt (kW) generator to provide emergency power. The booster pump station operation is controlled by two 1 MG reservoirs located in the High zone. The nominal hydraulic elevation is 1,531 feet, resulting in a static pressure range of 70 to 115 psi .

During emergencies, the High zone can be supplemented by opening the valve that controls the intertie from the Nob Hill Water Association.

A summary of the pressure zone operating conditions is presented in Table 3-37.



Legend

City Limits Boundary

Waterlines

DIAMETER (in Inches)

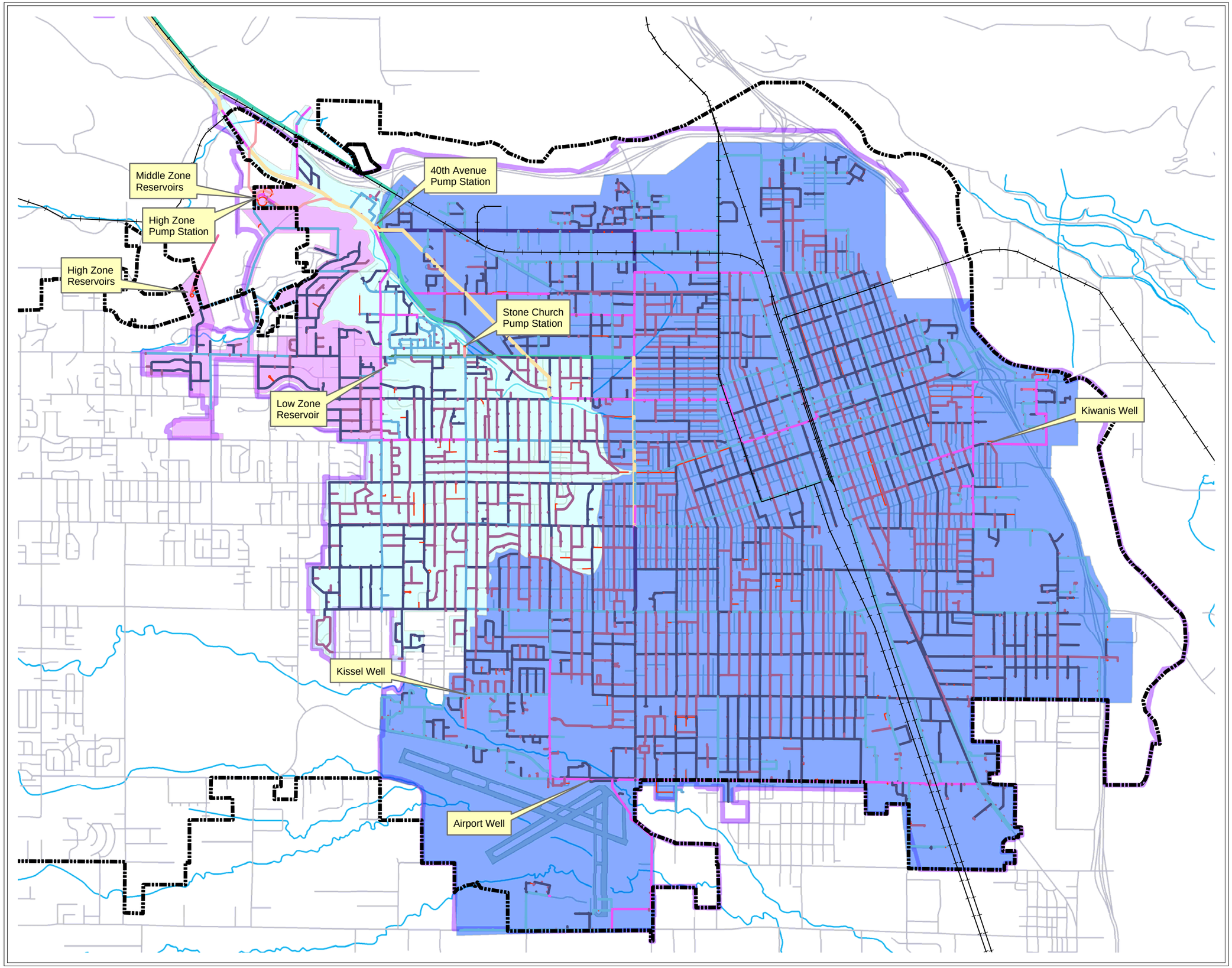
- 0 - 3
- 4
- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 36
- 48
- 54

Water System Plan Update
Figure 3-18

Water Distribution Piping

N
W E
S

0 0.15 0.3 0.6 0.9 1.2 Miles



Legend

City Limits

Pressure Zones

- Low Zone
- Middle Zone
- High Zone

Water System Plan Update
Figure 3-19

Water System Pressure Zones

N
W E
S

0 0.15 0.3 0.6 0.9 1.2 Miles

Table 3-37 Summary of Pressure Zone Operating Conditions			
Pressure Zone	**Nominal Hydraulic Elevation (feet)**	**Static Pressure Range (psi)**	
		Low	**High**
Level 1 (Low)	1,264	54	110
Level 2 (Middle)	1,380	43	105
Level 3 (High)	1,531	70	115

System Conditions and Leakage
The distribution system is generally in very good condition. In 2008/09, the City of Yakima conducted an extensive leak detection program. The program used extremely sensitive sound amplification instruments and a computer-based leak correlation program to help pinpoint the location of the leaks. Approximately 280 miles of the distribution system were included in the program. In this program, 15 leaks were detected and repaired in water mains, meters, hydrants, service lines, service connections, and valves. Additional leak detection and repair programs had been previously conducted in 1996, 1997, 1999, and 2000.

The distribution system mapping is included in the City's Geographic Information System (GIS). This system enables the Water Division personnel to continually update the map to record changes. The GIS mapping also facilitates recordkeeping for tracking the age and condition of the distribution system pipe segments. In 1995 City also implemented a maintenance management system which has been named "Automated Inventory and Maintenance Management Systems" (AIMMS). This program includes information about all of the City's facilities and equipment. This system automated the Water/Irrigation Division's existing preventive maintenance program. Refer to Chapter 6 for more complete information regarding the AIMMS.

Distribution System Design Standards
Refer to Chapter 7 of this plan for a discussion of the City of Yakima Development Standards and Water System Specifications and Details. These standards cover pipe and valve materials, valve and hydrant spacing, and water/sewer separation. Copies of these water system standards are included in Appendix O and Appendix P, respectively.

Hydraulic Capacity Analysis

The purpose of the hydraulic analysis was to evaluate the hydraulic capacity and operational behavior of the City's water distribution system and to determine how the supply, pumping, and storage components interact. The City's water distribution system was evaluated using the ArcInfo and ArcCAD Geographic Information System (GIS) and EPANET hydraulic analysis software. This combination of software was first used in the development of the 1995 Water Comprehensive Plan to add hydraulic analysis capabilities to the City's existing ArcInfo and ArcCAD systems. This application of the EPANET hydraulic model allows City staff to perform static and dynamic hydraulic and water quality analyses. The City has adopted the new versions of the EPANET model as they have become available. EPANET Version 2.0 was used for the hydraulic model analyses conducted in the development of this Water System Plan Update.

This Water System Plan Update included a review and calibration of the City's current water distribution system hydraulic model by the Akel Engineering Group (AEG). Tony Akel, P.E., the owner of AEG provided similar model review and calibration assistance for the 2004 Water System Plan Update at which time he still worked for Carollo Engineers.

The model has been generally kept current and well maintained by the Water/Irrigation Division staff. Using data provided by the City of Yakima Geographic Information Systems (GIS) Department staff, Akel Engineering Group developed exhibits that were used for mapping the existing distribution system, as extracted from the hydraulic model. These exhibits were reviewed by Water/Irrigation Division staff prior to analysis of the model by AEG. The updated hydraulic model is based on the distribution system as shown in Figures 3-18 and 3-19.

The hydraulic model data elements required for performing the calculations of pressures at nodes and the flows in pipe segments include the following data sets:

1. Physical data set,
2. Operational data set,
3. Consumption data set, and
4. Calibration data set

Physical data set

The physical data set includes information on the physical characteristics of the water distribution facilities. Components of this set include pipe diameters and lengths, pipe roughness coefficients, valve diameters, tank sizes, geographical locators (x and y coordinates), and elevations (z coordinates) at junctions, tanks, pumps, and valves. The level of confidence in the component data of this set is relatively high since Water/Irrigation Division staff has diligently kept the physical characteristics updated in their GIS database. The physical data set used in the current model incorporates recommendations which were developed in the 2004 Water System Plan Update with regard to the pipe roughness coefficients assigned to the various types of pipe which make up the distribution system.

Pipe Roughness

As pipes age, their roughness tends to increase. This increase in roughness produces a lower Hazen-Williams C-factor or a higher Darcy-Weisbach roughness coefficient, resulting in greater

frictional headloss in flow through the pipe. The most popular method for estimating the headlosses in pipes in the United States is the Hazen-Williams method. Prior to 2004, the City of Yakima hydraulic model used the Darcy-Weisbach coefficients. At that time the more common Hazen-Williams coefficients were incorporated into the model instead. Table 3-38 provides comparisons of roughness coefficients between Hazen-Williams and Darcy-Weisbach.

Table 3-39 provides recommended coefficients for new and aging cast iron pipes. These recommended pipe roughness factors were developed for the 2004 Plan based on a distribution system map with pipe materials and age maintained by City staff.

Table 3-38 Comparative Pipe Roughness Coefficients for City of Yakima Water System Hydraulic Model

Pipe Material	Manning's Coefficient n	Hazen-Williams C	Darcy-Weisbach Roughness Height	
			k (mm)	k (0.001 ft)
Asbestos cement	0.011	140	0.0015	0.005
Brass	0.011	135	0.0015	0.005
Brick	0.015	100	0.6	2
Cast-iron, new	0.012	130	0.26	0.85
Concrete:				
Steel forms	0.011	140	0.18	0.6
Wooden forms	0.015	120	0.6	2
Centrifugally spun	0.013	135	0.36	1.2
Copper	0.011	135	0.0015	0.005
Corrugated metal	0.022	---	45	150
Galvanized iron	0.016	120	0.15	0.5
Glass	0.011	140	0.0015	0.005
Lead	0.011	135	0.0015	0.005
Plastic	0.009	150	0.0015	0.005
Steel				
Coal-tar enamel	0.010	148	0.0048	0.016
New unlined	0.011	145	0.045	0.15
Riveted	0.019	110	0.9	3
Woodstave	0.012	120	0.18	0.6

Source: Haestad Methods

Table 3-39 Recommended Hazen-Williams Roughness Coefficients for City of Yakima Water System Hydraulic Model	
Pipe Material	**Roughness Coefficient (C)**
Asbestos Cement	140
Brass	130-140
Brick sewer	100
Cast-iron	
New, unlined	130
10 yr. Old	107-113
20 yr. Old	89-100
30 yr. Old	75-90
40 yr. Old	64-83
Concrete or concrete lined	
Steel forms	140
Wooden forms	120
Centrifugally spun 135	135
Copper	130-140
Galvanized iron	120
Glass	140
Lead	130-140
Plastic	140-150
Steel	
Coal-tar enamel, lined	145-150
New unlined	140-150
Riveted	110
Tin	130
Vitrified clay (good condition)	110-140
Wood stave (average condition)	120

Source: Haestad Methods

Operational data set

The operational data set describes the operational characteristics of the hydraulic controls. Tank water levels and rates of replenishment, pump characteristic curves and pump controls , PRV settings (downstream and upstream), groundwater seasonal elevations (winter/summer) for wells, flow control valve settings, and other hydraulic controls. The operational data set can often be obtained from SCADA measurements

Surface Supply
The City's primary source of potable water is the surface Water Treatment Plant (WTP) which diverts and treats water from the Naches River and conveys it to the transmission system. Flow from the WTP can be modeled as a reservoir and flow control valve that is based on the maximum capacity of the plant, and/or 2) adding a diurnal pattern to the flow from the WTP.

Groundwater Wells
The City's existing groundwater wells are designated for seasonal/emergency use. The wells include the Kiwanis Park well, the Airport well, and the Kissel Park well. The pump manufacturer curves can be obtained and entered in the hydraulic model to provide a representation of their operational characteristics.

Consumption data set

The consumption data set consists of water requirements that are applied at junction nodes to simulate various demand conditions. The demands are calculated based on the average annual production records and assigned to nodes/junctions of the hydraulic model.

The demands can be normalized to the representative average annual daily demand (ADD) for the recent years (2002 to 2009). In this task, recent water production and consumption records were reviewed to determine the average demand. Higher demands, representing the maximum day or peak hour, can be simulated by applying peaking factors. Table 3-40 provides a typical diurnal pattern for the City of Yakima.

Table 3-40 Daily Diurnal Demand Patterns for City of Yakima Water System Hydraulic Model		
Hour	**Ratio of Hourly Demand to ADD**	
	Annual Average Daily Demand (ADD)	**Maximum Day Demand (MDD)**
1	0.88	1.53
2	1.00	1.75
3	0.88	1.53
4	0.44	0.77
5	1.00	1.75
6	1.06	1.86
7	1.31	2.30
8	1.56	2.73
9	1.19	2.08
10	1.06	1.86
11	1.41	2.46
12	1.03	1.80
13	1.00	1.75
14	0.97	1.70
15	0.50	0.88
16	0.69	1.20
17	1.03	1.80
18	1.00	1.75
19	0.97	1.70
20	1.09	1.91
21	1.06	1.86
22	0.91	1.59
23	0.94	1.64
24	1.00	1.75
24 Hour Average	**1.00**	**1.75**

Calibration data set

In addition to the previously described physical, operational, and consumption data sets, the calibration data set is also needed for comparing the hydraulic model predictions with field observed and measured values. The comparison should yield reasonably close pressures. The calibration data set consists of pressure measurements at representative distribution system locations.

The existing hydraulic model was calibrated previously during the preparation of the 2004 Water System Plan Update and was shown to match well with field measurement under a series of steady state calibration tests. In order to confirm the integrity of the model and verify its accuracy it is necessary to calibrate the model periodically as part of each Water System Plan Update.

For the 2010 WSP Update, an Extended Period Simulations (EPS) hydraulic model calibration was conducted with the assistance of the Akel Engineering Group. An EPS provides a more complete calibration data set than do steady-state calibration tests, and is therefore the preferred model calibration method.

The first step in conducting the EPS hydraulic model calibration was consisted of identifying locations for installing temporary pressure loggers in the field. The calibration plan called for each pressure logger to be installed to monitor pressures for a period of one week.

A total of 9 monitoring sites were selected throughout the distribution system to provide representative pressure readings for the existing Low Pressure Zone (Level 1), Medium Pressure Zone (Level 2), and High Pressure Zone (Level 3). The monitoring sites are shown in Table 3-41 and shown on Figure 2 in Appendix E. The table also identifies the size of the transmission main closest to the monitored site.

City staff had previously purchased the pressure loggers and they were installed between the period of May 7, 2010 and June 11, 2010, in accordance with the calibration plan. The pressure loggers measured at least seven days of pressure readings at each site.

One of the pressure loggers (P0-0), located in the Low Pressure Zone, remained stationary throughout the duration of the calibration plan to monitor overall pressures variations.
The loggers recorded a pressure reading at 5-minute intervals, and at the conclusion of the monitoring program, the data was downloaded and prepared for comparison with the model simulations. Figure 3 in Appendix E is a composite graph that consolidates and summarizes the field measured pressures, from each of the monitored sites, throughout the duration of the monitoring period.

In addition to the field monitored pressure data, actual operational data recorded by the SCADA system, and coinciding with the flow monitoring period, was also extracted and used for calibration purposes. The SCADA information included storage reservoir levels for each existing reservoir and flows at booster stations.

The calibration process was iterative and resulted with satisfactory comparisons between the field measurements and the hydraulic model predictions at the 9 sites and at the storage

reservoirs. The calibration summary for average values is also included on Table 3-41, while the detailed EPS results were graphically summarized, for each site, and are shown in Figures 4 through 15 of the hydraulic model calibration technical memorandum which is including in Appendix E.

The calibrated hydraulic model becomes the benchmark for further analyses and evaluations of the distribution system. The calibrated model can be confidently used for hydraulic analysis, water trace analysis, and water age analysis.

Hydraulic models are difficult to maintain and usually become less accurate as field conditions change over the years. This hydraulic model update and calibration effort conducted as part of this WSP Update confirmed a high level of integrity in the City of Yakima existing hydraulic model.

Table 3-41 Extended Period Simulation (EPS) Hydraulic Model Calibration – Summary of Results

Location No.	Location	Week No.	Monitoring Dates	Pipe Size	Average Field psi	Average Model psi	Average Difference		EPS Figure Ref
							psi	%	
P0-0	25th Ave & River Rd, Seneca	1-3	5/21/10 - 6/11/10	20	58.5	60.7	2.3	3.9%	Figure 4
P1-1	17th St & Yakima Ave, Oxford Inn	1	5/7/10 - 5/17/10, 5/21/10 - 5/28/10	12	88.9	93.5	4.6	5.1%	Figure 5
P1-2	Front St & Pine St	1	5/7/10 - 5/17/10, 5/21/10 - 5/28/10	12	84	86.4	2.4	2.9%	Figure 6
P1-3	Rudkin Rd & Mead Ave	1	5/21/10 - 5/28/10	12	103	109.5	6.4	6.3%	Figure 7
P2-1	Washington Ave, Airport Well	2	5/28/10 - 6/4/10	16	84.4	56.9	2.5	2.9%	Figure 8
P2-2	40th Ave & Arlington St	2	5/28/10 - 6/4/110	12	94.4	98.1	3.7	3.9%	Figure 9
P2-3	24th Ave & Summitview Ave	2	5/28/10 - 6/4/110	12	85.4	82.6	-2.7	-3.2%	Figure 10
P3-1	42nd Ave & Douglas Dr, Med Clinic	3	6/4/10 - 6/11/10	12	114.4	113.8	-0.6	-0.5%	Figure 11
P3-2	52nd Ave & Englewood Ave	3	6/4/10 - 6/11/10	12	90.2	86	-4.2	-4.6%	Figure 12

Results of Hydraulic Model Analyses

The hydraulic model was run to simulate fire flow conditions at representative node locations throughout the system. The fire-flow demands (in gpm) and durations (in hours) were based on the land use and building types which presently exist in the vicinity of the node locations as determined by the International Fire Code Appendix B, Table B105.1, Fire Flow Requirements for Buildings**.** These requirements are used by the City's fire code enforcement officials in establishing fire-flows and durations for all structures within their jurisdiction.

The results of these hydraulic model analyses are presented in Table 3-42. The Department of Health requirement that pressure at all points in the system remain a minimum of 20 psi under fire-flow conditions can been met in all cases according to these hydraulic model analyses.

All of the model runs were done at 4 hours, the maximum required by the IFC.

Table 3- 42 Hydraulic Analysis under Fire Flow Conditions at Selected Nodes

Flow Node #	**Location**	**Fire Flow (gpm)**	**Duration (hours) 4 hours for all**	**Residual Pressure (psi)**
2651	By Greenway/I-82 across from Gateway	5000	4	42
2652	Fair Avenue and Gateway Center	5000	4	48
1179	Pacific and 18 St.	3000	4	46
1909	Rudkin Road and East Mead	4000	4	48
1826	S. 1st St. and Washington Ave.	4000	4	70
1826	S. 1st St. and Washington Ave.	5000	4	62
1920	16th Ave. and Ahtanum	6000	4	52
1794	24th Ave. and Washington Ave.	6000 4000	4	44 48
1729	36th Ave. and Washington Ave.	4000 3000	4	28 37
2173	Nob Hill Blvd. and 46th Ave.	4000	4	30
142	N. 6th Ave. and River Road	3000	4	50

Table 3- 42 Hydraulic Analysis under Fire Flow Conditions at Selected Nodes				
Flow Node #	**Location**	**Fire Flow (gpm)**	**Duration (hours) 4 hours for all**	**Residual Pressure (psi)**
142	N. 6th Ave. and River Road	5000	4	42
142	N. 6th Ave. and River Road	6000	4	38
2173	Nob Hill Blvd. and 46th Ave.	2000	4	71
2173	Nob Hill Blvd. and 46th Ave.	3000	4	53
1384	S. 32nd Ave. and Nob Hill Blvd.	4000	4	56
1384	S. 32nd Ave. and Nob Hill Blvd.	5000	4	46
842	N. 44th Ave. and Summtiview	2000 3000	4	33 23
830	N. 40th Ave. and Summtiview	3000 4000	4	29 23
476	Englewood and N. 56th Ave.	2000	4	65
476	Englewood and N. 56th Ave.	3000	4	54
332	Webster and N. 44th Ave.	3000	4	65
817	N. 32nd Ave. and Summitview	3000	4	68
817	N. 32nd Ave. and Summitview	4000	4	63
817	N. 32nd Ave. and Summitview	5000	4	60
1859	River Road and N. 16th Ave.	5000 6000	4	52 50
1821	Longfibre and Washington Ave.	6000 4000	4	58 70
1667	E. Mead and S. 1st St.	6000	4	44

Table 3- 42 Hydraulic Analysis under Fire Flow Conditions at Selected Nodes				
Flow Node #	**Location**	**Fire Flow (gpm)**	**Duration (hours) 4 hours for all**	**Residual Pressure (psi)**
1640	W. Mead and S. 10th Ave.	3000	4	65
1640	W. Mead and S. 10th Ave.	4000	4	59
1409	Nob Hill Blvd. and S. 10th Ave.	5000	4	47
1378	Nob Hill Blvd. and Railroad Ave.	6000 5000	4	20 34
1442	Nob Hill Blvd. and S. 18th St.	4000	4	50
871	Maple and Fair Ave.	4000	4	56
966	S. Front St. and Pine Ave.	4000	4	54
419	Poplar Ave. and N. 1st St.	5000	4	37
128	Erickson and N. 6th St.	4000 5000	4	36 24
5872	N. 11th St. and E. “B” St.	4000	4	51
5872	N. 11th St. and E. “B” St.	5000	4	42
5770	“S” St. and N. 4th St.	4000 5000	4	38 26
993	W. Chestnut Ave. and S. 24th Ave.	3000	4	50
864	Yakima Ave. and 6th Ave.	5000	4	53

Based of the hydraulic analyses conducted and summarized in Table 3-42, above, no deficiencies were noted in the distribution system at this time.

3.3.6 Summary of System Deficiencies

The individual system component analysis sections included in this chapter identified a number of needed improvements. Based on these analyses, a list of system deficiencies has been developed for each water system functional group. Each of these deficiencies is briefly described in this section.

The list of deficiencies will be prioritized. An assessment of various improvement alternatives and development of improvement schedules is provided in the next section. When evaluating water system needs, the Department of Health gives highest priority to health related issues. These priorities are taken into consideration in the development of the recommended improvement schedule.

The system deficiencies identified in this Chapter are summarized below for each of the following water system component facilities:

- Source
- Water Treatment
- Storage, and
- Distribution

Source

The current normal source of supply is the Naches River Water Treatment Plant with a nominal capacity of 25 MGD. This supply is adequate to meet the projected maximum day demand (MDD) up until 2020. The three active wells (Kiwanis, Airport, and Kissel Park) have been designated as seasonal/emergency use supplies. A drought condition such as that which occurred during 2001 is an example of an emergency condition in which the wells would be activated, as they were then. A majority portion of the normal surface water source of supply is subject to proration during low water years. In 2001, which has been the most severe drought since the Naches Water Treatment Plant has been in operation, the output of the water treatment plant was reduced to 11.9 MGD due to proration of the storage capacity water right. Including the emergency wells the total supply capacity during 2001 was 23.5 MGD (refer to Table 3-22). Referring to Figure 3-2, it can be projected that during a severe drought condition similar to 2001, the available supply might be less than the MDD beginning in 2015 if no additional source of supply is placed into service prior to that time. However, the new Gardner Park Well is under construction with a schedule completion in 2012.

Water Treatment

The City of Yakima Naches River Water Treatment Plant does not have any deficiencies that need to be addressed in the current capital improvement plan. Nevertheless, improvements to the residual solids handling facilities, as summarized below, are recommended to improve the WTP operational efficiency.

Recommended Residual Solids Handling Improvements

A Backwash Settling Basin Project Report was prepared in April 2010 by Huibregtse, Louman Associates (HLA). The report recommended the construction of four (4) new common wall concrete settling basins of 400,000 gallons each for a total settling basin volume of 1,600.000 gallons. The recommendations are based on an average daily backwash and filter-to-waste discharge of 778,100 gallons. The new settling basins would provide adequate settling time for particles in the filter backwash stream. A new pump station would be constructed to recycle the settling backwash and filter-to-waste water back to the WTP influent. The average recycle return rate would be 750 gpm with a maximum return rate of 1300 gpm. The estimated annual volume of dried solids to be removed from the settling basins would be 350 cubic yards. The existing settling basin does not allow for drying of the solids which must be pumped out wet.

The proposed project would also include a new auxiliary power generator and a new electrical service to the WTP. The estimated costs for the new backwash basin and electrical service are as follows (HLA 2010):

Structural Concrete Backwash Settling Basins	$2,349,300
Recycle Water Pump Station	$ 333,600
Water Treatment Facility Electrical Service Upgrades	$1,073,000
Total Estimated Cost	$3,755,900

The recommended improvements to the residuals handling facilities are scheduled for installation in 2012 or later.

Storage

Based on the storage analysis presented Section 3.3.4 of this Water System Plan Update, the existing storage capacity is adequate for the projected supply and demand conditions through 2030. For historical reasons the largest storage capacity is located in Level 2 although that storage capacity is also available to Level 1 where the majority of the demand is located. One problem that has been identified is the low turnover rate in the Level 2 reservoirs during low demand periods.

The reservoirs have been well maintain and are currently in good condition. With normal periodic cleaning and maintenance, their useful life can be expected to extend well beyond the 20 year planning period.

Distribution

Several distribution projects, while not needed to correct any existing deficiencies, are included in the capital improvement program as part of the City's on-going efforts to maintain and upgrade the quality of the system to meet current and future needs. Each of these proposed projects is described briefly, below and in the capital improvement program budget presented in Chapter 8 of this Water System Plan Update.

Advanced Metering Infrastructure (AMI) (FUND at $10M)

This project would replace some existing water meters, upgrade other existing meters and install new infrastructure for an AMI system. The new AMI system will allow water meter reads to be transmitted to the utility billing system multiple times per day, eliminating the need for in the field manual meter reading. AMI will improve meter reading accuracy, billing accuracy, identify customer usage patterns, potential customer leaks and provide improved customer service. Components of the AMI system include new water meters, radio transmitters for existing water meters, structures for data collection units, and software.

Private Water Main Replacement Program (FUND at $175K per year)

This on-going program replaces private mains less than 6-inch (in some cases 1-inch galvanized) and complete loops in the areas where these mains are replaced. This project improves domestic flows to current residential customers, provides fire protection in areas where no fire hydrants have previously existed and improves overall system performance and reliability by looping the new mains to existing mains.

Open Gear Valve Replacement (Fund at $25,000 per year)

There are 16-inch and larger open gear gate valves throughout the water system that are fifty to seventy-five years old and are at the end of their useful life. Some valves are no longer operable and parts are not available for repair and maintenance of the valves. This project would systematically replace one to two valves each year until all have been replaced.

The following projects do not yet have cost estimates and are not yet included in the list of projects to be funded in the current capital improvement plan. The projects and the associated needs will be addressed with the 2012 Cost of Service and Rate Study. A change in the form government (currently the City Manager form) is under consideration. If a change is made, it could affect the budgeting process and the prioritization of the projects identified in the capital improvement plan.

Del Monte Site Waterline Replacement

Currently, the existing 8-inch CI and 12-inch CI public waterlines located on the Del Monte property at West Walnut Street/West Pine Street/South 1st Avenue are underneath existing buildings. This not only presents a liability to the City should a water main break occur, repair and maintenance of these waterlines is not possible. This project would abandon the existing waterlines and install a new 12-inch waterline around the south end of the existing building (West Pine Street), as well as a new BNSF railroad crossing to South Front Street. Project cost may possibly be shared with Del Monte.

East Mead Avenue Water Main

The existing 8-inch main on East Mead Avenue east of South 1st Street is only marginally sufficient to convey fire flows to the commercial/industrial area along I-82. An improvement completed under an earlier CIP should be extended to include a 12-inch main along East Mead Avenue between South 1st Street and the existing 12-inch pipe that extends eastward from South 10th Street. This project would replace the existing 8-inch in Mead from South 1st Street to South 10th Street and replace about 300ft of existing 6-inch in South 1st Street with a 12-inch main.

Viola Avenue Freeway Crossing

Currently, the 6-inch main that crosses under I-82 is only marginally sufficient to convey fire flows to the industrial area east of I-82, including the Yakima WWTP and surrounding commercial areas. A 12-inch main is required which will extend from the intersection of Rudkin Rd. and Viola Avenue under I-82 and connect to the existing waterlines at South 22nd Street and Viola Avenue. Design and specification have been completed and are ready for construction once funding is available.

Long Fiber to South 1st Street Water Main

This project will connect the existing 12-inch main in Long Fiber Road to an existing 12-inch main in South 1st Street, including crossing the BNSF railroad, to complete a loop which will better serve this area. This will strengthen the distribution system at this location, improving fire flows and providing service to future development in this area. This project could be completed as part of a new development.

Lead-Oakum Joint Waterline Replacement

In the older downtown core area of the City of Yakima, there are existing cast-iron waterlines with pipe joints that are sealed with oakum and lead, as opposed to the standard rubber gasket. Not only are these waterlines of an age where they're nearing the end of their useful life, should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline.

Two-bolt Joint Waterline Replacement

The City of Yakima has existing waterlines with pipe joints joined together with an uncommon two-bolt system, as opposed to the standard rubber gasket. Not only are these waterline of an age where they're nearing the end of their useful life, should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline.

Undersized Waterline Replacement

This project replaces aging, undersized waterlines throughout the system within commercial/industrial and downtown core areas. Replacement of the undersized lines will improve overall system performance, improve fire flows for surrounding businesses, and provide for future development. Replacement will also eliminate aging waterlines, which will require on-going repair. Depending on the area, replacements may also include waterlines identified as part of the Lead Oakum Joint Waterline Replacement project.

New Waterline Installation in Unserved Areas

This project installs all new water facilities – waterlines, water services and fire hydrants – in areas of the City which currently do not have public water facilities. Currently, properties in these areas have individual wells, some of which are shallow and improperly constructed according to current standards. Installation of the new facilities would provide fire protection to these area, provide water service to properties (once appropriate connection fees are paid) and provide for future development within the area. Projects may be coordinated with proposed sanitary sewers projects in the same areas.

Mill Site Redevelopment

In conjunction with private developer funding, this project installs unanticipated waterlines and facilities in the currently underdeveloped area of the old Boise Cascade lumber mill site (east of I-82 and north of North Fair Avenue). The project may replace existing, undersized facilities to provide adequate flows to new development at the site, and it may also replace existing facilities that are in poor condition and are incapable of providing for the future needs of the area.

3.3.7 Selection and Justification of Proposed Improvement Projects

This section contains analyses and discussion of potential improvements that will resolve existing and anticipated deficiencies. Analyses and discussion are presented for each of the water system functional components (Source, Water Treatment, Storage, and Distribution) in the same order that they were discussed in the previous section.

Source

As discussed above in Section 3.3.6, it is projected that an additional normal supply source will be necessary by 2020 in order to meet the MDD without have to utilize the emergency well supplies. The source capacity analysis presented in Table 3-22 is based on the development of new supply sources as shown below in Table 3-43.

Table 3 -43 New Source of Supply to Meet Future MDD

New Source	Capacity MGD	Year Installed	Type of Supply
Gardner Park Well	4.3	2011	Seasonal/Emergency[1]
ASR Well No. 1	3.6	2020	Normal[1]
ASR Well No. 2	3.6	2025	Normal[1]

[1]. Both ASR wells when installed will be designated as normal sources.

The alternatives for developing new supply sources for the City of Yakima water system are limited by water rights considerations. As discussed in Section 4.3 of this Water System Plan Update, the City of Yakima holds a number of water rights that supply the City's domestic and municipal irrigation distribution systems. All of the City's surface water rights are currently under the jurisdiction of the Yakima County Superior Court as part of the surface water rights adjudication, *Ecology v. Acquavella, et al*. On November 21, 2002, the Court issued a Conditional Final Order that approves a proposed settlement of the City's Naches River water rights diverted at the Naches River Water Treatment Plant and at Nelson Bridge. For purposes of this plan, the Conditional Final Order provides an appropriate point of reference for the analysis of future supply source development. Refer to Section 4.3 for a complete discussion of the individual water rights.

Ideally any new source of normal water supply would not be subject to proration during low water years and would be available year around. All but one of the surface water rights are subject to seasonal time of use limitations. . The location for the new 3000 gpm deep well is the Gardner Park located in the southeast section of Yakima. The property is already owned by the City.

Another alternative which was considered as a possible new source of supply was the installation of a new membrane filtration plant near Nelson Bridge. A preliminary cost estimate for this alternative was $8,000,000. In addition to the relatively high cost, the water right status of the surface water withdrawal which would supply this plant has not yet been resolved and may not be resolved for several more years. For these reasons this alternative will not be considered

further at this time. It could be considered again in future a Water System Plan Update should the circumstances warrant.

Aquifer storage and recovery (ASR) is discussed in Chapter 4 as a possible source of additional supply during peak use periods or under emergency conditions. During seasonal low demand periods water would be treated in excess of the amounts required to meet demand with the excess being stored in the aquifer for later withdrawal during peak demand periods. This in effect enables the City to utilize their excess water right capacity during low demand periods to meet peak demands in summer months when surface water supplies are limited be drought conditions or other emergencies.

Transmission Main Leak Detection (Fund at $20,000)
This project would provide a detailed leak detection survey on all transmission mains (30-inch through 48-inch concrete pipe). Methods specific to leak detection on large, concrete transmission mains with limited service connections is necessary to obtain accurate results for pinpointing the location of leaks. Some methods of leak detection also provide a video analysis of interior integrity of the pipeline. Currently, the City of Yakima has approximately 9 miles of 30-inch to 48-inch pipe.

Water Treatment Plant

Residuals Handling (Fund at $3.7 M)
Recommended improvements to the Residuals Solids Handling Facilities were described in Section 3.3.6, above. This improvements are not required by current regulatory requirements, but are recommended to improve plant efficiency and reduce on-going maintenance costs.

Storage

As discussed in Section 3.3.6, above, the existing storage capacity is adequate for the projected supply and demand conditions through 2030. The only deficiency which had been previously noted (in the 2004 Water System Plan Update) was the low turnover rate in the Level 2 reservoirs during low demand periods. This deficiency was corrected with the installation of an automated flow/pressure control valve interconnection between Level 2 and Level 1 in 2007. The control valve interconnection was installed within the 40th Avenue Pump Station. In the future, it could be tied into the existing telemetry system at the 40th Avenue Pump Station to enable control remotely by the operators from the Water Treatment Plant.

Distribution

The distribution projects which have been selected for inclusion in the current capital improvement program include:

Advanced Metering Infrastructure (AMI) (Fund at $10M)

AMI will improve meter reading accuracy, billing accuracy, identify customer usage patterns, potential customer leaks and provide improved customer service. Components of the AMI system include new water meters, radio transmitters for existing water meters, structures for data

collection units, and software. AMI will allow for better monitoring and improvement of ongoing water conservation and distribution system leakage reduction programs.

Private Water Main Replacement Program (Fund at $175K per year)

This project improves domestic flows to current residential customers, provides fire protection in areas where no fire hydrants have previously existed and improves overall system performance and reliability by looping the new mains to existing mains.

Open Gear Valve Replacement (Fund at $25,000 per year)

This project would systematically replace one to two 16-inch and larger open gear gate valves each year until all have been replaced, thereby improving long-term distribution system reliability.

Other distribution system projects described in Section 3.3.6, will be implemented in the future as funds become available.

Chapter 4

Conservation Program, Water Right Analysis, System Reliability, and Interties

4 Conservation Program, Water Right Analysis, System Reliability, and Interties

The objective of this chapter is to develop a conservation program that will promote efficient water use, ensure adequate water rights are secured for existing and future needs, promote system reliability, and describe existing and proposed interties. Applicable state laws include RCW 90.03.005, .080, 383 (3), and .400, RCW 43.20.230, and .235; RCW 43.70.310, RCW 43.27A.090 (6), RCW 90.44.110, Chapter 90.46 RCW, RCW 90.54.020 (2) (6), .050 and .180, as well as WAC 246-290-100 and Chapter 173-590 WAC. This chapter consists of five main sections:

- Water Use Efficiency Program Development and Implementation;
- Source of Supply Analysis;
- Water Right Evaluation;
- System Reliability; and
- Description of existing and proposed interties.

A conservation program, as presented in this chapter, is one of the three required elements of a conservation plan. The other two elements, water use data collection and water demand forecasting, are discussed in Chapter 2, *Basic Planning Data and Water Demand Forecasting.*

4.1 Conservation Program Development and Implementation

4.1.1 Introduction

Water conservation plans include three elements:

- Water use efficiency program – Evaluation and selection of specific conservation measures for implementation.
- Water demand forecasting – Calculation/estimation of water demand six and twenty years into the future.
- Water use data collection and reporting – Collection of specific water use data elements.

Development and implementation of a water use efficiency (WUE) program is required by the Department of Health for approval of a water system plan. It is also required by the Department of Ecology when applying for new water rights. The applicable water use efficiency program requirements and guidelines are contained in *Water Use Efficiency Guidebook*, Third Edition, January 2011 (DOH 331-375)

The requirements for a water use efficiency program vary based upon water system size and whether or not additional water rights will be needed within twenty years. In all cases, the larger the size of the system, the more detailed and comprehensive the program. Additionally, if water rights are identified as being necessary within twenty years in the systems water demand forecast, the conservation planning must also evaluate conservation/efficiency measures in addition to other supply alternatives.

4.1.2 Required Conservation (Water Use Efficiency) Measures for Municipal Water Systems

Background

In 2003, the Washington State Legislature passed Engrossed Second Substitute House Bill 1338, better known as the Municipal Water Law, to address the increasing demand on our state's water resources. The law established that all municipal water suppliers must use water more efficiently in exchange for water right certainty and flexibility to help them meet future demand. The Legislature directed the Department of Health (DOH) to adopt an enforceable Water Use Efficiency (WUE) program, which became effective on January 22, 2007. The requirements of the program are summarized in Table 4-1.

Table 4-1 Summary of Water Use Efficiency (WUE) Program Requirements

Requirement	Deadline for municipal water suppliers with 1,000 or more connections	Comments
Begin collecting production and consumption data	January 1, 2007	Already in place
Include WUE program in planning documents	January 22, 2008	To be included in this current WSP update
Set your own WUE goals	January 22, 2008	Adopted by the Yakima City Council in January 2008
Submit service meter installation schedule	July 1, 2008	System has been fully metered for many years
Submit first annual performance report	July 1, 2008	Submitted in June 2008
Meet distribution leakage standard (based on 3-year rolling average)	July 1, 2010	Established as one of the WUE goals
Complete installation of all service meters	January 22, 2017	System already fully metered

4.1.3 Water Use Efficiency Goals

The regulation (WAC 246-290-830) requires the governing body of the municipal water system (the Yakima City Council in this case) to develop the water use efficiency goals through a public

process. The current WUE goals were considered in a public hearing at the regular January 15, 2008 City Council meeting. A copy of the Council Action Minutes from that meeting and a signed copy of Resolution No. R-2008-11 adopting the Water Use Efficiency Goals are included in Appendix G. The hearing allowed for public input on the proposed goals. The Water Use Efficiency Goals established through this process are as follows:

1. Reduce DSL to 10% or less by July 1, 2010.

2. Maintain the current residential use per capita of 74.9 gallons per capita per day for the residential customer class as determined in the 2004 Water System Plan Update (this goal is appropriate since the Yakima Water System is not expanding and current per capita use is already low based estimates in the current Water System Plan update. The per capita usage estimate based on consumption based on the data analyzed in preparing the 2010 Water System Plan update was about 88 gpcd for the residential class in Level 1. This confirms that maintaining a per capita use of 74.9 gpcd will require continuing efforts to conserve water by implementing WUE measures and that it is an appropriate goal.)

4.1.4 Water Use Efficiency Measures

As part of a water system plan, DOH regulations also require the implementation a specified number of water use efficiency measures. Systems with more than 10,000 service connections (such as the City of Yakima) are required to implement nine WUE measures. The evaluation and selection of measures should be related to the cost-effectiveness of the measures. An evaluation of WUE measures was included in the WSP update planning process. Based on this evaluation of possible measures, 12 measures were identified as being the most likely to be cost effective. These measures are listed in Table 4-2. Refer to Section 4.1.5 for a description of the Conservation Program and a discussion of the selection of the recommended WUE Measures.

Table 4-2 Recommended Water Use Efficiency Measures (nine measures required)

Indoor Residential	Outdoor and Large Separately Metered Irrigation Customers	Industrial/Commercial/ Institutional
Conservation rates	Conservation rates	Conservation rates
Customer leak detection education	Water bill showing consumption history	Water bill showing consumption history
Water bill showing consumption history	Irrigation Demonstration Project (e.g. BOR program)	Using reclaimed Water (WWTP)
Advanced Metering Infrastructure (AMI)	Advanced Metering Infrastructure (AMI)	Advanced Metering Infrastructure (AMI)

4.1.5 Conservation Program and Program History

The elements included in the conservation program include the following:

- Conservation Objectives (WUE Goals)
- Evaluation of WUE Measures
- Identification of Selected Conservation Activities (WUE Measures)

The City has established four main objectives to be achieved in its conservation program:

1) Minimize impact of conservation program on domestic water rates
2) Encourage conservation ethic through increased customer awareness
3) Reduce commercial and industrial water consumption
4) Comply with DOH guidelines and state law.

In recent years the City has made significant progress towards achieving its conservation objectives by implementing the required measures and by implementing many other measures suggested for consideration. A brief summary of the City's past and ongoing water conservation activities is presented below.

Beginning in 1989, the City began to distribute water conservation brochures to educate the public about water conservation, including *Water Saving Guidelines* 1, 2, 3, *and* 4 from DOH and the Washington State Department of Ecology. While the water savings associated with public education are difficult to quantify, public education is crucial for the implementation of a successful program.

All sources of supply and all customer accounts on the potable water system are metered, enabling the City to measure water consumption and provide the basis for evaluating water use patterns and the potential for conservation. In 1990, the City began a program to replace existing 3-inch and larger meters with state-of-the-art compound/turbine meters to ensure greater accuracy in monitoring water usage.

The City of Yakima has conducted an extensive and ongoing leak detection program. The program used extremely sensitive sound amplification instruments and a computer-based leak correlation program to help pinpoint the location of the leaks. Approximately 220 miles of the distribution system (90 percent of the total system) were included in the program. In this program, 85 leaks were detected and repaired in water mains, meters, hydrants, service lines, service connections, and valves. It should be noted that none of these leaks were significant in relation to the observed distribution system leakage observed during this period.

All water from a potable source used at the wastewater treatment plant is metered. Since the late 1970s, reclaimed water has been used for all wash downs and for irrigation at the treatment plant. The wastewater treatment plant uses 1.0 to 1.5 MGD of reclaimed water for 8 months per year and 0.5 to 0.7 MGD for the remainder of the year. (See Section 4.1.7 for a discussion of other water reuse options evaluated in the plan.)

In July 1993, the new state building code went into effect, prohibiting the sale in Washington of plumbing fixtures that do not meet the standards for efficient water use (maximum of 1.6 gallons per flush for toilets and 2.5 gallons per minute for faucets and showerheads). Thus, all fixtures in Yakima installed after July 1993 should be water efficient fixtures and will result in reduced indoor water use.

Evaluation of Water Use Efficiency Measures

The steps used to evaluate the potential measures for Yakima's WUE program include:

- Identify potential WUE measures
- Estimate costs and savings for each measure
- Estimate participation rates
- Screen measures for cost-effectiveness

During the preparation of the previous water system plan updates, an initial list of 25 potential conservation measures was developed for consideration by City staff and the Advisory Committee. The list included measures implemented by other Northwest water utilities and the minimum program measures required by DOH. From these 25 measures, the measures that were deemed to be applicable to Yakima were placed on a "short list" for more detailed evaluation.

Measures that have already been implemented (installation of source meters and service meters, high technology meters, leak detection, and the new state plumbing code) were included in the measures selected for the conservation program so that the conservation savings already achieved could be quantified. The inventory of the sources and potential uses for reclaimed water is presented in Section 4.1.9 of this chapter.

Once the short list of conservation measures was developed, the measures were evaluated to determine which ones would provide the maximum effectiveness in water savings at the lowest possible costs

The measures selected include:

Conservation Rates (all user categories) - In October 2007 the City conducted a Cost of Services and Rate Study which established a transition to a conservation rate structure, which was completed in January 2009. The existing water rate structure includes a minimum bill (ready-to-serve-charge) similar to the one defined in the American Waterworks Association's M1 - Water Rates Manual. Another Cost of Service and Rate Study will be completed in the spring of 2012. This study will evaluate the merits of enhancing the current conservation rate structure. Sewer use charges are linked to water consumption, and in Yakima, the sewer use charges are higher than the water consumption charges. This provides a very significant additional incentive to conserve water.

Customer leak detection education (indoor residential category) – Customer leak detection education will be carried out using billing inserts. Customers will also be directed to the City's website for additional information on leak detection and other water efficiency measures. Links will be provided to EPA's WaterSense program as well as to Pacific Power and Cascade Natural Gas incentive programs for water saving fixtures and appliances. Energy Star appliances (e.g. clothes and dishwashers) save water as well as energy.

Water bill showing consumption history (all user categories) – In previous plans, consumption history on the billings was not determined to be cost effective. However, with the implementation of the new billing system in 2010, it is now possible and cost effective to include consumption history of the bills for all user categories.

Irrigation Efficiency Demonstration Projects (**Outdoor and Large Separately Metered Irrigation Customers) –** the City will seek out collaborative partnerships with the Bureau of Reclamation and large separately metered irrigation customers to demonstration water use efficiencies measures such as wireless control systems utilizing moisture sensors and other improved irrigation system technologies. The results of the demonstration projects will be provided to other potential users through media reports, the City website, and targeted mailings.

Increased Use of Reclaimed Water at the Wastewater Treatment Plant (**Industrial/ Commercial/ Institutional**) **-** Since the late 1970s, reclaimed water has been used for all wash downs and for irrigation at the wastewater treatment plant WWTP). The wastewater treatment plant uses 1.0 to 1.5 MGD of reclaimed water for 8 months per year and 0.5 to 0.7 MGD for the remainder of the year. The Wastewater Division is currently evaluating additional reuse options, including the use of reclaimed water for restoration of floodplain property adjacent to the WWTP. (See Section 4.1.7 for a discussion of other water reuse options evaluated in the plan.)

Advanced Metering Infrastructure (All user categories) - The implementation of Automated Meter Reading/Advanced Metering Infrastructure (AMR/AMI) is included in the Water System Capital Improvement Plan (see Chapter 8). AMR/AMI will allow for real time monitoring and geocoding of consumption data and will be extremely valuable in evaluated the effectiveness of the water use efficiency measures and in future water system planning. The AMR/AMI project will involve replacement and upgrade of virtually all of the existing water meters. The new meters will be required in order to be compatible with the AMR/AMI technology.

Measures That Were Not Selected for the Conservation Program

The other measures that were evaluated in the previous water system plan, but are not recommended for implementation at this time, are described briefly below. (Note that Consumption History on Billings was not selected in the previous evaluations, but will now be included as part of the new billing system).

Retrofit Kits and Residential Water Audits - Other items which were considered included retrofit kits, the toilet flappers (devices that regulate the amount of time for filling the toilet bowl) and the residential water audits, are expensive to implement. The toilet flappers often require installation by utility personnel; toilet flappers that are only delivered to the customer are often not installed. The residential water audits are usually conducted by a representative of the

water utility at the resident's request. The utility representative discusses indoor and outdoor water use, suggests water saving practices, and may install water retrofit devices. Audits typically take approximately one hour. The cost of the audit includes scheduling, follow-up, and materials and conservation devices. Although this measure was not shown to be cost-effective using utility personnel, the City may want to consider diverting some of its community youth volunteers to a pilot residential audit program. The costs of such a program would be less, and the publicity surrounding such efforts would promote the conservation message. The City may wish to explore, in the future, the possibility of collaborating with Pacific Power and Cascade Natural Gas to distribute retrofit kits. The advantage to Pacific Power and Cascade Natural Gas would be the energy saved from decreased use of hot water.

Landscape Management/Xeriscape - Although this measure was not shown, in the previous plans, to be cost-effective for the City to implement, the City may want to discuss the idea of promoting regionally adapted, low-water-use landscaping with the nurseries and landscaping industry in Yakima. Such plants require both less care and less water and provide a diverse landscape. Where feasible the City will try to educate water users about xeriscape options through the City's website which can provide links to outside resources such as the Yakima Area Arboretum and Master Gardeners.

Commercial/Industrial Audits - Like the residential audits, commercial/industrial can be time-consuming and expensive for the City to conduct. However, the City may want to consider holding a forum with key business leaders to discuss the idea of water conservation, encourage them to explore ways of reducing their own water use (and hence their water bills), and provide examples of businesses and industries that have successfully reduced water use without sacrificing product quality or service. The potential for use of reclaimed water to offset potable water use is discussed in Section 4.1.9 of this chapter.

4.1.6 Evaluation of Water Use Efficiency Program

During the period from 2002 through 2009, the observed distribution system leakage ranged from 10.4% in 2004 to 31.7% in 2008. (See Table 4-3)

The reasons for the very high estimated DSL in 2008 are not fully understood at this time. One of the suspected reasons for the high degree of variability in estimated DSL over the period lies in the billing system itself. Meter reading is bi-monthly and because of the way the billing cycles fall, the usage in sometimes entered into the billing system in the year following the actual time of use. In 2008 the reported authorized use was dramatically lower than in 2007 while the total amount of water supplied was slightly more in 2008 than in 2007. Throughout the period from 2002 to 2009, the number of customer connections in each user class has remained essentially unchanged.

Ongoing leak detection efforts over the years have failed to identify any significant amounts of actual leakage in the distribution system. Efforts to better understand and reduce the DSL have therefore focused initially on upgrading the billing system and undertaking a meter replacement program. Work on the development of a new billing system was initiated in 2009. The new system was implemented in July of 2010. The new billing system in conjunction with the City's

geographic information system (GIS) will enable geo-coding of consumption data which will be a valuable tool to help better understand DSL and the most cost effective ways to reduce it through the implementation of the water use efficiency measures listed in Table 4-2.

In another important step toward gaining a better understanding water consumption and DSL, the City undertook a feasibility study of Automated Meter Reading/Advanced Metering Infrastructure (AMR/AMI). The implementation of AMR/AMI is included in the Water System Capital Improvement Plan (see Chapter 8). AMR/AMI will allow for real time monitoring and geocoding of consumption data and will be extremely valuable in evaluated the effectiveness of the water use efficiency measures and in future water system planning. The AMR/AMI project is scheduled to begin in 2011 and to be completed in 2013.

As noted above, the Yakima City Council adopted the water use efficiency measures listed in Table 4-2 in January 2008. From 2008 to 2009 the DSL dropped from 31.7% to 17.0%. This is nearly a 15% reduction, but still significantly higher than the WUE goal of 10% or less. It should be noted that the new billing system was not yet in place in 2009. However, the Water/Irrigation Division staff had been working closely with the Finance Department during this period to identify and correct inaccuracies in the old billing system where possible. Some of the reduction in DSL between 2008 and 2009 is likely due to the implementation of WUE measures, but it will be very difficult to quantify these reductions until the new billing system is fully operational and the AMR/AMI system has been implemented.

The Yakima Water System has been fully metered for many years. It is suspected that many of the existing meters are underreporting water consumption due to their age and other factors. Underreporting meters could also be a significant factor in the observed high percentages of DSL. Because the implementation of AMR/AMI will in most cases require replacement of the meter when a transmitter head is installed, the meter replacement program which had been planned will be deferred until the AMR/AMI project moves forward. The cost of the AMR/AMI project is included in the current budget. (Refer to Chapter 8 – Improvement Plan).

Table 4-3 Estimated Distribution System Leakage (2002 through 2009)

	2002	2003	2004	2005	2006	2007	2008	2009
Total Authorized Use (100 ft^3)	4,836,514	4,761,074	4,904,298	4,601,989	5,158,254	5,130,874	4,244,964	4,746,321
Total Supplied Water (100 ft^3)	6,062,834	5,949,198	5,475,557	6,052,444	6,336,210	6,066,990	6,215,560	5,718,243
DSL (100 ft^3)	1,226,320	1,188,124	571,259	1,450,455	1,177,956	936,117	1,970,596	971,922
DSL as % of Water Produced	20.20%	20.00%	10.40%	24.00%	18.60%	15.40%	31.70%	17.00%

4.1.7 Consumer Education Program

The yearly consumer education program will include a billing insert with the annual report providing water system users with information on water use efficiency measures. As previously noted, all bills now include consumption history. The City's website will be regularly updated to provide links to water conservation educational resources.

WaterSense is an EPA-sponsored partnership program, launched in 2006, that seeks to protect the future of our nation's water supply by promoting water efficiency and enhancing the market for water-efficient products, programs, and practices. The City of Yakima joined the WaterSense program in September 2010.

WaterSense brings together local water utilities and governments, product manufacturers, retailers, consumers, and other stakeholders to:

- Decrease indoor and outdoor non-agricultural water use through the adoption of more efficient products and practices.
- Help consumers make water-efficient choices, including differentiating between products and services in the marketplace and adopting simple daily activities that reduce water use.
- Encourage innovation in manufacturing
- Establish and standardize rigorous certification criteria that ensure product efficiency, performance, and quality.

WaterSense helps consumers identify water-efficient products and programs that meet WaterSense water efficiency and performance criteria. Products carrying the WaterSense label perform well, help save money, and encourage innovation in manufacturing.

WaterSense partners with manufacturers, retailers and distributors, and utilities to bring WaterSense labeled products to the marketplace and make it easy to purchase high-performing, water-efficient products.

WaterSense also partners with irrigation professionals and irrigation certification programs to promote water-efficient landscape irrigation practices.

4.1.8 Water Loss Control Action Plan

The City of Yakima established a Water Use Efficiency Goal to reduce DSL to less than 10% by 2010. This goal has not yet been achieved. The estimated DSL for 2009 was 17%. Because of this a Water Loss Control Action Plan is required.

Actions which have already been implemented include:

- A new billing system (put on line in 2010)
- A new source meter on each of the seasonal/emergency wells
- Ongoing transmission main and distribution system leak detection monitoring and repair

As has been previously noted, no significant amount of leakage has been detected in either the transmission main or the distribution system since the systematic leak detection program was implemented in the early 1990s.

The most significant planned action to reduce DSL is the AMR/AIM project which is scheduled to begin in 2011. This project would replace most existing water meters, upgrade other existing meters and install new infrastructure for an AMI system. The new AMI system will allow water meter reads to be transmitted to the utility billing system multiple times per day, eliminating the need for in the field manual meter reading. AMI will improve meter reading accuracy, billing accuracy, identify customer usage patterns, potential customer leaks and provide improved customer service. Components of the AMI system include new water meters, radio transmitters for existing water meters, structures for data collection units, and software. The estimated cost of the AMR/AMI project is $10 million dollars and this cost is included in the capital improvement budget (see Chapter 8).

As a result of replacing meters and implementing AMI, it is expected that revenues will increase from more accurate billing information. The city has taken steps to verify the source meters accuracy and have them calibrated on a regular basis. (As noted above, new magnetic flowmeters have recently been installed on each of the wells replacing the older insertion type flowmeters.) The new AMI system will provide an opportunity to conduct an accurate DSL each day.

Another Cost of Service and Rate Study will be completed in the spring of 2012. This study will evaluate the merits of enhancing the current conservation rate structure.

4.1.9 Water Reuse

An inventory of the potential sources and uses for reclaimed water is required by the *Conservation Planning Requirements* to be included in the conservation plan. A discussion of the regulations governing the use of reclaimed water and the potential sources and uses is presented below. The use of reclaimed water was not included in the current conservation plan except for its continued use at the wastewater treatment plant.

Reclaimed water is commonly used for landscape irrigation, agricultural irrigation, or industrial processes. The feasibility of using reclaimed water as a water supply depends upon the quality and quantity of the reclaimed water, the requirements of the intended application site, the economics of treating, supplying, and distributing the reclaimed water, and public acceptance.

Regulations

In 1996, Chapter 90.46 RCW was enacted by the legislature to address reclaimed water use. In passing this legislation, the legislature has encouraged the development of wastewater reclamation and reuse facilities and the use of reclaimed water for domestic, agricultural, industrial, recreational, and fish and wildlife habitat including wetlands. The legislature directed the departments of Health and Ecology to coordinate efforts towards developing an efficient and streamlined process for creating and implementing processes for the use of reclaimed water.

The legislature declared that the people of the state have a primary interest in the development of facilities to provide reclaimed water to replace potable water in non-potable applications, to supplement existing surface and groundwater supplies, and to assist in meeting future water requirements of the state. The legislature also declared that the use of reclaimed water is not inconsistent with the policy of anti-degradation of state waters as provided under Chapter 90.48 RCW and Chapter 90.54 RCW. Reclaimed water facilities are water pollution control facilities as defined in Chapter 70.146 RCW and are eligible for financial assistance as provided in that RCW.

The Washington State Department of Health (DOH) issued final water reclamation and reuse standards in Chapter 246-272 WAC in September of 1997. These standards, as directed by the legislature, were the result of a joint effort by Ecology and DOH. While the standards are primarily administered by the DOH for facility plan review, Ecology has state wastewater discharge permitting authority under the provisions of Chapter 90.48 RCW.

The 1997 Reclamation and Reuse Standards (Chapter 246-272 WAC) establish requirements for wastewater treatment and reuse. A multi-tiered (Class A through D) reclaimed water classification system defines the characteristics of the reclaimed water for each class. The definitions for each class are listed below:

> "Class A Reclaimed Water" means reclaimed water that, at a minimum, is at all times an oxidized, coagulated, filtered, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of coliform organisms does not exceed 23 per 100 milliliters in any sample.
>
> "Class B Reclaimed Water" means reclaimed water that, at a minimum, is at all times an oxidized, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of total coliform organisms does not exceed 23 per 100 milliliters in any sample.
>
> "Class C Reclaimed Water" means reclaimed water that, at a minimum, is at all times an oxidized, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 23 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed, and the number of total coliform organisms does not exceed 240 per 100 milliliters in any sample.
>
> "Class D Reclaimed Water" means reclaimed water that, at a minimum, is at all times an oxidized, disinfected wastewater. The wastewater shall be considered adequately disinfected if the median number of total coliform organisms in the wastewater after disinfection does not exceed 240 per 100 milliliters, as determined from the bacteriological results of the last 7 days for which analyses have been completed.

Reclamation and reuse regulations specifically identify groundwater recharge as a beneficial use, and reclaimed water can be used to mitigate water rights limitations, should they exist.

Potential Sources

Effluent from wastewater treatment plants is the most common source of reclaimed water for municipal applications; however, other sites may also serve to provide a source of water for reuse, depending on the reliability and treatment requirements of the applied water. The primary source of reclaimed water in the City is the Yakima Regional Wastewater Treatment Plant (WWTP) located between Interstate 82 and the Yakima River off Frontage Road. The activated sludge plant is operated by the City of Yakima and primarily discharges secondary effluent into the Yakima River. The WWTP is the most likely source for reclaimed water for additional uses within the City. During the early irrigation season, a portion of the effluent is used to irrigate 95 acres of adjacent farmland. In the past, wastewater from a pear processing facility was used to irrigate pasture land during the latter part of the irrigation season. The practice has recently been discontinued due to Department of Ecology imposed regulatory considerations.

Boise Cascade operated a timber products facility at the northern end of the City, until 2009 at which time the facility was closed. When in operation, the facility had five water meters and used approximately 346,000 CCF of water per year. The previous Water System Plan Update had identified the timber facility as a potential reuse site. Planning is currently under way to develop the old mill site for mixed commercial development. It is less likely that such development would lend itself to water reuse opportunities.

There is one fish hatchery located in the vicinity of the City. Currently, wastewater from the hatchery is discharged into adjacent surface waters. The fish hatcheries could potentially become a source of reclaimed water, although their distance from the City would likely eliminate most uses other than agricultural irrigation based on economics.

Potential Reclaimed Water Users

The feasibility of using reclaimed water depends on the volume and quality of the source, the size and location of suitable application sites and the proximity of the source to the application or use sites. Table 4-4 presents an inventory of potential reclaimed water users located within 2 miles of the WWTP, which was considered to be the most likely source of water. As the distance from the source increases, the economic feasibility of serving reclaimed water typically diminishes unless there is a large, constant user available. Potential users were identified based on maps of the area and a listing of the top 30 water users.

Table 4-4 Potential Reclaimed Water Users Within 2 Miles of the WWTP	
Application	**Number**
Golf courses	2
Parks and arboretum	9
Schools	5
Industrial/commercial facilities	2
Nurseries	1
Freeway landscape irrigation	1
Yakima WWTP	1
Misc.-pipeline flushing, street cleaning dust control, etc.	---

Although two industrial/commercial facilities with high water use are located within the 2-mile radius area, it is unlikely that either would use reclaimed water. Both facilities work with food products.

The remaining reuse applications could potentially use a range of Class A to Class C reclaimed water, depending on the specific water quality requirements of each use as represented in the *Water Reclamation and Reuse Standards* (September 1997, Department of Ecology Publication No. 97-23).

In general, a suitability study is required to determine whether reclaimed water is feasible for landscape or agricultural irrigation. The chemical quality of the water must be compared with the water quality and quantity requirements of the vegetation on which it will be applied. For industrial applications, a reclaimed water characterization is required to provide potential industrial users the information necessary to make an informed decision. Elements of a characterization would include chemical composition, corrosivity, annual temperature cycles, and physical attributes such as color, scaling potential, and particulate content.

Although use of reclaimed water in Yakima may be technically feasible, some institutional constraints must be considered. The unit cost of potable water is relatively low in Yakima, so the unit cost of reclaimed water may exceed the unit cost of potable water and may be difficult to sell. Although the use of reclaimed water to help meet large-scale agriculture's irrigation needs would likely be acceptable, the quantities of reclaimed water that could be made available may be too small to justify the investment in reclaimed water facilities. Finally, the use of reclaimed water to irrigate schools, parks, and other public landscaping may meet with public skepticism unless it is accompanied by a public education program focused on the safe use of reclaimed water.

4.2 Source of Supply Analysis

4.2.1 General

The purpose of a source of supply analysis is to evaluate opportunities to obtain or optimize the use of existing sources already developed, and evaluate other innovative methods to meet water needs. DOH planning guidelines require a source of supply analysis for systems that will be pursuing water rights within 20 years of approval of their WSP as defined by the water demand forecast (see Chapter 2, *Basic Planning Data and Water Demand Forecasting*). A discussion of the current status of the water rights held by the City of Yakima is provided in the following section of this chapter. The City does not anticipate the need to pursue additional water rights within 20 years of the completion of this WSP update. For that reason, a formal source of supply analysis will not be included here. The City did, however, undertook an Aquifer Storage and Recovery (ASR) pilot study beginning in 2000. ASR is being considered as a means of better utilizing existing primary water rights. ASR could serve to supplement existing water supplies should future demands or supply conditions require additional supply sources. A summary of the ASR study is provided below.

4.2.2 Aquifer Storage and Recovery (ASR)

The City of Yakima conducted an Aquifer Storage and Recovery (ASR) pilot test under the direction of Golder Associates during the winter of 2000-2001 to assess the operational and technical feasibility of incorporating ASR as part of the municipal water supply system. The source of the water was the Naches River (Rowe Hill) Water Treatment Plant (WTP). The recharge well was the City's Kissel Well, which is screened between 876 and 1,163 feet below ground surface, in the Lower and Middle Members of the Upper Ellensburg Formation.

Recharge to the Kissel Well was conducted for 25 days at a rate of approximately 1,200 gallons per minute (gpm). A total of 45.2 million gallons (Mgal; approximately 139 acre feet [AF]) was recharged. After a storage period of 55 days, recovery was conducted at a constant pumping rate of approximately 2,000 gpm for 30 days. A total of 89.7 Mgal (275 AF) was recovered. Additional water was removed during post-pilot test step tests.

Water for the pilot test was delivered through the existing municipal water supply system of the City of Yakima. The distribution system operated without disruption of public service.

Short-term well efficiency of the Kissel Well at a pumping rate of 2,000 gpm decreased during recharge activities by approximately 25%. It is interpreted that introduction of distribution system pipe scale and to a lesser extent precipitation of aluminum hydroxide (gibbsite) may have caused most of the temporary reduction in well efficiency. Well efficiency was fully recovered after approximately eight hours of pumping, most likely as a result of effective flushing of any introduced scale, and precipitated minerals.

Groundwater levels increased in the aquifer during recharge and remained approximately six feet above the ambient static groundwater level during the approximately two month period of storage. The maintenance of raised water levels during the storage period indicates that the recharged water is not migrating rapidly away from the recharge well or leaking from the storage

zone. This indicates that physical aquifer properties of the Lower Member of the Upper Ellensburg Formation are favorable for a full-scale ASR program in that recharged water is relatively contained by the aquifer.

Water quality monitoring throughout the pilot test indicated compliance with drinking water standards. Although disinfection byproduct (DBP) concentrations did increase temporarily during storage before decreasing, DBP concentrations remained well below drinking water standards at all times. Based on the results of tracer analyses, it is estimated that approximately 70% of the water recharged to the aquifer was recovered.

Aquifer Storage and Recovery in the Ellensburg Formation aquifer of the Ahtanum-Moxee Basin is hydrogeologically feasible. The aquifer has significant storage capacity and the response to artificial recharge is a sustained rise in aquifer water levels. Recharge can be accomplished through the Kissel Well. Recharge through the Airport and Kiwanis Wells may be possible although pilot testing at those wells would be needed to ensure feasibility. However, use of these wells in an ASR program will not result in an increase in the total withdrawal capacity of the City of Yakima's groundwater supply system.

To increase the capacity of the groundwater supply system, additional wells will have to be installed. Permitting of withdrawals is anticipated to be facilitated if they are operated as part of an ASR program. Permitting of an ASR program would likely be facilitated by development of regulations by the Washington Department of Ecology. Key regulatory components that will affect the feasibility for the City of Yakima include: 1) how ASR operations using chlorinated potable water containing DBPs will be addressed under existing Water Quality Standards for Groundwater (Ch. 173-200 WAC); and, 2) the means of quantifying the permitted amount of water that may be recovered following recharge.

As noted above, recharge testing at the Kissel Well has been conducted at rates of about 1,000 to 2,000 gpm, and the well was operated during the pilot test at about 1,200 gpm. The recharge capacity of the other City wells (Airport and Kiwanis) has not been tested, however, ASR is also expected to be feasible at these wells.

A constant recharge rate was maintained over the recharge period, indicating that the distribution system pressure was sufficient to allow recharge to the well with the rising water level and decrease in recharge efficiency during the recharge period. Although the distribution system pressure at the Kissel Well was relatively constant at about 55 psi, the system pressure in other parts of the distribution system ranges up to 110 psi, including at prospective future dedicated ASR well sites. Higher system pressure will allow higher recharge rates. Hydraulic modeling of the distribution system is recommended to determine the resulting individual and cumulative effects of conducting recharge from multiple points in the distribution system.

Recharge water may be available for approximately 200 days (approximately October 15 to May 15). If three wells are used for recharge over this period with an average recharge rate of 1,000 gpm per well, a total of 864 Mgal (approximately 2,650 AF) could be recharged, assuming water availability and continuous recharge.

The recovery capacity of the three existing City wells is about 8,050 gpm (11.6 MGD). If the assumed peak City demand is 22 MGD, the existing wells have about half of the capacity required to meet demand in the event of a total shutdown of the Naches River Treatment Plant. New wells or other supplies may be advisable to increase system capacity in the event of a long-term shutdown of the Naches River (Rowe Hill) Treatment Plant.

If the City were to pursue the drilling of additional wells for the purposes of an ASR program, the following items should be given consideration when siting wells:

1. Hydraulic modeling of the distribution system should be conducted to determine the resulting individual and cumulative effects of conducting recharge from multiple points in the distribution system
2. New wells should be sited in areas where the Ellensburg Formation is the thickest. Figure 2.8 in the Technical Compilation (Golder, 2000a) provides information on the thickness of the Ellensburg Formation.
3. New wells should be completed in the Lower Member of the Upper Ellensburg Formation.
4. New wells should be sited in areas of low aquifer hydraulic gradient.

The general area of the Ahtanum-Moxee Basin that meets these criteria shown in Figure 5-1 in the ASR report (see Appendix S). Candidate well sites include, Elks Park, the White Dove Mobile Home Park, the south railroad yard, and Gardner Park. It is recommended that development of a full-scale ASR program follow a phased approach in which new ASR wells would be installed and evaluated sequentially. Continued monitoring of this system, including well efficiency and aquifer response would allow for informed decisions regarding the siting of subsequent wells.

4.3 Water Right Evaluation

4.3.1 Permits, Certificates, Claims, and Applications

The City of Yakima holds a number of water rights that supply the City's domestic and municipal irrigation distribution systems. All of these water rights are described in the following narrative and in Tables 4-5 and 4-6. The City holds several other water rights that are not discussed in this plan because they are not part of the City's municipal water distribution systems and are not used for domestic purposes.

As described elsewhere in this plan, the City's domestic water distribution system is primarily supplied by surface water, with diversions occurring at the City's Naches River Water Treatment Plant. (The City's Naches River Water Treatment Plant has also been known as the Rowe Hill or Gleed plant.) The City currently uses its groundwater supply system as a seasonal/emergency backup supply. The City also has three interties with the Nob Hill Water Association for emergency supply purposes.

The City also owns a municipal irrigation distribution system. The system is supplied by surface water with diversions occurring at the Nelson Bridge diversion. By serving some of the need for irrigation of residential property, operation of the system lessens the demand on the City's domestic water distribution system. Water rights associated with the municipal irrigation system are described in the following narrative and in Tables 4-5 and 4-6.

All of the City's surface water rights are currently under the jurisdiction of the Yakima County Superior Court as part of the surface water rights adjudication, *Ecology v. Acquavella, et al*., Yakima County Superior Court, Cause No. 77-2-01484-5. On November 21, 2002, the Court issued a Conditional Final Order that approves a proposed settlement of the City's Naches River water rights diverted at the Naches River Water Treatment Plant and at Nelson Bridge. Future steps will occur to implement the Conditional Final Order, including for example the issuance of permit and certificate documents by the Department of Ecology in preparation of the Final Decree. For purposes of this plan, the Conditional Final Order provides an appropriate point of reference. Accordingly, the water right parameters discussed in this plan are as set forth in the Conditional Final Order.

Narrative Description

A. Surface Water Rights

1. Claim # 120529 (6/30/1902 – 10 cfs)

Source Type: Surface water (Naches River).

Source Location: Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.

Purpose of Use: Municipal supply.

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: Year round.

Provisions or Limiting Conditions: None

2. Claim # 064441 (5/10/1905 -- Reclamation Contract Water Right)

Source Type: Surface water (Naches River).

Source Location: Naches River Water Treatment Plant: 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
or
Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE ¼ NW ¼ of Section 9, Township 13 North, Range 18 East.

Purpose of Use: Municipal supply.

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: The beginning of storage control, as determined by the US Bureau of Reclamation, through October 15.

Provisions or Limiting Conditions:

- Of the 5,083 acre feet available for diversion under this right, 3,583 may be diverted at the Naches River Water Treatment Plant, and 1,500 acre feet may be diverted at Nelson Bridge.

- After a "transition period" ending in 2013, the annual quantity available for diversion at Nelson Bridge is reduced by 583 acre feet (*i.e.*, portion of the right diverted at Nelson Bridge decreases to 917 from 1,500 acre feet).

- 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141 and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant.

- Like other Bureau contract water, this contract right is subject to pro-ration in water short years. The contract states: "In years of shortage, the diversion and delivery of water provided for in this contract shall be reduced on a proration or proportionate basis in accordance with paragraphs 18 and 19 of the judgment of January 31, 1945."

3. Certificate 938-D (10/1/1928 – 3 cfs – Former Oak Flats)

Source Type: Surface water (Naches River)

Source Location: Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.

Purpose of Use: Municipal supply.

Place of Use: Certificate reads "City of Yakima." Current and future service areas.

Time of Use: Restricted to off-season (non-storage control period) use only – see below.

Provisions or Limiting Conditions:

Ecology's August 14, 2000 approval of a change of point of withdrawal imposed the following conditions:

- "This is a natural flow right. As such, this right shall not obligate the United States Bureau of Reclamation to provide storage flows at any time."

- "This right has a priority date of October 1, 1928. As such, it is junior to all prior rights on the Naches River, including the May 10, 1905 Yakima Project right(s) held by the United States Bureau of Reclamation."

- "No diversion shall be made pursuant to this right when the Naches/Yakima river system is on storage control."

- In addition, this water right is subject to pending adjudication in *Acquavella* and was not included in the settlement.

5. Water Right # S4-01141 (A) and (B) (1/29/1951 – 30 cfs)

(a) Certificate S4-01141 (A)

Source Type: Surface water (Naches River).

Source Location: Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.

Purpose of Use: Municipal supply.

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: Restricted to off-season use (October 16 to the beginning of storage control) only – see below.

Provisions or Limiting Conditions:

- 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141 and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant.

Certificate contains the following conditions:

- "Beginning with the period each year when waters are released from the Bumping Lake or Tieton Reservoirs to supplement the natural flow of the Naches River to supply water for various irrigation projects to October 15, no water shall be available for diversion under this certificate."

- "Screening of the diversion intake shall be maintained in accordance with terms of the permit."

- "No dam shall be constructed in connection with this diversion."

(b) Permit S4-01141P (B)

Source Type: Surface water (Naches River).

Source Location: Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.

Purpose of Use: Municipal supply.

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: Restricted to off-season use (October 16 to the beginning of storage control) only – see below.

Provisions or Limiting Conditions:

Certificate contains the following conditions:

- "Full beneficial use shall be within 20 years of issuance of this permit [i.e., by 2023]. The permittee shall submit status reports to the Department of Ecology, Central Regional Office, Water Resources program through submittal of the Department of Health required Water System Plans."

- "Screening of the diversion intake shall be maintained in accordance with applicable law of Department of Fisheries and Wildlife."

- "No dam shall be constructed in connection with this diversion."

5. Claim # 120528 (4/1/1869 – Former Glaspey)

Source Type: Surface water (Naches River).

Source Location: Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE ¼ NW ¼ of Section 9, Township 13 North, Range 18 East.

Purpose of Use: Municipal supply.

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: April 1 through October 31

Provisions or Limiting Conditions: None

6. Claim # 120528 (6/30/1878 – Former Old Union)

Source Type: Surface water (Naches River).

Source Location: Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE1/4 NW1/4 of Section 9, Township 13 North, Range 18 East.

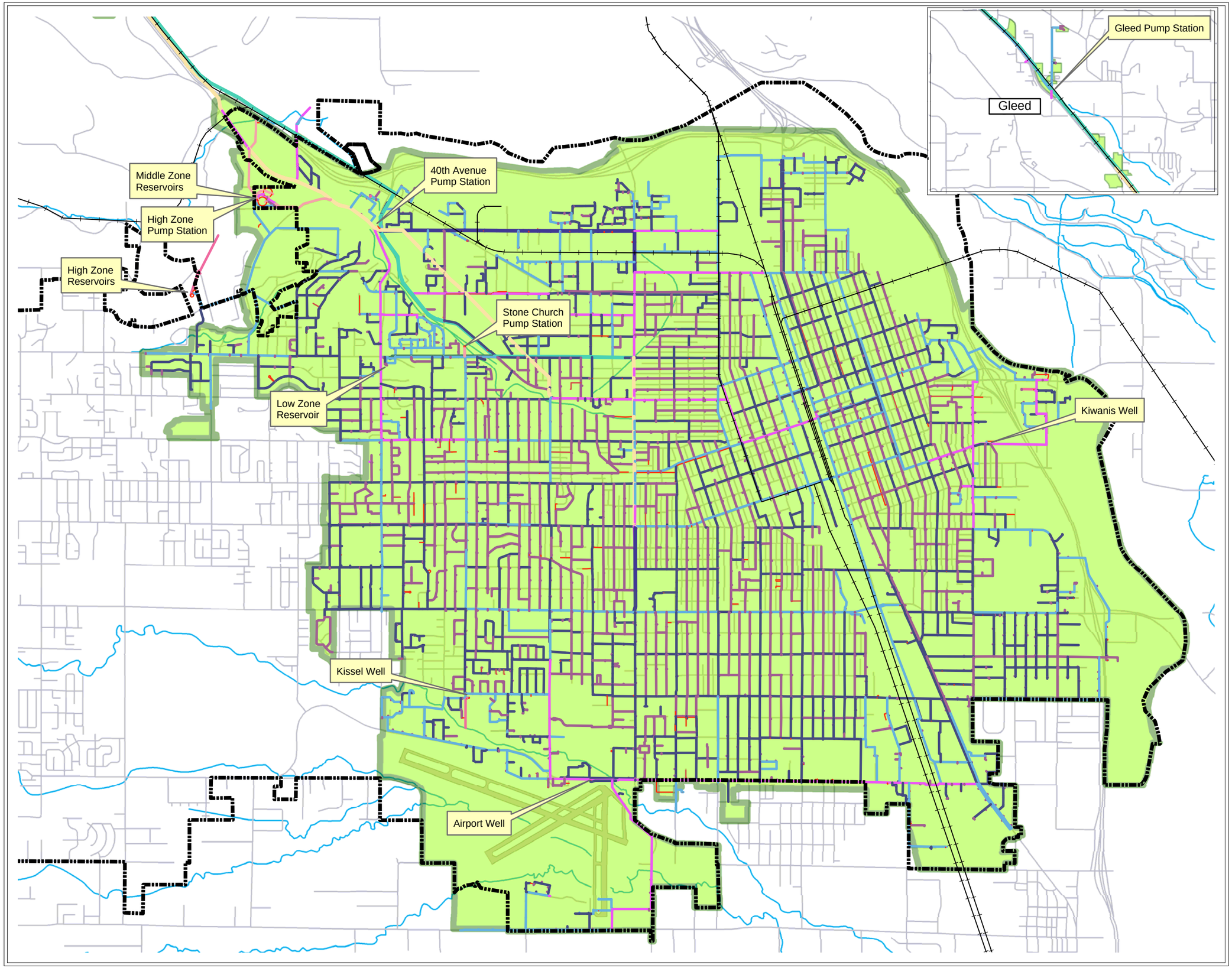
Purpose of Use: Municipal supply

Place of Use: City of Yakima current Place of Use area as shown on Figure 4-1.

Time of Use: April 1 through October 31.

Provisions or Limiting Conditions:

- After a "transition period" ending in 2013, the annual quantity is reduced to 2,879 acre feet (from 5,585 acre feet).



Legend

City Limits

Place of use / Existing, Retail and Future Service Area

Water System Plan Update
Figure 4-1

Place of Use

N
W
E
S

0 0.15 0.3 0.6 0.9 1.2 Miles

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B. Groundwater Rights

1. Water Right # 190-A (A) and (B)P (10/01/1948 – Former Wright)

(a) Certificate #190-A(A)

Source Type: Ground water.

Source Location:: Kissel Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well, drilled to 1171 feet, is approximately 300 feet east and 100 feet south of the north west corner of Section 35.

Purpose of Use: Municipal supply.

Place of Use: Superceding certificate reads "City of Yakima." Current and future service areas.

Time of Use: Year round.

Provisions or Limiting Conditions:

Rescinding Order (of prior certificate) contains the following:

- "A Superseding Certificate No. 190-A(A) shall issue to the City of Yakima in the amount of 900 gpm, 958 acre-feet per year for a municipal water supply."

Superceding certificate contains the following conditions:

- "Of the 900 gpm and 1448 acre-feet of water authorized, only 900 gpm and 958 acre-feet per year have been perfected by application to beneficial use."

- "Based on the preceding, the 490 acre-feet not withdrawn under Ground Water Certificate 190-A is rescinded due to lack of perfection of the water to the authorized beneficial use. Therefore; a superceding Certificate No. 190A(A) shall issue to the City of Yakima in the amount of 900 gpm, 958 acre-feet per year for municipal water supply."

(b) Permit #190-A(B)P

Source Type: Ground water.

Source Location: Kissel Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well was drilled to 1171 feet.

Purpose of Use: Municipal supply.

Place of Use: Superceding permit reads "City of Yakima." Current and future service areas.

Time of Use: Year round.

Provisions or Limiting Conditions:

Rescinding Order (of prior certificate) contains the following:

- "A Superseding Permit No. 190-A(B) shall issue to the City of Yakima in the amount of 900 gpm [not additive to Ground Water Certificate No. 190-A(A)], 490 acre-feet per year for a municipal water supply. The water is to be put to full beneficial use by July 1, 2025."

Superceding permit contains the following conditions:

- "The authorization would in no way excuse the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations including those administered by other programs of the Department of Ecology and those administered by local and State Health Departments for public water supplies."

- "A final Certificate of Water Right will reflect the extent of beneficial use within the limitations of the permit."

- "A written report describing the water system status (i.e., Water Comprehensive Plan) shall be submitted every 6 years to the Central Regional Office, Department of Ecology Water Resources Program."

- "A water conservation plan must be in place and implemented. This plan may include rate structures that are intended to ensure efficient water use is encouraged and additional measures that the City deems appropriate and incorporates into their comprehensive water system plan."

- "Metering of water withdrawn from the source well with record keeping and periodic reporting of information to Ecology."

2. Certificate GWC 2851-A
(as amended by Change Application CG4-CWC2581-A@2 and YAKI-05-04)

Source Type:	Ground water.
Source Location:	Kissel Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well was drilled to 1171 feet.
Purpose of Use:	Municipal supply.
Place of Use:	Service area described in the recent Water System Plan as approved by the DOH, so long as the City is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.
Priority Date:	8/21/1956
Time of Use:	Year round
Qi:	2,000 gpm – additive to Gardner Well Max 3,000 gpm
Qa:	4,650 Acre Feet are additive to the other rights held by the City and 3,350 Acre Feet are non-additive to the City's other rights, available as an alternate source of supply to such other rights up to a combined total annual use under all rights of 29,178 AF. (4,560 AF total from Kissel - Gardner Wells)

Provisions or Limiting Conditions:

- The amount of water authorized under the right is a maximum limit that shall not be exceeded and the water user shall be entitled only to that amount of water within the specified limit that is beneficially used and required. The total quantity of water withdrawn from all replacement wells under this right shall remain unchanged, and shall not exceed 5,000 gallons per minute or 8,000 acre-feet per year. The rate of withdrawal at any one of the authorized replacement wells shall not exceed 3,000 gallons per minute under existing rights. The right's Qi of 5,000 gpm is additive to the City's other rights. Of the 8,000 AF, 4,650 AF are additive to the other rights held by the City as of the date of this ROE. The remaining 3,350 AF are non-additive to the City's other rights, available as an alternate source of supply to such other rights up to a combined total annual use under all rights of 29,178 AF.

- Installation and maintenance of an access port as described in Ground Water Bulletin No. 1 is required for all replacement points of withdrawal. An air line gauge may be installed in addition to the access port.

- All water wells constructed within the State shall meet the minimum standards for construction and maintenance as provided under RCW 18.104 (Washington Water Well Construction Act of 1971) and Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Water Wells).

- The proposed new replacement well (Gardner) shall be sealed in compliance with the minimum standards for sealing wells into an unconsolidated formation as described in Chapter 173-160-241 WAC. The proposed new replacement well(s) (Elks, Gardner and Southeast Yakima) may encounter artesian flowing conditions, therefore, as per Chapter 173-160-251 WAC, written sealing plans for controlling flowing wells shall be submitted to Ecology's Central Regional Office well construction coordinator for review and comments prior to the initiation of any well construction activities.

- The source aquifer zone for the proposed Gardner well is restricted to the middle and lower members of the Upper Ellensburg Formation. For the proposed Gardner well, the un-perforated casing shall extend to a depth of 700 feet below land surface, respectively, unless otherwise approved in writing by Ecology.

- An approved measuring device shall be installed and maintained for all replacement points of withdrawal in accordance with Chapter 173-173 WAC ("Requirements for Measuring and Reporting Water Use"). Ch. 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements.

- Water use data shall be recorded daily. The maximum monthly rate of withdrawal and the monthly total volume shall be recorded by the City and submitted to Ecology.

- The following information shall be included with each submission of water use data: owner, contact name if different, mailing address, daytime phone number, WRIA, Certificate No., source name, annual quantity used including units, maximum rate of withdrawal including units, period of use, monthly meter readings including units, peak monthly flow including units, purpose of use, well tag number, and period of use. Ecology prefers web-based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information.

- Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements. Installation, operation and maintenance requirements are enclosed as a document entitled "Water Measurement Device Installation and Operation Requirements".

- Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.
- The City shall submit a metering plan to insure the 5,000 gpm Qi is not exceeded among the authorized sources.

Until superceding certificate issues, City to report progress in putting water to use at replacement points of withdrawal in all Water System Plan updates to "January 1, 2034".

3. **Certificate GWC 2851-A**
(as amended by Change Application CG4-CWC2581-A@2 and YAKI-05-04)

Source Type:	Ground water.
Source Location:	Gardner Park Well: SE ¼ SE ¼ Sec. 36, Township 13 North, Range 18 East
Purpose of Use:	Municipal supply.
Place of Use:	Service area described in the recent Water System Plan as approved by the DOH, so long as the City is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.
Priority Date:	8/21/1956
Time of Use:	Year round
Qi:	3,000 gpm – Additive to Kissel Max 3,000 gpm
Qa:	4,650 Acre Feet are additive to the other rights held by the City and 3,350 Acre Feet are non-additive to the City's other rights, available as an alternate source of supply to such other rights up to a combined total annual use under all rights of 29,178 AF. (4,560 AF total from Kissel - Gardner Wells)

Provisions or Limiting Conditions:

- The amount of water authorized under the right is a maximum limit that shall not be exceeded and the water user shall be entitled only to that amount of water within the specified limit that is beneficially used and required. The total quantity of water withdrawn from all replacement wells under this right shall remain unchanged, and shall not exceed 5,000 gallons per minute or 8,000 acre-feet per year. The rate of withdrawal at any one of the authorized replacement wells shall not exceed 3,000 gallons per minute under existing rights. The right's Qi of 5,000 gpm is additive to the City's other rights. Of the 8,000 AF, 4,650 AF are additive to the other rights held by the City as of the date of this ROE. The remaining 3,350 AF are non-additive to the City's other rights, available as an alternate source of supply to such other rights up to a combined total annual use under all rights of 29,178 AF.

- Installation and maintenance of an access port as described in Ground Water Bulletin No. 1 is required for all replacement points of withdrawal. An air line gauge may be installed in addition to the access port.

- All water wells constructed within the State shall meet the minimum standards for construction and maintenance as provided under RCW 18.104 (Washington Water Well Construction Act of 1971) and Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Water Wells).

- The proposed new replacement well Gardner) shall be sealed in compliance with the minimum standards for sealing wells into an unconsolidated formation as described in Chapter 173-160-241 WAC. The proposed new replacement well (Gardner) may encounter artesian flowing conditions, therefore, as per Chapter 173-160-251 WAC, written sealing plans for controlling flowing wells shall be submitted to Ecology's Central Regional Office well construction coordinator for review and comments prior to the initiation of any well construction activities.

- The source aquifer zone for the proposed Gardner well is restricted to the middle and lower members of the Upper Ellensburg Formation. For the proposed well, the un-perforated casing shall extend to a depth of 700 feet below land surface, respectively, unless otherwise approved in writing by Ecology.

- An approved measuring device shall be installed and maintained for all replacement points of withdrawal in accordance with Chapter 173-173 WAC ("Requirements for Measuring and Reporting Water Use"). Ch. 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements.

- Water use data shall be recorded daily. The maximum monthly rate of withdrawal and the monthly total volume shall be recorded by the City and submitted to Ecology.

- The following information shall be included with each submission of water use data: owner, contact name if different, mailing address, daytime phone number, WRIA, Certificate No., source name, annual quantity used including units, maximum rate of withdrawal including units, period of use, monthly meter readings including units, peak monthly flow including units, purpose of use, well tag number, and period of use. Ecology prefers web-based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information.

- Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements. Installation, operation and maintenance requirements are enclosed as a document entitled "Water Measurement Device Installation and Operation Requirements".

- Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

- The City shall submit a metering plan to insure the 5,000 gpm Qi is not exceeded among the authorized sources.
- Until superceding certificate issues, City to report progress in putting water to use at replacement points of withdrawal in all Water System Plan updates to "January 1, 2034".

4. Certificate #5318-A (7/24/1958 – Airport)

Source Type: Ground water.

Source Location: Airport Well: NE1/4 NW1/4 SE1/4, Section 35, Township 13 North, Range 18 East. Airport Well, also known as Well #5, is 16 inches in diameter and drilled to a depth of 1099 feet.

Purpose of Use: Municipal supply.

Place of Use: Certificate reads "City of Yakima." Current and future service areas.

Time of Use: Year round.

Provisions or Limiting Conditions:

Certificate contains the following condition:

- "The total yearly withdrawal authorized under this filing shall be considered as a supplemental and/or additional supply. Withdrawal at any given time shall be limited to 3200 acre-feet per year, or that quantity necessary to supplement the available supply to satisfy existing requirements."

5. Certificate #4646-A (8/04/1958 – Kiwanis)

Source Type: Ground water.

Source Location: Kiwanis Well: SW ¼ NW ¼ of Section 20, Township 13 North, Range 19 East.

Purpose of Use: Municipal supply.

Place of Use: Certificate reads "City of Yakima." Current and future service areas.

Time of Use: Year round.

Provisions or Limiting Conditions:

Certificate contains the following condition:

- "The total yearly withdrawal authorized under this filing shall be considered as a supplemental and/or additional supply. Withdrawal at any given time shall be limited to 3680 acre-feet per year, or that quantity necessary to supplement the available supply to satisfy existing requirements."

6. Permit #G4-29864P (12/08/1988 – Kissel)

Source Type: Ground water.

Source Location: Kissel Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well was drilled to 1171 feet.

Purpose of Use: Municipal supply.

Place of Use: Permit reads "Service area of the City of Yakima. Current and future service areas.

Time of Use: Year round.

Provisions or Limiting Conditions:

Permit contains the following conditions:

- "This well shall be cased and permanently sealed by pressure grouting to a minimum depth of 460 feet below land surface. Such sealing shall be performed in accordance with the provisions and standards of WAC Chapter 173-160-075 and Chapter 173-160-245 through 173-160-285 (Minimum Standards for Construction and Maintenance of Water Wells)."

- "All water wells constructed within the state shall meet the minimum standards for construction and maintenance as provided under RCW 18.104 (Washington Water Well Construction Act of 1971) and Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Water Wells)."

- "Flowing wells shall be so constructed and equipped with valves to ensure that the flow of water can be completely stopped when not being used. Likewise, the well shall be

so maintained as to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps -- either above or below land surface."

- "If flowing conditions are encountered, a suitable pressure gauge shall be installed and maintained to measure the shut-in well water pressure."

- "Installation and maintenance of an access port as described in Ground Water Bulletin No.1 is required. An air line and gage may be installed in addition to the access port."

- "Ground Water Certificate No. 2851-A shall be formally relinquished before issuance of a certificate for the proposed well."

- "The City of Yakima public water system shall comply with all applicable provisions of the Interim Guidelines for Public Water Systems Regarding Water Use Reporting, Demand Forecasting, Methodology and Conservation Programs, or rules later adopted for implementing the interim guidelines by 1996. Failure to comply shall be grounds for permit cancellation."

Table 4-5 Existing Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Existing Consumption**		**Current Water Right Status (Excess/Deficiency)**	
					Maximum Instantaneous Flow Rate (Qi)	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**
Permits/ Certificates 1. 938-D	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	”	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[1] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit	”	10/01/1948	Kissel Well	Primary/Supplemental	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A	”	8/21/1956	Kissel Well	Primary/Supplemental	2000 gpm	4,650[2] AF/YR				
5. GWC 2851-A	“	8/21/1956	Gardner Well	Primary/Supplemental	3000 gpm	4,560[3] AF/YR				
6. 5318-A	”	07/24/1958	Airport Well	Primary/Supplemental	2800 gpm	3200 AF/YR				
7. 4646-A	”	08/04/1958	Kiwanis Well	Primary/Supplemental	2300 gpm.	3680 AF/YR				
Claims 1. 120528	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				

[1] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. The combined quantity limitation does not apply to Permit S4-01141(B).

[2] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

[3] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

Table 4-5 Existing Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Existing Consumption**		**Current Water Right Status (Excess/Deficiency)**	
2. 120528	”	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	5,585 AF/YR (2,879 AF/YR beginning in 2013)				
3. 120529	”	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (4/1-10/31)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	5,083AF/YR[4] 3,583 AF/YR at WTP and 1,500 AF/YR at Nelson Bridge (Total of 4,500 AF/YR beginning in 2013)				
TOTAL	*********	*******	**********	**********	Low:[5] 17,503 gpm High:[6] 40,589 gpm	29,178 AF[7]	19,757 gpm (MDD + 9.43cfs Apr to Oct irrigation)	17179 AF (actual 2009)	40,589 gpm – 19,757 gpm = 20,832 gpm	11,999 AF

[4] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge.

[5] The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The “low” figure shown in the table only reflects water available as primary supply through the City’s current domestic water supply system -- the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the emergency groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of USBR storage control through October 15).

[6] The “high” Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit 190-A(B)P, which is supplemental to the Qi authorized under certificate 190-A(A). It also does not include the Qi authorized under permit G4-29864P, which appears to be supplemental to the Qi authorized under ground water certificate 4116.

[7] Quantity established with water right change CG4-CWC2581-A@2

Table 4-5 Existing Water Right Status

Permit Certificate or Claim	Name of Rightholder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights		Existing Consumption		Current Water Right Status (Excess/Deficiency)	

Intertie Name/Identifier	Name of Purveyor Providing Water	Existing Limits on Intertie Water Use		Existing Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1. Nob Hill Water	Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)		N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water	Nob Hill Water S. 45th Ave. & Tieton Dr.		N/A	N/A	N/A	N/A	N/A
3. Nob Hill Water	Nob Hill Water (32nd Ave. & Ahtanum Rd.		N/A	N/A	N/A	N/A	N/A
TOTAL *********	******* ********** **********		N/A	N/A	N/A	N/A	N/A

Pending Water Right Application	Name on Permit	Date Submitted	Primary or Supplemental	Pending Water Rights	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested

Table 4-6 Forecasted Six Year Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Forecasted Consumption (6-year population/demand projections)**		**Current Water Right Status (Excess/Deficiency)**	
					Maximum Instantaneous Flow Rate (Qi)	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**
Permits/ Certificates 1. 938-D	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	”	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[8] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit	”	10/01/1948	Kissel Well	Primary/Supplemental	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A	”	8/21/1956	Kissel Well	Primary/Supplemental	2000 gpm	4,650[9] AF/YR				
5. GWC 2851-A	“	8/21/1956	Gardner Well	Primary/Supplemental	3000 gpm	4,560[10] AF/YR				
6. 5318-A	”	07/24/1958	Airport Well	Primary/Supplemental	2800 gpm	3200 AF/YR				
7. 4646-A	”	08/04/1958	Kiwanis Well	Primary/Supplemental	2300 gpm.	3680 AF/YR				
Claims 1. 120528	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				

[8] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. The combined quantity limitation does not apply to Permit S4-01141(B).

[9] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

[10] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

Table 4-6 Forecasted Six Year Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Forecasted Consumption (6-year population/demand projections)**		**Current Water Right Status (Excess/Deficiency)**	
2. 120528	”	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	5,585 AF/YR (2,879 AF/YR beginning in 2013)				
3. 120529	”	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (4/1-10/31)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	5,083AF/YR[11] 3,583 AF/YR at WTP and 1,500 AF/YR at Nelson Bridge (Total of 4,500 AF/YR beginning in 2013)				
TOTAL	*********	*******	**********	**********	Low:[12] 17,503 gpm High:[13] 40,589 gpm	29,178 AF[14]	20,777 gpm (MDD + 9.43cfs Apr to Oct irrigation)	18,646 AF (projected 2016)	40,589 gpm – 20,777 gpm = 19,812 gpm	10,532 AF

[11] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge.

[12] The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The “low” figure shown in the table only reflects water available as primary supply through the City’s current domestic water supply system -- the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the emergency groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of USBR storage control through October 15).

[13] The “high” Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit 190-A(B)P, which is supplemental to the Qi authorized under certificate 190-A(A). It also does not include the Qi authorized under permit G4-29864P, which appears to be supplemental to the Qi authorized under ground water certificate 4116.

[14] Quantity established with water right change CG4-CWC2581-A@2

Table 4-6 Forecasted Six Year Water Right Status

Intertie Name/Identifier	Name of Purveyor Providing Water	Existing Limits on Intertie Water Use		Forecasted Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1. Nob Hill Water	Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)		N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water	Nob Hill Water S. 45th Ave. & Tieton Dr.		N/A	N/A	N/A	N/A	N/A
3. Nob Hill Water	Nob Hill Water (32nd Ave. & Ahtanum Rd.		N/A	N/A	N/A	N/A	N/A
TOTAL *********	******* ********** **********		N/A	N/A	N/A	N/A	N/A

Pending Water Right Application	Name on Permit	Date Submitted	Primary or Supplemental	Pending Water Rights	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested

Table 4-7 Forecasted 20-Year Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Forecasted Consumption (20-year population/demand projections)**		**Current Water Right Status (Excess/Deficiency)**	
					Maximum Instantaneous Flow Rate (Qi)	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**	**Maximum Instantaneous Flow Rate (Qi)**	**Maximum Annual Volume (Qa)**
Permits/ Certificates 1. 938-D	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	”	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[15] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit	”	10/01/1948	Kissel Well	Primary/Supplemental	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A	”	8/21/1956	Kissel Well	Primary/Supplemental	2000 gpm	4,650[16] AF/YR				
5. GWC 2851-A	“	8/21/1956	Gardner Well	Primary/Supplemental	3000 gpm	4,560[17] AF/YR				
6. 5318-A	”	07/24/1958	Airport Well	Primary/Supplemental	2800 gpm	3200 AF/YR				
7. 4646-A	”	08/04/1958	Kiwanis Well	Primary/Supplemental	2300 gpm.	3680 AF/YR				
Claims 1. 120528	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				

[15] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. The combined quantity limitation does not apply to Permit S4-01141(B).

[16] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

[17] Combined limit of 4,650 acre feet at the Kissel and Gardner Wells

Table 4-7 Forecasted 20-Year Water Right Status										
Permit Certificate or Claim	**Name of Rightholder or Claimant**	**Priority Date**	**Source Name/Number**	**Primary or Supplemental**	**Existing Water Rights**		**Forecasted Consumption (20-year population/demand projections)**		**Current Water Right Status (Excess/Deficiency)**	
2. 120528	”	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	5,585 AF/YR (2,879 AF/YR beginning in 2013)				
3. 120529	”	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (4/1-10/31)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	5,083AF/YR[18] 3,583 AF/YR at WTP and 1,500 AF/YR at Nelson Bridge (Total of 4,500 AF/YR beginning in 2013)				
TOTAL	*********	*******	**********	**********	Low:[19] 17,503 gpm High:[20] 40,589 gpm	29,178 AF[21]	22,652 gpm (MDD + 9.43cfs Apr to Oct irrigation)	20,382 AF (projected 2030)	40,589 gpm – 22,652 gpm = 17,937 gpm	8,796 AF

[18] Subject to a combined quantity limitation: 7,826 acre feet is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River Water Treatment Plant. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge.

[19] The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The “low” figure shown in the table only reflects water available as primary supply through the City’s current domestic water supply system -- the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the emergency groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of USBR storage control through October 15).

[20] The “high” Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit 190-A(B)P, which is supplemental to the Qi authorized under certificate 190-A(A). It also does not include the Qi authorized under permit G4-29864P, which appears to be supplemental to the Qi authorized under ground water certificate 4116.

[21] Quantity established with water right change CG4-CWC2581-A@2

Table 4-7 Forecasted 20-Year Water Right Status

Intertie Name/Identifier	Name of Purveyor Providing Water	Existing Limits on Intertie Water Use		Existing Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1. Nob Hill Water	Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)		N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water	Nob Hill Water S. 45th Ave. & Tieton Dr.		N/A	N/A	N/A	N/A	N/A
3. Nob Hill Water	Nob Hill Water (32nd Ave. & Ahtanum Rd.		N/A	N/A	N/A	N/A	N/A
TOTAL *********	******* ********** **********		N/A	N/A	N/A	N/A	N/A

Pending Water Right Application	Name on Permit	Date Submitted	Primary or Supplemental	Pending Water Rights	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested

4.4 Water System Reliability Analysis

The purpose of the water system reliability analysis is to summarize the steps which can be undertaken to ensure that an adequate quantity of water can be provided at all times. When water shortages or interruptions in service occur, public health can be threatened because customers may use other non-potable sources of water inappropriately, or system pressure may be reduced such that basic public health needs are not met or other back flow related problems occur.

Source Reliability: The normal water supply source for the City of Yakima is the Naches River Water Treatment Plant located approximately 9 miles west of Yakima on Highway 12. Potential causes of reduction or interruption of the normal supply source include:

- Spring runoff resulting in flooding and increased turbidities exceeding the process capabilities of the Water Treatment Plant.
- Extended periods of drought resulting in loss of river flow.
- USBR proration of water storage rights.
- Failure of 48 inch transmission main transporting water from the Water Treatment Plant to the City's water distribution system.
- During winter months, the Water Treatment Plant supply could be temporarily reduced or interrupted due to icing of the intake structure or contact basins.

A failure of the Naches River WTP supply was caused by a break in the 48-inch transmission main in spring 1974. The pipeline floated during flooding conditions and was out of service for approximately 3 months for repairs because a significant length of the pipeline was damaged. The configuration of the 48-inch transmission main has since been altered to ensure that the pipeline is always full, eliminating the potential for flotation during flooding. It is estimated that the extent of any future failure of the 48-inch pipeline would be limited to short lengths and could be repaired within 3 days. This type of failure would, however, reduce the available supply to the entire system.

Reduction or interruption in supply due to high turbidity or icing conditions would not be expected to last more than 3 days.

The City has approximately 11.6 mgd available from the existing groundwater well supplies. The wells are categorized as seasonal/emergency sources of supply only would be put into service in the event of the types of failures identified above.

The City also has interties with Nob Hill Water Association. Prolonged supply from these interties cannot be relied upon because these systems may not have excess supply capacity available in the summer months.

The water quality characteristics of the Naches River water supply have been summarized in Chapter 3. As indicated there, the raw water turbidity values exceed 15 NTU approximately 6 % of the time. Raw water turbidity of 15 NTU is the recommended limit for the direct filtration treatment process.

Water quality data for the seasonal/emergency well sources is also provided in Chapter 3.

Water Right Adequacy: A detailed discussion the status of the current water rights is included in Section 4.3 of this WSP update. The rights which are "contract rights" can be reduced through proration by the USBR in water short years. Under these conditions the seasonal/ emergency well supplies are brought on line to make up the difference. In the future, Aquifer Storage and Recovery (ASR) may be used to further augment the well supplies in water short years (see discussion in Section 4.2 and below under *Water Shortage Response Planning*). Specific measures taken in response to water shortages are described below.

Facility Reliability: A detailed discussion of the water treatment facilities is included in Chapter 3 of this Water System Plan Update. The plan includes recommendations for improvements necessary to maintain the reliability and performance of the treatment facilities.

Water Shortage Response Planning

Short term reduction or loss of the Naches River WTP supply due to raw water high turbidity, transmission main failure, or icing conditions in the WTP have historically lasted three days or less. The response to short term disruptions such as these is to activate one or more of the seasonal/emergency well supply sources. Depending on the magnitude and duration of the WTP supply disruption, it may be necessary to utilize some of the standby storage capacity. Refer to Section 3.3.4 of this Water System Plan Update for the discussion of the storage capacity analysis as it relates to stand-by storage and emergency storage requirements.

Potential causes of longer term reduction or interruption of the normal supply source include:

- Extended periods of drought resulting in loss of river flow.
- USBR proration of water storage rights.

The purpose of water shortage response planning is to identify measures which can be implemented under these circumstances. These measures could include demand reduction, supply augmentation, or a combination of both.

Problem Assessment: The City's 1902 surface water right of 10 cfs (6.5 MGD) for the Naches River Water Treatment Plant is a senior right. The other rights for the WTP withdrawal are subject to proration or interruption in years of extreme water shortage. In 2001, which has been the worst water shortage year since the existing WTP has been in service, the USBR contract water rights were prorated to 29% of normal during the summer months. In was necessary during this period to make up the supply shortfall by bringing the seasonal/emergency well supply sources on line. By utilizing the emergency wells it was not necessary to implement demand reduction measures other than the ongoing conservation measures that are described in Section 4.1 of this water system plan. However, in future years if demands increase and as the possibility exists for more serious drought conditions as a result of climate change, it may become necessary to implement additional demand reduction measures and/or supply augmentation.

Options for Demand Reduction in a Water Shortage: Selected demand reduction options would be implemented based on the degree of water shortage that exists. Stages of a water shortage and corresponding demand reduction measures include (source: *Guidelines for the Preparation of Water Shortage Response Plans*, Washington State Department of Health, DOH PUB. #331-301 June 2005

- **Stage 1: Minor Shortage - Voluntary Measures**
  This is the first step in reducing water consumption during a potential or actual water shortage. Based on experience in other states, a 5 to 10 percent reduction in consumption can be achieved with a voluntary program. An appropriate response at this stage is initiation of a public information program.
- **Stage 2: Moderate Shortage – Mandatory Measures**
  Based on the experience of utilities in other states, a 10 to 20 percent reduction in consumption can be achieved with a mandatory program. An appropriate response at this stage is to institute mandatory demand reduction measures, enforceable under the authority of special ordinances, or a revised rate schedule.
- **Stage 3: Severe – Rationing Program**
  Upwards of 30 percent savings can be achieved with a water-rationing program. An appropriate response at this stage is instituting rationing programs through fixed allotments or percentage cutbacks. This response should be initiated only in rare circumstances. It allows the maximum amount of water savings possible in a community without severe hardship. Again, this action would have to be enforceable under the authority of special ordinances.

Demand reduction options should be considered corresponding to each stage of water shortage are summarized in provided in Tables 4-8 through 4-12.

Table 4-8 Suggested Public Information Demand Reduction Actions

Stage	Water Shortage Condition	Public Information Actions
1	Minor: Voluntary Measures	- Prepare and distribute water conservation materials (bill insert, etc.). - Prepare and disseminate technical conservation information to specific customer types. - Prepare conservation retrofit kits. - Coordinate media outreach program. - Issue news releases to the media.
2	Moderate: Mandatory Program	- Distribute conservation retrofit kits. - Continue public information program.
3	Severe: Rationing Program	- Continue public information program.

Table 4-9 Suggested Government Demand Reduction Actions		
Stage	**Water Shortage Condition**	**Government Actions**
1	Minor: Voluntary Measures	- Increase enforcement of hydrant opening. - Increase meter reading efficiency and meter maintenance. - Promote intensive leak detection and repair program. - Draft and adopt ordinances* banning water waste. A typical ordinance could require: - No unfixed leaks; - No hosing of paved surfaces; - No fountains except those using re-circulated water; - No water running onto streets; - No watering during the middle of the day; and - No irrigation runoff. - Draft and adopt ordinances allowing a utility to declare a water emergency and requiring: - Fixed consumption allotments or percentage cutbacks (rationing). - All homes and businesses to have retrofitted showers and toilets.
2	Moderate: Mandatory Program	- Reduce water usage for main flushing, street cleaning, public fountains, and park irrigation. - Watering of parks, cemeteries, etc., restricted to nights or designated irrigation days.
3	Severe: Rationing Program	- All public water uses not required for health or safety prohibited unless using tank truck water supplies or reclaimed waste water - Irrigation of public parks, cemeteries, etc., severely restricted. - Pool covers required for all municipal pools. - Main flushing allowed only for emergency purposes. - Reduce system pressure to minimum permissible levels.

Table 4-10 Suggested User Restrictions Demand Reduction Actions		
Stage	**Water Shortage Condition**	**User Restrictions**
1	Minor: Voluntary Measures	- Implement voluntary water use reductions (see Table 4-12, above).

2	Moderate:
	Mandatory Program
		- Implement ordinance banning water waste (see Table 4-13, above).
		- Adopt landscape irrigation restrictions incorporating one or more of the following:
		  - Time of day (e.g., 7 p.m. to 7 a.m., etc.) weekly frequency (e.g., odd/even, time per week, etc.)
		  - sprinkle bans (e.g., hand)
		- Commercial car washed should intensify voluntary use reductions.
		- Golf course irrigation restricted to 6 p.m. to 11 a.m. on designated irrigation days.

3	Severe: Rationing Program	- Implement ordinance allowing utilities to declare a water emergency and to require rationing (see Table 4-13, above) - Car washing permitted only during specified watering hours of designated irrigation days. - Times of day restrictions applied to commercial car washes. - Golf course watering times and weekly watering limits reduced. - Manage water consumption to stay within water allotments. - Permissible watering hours and weekly frequency for landscaping irrigation further reduced.

Table 4-11 Suggested User Penalties Demand Reduction Actions		
Stage	**Water Shortage Condition**	**User Penalties**
1	Minor: Voluntary Measures	- None
2	Moderate: Mandatory Program	- Warning. - House call. - Shut off and reconnection fee.
3	Severe: Rationing Program	- Fines.

Table 4-12 Suggested Pricing Demand Reduction Actions		
Stage	**Water Shortage Condition**	**Pricing**
1	Minor: Voluntary Measures	- None.
2	Moderate: Mandatory Program	- Institute rate changes to encourage conservation. - Impose surcharges.
3	Severe: Rationing Program	- Same as above.

Ordinances should be adopted for all demand reduction measures requiring legal sanction or authorization. Those measures which require such sanction or authorization should be identified in advance to allow plenty of time to get ordinances passed. For the City of Yakima surface water supply source, water shortage conditions can be anticipated well in advance of their occurrence from precipitation and snowpack data. This data is monitored very closely each year by the U.S. Bureau of Reclamation. Bureau of Reclamation personnel should be consulted each spring to assess the possibilities for water shortages in the upcoming summer months.

Options for Supply Augmentation in a Water Shortage: Thus far, the City of Yakima has been able to meet current demands even in water short years by supplementing the surface water supply with the emergency well supply sources. In 2001 it was necessary to rely on the wells for a significant amount of the demand during the summer months. In future years, as demands increase, and with the possibility that more severe drought conditions could occur, it is possible that demand reduction and/or supply augmentation will be necessary. As discussed in Section 4.3, all of the City's surface water rights are currently under review by the Yakima County Superior Court as part of the *Acquavella* surface water rights adjudication, and it is unlikely that additional surface water rights could be obtained in the future.

However, the Aquifer Storage and Recovery (ASR) pilot test described in Section 4.2 demonstrated that physical aquifer properties of the Lower Member of the Upper Ellensburg Formation are favorable for a full-scale ASR program in that recharged water is relatively contained by the aquifer. Using three ASR wells, it is estimated that a total of 864 Mgal (approximately 2,650 AF) could be recharged over a 200-day period (October 15 through May 15) at an average recharge rate of 1,000 gpm per well. At a recovery rate of 100%, this would supply approximately 10.8 MGD for a period of 80 days. At a 2500 gpm recovery rate for each ASR well, three ASR wells would be required to produce 10.8 MGD.

The recovery capacity of the three existing City wells is about 8,050 gpm (11.6 MGD). When using the proposed ASR wells in conjunction with existing wells the total capacity of the emergency sources would be 22.4 MGD. The addition of three 2500 gpm ASR wells is taken into consideration in the storage and supply analyses included in Chapter 3 of this Water System Plan Update. Additional ASR recovery wells could be considered if additional emergency supply augmentation were required in future years.

4.5 Interties

As discussed in Chapter 1 of this Water System Plan Update, the City of Yakima has three interties with the Nob Hill Water Association. A summary of the interties, including location, size, hydraulic grade line (HGL), adjacent purveyor, and other data, are included in Table 1-5 in Chapter 1. All of these interties are activated manually. The City of Yakima hydraulic grade line elevations shown in the table are based on the hydraulic grade line at the storage reservoir when full and under static conditions.

The three interties with the Nob Hill Water Association are located at West Lincoln Avenue and North 56th Avenue, Tieton Drive and South 45th Avenue, and South 32nd Avenue and Ahtanum. These interties are for emergency purposes only and are covered in a Memorandum of Understanding between the City and the Association dated September 6, 2000, a copy of which is included in Appendix E. These interties are not designed for normal operation of either system and are not considered as a source of supply in the storage and supply analyses presented in Chapter 3 of this plan.

No new non-emergency interties are proposed or anticipated during the 20 year planning period.

Chapter 5

Source Water Protection

5 Source Water Protection

5.1 Source Water Protection Overview

The objective of this chapter is to outline a program to protect, and if possible, improve, source waters used by the City of Yakima water system. Source water protection for Group A systems is required under WAC 246-290-135, -668 and -690.

The appropriate measures to be taken to ensure adequate source water protection depend on whether the source of supply is surface water or ground water. If the utility uses ground water, a wellhead protection program is required. A watershed control program is required for utilities using surface water. The City of Yakima's primary source of supply is surface water which is treated by the Naches River Water Treatment Plant. In addition, the City currently has three groundwater wells which are used as seasonal/emergency sources of supply.

5.2 Wellhead Protection Program

The Upper Yakima Valley Regional Wellhead Protection Plan (WHPP) was completed in October 2000. The purpose of this plan is to identify potential sources of contamination near the member purveyors' groundwater supplies, implement management strategies to prevent contamination of those supplies, and develop a contingency plan for the contamination mitigation in the event that groundwater does become contaminated. In this Regional WHPP, each member community in the Upper Yakima Valley plays a role in protecting the groundwater supplies of the entire area by pooling resources and management efforts to target an audience beyond that which could be reached at a local level.

The member purveyors participating in this wellhead protection plan include:

Yakima County
City of Yakima
Town of Naches
City of Moxee
Town of Tieton
City of Union Gap
City of Selah
Nob Hill Water Association

The Town of Naches wellhead protection area also lies within the City of Yakima's surface water supply watershed

Regional management efforts adopted by the eight purveyors forming the Regional Wellhead Protection Committee include:

- Development of a Geographical Information System (GIS) database of the wellhead protection areas, potential contamination sources, and water quality data in order to monitor and track sources and receptors.

- Development of a planning trigger to distribute wellhead protection notification letters for development changes (i.e. building permits, zoning changes, SEPA, etc.) within wellhead protection areas.

- Coordination with Ecology to prioritize their Hazmat Technical Assistance Sweep within wellhead protection areas.

- Coordination with the State Health Department's Sanitary Surveys to ensure up-to-date information is maintained in the regional GIS potential contamination source inventory.

- Coordination with County Health District to identify septic tanks and private wells with Global Positioning System (GPS) units.

- Coordination with the Washington Association of Realtors to adopt a Property Disclosure Addendum that will help to identify private and abandoned well locations during property transfers.

- Designation of the 6-Month wellhead protection area as a critical "Red Zone" by County Emergency Management (LEPC) in order to prioritize wellhead protection during emergencies (i.e. hazardous material spills)

- Public education efforts including literature distribution.

- Coordination with Education Services District (ESD) which provides continuing education to area teachers in order to better integrate wellhead protection and water issues into school curriculum.

- Development of a regional website to increase public awareness on the need to protect groundwater.

- Development of a logo for wellhead protection area signs.

- Development of an interlocal agreement among the eight purveyors to make sure that wellhead protection is given a high priority in the Upper Yakima Valley.

The Wellhead Protection Plans for the City of Yakima and the Town of Naches are incorporated into this Water System Plan Update by reference.

5.3 Watershed Control Program

5.3.1 Regulatory Requirements/Program Overview

Watershed control requirements apply to all Group A systems using surface water, (i.e. both filtered and unfiltered systems). A watershed control program is an integral part of a

purveyor's overall strategy to ensure public health protection. The term “watershed” refers to the hydrologic drainage upstream of a utility’s surface water intake. The watershed affects the physical, chemical and microbiological quality of the source.

The watershed for the City of Yakima surface water source does not meet the criteria to remain unfiltered under the Surface Water Treatment Rule (SWTR), which is detailed in Part 6 of Chapter 246-290 WAC. The surface water supply has been filtered since the Naches River Water Treatment Plant was placed into service in the early 1970s.

Several extensive analyses of the surface water resources and water quality of the Yakima River basin have been conducted in recent years including:

- Yakima River Basin Water Quality Plan (YRBWQP), by the Yakima Valley Conference of Governments, June 1995.

- Surface-Water-Quality Assessment of the Yakima River Basin, Washington Overview of Major Findings, 1987–91, U.S. GEOLOGICAL SURVEY, Water-Resources Investigations Report 98–4113 (1999).

- Watershed Assessment Yakima River Basin, Yakima River Basin Watershed Planning Unit and Tri-County Water Resources Agency, January 2001.

- Technical Memoranda - Yakima River Watershed Plan, Yakima River Basin Watershed Planning Unit and Tri-County Water Resources Agency, Fall 2002.

- Watershed Management Plan Yakima River Basin, Yakima River Basin Watershed Planning Unit and Tri-County Water Resources Agency, January 2003.

Streamflow data for the Naches River near Naches was obtained from the US Bureau of Reclamation Pacific Northwest Region Yakima Hydromet Archive Data Access web site (http://mac1.pn.usbr.gov/yakima/yakwebarcread.html)

The data used in figures and tables presented in the following watershed characterization were derived from these sources as noted.

5.3.2 Watershed Description/Characteristics

Location

The City of Yakima's primary source of water is the Naches River. The City operates a 25-mgd water filtration plant located approximately 3 miles southeast of the City of Naches, and approximately 4.4 miles downstream of the confluence between the Tieton and Naches Rivers. The Naches River drainage is located on the eastern slope of the Central Washington Cascades in the Wenatchee National Forest. Figure 5-1 shows the location of the watershed and filtration plant and intake structure. The watershed area for Yakima’s surface water supply consists of most of the area comprised by Water Resources Inventory Area (WRIA) Number 38.

Drainage Area

The watershed drainage area is approximately 980 square miles. The Cleman Mountains form the divide between Wenas Creek and the Naches River and provide the northeastern boundary of the triangular-shaped drainage area. The west boundary is the Cascade Range and the southern boundary is formed by the Klickton Divide and Divide Ridge. The Naches River watershed is composed of two major subdrainages: the Tieton River drainage and the Naches drainage; the divide between the two is Bethel Ridge. The two rivers join at the junction of Highways 410 and 12, and continue southeasterly as the Naches River.

The Naches watershed is part of the larger Yakima River basin. The Naches watershed is approximately 15 percent of the total Yakima River basin drainage area. Data for the overall Yakima River basin, as presented in the YRBWQP, June 1995, were used to describe features of the Naches watershed.

Hydrology

The major streams and rivers in the Naches River basin are shown in Figure 5-1. The average annual precipitation in the Naches basin ranges from 140 inches at the headwaters to 20 inches in the lower watershed. A USBR stream gauge is located on the Naches River just downstream of the Wapatox Canal diversion. Tables 5-1 and 5-2 summarize data for this gauging station. Because the gauge is located below the Wapatox Canal, the flows reported below do not include the water diversion into the canal. The flows, therefore, represent the discharge in the Naches River at what has historically been the City of Yakima Naches River WTP auxiliary river intake. The drainage area upstream of the gauging station is 941 square miles, as compared to approximately 980 square miles at the treatment plant intake. The treatment plant intake was originally designed to use the discharge water from PP&L (now Pacific Power) Wapatox Canal power generating station, so the Wapatox power plant return flow was also part of the water supply available to the City at the intake. Late in 2002, the power generating station was purchased by the Bonneville Power Administration (BPA) and shut down to allow most of the Wapatox diversion to remain in the river to improve fish passage in the reach between the diversion and the WTP. New fish screens were installed on the WTP intake with project completion scheduled in 2004. After completion of the new intake screen project, the river intake near the WTP became the normal source of surface water supply.

Table 5-1 US Bureau of Reclamation Stream Flow Data Naches River at Naches, WA Monthly Average, Average Low, and Average High for Water Years 2004-2009			
Month	**Average (cfs)**	**Average Low (cfs)**	**Average High (cfs)**
January	1222	556	2512
February	857	612	1485
March	1395	500	4336
April	2034	1768	2584
May	3794	1522	5665
June	2893	516	4888
July	857	339	1718
August	636	499	702
September	1873	1520	2248
October	720	584	840
November	1118	467	3206
December	832	676	1247
Annual	1519	797	2619

Table 5-2 Naches River Near Naches River Flow Statistics	
Condition	**Value**
Drainage Area	941 square miles
Mean Annual Flow	1,255 cfs
7-Day, 10-Year Low Flow	90 cfs
90th Percentile Exceedance Flow for Mean Daily Discharge	157 cfs
50th Percentile Exceedance Value for Mean Daily Discharge	743 cfs
10th Percentile Exceedance Value for Mean Daily Discharge	3,085 cfs

Geology and Soils

The soils in the upper Naches River basin are primarily cool, stony, forest soils and dark, stony, rangeland soils varying in depth from very shallow to deep. The midbasin consists primarily of dry silty and loamy soils; some areas contain drainage-impeding hardpans. The lower basin is primarily dry, coarse, silty soils, some with lime layers at 2 to 4 feet, and dark, stony, rangeland soils, some with hardpan.

Topography
Topographic features of the watershed are shown in Figure 5-2. Elevations in the watershed vary from about 6,800 feet near the western and northern watershed boundaries to about 1,300 feet near the water treatment plant. The Klickton Divide and Divide Ridge form the southern and southeastern borders. This ridge separates the Tieton River drainage from the Cowiche Creek drainage. The northern border of the watershed is formed by several mountains and ridges including Blowout Mountain, Mt. Clifty, portions of Manastash Ridge (west end), Quartz Mountain, Bald Mountain, and Clemen Mountain. The watershed is primarily forested, but also contains flat valleys lying between steep forested or rock slopes that are used primarily for agricultural purposes or for livestock grazing.

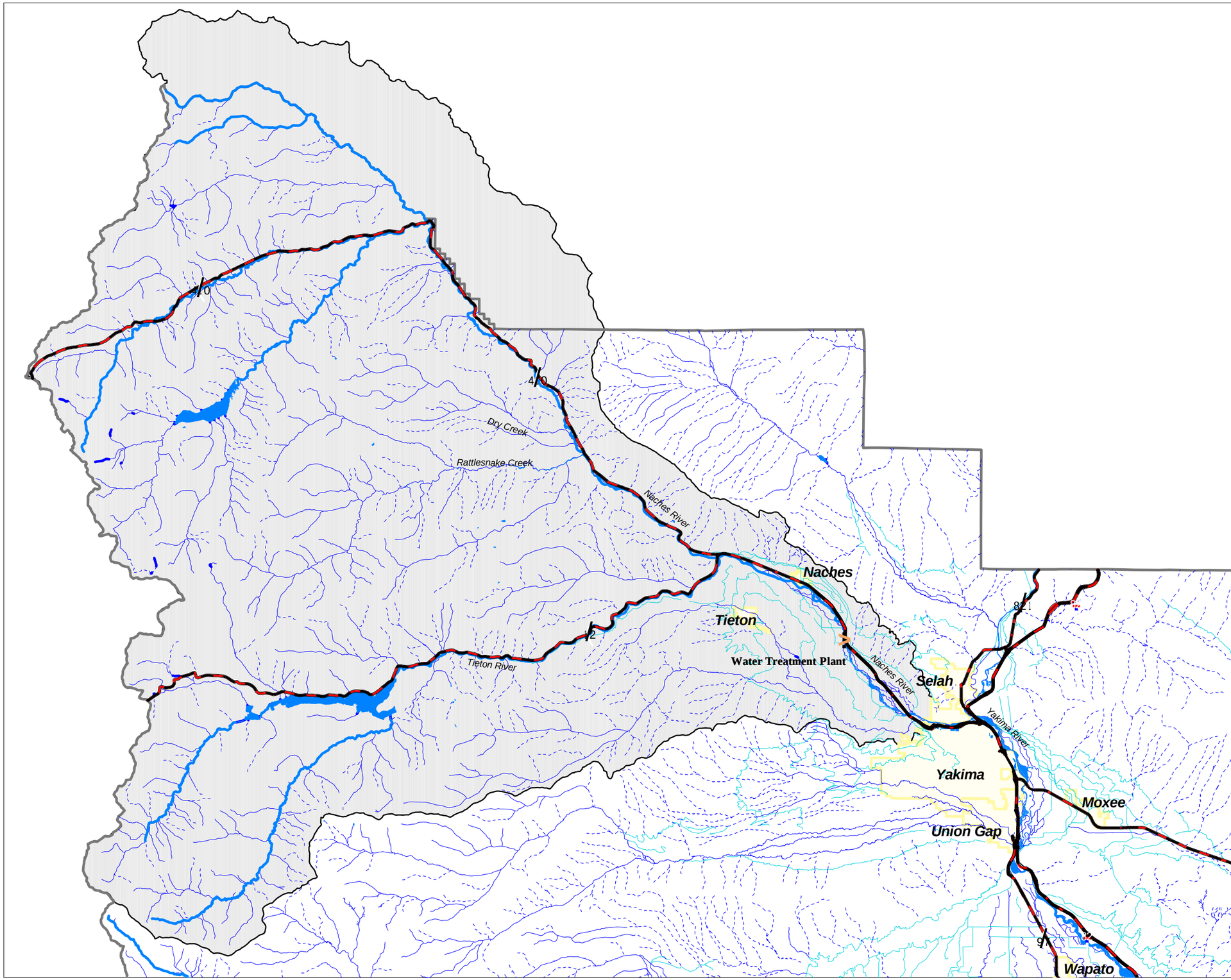
Point of Diversion
The City's intake structure is located downstream of the City of Naches wastewater treatment plant (WWTP). In order to minimize the potential contamination of the river from a failure at the Naches WWTP, the water treatment plant intake was originally designed to utilize the return flow from PP&L's Wapatox Canal whenever the power-generating facility is operating. The Wapatox diversion is upstream of the Naches WWTP, so the risk of water quality degradation from a treatment plant failure would be reduced when the Wapatox is operating, normally April to October.

However, City staff has collected and analyzed river water samples from both diversion points and have determined that there is currently no reason for significant concern. City staff has developed an operations manual that includes procedures for reacting to contamination events that might occur upstream of the intake structure. This issue is addressed further in Sections 5.3.3 and 5.3.4 of this chapter.

Wildlife
The YRBWQP (reference Table I.C.3-2) indicates that the following animal species are present in the Naches watershed:

- Mountain sheep
- Chukar
- Rocky Mountain elk
- Mule deer
- Golden eagle
- Great Blue heron
- Bald eagle
- Osprey
- Spotted owl
- Beaver
- Bear

Overall, the watershed supports a diverse wildlife mix and the YRBWQP indicates several locations that provide good to excellent habitat for the animals and fish residing in the watershed. The Tieton River and Little Naches drainages contain old growth forest that serves as habitat for the spotted owl.



Water Treatment Plant

State & Fed Roads

Streams

Perennial Stream

Intermittent Stream

Lake or Pond

Canal or Ditch

Aquaduct

Siphon

Cities

County Line

Watershed Boundary

0 2 4 6 8 10 Miles

N

Water System Plan Update

Figure 5-1
Location of Watershed

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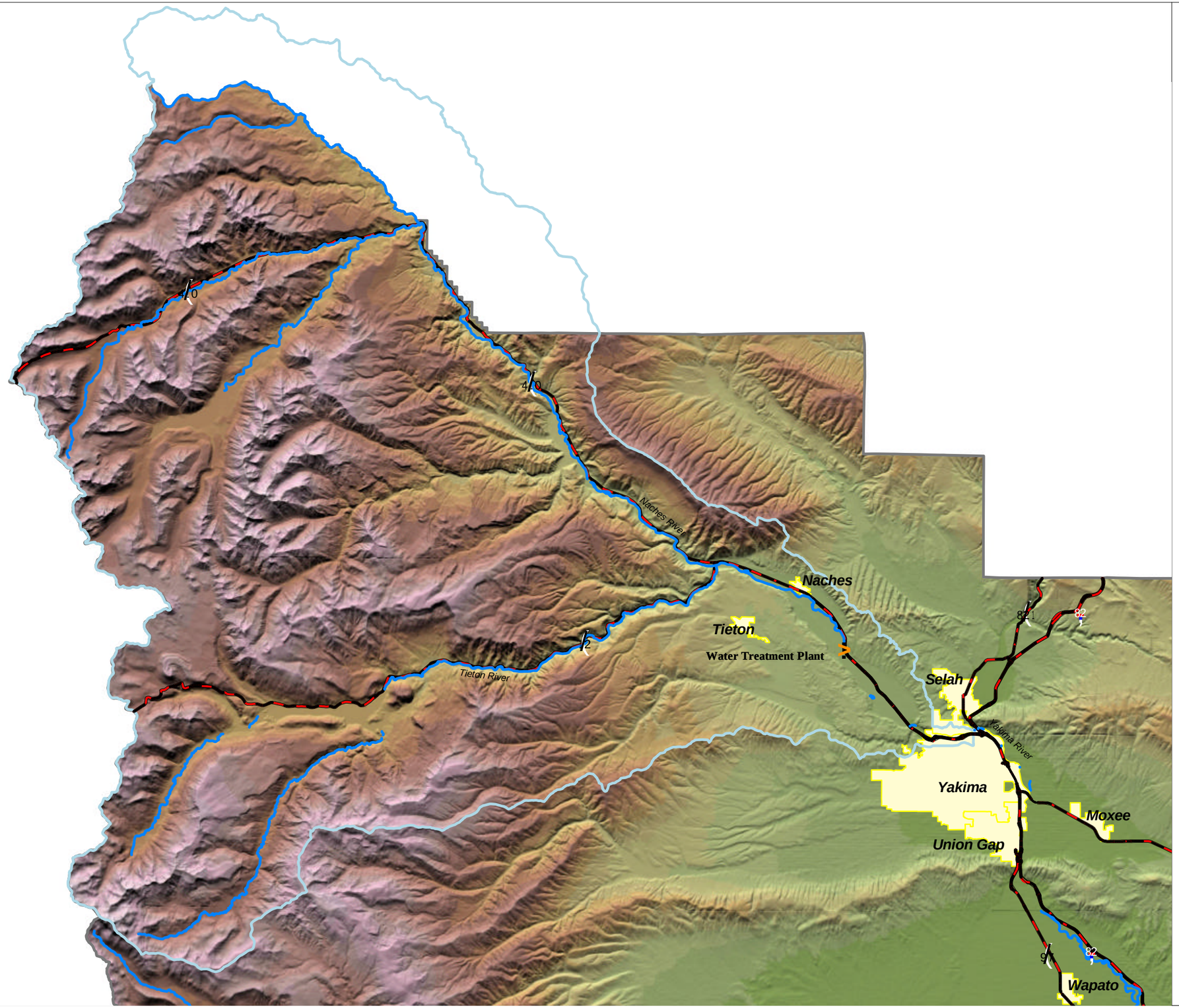
Plot date: Mar 17, 2003; map1



Water Treatment Plant

Rivers

State & Fed Roads

Watershed Boundary

Cities

County Line

0 2 4 6 8 10 Miles

N

Water System Plan Update

Figure 5-2
Watershed Topographic Map

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Plot date: Mar 18, 2003; 6

Land Ownership
The majority of the watershed is part of the Wenatchee National Forest administered by the U.S. Forest Service (USFS). Approximately 41 percent of the watershed area is within the Norse Peak and William O. Douglas Wilderness Areas. Portions of the watershed are owned by the State of Washington, while some of the watershed is privately owned. Table 5-3 shows the land ownership in the Naches watershed. Figure 5-3 provides a geographic representation of land ownership.

Table 5-3
Naches Watershed Land Ownership

Ownership Type/Agency	Square Miles	Percent of Watershed Area
National Forest (including wilderness)	850[a]	87
State of Washington	50	5
Private Ownership/Unknown	80	8
Totals	980	100

[a]Including 350 square miles of wilderness area.

Of the state-owned land in the watershed, roughly half is managed by the Department of Natural Resources, and the other half is managed by the Department of Fish and Wildlife. Virtually all of the state lands are in the lower Naches area, just upstream from the City of Naches.

5.3.3 Identification of Activities/Land Uses Detrimental to Water Quality

Land Uses
The watershed area is host to a variety of land uses including municipal development at the City of Naches, several small rural mountain communities, agricultural uses, livestock grazing, forestry, recreation, and at least one sawmill. The land use designations are shown geographically on Figure 5-4. There are two state highways that traverse the watershed from east to west: Highway 12 and Highway 410. Highway 12 parallels the Tieton River and Highway 410 parallels the Naches River for several miles. The Burlington Northern Railroad had a short segment of line paralleling the north bank of the Naches River from the treatment plant into Naches. The track ends just west of Naches and is currently not in use.

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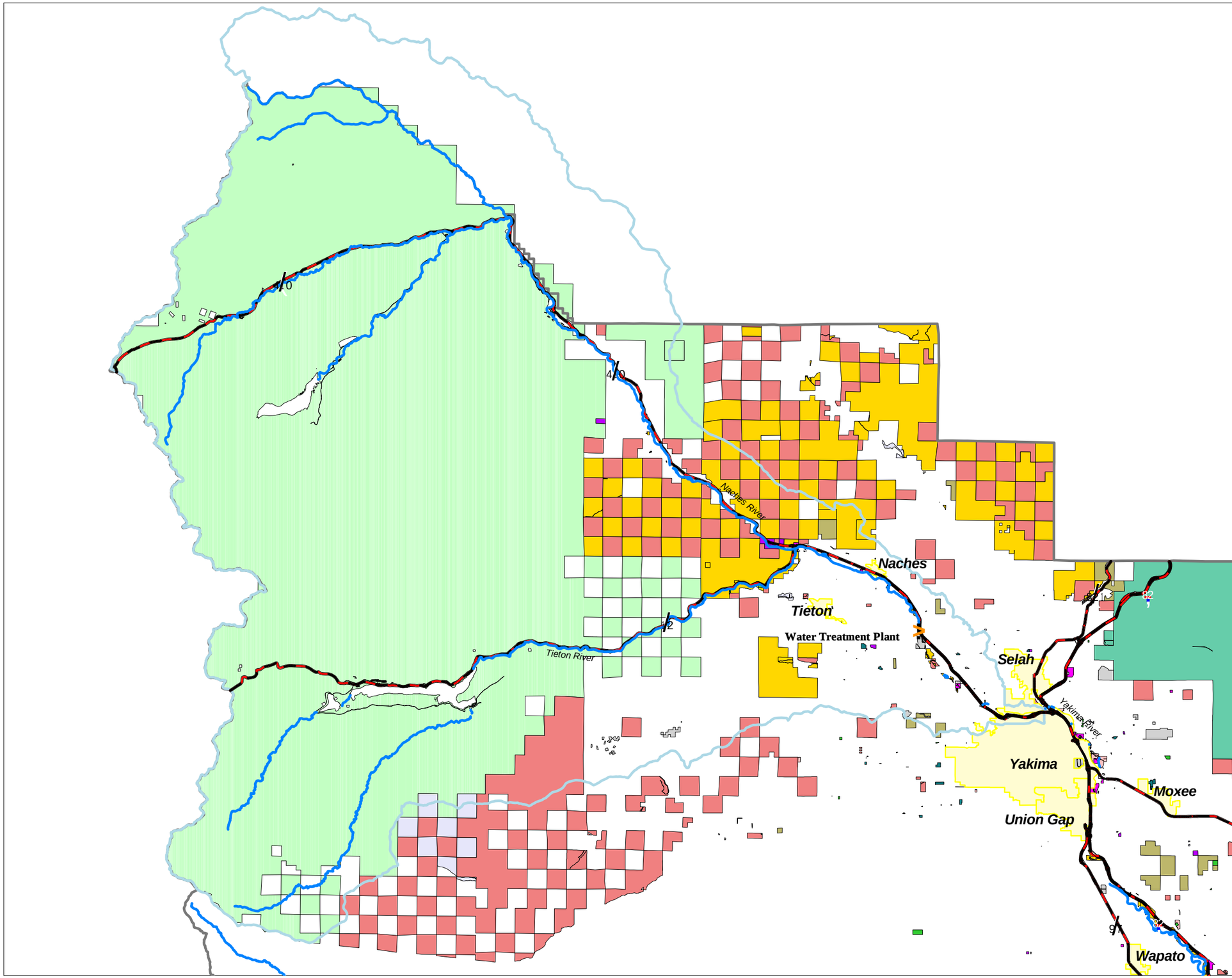


Water Treatment Plant
Rivers
State & Fed Roads
Watershed Boundary

Cities

County Line

Public Owned Land
- US Bureau of Land Management
- US Dept of Defense
- US Fish & Wildlife
- US Forest Service
- Other Federal Agencies
- WA Dept of Fish & Wildlife
- WA Dept of Natural Resources
- WA Dept of Transportation
- Other State Agencies
- Yakima County
- School Districts
- Irrigation Districts
- Fire Districts
- Municipal

0 2 4 6 8 10 Miles

N

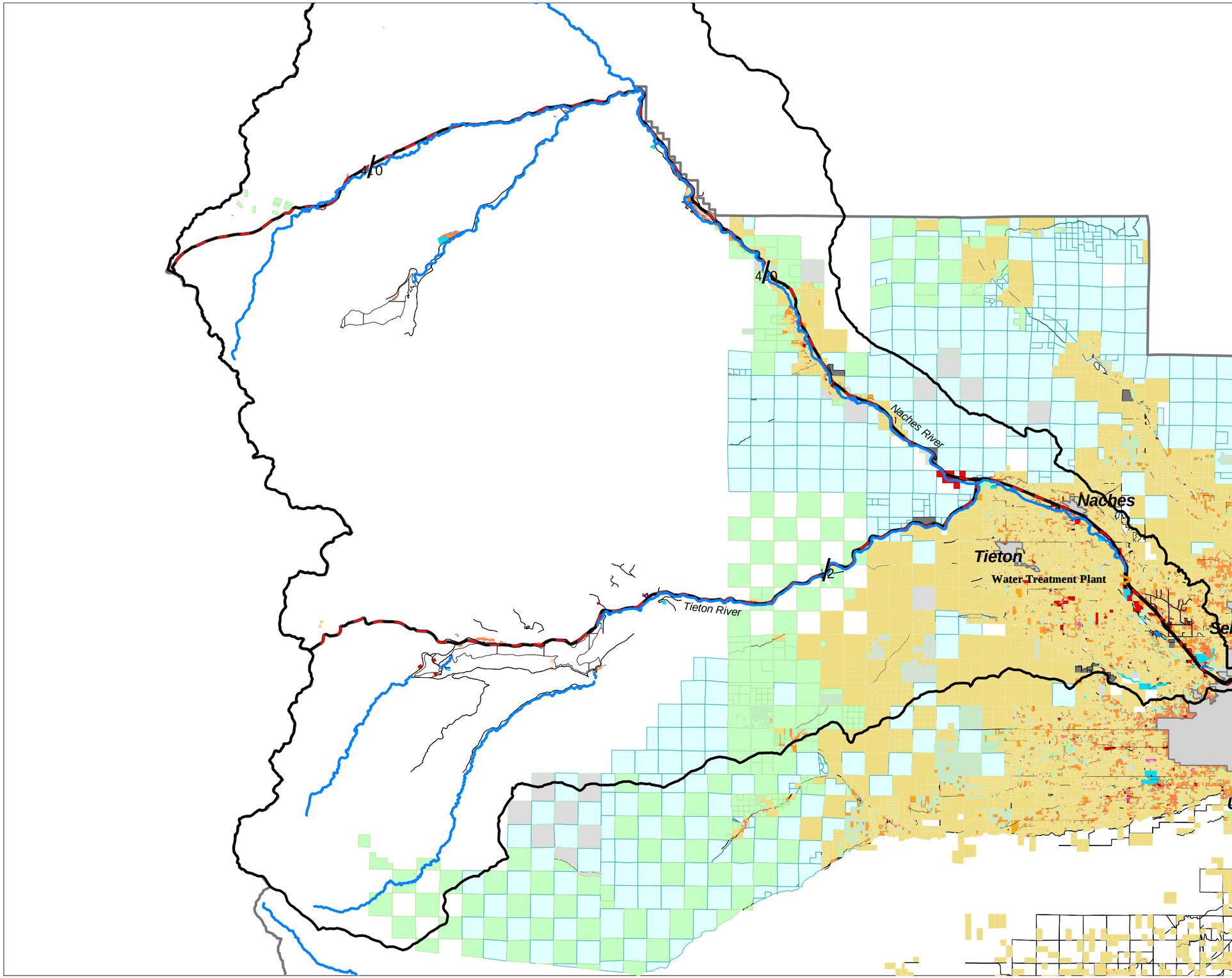
Water System Plan Update

Figure 5-3
Watershed Land Ownership

Copyright (C) 2003 Yakima County

This map was derived from several databases. The County cannot accept responsibility for any errors. Therefore,there are no warranties for this product.

Plot date: Mar 18, 2003; map3



Water Treatment Plant
Rivers
State & Fed Roads
Watershed Boundary

Cities

County Line

Land Use
- Residential
- Commercial & Wholesale
- Education & Government
- Parks & Other Open Spaces
- Agriculture
- Forestry
- Mining
- Vacant
- State Lands
- Fed & Yak. Nat. Trust Lands

0 2 4 6 8 10 Miles

N

Water System Plan Update

Figure 5-4
Watershed Land Use Map

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Plot date: Mar 18, 2003; map2

Although there is a wide range of land uses in the watershed, the intensity of these uses is low. The majority of the watershed is a reserved wilderness area or national forest. However, the development that does exist is concentrated along the state highways, which parallel the two major rivers. Therefore, the potential does exist for contamination of the water supply. A brief discussion of each land use type is provided below.

Agriculture

As indicated in Figure 5-4, the Naches watershed above the Water Treatment Plant contains very little agricultural land. The agricultural land in the watershed is concentrated in the lower Naches subbasin, near the City of Naches, and along Highway 410 paralleling the Naches River. However, the Yakima Tieton Irrigation Canal parallels the Tieton River from downstream of the Tieton Dam area to near the mouth of the Tieton River. The City's water supply was historically diverted into the Wapatox Canal before entering the City's intake structure. Water quality analysis results for the City's raw water supply have to date shown no indication of VOC, SOC, or pesticide problems. The risks associated with the possibility of agricultural crop spray entering the water supply as overspray along the Wapatox Canal will be somewhat reduced with the change in the normal point of diversion. There will still exist the potential for contamination from accidental/intentional introduction of agricultural or other hazardous chemicals into the Naches River, however greater dilution would take place. The risk and response to these conditions would be similar to the actions necessary for a transportation chemical spill, although detecting the problem in time to initiate response activities would be more difficult because the party responsible for the contamination may not even be aware that it is occurring.

Dairies, Feedlots, and Livestock Grazing

According to the YRBWQP, there are no known dairies or significant herds of dairy cows in the Naches River basin (reference Figures I.D.2.b-1 and I.D.2.b-4 in the YRBWQP). Feedlot data are only available by county, and there was no mapping showing the distribution of feedlots within Yakima County. The YRBWQP (reference Figure I.D.2.d-1) shows that rangelands within the Naches basin are concentrated near the confluence of the Naches and Tieton Rivers, just upstream of the City of Naches. This rangeland area corresponds closely with Washington Department of Fish and Wildlife managed lands. A smaller concentration of rangeland is also present in the lower Tieton basin and in the southwestern portion of the Naches basin, within the William O. Douglas Wilderness Area.

Recreation

Fishing is a primary form of recreation in the Naches watershed. The American, Bumping, Little Naches, and Tieton Rivers, Rattlesnake Creek, and Bumping and Rimrock Lakes all contain various species of trout. The lakes also support Kokanee salmon.

Dispersed recreational uses such as backpacking, hiking, hunting, fishing, skiing, snowmobiling, off-road vehicle travel, camping, rafting, and kayaking are all common in the Yakima River basin. Most of the uses are present to some degree in the Naches watershed. There are no state or federal parks within the watershed, but there are at least 43 developed recreation sites in the watershed, most of which are managed by the USFS. The primary water quality concerns associated with recreation are nitrates and bacteriological contamination. Water quality analysis

results for the City's raw water supply show that nitrate and bacteriological levels are well within the treatment plant's operating range for effective removal. Historical water quality data for the Yakima River basin, including the Naches River, have been summarized in the YRBWQP as well as the USGS Water-Resources Investigations Report 98–4113 (1999). Additional statistical analysis of available nitrate and bacteriological data may help evaluate whether concentrations of these parameters are increasing significantly over time. Future monitoring plans should include sites within the watershed that would provide information on the impact of recreation on water quality.

Managed Forest Lands

A land-use summary of the 850 square miles of National Forest in the watershed area is shown in Table 5-4.

Table 5-4
Naches Watershed
Land Uses Within National Forest Boundary

Type of Use	Total Acres (sq. miles)	Percent of National Forest Area
Private Land	35,978 (56)	6.6
Wilderness	223,768 (350)	41.2
Intensive Harvest	112,404 (176)	20.7
Other Harvest	128,113 (200)	23.5
Non-Harvest	43,604 (68)	8.0
Total Acreage	543,869 (850)	100

Wilderness and Protected Multi-Use Natural Areas

Approximately 71 percent of the 50,293-acre Norse Peak Wilderness is within the Naches watershed. The Norse Peak Wilderness Area has only 52 miles of trail, and visitor use is moderate. As a comparison, the Alpine Lakes Wilderness to the north, which is not within the watershed, contains 800 miles of trail and is one of the most heavily visited natural areas in Washington. Approximately 68 percent of the 151,730 acres of the William O. Douglas Wilderness is within the Naches watershed. The William O. Douglas Wilderness Area contains approximately 250 miles of trail and is moderately visited. A small portion (roughly 30,000 acres) of the Goat Rocks Wilderness is within the Naches watershed. The overall Goat Rocks Wilderness Area contains 120 miles of trails. The Pacific Crest National Scenic Trail crosses all three wilderness areas from north to south. Portions of the Oak Creek Wildlife Area are also located within the Naches watershed. This wildlife area supports deer, elk, and mountain sheep.

Two segments of river within the watershed are eligible to be designated as wild and scenic rivers: the American River from the confluence with the Rainier Fork to the confluence with the

Bumping River (16 miles, scenic status) and the American River from its headwaters to the confluence with the Rainier Fork (6 miles, wild status).

Roads and Transportation Corridors
As stated earlier, Washington State Highway 410 parallels the Naches and American Rivers across the entire watershed and US Highway 12 parallels the Tieton River to Rimrock Lake, parallels the north shore of the lake and continues parallel to Clear Creek until it exits the western boundary of the watershed. There are also numerous USFS roads, county roads, and other secondary roads traversing the watershed. A short spur of Burlington Northern Railroad line runs parallel to the Naches River from the mouth of the river to the City of Naches.

Municipal and Industrial Wastewater
The City of Naches WWTP is located about 3 miles upstream of the City of Yakima WTP and discharges into the Naches River. Figure 5-1 shows the location of the City of Naches with respect to the water treatment plant. The treatment plant is a secondary treatment facility operating between a 90 and 95 percent biochemical oxygen demand (BOD) and total suspended solids (TSS) removal efficiency. The Naches WWTP is currently undergoing a major upgrade which will improve reliability and performance to further reduce the potential for impact on the WTP source of supply. The improvements to the Naches WWTP are scheduled for completion in 2003.

Septic Tanks
The Town of Naches is sewered. Wastewater disposal outside the city limits is by septic tanks and drain fields. The total population in the watershed above the Naches-Tieton confluence is approximately 1,185 persons, according to the YRBWQP (reference Figure I.A-8). In addition, septic systems are probably present in some of the 43 camping areas and resorts that are located in the watershed. The largest concentrations of septic systems are probably in the communities of Squaw Rock, Pine Cliff, Gold Creek, and Rimrock. The urban and built-up areas within the Naches basin are, therefore, limited and are concentrated in the lower Naches subbasin.

Residential and Commercial Land Uses
The average population density above the Naches-Tieton confluence is about 1.2 persons per square mile. An additional 6,637 people live in the lower Naches drainage between the confluence and Selah, but this number does not include Selah. The equivalent gross population density is about 170 people per square mile. In addition to the City of Naches, other populated centers are the communities of Squaw Rock, Pine Cliff, Gold Creek, and Rimrock Retreat (also known as Trout Lodge). Rimrock Retreat is located near the Rimrock Reservoir on the Tieton River and the other three communities are located along Highway 410 upstream of the City of Naches.

Mining
Small-scale mining is present in the watershed. Figure I.D.2.h-1 from the YRBWQP shows the mining areas and types of metal that have been extracted from these areas. The Bumping Lake Mining District has produced a total yield of less than 10,000 troy ounces of gold and silver, and though the presence of lead, zinc, and uranium has been detected, no economic deposits have

been discovered. Silver, copper, gold, and tungsten have also been found northeast of the Tieton River headwaters. Three sand and gravel mining sites are located near the mouth of the Tieton River.

Table 5-5 summarizes land uses in the watershed and indicates the possible contaminants from each type of land use. This table was adapted from *Effective Watershed Management for Surface Water Supplies*, American Water Works Association Research Foundation (AWWARF), 1991.

Table 5-5
Land-Use Pollutant Analysis Matrix

Land Use/Contamination Source	**Contaminant**											
	Turbidity	pH	Nitrogen, Phosphorus	Algae	Viruses, Parasites	Bacteria	THM Precursors	Pesticides	Other SOCs	VOCs	Heavy Metals	Iron, Manganese
Cropland Runoff	X		X	X	X	X	X	X			X	X
Grazing	X		X	X	X	X	X					
Recreation					X	X						
Forest Management	X		X	X		X	X	X				
Roads (surface runoff)	X		X	X			X					
Wastewater Discharge (municipal and industrial)	X	X	X	X	X	X	X	X	X	X	X	X
Septic Tanks		X	X	X	X	X	X	X				
Urbanization	X	X	X	X	X	X	X	X	X	X	X	X
Hazardous Materials/ Chemical Spills (transportation and agricultural users)								X	X	X	X	X
Mining	X	X									X	X

Source: Effective Watershed Management for Surface Water Supplies, AWWARF 1991.

5.3.4 Watershed Management and Control Measures

The vast majority of the City of Yakima surface water supply watershed is publicly owned. As pointed out in the Department of Health Sanitary Survey report dated April 22, 2002, the City is unable to control activities in the watershed which include; recreation, timber harvesting, vehicle traffic on two major transportation corridors, irrigation water storage and delivery systems including Rimrock and Bumping Lakes, and the Town of Naches Wastewater Treatment Plant. As stated in the Sanitary Survey report, the City is "doing the best that they can under the current ownership and control." The most effective approach available to the City under these circumstances is to work closely with the other federal, state, county and tribal agencies with jurisdiction over activities in the watershed to make sure that the policies and decisions affecting watershed management and water quality fully consider the potential impacts on the City's water supply.

The most recent and comprehensive water quality enhancement strategy for surface waters was developed as part of the Yakima River Watershed Management Plan prepared under the direction of the Yakima River Basin Watershed Planning Unit and the Tri-County Water Resources Agency. The City of Yakima Water Division was actively involved in this planning process, and a representative of the Yakima City Council serves on the board of directors of the Tri-County Water Resources Agency. The City will continue to actively support the ongoing planning and implementation of the water quality enhancement strategies identified in this plan particularly as they affect the watershed for the Naches River surface water supply. Specific water quality goals, objectives, and recommended actions were outlined in a Technical Memorandum titled *Yakima River Basin Watershed Plan (Task 2-360) Surface Water Quality Strategy, January 2002*. This surface water quality strategy as described in this technical memorandum is summarized in the following sections with emphasis on those components which are most important and most applicable to WRIA 38 and the Yakima surface supply watershed.

Water Quality Goals

The water quality strategy technical memorandum includes an overall goal and six supporting categorical goals. The categorical goals each have supporting objectives and actions proposed as necessary to implement the goals. The goals, objectives and related rationale are described below.

The overall goal of this strategy is: Protect and improve water quality consistent with the needs of aquatic life, public/private water supplies, recreation, and other uses.

More specific categorical goals were identified to support overall goal achievement for this strategy. The six categorical goals are listed below, together with the rationale supporting each goal:

> **1. Reduce non-point source pollution**
>
> This categorical goal stresses non-point source pollution reduction and prevention. Best management practices as well as other approaches involve non-point pollution prevention activities that help maintain the integrity of high quality water generated in the upper watershed. Extending the concept of non-point source pollution, this can also include

maintenance and/or establishment of riparian vegetation, which helps stabilize streambanks (reducing soil erosion) and provides shade cover (to help keep waters cool).

2. Support/maintain point source programs
This categorical goal calls for support and maintenance of point source pollution controls. Point sources such as municipal wastewater treatment plants or confined animal feeling operations are currently controlled through permit programs that require regular monitoring and reporting. Support of these programs is necessary to continue controlling point source pollution.

3. Improve interagency coordination of water quality programs
This categorical goal addresses a need for improved interagency coordination for water quality programs. In the recent past an interagency committee performed this function in the Yakima Watershed; however, the group was recently disbanded. There is a current need to reestablish an effective interagency coordinating forum.

4. Improve watershed-wide information base
This categorical goal seeks to improve and broaden the base of watershed-wide information. This goal is important for site-specific problem definition as well as for evaluation of water quality responses from a variety of project actions. The nature of local problems and cause-effect relationships also need to be better understood.

5. Ensure water quality standards reflect natural regional conditions
This categorical goal is important as a guiding principle for regulatory agency consideration given concerns over local applicability of certain water quality criteria such as those associated with current water temperature standards and background levels associated with turbidity criteria. Water quality standards, when set, reviewed and enforced, should consider geographic conditions and natural background conditions. Studies are needed because regional conditions such as climate impacts are important to fish distribution, vegetation, hydrology and baseline water quality levels. Warmer summer air temperatures on the eastern slopes of the Cascades may account for the large number of 303(d) listings for temperature, many of which are in forested areas. Local public support for water quality and habitat protection enhancement efforts is increased when there is strong locally relevant rationale.

6. Minimize water resource management impacts on water quality.
This categorical goal focuses on water quality impacts of water resource management on surface waters. Streamflow maintenance affects water quality through dilution, aeration and velocity effects. Water quantity affects water quality. Water resource development and operations can affect water temperatures through diminished flow, but also potentially can be used to enhance water quality (e.g. temperature) through carefully managed reservoir releases.

Recommended Objectives and Actions
Ten objectives were developed in the *Surface Water Quality Strategy* considering one or more aspects of the goals. These more specific objectives deal with aspects of the goals and other more detailed approaches that were considered in the development of actions. Categories of

proposed actions are identified and clustered under each objective. The objectives are listed for convenience below with their narrative statements:

(1) Reduce/mitigate forest practices impacts
(2) Reduce/mitigate agriculture impacts
(3) Reduce/mitigate stormwater impacts
(4) Reduce/mitigate resource extraction impacts
(5) Reduce/mitigate recreation impacts
(6) Maintain/improve compliance with discharge permits
(7) Improve interagency coordination
(8) Improve understanding of watershed problems and solutions
(9) Ensure water quality standards reflect natural regional conditions
(10) Minimize water resource impacts on water quality.

Discussions of each objective and proposed actions for water quality improvement are provided below. Each objective statement is followed by its purpose, rationale, relationships to goals, and other objectives and a list of proposed actions. In many cases, the recommended actions are already being implemented to some degree by various agencies.

Objective 1: Prevent/Mitigate Forest Practices Impacts

Purpose: Support and encourage use of forest practice activities to protect and enhance water quality.

Rationale: Activities on forested lands can have significant impacts on water quality, particularly as related to soil erosion and water temperature. Forest practice-related activities including timber harvest and road maintenance can alter hydrology with attendant impacts on streams, particularly in the headwaters of the watershed. Protection of forested headwater drainages is critical as a source of high quality water for downstream reaches, which support a variety of beneficial uses.

Proposed Actions: Actions identified under Objective 1 are intended to support the USFS, national forest plans and forest practice rules under the Forest Practices Board consistent with recommendations of the USFS and DNR watershed assessments and supporting activities. These sources have identified numerous actions to protect and improve water quality.

Specific actions addressing water quality include:

Improve Forest Road/Trail Management.

Numerous projects, plans and programs on federal and state/private forest lands are associated with forest roads and trails. These range from impact assessments, design modifications, and road density reduction programs to decommissioning of specific roads, trails or stream crossings. Examples of potential projects and programs under the *Improve Forest Road/Trail Management* category include:

- Management of Forest Roads
- Design of Forest Roads/Culverts
- Construction Practices for Forest Roads

- Erosion Control for Forest Roads
- Decommissioning of Forest Roads/Trails
- Road Fill Evaluation
- Road Density Evaluation.

Improve Timber Harvest Management.

Harvest-related actions include evaluations associated with pre-harvest plans and related criteria (e.g., riparian buffers) and mitigation of past logging impacts. Actions under this category addressing water quality include:

- Evaluations of Unstable Slopes
- Timber Harvest Management Plans
- Riparian Canopy Closure Improvements
- Road and Timber Harvest Buffers
- Restoration of Riparian Recreation Areas
- Soil Compaction Mitigation.

Other Watershed Actions

There are a number of types of water quality-related actions which are more general in nature or which do not fit into the previously identified action groups. These include:

- Forest Pesticide Controls
- Watershed Assessments
- Evaluations of Water Temperature Impacts
- Acid Rain Studies in Alpine Lakes
- Coordinated Resource Management Plans
- Water Quality Monitoring.

Control of non-point pollution within the forested areas of the watershed receives high priority because of the importance of these headwaters to the quality of the City of Yakima surface water source of supply. Many of the kinds of actions identified are protective and/or preventive in nature but there are also mitigation or restoration needs, which are very important in selected subbasins where water quality impairment (e.g., erosion/turbidity) is an issue. The US Forest Service, DNR and private timber company watershed assessments outline management needs and prescriptions for recovery in specific subbasins. Obstacles to implementation of some actions exist due mainly to increasing recreational use pressures and the economics of timber harvest. The actions identified are mainly associated with on-going maintenance and good land stewardship.

The Forest and Fish Report, developed for the State Forest Practices Board and the Governor's Salmon Recovery Office in the late 1990s, outlined a proposal for new forest practices rules, statutes and programs to protect salmon habitat on now federal lands in Washington. Ongoing federal Forest Service activities and the new state forest practice rules based on Forest and Fish Report recommendations include numerous elements which are directly linked to water quality protection and others which are more closely associated with habitat management.

Objective 2: Prevent/Mitigate Agricultural Impacts

Purpose: Emphasize control of non-point pollution from agricultural sources to protect and improve water quality throughout the watershed.

Rationale: Non-point pollution from agricultural activities is a particular problem in the Yakima River watershed. Sources are varied, ranging from irrigation return flow and agricultural chemicals to confined animal feeding operations and dairies. Many of the surface waters in the lower reaches of tributaries are in violation of water quality standards, reflecting past pesticide use and other practices. Other problems include turbidity and water temperature. Ongoing efforts by the Department of Ecology (Ecology) working with Conservation Districts, NRCS, Irrigation Districts and local water users to reduce non-point source impacts through TMDL programs are successfully addressing some of these problems. As efforts continue, additional improvements will be realized.

Proposed Actions: Actions identified under Objective 2 are categorical in nature reflecting the diversity of agricultural activities. These categorical action groups relate to irrigation, agricultural chemicals, animal confinement and other miscellaneous topics. Action categories and identified project types addressing water quality are listed below:

Improve Irrigation Water Management

The following activities and other action needs are suggested for improvement of irrigation water management to benefit water quality. Progress is being made on many of these actions already in the Yakima Basin. Examples of types of actions under the *Improve Irrigation Water Management* category include:

- Irrigation District system improvements
- Irrigation Scheduling and Management
- On-farm Irrigation System Upgrades/Conversions
- Polymer Use for Tailwater Quality
- On-Farm Sediment Ponds
- Off-Farm Sediment Ponds
- Tailwater Pump Back Systems

Improve Cropland Management

Tillage, residue management, and other practices have water quality implications for both irrigated and dry land farming. Examples of types of actions are listed below:

- In-Furrow Residue Placement
- Row Crop Erosion Control
- Tillage Management.

Reduce Impacts of Agricultural Chemicals

Agricultural chemicals used in the watershed include pesticides for control of weeds, insects, other plant and animal pests; fertilizers such as nitrates, ammonium compounds and phosphates; and special chemicals for enhancement of crop quality or environmental factors (e.g., polymers for erosion control). Polymer use has improved water quality and received significant support,

but refinements are needed to achieve proper dosages for particular sites. Some past practices (e.g., DDT use outlawed in 1970s but previously applied on agricultural crops, forests, and in urban areas) have left accumulated residues in soils and aquatic life. Actions that could help understand and reduce impacts of agricultural chemicals are:

- Split Fertilizer Applications
- Soil Fertility Testing
- Pesticide Application Training
- Pesticide Licensing Programs
- Row Crop Soil Erosion Controls
- Irrigation Water Management
- Deep Percolation Evaluations
- Aerial Spraying Accuracy Evaluations
- Polymer Use Evaluations and Education
- Wind Criteria for Pesticide Application.

Address Livestock Impacts

Activities associated with confined animal feeding operations (CAFOs), dairies, ranching, and small holdings (hobby farms) have water quality impacts. While these activities occur mainly in areas designated for agricultural production, they may occur on a smaller scale in rural residential areas as well. CAFOs and dairies are regulated through state permits and these generally address runoff issues and manure storage. Less intensively used lands such as pastures are managed more on a voluntary basis with input from advisory agencies such as the Washington State University Cooperative Extension (WSUCE). Some aspects of ranching and general animal confinement are more controlled to discourage animals from accessing tributary streams. There has been considerable attention in recent years to reducing water quality impacts of large animals on the region's waterways. Existing permit programs and voluntary measures to address water quality concerns offer means of making progress on this issue. Example of more specific actions are listed below, some of which are ongoing:

- Maintain Technical/Financial Support to CAFOs
- National Pollutant Discharge Elimination System (NPDES) Permitting of CAFOs.
- Maintain Dairy Permit Programs
- Voluntary Fencing of Streams
- Voluntary Buffer Strips near Streams
- Small Landowner Assistance Programs
- Application of Public Land Grazing Programs
- Out of Stream Water Source Developments
- Manure Management
- Support Conservation District Efforts regarding Dairies
- Support Ecology TMDL Efforts

Control Other Agricultural Impacts

There are impacts of agricultural-related activities that are not covered under the previous action groups. Needs also include educational and water quality monitoring activities as well as impacts

of agribusiness operations and irrigation canal maintenance. Examples of other agricultural-related project actions include:

- Roadside Spraying Evaluations
- Aquatic Weed Control Evaluations
- Silt Removal from Canals/Laterals
- Canal Weed Control Impacts
- Pesticide Residue Monitoring in Aquatic Life
- Agricultural Soil Monitoring for Pesticides
- Educational and Assistance Programs for Small Farms/Ranches
- Educational Tours/Demonstration for Commercial Growers
- Consider Water Quality Impacts in Routine Operations and Maintenance Actions on Irrigation Drains.

Based on studies reviewed in the Yakima River Basin Watershed Assessment (January 2002), agricultural land uses are strongly correlated with water quality impairment in the lower reaches of the Yakima River watershed. Water quality is generally excellent in the headwaters and deteriorates significantly within intensively farmed areas of the Yakima Valley. The impacts of agricultural activities in WRIA 38 above the WTP intake are more limited, however, there are significant agricultural lands between the confluence of the Naches and Tieton rivers and the WTP. There are also significant grazing areas and pasture lands in the Naches River basin above the confluence. In addition, the Oak Creek Feeding area on the Tieton River just upstream of the confluence is similar to a confined animal feeding operation during the winter months when the elk herd for winter feeding. While water quality impairment due to these agricultural activities does not appear to be significant at this point, the city should work with the US Forest Service, DNR, and landowners to encourage the implementation of the agricultural-related actions items identified above wherever necessary to maintain the quality of the surface water supply.

Objective 3: Prevent/Mitigate Stormwater Impacts

Purpose: Control municipal/industrial stormwater run-off impacts through implementation of approved management plans.

Rationale: Stormwater runoff from developed urban areas and industrial sites contains pollutants that require management to avoid adverse impacts to receiving waters. State and regional guidelines exist (e.g., Eastern Washington stormwater guidelines) which identify appropriate stormwater management practices. Stormwater ordinances have been adopted by county governments and other municipalities in the Yakima basin, which identify water quality control approaches such as use of retention basins and bioswales.

Proposed Actions: Actions identified with Objective 3 are associated with municipal and industrial stormwater planning and related implementation. Accordingly, two action groups have been identified as follows:

Plan and Implement Municipal Stormwater Runoff Controls

Actions identified for improvement of municipal stormwater runoff control plans and related implementation are listed below:

- Municipal Stormwater Ordinances
- Regional Stormwater Runoff Control Guidelines
- Municipal Stormwater Control Plans
- Regional Stormwater Impact Assessments.

Plan and Implement Industrial Stormwater Runoff Control

Actions identified for control of industrial stormwater are listed below:

- Industrial Stormwater Ordinances
- Regional Industrial Stormwater Guidelines
- Industrial Stormwater Control Plans
- Regional Stormwater Impact Assessments

Stormwater runoff management is needed in the Yakima Basin but is considered of lesser priority in most of the watershed than topics covered by Objectives 1 and 2. Potential stormwater impacts from larger municipalities such as the cities of Yakima, Richland, Ellensburg, Prosser, and Sunnyside may be significant, particularly from storms that may increase pollutant loads during times of lower river flow. The City of Yakima should work closely with the Town of Naches and Yakima County to ensure that appropriate stormwater management practices are followed for any municipal or industrial development within the watershed.

Objective 4: Prevent/Mitigate Resource Extraction Impacts

Purpose: Control water quality impacts from mining and extraction of gravel, and/or other natural resources.

Rationale: Gravel mining activities have affected water quality in the Yakima Basin. There are major gravel extraction operations currently near the Yakima River mainstem. Gravel quarries operate under Ecology discharge permits and there are studies planned to evaluate effects of gravel quarry operations, including effects of varying locations on the floodplain, because of water quality and fish habitat concerns. Other natural resources extraction, such as coal mining, gold mining, and natural gas exploration has occurred in the watershed. Resource extraction impacts are not, as the present time, adversely affected the surface water quality in WRIA 38 above the WTP intake. The City should, however, make sure that they are notified of any proposed resource extraction activities within the watershed, so that the potential water quality impacts can be identified and mitigated during the permitting process for these activities.

Proposed Action: Actions proposed under Objective 4 are grouped in one category as follows.

Evaluate Gravel Extraction Operations

There is a variety of concerns regarding gravel quarry operations, particularly within flood plain areas. Specific actions identified are listed below:

- Gravel Quarry Relocation Studies
- Gravel Extraction Impact Evaluations

- Gravel Extraction Permit Assessment
- Gravel Quarry Relocation Assistance

These actions address localized impacts, which are important to water quality and fish habitat. Because these impacts are localized, they are considered a lower priority in the context of the overall Yakima Basin. Channel restoration activities will require time for healing. There are economic impacts associated with major changes in gravel extraction, which need to be considered along with possible benefits of restoration, relocation or other controls of gravel operations.

Objective 5: Prevent/Mitigate Recreation Impacts

Purpose: Control or relocate recreational activities and restore damaged recreational sites where water quality impacts occur.

Rationale: Recreational uses can degrade water quality particularly where activities are near or within water bodies. Campgrounds in riparian areas that are intensively used result in soil compaction and alter runoff rates causing soil erosion. Stream crossings by recreational vehicles (e.g., ORVs) can be protected by hardening or relocated to less sensitive sites. Roads and trails to accommodate recreational use can contribute to erosion problems by concentrating runoff or because of design deficiencies, particularly in areas with a dense network of roads and trails. Objective 5 is closely allied with Objective 1 (forest practices) as both involve forest-oriented activities with many similar impacts associated with forest roads, compaction and soil erosion.

Proposed Actions: The kinds of actions required to address Objective 5 are similar to some of those identified for timber harvest-related activities under forest practices. Additional actions specifically addressing objective 5 are described below:

Improve Recreational Use Management

Recreation activities can increase pressures on forested environments. Recreation management for water quality protection typically requires a wide variety of considerations ranging from mitigation of past damage to careful management of on-going activities such as campgrounds near streams. Action categories under recreation management include:

- Off Road Vehicle Controls
- Stream Crossing Mitigation
- Soil Compaction Mitigation
- Campground Management/Facilities
- Recreational Use Evaluations
- Camping/ORV Use Evaluations
- Snowmobile Use Mitigation

Based on watershed assessments conducted in forested areas recreational use impacts vary widely and are generally most significant near waterways, particularly where activities are within riparian corridors. Priorities for mitigation will vary depending on the project and its locations. Prevention-related priorities are generally high in order to guide future planning for

campgrounds and their access. Stream crossings and other more direct impact zones should generally be prioritized higher than upland projects involving diffuse recreation unless impacts on water quality are particularly compelling. Campground sanitation problems should receive high priority. Obstacles to implementation are expected especially where controls are needed to reduce intensity of recreational use in sensitive riparian areas and pristine uplands. Recreational use pressures are intensifying in the forested region so conflicts are likely when access is restricted. Rationale for water quality protection will need to be strong and communicated to the public in order to ensure support.

Objective 6: Support/Maintain Point Source Pollution Control Programs

Purpose: Continue to stress point source pollution controls as an ongoing need.

Rationale: Considerable progress has been made in the abatement of point source pollution sources through construction and operation of wastewater treatment plants and other facilities. Permit programs have been refined and treatment technologies have advanced since the 1960s when the nation began to focus on cleanup- of municipal and industrial wastewater. Effective laws are in place and major progress has been achieved. Needs will generally consist of expanding facilities to meet the needs of population growth and replace aging facilities, or to address new regulatory requirements and technological advances in the future. These needs can generally be addressed within the framework of the existing NPDES permitting process, including provisions for expansion to serve growth, upgrading and maintenance of facilities to meet regulatory requirements, and continued monitoring of effluents and receiving waters.

Proposed Actions: Actions identified under objective 6 include facility improvements on an as-needed basis. These are described below:

Upgrade Wastewater Facilities

There is one municipal wastewater treatment plant (the Town of Naches) and several small industrial facilities in the Naches basin above the WTP intake. There may also be areas around the Town of Naches which will need to be sewered as growth continues. The kinds of project actions needed include:

- Address Pollutant Loading Impacts in Permit Process
- Existing Municipal Treatment Plant Enlargements
- Existing Municipal Treatment Plant Upgrades
- Development of New Municipal Wastewater Facilities
- Enlargement/Upgrading of Industrial Wastewater Facilities
- Development of New Industrial Wastewater Facilities
- Effluent Outfall Improvements
- Effluent Reclamation/Reuse Facilities (e.g., spray fields)
- Pumping Station and other Collection System Upgrades.

Accommodate Service Area Growth

As required in State rules, municipal facilities need to accommodate incorporation of new areas and growth to protect both ground and surface waters. Actions needed include facility service expansion and regulations as listed below:

- Sewer and Water Extensions to Serve Growth
- Hookup Ordinances
- Septic System Density Limitations
- Water Well Density Limitations
- Sewer Areas of Growth near Municipalities

Point source pollution controls require continued monitoring and periodic upgrading to provide capacity treatment capabilities to accommodate growth and stricter effluent quality requirements such as ammonia, chlorine, and bacteriological limits. As noted previously, The City of Naches WWTP discharges into the Naches River about 3 miles upstream of the City of Yakima WTP intake. Because of the proximity of the WWTP discharge to the WTP intake, future NPDES permits conditions and design criteria for the Naches WWTP should include provisions for meeting Reliability Class I as defined by the Washington State Department of Ecology Criteria for Sewage Works Design.

Objective 7: Improve Interagency Coordination

Purpose: Coordinate water quality improvement and monitoring projects.

Rationale: The Yakima River drainage covers a large area with many jurisdictions that need to coordinate programs and projects to meet watershed water quality goals. In the recent past, an Interagency Council (IAC) reviewed and coordinated these activities. The IAC later became involved with prioritization of proposed salmon habitat restoration projects and controversy resulted that caused the group to disband. A similar interagency council is needed to coordinate water quality and habitat projects. This organization should be carefully structured to provide broad interagency involvement. Prioritization of grant applications and other proposed projects can now be accomplished by others such as lead entity groups established specifically for this purpose.

Improve Interagency Coordination

The main focus of the proposed action is to reestablish a coordinating council covering the watershed, which would have the following characteristics and functions:

- Multi-agency Participation
- Forum for Coordination of Water Quality Projects
- Coordination of Water Quality Monitoring Plans
- Water Quality Data Sharing
- Forum for Discussion of Water Quality Topics
- Forum for Discussion of Habitat Topics
- Forum for Discussion of Water Resource Projects
- Forum to Facilitate Interagency Collaboration
- Forum to Compare Local Government Guidelines/Regulations
- Upgrade Data Exchange

The purpose of objective 7 is particularly important since there is currently no formal intergovernmental coordination forum in the watershed. The coordinating groups would

logically involve federal, state and tribal agencies which made up the previous IAC, but could include an expanded group of local entities including irrigation and timber entities, county governments and municipal governments.

Objective 8: Improve Understanding of Watershed Problems and Solutions

Purpose: Improve understanding of causal mechanisms, problems and effectiveness of solutions.

Rationale: Information is key to understanding of watershed problems, their causes and effects of enhancement activities. Monitoring is one component of this information need but there is also a need for better understanding of complex interrelationships between water quality and habitat factors and effects concerned with fish/aquatic life protection and other uses. Additional research and monitoring data are needed. These informational processes are needed as feedback to guide future water quality and watershed improvement projects. These activities will need to be undertaken through intergovernmental coordination rather than by individual municipalities

Proposed Actions: There are a number of types of actions identified under this objective as identified below:

Basic Research to Improve Understanding of Cause and Effect

Examples of research needs for water quality and watershed management are listed below:

- Groundwater-Surface Water Interactions
- Climate and Water Temperature Interactions
- Flow and Water Quality Interactions
- Water Quality Effects on Movements of Migrant Spawners
- Riparian Shade Effects on Temperature
- Turbidity Causes from Miscellaneous Sources
- In-River Sedimentation Processes
- Pesticide Decay in Aquatic Life/Sediments
- Pesticide Decay in Soils
- Pesticide Contamination Pathways
- Effectiveness of Polyacrylimides
- Effectiveness of Best Management Practices
- Fertilizer Losses/Uptake
- Effects of Reservoir Releases on Turbidity
- Effects of Reservoir Releases on Temperature.

Improve Problem and Solution Definition

Definition of site-specific local needs and problems and the characterization of outcomes of projects is important and requires more information. Examples of needs are listed below:

- Detailed Geographic Breakdown of Specific Needs
- Stream Reach Assessments of Water Quality
- Prioritization of Problems within Reaches
- Assessment of Tributary Water Quality on Mainstem
- Determination of Specific Project Outcomes

- Adaptive Management Guidance

Expand Monitoring Activities

Water quality and other related watershed monitoring will need to be evaluated to ensure both data integrity and geographical coverage. Specific actions could include:

- Broaden Monitoring to cover entire geographic area
- Expand tributary monitoring outside of forest areas
- Organize mainstem river monitoring
- Broaden topics covered in monitoring information base
- Upgrade data exchange network.

Objective 9: Ensure Water Quality Standards Reflect Natural Regional Conditions

Purpose: Water quality standards criteria need to be attainable considering natural regional conditions such as climate and geology.

Rationale: Criteria used in water quality standards should protect beneficial uses while reflecting what is naturally attainable in the region considering climactic and geologic factors. Certain criteria such as turbidity are strongly influenced by natural processes (e.g., hydrology, soil erodibility) and reference background levels, which are to be used to determine compliance. Other criteria such as water temperature are linked closely to climatic driven factors such as air temperatures, presence vegetative shade cover, groundwater/surface water interactions and seasonal streamflows. There are also factors caused by human activity (e.g., removal of trees near waterways) that influence stream temperatures. Background levels for turbidity and temperature need to be better defined in the Yakima watershed.

Proposed Actions: There are specific actions associated with objective 9 that are intended to provide information to standard setting agencies, as follows:

Refine Water Temperature Criteria

Information is needed to better relate observed water temperatures to natural background conditions and associated temperature influencing factors to determine standards compliance and to model temperature. Example project actions are:

- Historic Riparian Vegetative Cover Maps
- Simulations of Groundwater – Surface Water Interaction
- Water Temperature Modeling
- Climatic Change Evaluations re Water Temperature
- Rationale for Special Temperature Standards
- Natural Bull Trout Distributions
- Timing/Seasonality of Temperature Criteria
- Diurnal Duration of Elevated Temperatures
- Critical Life Stage Timing by Geographic Area
- Refugia Locations and Migration Linkages
- Cold Water Source Evaluations

- Assessments of Human Related Effects

Define Background Turbidity Levels

More information is needed to set background levels of turbidity as a basis for determining compliance with current standards. Examples of needs are:

- Soil Erodibility/Erosion Risk Mapping Associated with Turbidity
- Turbidity Resulting from Natural Runoff from Undisturbed Wilderness Areas
- Turbidity Levels Associated with Various Storm Frequencies
- Effects of Reservoirs on Background Turbidity
- Turbidity Measurements during Snow Melt Events
- Turbidity Measurements from Rainfall Events
- Duration of Turbidity Levels Following Events
- Diurnal Fluctuations in Background Turbidity.

The information needed to meet needs of Objective 9 is expected to be used to develop rationale for water quality standards that are currently under review.

Objective 10: Minimize water resource impacts on water quality

Purpose: Design and operate surface and groundwater management activities to minimize water quality impacts and improve water quality.

Rationale: Water quantity affects water quality. Surface water storage reservoirs and groundwater extraction can affect local water quality. Flow in surface waters is affected by water resource project operations including reservoir storage and release, canals and drains, (operational spills) and pumping from shallow aquifers near creeks. Opportunities exist for utilizing water resource projects and programs as a means to enhance in-stream flows and related water quality conditions while supporting water uses.

Proposed Project Actions: The types of actions envisioned under Objective 10 vary among the kinds of water resource project elements involved. Projects may rely on reservoir releases, reservoir outlet modifications, or shallow groundwater modification involving pumping or infiltration/recharge.

Improve Surface Water Resource Project Operations

Examples of water resource project facility use in water quality control include deliberate releases for water supply that alter water quality through dilution effects and stratification in reservoirs as surface warming and due to water density differences. Example actions are listed below:

- Flow Augmentation from Storage Releases
- Flow Augmentation from Canal Releases
- Multilevel Outlets for Storage Reservoirs
- Impact Evaluations of Reservoir Warming and Cooling
- Flow-Quality Relationship Studies.

Assess Groundwater Impacts on Surface Water

There are interactions between shallow groundwater and surface water in the watershed that affect water quality (e.g., ongoing studies by Jack Stanford for USBR). Groundwater seepage and exchanges between surface and subsurface flows along the mainstem and in tributaries have water quality impacts. Assessment actions are listed below:

- Evaluate seepage to Streams in Agricultural Areas
- Evaluate Impacts of Pumping from Shallow Groundwater
- Evaluate Shallow Aquifer Storage Benefits to Mainstem Hyporheic Zone
- Consider Recharge of Shallow Groundwater with Return Flow
- Evaluate Cooling Effects of Percolation from Cropland Irrigation

Natural hydrographs are altered as result of storage reservoir operations, diversions and return flow accretions. Impacts result that can be mitigated by well-designed projects or operations. Multiple uses of existing water resource infrastructure can benefit water quality. Past federal laws have encouraged flow augmentation from storage for water quality benefit and multilevel reservoir outlet structures for downstream water quality enhancement. Management of present and future water resources to benefit all uses is a major challenge.

5.3.5 Recommended Specific Actions for Watershed Monitoring and Control

The following additional activities are currently being pursued by the City to improve the effectiveness of this watershed protection plan. The water system operational activities are the responsibility of the Water/Irrigation Division staff. The area wide planning activities are being addressed by the City of Yakima's ongoing participation as a member of the Tri-County Water Agnecy.

1. Establish Sanitary Control Area. A sanitary control area should include areas of high vulnerability within the watershed. Portions of the watershed that may be designated as part of the sanitary control area include: areas directly adjacent to the City's diversion, a designated-width buffer zone (50 to 100 feet) along each bank of the river, with the lower reaches of the Naches and Tieton Rivers being most important, highly erosive areas, culverts that empty directly into the river, and reaches of the river where the stream is a "gaining" stream (groundwater is contributing to surface water flow).

2. Establish communication with landowners and public agencies that conduct activities in the watershed that could pose a threat to water quality, such as the USFS, commercial users, Town of Naches, State Patrol, etc. The following steps are suggested:

    a. Request that the City be added to the Washington State Patrol's emergency contact list when a hazardous material spill occurs on one of the highways (410 or 12). A written request should be sent to Washington State Patrol, 2715 Rudkin Rd., Union Gap, WA 98903.

b. Contact agencies and explain the reason(s) why the City's water supply needs must be taken into consideration in policies and decisions pertaining to activities in the watershed.

c. Establish communications with the Ecology Departments of Water Quality and Toxic Wastes. Obtain an updated listing of potential contamination sites in the Naches watershed. The contacts for obtaining additional information on contamination sites in the Naches basin are provided in Table 5-6.

d. Establish communications with Yakima County Planning Department and request that the City can be notified of pending commercial/industrial development proposals within the Naches watershed.

3. Establish a more specific assessment of contamination sources through a detailed visual assessment, direct communications with watershed users, and review of Ecology data on contamination sources in the Naches watershed. Establish specific procedures for monitoring and emergency notification in the event of contamination of the river (see item 5 below).

4. Develop and maintain an emergency contact list and distribute to all agencies conducting activities in the watershed that are potential sources of contamination (see Table 5-5).

5. Establish communications protocol and response plan for most critical watershed emergencies, such as transportation spills, a failure at the Naches wastewater plant, or an accidental release from any industrial or commercial site located upstream of the intake. The plan should include the following:

    a. Emergency numbers for City staff, other agencies, and watershed landowners/users, including responsibility and authority. Identify all conditions under which the City should be notified of an emergency in the watershed area and the person responsible for notification.

    b. Establish criteria (under what conditions/contamination events) the WTP should be shut down and the procedures to follow for the shutdown (start up of wells, public notification) in addition to specific mechanical tasks required to shut down plant.

    c. Establish well startup criteria and procedure (Refer to Chapter 6, Operation and Maintenance Program and also the Emergency Operations Guidelines included as Appendix T to this Water System Plan Update).

    d. Establish criteria and protocol for use of interties with adjacent purveyors for emergency supply (if potential exists).

e. Establish plan for emergency water sampling needs (for use in assessing degree of contamination and for determining when to shut down the WTP and when to resume normal operations).

f. Establish public notification procedures. The most critical message will likely be to reduce water use, if the WTP cannot be used. If the surface source must be used during the contamination event, a second message may be to boil water or temporarily use alternative sources of water for drinking, cooking, and/or bathing. Prepared public statements should be written in advance to address the most critical emergency scenarios to ensure that important facts are not inadvertently omitted in the haste of the emergency situation.

g. Establish a contamination cleanup plan for the most critical emergencies (transportation spills, and M/I treatment system failures), including responsibility, emergency contacts, and any involvement by City staff. Establishment of this plan could require substantial cooperative efforts between agencies using the watershed.

h. Determine cleanup equipment needs, location, and contact person including equipment available from other agencies, such as fire departments, USFS, Bureau of Reclamation, and Washington Department of Transportation.

6. Involve affected watershed users in the development of the response plan in item (5). Review the response plan with affected users and obtain approval. All agencies with a role in the response effort should sign the final plan and receive a copy.

7. Add the watershed contamination response plan to the City's current emergency plan, and review and update every 2 to 3 years.

8. Participate in on-going watershed management and monitoring efforts by Yakima County, the USBR, the Department of Ecology, and the USFS.

Table 5-6 City of Yakima Watershed Protection Plan Partial List of Contacts			
Name of Agency	**Location/Address**	**Contact Person**	**Phone Number**
Hazardous Chemical Spills-Transportation System			
Washington Department of Transportation	2809 Rudkin Rd. Union Gap, WA 98903	Various	(509) 577-1600
Washington State Highway Patrol	2715 Rudkin Rd. Union Gap, WA 98903	Various	(509) 575-2320
Agricultural Chemical Contamination			
US Bureau of Reclamation	1917 Marsh Rd. Yakima, WA 98901	Chuck Garner, Hydrology Department Head	(509) 575-5848
Yakima-Tieton Irrigation District	470 Camp Four Rd. Yakima, WA 98908	Rick Dieker, District Manager	(509) 678-4101
US Bureau of Reclamation (operators of the Wapatox Canal)	1917 Marsh Rd. Yakima, WA 98901	Walt Larric, Field Office Manager	(509) 575-5848
Municipal/Industrial Contamination			
Washington Department of Ecology	15 W. Yakima Ave. Suite 200 Yakima, WA 98902	Various	575-2490
City of Naches (Public Works Foreman)	306 Naches Av Naches, WA 98937	Mike Davis	(509) 653-2881
Yakima County Public Services Dept.	Room 417,. Courthouse Yakima, WA 98901	Vern Redifer, Director of Public Services	(509) 574-2300
Other State Agencies with Watershed Interests			
Washington Department of Health	16201 E. Indiana Ave. Ste. 1500 Spokane Valley, WA 99216	Andy Cervantes, Regional Engineer	(509) 329-2120
Washington Department of Fish and Wildlife	1701 S 24th AV Yakima, WA 98902-5720	Eric Bartrand	(509) 457-9310
Washington Dept. of Natural Resources	2211 Airport Rd. Ellensburg, WA 98926	Various	(509) 925-8510
Forest Management/Recreation			
USFS-Naches Ranger Station	10237 Highway 12 Naches, WA 98937	District Ranger Various	(509) 653-2205

5.3.6 Monitoring Program

As described in this Chapter of the Water System Plan Update, the City of Yakima Watershed is very large and encompasses a wide range of land uses and land ownership. Several agencies including the USBR, the USGS, the USFS, and the Department of Ecology maintain on-going water quality monitoring programs within WRIA 38. The Water/Irrigation Division does not have the staff or the resources to conduct routine monitoring within the watershed.

However, the City of Yakima will continue to work with the Yakima River Basin Water Resources Agency to support the water quality goals of the Watershed Management Plan which has been developed under the Watershed Management Act (Chapter 90.82 RCW) administered by the Department of Ecology. By participating in this inter-agency effort, the City can make sure that potential water quality impacts to the surface water supply source are fully considered in all planning and land use policy decisions affecting the watershed.

The City will continue to monitor the raw water quality of the surface water supply. In addition, the City plans to install on-line turbidity monitoring at the raw water intake structure. This will provide up to an hour to react to changes in raw water quality that might affect the water treatment plant performance.

Chapter 6

Operation and Maintenance Program

6 Operation and Maintenance Program

6.1 Water System Management and Personnel

Figure 6-1 is an organizational chart for the City of Yakima Water/ Irrigation Division.

Water and Irrigation Division Manager
The Water and Irrigation Division Manager, Dave Brown, is responsible for overall management of the water utility, preparing and managing the annual budget, managing the water utility staff, responding to customer questions and concerns, and reporting on water system operations to the City Manager and Assistant City Manager.

Water and Irrigation Engineer
The Water and Irrigation Engineer, Mike Shane, is responsible for contract administration and field engineering. He also assists with operations, financial matters, and policy development.

Water Treatment Plant Supervisor
The Water Treatment Plant Supervisor, Jeff Bond, is responsible for the overall operation of the Naches River Water Treatment Plant, the wells, the reservoirs, and the pump stations. He is also responsible for the water quality monitoring of the system. His staff includes six WTP operators, all of whom are certified (as WTPO-2 or WTPO-3) and two additional staff operators.

Water Distribution Supervisor
The operation of the distribution system is under the direction of the Water Distribution Supervisor, James Dean. He oversees a staff of 16 who perform installation of new services, fire hydrants, and fire services; preventive maintenance, repairs, and replacement of pipelines, PRVs and meters; and testing of cross-connection control devices and large valves. Meter reading is performed by utility billing staff and is, therefore, not included within the responsibilities of water distribution staff.

Waterworks Crewleaders and Waterworks Specialist I and II
Eleven positions within the water distribution group are classified as Waterworks Crewleaders or Waterworks Specialists I or II, as follows:

- Waterworks Crewleaders are crew leaders for distribution system operations and maintenance
- Waterworks Specialists II are primarily equipment operators
- Waterworks Specialists I are general laborers

Water Device Technicians
The distribution group includes two device technicians who are primarily responsible for cross-connection control and repair of large meters.

The responsibilities and authority for key functions are summarized in Table 6-1.

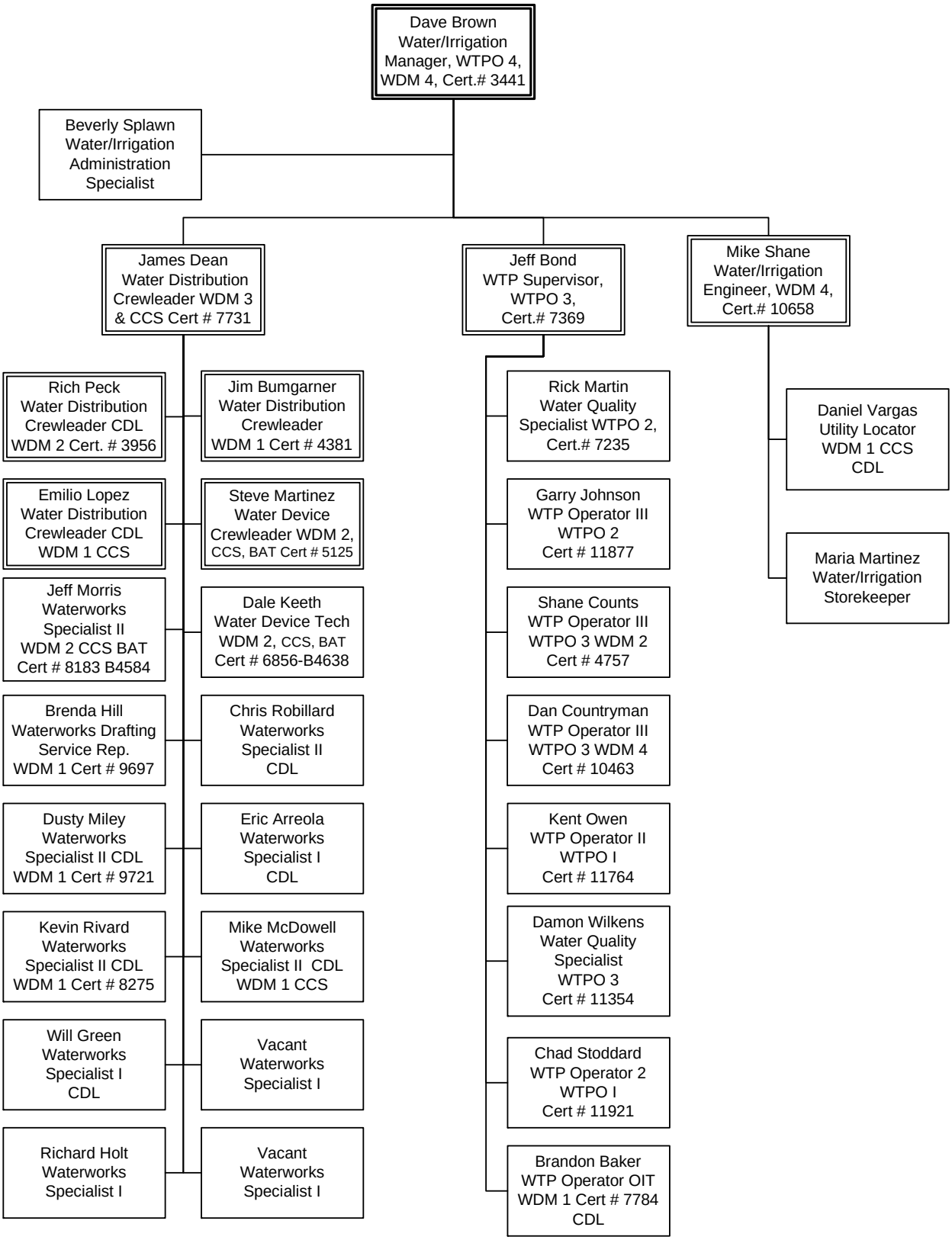

Figure 6-1 City of Yakima Water/Irrigation Division Organizational Structure

Table 6 - 1 Responsibility/Authority for Key Functions	
Key Function	**Position/Responsible Person**
Day-to-day Distribution Operations Day-to-day Supply/Treatment Operations	Water/Irrigation Manager - Dave Brown Water Distribution Supervisor – James Dean Water Treatment Plant Supervisor - Jeff Bond
Preventive Distribution Maintenance Preventive Supply/Treatment Maintenance	Water Distribution Supervisor - Alvie Maxey Water Treatment Plant Supervisor - Jeff Bond
Field Engineering	Water/Irrigation Engineer – Mike Shane
Water Quality Monitoring	Water Treatment Plant Supervisor - Jeff Bond Water Quality Specialist - Rick Martin
Distribution System Troubleshooting Supply/Treatment System Troubleshooting	Water Distribution Supervisor - James Dean Water Treatment Plant Supervisor - Jeff Bond
Distribution Emergency Response Supply/Treatment Emergency Response	Water Distribution Supervisor - James Dean Water Treatment Plant Supervisor - Jeff Bond
Cross-Connection Control	Water Distribution Supervisor - James Dean
Capital Improvements Program Implementation	Water/Irrigation Engineer - Mike Shane Water/Irrigation Division Manager - Dave Brown
Budget Formulation	Water/Irrigation Division Manager - Dave Brown Water/Irrigation Engineer – Mike Shane
Distribution System Pressure/Flow Complaints Water Quality Complaints	Water Distribution Supervisor - James Dean Water Treatment Plant Supervisor - Jeff Bond Water Quality Specialist - Rick Martin
Public and Press Contact	Water/Irrigation Division Manager - Dave Brown (primary, all supervisors may have some role)

6.2 Operator Certification

The Washington State Department of Health (DOH) requires every community public water system to maintain at least one certified operator on staff at or above the classification level for that community. The City of Yakima water system is classified as Level 4 (Table 6-2). On-duty operators must maintain a certification level not more than one level lower than the classification of the community water system. The Naches River WTP is classified as Level 3 based on its size

and complexity. Therefore, the WTP must retain at least one Level 3 Operator, and all operators must be certified at Level 2 or higher.

Table 6-2 Washington DOH Water System Classification Guide

Classification Level	Population Served[1]
S	< 251
1	251 – 1,500
2	1,501 – 15,000
3	15,001 – 50,000
4	> 50,000

1. DOH recommends assuming 2.5 people per service connection if service population is unknown

State regulatory language establishes various organizational positions for personnel working for the City Water Division. For the Naches River WTP the following positions are occupied by City personnel:

- Water Distribution Manager (WDM)
- Water Distribution System Specialist (WDS)
- Water Treatment Plant Operator (WTPO)
- Backflow Assembly Tester (BAT)

These positions must be filled by personnel meeting State mandated requirements. In addition to the educational and experience requirements, personnel holding each of the four organizational positions found in the water system must pass an examination. Various levels of certification for Water Distribution Manager and Water Treatment Plant Operator require different levels of education and experience (Table 6-3). Annual renewal for each of the four certified positions includes an application fee and the accumulation of continuing education units (CEUs) during a State designated "professional growth reporting" period. The professional growth reporting period for the City of Yakima water system is 3 years. Thus, in a 3-year period, each certified individual must accumulate 3 CEUs. Typically, 0.1 CEUs are awarded for every hour of classroom time for an approved technical session or teleconference.

An organization chart for the City of Yakima Water Division showing the City's certified water treatment plant operators is provided above in Figure 6-1. The City of Yakima currently retains nine certified water treatment plant operators to maintain and operate the main water treatment facility (Naches River WTP) and three wells.

Table 6-3 Education and Operating Experience Requirements City of Yakima **Naches River WTP**

Water Works Operator Classifications	Level of Certification									
	Operator-in-training (OIT)[1]		1		2		3		4	
	Education	Operating Experience	Education	Operating Experience	Education	Operating Experience	Education	Operating Experience	Education	Operating Experience
WDM	12	3 mo[2]	12	1	12	3	14	4	16	4
WTPO	12	3 mo[2]	12	1	12	3	14	4	16	4

1. Thirty hours of relevant water system training (3 CEUs or 3 college credits) may be used in place of 3 months of experience.
2. Units of months, all other units given in years.

6.3 System Operation and Control

In this section, the major system components and the procedures used to operate and maintain them are described.

Major System Components – Overview

The major water system components that are operated by the water utility are the Naches River Intake and Naches River Water Treatment Plant (WTP), the three wells (Kiwanis Park, Airport, and Kissel Park), the five storage reservoirs, the four pump stations, the pressure-reducing valves (PRVs), and the distribution system. The location of all of the components except for the distribution system is shown in Figure 1-2. The nonpotable irrigation system that serves many parts of the City with water for irrigation is not discussed in this section.

The Naches River WTP operates year-round as the primary source of water. Additional supplies to meet peak demands are provided by one or more of the three wells. The treatment plant and wells deliver water to the low pressure zone. The booster pump stations deliver water to the Middle and High pressure zones. Water is stored in the five distribution reservoirs until needed by the customers. The PRVs control the flow of water between the High and Middle pressure zones and between the Middle and Low pressure zones.

The three wells pump directly into the low pressure zone of the distribution system. Disinfection is provided for at each site. These groundwater supplies are utilized as a secondary water source and are maintained in a standby status.

The three emergency interties between the Nob Hill Water Association and the City of Yakima distribution systems are as follows:

1. This intertie is located at the intersection of 56th Avenue and Lincoln Avenue. This connection is between the City of Yakima's high pressure zone and Nob Hill Water Association's middle pressure zone. The City of Yakima High Zone System pressure exceeds the Nob Hill Water System pressure by approximately 7 psi.

2. This intertie is located at the intersection of 45th Avenue and Tieton Drive. This connection is between the City of Yakima's middle pressure zone and Nob Hill Water Association's low pressure zone. This intertie was installed to provide a secondary supply to the hospitals on Tieton Drive. Utilization of the intertie for this purpose requires the isolation of the main line in Tieton Drive to divert water directly to the hospitals.

3. This intertie is located at S. 32nd Avenue and Ahtanum Road. This connection is between the City of Yakima's low pressure zone and Nob Hill Water Association's low pressure zone through a two way pressure reducing valve. Flow is limited to 2,500 gpm in both directions.

The sources of supply are summarized in Table 6-4 below.

Table 6-4 City of Yakima Sources of Water Supply							
Source Name	**Type**	**Primary**	**Seasonal/ Emergency**	**Capacity MGD**	**Well Depth Ft.**	**Pump Capacity gpm**	**Pump HP**
Naches River at WTP	Surface Water	X		25		Gravity Flow	
Kiwanis Park	Ground Water		X	3.4	850	2,350	300
Airport	Ground Water		X	4.0	1,100	2,800	300
Kissel Park	Ground Water		X	4.2	1,171	2,900	300
Gardner Park[1]	Ground Water		X	4.3	900	3,000	700
Nob Hill Water Assn.	Interties		X				
[1] The Gardner Park Well is scheduled to go online in late 2011 or 2012							

Should the primary water supply source cease to be available, the following alternatives may be utilized to augment or replace the water system supply needs.

1. Activation of the City of Yakima's wells.

   Failure of the water system's main supply to be available may require rationing or restriction of use of the remaining available water supplies.

   The City of Yakima's groundwater sources are ample enough to meet the system's average day demand. Restrictions of water use may only be necessary during periods of the year when water usage exceeds the average day demand.

2. Activation of the interties with the Nob Hill Water Association.

   Utilization of the interties with the Nob Hill Water System as a sole source of supply would require rationing. This is because the amount of water available from Nob Hill's water system is limited; especially during the peak use summer months. In addition, the hydraulic capability of the piping making the interties is not of sufficient size to allow flows large enough to meet the City's needs. Therefore, isolation of the hospitals on Tieton Drive will need to be evaluated to insure that their supply is adequate.

3. Hauling of potable water from other safe sources.

Hauling of water would <u>only</u> be implemented in <u>extreme emergency</u> when complete loss of the primary, secondary, and intertie source of supplies has occurred.

Detailed procedures and alternatives for handling a loss of water supply are included in the Emergency Operations Guidelines (Appendix T)

Description, and Operation and Maintenance of Major System Components

Summary descriptions of major system components and functions and the procedures used to operate the major components of the water supply and treatment system are provided below. For detailed descriptions of the systems and operational procedures refer to the Naches River Water Treatment Plant Operation and Maintenance Manual (January 2006, or latest edition).

Naches River Water Treatment Plant

Raw Water Intake

Raw water is supplied to the Naches River Water Treatment Plant (WTP) by a raw water pipeline connected to intake facilities adjacent to the Naches River, located approximately 3,500 feet upstream of the WTP facilities. The intake consists of a series of five flat-panel screens designed to achieve fish screening criteria for endangered species protection. The screens are cleaned via air wash supplied to each screen by an air piping manifold with a series of orifices located immediately behind each screen. The screen structure is separated from the river by a concrete wall and an auxiliary intake gate/headwall structure located 1,000 feet upstream of the screens. Water is normally supplied to the screens through discharge from the Wapatox Canal, unless the canal is off-line in which case the gates in the headwall must be opened to allow water from the river to flow into the facilities. Water discharges from the facilities over an Obermeyer weir that functions to maintain the water surface above the top of screens.

The Raw Water Intake Facilities Components and Function are summarized in Table 6-5.

Table 6-5	**Raw Water Intake Facilities Components and Function** City of Yakima **Naches River WTP**			
Components	**Components Materials**	**Function**	**Failure Criteria[1]**	**Primary Failure Consequences**
Raw Water Pipeline	54-inch RCCP	Convey raw water	Vital	Plant shutdown
Screens (SNU - 201 to 205)	Wedge-wire screen, stainless steel	Prevent fish and debris from entering RW pipeline	Critical	Screening does not meet ESA criteria
Screen Baffles (one per screen)	Stainless steel, adjustable vanes	Equalize flow withdrawal rates across screens	Critical	Variable withdrawal rates across screens
Air Wash Receiver (ARU-210) & Compressor (ACU-210)	1 steel receiver tanks (650 & 400 gal) and components, 1 10-hp, 34.8 scfm, 810 rpm compressor	Generate air for backwashing of screens	Critical	Head across screens may exceed ESA criteria, screen fouling
Obermeyer Weir & Inflation Compressor (ACU-230)	Rubber air bladder, steel weir gate	Maintains water elevation in front of screens Controls flow rate in-front of screens	Critical	Water levels drop in front of screens
Fish Barrier	Steel tubing and frame	Prevent fish from entering forebay in front of screens	Critical	Reduces fish protection
Turbidimeter (AE/AIT-200)	Hach turbidity probe (T-line)	Measures raw water turbidity	NA	NA
Differential Bubblers	Tubes with DIP control	Measures water elevation & screen water differential	Critical	Automatic screen cleaning inoperable
Low pressure compressor (ACU-220)	3-hp, 9.4 scfm compressor	Reduce ice formation in front of screens in winter	NA	NA

1. Critical = Failure causes problems but plant operation is possible.
   Vital = Failure requires plant shutdown.

Flash Mix

Proper feed and mixing of chemicals is of fundamental importance for a properly working water treatment facility. The flash mix process imparts energy to the water to ensure complete mixing of chemicals. A pump diffusion type flash mix is utilized at the Naches River WTP. A side stream of water is drawn from the raw water pipeline and pumped back into the pipeline in the

opposite direction of the main flow, thereby creating a turbulent mixing zone. Chemicals that can be injected at flash mix include the following:

- Primary Coagulant (alum or ferric chloride);
- Sodium Hypochlorite;
- Coagulant Aid Polymer;
- Caustic Soda.

The Flash Mix components and function are summarized in Table 6-6.

Table 6-6 Flash Mix Components and Function

Components	Components Materials	Function	Failure Criteria[1]	Primary Failure Consequences
Raw Water Pipeline	36-inch steel	1) Conveys raw water	Vital	Plant shutdown
Flash Mix Pump	5 hp	2) Pumps side stream of water 3) Provides mixing energy	Critical	Use Backup Flash Mix Basin
Nozzle	Non-clog	4) Creates turbulent mixing zone	Critical	Use Backup Flash Mix Basin

1 Critical = Failure causes problems but plant operation is possible.
Vital = Failure requires plant shutdown.

Contact and Sedimentation Basins

Two rectangular Contact Basins are located between the flash mix basin and the filters. Coagulated water must flow through a contact basin before reaching the filters. Chemicals added in the flash mix basin have additional contact time in the basins before reaching the filters. Basin contact time improves the following processes:

- Flocculation. Alum and coagulant aid polymer react with natural suspended solids to create “floc” particles. The “floc” particles settle in the contact basins and are removed in the filters. No mechanical flocculation energy is added in the contact basins.
- Disinfection. Prechlorination at the flash mix basin provides additional contact time before the final application of chlorine. Longer chlorine contact time improves disinfection.
- Taste and Odor Reduction. When powdered activated carbon (PAC) is used, the Contact Basins allow PAC to adsorb taste and odor compounds before reaching the filters, where the PAC is removed.
- Solids Removal. The basins remove sand and other heavy particulate matter by gravity settling during episodes of high raw water turbidity. This protects the filters from shortened filter runs that would result from excessive solids loading onto the filters.

The Contact and Sedimentation components and function are summarized in Table 6-7.

Table 6-7 Contact Basin Components and Function

Components	Component Materials / Approximate Sizing	Function	Failure Criteria[1]	Primary Failure Consequences
South Contact Basin No. 1 (WTP017)	Concrete basin	Flow conveyance Contact time Solids removal (high turbidity events)	Critical	Use Basin No. 2
North Contact Basin No. 2 (WTP018)	Concrete basin	Flow conveyance Contact time Solids removal (high turbidity events)	Critical	Use Basin No. 1
Basin Inlet Gate (One per Basin)	30-inch (W) x 72-inch (H)	Isolate basin during inspection/ maintenance	Critical	Use other basin
Basin Outlet Gate (One per Basin)	30-inch (W) x 60-inch (H)	Isolate basin during inspection/ maintenance	Critical	Use other basin
Baffles (Inlet and Outlet)	Two rows of 16’ x 8” vertically mounted wood planks (14” spacing)	Sediment deflection	NA	NA
Basin Overflow	36-inch diameter concrete pipe connected to 42-inch diameter pipe	Protects against uncontrolled overflow	Critical	Operate to prevent overflow
Hydrostatic Relief Valve	4-inch diameter valve	Protects basins against groundwater uplift force when basin is empty	Critical	Keep water in basin
Ice Prevention Blower (WTP182)	7.5 hp air blower with 3/4 to 2-inch diameter air distribution pipes	Reduces the formation of ice in the basins	Critical	Manual ice removal
Basin Level Transmitter (WTP059)	Pressure transmitter, air supply, and 1/4-inch diameter bubbler tube	Provides water level to the SCADA system	Critical	Manual flow control
Basin Drain (one per basin)	12-inch diameter mud valve	Drain water from basins Solids removal	Critical	Temporary plug
Filter Influent Conduit	6 foot (W) x 5 foot (H) concrete channel	5) Convey water from Contact Basins to Filters	Vital	Plant shutdown

1. Critical = Failure causes problems but plant operation is possible.
   Vital = Failure requires plant shutdown.
   NA = Not applicable as a failure criteria.

Filters

Granular media filtration is a fundamental treatment process used in water treatment plants. The basic mechanisms of particle removal include interception, sedimentation, and diffusion within the granular media.

The Naches River WTP filters operate as a contact filtration process. This means that contact basins upstream of the filters provide time for the development of filterable particles following coagulation. There is no flocculation or sedimentation process upstream of the filters to condition or remove particles.

The WTP has four filters with dual media, consisting of a layer of anthracite coal on top of a layer of silica sand. The media is supported by plastic tri-lateral filter underdrains. The filter media, underdrains, troughs, and surface wash system were replaced in 2005. The filter component and failure criteria are summarized in Table 68.

Table 6-8 Filter Component Function and Failure Criteria

Component	Function	Failure Criteria[1]	Primary Failure Consequences
Filter beds (four total)	Includes structure, underdrain, and media	Critical	Failure of one or more filters increases filtration rate through remaining filters, or decreases plant production.
Filter effluent meter	Controls filter effluent valve position	Critical	Operate valve manually
Surface wash meter and backwash supply meter	Control backwash and surface wash valve positions	Critical	Operate valves manually
Filter valves	Control filter operation in backwash and production	Critical	Complete failure of a valve removes that filter from service. Operate valve manually in event of valve actuator failure
Backwash supply pumps (two total)	Refill backwash supply tank	Critical	One pump is required for service, the other is redundant
Backwash storage tank (one total)	Source of backwash water flow and pressure	Vital	Remove from service only for the interval between backwashes without plant shutdown
Filter influent flume / filter effluent conduit / common piping	Convey flow to and from the filters	Vital	Failure requires plant shutdown

1. Critical = Failure causes problems but plant operation is possible.
Vital = Failure requires plant shutdown.
NA = Not applicable as a failure criteria.

Disinfection
The disinfection process kills or inactivates microorganisms, including bacteria, protozoa, and viruses. The Naches River WTP utilizes chlorine to disinfect the water. Section 11, "Chemical Feed Facilities" contains a discussion of the chlorine storage and delivery system. This section focuses on measurement and reporting of disinfection.

Disinfection at the Naches River WTP is achieved in two steps, "Sequence 1" and "Sequence 2". Sequence 1 takes place when the water is in the basins or pipelines at the WTP. Sequence 2 takes place in the pipeline between the clearwell and the Gleed Pump Station. The total level of disinfection achieved is the sum of disinfection achieved in Sequence 1 and Sequence 2.

The Surface Water Treatment Rule (SWTR) governs the required removal and inactivation of microbial pathogens. The minimum performance requirements presented below are based upon the classification of the Naches River WTP as a direct filtration facility, that is, without conventional flocculation and sedimentation processes for solids removal upstream of the filters.

Giardia cyst removal and inactivation requirement: 3-log (99.9%)

- 2-log (99%) removal via filtration
- 1-log (90%) inactivation via disinfection

Virus removal and inactivation requirement: 4-log (99.99%)

- 3-log (99.9%) removal via filtration
- 1-log (90%) inactivation via disinfection

The requirement for both removal and disinfection of microorganisms provides multiple barriers against contamination of the public water supply.

CT Control Valves: The hydraulic gradient originally was such that the 48 inch pipeline did not become full of water under normal circumstances until somewhere between Eschbach Road and the community of Gleed. In 1998 a set of control valves was installed in the 48 inch main next to the Gleed Pump Station. These valves are automatically monitored and controlled from the Water Treatment Plant so that the pipeline between Gleed and the plant remains full and therefore provides the required CT time. If the CT Control Valves were to fail, one of the operators would drive to Gleed adjust valves by hand and observe the pressure reading locally to insure the proper valve settings.

Residuals Handling Facilities
The water treatment process removes particles from the water through settling in the contact basins and capture in the filter media. The primary source of solids is filter waste washwater, that is, the spent washwater resulting from a filter backwash. The Naches River WTP uses a waste recycle pond/lagoon to concentrate the solids before final disposal. Clarified water from the lagoon is recycled back to flash mix, at the head of the treatment process. Periodically, the lagoon solids are pumped to a transport truck and taken off site for dewatering and ultimate disposal. Residuals Handling Facilities Components and Function are summarized in Table 6-9.

Table 6-9 Residuals Handling Facilities Components and Function				
Components	Component Materials / Sizing	Function	Failure Criteria[1]	Primary Failure Consequence
Lagoon Recycle Pump	600 gpm pump (WTP266)	Recycles clarified water to the water treatment plant process	Critical	Overflow to river
Lagoon Level Pressure Transmitter	Pressure transmitter (WTP060)	Provides lagoon level signal to SCADA system for control of Lagoon Recycle Pump	Critical	Manual operation or overflow to river
Lagoon	850,000-gallon, earth lined	Clarifies filter waste washwater; stores and thickens solids	Vital	Backwash not possible
Inlet Pipe	42-inch diameter concrete pipe	Conveys waste streams to lagoon	Vital	Backwash not possible
Inlet Structure	42-inch diameter concrete	Distributes waste stream flow into the lagoon	Vital	Backwash not possible

1. Critical = Failure causes problems but plant operation is possible.
   Vital = Failure requires plant shutdown.

Chemical Feed Systems

The Naches River WTP has seven chemical feed systems that are utilized in the water treatment process, each with specific treatment objectives. Five of the systems feed liquid chemical using peristaltic chemical metering pumps. The on-site sodium hypochlorite generation system uses salt, water, and electricity to generate liquid sodium hypochlorite that is then fed from bulk storage tanks via peristaltic chemical metering pumps. The powdered activated carbon (PAC) feed system uses a dry volumetric feeder.

Five of the chemical feed systems were constructed in 2004 as part of the Chemical and Filter Gallery Upgrade Project, including the primary coagulant, coagulant aid polymer, filter aid polymer, caustic soda, and on-site sodium hypochlorite generation feed systems. The fluoride and PAC systems predate the 2004 improvements. The seven chemical feed systems, associated treatment goals, and failure criteria are outlined in Table 6-10.

Table 6-10 Chemical Systems, Treatment Goals, and Failure Criteria				
Chemical	**Form**	**Treatment Goal**	**Failure Criteria[1]**	**Primary Failure Consequences**
Primary Coagulant (ACH or Alum)	Liquid	Suspended solids removal	Vital	Plant shutdown[2]
Coagulant Aid Polymer	Liquid	Suspended solids removal	Critical	Increased potential for filter breakthrough
Caustic Soda	Liquid	Finished water pH adjustment	Critical	Increased potential for metal corrosion
Filter Aid Polymer	Liquid	Floc stabilizer	Critical	Increased potential for filter breakthrough
Fluoride	Liquid	Dental protection	Critical	Decreased level of dental health protection
Sodium Hypochlorite	Liquid Generated On-Site	Disinfection of bacterial/viral/protozoan microbes	Vital	Plant shutdown[2,3]
Powdered Activated Carbon (PAC)	Dry	Taste and odor reduction	Critical	Increased possibility of T&O complaints[4]

1. Critical: Failure causes problems but plant operation is possible. Vital: Failure requires plant shutdown.
2. Redundancy in primary coagulant and chlorine systems requires multiple failures before plant shutdown is necessary.
3. See Sodium Hypochlorite subsection for description of emergency feed system.
4. Provided taste and odor compounds are present.

Transmission Mains

Description: The transmission mains are pretensioned concrete cylinder pipe and range in size from 54 inch to 48 inch to 30 inch.

54 inch = 3,500 L.F.
48 inch = 45,200 L.F.
30 inch = 3,000 L.F.

These mains were installed during the period of 1968-1972. Water flows through these pipelines utilize the force of gravity only. No pumps are required to aid the movement of water. The 54 inch transmission main moves water from the Naches River Raw Water Intake Structure to the Naches River Water Treatment Plant.

The 48 inch transmission main moves water from the Naches River Water Treatment Plant to the City of Yakima's domestic water distribution system.

The 30 inch transmission main moves water between the equalizing reservoir at 40th Avenue and Englewood and the 48 inch transmission main.

Transmission Main Operating Modes and Alternatives: The function of the transmission facilities is to transport large quantities of water from the source to the point of treatment and disinfection (Naches River Water Treatment Plant) and from this point to the City's distribution system.

The 48 inch transmission main has outlets installed along its length at intervals of approximately every 1000 feet. Connections to this main can be accomplished through the use of an existing outlet or by direct tap.

The 48 inch pipeline follows Highway SR 12 from the Water Treatment Plant crossing the Naches River to 40th Avenue where it turns south on 40th Avenue to Powerhouse Road. The main turns and runs along Powerhouse Road to Englewood Avenue at the intersection of Powerhouse Road and Englewood Avenue. The 30 inch pipeline between the equalizing reservoir at 40th Avenue and Englewood Avenue and the 48 inch pipelines are connected. The 48 inch main continues from this junction along Englewood Avenue to the intersection of 16th Avenue and Cherry Avenue where the 48 inch pipeline terminates with several distribution pipelines radiating out from this terminus.

Should the transmission facility cease to function between the source and 40th Avenue then this loss will be treated as a loss of supply. Should the break occur between 40th Avenue and 16th Avenue, then the damaged section will need to be isolated until repairs or replacement can be accomplished.

Detailed procedures and alternatives for handling a transmission line failure are included in the Emergency Operations Guidelines (Appendix T).

Distribution and Storage Systems

The City's distribution system is adjacent to several water systems, but is only intertied with the Nob Hill Water Association and the City of Union Gap. Three interties exist with Nob Hill Water Association and one with the City of Union Gap. Nob Hill Water interties are located in the high zone pressure area at the intersection of 56th Avenue and Lincoln Avenue, at the intersection of 45th Avenue and Tieton Drive which is within the middle pressure zone and at S. 32nd Ave. and Ahtanum Road. The Union Gap intertie is located at the intersection of S. 3rd Ave. and W. Washington Ave.

The distribution pipelines are 4 to 24 inches in diameter. The pipe materials are mainly cast iron, with ductile iron being used since the early 1970's. There are several steel pipelines and many unlined cast iron pipelines remaining in the system.

The City's existing storage capacity is 32 million gallons (MG) distributed among five reservoirs within the three pressure zones. Each pressure zone has an established hydraulic elevation. This elevation is maintained by the distribution reservoir/s located in each of the pressure zones. The reservoirs are shown on the hydraulic profile and listed on the following table (Table 6-11). The table indicates the volume of storage, the zone served, the type of material, and the overflow and floor elevation of the five reservoirs in the distribution system.

Table 6-11 Distribution Storage Reservoirs

Zone Designation	Location	Volume MG	Max. Elevation	Min. Elevation	Zone Served	Construction Material
Low Zone	40th Ave. & Englewood	6	1,264 ft	1,234 ft	Low	Reinforced Concrete
Middle Zone	Reservoir Road	24 (two at 12 MG ea.)	1,380 ft	1,356 ft	Middle	Reinforced Concrete
High Zone	Scenic Drive	2 (two at 1 MG ea.)	1,531 ft	1,511 ft	High	(1) pretensioned concrete (1) steel

Distribution and Storage Systems Operating Modes and Alternatives: The function of the distribution system is to deliver potable water to the service connections and fire hydrants.

The function of the storage reservoirs is to provide: 1) standby water storage for emergencies and short-term interruptions of source of supply; 2) additional source of water for fire protection purposes; 3) equalizing water for changes in water demands within the system.

Distribution pipelines branch off from the transmission mains, conveying water to the three pressure zones -- high, middle, and low. Gravity alone provides adequate pressure to serve water to the low zone. Booster pump stations push the water up to the reservoirs in the middle and high zones, and pressure-reducing valves (PRV's) regulate water flows back from the middle to the low zones when necessary. Normally closed valves and one PRV station may be operated to move water from the high zone to the middle zone. Conversely, portions of the high zone could be served (at lower pressure) from the middle zone through operation of these normally closed valves and existing check valves.

The six million gallon reservoir at 40th Avenue and Englewood Avenue is utilized as an equalizing reservoir for the entire water system. The flow at the WTP is based upon levels in this reservoir. Any water not consumed by the low pressure zone through customer demand; or by pumping to the middle and high pressure zones, is stored here.

Should the distribution system cease to function in specific areas, these areas may be isolated by closing valves to sections as needed based to the distribution grid system in the affected area.

Should the entire distribution system fail to provide its function, then water would necessarily have to be hand carried or transported by vehicles. No fire protection would be available from the system. Fire Department tankers would have to be utilized for fighting fires.

Potable water would need to be made available at distribution points throughout the system. The Yakima Firing Center, the National Guard, and private carriers may be pressed into service in an emergency. Fire stations, City parks, and other City property make good points of distribution of potable water. City residents would be notified of these distribution points and instructed to bring containers to receive their allotment of water.

The source of water for supplying the distribution points could be the Kiwanis Park and Airport artesian wells. Additionally, potable water could be purchased from any adjacent purveyors that would still have a safe plentiful supply.

Should the storage reservoirs cease to function, the system's ability to meet all demands would become undependable. Some fire fighting capability might be retained, but not to normal standards.

The interties with Nob Hill Water Association could be utilized to place their reservoirs into shared operation, it is unlikely that water could be obtained from the intertie with the City of Union Gap as the system pressure in the City system is much greater than the City of Union Gap. The reservoirs could be isolated and water supply pumped directly into the system from the wells or by the gravity from the WTP. The 48" transmission main could act as a reservoir during an emergency. During extended emergencies portable storage reservoirs or temporary reservoirs could be utilized to accomplish the same function as a storage reservoir.

Detailed procedures and alternatives for handling a distribution and storage system failure are included in the Emergency Operations Guidelines (Appendix T).

Distribution and Storage System Routine Operation and Maintenance: Routine operation of the distribution system consists of operating line valves and manually opening and closing interties (when needed). Hydrants are flushed annually.

The levels in the five storage reservoirs are controlled by the SCADA system. The levels in the system's reservoirs are continuously monitored by telemetry and recorded on 7-day charts and in the history files of the City's computer system.

Booster Pump Stations

The pump stations are listed in Table 6-12, indicating the location, the supply location, the zone that is served, the number of pumps in each station, pump capacity, and some other characteristics.

Table 6-12 Booster Pump Stations										
Station Name	Location	Zone Supply	Zone Service	Pump No.	Pump HP	TDH (ft.) Opera-ting	TDH (ft.) Shut Off	Pumping Rate (gpm)	Local Elev. (ft.)	Pump Manufact -urer
High Zone, Third Level*	City Reservoir Road	Middle	High	1 2 3	125 125 30	203.5 203.5 203.5	315 315 315	1,700 1,700 400	1372	Byron-Jackson Byron-Jackson Simons
40th Avenue	40th Ave. & Powerhouse Road	Low	Middle	2 3 4	40 60 100	126 125 130	182 176 240	 1,000 1,500 2,500	1146	Peerless Peerless Peabody Floway
Gleed**	Gleed 3211 Mapleway	Low	Gleed	1 2 3 4	5 5 --- 125	135 135 --- 300	212 212 --- 350	80 80 --- 2,000	1245	Aurora Aurora --- Aurora
Stone Church	Englewood Ave. & 32nd Ave.	Lo	Middle	1 2 3	125 100 50	172 172 172	221 221 235	2,500 1,500 700	1150	PACO PACO PACO

Note: Telemetry is controlled from reservoir level transmitters for pump start and stop.
* Only one 125 hp pump at a time is capable of operating in the High Zone.
** Gleed is controlled by pressure activated controls.

Booster Pump Stations Operating Modes and Alternatives: The booster pump stations provide water to the middle and high zones, as shown in the hydraulic profile. The 40th Avenue and Stone Church pumps are operated in a verity of lead lag positions depending on the demand and the season. The difference in water demands is due to an irrigation demand in the middle and high zones. These pumps are controlled by the middle zone's two reservoir levels through the radio telemetry system.

The high zone pumping station is only capable of operating one of the 125 hp pumps at a time. This is due to the size of the electrical service available when the facility was constructed. The two 125 hp pumps are alternated with one placed in a standby role, while the other is being used and with the 40 hp pump placed in the lag position. The smaller 40 hp pump is placed in the lead during low demand times. This station's pumps are controlled by the water levels in the high zone’s two reservoirs through the radio telemetry system.

The Gleed pumping station is operated by utilizing the two 5 HP pumps to meet domestic water demands and the 125 HP pump for fire flow demands. This station's pumps are controlled by pressure sensing controls and a hydropneumatic tank. At 55 psi the lead pump will start and run until pressure builds to 75 psi. Should the pressure continue to drop after the lead pump starts then at 45 psi the backup pump starts. This pump shuts off at 65 psi. Should the first two pumps be unable to supply sufficient pressure above 30 psi, the 125 HP will start and run until it has run at 90 psi for 12 minutes before shutting off. A pressure relief valve is located in the manifold

system and allows the bypass of water back into the 48" transmission main of any water in excess of 100 psi.

Should the 40th Avenue and Stone Church pump stations cease to function, the available supply in the twin twelve (12) million gallon reservoirs needs to be determined. If additional water supply is needed to meet the demands, the Nob Hill Water Association may also be contacted to furnish a source of water through the emergency intertie in the middle and high zones. Should the station cease to function because of an electrical power outage, a portable electrical generator might be used to restore electrical power to the 40th Ave. pump station and/or depend on the generator at the Stone Church pump station.

Should the High Zone Pump Station cease to function, the available supply in the twin one (1) million gallon reservoirs needs to be determined. If additional water supply is needed to meet demands, the Nob Hill Water Association may be contacted to furnish a source of water through the emergency intertie at 56th Avenue and Lincoln Avenue. Should the station cease to function because of an electrical power outage, the electrical generator should be used to restore electrical power to the site.

Should the Gleed pump station cease to function, the customers are without a water supply at adequate pressure (greater than 30 psi). However, as long as the 6 million gallon reservoir at 40th Avenue and Englewood Avenue is capable of maintaining at least a minimum level there is a positive pressure at Gleed. Currently, there are less than twenty customers served by this pump station and one school. Water supply for domestic purposes would continue to be available at low pressure (10-15 psi). A local carrier with a food grade tanker may be filled with water and connected to the fire hydrant near the Naches Primary School to supply the Gleed System. The Gleed Fire Department should be notified immediately if the station is to be out of service for any length of time. This rural department has the capability of fighting fires without adequate water supplies available close at hand through use of tanker trucks and can dispatch additional tanker units if necessary.

Detailed procedures and alternatives for handling a booster pump system failure are included in the Emergency Operations Guidelines (Appendix T).

Booster Pump Station Routine Operation and Maintenance: The four pump stations are controlled by the SCADA system, but are visited three times per week to check building temperature and pump operation.

Pressure Reducing Valve (PRV) Stations

The PRV stations are listed in Table 1-3 in Chapter 1, indicating the location, size, pressure settings, the zone that is served and some additional information.

The valves listed as "not in service" have been made redundant through changes in the boundaries of the pressure zones and are no longer required.

PRV Operating Modes and Alternatives: Control of water flow between the middle and low pressure zones is provided by the PRV's located throughout the distribution system. These control valves are set to open and close at various hydraulic elevations depending on the intended purpose of the valve (continual supply or emergency only).

The normal use of the City's PRV's is to provide additional water flow for emergency purposes. The reduction of pressure in the low zone under emergency conditions because of a fire flow or other large water demand will cause the hydraulic elevation to decrease. This reduction in hydraulic elevation will cause the normally closed hydraulically actuated valves to open and provide additional flow into the low zone.

Should the PRV stations cease to function, the valves may be manually operated either open or closed.

The effects of the PRV stations having failed are: 1) Water movement between zones which will result in losses and increases in water pressure in the distribution system, if failure is in the open position. 2) Inadequate water flows during an emergency or other high demand situations, should the valve fail in the closed position.

Detailed procedures and alternatives for handling a PRV failure are included in the Emergency Operations Guidelines (Appendix T).

PRV Routine Maintenance: The PRVs are checked and tested on a quarterly basis.

Wells

The five wells are visited at least twice each day when in operation, but are also monitored by the SCADA System. Operational procedures include checking the chlorination equipment, reading the flowmeter, and checking the building's temperature, motor amperage, well drawdown, and the hour meters on the motors. Currently, the wells are started and stopped manually.

Additional information regarding procedures and alternatives for well operation in the event of a loss of supply or water shortage are included in the Emergency Operations Guidelines (Appendix T).

Preventive Maintenance Program

Preventive maintenance consists of regularly servicing pumps and motors, exercising valves and hydrants, cleaning reservoirs, and flushing dead-end lines and other pipelines. These activities are performed on a priority basis, with service for pumps, motors, and meters being the highest priority.

In 1994 and 1995 City implemented a maintenance management system we named “Automated Inventory and Maintenance Management Systems” (AIMMS). This program includes infor-

mation about all of the City's facilities and equipment. This system has been implemented by the Water/Irrigation Division to automate the existing preventive maintenance program.

AIMMS consists of number of modules that track and control purchasing and maintenance. A complete description of the AIMMS modules and their components is included in Section 6.9 of this Water System Plan Update.

Chemicals, Equipment, and Supplies

The utility maintains an inventory of equipment, such as vehicles, portable pumps, and backhoes, for servicing the water system. The utility also keeps a stock of regularly used supplies and chemicals. In addition to the materials and supplies maintained at the service yard, the utility maintains three completely equipped service trucks complete with the tools and equipment normally required for system operation and maintenance.

Tables 6-13 and 6-14 list the equipment and materials, respectively, that are maintained by the utility. Suppliers used by the utility for pipe materials and pump service are shown in Table 6-15.

Table 6-13 Water Division Equipment Listing			
Number	**Description**	**Fuel Type**	**Location**
3	Backhoe/Loaders	Diesel	City Shops Complex
1	Boom Truck	Diesel	City Shops Complex
3	Service Vans	Diesel	City Shops Complex
1	4WD Pickup Truck	Gas	Water Treatment Plant
1	4WD Pickup Truck	Gas	Water Treatment Plant
3	4WD Pickup Truck	Gas	City Shops Complex
1	Valve Trucks	Gas	City Shops Complex
2	Valve/Vacuum Trailers	Gas	City Shops Complex
1	5 Yd. Dump Truck	Diesel	City Shops Complex
2	10 Yd. Dump Truck	Diesel	City Shops Complex
1	Staff Car	Gas	City Shops Complex
2	Air Compressor	Diesel	City Shops Complex
2	Compact Pickup Truck	Gas	City Shops Complex

Table 6 -14 Materials on Hand		
Item	**Size and Material Type**	
Pipe	4-, 6-, 8-, 12-, and 16-inch DI	
Service Lines and Fittings	3/4 to 6 inch	
Repair Bands	Full circle stainless steel for all above sizes	
Couplers	Romac for all above sizes	
Valves	3 to 6 inch Gate Valves 6 to 12 inch tapping valves 8 to 16 inch Butterfly Valves	
Hydrants	4 to 6 foot bury	
Reducers	Miscellaneous for above sizes	
Calcium Hypochlorite		
Tees	Miscellaneous for above sizes	
Treatment Plant Chemicals	Alum or ACH Sodium Hypochlorite Polymer Activated carbon Caustic Soda Fluoride	
Treatment Plant Equipment	Spare PLC Spare PLC cards Spare Telemetry Radio Recycle pump Sump Pumps Surface Wash Nozzles Anthracite Coal	

Table 6-15 Support agencies/organizations for Materials and Services					
Organization	**Address**	**Name**	**Tele-phone**	**Available Resources**	**Required Authorization**
TTC Construction	2206 Jerome Ave.	AJ Heckart	457-3969 945-6749	Debris removal Large excavation equipment	Emergency PO
Picatti Bros.	105 S. 3rd Ave.	N/A	248-2540	Motor and pump repair	Emergency PO
Russell Crane Service	505 Locust		457-6341	Debris removal	Emergency PO
Ken Leingang Excavating	1117 N. 27th Ave.	Ken or Daren Leingang	575-5507	Large excavation equipment	Emergency PO
Hoydar Buck Inc.	210 W. Orchard (Selah)		697-8800	Electrician	Emergency PO
H D Fowler	100 River Rd.		248-8400	Pipe and appurtenances	Emergency PO
Montgomery Irrigation	1901 S. 13th St.		248-9046	Pumps and appurtenances	Emergency PO
Nob Hill Water	6111 Tieton Drive	Zella West or Dave England	966-0272	Manpower and equipment	N/A
SECO Rental	515 S. 5th Avenue	N/A	248-7900	Pumps and construction equipment	Emergency PO
Washington Department of Fish & Wildlife Screen Shop	3705 W. Washington	Shop Person	575-2733	Temporary Fish Screens	Emergency PO
LTI, Inc.	123 Alexander Rd. Sunnyside, WA		800-422-5993	Tank Trucks	Emergency PO

6.4 Water monitoring and Sampling

Raw water, process water, and finished water are all monitored at the Naches River WTP. Data is collected for purposes of historical benchmarking, process control, and regulatory requirements. The primary objective for monitoring is to control processes so a safe finished water is produced. Water quality monitoring is critical to plant operation because water quality characteristics of the Naches River can change rapidly.

The DOH holds regulatory primacy, that is, the right to enforce and monitor compliance of all public water systems in the State. Each month, the State receives water quality data from the Naches River WTP and private/state labs contracted by the City of Yakima. Water quality standards enacted by the State are at least as stringent as federal mandated standards.

State and federal regulations provide instructions regarding sample collection and analysis methods. Water quality monitoring and sample collection at the Naches River WTP is conducted for process control (Table 6-16) as well as regulatory reporting requirements (Table 6-17). All process control parameters are monitored using on-line instruments tied into the SCADA system.

The requirements for development of inorganic monitoring plans are described in WAC 246-290-300 (3f). Organic chemical monitoring plan requirements are described in WAC 246-290-300 (7e). Copies of the current monitoring plans are included in Appendix sections as listed below.

Appendix H	Coliform Monitoring Plan
Appendix I	Inorganic Chemicals Monitoring Plan
Appendix J	Organic Chemicals Monitoring Plan
Appendix K	Radionuclides Monitoring Plan
Appendix L	Stage 1 Disinfectant/Disinfectant By-Products Monitoring Plan
Appendix M	Turbidity/Free Chlorine Residual/pH Monitoring Plan

Table 6-16 Automated Water Sampling and Monitoring for the Naches River WTP				
Process Stream	**Sampling Location**	**Water Quality Parameter**	**EPA Testing Method**	**"Standard Methods"[3] Testing Method**
Raw water	Raw water pipeline	Turbidity	180.1	2130
Raw water	Raw water pipeline	pH	150.1	4500 - H^+
Filtered water[1]	Filter effluent pipe[4]	Turbidity	180.1	2130
Filtered water[2]	Filter effluent conduit[5]	Turbidity	180.1	2130
Filtered water[1]	Filter effluent pipe[4]	Free Cl_2	330.5	4500 - Cl
Finished water	Filter effluent conduit[5]	Free Cl_2	330.5	4500 - Cl
Finished water	Filter effluent conduit[5]	Fluoride	9214	4500 - F^-
Finished water	Gleed Pump Station	Free Cl_2	330.5	4500 - Cl
Finished water	Gleed Pump Station	pH	150.1	4500 - H^+
Finished water	Gleed Pump Station	Fluoride	9214	4500 - F^-

1. Individual filter effluent
2. Combined filter effluent
3. *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, Clesceri, L., Greenberg, A., Eaton, A., American Public Health Association.
4. Sample tap located at the coagulation control center.
5. Sample tap located at the water quality lab sink.

Table 6-17 Finished Water Quality Monitoring for the Naches River WTP

Water Quality Parameter	Frequency of Measurement[4]	Sampling Location[1]	EPA Testing Method	"Standard Methods"[2] Testing Method	Location of Analysis
Turbidity	Continuous	WTP	180.1	2130	WTP
pH	Continuous	WTP	150.1	4500 - H^+	WTP
pH	Continuous	Gleed	150.1	4500 - H^+	Gleed
Fluoride	Continuous	WTP	9214	4500 - F^-	WTP
Fluoride	Continuous	Gleed	9214	4500 - F^-	Gleed
Temperature	Continuous	WTP	170.1	2500	WTP
Temperature	Continuous	Gleed	170.1	2500	Gleed
Free Cl_2	Continuous	WTP	330.5	4500 - Cl	WTP
Free Cl_2	Continuous	Gleed	330.5	4500 - Cl	Gleed
Free Cl_2	Continuous	Well	330.5	4500 - Cl	Airport Well
Free Cl_2	Continuous	Well	330.5	4500 - Cl	Kiwanis Well
Free Cl_2	Daily	Reservoir Rd.	330.5	4500 - Cl	Reservoir Rd.
Free Cl_2	Daily	WWTP	330.5	4500 - Cl	WWTP
Free Cl_2	Daily[3]	City Hall	330.5	4500 - Cl	City Hall
Free Cl_2	Daily[3]	City Shops	330.5	4500 - Cl	City Shops
Alkalinity	Weekly	WTP	310.2	2320	WTP
Calcium Hardness	Weekly	WTP	215.2	2340	WTP
Fluoride	Monthly	Gleed	300	4500 - F^-	Private Lab[6]
TOC	Monthly	WTP	415.1	5310	Private Lab[6]
Bacteriological	Monthly[5]	WTP	MICROBI (MPN)	9223	State Lab[8]
Bacteriological	Monthly (70)	System	MICROBI (P/A)	9223	State Lab[7]
Free Cl_2 Residual	Monthly (70)	System	330.5	4500 - Cl	System[11]
TTHM	Quarterly	WWTP	524.2	6232	Private Lab[8]
HAA5	Quarterly	System	552.2	6251	Private Lab[8]
Complete Inorganics	Yearly	WTP	6010C, 6020A	3120, 3125	State Lab[7]
TTHM - FP	Yearly	Wells	510.1	---	Private Lab[8]

Table 6-17 Finished Water Quality Monitoring for the Naches River WTP

Water Quality Parameter	Frequency of Measurement[4]	Sampling Location[1]	EPA Testing Method	"Standard Methods"[2] Testing Method	Location of Analysis
VOC	Yearly	WTP	524.2	6200	Private Lab[10]
Radionuclides	Every 3 Years	WTP	900	7110	State Lab[7]
Lead and Copper	Every 3 Years	System	200.8	3125	Private Lab[6]
SOC (Waiver)	Every 3 years (2)	WTP	515,525,531	---	Private Lab[10]
Complete Inorganics	Every 3 Years	Wells	6010C, 6020A	3120, 3125	State Lab[7]
Asbestos (Reduced)	Every 9 Years	WTP	100.2	2570	Private Lab[9]

1. "WTP" = WTP lab sample tap, "Gleed" = Gleed pump station sample tap, " Reservoir Rd." = Reservoir Rd. pump station sample tap, "WWTP" = wastewater treatment plant sample tap, "System" = various business and municipal locations throughout the city, "Wells" = Kiwanis Park, Airport and Kissel Park wells, "City Hall" = Yakima city hall basement (custodial sink), "City Shops" = 2301 Fruitvale Blvd.
2. *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998, Clesceri, L., Greenberg, A., Eaton, A., American Public Health Association.
3. "Daily" - once per day, Monday through Friday only.
4. Numbers in parenthesis represent # of samples taken during a sampling event.
5. Raw water sample taken for comparative purposes.
6. Alliance Analytical, 401 E. "S" Street, Yakima, WA., (509) 248-4695
7. Washington State Public Health Laboratory, 1610 NE 150th Ave., Shoreline, WA, 98115, (206) 361-2896.
8. Edge Analytical, 11525 Knudson Rd., Burlington, WA, 98223, (360) 757-1400.
9. Lab/Core, Inc., 7619 6th Ave. NW, Seattle, WA, 98117 (206) 781-0155.
10. Anatek Labs, Inc., 1282 Alturas Drive, Moscow, ID., (208) 883-2839
11. Samples measured in the field using portable sampling equipment.

The Gleed pump station, downstream of the water treatment plant, contains automated instrumentation to measure pH, temperature, pressure, free chlorine, and fluoride. These data are transmitted to the WTP via telemetry. "CT" calculations for the finished water are made based upon the water quality data collected at Gleed pump station and as described further in Section 9, "Disinfection". There are no service connections between the plant and Gleed pump station. By the time finished water has reached Gleed pump station, chemicals have been thoroughly mixed so that an accurate measurement of residual chlorine and fluoride can be made.

Water quality parameters are submitted to the DOH on a monthly basis. Some parameters are measured at the water quality lab inside the WTP, and some are measured at outside certified labs. Samples are collected from dedicated sample taps at the WTP, the three wells, and additional locations in the distribution system.

Various other process related parameters are included in the monthly reports submitted to DOH in addition to water quality data. Such information is collected daily and includes:

- Plant production volume (gallons);
- Production time (hours);

- Washwater usage (gallons); and
- Usage of Aluminum Chlorohydrate (ACH), alum, sodium hypochlorite, coagulant aid polymer, filter aid polymer, caustic soda, and fluoride (pounds).

The three wells (Airport Well, Kiwanis Well, Kissel Well) report production volume, production time, and chlorine usage.

State required reports are submitted electronically once a month. Two copies are retained at the Naches River WTP; each copy resides on separate computer system. Data on each of the computer systems is backed up once per month. These backups are stored in a separate room from the computers.

Surface Water Treatment Rule Monitoring Requirements

The SWTR requires special monitoring and reporting requirements for filtered surface waters. These requirements are discussed in WAC-246-290-664, -666 and -668. In summary, monitoring and reporting are required for the following:

1. Source coliform monitoring is required as shown in Table 6-17.

2. Source turbidity monitoring is required as shown in Table 6-17.

3. Filtered water turbidity monitoring is required as shown in Table 6-17.

4. Calculation of inactivation ratio (CT monitoring) is required as shown in Table 6-17.

5. Disinfectant residual must be monitored at entry to distribution system and at coliform monitoring sites, as shown in Table 6-17.

6. The following conditions should be reported to DOH before the end of the next business day following the event:

    a. Waterborne disease outbreak

    b. Turbidity of effluent exceeds 1.0 NTU

    c. Residual disinfection concentration falls below 0.2 mg/L at entry to distribution system

    d. Emergency events that could affect water quality, such as spills of hazardous materials in watershed or treatment process failures

7. Report all SWTR monitoring results (items 1 through 5 above) within 10 days of the end of each month. Monthly reporting requirements are described in detail in WAC 246-290-666(3).

8. Watershed control programs must be developed and updated at least every 6 years. Requirements for watershed control are detailed in WAC 246-290-668. Chapter 8 includes a contamination assessment and recommendations for a framework to develop and implement a watershed control program for the City's Naches watershed.

Violations Procedures

Follow-up actions for various types of MCL violations are specified in detail in WAC 246-290-320. In general, the following actions must be taken each time a primary standard violation occurs:

1. Notify the DOH in accordance with WAC 246-290-480.

2. Notify the consumers served by the system. Notification requirements for various types of MCL violations are specified in WAC 246-290-330.

3. Determine the cause of contamination.

4. Take any additional actions as directed by DOH.

If a secondary standard is exceeded, notify DOH and take action as directed by DOH.

Follow-up monitoring must be conducted when MCL violations occur. Specific requirements for follow-up monitoring are described in WAC 246-290-320(2) through (9). Bacteriological violations require repeat sampling in accordance with the City's coliform sampling plan (see Appendix N), and WAC 246-290-320(2).

In the case of contamination of the surface supply, the City can shut down the water treatment plant and use groundwater only. The wells are capable of supplying approximately 12 MGD (about equal to the City's current ADD). The City also has the ability to activate interties with the Nob Hill Water Association. The City's emergency plan (Appendix O) describes procedures for accommodating a WTP shutdown as a result of inadequate finished water quality.

Coliform Monitoring Plan

The City of Yakima Water Division has developed a Coliform Monitoring Plan in accordance with the requirements of WAC 246-290-300 and the DOH guidelines presented in *Preparation of a Coliform Monitoring Plan*. The Coliform Monitoring Plan is presented in Appendix H.

6.5 Emergency Response Program

The City of Yakima Water/Irrigation Division has developed an Emergency Response Plan for its water treatment plant and distribution facilities. The complete plan is shown in Appendix T.

Emergency Call-Up List

After normal working hours, emergencies with the water system are handled through an emergency calling procedure. An updated version of the emergency call-up list contained in the City's emergency plan is presented in Table 6-18. In the event of an emergency, a report is called in to the Water/Irrigation Division Operations Center, which is staffed 24 hours a day. The Operations Center directs the call to the appropriate person on call.

In the event of an emergency situation involving the City's water system, the utility might need to inform the public or other services (such as medical services) immediately. Media contact is conducted by emailing bulletins or press releases to the local media representatives on file:

Table 6-18 Water /Irrigation Division Employees Emergency Call Out List

WATER/IRRIGATION DIVISION ADMINISTRATION

Brown, Dave	Water/Irrigation Manager	hm	On file
		Cell Phone	On file
Martinez, Maria	Water/Irrigation Storekeeper		On file
Shane, Mike	Water/Irrigation Engineer	hm	On file
		Cell Phone	On file
Smith, Ron	Utilities Locator	hm	On file
		Cell Phone	On file

WATER DISTRIBUTION STAND-BY PHONE 728-2356

Arreola, Eric	Waterworks Specialist I		On file
Bumgarner, Jim	Water Distribution Crewleader	hm	On file
		Cell Phone	On file
Dean, James	Water Distribution Supervisor	hm	On file
		Cell Phone	On file
Green, William	Waterworks Specialist I	728-4698	On file
Hill, Brenda	Waterworks Drafting/Service Rep.		On file
Holt, Richard	Waterworks Specialist I		On file
Keeth, Dale	Water Device Technician	hm	On file
		Cell Phone	On file
Lopez, Emilio	Water Distribution Crewleader		On file
		Cell Phone	On file
Martinez, Steve	Water Device Crewleader	hm	On file
		Cell Phone	On file
McDowell, Mike	Waterworks Specialist II		On file
Miley, Dusty	Waterworks Specialist II		On file
Morris, Jeff	Waterworks Specialist II		On file
Peck, Rich	Water Distribution Crewleader	hm	On file
		Cell Phone	On file
Rivard, Kevin	Waterworks Specialist II		On file
Robillard, Chris	Waterworks Specialist II		On file
Vargas, Daniel	Waterworks Specialist II		On file

Table 6-18 Water /Irrigation Division Employees Emergency Call Out List (continued)

WATER TREATMENT PLANT Cell Phone 728-2363

Baker, Brandon	WTP Operator OIT		On file
Bond, Jeff	WTP Supervisor		On file
		Cell Phone	On file
Countryman, Dan	WTP Operator III		On file
Counts, Shane	WTP Operator III		On file
Johnson, Garry	WTP Operator III		On file
Martin, Rick	WTP Operator III		On file
Owen, Kent	WTP Operator II		On file
Stoddard, Chad	WTP Operator II		457-6904
Wilkens, Damon	Water Quality Specialist	hm	698-5240
		Cell Phone	728-2361

IRRIGATION - Rounds Cell 728-2352 - STAND-BY 728-2413

Harrison,Bradley	Irrigation Crewleader	hm	On file
		Cell Phone	On file
Maxey, Alvie L.	Irrigation Supervisor	hm	On file
		Cell Phone	On file
Mayer, Matt	Irrigation Specialist I		On file
Sanislo, Rich	Irrigation Crewleader		On file
		Cell Phone	On file
Splawn, Beverly	Waterworks Admin. Spec.		On file
Vetsch, Brian	Irrigation Specialist II		On file
Wallberg, Joey	Irrigation Specialist II		On file
Winters, Zach	Irrigation Specialist II		On file

Do Not Give Out Home Phone Numbers

1/18/2011

Contingency Operational Plan
Contingency plans must address the possibilities of loss or reduction of water supply, distribution system disruption, loss of telemetry, and power failure.

Sources of Supply: Water service from the major water supply source, the Naches River Water Treatment Plant, could be interrupted because of high turbidity runoff conditions, extended drought, contamination in the river, or blocking of the intake structure.

Fortunately, the City has capacity in the three wells to provide 11.5 MGD of supply. In the event of high-turbidity conditions or a spill, the public would be notified to curtail water use for the few days necessary to clean up the spill. During drought, an emergency curtailment program would be implemented to limit overall water use to the output of the wells.

If the water service from the water treatment plant was interrupted between the plant and Gleed, Gleed could be without water because the water treatment plant and 48-inch transmission main are Gleed's only source of supply and storage. In the event of such an emergency, Gleed could either use its booster pump station to draw water remaining in the downstream portion of the 48-inch transmission main or receive its water from tanker trucks. We need to discuss.

Distribution system: The distribution system in general has adequate redundant piping to continue to provide service in case of disruption of service as the result of a main break or sabotage. In addition, each of the pressure zones can be served from the adjacent pressure zone in case of emergency by using PRVs, booster pump stations, and the emergency interties with Nob Hill Water Association.

Loss of Telemetry System: Another concern is the potential for loss of the radio-based telemetry system due to equipment failure or power interruption. When the telemetry system is not operational, the booster pump stations and wells can be operated manually and would require that the reservoir levels be monitored visually.

Power failure: Loss of power has historically not been a serious concern to the water utility because power is nearly always restored within a few hours. The water system has enough reservoir storage to supply demands for the duration of the power outage, and water can be moved from the High zone to the rest of the system by gravity. The Water Treatment Plant, Stone Church Pump Station and the Third Level Pump Station have standby generators which enables these facilities to remain operation even under extended periods of outage. If a power failure affecting the distribution system is of extended duration, portable generators could be obtained from the Yakima Training Center or Washington State National Guard.

6.6 Safety Procedures

The City of Yakima Water/Irrigation Division practices a safety program to ensure the health and welfare of water system personnel. All appropriate Occupational Safety and Health administration (OSHA) and Washington Industrial Safety and Health Administration (WISHA) regulations are followed during operation of the system. Maintenance and operation personnel are trained in safety practices, including confined space, asbestos handling, first-aid, fall restraint, and chlorine safety training. Specific safety considerations for the City of Yakima water system are provided in the following sections.

Confined Space

Some of the water treatment plant and distribution system valves and other system components are located in vaults or other confined spaces. All water system personnel are trained in confined space safety and the City maintains and operates the required safety equipment (blower, sniffer, tri-pod and harness) necessary to mitigate the dangers associated with confined space.

Asbestos Handling

Water/Irrigation Division personnel have been trained on the proper methods for repair and disposal of AC pipe in compliance with OSHA standards. General procedures for handling of AC pipe include:

- Notification of the local clean air authority in advance of work if possible.
- Use of protective garments.
- Wetting of area to be services throughout the maintenance to minimize dust.
- Cleaning debris off of tools with wet disposable towels.
- Placing of towels, scraps, parts, and garments into disposable bag for transportation to nearest landfill.

It should be noted that the City of Yakima has only a small amount of asbestos-cement pipe left in the system with the ultimate goal of eventually eliminating all remaining pipe made of this material.

Fall Restraint

Each of the City's elevated reservoirs (The two 1 MG Level 3 reservoirs) are equipped with safety-climb structures that mitigate the threat of falling to Water/Irrigation Division personnel. Appropriate harness-type fall gear is used whenever inspecting reservoir roofs and interiors.

Hazardous Chemicals

The use of chlorine gas for disinfection of the treatment plant and well water supplies is a significant hazard to water system personnel. The operating staff has special training and education to mitigate the potential dangers associated with the handling and use of this chemical.

As discussed in Chapter 3 of this plan. The water treatment plant has converted from gaseous chlorine to on-site generation of sodium hypochlorite. This was done primarily based on the safety concerns associated with chlorine handling. All of the chlorination systems at the wells have been converted to calcium hypochlorite tablet systems to eliminate chlorine gas at these locations also.

The other hazardous chemical used at the water treatment plant is fluoride in the form of hydrofluosilicic acid. This highly corrosive and toxic chemical is located is a separate building. The acid is stored in a high density polyethylene tank with secondary containment for the entire tank volume. As in the case of chlorine, the operating staff has special training and education to mitigate the potential dangers associated with the handling and use of hydrofluosilicic acid.

The Material Safety Data Sheets (MSDS) for these chemical are maintained at the place of use (the WTP and the Water/Irrigation Division Office/Shop facilities).

6.7 Cross-Connection Control Program

Section 7.68.070 of the Yakima Municipal Code, titled *Cross connection control*, requires that, no water service shall be installed or continued in use by the purveyor unless the water supply is protected by backflow prevention devices as may be required by this section. The complete text of Chapter 7.68 of the Municipal Code, including Section 7.68.070, is included in this plan as Appendix D. This section of the code, as adopted by Ordinance No. 3078, implements WAC 246-290-490 which establishes cross connection control requirements for all community water systems within the State of Washington.

Section 7.68.070 requires that the policies, procedures, and criteria for determining appropriate levels of protection shall be in accordance with the "Accepted Procedure and Practice in Cross Connection Control Manual--Pacific Northwest Section--American Waterworks Association, Third Edition," or any superseding edition. This manual is incorporated by reference into this water system plan update. A copy of the latest Cross Connection Control Annual Report is included in this plan as Appendix N.

6.8 Customer Complaint Response Program

All water service related complaints are handled through the Water/Irrigation Division office which can be reached at (509) 575-6154. This number also serves as the Nights and Weekend Emergency telephone number to report problems and complaints after normal working hours.

All water quality complaints are referred to the Water Quality Supervisor at the Water Treatment Plant. The Water Quality Supervisor investigates the complaints and maintains records describing the nature of the complaint and the steps taken to resolve it. All complaints are assigned a work order number which can then be tracked in the Automated Inventory and Maintenance Management Systems (AIMMS). AIMMS is a City wide program which tracks information about all of the City’s facilities and equipment. Additional information on AIMMS is included in Chapter 6 of this Water System Plan Update.

All low pressure and other distribution system related complaints are referred to the Distribution Supervisor who investigates and takes corrective actions as necessary. As with the water quality complaints, the distribution system related complaints are assigned a work order number and tracked in AIMMS.

6.9 Recordkeeping and Reporting

In 1994 and 1995 City implemented a maintenance management system which ahs been named "Automated Inventory and Maintenance Management Systems" (AIMMS). This program includes information about all of the City's facilities and equipment as well as recordkeeping and reporting.

AIMMS consists of number of modules that track and control purchasing and maintenance.

- Purchasing Module
  - Generates purchase orders
  - Tracks purchases of materials, equipment and services
  - Tracks costs
- Stores Module
  - Generates requisitions for materials, equipment and services
  - Tracks inventory of materials and equipment
  - Issues materials, equipment and services to "Work Orders"
  - Receipts materials, equipment and services from purchase orders
  - Generates requisitions for materials and services based on inventory levels and/or requisitions from "Work Orders"
- Maintenance Module
  - Assigns a unique number to each piece of equipment
  - Generates work orders for all work
  - Generates preventive maintenance work orders based on input schedule
  - Tracks all work
  - Tracks all materials, equipment and services used
  - Tracks labor hours and costs
- Project Module
  - Tracks special projects including Capital Improvements

In addition to the AIMMS recordkeeping and tracking program, the SCADA system software at the Naches River Water Treatment Plant provides for collection and storage of all of the water system process monitoring and control data.

6.10 O & M Manual

As previously noted a detailed Operation and Maintenance Manual for the Water System components has been prepared (January 2006). This manual should be referred to for detailed descriptions of all operation and maintenance procedures.

Chapter 7

Distribution Facilities Design and Construction Standards

7 Distribution Facilities Design and Construction Standards

7.1 General

The objective of this chapter is to describe and provide design and construction standards for water system distribution facilities to enable the City of Yakima Water Division to utilize an alternative approval process. By obtaining advance approval of design and construction standards (i.e., performance standards, sizing criteria, and construction materials and methods) along with an approved WSP, water purveyors do not need to obtain written DOH approval of individual project reports and construction documents for distribution mains and other distribution-related facilities. The purveyor must still comply with all applicable sections of the regulations, including project report and construction document requirements listed under WAC 246-290-110 and -120, whether or not documents are submitted individually to DOH for approval.

Types of distribution-related projects eligible under the alternative review process include distribution reservoirs/storage tanks, booster pump facilities, transmission mains, distribution mains, pipe linings, and tank coatings. Source of supply and water quality treatment projects are not eligible under this alternative review process. Such projects must be submitted to DOH for review and approval prior to construction. Source of supply projects refer to all work involving the development of a new source, redevelopment of an existing source at the wellhead, interties, and/or any project that would result in source capacity changes (i.e. either increase or decrease source production capability). Design and construction standards must be based on DOH design guidance or other documents generally accepted by engineering professionals as containing fundamental criteria for design and construction of water utility projects. The water system standards must be at least as stringent as those discussed in Chapter 246-290 WAC and should not deviate from department design guidance unless adequately justified. Justification must include other acceptable industry standards, such as those referenced in WAC 246-290-200.

This portion of the Water System Plan Update addresses the following elements related to water system distribution facilities design and construction:

1. Project Review Procedures;
2. Policies and Requirements for Outside Parties;
3. Design Standards;
4. Construction Standards; and
5. Construction Certification and Follow-up Procedures.

The information contained here should be useful to a design engineer to prepare detailed construction plans and specifications. However, these plans and specifications

are not required as a condition associated with utility-controlled distribution-related projects. They are required for projects involving water treatment, new sources of supply, and storage reservoirs. Additional guidance is available from DOH on project report and construction document review.

7.2 Project Review Procedures

It is City of Yakima policy that all improvements to be installed as PUBLIC facilities or in public right of way must be shown on engineering design plans, reviewed by the CITY OF YAKIMA, WATER/IRRIGATION and ENGINEERING DIVISIONS and approved by the City Engineer prior to commencing any construction. The engineering design plans must be stamped, signed and dated by a Professional Civil Engineer licensed in the State of Washington. The plans must include all of the applicable requirements outlined below.

At completion of construction, a set of reproducible RECORD DRAWNGS depicting all facilities as constructed shall be submitted to the City Engineer's Office, together with a construction cost summary for all public utilities and a transfer of ownership for all facilities.

The purpose of this procedure is to outline the information that must be shown on all plans in order for the Engineering Division to properly review the design. This shall apply to all projects within the City's jurisdiction including water system extensions and other water system improvement projects.

A detailed outline of the plan submittal requirements is available from the Engineering Division upon request. A copy of this document titled ENGINEERING DIVISION ADMINISTRATIVE PROCEDURES – *ENGINEERING DESIGN PLAN REQUIREMENTS*, is included as Appendix Q to this Water System Plan Update.

The City’s Engineering Design Requirements also include by reference, the Department of Health Water System Design Manual.

7.3 Policies and Requirements for Outside Parties

Yakima Municipal Code Title 12 – DEVELOPMENT STANDARDS establishes requirements and standards for the design and construction of public works improvements by private applicants in conjunction with subdivision or development of real property, and establish fees for the city engineer's review of design documents for and inspection of the public works improvements. Chapter 12.04 WATER addresses the specific requirements applicable to the extension of municipal water service to the development.

Specific requirement of Chapter 12.04 include:

12.04.030 Looping required.

All water lines shall be looped. Temporary dead-end water lines may be permitted based upon an agreement between the developer and the city with provisions for timely completion of looping.

12.04.040 Minimum size and material standards.

New water lines in the city of Yakima water system shall be constructed of Class 52 ductile iron and shall be a minimum of eight inches in diameter. Improvements and additions to the Nob Hill Water Company system shall conform to the requirements of Nob Hill Water Company.

In addition, the City of Yakima Engineering Division has published the following documents which also apply to developer water service extensions:

WATER – Specifications and Details (1999, or latest edition)

CITY OF YAKIMA PROCEDURES MANUAL FOR CONSTRUCTION OF PUBLIC WORKS

Both of these documents are available upon request from the City of Yakima Engineering Division and are also included in this plan Appendix P and Appendix R, respectively.

The above PROCEDURES MANUAL also includes the necessary forms and checklist which are to be completed for each project which include the following:

- Public Improvement Procedure Checklist
- Project Acknowledgment (City)
- Permit to Construct Public Improvements (City)
- Contractor's Indemnity Agreement (Contractor)
- Notice of Substantial Completion (Consulting Engineer)
- Final Project Inspection (City)
- Correction Notice (City)
- Certification of Work Completion (Consulting Engineer)
- Affidavit of Release of Liens and Claims (Owner/Developer and Contractor)
- Final Acceptance (City)
- Warranty Inspection (City)

7.4 Design Standards, (Performance Standards and Sizing Criteria)

The criteria and standards are based, in some cases, on regulatory requirements and, in other cases, on the City's policy for service. The two sources for standards are the Insurance Services Office (ISO) and the State of Washington Department of Health (DOH).

The function of the distribution system is to convey water to customers at adequate service pressures and to provide fire flows. The capacity of the distribution system should be such that it can meet peak-hour demands with a residual pressure of no less than 30 psi. The distribution system should also be able to provide the required fire flows during a peak-hour demand. According to WAC 246-290-230, the minimum system residual pressure permitted throughout the rest of the system to prevent backflow from a customer service into the system under fire flow conditions is 20 psi.

Usually, the inability to meet the above demand conditions is a result of inadequate distribution capacity; that is, pipes are not large enough or the pipeline grid is not well distributed and lacks redundancy. The capacity of the distribution system is greatly reduced when head loss is greater than about 1 foot per 100 feet of pipe length.

The minimum pipeline diameter is dictated by the minimum residential fire-flow requirement of 1,500 gpm. Accordingly the City of Yakima Municipal Code and related design standards require that 8 inches be the minimum pipe diameter, in order to keep the velocity in the pipe below 10 feet per second.

Pipeline velocities should also be maintained at approximately 3 to 5 feet per second for pumped systems and 7.5 feet per second for peak-hour conditions. It can generally be shown that it is more cost-effective (over a facility's service life) to increase the pipeline diameter to maintain 3 to 5 feet per second than to increase the pump horsepower.

The spacing of supply mains, arteries, secondary feeders, and fire hydrants are factors considered in determining the Insurance Service Office (ISO) fire rating. According to the ISO's *Grading Schedule for Municipal Fire Protection*, "... supply mains, arteries and secondary feeders shall extend throughout the system, shall be properly spaced (not more than 3,000 feet apart), and looped for mutual support and reliability of service ...." Table 5 in the *Grading Schedule* shows the average areas recommended to be served by a fire hydrant for varying fire flows. Fire hydrants that serve a larger area for a particular fire flow can result in deficiency points being assessed against the City, thus lowering the City's fire rating.

Pressure zone boundaries are based on ground contours and reservoir overflow elevations. The lower boundary of the zone is along the ground surface contour that results in pressures of no more than 100 psi during static conditions (usually occurring in the early morning hours). The upper boundary of the zone is along the ground surface contour that results in static pressures of no less than 40 psi. This low-pressure standard is usually sufficient to ensure that the pressure will not be below 30 psi during peak demand conditions.

Only the minimum number of pressure zones should be created. Wherever pressure zones are created, the system becomes fragmented and the water conveyance capacity can be severely limited by the PRV "bottleneck." Also, it is desirable to limit the number

of PRVs because as a mechanical device they require maintenance and are subject to failure. ISO fire-fighting standards consider pipelines much more reliable than PRVs.

The number of PRVs serving any given zone should be sufficient to meet fire-fighting requirements if one is out of service. Therefore, at least two, and ideally three, PRVs should serve each zone.

Pump station capacities must be adequate to provide peak-hour demands and fire-flow demands when pumping to a closed system (a pressure zone without storage). All pump stations require a minimum of two pumps for flexible operation. The total capacity of the pumps in a given pump station should generally be 25 to 50 percent greater than the calculated required capacity of the pump station, allowing a pump to be repaired without reducing supply capability. To increase emergency reliability, at least one pump in each pump station should be equipped with auxiliary power, which would include a diesel generator, a natural gas engine, or an auxiliary hookup so that it can be run from a portable generator to supplement the standard electric motor drive. In this way, some emergency supply capacity is available even if a general power outage occurs. A similar degree of reliability could be provided if the pressure zone is served by a second pump station, provided the second pump station is on a separate power distribution grid.

7.5 Construction Standards, (Materials and Methods)

Specifications for the materials and methods of construction of water system extensions are included in the most current edition of the Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction, as well as the above referenced document titled WATER – Specifications and Details available from the Engineering Division. The requirements of these specifications include, but are not limited to the following:

> All water mains shall constructed using ductile iron pipe Class 52 with cement mortar lining complying with ANSI/AWWA C105/A21.50, C151/A21.51, and C104/A21.4 most current editions.
>
> Gate valves shall be resilient seated conforming to ANSI/AWWA C509 latest edition.
>
> Butterfly valves shall conform to ANSI/AWWA C504 latest edition.

Refer to the document titled WATER – Specifications and Details, in Appendix P, for complete information regarding specifications and water system construction details.

7.6 Construction Certification and Follow-up Procedures

The steps that the City of Yakima Engineering Division takes to assure that a water system extension project has been constructed in accordance with the applicable standards are described in the above referenced PROCEDURES MANUAL and WATER – Specifications and Details. The following description of the specific steps related to project completion and acceptance are excerpted from the PROCEDURES MANUAL:

> Step VII
> Upon written notice that the public improvements have been substantially completed, the City will, in the company of the Consulting Engineer and/or the Owner/Developer or his Agent, make a final inspection of the construction. The Owner/Developer shall see that all necessary additions, corrections, repairs, and/or modifications are made.
>
> Step VIII
> At the conclusion of construction and when all corrections and repairs have been made, the Consulting Engineer shall submit a reproducible set of "As Built" Record Drawings along with a Certification of Work Completion and a request for acceptance by the City. The City's inspector and the Owner/Developer's contractor will provide the Consulting Engineer with field notes of changes to the approved plans. It is the responsibility, however, of the Consulting Engineer to assume conformance of the construction with the plans and specifications. The Consulting Engineer shall also make all other appropriate certifications and copies shall be furnished to the City.
>
> No building or service connection to sanitary sewers, storm drains, or water lines will be permitted until these systems have received final acceptance by the City, or unless otherwise approved by the City for connections.
>
> No permit shall be issued for any building construction until all of the public improvements included in the permit are fully operational and accepted by the City unless agreed to in writing by the City.
>
> Step IX
> When all public improvements have been completed in an acceptable manner, the City shall certify its acceptance in writing. Final acceptance by the City shall not relieve the Owner/Developer, the Consulting Engineer, or the Contractor of any liability, present or future, for failure or omissions directly relating to the improvements as included in the approved plans and specifications. The City's letter of acceptance shall specify the effective period of the warranty.

For the complete text of the PROCEDURES MANUAL refer to Appendix R.

The specific requirements for hydrostatic pressure testing and final flushing and bacteriological testing are addressed in the Engineering Division's WATER – Specifications and Details which include the following provisions:

All water mains and appurtenances shall be tested under a hydrostatic pressure of 180 psi.

The Developer will pay for the cost of bacteriological testing. City Engineering Inspector with a Contractor Representative will collect bacteriological tests.

Chapter 8

Improvement Program

8 Improvement Program

8.1 Objective

The objective of this chapter is to outline an improvement program by incorporating the system needs identified in the previous chapters. The identified improvements have been analyzed and prioritized in the development of the improvement program schedule for this Water System Plan Update as required by WAC 246-290-100.

The previously identified improvement projects have been evaluated and prioritized based on the following criteria:

- **Health Standards:** Does the improvement option conform with all of the applicable health regulations and standards?
- **Land Use:** Does the improvement option conform with and support adopted land use plans and policies?
- **Quantity:** Does the improvement alternative result in an adequate amount of future water supply source?
- **Reliability:** How much increased reliability does the improvement alternative provide the system? Is the system's desired level of reliability being achieved?
- **Costs:** What are the initial and annual capital costs? What are on-going costs for operation and maintenance of the improvement alternative?
- **Regional Benefit:** To what degree will the improvement alternative fulfill regional goals as well as individual system needs? Take into account regional water system needs and other multi-purpose benefits, such as flood control, and recreation.
- **Environmental Effects:** What kinds of environmental impact will the improvement alternatives create? Can negative impacts be mitigated?
- **Flexibility:** How well can the improvement alternative respond to changes in land use patterns, water demand projections, and resource management decisions? Can it be phased in?
- **Implementation:** How easy will it be for the improvement alternative to be accepted, designed, constructed, and financed?
- **Life Expectancy:** What is the useful life expectancy of the facility improvements?
- **Risk:** What risks are associated with selecting, or not selecting, alternatives improvements taking into account health risks, economic risks, and reliability of service risks?

The specific improvements which are recommended based on the evaluations conducted in the development of this plan are summarized in the following section.

8.2 Descriptions of Recommended Improvements

The improvements identified in this Water System Plan Update are described here in the following functional component categories:

- Source of Supply
- Water Treatment
- Storage, and
- Distribution

Source of Supply

The current normal source of supply is the Naches River Water Treatment Plant with a nominal capacity of 25 MGD. This supply is adequate to meet the projected maximum day demand (MDD) up until 2020. The three active wells (Kiwanis, Airport, and Kissel Park) have been designated as seasonal/emergency use supplies.

A new 3000 gpm deep well located in Gardner Park is currently under construction (2010) and scheduled for completion in 2012. This new well will enable the City to beneficially use the balance of the Ranney Well water right, and provide an additional seasonal/emergency source of supply.

Aquifer storage and recovery (ASR) is discussed in Chapter 4 as a possible source of additional supply to meet future maximum day demands or under emergency conditions. Two ASR wells are proposed. If the projected maximum day demands are realized by the year 2020, one of the proposed ASR wells would be needed at that time. The second ASR well would be installed in 2025. Since the need for the ASR wells is projected to occur beyond the time frame of the current capital improvement plan (CIP), no cost estimates have been developed for this Water System Plan Update.

Transmission Main Leak Detection (Fund at $20,000)
This project would provide a detailed leak detection survey on all transmission mains (30-inch through 48-inch concrete pipe). Methods specific to leak detection on large, concrete transmission mains with limited service connections is necessary to obtain accurate results for pinpointing the location of leaks. Some methods of leak detection also provide a video analysis of interior integrity of the pipeline. Currently, the City of Yakima has approximately 9 miles of 30-inch to 48-inch pipe.

Water Treatment

The recommended improvements in the water treatment facilities are described briefly below:

Backwash Settling Basin and new Electrical Service with Emergency Backup (Fund)

Construction of multiple concrete lined basins with a recycle pump station is recommended to replace the existing unlined basins and residuals handling process. The current electrical service is a 3-wire service and has reached capacity. The new service would be a 4-wire grounded

service and be large enough to provide reserve capacity. Along with the new electrical service, a new larger emergency backup generator system will be required. The estimated cost of the backwash settling basin upgrade and new electrical service is $3,700,000, including engineering and contingency.

PLC Replacement/Upgrade (Fund at $500,000)

This project upgrades the Programmable Logic Controllers (PLC) at the Water Treatment Plant and all remote sites (pump stations, etc.). The existing Square D Symax PLC's are nearly 20 years old, and it is becoming more difficult to obtain spare parts. The system will be upgraded with new PLCs and associated hardware components. There are a total of eleven sites that that will receive the PLC upgrade. Estimated cost - $500,000.

Naches River Levee Modifications

The existing levee along the Naches River adjacent to the Water Treatment Plant is not currently designated as a 100-year flood protection levee. If Yakima County modifies the existing levee at Eshbach Park (across the river from the WTP), allowing flood waters to migrate west of the existing river channel, the levee adjacent to the WTP will meet the requirements to be designated as a 100-year levee. If the levee at Eshbach Park is not modified by Yakima County, then the City of Yakima will need to work with the Army Corps of Engineers to bring the WTP levee up to an elevation that will meet the requirements for a 100-year flood plain designation. Estimated cost to be determined after an evaluation has been made on the Eshbach Park levee by Yakima County Flood Zone Control District.

Distribution

The following distribution projects, while not needed to correct any existing deficiencies, are included in the capital improvement program as part of the City's on-going efforts to maintain and upgrade the quality of the system to meet current and future needs.

Advanced Metering Infrastructure (AMI) (FUND at $10M)

This project would replace some existing water meters, upgrade other existing meters and install new infrastructure for an AMI system. The new AMI system will allow water meter reads to be transmitted to the utility billing system multiple times per day, eliminating the need for in the field manual meter reading. AMI will improve meter reading accuracy, billing accuracy, identify customer usage patterns, potential customer leaks and provide improved customer service. Components of the AMI system include new water meters, radio transmitters for existing water meters, structures for data collection units, and software. This project should begin in 2011.

Private Water Main Replacement Program (FUND at $175K per year)

This on-going program replaces private mains less than 6-inch (in some cases 1-inch galvanized) and complete loops in the areas where these mains are replaced. This project improves domestic flows to current residential customers, provides fire protection in areas where no fire hydrants have previously existed and improves overall system performance and reliability by looping the new mains to existing mains.

Open Gear Valve Replacement (Fund at $25,000 per year)

There are 16-inch and larger open gear gate valves throughout the water system that are fifty to seventy-five years old and are at the end of their useful life. Some valves are no longer operable and parts are not available for repair and maintenance of the valves. This project would systematically replace one to two valves each year until all have been replaced.

The following projects do not yet have cost estimates and are not yet included in the list of projects to be funded in the current capital improvement plan. The projects and the associated needs will be addressed with the 2012 Cost of Service and Rate Study. A change in the form government (currently the City Manager form) is under consideration. If a change is made, it could affect the budgeting process and the prioritization of the projects identified in the capital improvement plan.

Del Monte Site Waterline Replacement

Currently, the existing 8-inch CI and 12-inch CI public waterlines located on the Del Monte property at West Walnut Street/West Pine Street/South 1st Avenue are underneath existing buildings. This not only presents a liability to the City should a water main break occur, repair and maintenance of these waterlines is not possible. This project would abandon the existing waterlines and install a new 12-inch waterline around the south end of the existing building (West Pine Street), as well as a new BNSF railroad crossing to South Front Street. Project cost may possibly be shared with Del Monte.

East Mead Avenue Water Main

The existing 8-inch main on East Mead Avenue east of South 1st Street is only marginally sufficient to convey fire flows to the commercial/industrial area along I-82. An improvement completed under an earlier CIP should be extended to include a 12-inch main along East Mead Avenue between South 1st Street and the existing 12-inch pipe that extends eastward from South 10th Street. This project would replace the existing 8-inch in Mead from South 1st Street to South 10th Street and replace about 300ft of existing 6-inch in South 1st Street with a 12-inch main.

Viola Avenue Freeway Crossing

Currently, the 6-inch main that crosses under I-82 is only marginally sufficient to convey fire flows to the industrial area east of I-82, including the Yakima WWTP and surrounding commercial areas. A 12-inch main is required which will extend from the intersection of Rudkin Rd. and Viola Avenue under I-82 and connect to the existing waterlines at South 22nd Street and Viola Avenue. Design and specification have been completed and are ready for construction once funding is available.

Long Fiber to South 1st Street Water Main

This project will connect the existing 12-inch main in Long Fiber Road to an existing 12-inch main in South 1st Street, including crossing the BNSF railroad, to complete a loop which will better serve this area. This will strengthen the distribution system at this location, improving fire flows and providing service to future development in this area. This project could be completed as part of a new development.

Lead-Oakum Joint Waterline Replacement

In the older downtown core area of the City of Yakima, there are existing cast-iron waterlines with pipe joints that are sealed with oakum and lead, as opposed to the standard rubber gasket. Not only are these waterlines of an age where they're nearing the end of their useful life, should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline.

Two-bolt Joint Waterline Replacement

The City of Yakima has existing waterlines with pipe joints joined together with an uncommon two-bolt system, as opposed to the standard rubber gasket. Not only are these waterline of an age where they're nearing the end of their useful life, should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline.

Undersized Waterline Replacement

This project replaces aging, undersized waterlines throughout the system within commercial/industrial and downtown core areas. Replacement of the undersized lines will improve overall system performance, improve fire flows for surrounding businesses, and provide for future development. Replacement will also eliminate aging waterlines, which will require on-going repair. Depending on the area, replacements may also include waterlines identified as part of the Lead Oakum Joint Waterline Replacement project.

New Waterline Installation in Unserved Areas

This project installs all new water facilities – waterlines, water services and fire hydrants – in areas of the City which currently do not have public water facilities. Currently, properties in these areas have individual wells, some of which are shallow and improperly constructed according to current standards. Installation of the new facilities would provide fire protection to these area, provide water service to properties (once appropriate connection fees are paid) and provide for future development within the area. Projects may be coordinated with proposed sanitary sewers projects in the same areas.

Mill Site Redevelopment

In conjunction with private developer funding, this project installs unanticipated waterlines and facilities in the currently underdeveloped area of the old Boise Cascade lumber mill site (east of I-82 and north of North Fair Avenue). The project may replace existing, undersized facilities to provide adequate flows to new development at the site, and it may also replace existing facilities that are in poor condition and are incapable of providing for the future needs of the area.

8.3 Improvement Schedule

A summary schedule of the recommended improvements is provided in Table 8-1, below.

Table 8-1 Summary of Recommended Capital Improvements 2010 to 2016

Project Description	WSP Section(s) reference(s)	Cost Estimate	Financing Source	Year(s)
Source Improvements				
New Well at Gardner Park	Section 3.3.2	$2,700,000	PWTF[1]	2010-2011
Transmission Main Leak Detection	Section 3.3.6	$20,000	O&M transfer	
Aquifer Storage Recovery Well #1	Section 3.3.2	TBD	TBD	2020
Aquifer Storage Recovery Well #2	Section 3.3.2	TBD	TBD	2025
Water Treatment				
WTP PLC Replacement	Section 3.3.3	$500,000	Bond	2012-2013
WTP Lagoons / electrical service	Section 3.3.3	$3,755,900	PWTF[1], Bond, DWSRF[2]	2012-2013
Naches River Levee Modifications	Section 3.3.3	TBD	TBD	2012 or 2013
Distribution				
Advanced Metering Infrastructure	Section 3.3.6	$10,000,000	Bond	2011-2013
Water Main Replacement Program	Section 3.3.6	$1,025,000	O&M transfer	2011 – 2016
Open Gear Valve Replacement	Section 3.3.6	$150,000	O&M transfer	2011 – 2016
Identified needs which will be addressed in 2012 Rate Study				
East Mead Avenue Water Main	Section 3.3.6			
Viola Avenue Freeway Crossing	Section 3.3.6			
Long Fiber to S. 1st St. Water Main	Section 3.3.6			
Private Water Main Replacement	Section 3.3.6			
Del Monte Waterline Replacement	Section 3.3.6			
Lead-Oakum Joint Line Replacement	Section 3.3.6			
Two-bolt Joint Line Replacement	Section 3.3.6			
Undersized Waterline Replacement	Section 3.3.6			
New Waterlines in Unserved Areas	Section 3.3.6			
Mill Site Redevelopment	Section 3.3.6			

[1] Public Works Trust Fund [2] Drinking Water State Revolving Fund

The recommended capital improvements are shown in the order in which they are scheduled for implementation in Table 8-2.

Table 8-2 Capital Improvement Schedule 2011 to 2016 (Costs in 2010 Dollars)								
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017-30**	**Totals**
Source of Supply								
New Well at Gardner Park	$1,500,000							$1,500,000
Transmission Main Leak Detection	$20,000							$20,000
Aquifer Storage Recovery Well #1							TBD	TBD
Aquifer Storage Recovery Well #2							TBD	TBD
Water Treatment Plant								
WTP PLC Replacement		$250,000	$250,000					$500,000
WTP Lagoons / electrical service		$1,877,950	$1,877,950					$3,755,900
Naches River Levee Modifications								
Distribution								
Automated Metering Infrastructure	$2,000,000	$3,000,000	$5,000,000					$10,000,000
Open Gear Vale Replacement		$25,000	$25,000	$25,000	$25,000	$25,000		$125,000
Private Water Main Replacement	$150,000	$175,000	$175,000	$175,000	$175,000	$175,000		$1,025,000
Distribution projects planned, but funding availability not yet confirmed								
East Mead Avenue Water Main								
Viola Avenue Freeway Crossing								
Long Fiber to S. 1st St. Water Main								
Del Monte Waterline Replacement								
Lead-Oakum Joint Line Replacement								
Two-bolt Joint Line Replacement								
Undersized Waterline Replacement								
New Waterlines in Unserved Areas								
Mill Site Redevelopment								
Totals	$3,670,000	$5,327,950	$7,327,950	$200,000	$200,000	$200,000		**$16,925,900**

Chapter 9

Financial Program

9 Financial Program

9.1 Objective and Plan Content

The objective of the financial program is to identify the total cost of providing water service, assure that the utility improvement schedule will be implemented, and assist in establishing adequate fees for service. Statutory authority for financial program is derived from Chapters 43.20, 70.116 and 70.119A RCW. Regulatory authorities include Chapters 246-293 and 246-294 WAC, plus WAC 246-290-100.

Financial planning is one of the most important aspects of the Water System Plan. A comprehensive financial program is needed to successfully implement the recommended capital improvements and the continued operation and maintenance of the system. A complete funding program must indicate that the utility will be financially viable for the planning period. In order for a system to be financially viable, it must have the capacity to obtain sufficient funds to develop, construct, operate, maintain and manage the water system on a continuing basis in full compliance with federal, state and local requirements.

The financial program for this Water System Plan Update includes the following information:

- Past and Present Financial Status
- Available Revenue Sources
- Allocation of Revenue Sources
- Program Justification
- Assessment of Rates

In October 2007, a Domestic Water System Rate Update was developed by the FCS GROUP based on previously established Utility fiscal policies, development of a capital financing plan for the Capital Improvement Program, an update of annual revenue needs, and development of a schedule of proposed rates for years 2008 through 2012. Another Domestic Water System Rate Update will be completed in 2012. The financial plan for the years 2013 through 2017 will be re-evaluated in the 2012 study.

The methods used in this study followed general industry guidelines for developing utility rates – rates must generate enough revenue to maintain self-supporting and financially viable utilities without undue discrimination toward or against any customer.

The following fiscal policies were incorporated into the analyses:

- *Self-Sufficient Enterprise Fund* - Rates were developed with the expectation that the Utility will continue to operate as a self-supporting enterprise fund, generating necessary revenues from user fees rather than from property taxes or other non-utility sources.
- *System Replacement Funding* - The purpose of system replacement funding is to provide for the replacement of aging system facilities to ensure sustainability of the system for

ongoing operations. This study incorporates direct rate funding for capital projects in the amount of $700,000 per year. This level of funding approximates annual depreciation expense less debt principal payment; therefore no additional funding is necessary for system replacement at this time.

- *Reserve Levels* - Cash reserves are a necessary and appropriate part of prudent utility management and on-going operations. The minimum operating fund balance target was set at $1 million, which falls within the industry standard of 45 to 90 days of O&M. The capital contingency reserve was maintained at $750,000, within the industry standards of 1% to 2% of system assets. Per bond covenants, the City maintains restricted reserves equal to one year's annual principal and interest payment on all outstanding revenue bonds.
- *Debt Service Coverage* - The City's current minimum coverage requirement on outstanding revenue bonds is 1.25 times annual revenue bond debt service, using the net revenues of the Utility. The City's has an internal policy to set rates such that the Utility will meet coverage of at least 2.0 times annual revenue bond debt service.
- *Debt Management* – The City's general policy is to maintain debt service below 25 percent of the total Utility budget. Debt service is currently 8 percent of the budget, increasing to 12 percent of the budget by the end of the study period.

The second step of the study was a cost of service analysis, which allocated revenue requirements in accordance with various customer class demands. Uniform unit costs were calculated and used to distribute requirements to all classes based on customer demands. The cost of service analysis provided a guide toward making rate adjustments for each customer class. From the results of the cost of service analysis, the final step, a rate design, was accomplished.

The major findings of the 2007 rate study were as follows

- The Utility customer base is projected to increase from about 18,800 to 19,300 by the end of the study period, assuming customer growth of 0.5 percent per year. Revenue under existing rates increases from $6.4 million to $6.6 million over the study period.
- The City has identified $15.2 million (inflated dollars) in projects over the next five years consisting of replacement and rehabilitation projects necessary to sustain viable operation of the system, as well as supply and treatment projects necessary to comply with state and federal regulations and ensure the public health and safety of the community. In addition to the use of direct rate-funding and cash reserves, a revenue bond issue of $3 million and $7.6 million in low-interest state loans are needed to fund identified capital projects.
- New annual debt service payments reach just over $600,000 by the end of the study period, which when added to the existing debt burden, totals just over a $1 million in total debt service payments.
- Operating & maintenance (O&M) expenses consist of the cost of personnel and materials to supply, pump, and distribute water on a routine basis. O&M expense projections are based on the 2007 budget, plus 3.0 percent annual inflation and/or known cost changes. Salaries and benefits represent about 31 percent of the total Utility budget, up from about

28 percent last year. No new staff is anticipated in this study period. Total O&M costs range from $5.6 million to $7 million over the study period.

- Study findings concluded that annual revenue adjustments are potentially necessary in each year of the planning period. Three scenarios were developed incorporating varying strategies to phase-in the revenue needs over the study period:

9.2 Past and Present Financial Status

A summary of the operating income and expenses for the previous seven years is included in Table 9-1.

Obligations of the Domestic Water Utility Capital Fund are met from a combination of available funds on hand, proposed low interest loans, grants, cash transfers from the Domestic Water Utility Operating Fund, and interest income. It should be noted that the combination of funding sources shown in the capital-financing plan is dependent upon the amount of estimated capital costs to be incurred in any given year of the program. Should either of these amounts differ from the assumptions provided, the combination of funding sources could change.

Table 9-1 Summary of Income and Expenses 2003 to 2009							
Revenues	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
474 Water Operating Revenue	$5,717,644	$6,055,415	$5,848,935	$6,528,366	$6,831,147	$6,802,383	7,547,083
Beginning Unencumbered Balance	2,104,111	2,255,723	2,603,983	2,115,184	1,652,595	1,889,503	1,860,721
Expenditures							
474-122 Fire Suppression	159,910	171,977	166,277	207,780	250,082	243,866	229,872
474-129 Fire Suppression Admin.	24,698	23,047	25,772	26,842	27,463	29,821	31,591
474-341 Water Distribution	1,668,556	1,653,082	1,692,483	1,789,106	1,896,578	1,973,082	2,005,559
474-343 Water Treatment Plant, Transmission & Storage	1,054,109	1,119,856	1,376,607	1,240,480	1,275,036	1,299,263	1,461,861
474-348 Water/Irrigation Engineer	67,197	40,946	63,522	66,982	47,591	49,429	54,150
474-349 Water Administration	182,496	219,026	242,363	2,004,751	1,999,980	2,064,598	2,200,612
474-641 Interfund Charges Insurance	112,323	142,115	170,457				
474-645 Debt service, and transfers	974,577	946,468	1,162,809	1,655,015	1,097,509	1,171,105	1,313,811
474-646 Interfund in Lieu Tax, City and Customer Services	1,322,165	1,390,641	1,437,445				
Total Expenditures	5,566,032	5,707,158	6,337,734	6,990,955	6,594,239	6,831,165	7,297,455

[1] Estimated amount for beginning unencumbered balance.

9.3 Available Revenue Sources

Revenue for the Operating Fund is derived from user charges for metered water sales, miscellaneous revenues such as hookup fees and penalties, new water services, rental income, personnel services, and interest income from operations.

Obligations of the Domestic Water Utility Capital Fund are met from a combination of available funds on hand, proposed low interest loans, grants, cash transfers from the Domestic Water Utility Operating Fund, and interest income. It should be noted that the combination of funding sources shown in the capital-financing plan is dependent upon the amount of estimated capital costs to be incurred in any given year of the program. Should either of these amounts differ from the assumptions provided, the combination of funding sources could change.

Based on City accounting records, a beginning balance of $3,464,285 is available in the Capital Fund for 2011.

Currently, there are limited alternative funding sources available. Given the nature of the state budget the PWRF program will not longer be available and there are very limited grant opportunities. Funding must come from Bonds, DWSRF and O & M Transfers from increased rates. However staff will continue to seek outside funding sources

Interest income is generated from the investment of available annual balances in the water utility Capital Fund. An average annual interest rate of 4.0 percent was assumed in the 2007 Rate Study. Currently most interest rates are less than 1%.

A Public Works Trust Fund (PWTF) loan was obtained in September of 2003 in the amount of $2,694,500. These loan funds were used for the WTP improvement project which included rapid mix (pumped flash mix) improvements, on-site chlorine for disinfection, new chemical feed and storage equipment, and pipe gallery modifications. A DWSRF loan of $957,200.00 was obtained in 2004, these funds were used for filter improvement at the WTP. A PWTF loans for $2,257,200.00 was obtain in 2008 for the Gardner Park Well. A DWSRF loan is anticipated for WTP residuals handling and new electrical service.

9.4 Allocation of Revenue Sources

Obligations of the Capital Fund include major capital improvements, bond reserve requirements for existing bonds, and capital financing issuance expense. Table 9-2 is the current and projected income and expense for capital through 2011. As previously noted, this projected CIP financing plan will be updated as part of the new cost of service and rate study to be completed in 2012. Table 9-2 shows a projected Capital Fund balance of $3,575,838 by the end of year 2011. Fund balances at the end of one year are generally carried forward to help fund projects the following year and to provide for unanticipated changes in project costs and schedules.

The Current and Projected Income and Expenses for Operating Fund through 2011 are shown in Table 9-3.

Table 9-2 Summary of current and projected income and expense for capital through 2011

Revenues	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**[1]
Transfer from Operating Fund	$500,000	$500,000	$600,000	$1,100,000	$500,000	$500,000	$625,000	$950,000	$800,000
Interest	3,950	15,749	24,444	8,000	8,000	8,000	4,000		
Grants	482,413	134,435	71,000						
Loans	538,900	2,020,875	710,170	310,896			1,015,740	564,300	677,160
Property Sale						1,297,066			
477 Water Capital Revenue	1,841,265	2,671,059	1,405,645	1,417,895	508,000	1,805,066	1,644,740	1,514,300	1,477,160
Beginning Unencumbered Balance	1,867,144	1,950,870	1,315,301	1,511,541	1,479,432	1,513,820	2,813,246	2,412,786	3,575,838
Total Expenditures	1,757,539	3,306,628	1,209,375	1,450,005	473,612	505,640	1,909,301	351,248	3,010,000

[1] Budget

Table 9-3 Summary of Current and Projected Income and Expenses for Operating Fund through 2011

Revenues	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**[3]
474 Water Operating Revenue	$5,717,644	$6,055,415	$5,848,935	$6,528,366	$6,831,147	$6,802,383	$7,547,083	$7,457,093	$7,644,337
Beginning Unencumbered Balance[1]	2,104,111	2,255,723	2,603,983	2,115,184	1,652,595	1,889,503	1,860,721	1,733,284	1,766,435
Expenditures									
474-122 Fire Suppression	159,910	171,977	166,277	207,780	250,082	243,866	229,872	286,085	280,594
474-129 Fire Suppression Admin.	24,698	23,047	25,772	26,842	27,463	29,821	31,591	31,397	31,762
474-341 Water Distribution	1,668,556	1,653,082	1,692,483	1,789,106	1,896,578	1,973,082	2,005,559	1,982,043	2,066,716
474-343 Water Treatment Plant, Transmission & Storage	1,054,109	1,119,856	1,376,607	1,240,480	1,275,036	1,299,263	1,461,861	1,417,172	1,553,142
474-348 Water/Irrigation Engineer	67,197	40,946	63,522	66,982	47,591	49,429	54,150	54,255	56,161
474-349 Water Administration	182,496	219,026	242,363	2,004,751	1,999,980	2,064,598	2,200,612	2,195,119	2,358,435
474-641 Interfund Charges Insurance	112,323	142,115	170,457						
474-645 Debt service, and transfers[2]	974,577	946,468	1,162,809	1,655,015	1,097,509	1,171,105	1,313,811	1,700,442	1,541,391
474-646 Interfund in Lieu Tax, City and Customer Services	1,322,165	1,390,641	1,437,445						
Total Expenditures	5,566,032	5,707,158	6,337,734	6,990,955	6,594,239	6,831,165	7,297,455	7,648,497	7,888,203

[1] Estimated amount for beginning unencumbered balance.
[2] Includes transfer for Operating fund to Capital Improvements Fund
[3] Budget

9.5 Program Justification

To provide for the continued operation of the Utility on a sound financial basis, revenue must be sufficient to meet revenue requirements.

Revenue for the Operating Fund is derived from user charges for metered water sales, miscellaneous revenues such as hookup fees and penalties, new water services, rental income, personnel services, and interest income from operations. Revenue of the Utility is derived principally from the sale of water. Estimates of future water sales revenues are based on a detailed analysis of the number of estimated customer meters, water usage, and projected customer growth throughout the study period. Water sales revenue is based on the rates, number of estimated meters, and projected volume of metered water.

The Utility also receives revenue from miscellaneous revenues such as hook-up fees, permitting fees, and penalties.

Interest income is based on the estimated available balances in the Operating Fund for each investment period, and an average annual interest rate of one percent.

Revenue requirements for the Operating Fund include operation and maintenance expense, debt service, transfers to the Capital Fund, routine capital outlays, and taxes. Operating and maintenance (O&M) expense consists of the cost of personnel and materials to supply, pump, and distribute water on a routine basis. Since these costs are an annual obligation of the Utility, they must be met from water sales revenue.

Transfers to the Capital Fund for cash financing of capital improvements vary each year based on needs and carry-over amounts, and will range in size from $100,000 to $700,000.

9.6 Assessment of Rates

In 2007 the City conducted a Rate Study Update which recommended that the City continue a transition to a conservation rate structure. This goal was reached in 2009. The existing water rate structure which includes a minimum bill (ready-to-serve-charge) similar to the one defined in the American Waterworks Association's M1 - Water Rates Manual and a single volume per unit of consumption.

Currently the minimum bi-monthly bill provides a customer with six (6) Units of consumption (600 cubic feet of water) plus a Ready-to-Serve Charge based on service size. This initial block and then Ready-to-Serve charge is designed to recover customer costs, as well as costs associated with use and capacity requirements of the smallest users.

Another Cost of Service and Rate Study will be conducted in 2012. This rate study is expected to evaluate if further steps in a conservation rate structure will be of value and supported by the Council and citizens. The study will also evaluate financing options for future Capital projects. For calendar years 2009 and beyond, the charge for domestic water supplied within the City of Yakima shall consist of a ready-to-serve charge and a charge for water consumed (Table 9-4 and Table 9-5).

Table 9-4 Ready-to-Serve Charges per Two-Month Period (7.68.250)

Meter size	2009 Jan 1	2010 Jan 1	2011 Jan 1	2012 Jan 1 and beyond
¾” and smaller	9.79	10.42	11.04	12.00
1”	13.57	14.47	15.33	16.18
1-1/2”	22.94	24.52	25.95	27.33
2”	34.24	36.62	38.74	40.76
3”	60.60	64.89	68.62	72.12
4”	98.25	105.26	111.30	116.91
6”	192.31	206.09	217.90	228.79
8”	380.52	407.89	431.22	452.68
10”	568.68	609.62	644.47	676.50
12”	832.15	892.09	943.08	989.91

Table 9-5 Charge for Water Consumed per UOC (7.68.250)				
UOC	**2009 Jan 1**	**2010 Jan 1**	**2011 Jan 1**	**2012 Jan 1 and beyond**
0-250	1.29	1.36	1.44	1.51
Over 250	1.29	1.36	1.44	1.51

A one-month period is defined as water service from one day up to thirty one days. A two-month period is defined as water service for thirty two days to two months.

The minimum charge for domestic water for a one month period for all meter sizes except ¾ inch shall be one half the two-month Ready-to-Serve charge above plus the charge for three (3) UOC at the 0 –250 UOC rate above. The ¾ inch meter size minimum charge for domestic water for a one month period shall be the ¾ inch two month Ready-to-Serve charge above plus the charge for three (3) UOC at the 0 –250 UOC rate above. The minimum charge for domestic water for a two month period for all meter sizes shall be the two-month Ready-to-Serve charge above plus the charge for six (6) UOC at the 0 –250 UOC rate above.

All charges for water supplied outside the city shall be computed by multiplying the applicable rates set forth in paragraphs A through D of this section by one and one-half.

A residential customer who undergoes kidney dialysis at his or her home, or whose home is also the home of a different person who undergoes home kidney dialysis, shall not be required to pay utility charges for domestic water service or sewer service for the quantity of water that is necessary for the home dialysis. In order to be excused from utility charges under this subsection, the residential customer must present to the director of finance and budget or their designee written documentation annually from a recognized kidney dialysis center certifying that the person requires dialysis and the quantity of water needed for that person's dialysis."

The bi monthly charges for each fire service are as shown in Table 9-8.

Table 9-6 Fire service charges (7.68.282)					
Size of Service	**Feb. 1 – Dec. 31, 2008**	**2009 Jan 1**	**2010 Jan 1**	**2011 Jan 1**	**2012 Jan 1 and beyond**
2”	5.76	5.76	5.76	6.00	6.00
3”	8.06	8.06	8.06	8.40	8.76
4”	14.10	14.88	15.72	16.60	17.54
6” including hydrant only	41.44	43.78	46.26	48.84	51.56
8”	88.26	93.24	98.50	104.00	109.82
10”	158.70	167.66	177.12	187.00	197.46
12”	256.48	270.96	286.26	302.30	319.12

Charges for fire services outside the city limits shall be computed by multiplying the applicable rate above by one and one-half.

The inside diameter of the pipe leading to a fire hydrant shall determine the service charge. Any fire hydrant installed and maintained by the city outside of city limits will be billed as a fire service, which charge shall be terminated at such time as the responsible consumer’s property is annexed to the city.”