
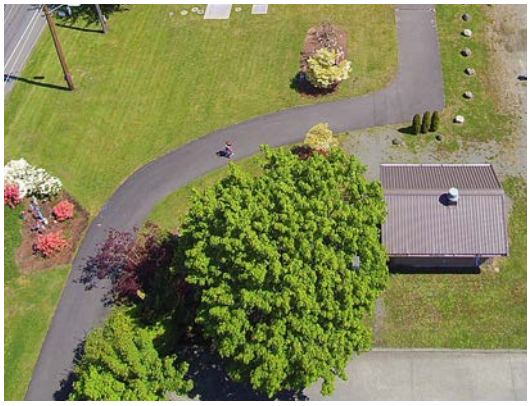

CITY OF BUCKLEY
Water System Comprehensive Plan

G&O #13229
DOH Water System ID #9000K
August 2017

Gray & Osborne, Inc.

CITY OF BUCKLEY

PIERCE COUNTY **WASHINGTON**

WATER SYSTEM COMPREHENSIVE PLAN

KARL W. JOHNSON STATE OF WASHINGTON 29986 REGISTERED PROFESSIONAL ENGINEER

DOMINIC J. MILLER STATE OF WASHINGTON 35679 REGISTERED PROFESSIONAL ENGINEER

8-30-2017

G&O #13229
AUGUST 2017

Gray & Osborne, Inc.
CONSULTING ENGINEERS

State of Washington
DEPARTMENT OF HEALTH
NORTHWEST DRINKING WATER REGIONAL OPERATIONS
20425 72nd Avenue South, Suite 310 • Kent Washington 98032-2388

May 2, 2018

HONORABLE MAYOR PAT JOHNSON & COUNCIL
CITY OF BUCKLEY
PO BOX 1960
Buckley WA 98321

Re: Buckley Water, ID # 09000
Water System Plan – **Approval (Correction for April 20, 2018 Letter)**
Pierce County
Submittal # 15-0509

Dear Honorable Mayor Pat Johnson and Council Members:

The City of Buckley's Water System Plan (WSP), received in this office on May 15, 2015, with resubmittals on August 31 and November 20, 2017, and April 16, 2018, has been reviewed, and in accordance with the provisions of WAC 246-290-100, is **APPROVED**.

Approval of the plan amendment is valid as it relates to current standards outlined in Chapter 246-290 WAC, revised January 2017, Chapter 246-293 WAC, revised September 1997, Chapter 70.116 RCW, the Pierce County Coordinated Water System Plan (CWSP), and is subject to the qualifications herein.

An approved update of this WSP is required on or before **April 20, 2024**, unless ODW requests an update or plan amendment pursuant to WAC 246-290-100(9).

APPROVED NUMBER OF CONNECTIONS

The analysis provided in the City of Buckley's WSP shows the water system has sufficient capacity to meet the growth projections during this planning period and that the next limiting factor is water right annual quantity. The water system can support an **"unspecified"** designation for its approved number of connections. A specific number of approved connections will not be applied at this time. Development may occur in compliance with the schedule and information provided in this WSP. This designation may be rescinded (and replaced with a specified number of approved connections) if ODW determines that the WSP is no longer representative of system activities.

CONSTRUCTION WAIVERS

Standard Construction Specifications were approved. Consistent with WAC 246-290-125 (2), the water system may proceed with the installation of distribution main extensions ***provided the water system completes and keeps on file, the enclosed construction completion report form*** in accordance with WAC 246-290-125 (2) and WAC 246-290-120 (5) and makes them available for review upon request by the department.

LOCAL GOVERNMENT CONSISTENCY

The plan amendment meets local government consistency requirements for WSP approval pursuant to RCW 90.03.386 and RCW 43.20.

SERVICE AREA AND DUTY TO SERVE

Pursuant to RCW 90.03.386(2), the service area identified in this WSP service area map may now represent an expanded "place of use" for this system's water rights. Changes in service area should be made through a WSP amendment.

Buckley Water has a duty to provide new water service within its retail service area.

WATER RESOURCES

The department's approval of your water system design does not confer or guarantee any right to a specific quantity of water. The approved number of service connections is based on your representation of available water quantity. If the Washington Department of Ecology, a local planning agency, or other authority responsible for determining water rights and water system adequacy determines that you have use of less water than you represented, the number of approved connections may be reduced commensurate with the actual amount of water and your legal right to use it.

Ecology did not comment.

WATER SYSTEM PLANNING

We recognize the significant effort and resource commitment involved in the preparation of this plan. Thank you for your cooperation and we look forward to working with you in the future.

Sincerely,

Jennifer Kropack
Regional Planner
(253) 395-6769

for John Ryding
Regional Engineer
(253) 395-6757

Enclosure: Construction Completion Report

Cc: Dave Schmidt, City Administrator, City of Buckley
John Dansby, Manager, City of Buckley
Dom Miller, PE, Gray & Osborne, Inc.
Dan Cardwell/Vaughan Cary, Pierce County, Planning and Land Services
Brad Harp, Tacoma-Pierce County Health Department
Tammy Hall, Department of Ecology

CITY OF BUCKLEY, WASHINGTON

ORDINANCE NO. 05-18

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF BUCKLEY, PIERCE COUNTY, WASHINGTON ADOPTING THE 2018 COMPREHENSIVE WATER SYSTEM PLAN.

WHEREAS, the Public Water System Coordination Act of 1977, RCW 70.116 and WAC 246-290-100, require that each purveyor within the boundaries of a critical water supply service area develop a water system plan for the purveyor's future service area; and

WHEREAS, WAC 246-290-100 provides that the purveyor shall update the plan and obtain department approval at least every ten (10) years; and

WHEREAS, the City previously adopted a water system plan in March, 2008; and

WHEREAS, pursuant to WAC 246-290-100 this plan expires in March, 2018 at which time the City was required to adopt an updated plan that had been reviewed and approved by DOH and Perce County; and

WHEREAS, the City contracted with and directed Gray & Osborne to update the existing water system plan; and

WHEREAS, draft copies of this updated plan were submitted to DOH and Pierce County; and

WHEREAS, on November 15, 2017 the City received a concurrence letter from Pierce County approving the updated water system plan; and

WHEREAS, on December 8, 2017 the City received a message from DOH that stated that DOH will approve the water system plan once the City Council had adopted a resolution or ordinance approving the plan; and

WHEREAS, pursuant to RCW 70.116 the new water system plan must be reviewed by the City Council to insure that the plan is not inconsistent with the land use plans, shoreline

master programs, and/or developmental policies of the general purpose local government or governments whose jurisdiction the water system plan affects; and

WHEREAS, City staff certifies that the updated 2018 Comprehensive Water System Plan is consistent with the land use plans, shoreline master programs, and/or developmental policies of the City; and

WHEREAS, the Transportation & Utilities Committee reviewed the 2018 Comprehensive Water System Plan and recommends that the City Council adopt the Plan; and

WHEREAS, the City Council conducted a public hearing on February 27, 2018 to solicit public input and comment from interested individuals or groups on the water system plan update, including but not limited to information on projected water system demands, anticipated capital improvements, financing alternatives, and updated water use efficiency goals; and

WHEREAS, the Comprehensive Water System Plan was reviewed for compliance with the State Environmental Protection Act (SEPA) and after conferring with the Washington Department of Ecology it was determined that the draft Comprehensive Water System Plan was exempt from SEPA review; and

WHEREAS, the City Council concurs with the Transportation & Utilities Committee's recommendation and desires to adopt the draft plan as the "2018 Comprehensive Water System Plan";

NOW THEREFORE THE CITY COUNCIL OF THE CITY OF BUCKLEY DOES NOW ORDAIN AS FOLLOWS:

Section 1. The "2018 Comprehensive Water System Plan" dated August 30, 2017 is hereby adopted by reference and replaces the "2008 Comprehensive Water System Plan."

Section 2. Severability. If any provision or portion of this Ordinance is held invalid, such invalidity shall not affect any other provision, or the application thereof, which can be given effect without the invalid provision or application, and to this end the provisions of this Ordinance are declared to be severable.

Section 3. This Ordinance shall be in full force and effect five days from and after its passage, approval and publication as provided by law.

Introduced, passed, and approved this 27th day of March, 2018.

Pat Johnson, Mayor

ATTEST:

Joanne Starr, City Clerk

APPROVED AS TO FORM:

Phil Olbrechts, City Attorney

PUBLISHED: April 4, 2018

EFFECTIVE: April 9, 2018

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CHAPTER 1

WATER SYSTEM DESCRIPTION

INTRODUCTION

In accordance with WAC 246-290 (DOH, April 30, 2012), water system plans need to be updated every 6 years. This Plan has been prepared to update the *2005 City of Buckley Water System Comprehensive Plan*, using the *DOH Water System Design Manual* dated December 2009, and the *DOH Water System Planning Handbook* dated April 1997. This Plan has also been written to be consistent with the *City of Buckley Comprehensive Plan*, dated December 2015, and the *Pierce County Coordinated Water System Plan* dated October 2001. This Plan will assess the current and future capabilities of the Buckley water system, recommend any needed improvements to allow the system to provide water service throughout the planning period, and meet the statutory requirements in Chapter 246-290-100 WAC (Water System Planning), Chapter 246-290-135 WAC (Source Protection), Chapter 246-290 WAC Part 5 (Water System Operations), Chapter 246-290 WAC Part 8 (Water Use Efficiency), and Chapter 246-293-250 WAC (Water System Coordination Act).

The purpose of Chapter 1 is to present background information for the City of Buckley *Water System Comprehensive Plan* (Plan). The chapter presents information on: ownership and management of the system; system background data; the existing system facilities inventory; related planning documents; service area and retail service area characteristics; service area agreements and policies; conditions of service, and the system management's complaint handling process.

SYSTEM OWNERSHIP AND MANAGEMENT

The City of Buckley is a public water system purveyor that provides water service within the existing City limits and designated Urban Growth Area (UGA). The City of Buckley Public Works Department's current mailing address is:

City of Buckley
Water Department
933 Main Street
P.O. Box 1960
Buckley, WA 98321-1960
Phone: 360-829-1921

The Water System name listed in the DOH official records is Buckley Water. The system is classified as a Group A system and the DOH water system identification number is 09000K. The primary contact person is Chris Banks, Utilities Superintendent.

Mr. Banks can be reached at (360) 761-7884. The Water Department reports to David Schmidt, the City Administrator. The Buckley Water Facilities Inventory (WFI) form is provided in Appendix A. Figure 1-1 shows the location of the City of Buckley.

The City has joint ownership of portions of its water system with Rainier School, a Washington State Department of Social and Health Services facility located within City limits. The City and Rainier School jointly own the water transmission main from South Prairie Creek. The City owns the Slow Sand Filter Water Treatment Plant (WTP), while Rainier School owns the land where the WTP is located. The City operates the raw water transmission line while Rainier School operates the water treatment plant. The City and Rainier School retain separate ownership of their respective water distribution systems. A management committee consisting of two representatives from the City and two representatives from the school meet annually to discuss operations, maintenance and capital improvements for the joint facilities. A copy of the current agreement between the City and DSHS is provided in Appendix B.

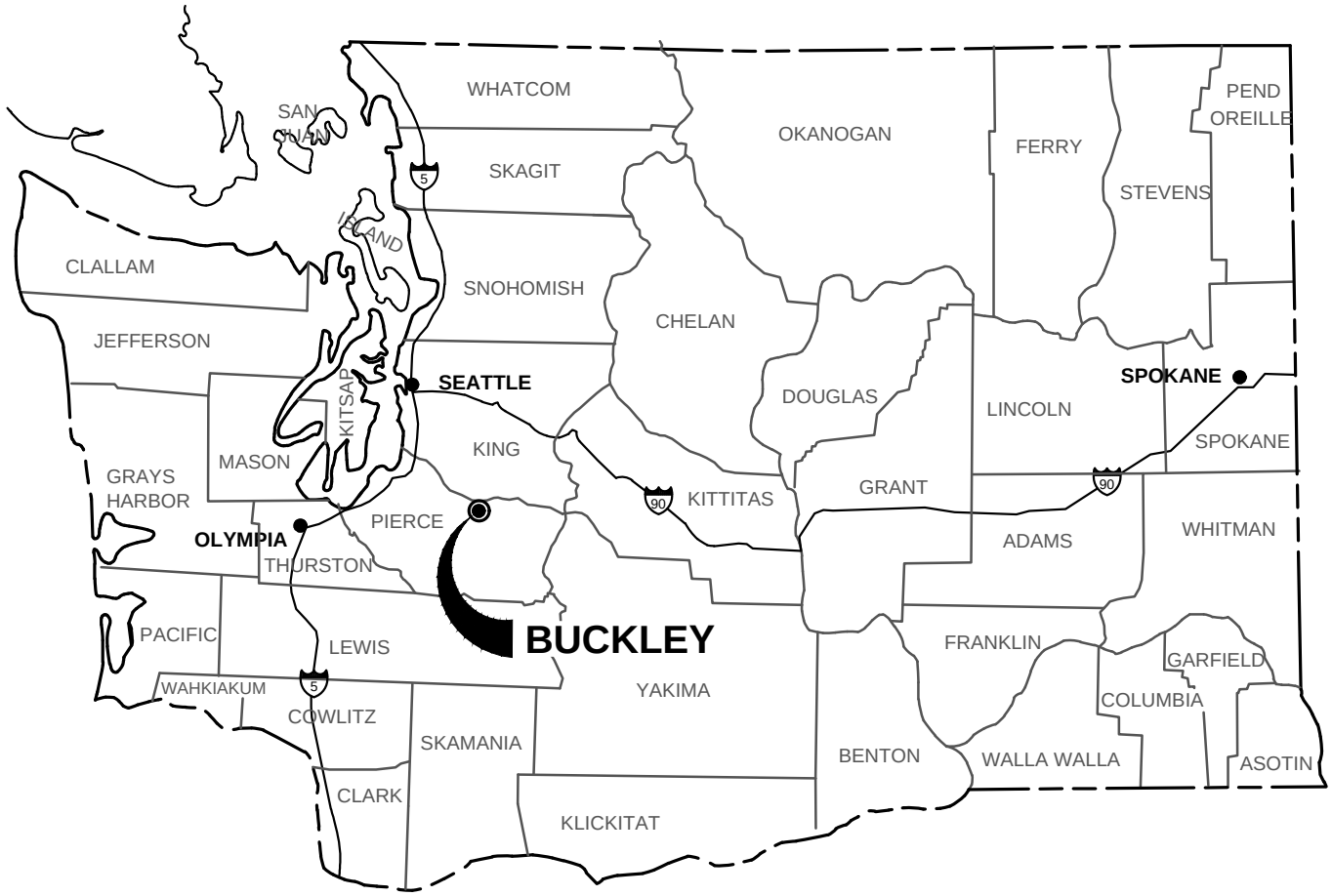
SYSTEM BACKGROUND AND HISTORY

The City's first water system was constructed in 1908. Three springs, Hamilton, Diemer and Dout, located approximately one half mile from the existing reservoir were used to supply water to the City. A pump system, with wood stave mains, transported the water from the springs to the City.

In 1926, the City began work to develop a new water supply because of pipe leaks, pump maintenance problems, and capacity concerns with the spring system. The City received a Certificate of Water Right for 2 cubic feet per second (cfs) from South Prairie Creek. The City held a special election in November 1926 and approved a bond proposal. In March 1927, the City accepted a bid of $40,000 to construct a transmission line to deliver water to the City. The City obtained a right-of-way for construction of the transmission line from the St. Paul and Tacoma Lumber Co. and adopted a watershed agreement. The Contractor completed the system in August 1927. The three springs also fed water into the new system. The system did not include headworks, but used a pipe laid in the Creek as an intake. Floating logs and leaves frequently interfered with the water supply.

The City stopped using Hamilton Spring after a landowner complained about property damage caused by a leak in the pipe originating at the spring. The City resumed using Hamilton Spring after repairing the main. The Diemer Spring main was also repaired at this time.

In 1938, Rainier School opened as a residential center for the developmentally disabled. The State designed the campus to be self-contained and built infrastructure systems to support the campus. Residential buildings were constructed for both patients and staff. Beginning in July of 1938, the City sold water to the School. Rainier School tapped directly into the City waterline for this water. In 1941, Rainier School connected its own system to South Prairie Creek, paralleling the City's water main. Rainier School



VICINITY MAP

NOT TO SCALE

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-1

VICINITY MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\BUCKLEY\13229 Water Plan\Figures\Figure 1-1.dwg, 8/11/2017 11:04 AM, JIM WEIS

obtained its own Certificate of Surface Water Right for 3.5 cfs for domestic water supply and irrigation of the 200 acres of farmland that supported the residents and staff of the School.

During this time, the City also built an intertie between a City of Tacoma water main and the City's wooden supply main. This intertie was disconnected in 1943 when the Department of Health raised concerns about possible contamination from Buckley's older system. In 1944, the City abandoned the three spring systems after determining that construction of a new supply main would be impractical. In 1944, the City also constructed a disinfection facility to chlorinate the water being supplied to City customers.

In 1946, Rainier School and the City of Buckley jointly improved the transmission line from South Prairie Creek. The City entered into an agreement with the School to contribute $44,000 to construct the system in return for 20 percent of the water. The joint system was completed in 1949. At that time, the City abandoned its aging transmission line. In 1961, the City and Rainier School both drilled wells for standby water supply. The City's Naches Street Well (also called Well 1), located near the center of Buckley was placed in service in 1967. Records on the original production capacity are not available and it is not known whether the line shaft vertical turbine pump installed in the well took full advantage of the production capacity of the aquifer.

The City and Rainier School hired an engineer to report on a proposal to consolidate their reservoir systems. In 1970, the population of Buckley almost equaled the population of Rainier School (1,710). The City experienced water shortages during this period due to storm-induced turbidity in South Prairie Creek. City water consumption ranged from 410,000 gallons per day (gpd) to nearly 1.5 million gpd during summer irrigation months. The high consumption rate was attributed to a lack of meters, prompting the City to begin a program to install meters on all services.

In 1985, the City conducted a hydrogeologic study of potential water resources in the Buckley area. The study included a drilling project that targeted a suspected aquifer at a depth of 200 feet on the eastern side of the City near Rainier School. The City drilled four test wells. The first well hit a bedrock bench, preventing development for water supply, and thereafter served as an observation well. Well 2 produced 150 gallons per minute (gpm) from an aquifer 90 to 105 ft. below land surface. Well 3 produced 200 gpm as long as Well 4 was not pumping. However, Well 3 has a relatively small casing because its purpose was to investigate the production capacity of an upper aquifer encountered at a depth of 60 ft. Well 4, with a larger casing, provided 280 gpm over a 3-month period. The City's engineers warned that limitations on capacity might be encountered over longer pumping periods due to aquifer dewatering.

The City placed Well 4 into service with a 280 gpm flow and placed Well 2 into standby service. The City did not place Well 3 into service because the small casing size prevented a pump with adequate capacity from being installed in the well. In 1992, the

City also rehabilitated the Naches Street Well. After cleaning the screens, a pump test indicated a capacity of 260 gpm. This well was then placed back into standby service.

Rainier School operates a 215 gpm well (Well 5) as an emergency backup source for their water system. The well is configured such that the water from the well is chlorinated as it enters the school's 2.3 million gallon (MG) reservoir. Operation of the School Well affects water levels in both Wells 2 and 4.

The City of Buckley and Rainier School hoped to avoid the costs of filtering the South Prairie Creek surface water source by developing additional ground water sources with sufficient capacity to supply the Buckley and Rainier School water systems' projected water demands. Both parties entered into an agreement that called for the City to become the water purveyor, operating and maintaining the joint system once the system switched from surface water to well water. However, the well program failed to provide adequate capacity to meet both of their needs.

In 1993, the City of Buckley commissioned an "Evaluation of Alternatives for Meeting the Surface Water Treatment Rule." Gray & Osborne Inc., the City Engineer, considered three alternatives in the report: ground water source development, wholesale water purchased from the City of Tacoma, and surface water treatment. The report recommended pilot testing of slow sand filtration. The pilot study was completed in June 1995. The tests indicated that the City's water supply could be effectively treated with slow sand filtration. The City and Rainier School completed construction of the Slow Sand Filter Water Treatment Plant, which went online in May 1997.

A copy of the most current agreement between the City and the Department of Social and Health Services is provided in Appendix B. In this agreement, the respective entities retain ownership of their water rights and those facilities specific to the operation of their systems. The City owns the water treatment plant and DSHS owns the land where the plant is located.

In 2012 the City completed a study of long term water supply options, including following options:

- Continue to operate and maintain the City's own sources together with sources jointly owned by the City and DSHS Rainier School and any future source development needs,
- Abandon the City's own sources and obtain all water supply for the City of Tacoma, or
- Maintain the City's existing sources and develop an active, full-time intertie with the City of Tacoma.

Following completion of the study, the City elected to maintain the City's own sources together with sources jointly owned by the City and DSHS Rainier School. A copy of the report is included in Appendix Q.

In 2015, the City completed the equipping of Trail Wells 1 and 2 (Wells 6 and 7) and the Trail Well Treatment Facility, which treats the trail wells for iron and manganese.

PROJECTS COMPLETED SINCE LAST WATER SYSTEM PLAN

PROJECTS INCLUDED IN PREVIOUS WATER SYSTEM PLAN

Substantial projects identified in the City's Water System Plan have been completed. Projects identified in the previous Water System Plan and their current statuses are summarized in Table 1-1.

TABLE 1-1

Summary of Projects Completed

Project Number	Year Planned	Project Description	Project Status
S-1	2005	Pilot Study for Increased Filter-Loading Rate at WTP	Not Completed
S-2	2005-2006	Drill and Equip 1 New Well	Trail Well 1 was drilled in 2005 and equipped in 2015.
S-3	2006-2007	Drill and Equip 1 New Well	Trail Well 2 was drilled in 2013 and equipped in 2015.
S-4	2010-2011	Drill and Equip 1 New Well	Not Completed
S-5	2012	Drill and Equip 1 New Well	Not Completed
S-6	2012	Surface Water Treatment for GWI Wells	No GWI wells were developed, so no GWI treatment is required.
S-7	2007	Tacoma Emergency Intertie	Completed in 2014.
T-1	2015	1,000 LF of 12-inch Restrained Water Main; Headworks	Partially Completed
T-2	2013	200 LF of 12-inch Restrained Water Main; Cliff Section 1	Not Completed
T-3	2016	200 LF of 12-inch Restrained Water Main; Suspension Bridge	Not Completed
T-4	2017	50 LF of 12-inch Restrained Water Main; Streambed Crossing	200 LF of 12-inch on cable suspension bridge across South Prairie Creek.
T-5	2021	50 LF of 12-inch Restrained Water Main; Cliff Section 2	Not Completed
T-6	2010	1,000 LF of 12-inch Restrained Water Main; Gravel Service Road	Completed
T-7	annually	Annual Leak Detection and Pipeline Replacement Program	Completed every two years.
Tr-1	2005	Water Treatment Plant Raw Water Control Valve	Completed
Tr-2	2005	Water Treatment Plant Raw Water Level Transducer	Completed
Tr-3	2006	Upgrade System Telemetry	Not Completed

TABLE 1-1 – (continued)

Summary of Projects Completed

Project Number	Year Planned	Project Description	Project Status
St-1	2005	Re-Roof 2.3 MG Reservoir	Completed in 2005
St-2	2005	Fence 2.3 MG Reservoir Site	Completed
St-3	2009	New 1.0 MG Reservoir	Not Completed
St-4	2005	0.75 MG Reservoir Abandonment	Completed
D-1	2006	100 LF of 8-inch Water Main; Elk Ridge Elementary to Heather	Partially Completed.
D-2	2006	50 LF of 10-inch Water Main; Ryan Road to Collins	Completed.
D-3a	2007	650 LF of 12-inch Water Main; Ryan Road in front of Elk Heights Plat	Completed.
D-3b	2008	2,600 LF of 12-inch Water Main; Ryan Road from SR 410 to Spiketon Road	Completed.
D-3c	2006	2,000 LF of 12-inch Water Main; Ryan Road from Spiketon Road to Elk Heights Plat	Partially Completed
D-4	2008	500 LF of 8-inch Water Main; Jefferson Street from 3rd to Pearl	Not Completed
D-5	2011	1,100 LF of 8-inch Water Main; Sections along Wheeler Road	Not Completed
D-6	2014	950 LF of 8-inch Water Main; Mason Avenue from A to D	Not Completed
D-7	2016	500 LF of 8-inch Water Main; Balm Street from 4th to Ewing	Not Completed
D-8	2018	2,000 LF of 8-inch Water Main; Mason Ave from Spruce to McNeeley	Not Completed
D-9	2019	2,850 LF of 8-inch Water Main; Sheets Street south of Ryan	Not Completed
D-10	2020	120 LF of 8-inch Water Main; A Street south of River Road	Not Completed
D-11	2020	800 LF of 8-inch Water Main; Klink Road south of Ryan	Not Completed
D-12	2020	450 LF of 8-inch Water Main; River Road north of Derringer	Not Completed
D-13	2021	600 LF of 8-inch Water Main; Franklin to Belvo	Completed
D-14	2022	2,200 LF of 8-inch Water Main; Derringer from Sorensen to McNeely	Not Completed
D-15	2024	1,100 LF of 8-inch Water Main; Extend SR 410 west to Mundy Loss	Not Completed
D-16	2023	2,800 LF of 8-inch Water Main; SR 410 from Hinkleman Extension to Mundy Loss Road	Not Completed

TABLE 1-1 – (continued)

Summary of Projects Completed

Project Number	Year Planned	Project Description	Project Status
D-17	2024	700 LF of 8-inch Water Main; Hinkleman Extension Road from SR 410 to 112th Street	Not Completed
D-18	2005	800 LF of 8-inch Water Main; Main Street from River Rd to A Street	Completed as 12-inch main
D-19	2005	600 LF of 8-inch Water Main; Rainier Street from Main to Mason	Not Completed
D-20	Not scheduled	4,200 LF of 12-inch Water Main; Hinkleman Road from Hinkleman Ext. to Mundy Loss	Not Completed
D-21	Not scheduled	400 LF of 12-inch Water Main; Butler Road to Hinkleman Road	Not Completed

OTHER PROJECTS

Other projects that were completed since the 2005 water system plan include compliance with Stage 2 Disinfection/Disinfectant Byproducts Rule (S2DBPR) and compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

NEARBY AND ADJACENT WATER PURVEYORS

Records of neighboring water systems were researched on the Washington State Department of Health Source Water Assessment Program (SWAP) web site (https://fortress.wa.gov/doh/eh/dw/swap/maps/). A total of 43 neighboring water system were identified within approximately 1 mile of the City of Buckley water service area. The major adjacent water purveyors include the City of Tacoma, Marion Water Company, Rainier School, and the City of Enumclaw. There are also four other smaller group A water systems, and 35 group B water systems[1] within approximately 1 mile of the Buckley City limits. These water systems are listed in Table 1-2. As can be seen, most of these water system have fewer than 10 water service connections.

[1] A group A water system is a water system that serves 15 or more full time residential service connections, or serves 25 or more people 180 or more days per year. A Group B water system is a water system that serves between one and fifteen full time residential service connections, or fewer than 25 people, for 180 or more days per year.

TABLE 1-2

Adjacent and Nearby Water Systems

No.	Water System Name	ID No.	Group	Connec-tions	Location
1	Tacoma, City of	86800N	A	138,199	Multiple
2	Enumclaw, City of	236001	A	8,109	Multiple
3	Rainier School	70850J	A	287	19N 06E Sect 02
4	Marion Water Co. Inc.	51750D	A	254	Multiple
5	Ryanwood Improvement Assn.	75070B	A	37	19N 06E Sect 16
6	Burnett Water District	09600B	A	32	19N 06E Sect 16
7	Mountain View Trailer Park	56875Y	A	19	19N 06E Sect 17
8	Uncle John's Water System	03620F	A TNC	1	19N 06E Sect 05
9	Mixed Up FLP Water System	504016	B	9	19N 06E Sect 15
10	Long Tom Water System	231769	B	8	20N 06E Sect 32
11	Rivers of Living Water	538347	B	8	20N 06E Sect 32
12	Cohrs Water System	39906X	B	7	20N 06E Sect 32
13	Merrifield Water System	37727K	B	7	20N 06E Sect 32
14	Burnett Landing I Water System	AB595E	B	6	19N 06E Sect 16
15	Fairway Water System	28564U	B	6	20N 06E Sect 32
16	Genisis Garden Water System	022091	B	6	19N 06E Sect 16
17	Lone Pine #3 Water System	05493P	B	6	19N 06E Sect 17
18	Meadows-End Water System	33626N	B	6	20N 06E Sect 32
19	Red Tail Point Water System	61314Y	B	6	19N 06E Sect 17
20	Barker – Van Every	092187	B	5	20N 06E Sect 32
21	Lone Pine #2 Water System	05138B	B	5	19N 06E Sect 17
22	Lone Pine #4 Water System	05497R	B	5	19N 06E Sect 17
23	Lot #25 Water System	45190W	B	5	20N 06E Sect 32
24	Mundy Water System	43028Y	B	5	19N 06E Sect 08
25	Spiketon Springs # 2 Water System	AA591P	B	5	19N 06E Sect 15
26	Buckley Community Well	30641D	B	4	19N 06E Sect 16
27	Cavanaugh Water System 2	00717R	B	4	19N 06E Sect 08
28	Darren Breault PWS	178011	B	4	19N 06E Sect 08
29	Gayle Creek Water System	050577	B	4	19N 06E Sect 17
30	Hancock PWS	00135F	B	4	19N 06E Sect 08
31	Hodge Miller	64846L	B	4	20N 06E Sect 32
32	Meadow Water System #67	339621	B	4	20N 06E Sect 32
33	Smith, Duane Water System	31278B	B	4	20N 06E Sect 32
34	Spiketon Springs #1 Water System	AA590H	B	4	19N 06E Sect 15
35	Young Community Supply	48514L	B	4	20N 06E Sect 32
36	Beeman Water System	02597P	B	3	20N 06E Sect 32
37	Eagle Crest Water System	03794F	B	3	19N 06E Sect 17
38	Lone Pine #1 Water System	06512A	B	3	19N 06E Sect 17
39	Burnett Landing II Water System	AB596K	B	2	19N 06E Sect 16
40	Hutton Nearhood WS	AA586C	B	2	19N 06E Sect 08
41	Strain Water System	04892M	B	2	19N 06E Sect 10
42	Stumpff Water System	AA054P	B	2	19N 06E Sect 08
43	Burnett Landing III Water System	AB597N	B	1	19N 06E Sect 16

Copies of Water Facilities Inventory forms for City of Tacoma, Marion Water Company, City of Enumclaw and Rainier School are included in Appendix C. A discussion of each of the larger of the above water systems and a general discussion of the smaller water systems follows.

TACOMA PUBLIC UTILITIES

Tacoma Public Utilities abuts the City of Buckley service area on the west, and supplies customers within the service area of the Green River pipeline number 1. The pipeline originates at the Howard Hanson Dam and extends to the McMillan Reservoir. The pipeline has two emergency interties with the City of Buckley water system, however Tacoma does not directly serve any City of Buckley residents. The intertie is discussed further in a following section.

MARION WATER COMPANY

The Marion Water Company is located west of the City of Buckley and provides service to about 250 connections, including water service to approximately 10 households and three businesses within Buckley City limits. The Marion Water Company wells are located west of the City. The City and the water company have an intertie at the intersection of Hinkleman Road and Hinkleman Extension. The intertie is discussed further in a following section.

THE CITY OF ENUMCLAW

The City of Enumclaw (in King County) provides water service on the north side of the White River. The nearest point of approach to the Buckley water system is about one mile to the north. There is no intertie between Enumclaw and Buckley, and it is unlikely that one will be developed in the foreseeable future. The presence of the White River and the county line, between the two communities serve as formidable blocks to creating and intertie, and the presence of the City of Tacoma pipeline in the vicinity make that a much more attractive intertie option. However, in the event that either Buckley or Enumclaw should need labor assistance in an emergency situation, water system operation staff from either system could be available to assist the other.

RAINIER SCHOOL

The DOH water system data tracking system lists Rainier School water system as active with two water sources, South Prairie Creek and Well 5, and does not list an intertie with the City of Buckley. The DOH tracking system indicates that the Rainier School water system is continuing to take distribution system coliform and disinfection byproducts samples. However, in practice, the City of Buckley runs Wells 1, 2, 4, and 5, and the South Prairie Creek water supply diversion and transmission line, while Rainier School runs the South Prairie Creek Slow Sand Water Treatment Plant. Division of responsibilities for the jointly owned facilities is detailed in a Joint Water Committee

Operating Agreement, DSHS Contract No. 1311-99516(1) dated April 15, 1997 (copy in Appendix B).

SMALLER SYSTEMS

Detailed reviews of the smaller neighboring water systems are beyond the scope of this plan. Typically, these small water systems each consist of a well, a pressure tank, and water distribution system with 4 inches in diameter or smaller water mains, and they rarely provide fire flow capability. It is not expected that any of these smaller systems could provide emergency supply or assistance to the City of Buckley. However, it should be noted that when small water systems fail, either due to failure of facilities or failure of management, the local and state health departments often look to nearby larger utilities to provide service or assistance. Therefore, it is possible that the City of Buckley could be asked to step in and assist with one or more of these small neighboring water systems during the planning horizon.

INTERTIES

The City of Buckley has interties with three other water purveyors, namely the Department of Social and Health Services (DSHS) Rainier School, Marion Water Company, and Tacoma Public Utilities.

RAINIER SCHOOL INTERTIE

The City of Buckley provides all water supply for the DSHS Rainier School water system at three locations along Levesque Road. Rainier School also has partial ownership of, and partial operations responsibility for, the South Prairie Creek water source (S-01) and slow sand filtration plant, as well as some of the Water Rights utilized by the City of Buckley. Division of responsibilities for the jointly owned facilities is detailed in a Joint Water Committee Operating Agreement, DSHS Contract No. 1311-99516(1) dated April 15, 1997 (copy in Appendix B).

MARION WATER COMPANY INTERTIE

The Marion Water Company intertie is a 6-inch main with a 4-inch meter and gate valve, which is normally opened, located at the intersection of Hinkleman Road and Hinkleman Extension. The intertie with the Marion Water Company is for the purpose of augmenting supply to Marion Water Company as needed to maintain pressure in the east end of the Marion Water Company distribution system. Marion Water Company can purchase water from the City of Buckley water system subordinate to City water demand. The City of Buckley does not obtain water from Marion Water Company.

TACOMA PUBLIC UTILITIES INTERTIES

One Tacoma Public Utilities intertie is available to supply the City of Buckley with water in the event of an emergency. The hydraulic gradient is such that the City of Buckley cannot use the water from the Tacoma system without a booster station. Therefore, the City of Buckley has constructed an emergency intertie booster pump station to allow for emergency supply to Buckley from the City of Tacoma water system. The booster pump station is between SR 410 and River Avenue to the north of the Post Office. Another Tacoma Public Utilities intertie is located at the intersection of Mundy-Loss Road and 112th Street. The interties has been used to provide water for Buckley.

GEOGRAPHY

The City of Buckley is located in Pierce County, Washington. Pierce County is bordered to the east by the Cascade Mountains and to the west by Puget Sound. The White River defines the northern edge of Pierce County and the City of Buckley City limits. Figures 1-1 and 1-2 show Buckley and neighboring communities. The area to the east of Buckley is primarily commercial, state and federal forest land. To the west are the Cities of Bonney Lake, Sumner, Puyallup, and Tacoma. To the south are the small towns of Wilkeson and Carbonado. To the north is King County and the City of Enumclaw.

The Buckley water system is located in North Central Pierce County within Sections 2, 3, 4, 10, and 11 of Township 19 North, Range 6 East. The City lies on a relatively flat plateau between Puget Sound and the Cascade Mountains, with drainage generally sloping from south and east to the north and west. The City is at an elevation range of 700 to 950 ft.

The White River, located on the northern border of City limits, is a major tributary to the Puyallup River. The Puget Sound Energy flume diverts water from the White River and releases water into Lake Tapps, west of the City. Streams located just outside City limits include South Prairie Creek and its tributaries, Page Creek, Gail Creek, and Spiketon Creek. Spiketon Creek flows within City limits for a short distance in the northeastern corner of the City.

The Washington State Department of Ecology (Ecology) well logs web site (http://apps.ecy.wa.gov/welllog/textsearch.asp) identifies 50 water well records as being located within Sections 2, 3, 4, 10, and 11 of Township 19 North, Range 6 East. These are further divided by section as follows:

Section (T19N, R6E)	Number of Wells
2	0
3	0
4	3
10	32
11	15
Total	**50**

It is possible that some of these records may be duplicates, and some may be dry, abandoned, or decommissioned wells. Also, some of these wells may be outside City limits. It is also possible that there are wells in the area that are not on the Ecology data base. Printouts of the well record listings are included in Appendix D.

INVENTORY OF EXISTING SYSTEM

A description of the facilities currently owned and operated by the City of Buckley is provided in the following sections. Figure 1-3 is a schematic representation of the City's existing facilities. Physical locations of facilities are shown on Figure 1-4.

SOURCES OF SUPPLY

The City water supply sources are summarized as follows:

South Prairie Creek

South Prairie Creek is a surface water supply that can provide an intake flow of up to 1,000 gpm through the transmission main to the Buckley water system. The use of this supply is limited to 725 gpm by the treatment capacity of the WTP.

Well 1 (Naches Street Well)

This well has a 10-inch diameter casing and is finished to a depth of 130 feet below ground surface (bgs). The capacity of this well is 260 gpm. The water from this well is metered, chlorinated on site with gas chlorine, and pumped directly into the water distribution system.

Well 2

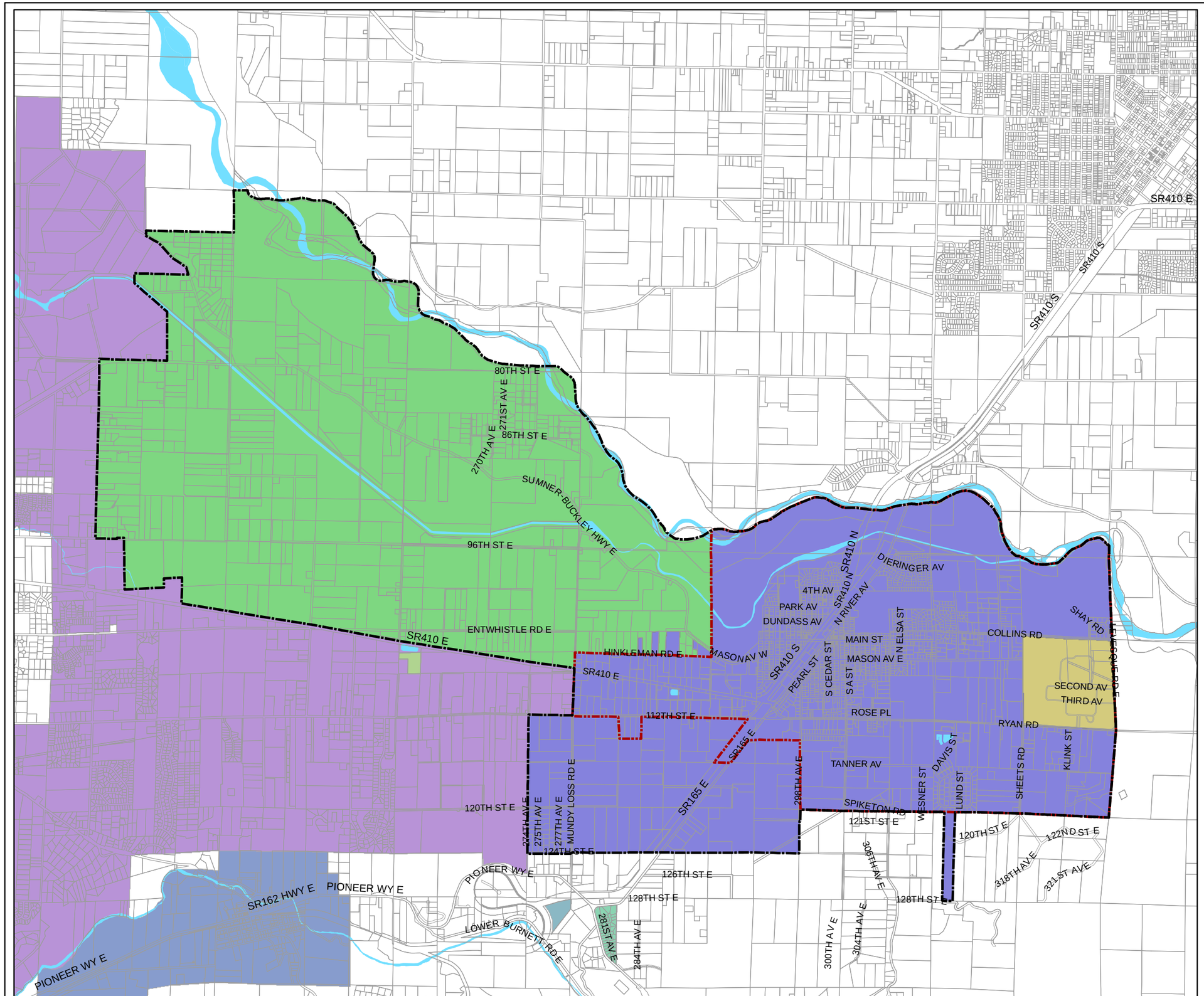
Well 2 has an 8-inch diameter casing and is finished to a depth of 170 feet bgs. The capacity of this well is 130 gpm. Water from this well can be pumped either to the slow sand filter system or directly the reservoir via a 6-inch A-C water transmission main. The water from this well is metered, and gas chlorination is available at the well site.

Well 3

Well 3 is currently used as an observation well. There are no plans to use this well as a water supply source for the City.

Well 4

Well 4, drilled in 1990, has a 16-inch diameter casing from 0 to 37 feet depth, and a 12-inch diameter casing from 2 feet above ground to 35.8 feet below ground. Well 4 is



Legend

WATER SERVICE AREA:

- Retail Service Area
- Service Area

NEIGHBORING UTILITIES:

- Marion Water Co. (Wholesale Service Area)
- Mt View Trailier Park
- Rainier School
- Ryanwood Improvement Assoc
- South Prairie
- Tacoma Water Division
- Uncle John's Water System
- City Limits & UGA

CITY OF BUCKLEY

WATER SYSTEM PLAN
FIGURE 1-2
RETAIL WATER SERVICE AREA
AND NEIGHBORING UTILITIES

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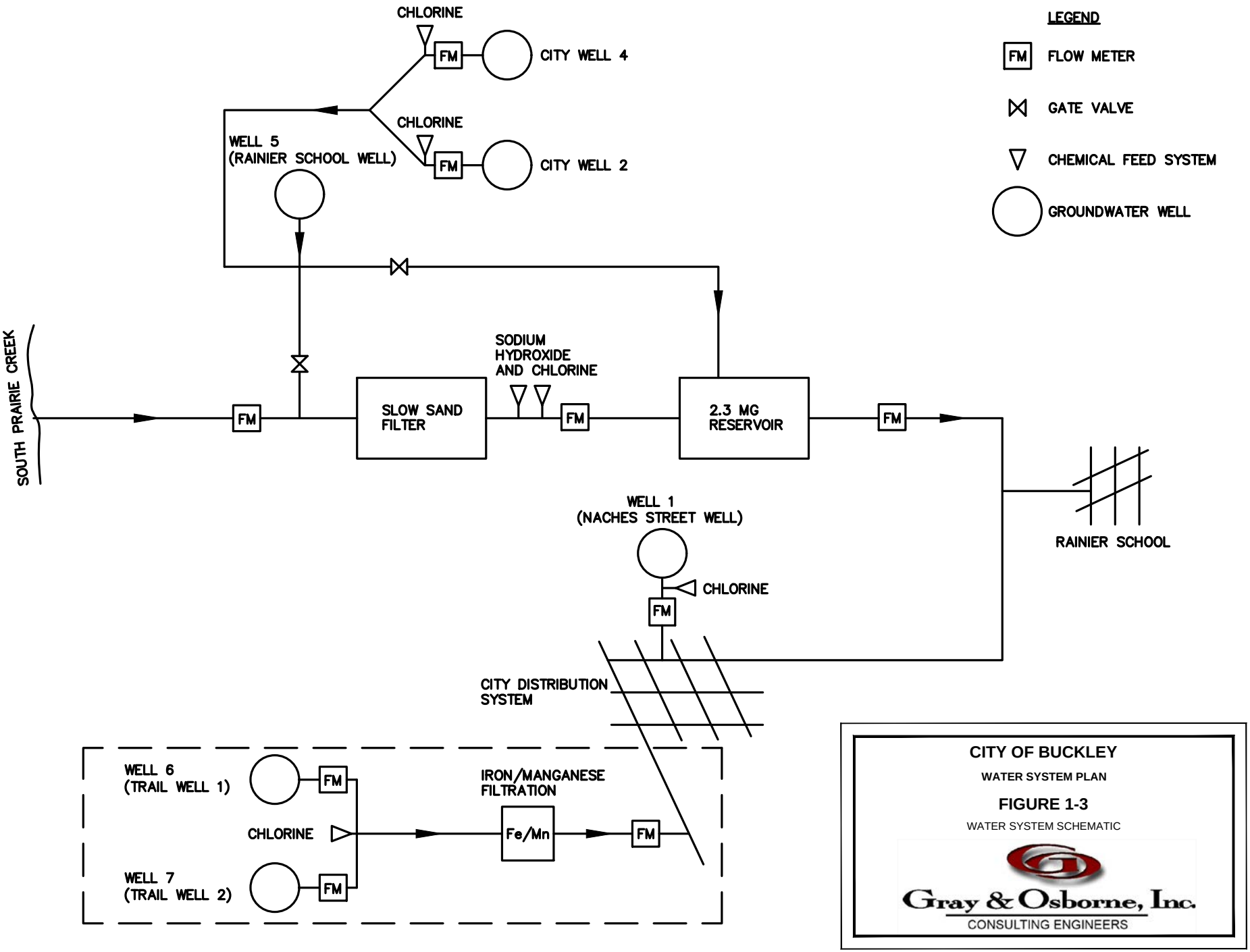

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-3

WATER SYSTEM SCHEMATIC

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CONSULTING ENGINEERS

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LEGEND

- BUCKLEY CITY LIMITS
- EXISTING CITY OF BUCKLEY WSA
- 4" WATER LINE
- 6" WATER LINE
- 8" WATER LINE
- 10" WATER LINE
- 12" WATER LINE
- 58" TACOMA WATER LINE
- INTERTIE AND BOOSTER PUMP STATION
- EXISTING WELL

0 600' 1200'
SCALE: 1"=600'

CITY LIMITS

TACOMA EMERGENCY INTERTIE BOOSTER STATION

NACHES STREET WELL NO. 1

TRAIL WELLS

ELK HEIGHTS BOOSTER STATION

WELLS NO. 2 AND 4

RAINIER SCHOOL WELL (WELL NO. 5)

WATER TREATMENT PLANT AND STORAGE RESERVOIR

WHITE RIVER MIDDLE SCHOOL

RAINIER SCHOOL

STATE ROUTE 410

STATE ROUTE 165

RIVER RD

MAIN ST

MASON AVE

HINKLEMAN RD

HINKLEMAN EXT

WHEELER ST

JEFFERSON AVE

COULS AVE

MOUNTAIN VIEW AVE

RYAN RD

112TH ST

WHITE RIVER PARK RD

COLLINS RD

SPIKETON RD

DAVIS ST

HATCH ST

DIVISION ST

MUNDY LOOP RD

MC NEELY ST

SHAY RD

LEVESQUE RD

KLINK RD

SHEETS ST

WESNER ST

REIGHERT LN

EVANS CT

QUINAULT CT

HARMON ST

SECOND AVE

THIRD AVE

FOURTH AVE

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-4

WATER SYSTEM MAP

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CONSULTING ENGINEERS

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screened with a 12-inch pipe-size, 100 slot, wire-wound stainless steel screen between the intervals of 35.8 feet to 56.3 feet depth, and 61.2 feet to 66.4 feet depth, and is gravel packed with pea gravel to a finished depth of 70 feet bgs. The well log reports a tested capacity of 540 gpm with 9.2 feet of drawdown after 72 hours. Well 4 has a current installed pumping capacity of 240 gpm. Water from this well can be pumped either to the slow sand filter system or directly to the reservoir via a 6-inch A-C water transmission main. The water from this well is metered, and gas chlorination is available at the well site.

Well 5 (Rainier School)

Well 5 is finished to a depth of 180 bgs. The current capacity of this well is approximately 215 gpm. Flow from this well is estimated from this well based on the flow rate and a run time meter. Water from this well can be pumped either to the slow sand filter system or directly to the reservoir via a 6-inch A-C water transmission main. Chlorine disinfection is not available at the Well 5 site.

Well 6 (Trail Well 1)

This well was drilled in 2005 as a test well to determine how much water could be available at the site located south of town along SR 165, near the Foothills Trail. The well was drilled to a depth of 197 feet, has a 6-inch casing to 135 feet and a 6-inch telescoping, 30-slot screen, installed from 135 feet to 155 feet. The well was pump tested in 2006 at 264 gpm with a drawdown of approximately 28 feet after 24 hours. The hydrogeology report prepared by Northwest Land & Water Services dated July 24, 2007, estimates that the site could yield 350 to 400 gpm from one or two wells at the site. Water quality testing indicated that this well has an elevated level of manganese, and requires treatment in order to be used by the City as a public water supply well.

The Trail Wells Treatment Facility project was completed in 2015. The treatment removes iron and manganese from the well water this well produces approximately 90 gpm. The reduced capacity of Trail Well 1 is due to the maximum size of pump that could be placed in the 6-inch casing.

Well 7 (Trail Well 2)

This well is located approximately 60 feet north of Well 6. It was drilled in 2013 in an attempt to develop the 350 to 400 gpm estimated by the 2007 Northwest Land & Water Services report referenced above. The well was drilled to a depth of 163 feet, has a 12-inch casing extending to 125.5, feet and a 12-inch telescoping 100-slot screen extending from 125.5 to 140.5 feet. The well was pump tested at 205 gpm with 50.7 feet of drawdown after 48 hours. The geologic material at this location appears to be somewhat less transmissive than the material at the Well No. 6 site approximately 60 feet to the south, resulting in a somewhat lower yield than predicted by the 2007 Northwest Land & Water Services report. Water quality testing indicates that this well also has an

elevated level of manganese, and requires treatment in order to be used by the City as a public water supply well.

The Trail Wells Treatment Facility project was completed in 2015. The treatment removes iron and manganese from the well water this well produces approximately 205 gpm.

Currently, the primary source of supply for the City is from South Prairie Creek. During the period between January 1, 2008 and December 31, 2014, South Prairie Creek provided approximately 64 percent of the system's water production. The remaining 36 percent of the water was produced by City and Rainier School wells.

A summary of the production capabilities of these sources is provided in Table 1-3. Well 3 is currently inactive. Additional analysis of Buckley's sources may be found in Chapter 3 of this Plan.

TABLE 1-3

City of Buckley and Rainier School Existing Water Sources

Source Name	DOH ID No.	Applicable Water Rights	Production Capacity, gpm	Source Status	Well Depth, ft
South Prairie Creek	01	S2-*01713 CWRIS S2-*05389 CWRIS	725 (1)	Active	N/A
Well 1 (Naches)	02	G2-01024P	260	Active	130
Well 2	03	G2-27595 G2-28335 CG2-302266 CL	130	Active	170
Well 3	None	None	Inactive	Inactive	60
Well 4	04	G2-27595 G2-28335 CG2-302266 CL	240	Active	70
Well 5 (Rainier School)	05	G2-27595 G2-28335 CG2-302266 CL	215	Active	180
Well 6 (Trail Well 1)	None	G2-01024P	90	Active	155
Well 7 (Trail Well 2)	None	G2-01024P	205	Active	143
Total Source Capacity			1,865		

(1) Based on a design capacity of 0.085 gpm/sf for the WTP.

WATER RIGHTS

The water rights information for this section was obtained from files maintained at Ecology. Copies of water rights are located in Appendix E. Water rights permits and certificate have been issued by Ecology under either the Surface Water Code of 1917 or the Ground Water Code of 1945. Upon approval of an application, Ecology issues a Water Right Permit, which allows the applicant to begin appropriating the water for beneficial use. The Applicant must file a proof of appropriation to establish beneficial use of the source before Ecology grants a "Certificate of Water Right." Ecology makes water right approvals only when an applicant has met four key criteria:

- The water will be put to beneficial use,
- No impairment to existing rights, or senior rights, will occur,
- Water is available for appropriation, and,
- Issuance of the requested water right will not be detrimental to the public welfare.

A summary of City of Buckley water rights is provided in Table 1-4. Included in this summary is the water right ID number, the name of the current sources, (points of diversion), the permitted instantaneous withdrawal or diversion rate (Q_i), the permitted annual withdrawal rate (Q_a), and the water right priority date. The instantaneous right represents the maximum pumping capacity allowed for all sources under the right.[2] The annual right represents the total volume of water that may be withdrawn or diverted during an entire year. The priority date provides a means of ranking those water rights that are junior or senior based on their date of application to DOE. The right with the earliest date would have the highest priority for withdrawal. The City of Buckley and Rainier School have combined water rights issued by Ecology for a total instantaneous right of 8.08 cfs (3,599 gpm). The total annual water right for the City and Rainier School is 2,146.72 acre-feet per year.

[2] Q_i is given as cubic feet per second (cfs) and as gallons per minute (gpm). This is done because surface water diversion rates are generally expressed as cfs, while groundwater withdrawal rates are generally expressed as gpm. Since Buckley has both surface water and groundwater rights that need to be added together for analysis purposes, Q_i is expressed as both cfs and gpm for clarity. One cfs is approximately equal to 448.8 gpm.

TABLE 1-4

City of Buckley Water Rights Summary

Water Right Number	Points of Withdrawal	Purpose	Instantaneous Limit, Q_i		Annual Limit, Q_a,	Priority Date
			cfs	gpm	ac-ft/yr	
S2-*01713 CWRIS	South Prairie Creek (Buckley)	Municipal	2.0	898	896	1926
CG2-01024	Well 1 (Naches Well) Well 6 (Trail Well 1) Well 7 (Trail Well 2)	Municipal	1.0	450	180	1964
G2-27595	Well 2 Well 4 Well 5 (Rainier School)	Municipal	0.62	280	36	1989
G2-28335	Well 2 Well 4 Well 5 (Rainier School)	Municipal	0.33	150	242	1991
S2-*05389 CWRIS	South Prairie Creek (Rainier School)	Domestic	0.5 (1)	224 (1)	362(2)	1941
		Irrigation	3.0 (1)	1,347 (1)	400(3)	1941
CG2-302266 CL	Well 2 Well 4 Well 5 (Rainier School)	Municipal	0.56	250	30.72	1939
Total			**8.02**	**3,599**	**2,146.72**	

(1) Ecology interprets Surface Water Rights S2-*05389 CWRIS as 0.5 cfs (224 gpm) for domestic use and 3.0 cfs (1,347 gpm) for irrigation use.
(2) Based on year-round production at the instantaneous water right rate of flow.
(3) There is no annual limit is on the Certificate S2-*05389 CWRIS. Ecology interpretation of the water right is 400 ac-ft/yr for irrigation.

The identified water rights have included rights separately identified for municipal water supply and irrigation uses. Table 1-5 provides a breakdown of the water rights as issued for these uses.

TABLE 1-5

Water Rights by Use

Designated Use	Instantaneous Limit, Q_i,		Annual Limit, Q_a,
	cfs	gpm	ac-ft/yr
Municipal/Domestic	5.02	2,252	1,746.72(1)
Irrigation	3.00	1,347	400(2)

(1) The sum of Buckley's water rights for South Prairie Creek and their wells plus the domestic portion of the surface water right for Rainier School.
(2) No limit is indicated on the Certificate. 400 ac-ft/yr is Ecology's interpretation of the water right.

A comparison of water rights to historic and projected water usage, and installed pumping capacities is provided in Chapter 3.

TREATMENT

A schematic of the water treatment system at the Slow Sand Filter Water Treatment Plant is provided in Figure 1-5. Water from South Prairie Creek is introduced into the equalization basin located in the chlorination building. The raw water is then distributed across the sand filter and treated by slow sand filtration. The filter has an available surface area of 8,500 square feet. The WTP is operated at a filter-loading rate of 0.085 gpm/sq ft, providing an available treatment capacity of 725 gpm. The water is chlorinated with gas chlorine after filtration and before entering the on-site storage reservoir. Chlorine contact time is provided in the reservoir.

Water produced from Wells 2, 4, and 5 can be directed through the slow sand filter, or they can be pumped directly into the reservoir. Gas chlorination is available at Wells 2 and 4, but is used only when the wells are discharged directly to the reservoir. When water is discharged from the wells directly to the reservoir, the chlorination rates at Wells 2 and 4 is adjusted to provide the target chlorine residual in the combined flow from Wells 2, 4 and 5. When the wells are discharged to the slow sand filter, the water is chlorinated as it leaves the filter system.

The Naches Street Well (Well 1) has its own gas chlorination system, and water from this well is pumped directly into the distribution system. No chlorine contact time is required for this well.

Water from Trail Wells 1 and 2 is treated with pyrolusite filter media to remove dissolved iron and manganese. The Trail Wells Treatment Facility includes five, 3-foot diameter vessels and has a design flowrate of 300 gpm and a design filter loading rate of 8.5 gpm/sq. ft. The raw well water is chlorinated with glass chlorine and sodium permanganate upstream of the filters. The treated water enters the distribution system near the intersection of Ryan Road and SR 165.

STORAGE

The system includes one in-ground storage reservoir, located adjacent to the slow sand filtration plant. This reservoir has a nominal capacity of 2.3 million gallons (MG). An older reservoir located approximately 1/4 mile south of the City's potable water reservoir is also potentially available for use in an emergency situation, but is currently disconnected from the system.

The emergency reservoir has a reported capacity of 750,000 gallons, but is not connected to the distribution system. The reservoir is available for use as emergency raw water

storage. Table 1-6 provides details of size, location, elevation, and dimensions of the reservoirs.

TABLE 1-6

City of Buckley Storage Facilities

Name	Nominal Capacity, MG	Location	Overflow Elevation, feet above MSL	Material
Main Reservoir	2.3	Near the intersection of Levesque and Ryan Roads in the SE corner of the City	882	Reinforced Concrete with a metal roof
Emergency Reservoir	0.75	Approximately 1/4 mile south of Main Reservoir	869	Reinforced Concrete with a metal roof

WATER TRANSMISSION

The transmission main conveying water from South Prairie Creek to the slow sand filtration plant is 28,400 feet (5.38 miles) long. Segments of the pipe are not accessible by road. A 1996 inspection of the line indicated that a section of the line in the creek has scouring damage. The City has repaired several sections of the pipeline in the last 10 years. The line has a capacity of between 900 and 1,000 gallons per minute. The pipe is constructed of the materials shown in Table 1-7.

TABLE 1-7

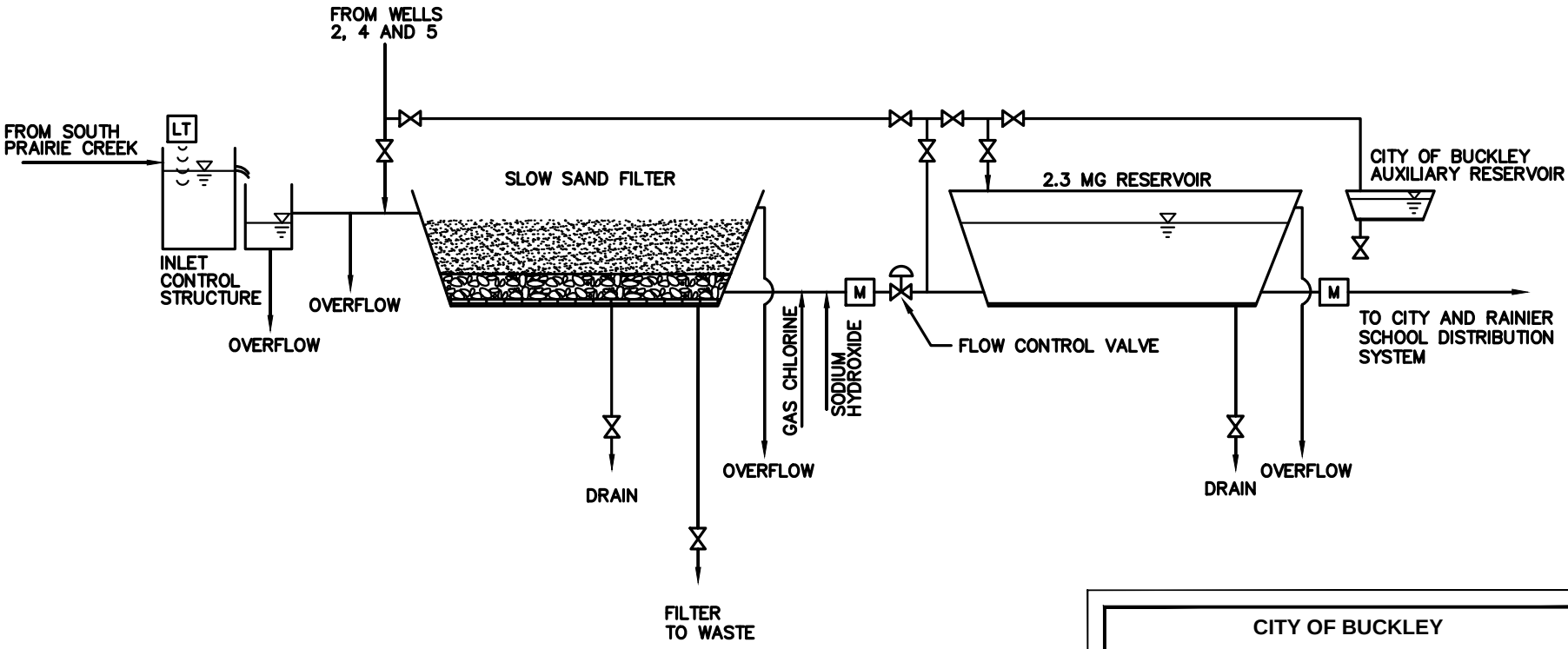
South Prairie Creek Transmission Line

Segment Diameter, inches	Segment Material	Segment Length, feet
10	Asbestos Cement	4,315
10	Spiral Welded Steel	18,275
12	HDPE	5,810
Total		**28,400**

Figure 1-6 shows the transmission line route from South Prairie Creek to the filtration plant.

WATER DISTRIBUTION SYSTEM

A scale map of the distribution system is depicted in Figure 1-4.



CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-5

WATER TREATMENT PLANT SCHEMATIC

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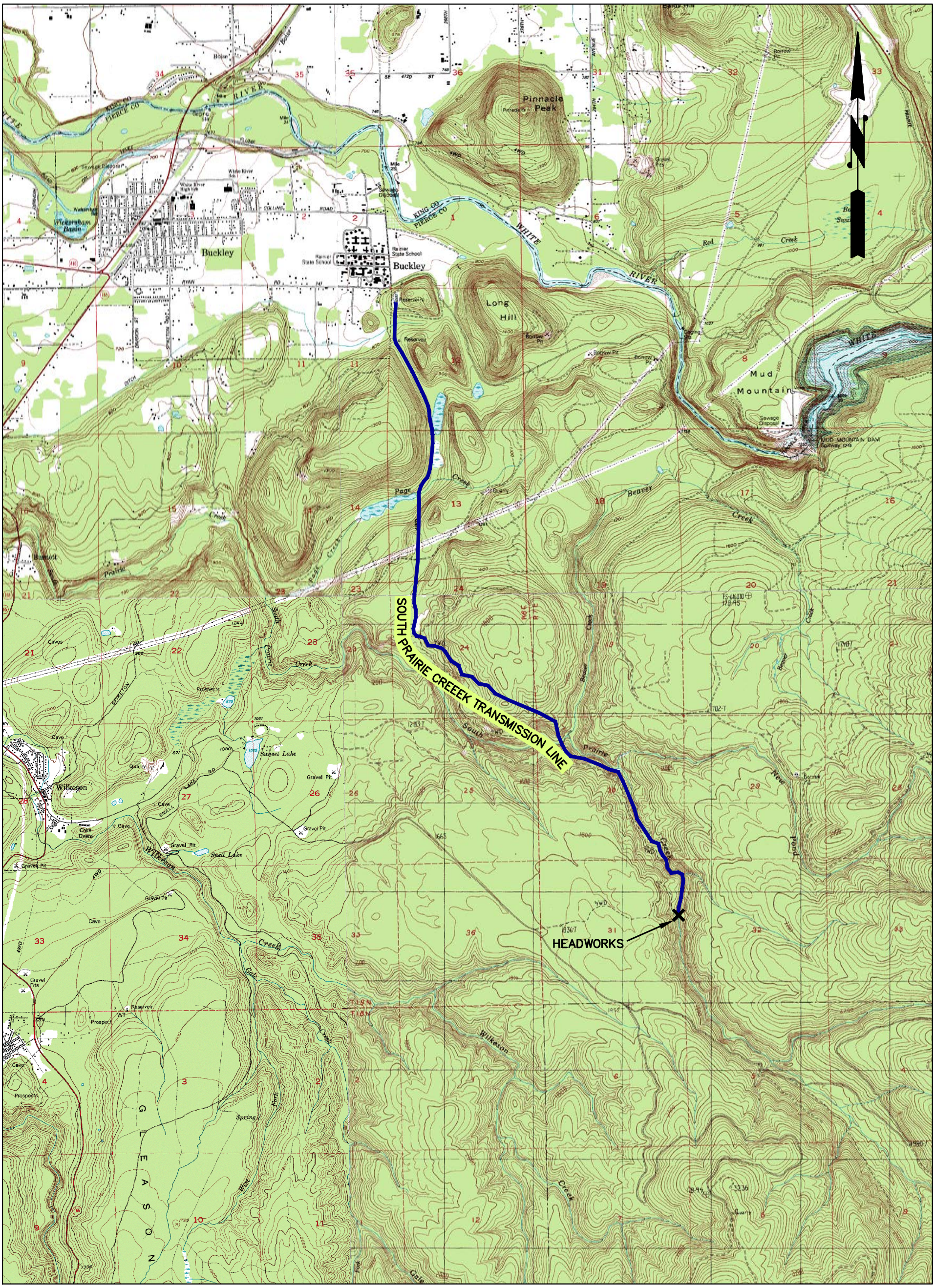

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-6

RAW WATER TRANSMISSION MAIN ALIGNMENT

Gray & Osborne, Inc.

CONSULTING ENGINEERS

Pipe Inventory

The City's distribution system consists of an estimated 32 miles of pipes ranging in size from 4 to 12 inches in diameter. Pipe materials include ductile iron pipe, asbestos cement pipe, and cast iron pipe. Table 1-8 summarizes the estimated lengths of various diameter pipes in the Buckley water distribution system.

TABLE 1-8

City of Buckley Water Distribution Pipe Length by Size

Pipe Size	4-inch	6-Inch	8-Inch	10-Inch	12-Inch	Total
Length, feet	33,645	36,910	57,530	14,622	25,836	168,542
Length, miles	6.37	6.99	10.90	2.77	4.89	31.92
Percent of Total	20%	22%	34%	9%	15%	100%

It is estimated that approximately 29 percent is ductile iron, approximately 25 percent of existing distribution system is asbestos concrete pipe, approximately five percent is cast iron, and approximately 42 percent of the existing water mains are of unknown material.

RELATED PLANNING DOCUMENTS

The following documents were consulted in the preparation of the 2017 Water System Comprehensive Plan:

CITY OF BUCKLEY COMPREHENSIVE PLAN, CITY OF BUCKLEY PLANNING DEPARTMENT, 2015.

This comprehensive Plan was developed to establish policies that would guide decision making in the City of Buckley for the 20-year planning period. The Plan intends to preserve the character of both the urban and rural areas within the UGA, protect and enhance the natural environment, create balanced neighborhoods and vital business districts, and manage the expansion of urban growth over time. This document discusses planning issues such as land use, housing, transportation, utilities, capital facilities, historic preservation, and economic development. It provides a description of the community from a landscape character and cultural perspective. Urban growth and land use goals and policies are addressed by the Plan.

CITY OF BUCKLEY 2005 WATER SYSTEM COMPREHENSIVE PLAN, 2005.

The previous water system Plan was developed to meet Washington State Department of Health (DOH) requirements and ensure that the City water system would be able to meet planned growth needs for the designated 6-year planning period. The 2005 Plan provides important data for the purpose of comparison to this updated Plan.

CITY OF BUCKLEY COMPREHENSIVE SEWER PLAN, 2017.

The Sewer Plan has planning and growth related elements that overlap the water system Plan.

PIERCE COUNTY COORDINATED WATER SYSTEM PLAN, 2001.

The water system Plan for Pierce County includes forecasts and planning requirements for the City of Buckley water system. This Plan for the City of Buckley must be consistent with the requirements set forth in the Pierce County Plan.

SERVICE AREA CHARACTERISTICS

CITY LIMITS

Existing City limits encompass an area of approximately 2,593 acres, and encompasses the entire UGA as approved by Pierce County. Existing City limits, UGA and Water Service Area boundaries are shown in Figure 1-2.

EXISTING LAND USE AND ZONING

Table 1-9 summarizes the current land use classifications for the City of Buckley.

TABLE 1-9

City of Buckley Current Land Use

Type of Land Use	Acres (approximate)	Percent of Total Area
Industrial and General Commercial	161	6.2%
Commercial and Mixed Use	336	13.0%
Urban High Density	90	3.5%
Urban Low Density	2,004	77.3%
Total	2,593	100.0%

Figure 1-7 is a map showing the land use and Figure 1-8 is a map showing the existing zoning for the City of Buckley.

SERVICE AREA AGREEMENTS

Pierce County has enacted the Water Utility Coordination Act, which requires that water utilities sign water service area agreements with neighboring utilities and file those agreements with the County. City of Buckley has service area agreements with their two major neighboring utilities in Pierce County, Tacoma Public Utilities, and Marion Water Company.

N

0 1,500 3,000 Feet

Legend

- CITY LIMITS

COND_DEF

- Commercial/Service
- Education
- Group Quarters/Other
- Industrial
- Mobile Homes
- Multi-Family Residential
- Open Space/Recreation
- Public Facilities
- Quasi-Public Facilities
- Residential Outbuildings
- Resource Land
- Single-Family Residential
- Transportation, Communication, Utilities
- Unknown
- Vacant
- Water Bodies

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-7
LAND USE DESIGNATIONS

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CONSULTING ENGINEERS

N

0 1,500 3,000 Feet

Legend

CITY LIMITS

BUCKLEY ZONING DESIGNATION:*

- CENTRAL COMMERCIAL
- GENERAL COMMERCIAL
- HISTORIC COMMERCIAL
- HIGH DENSITY RESIDENTIAL
- LIGHT INDUSTRIAL
- NEIGHBORHOOD MIXED USE
- PARKS / RECREATIONAL
- R-20,000 RESIDENTIAL
- R-8,000 RESIDENTIAL
- R-6,000 RESIDENTIAL
- SENSITIVE AREA

COUNTY ZONING DESIGNATION:**

- AGRICULTURAL RESOURCE LAND
- DESIGNATED FOREST LAND
- PARKS & RECREATION
- RURAL 10
- RURAL 20

*SOURCE: *CITY OF BUCKLEY, **PIERCE COUNTY GIS*

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 1-8
ZONING DESIGNATIONS

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CONSULTING ENGINEERS

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GROWTH MANAGEMENT ACT CONSIDERATIONS

The Growth Management Act was enacted in 1990 with the intention of controlling uncoordinated growth within the State of Washington. Inappropriate growth may pose a threat to the quality of life and the environment. It was determined by the state that public interests are best served by a cooperative and coordinated comprehensive land use planning process between citizens, communities, local government, and the private sector. The City of Buckley adopted its current *Comprehensive Plan* in 2015. This water system plan is required to conform to the *Comprehensive Plan*.

RETAIL SERVICE AREA

The retail service area consists of the City limits, excluding Rainier School, since the City does not provide retail water sales within the boundaries of Rainier School, plus a block of land southwest of the City extending from 112th Street E on the north to 124th Street E on the south, and 274th Avenue on the west to 298th Avenue on the east, and a few properties on the north side of Hinkleman Road, areas that are not in City limits or the UGA but are, or are intended to be, served by City of Buckley. The City limits, UGA boundary and Retail Water Service Area are depicted in Figure 1-2. Note, the City limits and the UGA boundary are the same boundary.

SERVICE AREA

The City's water service area includes the City's Retail Service Area described above, plus the boundary of the Marion Water Company and the boundary of Rainier School, since the City of Buckley sells wholesale water to both the Marion Water Company and Rainier School. The City's Service Area is shown in Figure 1-2.

FUTURE LAND USE AND ZONING

The *Comprehensive Plan* sets forth future land use designations and estimates projected needs. Generally, changes to land use designations have been minor since adoption of the current planning document.

WATER SYSTEM POLICIES

GENERAL POLICIES

The City has established public utility policies as a portion of the *Comprehensive Plan*. The Water Utility Policies section recognizes the need to coordinate planning and provide for service demands created by new growth. In addition, these policies, summarized below, express a commitment to appropriate rate structures and environmental compatibility.

W-1. Provide reliable water service for domestic use, fire flow and emergencies.
W-2. Promote conservation and encourage development of conservation devices and programs.
W-3. Improve the quality of water supply to all customers.
W-4. Encourage private well users in the planning area to access the City's or other water purveyor systems, provided that a fair share of costs are paid by the benefiting parties.
W-5. Insure a cost-effective water supply that meets City needs.
W-6. Participate in and facilitate the development of a regional water supply system that effectively balances regional water resources and supply needs while protecting the City's interests.
W-7. Develop agreements with other water purveyors in the UGA to consult with the City before approving additional water hookups.

WATER SERVICE AREA POLICIES

1. Satellite Service: The Buckley Water System will directly serve its entire service area. Satellite Service Management is not necessary.

2. Wholesaling of Water: The Buckley Municipal Code authorizes the City Council to dispose of any water remaining after the needs of the inhabitants of the City have been supplied. Currently the City and Marion Water Company have a wholesale agreement that authorizes the sale of "surplus" water to Marion Water Company in the event of a power outage or other unforeseen emergency.

3. Unmetered Water Use: The Buckley Municipal Code specifies a charge for unmetered water use, such as the filling of water tankers. Arrangements for such sale are made in advance, with the Utilities Superintendent. The sale of unmetered water is to occur at one location, designated by the Utilities Superintendent, which is equipped with a backflow prevention device to prevent contamination of the Buckley Water System.

4. Wheeling Water: The City of Buckley and Rainier School may jointly agree to wheel water to another water system from the common, transmission line, or they may individually decide to wheel water to another water system through their own, individually owned, distribution systems, provided a Plan, prepared by an engineer licensed by the State of Washington is submitted to and approved by the Department of Health. The water to be wheeled through the system shall be of compatible quality to the Water produced by the Buckley Water System.

5. Annexation: Annexation is not required in order to obtain water service, provided the property to be served lies within the City's Water Service

Area and is immediately adjacent to the City limits. Water customers outside the City are required to pay a surcharge.

6. Direct Connection and Remote System Policy: New developments in the service area must directly connect to the existing water system, except as subject to the agreement with the Marion Water Company. Satellite or remote systems will not be allowed.

7. Design and Performance Standards Policy: New development is required to meet the City of Buckley Development Guidelines and Public Works Standards. The Water System Standards are included in the Development Guidelines.

8. Surcharge for Outside Customers: The Water Utility imposes a surcharge on customers outside its corporate boundaries, but whose properties adjoin City limits. This fee is charged to cover overhead and administration costs not included in the water rate.

9. Formation of Local Improvement Districts Outside Legal Boundaries: Subject to staff and financial limitations, the City will work with property owners to develop a financial strategy that will facilitate construction of water facilities. Because of the transaction costs associated with Local Improvement Districts, the City favors the use of Cost Recovery Contracts as a funding mechanism for line extension to serve new development. Cost Recovery Contracts are authorized under BMC Chapter 13.30.

10. Service Area: The Buckley Water System intends to provide water at urban levels of service only within the City limits and City Urban Growth Area, in the next 20 years. New development will be expected to pay for extensions. The City may finance extension facilities to the extent that there is a significant coincidental benefit to existing rate payers.

11. Late-Comer Agreements: BMC Chapter 13.30 establishes a framework for contracts between the City and Developer who expands the municipal water system. The agreements are intended to allow developers to charge later users of the systems who did not contribute to the capital costs. These agreements are also meant to more fairly spread the cost of expansion of the system.

12. Over sizing: The City of Buckley will pay the material cost difference to install larger facilities than may be needed to provide service to a development so that future developments in the portion of the service area may be served. The burden shall be on the Developer to show that any development can be served by a smaller line than that included in the Comprehensive Water System Plan.

13. Cross-Connection Control Program: Cross connections within the City of Buckley are unlawful. The Buckley City Council adopted Chapter 14.05 of the Buckley Municipal Code to eliminate cross-connections in the water system. The code adopts by reference the regulations and procedures set forth in the "Cross-Connection Control Manual," published by the Pacific Northwest Section of the American Waterworks Association (PNS/AWWA).

14. Hazardous Contamination Prevention: The Buckley Municipal Code requires backflow prevention devices at all locations where any substance is handled under pressure so as to permit entry into the public water system and at any location where materials of toxic or hazardous nature are handled such that if back-siphoning should occur, serious health hazards may result.

15. Extension: An extension of the system resulting from service requests is available provided the requesting parties fall within the service area boundaries, and own property inside the City limits or immediately adjacent to the City limits. The costs associated with the extension are the responsibility of the parties requesting the extension. The proposed extension must comply with the City's adopted Development Regulations and be deeded over to the City upon inspection and acceptance of the completed extension.

16. Meters Policy: Meters shall be required for all waterline connections. An individual service meter may be used to service more than one unit in a multi-family unit of 4 or more units per BMC 14.04.132.

17. General Facility Charges Policy Materials: A fee will be charged by the City to new customers which represents the contribution to the costs of the existing and future capital facilities of the water utility.

CONDITION OF SERVICE POLICIES

The specific requirements facilitating the implementation of the utility's service area policies include:

Purveyor Responsibilities

- The City will provide safe drinking water, of adequate quantity, for water customers at the least practical cost.
- The City will develop construction standards for water system construction and review proposals for system expansion to ensure conformance with City Standards.

- The City will periodically conduct a leak survey to minimize water waste.
- The Water System shall develop a financing Plan to pay for capital projects, including allocating a portion of current revenues for future projects and correctly assessing a general facilities charge against new development.
- The City will provide water service consistent with the Municipal Water Law Duty to Serve requirements, provided:

    1. The water system 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 water system has sufficient water rights to provide service.

    4. The water system can provide service in a timely and reasonable manner.

Customer Responsibilities

- The customers shall pay for the operation and maintenance of the Water System and for replacement of the meters serving their properties.
- Rainier School contributes labor to offset its proportionate share of the water charge.

WATER RATES

Pursuant to Buckley Municipal Code (BMC) 14.04.130, the City's water rates are set by resolution of the City Council. Current rates and fees, including water rates, were set by Resolution No. 17-04. Water rates are summarized in Table 1-10. This rate structure is an *Inclining Block Rate Structure*, because the rate per 100 cubic feet increases as the usage increases.

TABLE 1-10

City of Buckley Water Service Rates[1]

Monthly Fee for the First 200 CF (1,496 gallons), $ per month[2]			
Meter Size	**2015**	**2016**	**2017**
≤ 3/4-inch	19.81	20.50	21.84
1-inch	25.12	26.00	27.69
1-1/2-inch	36.10	37.36	39.79
2-inch	50.24	52.00	59.80
3-inch	74.60	77.21	88.79
4-inch	121.01	125.25	144.03
6-inch	233.43	241.60	277.84
8-inch	571.90	591.92	680.70
Winter Additional Fees for Usage Over 200 CF per Month, $ per 100 Cubic Feet[2][3]			
Single Family and Multi-Family Residential			
200 – 700 CF	1.96	2.03	2.03
701 – 1,500 CF	2.31	2.39	2.43
Over 1,500 CF	2.72	2.82	2.90
Commercial and Industrial			
>200 CF	2.03	2.10	2.13
Schools			
>200 CF	1.91	1.98	2.01
Summer Additional Fees for Usage Over 200 CF per Month, $ per 100 Cubic Feet[2][3]			
Single Family and Multi-Family Residential			
200 – 700 CF	1.96	2.03	2.03
701 – 1,500 CF	2.56	2.65	2.69
Over 1,500 CF	3.29	3.41	3.51
Commercial and Industrial			
>200 CF	2.03	2.10	2.13
Schools			
>200 CF	2.03	2.10	2.13

(1) City Resolution No. 17-04.
(2) Rates shown are for service inside City Limits. Rates for service outside City limits are calculated by using the same rates as above, then adding a 20 percent surcharge.
(3) Winter Rates apply from October 1 through May 31. Summer rates apply from June 1 through September 30.

The City's water system connections fees and general facilities charges are also set by Title 14 of the Buckley Municipal code. Connection fees and general facilities charges are as follows:

Connection Fees (Resolution #17-04):

Waterline Connection	$800.00/connection*

*or the actual cost of labor and material expended to make the connection, whichever is greater

Inspection Fee	Cost
Water Meter, Setter, Vault fee	Cost of Components

Water System General Facilities Charges (Resolution #17-04):

For each single-family residence	$4,091.29
For each multi-family and/or accessory dwelling	$2,925.41
For all other uses	$4,091.29/each equivalent residential unit

COMPLAINTS

The Utilities Department maintains records of all complaints, including any corrective actions taken on water quality and quantity. The Utility Billing clerk receives complaints on shut-offs, and shall begin recording all complaints in a complaint log.

Every complaint for water quality is to be investigated and logged. Water quantity complaints are immediately investigated, and if caused by a leak, work is immediately begun to repair the leak. If the leaks are the result of repair, maintenance or other construction activity, the City advises the customer of the source and the estimated time of service resumption.

SERVICE AREA ORDINANCES

The City of Buckley has adopted a number of development, financing and operation ordinances, both directly and by reference, that are intended to ensure that the City water system is expanded and maintained in a compliant and responsible fashion. Table 1-11 summarizes service area ordinances pertinent to water supply. Copies of ordinances related to water supply are included in Appendix F.

TABLE 1-11

City of Buckley Service Area Ordinances

Ordinance	Policy Statement	Code
Water Main Extensions	Extensions required to serve new services within the community must be 6-inch minimum size and must be carried across the full width of the property served.	14.12
Latecomers Agreement	A person who constructs a main extension can be reimbursed for a prorated share of costs incurred when additional property owners access the extension.	14.12
Water Capital Project Fund	The City has a dedicated Water Capital Project Fund for the purpose of designing and constructing improvements to the water system.	3.406
Meters	All service connections shall be metered. The City owns and maintains the meters within City limits. Meters outside City limits are owned and maintained by the water user.	14.04.090 and 14.04.100
Fire Flow Standards	The City has adopted by reference, Appendix III-A of the Uniform Fire Code.	17.28
Water-Sewer Operations Fund	The City has a combined Water-Sewer Operations fund for the purpose of funding system operations and maintenance.	3.402
Minimum Water System Standards	The City has adopted and published *Development Guidelines and Public Works Standards, Rev. 5* (February 2017), that includes a section on Water System Standards. (See Appendix G)	17.08.010
Water System General Facility Charge (GFC)	The City has a GFC set at a rate of $3,632.33 per single family residence, $2,434.05 for each multi-family and/or accessory dwelling, and $3,489.00 per Equivalent Residential Unit (ERU) for all other uses.	14.04.320
Cross-Connection Control	City ordinance prohibits installation of a cross-connection. The City has adopted the procedures and practices published by the Pacific Northwest Section of the AWWA titled *Cross Connection Control Manual, Accepted Procedures and Practice*.	14.05
Sale of Surplus Water	The City can sell surplus water after City needs have been met.	14.04.110
Wheeling Water	The City does not currently wheel water, but would consider doing so on a case-by-case basis if such an arrangement is proposed in the future.	None

CHAPTER 2

BASIC PLANNING DATA

OBJECTIVE

The objective of this chapter is to present basic planning data and water demand forecasts needed to assess the current and future capabilities of the water system to provide service. This chapter will provide existing and future population and service connection projections, water use data, and develop the water demand associated with the planning element known as an Equivalent Residential Unit (ERU). This chapter also includes projected land use and water demands for 6- and 20-year planning periods.

The water use data and water demand forecasts found in this chapter comprise two of the three elements required for the development of a conservation program. The third required element is the implementation of the water use efficiency program and its component parts, which are addressed in Chapter 4.

PLANNING PERIOD

This Water System Plan will provide both 6- and 20-year projections for planning purposes. The 6-year projection is intended to allow the City to plan for near term capital improvements. The 20-year projections are intended to allow sufficient time to obtain water resources and implement long term planning strategies necessary to support future population. The 6-year planning period for this Plan is through the year 2022, while the 20-year planning period for this Plan is through the year 2036.

HISTORIC POPULATION TRENDS AND PROJECTIONS

POPULATION HISTORY

Population records for the City of Buckley and for Pierce County were obtained from the Washington State Office of Financial Management (OFM). This information is summarized in Table 2-1. This population data and other projections in this Plan include all population within the City limits, including the residents of Rainier School. Note that this data will differ slightly from water system service population if there are water services outside the City limits, and if there are any residences within City limits that are not on City water.

TABLE 2-1

City of Buckley and Pierce County Population, 1990 through 2016

Year	City of Buckley Population	City of Buckley Annual Rate of Increase (Percent)	Pierce County Population	Pierce County Annual Rate of Increase (Percent)
1990	3,516		586,203	
1991	3,606	2.56%	598,065	2.02%
1992	3,690	2.33%	610,619	2.10%
1993	3,835	3.93%	623,697	2.14%
1994	3,915	2.09%	636,802	2.10%
1995	3,962	1.20%	649,284	1.96%
1996	3,979	0.43%	653,212	0.60%
1997	3,979	0.00%	664,070	1.66%
1998	3,977	-0.05%	675,651	1.74%
1999	4,001	0.60%	688,884	1.96%
2000	4,145	3.60%	700,818	1.73%
2001	4,420	6.63%	709,288	1.21%
2002	4,467	1.06%	721,124	1.67%
2003	4,443	-0.54%	731,969	1.50%
2004	4,419	-0.54%	743,701	1.60%
2005	4,387	-0.72%	756,919	1.78%
2006	4,378	-0.21%	774,050	2.26%
2007	4,363	-0.34%	786,911	1.66%
2008	4,338	-0.57%	794,330	0.94%
2009	4,387	1.13%	796,900	0.32%
2010	4,354	-0.75%	795,225	-0.21%
2011	4,345	-0.21%	802,150	0.87%
2012	4,365	0.46%	808,200	0.75%
2013	4,370	0.11%	814,500	0.78%
2014	4,430	1.37%	821,300	0.83%
2015	4,440	0.23%	830,120	1.07%
2016	4,550	2.48%	844,490	1.73%
Average Growth Rate:		1.00%		1.41%

Source: Washington State Office of Financial Management (OFM) Intercensal Population Estimates and County Population Estimates.

OFM data indicate that the population in Buckley increased from 3,516 in 1990 to 4,550 in 2016. This represents an average annual growth rate of 1.00 percent for the City of Buckley. During the same period of time, the total population of Pierce County increased from 586,203 in 1990 to 844,490 in 2016. This represents an average annual growth rate of 1.41 percent for Pierce County as a whole.

POPULATION PROJECTIONS

The City of Buckley updated its Comprehensive Plan in 2015. The City had projected a growth rate based on an expanded UGA, but Pierce County Planning has rejected that expanded UGA, so the City has had to re-estimate growth projections based on existing city limits. In negotiations between City planning staff and County planning staff it has been agreed that planning population targets for the City are a population of 7,300 for the year 2030 and a population of 7,888 for the year 2035. A population increase from 4,550 in 2016, as shown in Table 2-1, to a population of 7,300 in 2030 represents an average annual growth rate of 3.43 percent. A population increase from 7,300 in 2030 to a population of 7,888 in 2035 represents an average annual growth rate of 1.56 percent.

OFM historic City of Buckley intercensal population estimates, projected City of Buckley population at the historic annual growth rate of 1.00 percent, and growth rate based on current Pierce County growth allocations, are shown in Figure 2-1, below.

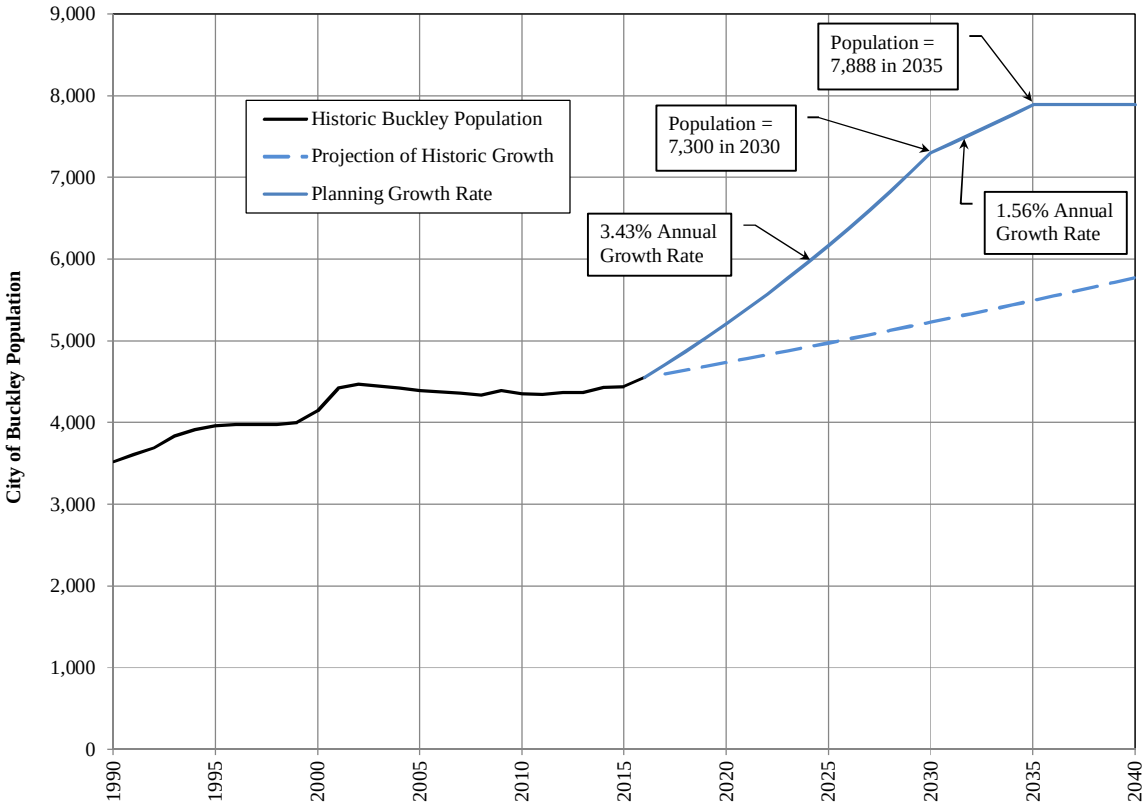


FIGURE 2-1

City of Buckley Historic and Projected Populations

PLANNING GROWTH RATE

As can be seen from Figure 2-1, the GMA population allocations agreed upon between the City and Pierce County are appreciably higher than the recent historic growth rates. However, at this time the City of Buckley reports that they have plats approved and in the works for 293 residential lots over the next 3 to 5 years. At an estimated average of 2.5 persons per household, the estimated population increase from these plats is 733. Estimating this to occur within 5 years, the population estimate for 2020 is 5,163 from these plats alone. This projected growth is shown in Figure 2-1 as "Planning Growth Rate" and in Table 2-2 below, and will be used for planning purposes in the remainder of this Plan.

TABLE 2-2

Projected City of Buckley Population

Year	Projected Population	Year	Projected Population
2017	4,706	2027	6,597
2018	4,868	2028	6,823
2019	5,035	2029	7,058
2020	5,208	2030	7,300
2021	5,387	2031	7,414
2022	5,572	2032	7,530
2023	5,763	2033	7,647
2024	5,961	2034	7,767
2025	6,166	2035	7,888
2026	6,378	2036	7,888

WATER USE CHARACTERIZATION

Water use characterization is an important aspect of water system planning. By evaluating the historical trends in the amount of water purchased and consumed, including peaking factors and the customer population, it is possible to provide forecasts of future demands on the water system. This is necessary in order to assess the capacity of the City's existing facilities and design future water system facilities.

WATER SERVICE CONNECTIONS BY CUSTOMER CLASS

At the end of 2016, the total number of water service connections within the City was 1,758. The City's customer base is comprised of residential, commercial, and industrial connections. Approximately 60 percent of the City's total water use is by residential customers. All City of Buckley service connections are metered and the City bills consumers based on metered water consumption. For billing purposes, water usage has

been divided into a number of customer classifications. This Plan uses the same classifications.

Table 2-3 provides a summary of the connections for the various types of customers for the years 2009 through 2016. Water service connections remained fairly constant from 2009 through 2012, then commercial and residential connections increased from 2013 through 2016.

TABLE 2-3

City of Buckley Service Connections by Customer Class[(1)]

Customer Class	2009	2010	2011	2012	2013	2014	2015	2016
Municipal	13	20	21	23	25	24	25	22
Commercial	100	99	97	101	109	110	133	135
School District	14	13	12	11	11	11	11	11
Post Office	1	1	1	1	1	1	1	1
WSU	1	1	1	1	0	0	1	1
Rainier School	4	4	5	5	10	9	9	11
Residential	1,390	1,391	1,377	1,388	1,442	1,451	1,454	1,492
Outside City	44	43	43	43	43	43	44	49
Total [(2)]	**1,565**	**1,569**	**1,554**	**1,571**	**1,641**	**1,647**	**1,678**	**1,716**

(1) The number connections for various customer classes vary from month to month. Totals provided in Table 2-3 are the maximum reported for each customer class for any month during each year.

(2) Total is the maximum total connections for any month during the year. This value does not equal the sum of the connections above because the various customer classes did not have their maximum numbers during the same month.

WATER PRODUCTION

Water production and usage by the City can be broken down into a few major components. Production represents the amount of water pumped from wells or from South Prairie Creek into the distribution system. Water demand for the system consists of customer consumption and distribution system leakage (DSL). Water production and water consumption are estimated based on water meter records and estimates of unmetered water uses.

Source Production History

Water production data is recorded from the City wells and water treatment plant. System production values were obtained for the seven sources. Monthly water production by source for 2009 through 2016 is shown in Figure 2-2. It can be seen that the distribution of production by source varies month to month, but most of the time the majority of the water production comes from South Prairie Creek, and the second most abundant supply coming from Wells Nos. 2 and 5. In May 2014, January through March of 2015, and in November 2015 through April 2016 there was no production from South Prairie Creek

because the transmission line was washed out, and due to upgrades that were completed on the pipeline.

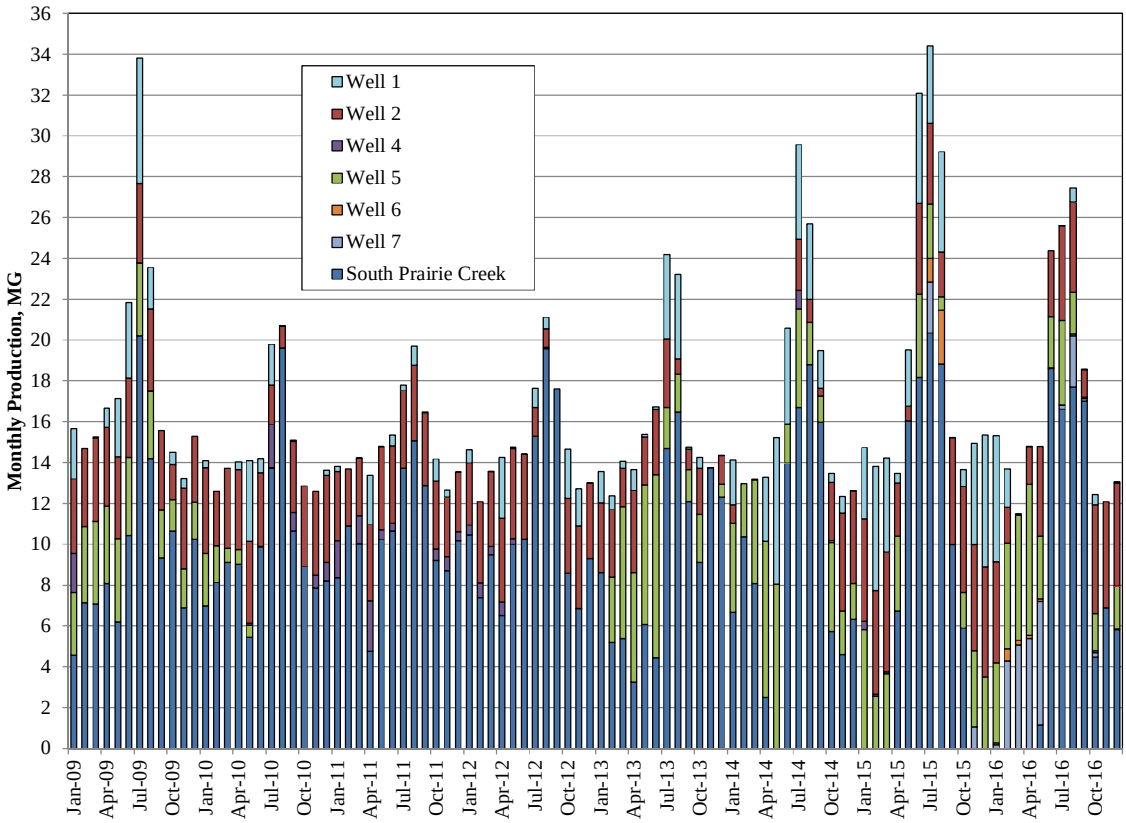


FIGURE 2-2

Monthly Water Production by Source

Annual water production by source is summarized in Table 2-4. South Prairie Creek is the largest source, with annual production ranging from 96.3 to 162.9 MG per year, and averaging 119.3 MG per year over the 9-year data period. Well 2 is the second largest source, with annual production ranging from 17.1 to 50.4 MG per year and averaging 35.2 MG per year over the 9-year data period. Production from Rainier School Well 5 declined in 2010 and was not used at all in 2011 or 2012 due to issues with the pump and drop pipe. The Rainier School Well has been placed back into service and was the second largest producer during 2013 and 2014. The Trail Wells were put into service in 2015.

TABLE 2-4

Annual Water Production by Source, 2008 – 2016 (MG)

Year	South Prairie Creek	Well 1	Well 2	Well 4	Well 5	Well 6	Well 7	Total Production
2008	162.9	9.0	18.8	0.1	30.0	0.0	0.0	220.8
2009	115.0	19.2	44.0	1.9	37.0	0.0	0.0	217.1
2010	117.5	7.7	41.0	4.9	6.4	0.0	0.0	177.5
2011	125.7	5.9	44.1	8.1	0.0	0.0	0.0	183.8
2012	135.6	9.4	38.1	2.8	0.0	0.0	0.0	185.9
2013	116.0	12.7	27.6	0.0	39.5	0.0	0.0	195.8
2014	109.6	28.6	17.3	1.0	48.7	0.0	0.0	205.2
2015	96.3	43.8	50.4	0.6	30.9	3.8	3.6	229.3
2016	105.0	9.3	40.3	0.1	34.2	1.4	24.0	214.3
Average	120.4	16.2	35.7	2.2	25.2	0.6	3.1	203.3

Annual water production by source is shown graphically in Figure 2-3.

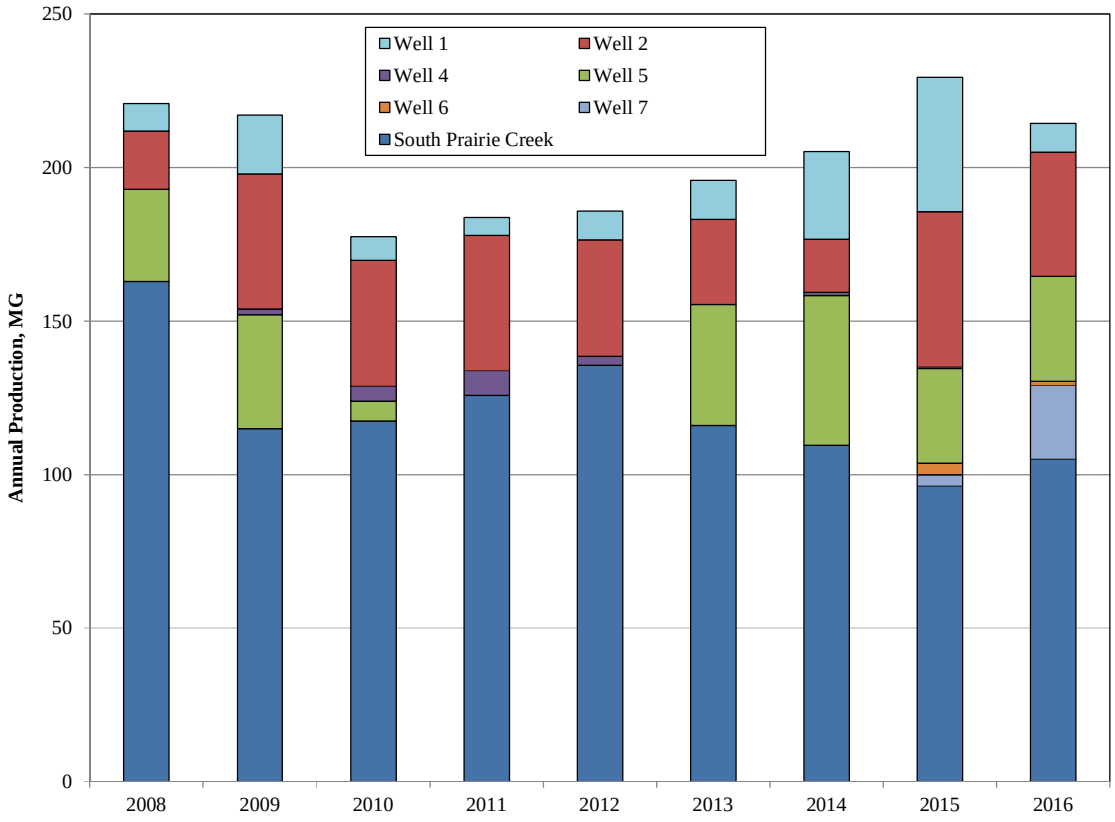


FIGURE 2-3

Annual Water Production by Source, 2008 – 2016

Percent production by source is summarized in Table 2-5. South Prairie Creek is the primary water source for the City, ranging from 42 to 74 percent and averaging 60 percent. Well 2 is the second most productive source, ranging from 9 percent to 23 percent, and averaging 18 percent of the total.

TABLE 2-5

Percent Water Production by Source, 2008 – 2016

Year	South Prairie Creek	Well 1	Well 2	Well 4	Well 5	Well 6	Well 7
2008	74%	4%	9%	0%	14%	0%	0%
2009	53%	9%	20%	1%	17%	0%	0%
2010	66%	4%	23%	3%	4%	0%	0%
2011	69%	3%	23%	5%	0%	0%	0%
2012	73%	5%	21%	1%	0%	0%	0%
2013	59%	7%	14%	0%	21%	0%	0%
2014	54%	14%	8%	0%	23%	0%	0%
2015	43%	20%	23%	0%	14%	2%	2%
2016	50%	5%	24%	0%	22%	1%	14%
Average	64%	7%	17%	1%	12%	0%	0%

Maximum Day Production

Maximum day production is an important statistic for water facilities planning and design. Source capacity, storage capacity and other important design criteria are based on maximum day design. Peak hour demand is also estimated based on maximum day demand. Daily water production records were reviewed and the maximum day demands for the data period January 2008 through December 2016 were determined. Maximum day demand, average day demand and the ratio of maximum day demand to average day demand for each year are shown in Table 2-6, below.

TABLE 2-6

Maximum Day Demand Records

Year	Maximum Day Demand, gpd	Average Day Demand, gpd	Maximum Day to Average Day Factor
2008	1,060,000	604,932	1.75
2009	1,525,000	594,795	2.56
2010	961,000	486,301	1.98
2011	1,110,000	503,562	2.20
2012	933,000	509,315	1.83
2013	1,247,000	536,438	2.32
2014	1,325,000	562,192	2.36
2015	1,619,000	628,250	2.58
2016	1,225,000	587,166	2.09

The average of the three highest peaking factors (i.e. years 2009, 2014 and 2015) is 2.50. For planning purposes a maximum day to average day peaking factor of 2.50 will be used.

WATER USE

Customer Consumption History

The City's monthly water usage records by customer class, from 2009 through 2016, are shown in Figure 2-4. It can be seen that Residential Usage is the greatest usage of any customer class. Rainier School usage is the second greatest usage, followed by Commercial and Municipal usage. Post Office usage is so small as to be not even noticeable on the chart. A distinct seasonal pattern is apparent, with maximum usage months typically coming in July, August and September.

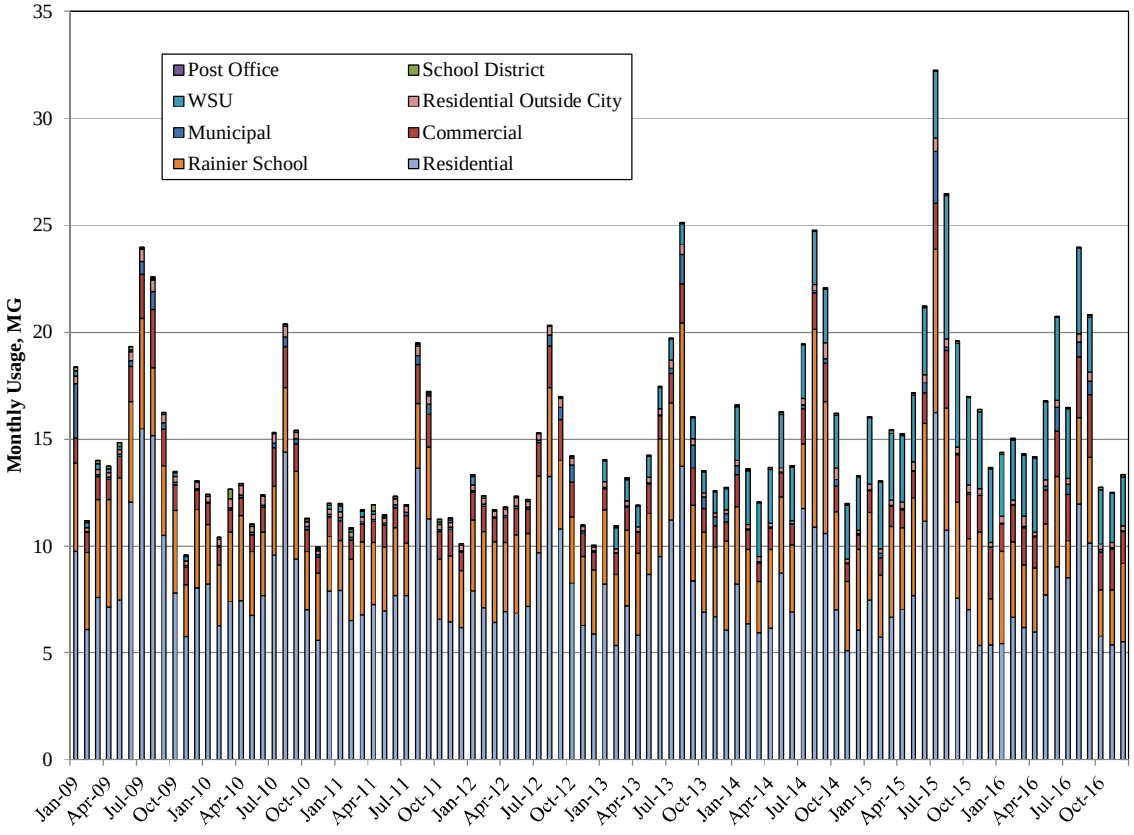


FIGURE 2-4

Monthly Water Usage Records

Annual water sales by customer class are summarized in Table 2-7.

TABLE 2-7

City of Buckley 2009-2016 Average Day Consumption (MG)

Year	Municipal Usage	Commercial Usage	School District Usage	Post Office Usage	WSU Usage	Rainier School Usage	Residential Usage	Outside City Usage	Total Usage
2009	5.15	16.20	1.26	0.02	1.67	49.33	112.84	3.84	190.31
2010	1.76	13.42	1.34	0.02	0.30	37.59	97.60	4.04	156.07
2011	1.94	13.67	1.12	0.02	1.36	35.11	94.93	3.34	151.49
2012	2.71	16.05	0.79	0.02	0.38	41.24	96.58	3.67	161.44
2013	4.30	14.41	0.58	0.02	11.75	49.44	97.73	3.20	181.42
2014	1.50	14.27	0.77	0.04	30.02	49.89	93.75	3.45	193.69
2015	3.65	19.55	0.87	0.03	44.53	52.85	98.01	3.95	223.44
2016	3.44	23.79	0.81	0.03	36.45	40.28	87.72	3.73	196.25

Annual water usage by customer class is shown graphically in Figure 2-5. As in Figure 2-4, above, Post Office usage is too small to show on the graph.

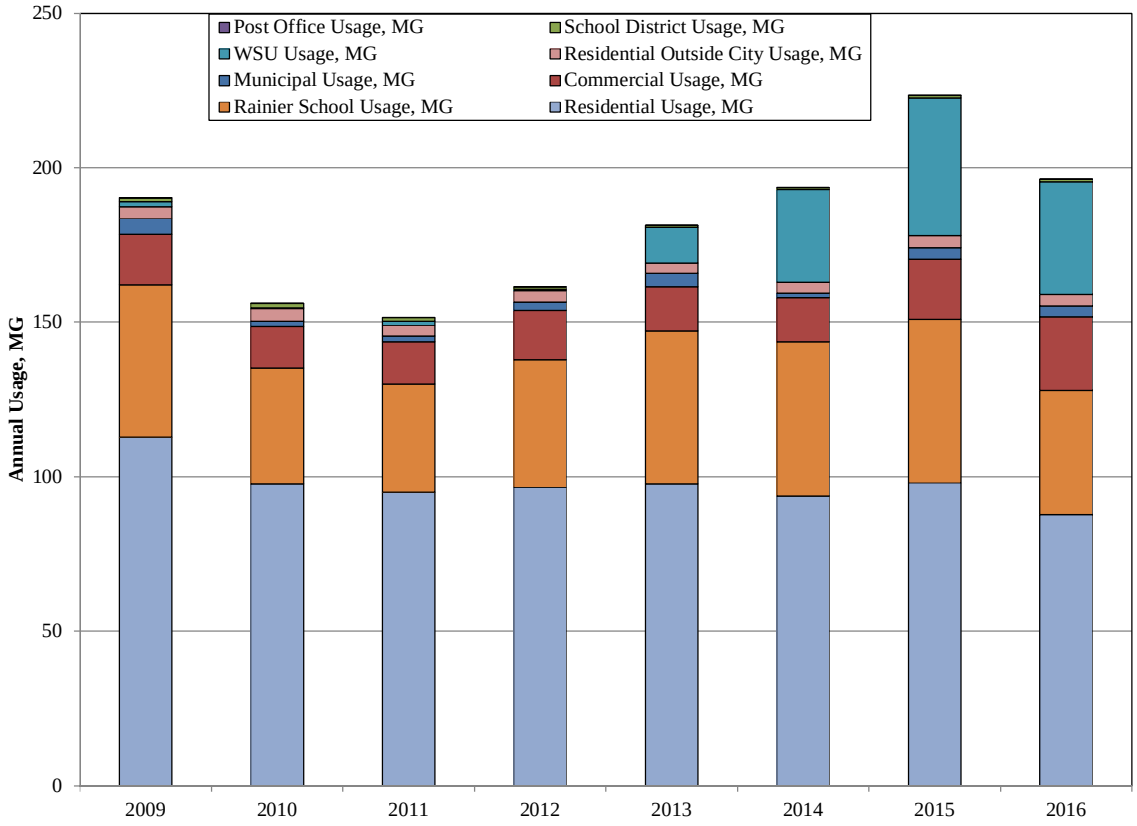


FIGURE 2-5

Annual Water Sales by Customer Class

Distribution System Leakage

Annual production, usage and DSL are summarized in Table 2-8. DSL varied from a high of 17.6 percent in 2011 to a low of 1.9 percent in 2015, with an average of 8.9 percent over the 8-year period from 2009 to 2016.

TABLE 2-8

Annual Production, Usage and DSL

Year	Production[(1)] MG	Consumption[(2)] MG	Non-Revenue[(3)] MG	DSL, MG	Percent DSL	3-year Average Percent DSL
2009	217.1	190.3	0.0	26.8	12.3%	--
2010	177.5	156.1	0.0	21.4	12.1%	--
2011	183.8	151.5	0.0	32.3	17.6%	13.9%
2012	185.9	161.4	3.6	20.9	11.2%	13.6%
2013	195.8	181.4	3.5	10.9	5.6%	11.3%
2014	205.2	193.7	1.5	10.0	4.9%	7.1%
2015	229.3	223.4	1.5	4.4	1.9%	4.0%
2016	214.3	196.3	5.4	12.7	5.9%	4.2%

(1) Production in million gallons (MG) from Table 2-4.
(2) Consumption in million gallons (MG) from Table 2-7.
(3) Non-Revenue Water based on estimated usage for flushing, Fire Department, water main breaks, and new development.

Annual production, usage and DSL are shown graphically in Figure 2-6.

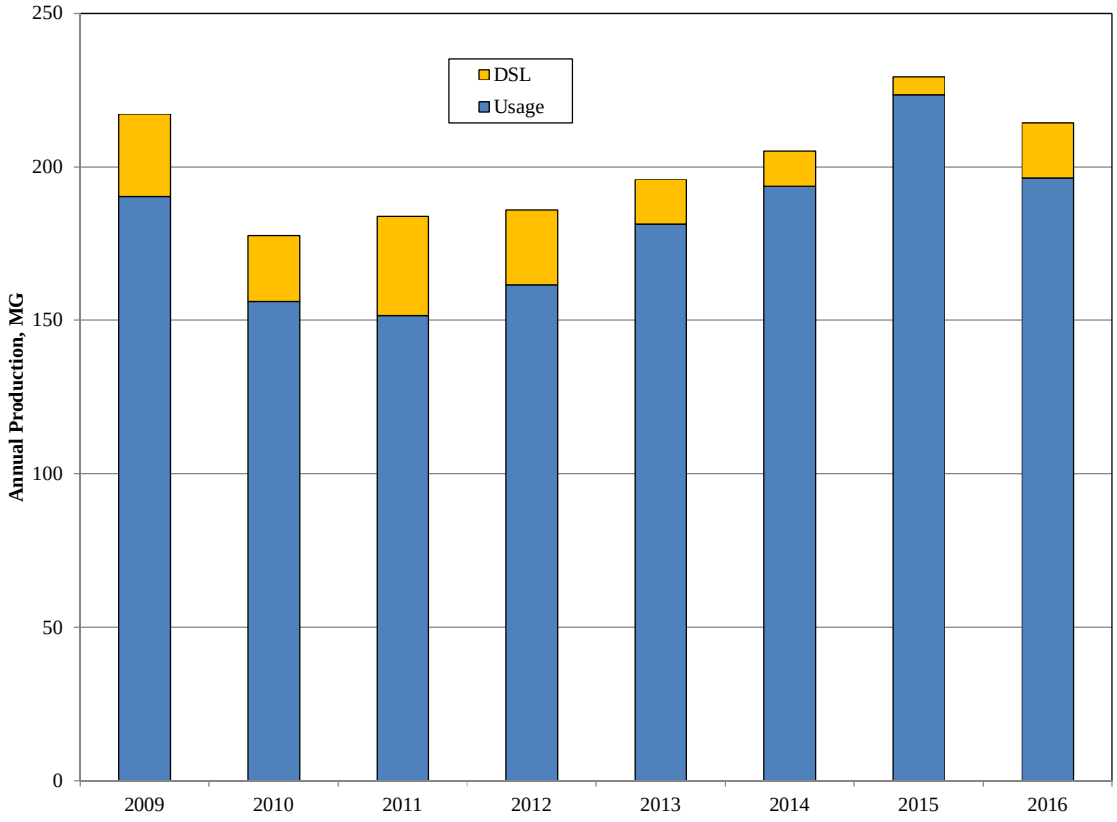


FIGURE 2-6

Annual Production, Usage and DSL

Equivalent Residential Units

The definition of an Equivalent Residential Unit (ERU) is the average day water consumption for one single-family residence. Multi-family and non-residential customers are then assigned an equivalent number of ERUs. When metered data is available, the average day water use for all single-family residential units is divided by the number of housing units to obtain an ERU. Since the number of residential connections changes from month, the most correct way to determine the average residential water usage per connection is to divide the total residential water usage for each month by the total number of residential connections for that month, then average the monthly values. Table 2-9 shows the monthly and annual average residential water usage for 2009 through 2016.

TABLE 2-9

Average Residential Water Use

Year	Residential Usage gpd	Residential Connections	gpd per Residential Connection
2009	309,159	1,385	223.2
2010	267,401	1,381	193.6
2011	260,072	1,373	189.4
2012	264,603	1,378	192.0
2013	267,758	1,417	189.0
2014	256,854	1,449	177.3
2015	268,516	1,452	184.9
2016	240,336	1,473	163.2

As can be seen, the average residential water use declined over the data period from 223 gallons per day per connection (gpd/conn) in 2009 to 163 gpd/conn in 2016. The average over the data period is 189 gpd/conn, and the average for the past 3 years is 175 gpd/conn. For planning purposes we will use a value of 175 gpd/conn as the value of an ERU for the City of Buckley.

Current ERUs

The maximum connections per customer class per year are shown in Table 2-3. However, since the water usage per connection varies by customer class, water usage by customer class is converted into ERUs per customer class for a more equitable comparison and for evaluation of system capacity. In addition, unmetered usage (e.g., flushing, Fire Department, water main breaks, new development) and DSL are also assigned an ERU value. Table 2-10 shows the average number of service connections and the ERUs represented by the usage of those connections in 2016.

There was an average of 1,473 residential service connections in 2016. These count as an average of 1,473 ERUs because residential services are, by definition, one ERU each, even though average residential water use in 2016 was less than the selected ERU value. This means that the number of residential ERUs shown in Table 2-10 is more than the number of ERUs that would be calculated by dividing the residential water use by the ERU value of 175 gallons per ERU per day.

The average of 22 municipal connections count as 54 ERUs, for an average of 2.45 ERUs per connection. The average of 133 commercial connections count as 372 ERUs, for an average of 2.80 ERUs per commercial connection. Unmetered usage in 2016 represented 85 ERUs and DSL in 2016 represented 198 ERUs. The total number of ERUs represented by the total water production in 2016 is 3,355, while the total number of ERUs shown in the ERU column of Table 2-10 is 3,455. This is a difference of

100 ERUs, and is due to counting each residential service as one ERU even though the average residential usage in 2016 was less than the ERU value of 175 gpd/conn.

TABLE 2-10

ERU Values for Water Use Categories for 2016

Customer Class/Usage	2016 Water Use, MG	2016 Average Number of Services	2016 Average gpd per Service	ERUs at 175 gpd per ERU	Average ERUs per Service
Municipal	3.44	22	428	54	2.45
Commercial	23.79	133	490	372	2.80
School District	0.81	11	203	13	1.16
Post Office	0.03	1	72	0	0.41
WSU	36.45	1	99,868	571	570.68
Rainier School	40.28	10	11,036	631	63.06
Residential	87.72	1,473	163	1,473	1.00
Outside City	3.73	46	222	58	1.27
Subtotal	**196.25**	**1,697**	**317**	**3,172**	**1.81**
Unmetered Usage	5.40	N/A	N/A	85	N/A
DSL	12.66	N/A	N/A	198	N/A
Total	**214.32**	**1,697**	**345**	**3,455**	**1.98**

Maximum Day Demand

The Maximum Day Demand (MDD) is the highest daily peak demand that the source, treatment, and storage components of the water system must be able to serve. The DOH Water System Design Manual, December 2009, recommends that actual water system use data be used when it is available. The maximum day to average day production factor determined earlier in this chapter is 2.50. The average day demand per ERU is estimated above at 175 gpd. Therefore, the maximum day demand per ERU is 2.50 x 175 = 437 gpd.

Peak Hour Demand

The maximum quantity of water used in a one-hour period during a maximum day demand is the Peak Hour Demand (PHD). The DOH *Water System Design Manual*, December 2009, provides a methodology for estimating PHD. The generalized equation is as follows:

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

Where: **PHD** = Peak Hourly Demand (gpm)
MDD = Maximum Day Demand (gpd/ERU)
C = Coefficient associated with ranges of ERUs
N = Number of equivalent residential service connections, ERUs
F = Factor associated with ranges of ERUs

For systems with greater than 500 ERUs, the values of C and F are 1.6 and 225, respectively. MDD is determined above to be 437 gpd. Inserting these values into the above equation yields the following:

$$PHD = (437/1440)[1.6 \times N + 225] + 18$$

This simplifies to the following formula for PHD for the City of Buckley:

$$\mathbf{PHD = 0.49 \times N + 86}$$

Summary of Demand Parameters

The system demand parameters derived above are summarized in Table 2-11.

TABLE 2-11

Summary of System Demand Parameters

Demand Parameter	Value
ADD, gpd per ERU	175
MDD, gpd per ERU	437
PHD, gpm, system-wide	0.49 x N + 86

WATER DEMAND PROJECTIONS

Future water demand is estimated to parallel population growth. For the purposes of this Plan we have assumed that non-residential demand will increase at the same growth rate as residential demand. Population projections for the next 20 years are shown in Table 2-2. Using the 3,455 ERUs estimated for 2016 in Table 2-10, and proportioning it to the 2016 OFM Population of 4,550 from Table 2-1, and the projected population of 4,685 for 2017 from Table 2-2, we get an estimate of 3,558 ERUs for 2017. Using the demand parameters in Table 2-11, and continuing to increase ERUs proportionately to projected population from Table 2-2, the demand projections for 2017 through 2036 are shown in Table 2-12.

TABLE 2-12

Projected Average Day Consumption and Demand

Year	ERUs	Average Day Demand, gpd	Annual Demand, ac-ft/yr	Maximum Day Demand, gpd	Maximum Day Demand, gpm	Peak Hour Demand, gpm
2017	3,573	625,000	700	1,561,000	1,084	1,840
2018	3,696	647,000	725	1,615,000	1,122	1,900
2019	3,823	669,000	749	1,671,000	1,160	1,960
2020	3,955	692,000	775	1,728,000	1,200	2,020
2021	4,091	716,000	802	1,788,000	1,242	2,090
2022	4,231	740,000	829	1,849,000	1,284	2,160
2023	4,376	766,000	858	1,912,000	1,328	2,230
2024	4,526	792,000	887	1,978,000	1,374	2,300
2025	4,682	819,000	917	2,046,000	1,421	2,380
2026	4,843	848,000	950	2,116,000	1,469	2,460
2027	5,009	877,000	982	2,189,000	1,520	2,540
2028	5,181	907,000	1,016	2,264,000	1,572	2,620
2029	5,359	938,000	1,051	2,342,000	1,626	2,710
2030	5,543	970,000	1,087	2,422,000	1,682	2,800
2031	5,630	985,000	1,103	2,460,000	1,708	2,840
2032	5,718	1,001,000	1,121	2,499,000	1,735	2,890
2033	5,807	1,016,000	1,138	2,538,000	1,763	2,930
2034	5,898	1,032,000	1,156	2,577,000	1,790	2,980
2035	5,990	1,048,000	1,174	2,618,000	1,818	3,020
2036	5,990	1,048,000	1,174	2,618,000	1,818	3,020

(1) ERUs are projected to increase proportional to projected population growth as shown in Table 2-2, starting from the estimated 2016 value of 3,455 ERUs from Table 2-10.

(2) Average Day Demand is the projected number of ERUs times the ERU value of 175 gpd per ERU from Table 2-11, rounded to the nearest 1,000 gallons.

(3) Annual Demand is average day demand for 365 days, converted to acre-feet per year.

(4) Maximum Day Demand is the projected number of ERUs times the MDD value of 437 gpd per ERU from Table 2-11, rounded to the nearest 1,000 gallons.

(5) Peak hour demand is calculated using the formula from Table 2-11 and the projected number of ERUs.

CHAPTER 3

SYSTEM ANALYSIS

OBJECTIVE

The purpose of this chapter is to determine if the existing system facilities are able to supply sufficient quality and quantity of water to meet existing and projected demands. In this chapter, three major planning components will be described in detail:

- System Design and Construction Standards
- System Component Analysis
- Summary of Deficiencies

The design and construction standards identify the standards that apply to the City's water system facilities. The system component analyses compare the various design standards to the City's existing facilities. Based on these analyses, a summary of deficiencies and options to improve compliance with the required standards are identified. Project costs and a prioritization of recommended improvements are presented in Chapter 8 of this Plan.

This chapter includes the following elements: system design standards, water quality analysis, system description and analysis, summary of system deficiencies, and selection and justification of proposed improvements.

SYSTEM DESIGN AND CONSTRUCTION STANDARDS

The City has adopted system design, water quality, and construction standards. These standards are summarized in the following sections.

DESIGN STANDARDS

Performance and design criteria typically address the sizing and reliability requirements for source, storage, distribution, and fire flow. WAC 246-290 contains general criteria and standards that must be followed in development of public water systems. In addition, Washington State Department of Health (DOH) has published its *Water System Design Manual* (December 2009) that provides more specific guidance for water system design. The design standards for the following subjects are discussed in the order shown below:

1. Average and Peak Day Demand.
2. Peak Hour Demand.
3. Storage Requirements.
4. Fire Flow Rate and Duration.

5. Minimum System Pressure.
6. Minimum Pipe Sizes.
7. Backup Power Requirements.
8. Valve and Hydrant Spacing.
9. Other System Policies.

DOH relies on various publications, agencies and the utility itself to establish design criteria. The following gives a brief description of three of the most widely recognized performance and design standards.

WAC 246-290, Group A Public Water Systems, Washington State Department of Health (March 2012).
This is the primary drinking water regulation utilized by the Washington State Department of Health (DOH) to assess capacity, water quality, and overall compliance with drinking water standards.

Water System Design Manual (WSDM), Washington State Department of Health (DOH) (December 2009).
These standards will serve as guidance for the preparation of plans and specifications for Group A public water systems in compliance with WAC 246-290.

Table 3-1 lists the suggested DOH Water System Design Manual guidance and the City of Buckley's policies with regards to each standard for general facility requirements.

TABLE 3-1

General Facility Requirements

Standard	DOH Water System Design Manual (December 2009)	City of Buckley Standard
Average Day and Maximum Day Demand	Average Day Demand (ADD) is the average day water usage of single family residential customers based on metered water use data. Maximum Day Demand (MDD) is estimated from ADD using a system maximum day peaking factor based on production records.	**ADD = 175 gpd per ERU**, based on a review of single family residential water sales records. **MDD = 437 gpd per ERU**, based on ADD x 2.50, derived from maximum daily water production records.
Peak Hour Demand	Peak hour demand is determined using the following equation: PHD = (MDD/1440)[(C)(N) + F] + 18 C = Coefficient from DOH Water System Design Manual Table 5-1 N = Number of connections, ERUs F = Factor of range from DOH Water System Design Manual Table 5-1	Peak hour demand is calculated using this DOH formula, derived from the formula in the DOH *Water System Design Manual*: **PHD = 0.49 x N + 86** Where N is the current number of ERUs served by the system

TABLE 3-1 – (continued)

General Facility Requirements

Standard	DOH Water System Design Manual (December 2009)	City of Buckley Standard
Source	Capacity must be sufficient to meet MDD.	Capacity must be sufficient to meet MDD and replenish fire suppression storage within 72 hours.
Storage	The sum of: Operational Storage Volume sufficient to prevent pump short-cycling. Equalizing Storage $V_{ES} = (Q_{PH} – Q_S) * 150$ Standby Storage $V_{SB} = (2 * ADD * N) – t_m * (Q_S – Q_L)$ Fire Suppression Storage $V_{FSS} = NFF * T$ ADD = average day demand, gpd/ERU N = number of ERUs Q_{PH} = peak hour demand, gpm Q_S = capacity of all sources, excluding emergency sources, gpm Q_L = capacity of largest source, gpm t_m = daily pump source run time, min NFF = needed fire flow, gpm T = fire flow duration, min	Same as DOH *Water System Design Manual*, using the formulas provided in the manual, Chapter 9.
Minimum System Pressure	The system should be designed to maintain a minimum of 30 psi in the distribution system under peak hour demand and 20 psi under fire flow conditions during MDD.	Same as DOH Water System Design Manual, Chapter 8.
Fire Flow Standard	The Pierce County Coordinated Water System Plan states that water systems in Pierce County shall meet, at a minimum, Pierce County fire flow standards, which are adopted in County Code Chapter 17C.60. These are as follows: Residential: 750 gpm for 45 min. Multifamily: 1,500 gpm for 60 min. Commercial: 1,500 gpm for 60 min. Industrial: 2,000 gpm for 120 min.	The City has adopted the International Fire Code standards. The following are the City's fire flow standards: Residential: 1,000 gpm for 60 min. Multifamily: 1,500 gpm for 120 min. Commercial: 1,500 gpm for 120 min. Industrial: 2,000 gpm for 120 min.
Minimum Pipe Sizes	The diameter of a transmission line shall be determined by hydraulic analysis. The minimum size distribution system line shall not be less than 6-inches in diameter.	The City has adopted a minimum water distribution main diameter of 6-inches for looped lines, and 8-inches for non-looped lines..

TABLE 3-1 – (continued)

General Facility Requirements

Standard	DOH Water System Design Manual (December 2009)	City of Buckley Standard
Reliability Recommend-ations	· Two or more sources of supply. · Supply capable of replenishing fire storage within 72 hours while meeting system MDD. · Sources capable of supplying MDD within an 18-hour period. · Sources meet ADD with largest source out of service. · Back-up power equipment for pump stations unless there are two independent public power sources. · Firm yield of surface water supplies supported by low flow of surface source. · Provision of multiple storage tanks. · Standby storage equivalent to ADD x 2, with a minimum of 200 gpd/ERU. · Low and high level storage alarms. · Looping of distribution mains when feasible. · Pipeline velocities not > 8 fps at PHD. · Flushing velocities of 2.5 fps for all pipelines.	Same as DOH *Water System Design Manual*, Chapter 5, with the exception of: Currently the City has only one potable reservoir. Flushing velocity goal of 2.5 fps may not be realized in some existing neighborhoods.
Valve and Hydrant Spacing	Sufficient valving should be placed to keep a minimum of customers out of service when water is turned off for maintenance or repair. Fire hydrants on laterals should be provided with their own auxiliary gate valve.	Valve standards are outlined in the City of Buckley Developer Standards. Minimum hydrant spacing is 600 ft in residential areas and 300 ft in commercial areas.

CONSTRUCTION STANDARDS

Construction Standards set forth the actual materials and construction standards that contractors, Developers, and the City must follow when constructing water system facility improvements. The City of Buckley *Development Guidelines and Public Works Standards*, including developer extension requirements, are provided as a separate document in Appendix G.

WATER QUALITY STANDARDS

The City of Buckley Water System is a public water supply system regulated by the Washington State Department of Health Drinking Water Regulations, WAC 246-290, the latest edition of which is dated October 1, 2011, as well as sections of Code of Federal Regulations (CFR) Title 40, Parts 141 and 143, adopted by reference in WAC 246-290. The City of Buckley has both surface water and ground water supply, so both surface

water supply regulations and ground water supply regulations apply. Where one standard may be more stringent than the other, such as in maintenance of a distribution system disinfection residual, the more stringent standard will apply.

WATER QUALITY ANALYSES

The following sections evaluate the record of water quality for the City of Buckley Water System. Water quality analyses are divided into the categories of Source Water Quality, Finished Water Quality, Delivered Water Quality, Water Quality Reporting, and Water Quality Complaints. Since the water system has several sources of supply there will be summaries of water quality records for each source. For the surface water source there are separate discussions of source water and finished water, but for the groundwater sources, since there is no treatment other than chlorination, there is no separate discussion of finished water quality. Water quality standards that apply to the water distribution system, including coliform, lead and copper, disinfectant residual, disinfectant byproducts and asbestos, are discussed under the heading of Delivered Water Quality. A review of water quality monitoring requirements relative to water quality monitoring completed is included under the heading Water Quality Reporting, and a review of water quality problems and complaints is included under the heading Water Quality Complaints.

SOURCE WATER QUALITY

As described in Chapter 1, The City of Buckley Water System has one surface water source of supply and four groundwater sources of supply. Source water monitoring includes inorganic chemicals (IOC), Volatile Organic Chemicals (VOC), Synthetic Organic Chemicals (SOC) and Radionuclides (RAD). In addition, for surface water supplies, source water monitoring includes daily turbidity, temperature and pH data.

Inorganic Chemical (IOC) Monitoring

Inorganic Chemical Monitoring results are summarized in Table 3-2 for the South Prairie Creek surface water source, and in Table 3-3 for the four groundwater sources. No samples exceed any primary Maximum Contaminant Level (MCL). The sample from Well No. 1 from May 15, 2007 was just at the secondary MCL for manganese, and the sample from Well No. 2 on the same day exceeded the secondary MCL for manganese. Excessive manganese is not a public health concern, but can cause staining of laundry and water fixtures. It is acceptable to manage manganese by blending high manganese water with lower manganese water.

TABLE 3-2

South Prairie Creek IOC Sampling Results

Constituent	Units	3/16/2005	3/5/2008	8/20/2009	5/12/2010	8/19/2011	MCL
Primary Regulated[(1)]							
Antimony	mg/L	< 0.005	< 0.006	< 0.005	< 0.005	< 0.003	0.006
Arsenic	mg/L	< 0.002	< 0.003	< 0.002	< 0.002	< 0.001	0.01
Barium	mg/L	< 0.1	< 0.4	< 0.1	< 0.1	< 0.01	2
Beryllium	mg/L	< 0.003	< 0.0008	< 0.003	< 0.003	< 0.0003	0.004
Cadmium	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0001	0.005
Chromium	mg/L	< 0.01	< 0.02	< 0.01	< 0.01	< 0.007	0.1
Copper	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	(2)
Cyanide	mg/L	< 0.05		< 0.05	< 0.05	< 0.01	0.2
Fluoride	mg/L	< 0.2	< 0.5	< 0.2	< 0.2	< 0.2	4/2 (3)
Lead	mg/L	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001	(2)
Mercury	mg/L	< 0.0005	< 0.0004	< 0.0005	< 0.0005	< 0.0002	0.002
Nickel	mg/L	< 0.04	< 0.1	< 0.04	< 0.04	< 0.005	0.1
Nitrate-N	mg/L	< 0.2	< 0.2	0.5	< 0.2	0.2	10
Nitrite-N	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	1
Total Nitrite/Nitrate	mg/L	< 0.4		0.5	< 0.4	0.2	(4)
Selenium	mg/L	< 0.005	< 0.01	< 0.005	< 0.005	< 0.002	0.05
Sodium	mg/L	< 5	11	8	< 5	< 5	(5)
Thallium	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.001	0.002
Secondary Regulated[(1)]							
Chloride	mg/L	1	< 20	3	1	1	250
Iron	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3
Manganese	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05
Silver	mg/L	< 0.01	< 0.1	< 0.01	< 0.01	< 0.01	0.1
Sulfate	mg/L	2	< 50	8	2	2	250
Zinc	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	5
Physical Characteristics[(1)]							
Color	CU	5	< 15	< 5	< 5	< 5	15
Conductivity	µmhos/cm	54	270	60	28	51	700
Hardness	mg/L	23		42	12	27	(6)
Turbidity	NTU	0.2	< 0.1	< 0.1	0.2	0.3	1
Other Analyses[(1)]							
Aluminum	mg/L		< 0.05				(7)
Calcium	mg/L		25				(7)
Magnesium	mg/L		5.6				(7)

(1) Values preceded by < indicate that the chemical, if present, was lower than the detection limit indicated.

(2) Copper and Lead are regulated at the consumer's tap through the Lead and Copper Rule.

(3) Fluoride has two standards: A Primary Standard of 4 mg/L set for potential health impacts, and a secondary standard of 2 mg/L for potential aesthetic impacts.

(4) Nitrate, Nitrite, and Combined Nitrate and Nitrite are reported as equivalents of nitrogen.

(5) There is no MCL for sodium. However, EPA has established a "level of concern" of 20 mg/L for people on a restricted sodium diet.

(6) There is no MCL for hardness. Hardness ranges, expressed as mg/L as calcium carbonate, are generally accepted as follows: Soft 0-60; Moderately Hard 61-120; Hard 121-180; Very Hard ≥181.

(7) Aluminum, calcium and magnesium results were included in the 3/5/2008 sample, but are not part of the standard IOC test.

TABLE 3-3

Groundwater Sources IOC Sampling Results

Sample Location		Well 1, Naches	Well 2	Well 3	Well 4	Well 5, Rainier School		Trail Well 2	Trail Wells 1 and 2	
Constituent	**Units**	**5/15/2007**	**6/21/2016**	**6/21/2016**	**7/29/2008**	**5/12/2010**	**8/19/2011**	**7/31/2013**	**12/28/2016**	**MCL**
Primary Regulated[1]										
Antimony	mg/L	< 0.005	<0.003	<0.003	< 0.005	<0.005	< 0.003	<0.003	< 0.003	0.006
Arsenic	mg/L	0.002	0.003	0.003	0.003	<0.002	< 0.001	0.004	0.004	0.01
Barium	mg/L	< 0.1	<0.1	<0.1	< 0.1	<0.1	< 0.01	<0.01	< 0.1	2
Beryllium	mg/L	< 0.003	<0.0003	<0.0003	< 0.003	<0.003	< 0.0003	<0.0003	< 0.0003	0.004
Cadmium	mg/L	< 0.002	<0.001	<0.001	< 0.002	<0.002	< 0.0001	<0.0001	< 0.001	0.005
Chromium	mg/L	< 0.01	<0.007	<0.007	< 0.01	<0.01	< 0.007	<0.007	< 0.007	0.1
Copper	mg/L	< 0.02	<0.02	<0.02	< 0.02	<0.02	< 0.02	<0.02	< 0.02	[2]
Cyanide	mg/L	< 0.05	<0.01	<0.01	< 0.05	<0.05	< 0.01	<0.01	< 0.01	0.2
Fluoride	mg/L	0.2	<0.2	<0.2	< 0.2	0.3	< 0.2	0.3	0.3	4/2 [3]
Lead	mg/L	< 0.002	<0.001	<0.001	< 0.002	<0.001	< 0.001	0.003	< 0.001	[2]
Mercury	mg/L	< 0.0005	<0.0002	<0.0002	< 0.0005	<0.0005	< 0.0002	<0.0002	< 0.0002	0.002
Nickel	mg/L	< 0.04	<0.005	<0.005	< 0.04	<0.04	< 0.005	<0.005	< 0.005	0.1
Nitrate-N	mg/L	0.3	0.3	<0.2	< 0.2	1.4	0.2	<0.2	< 0.2	10
Nitrite-N	mg/L	< 0.2	<0.1	<0.1	< 0.2	<0.2	< 0.1	<0.1	< 0.1	1
Total Nitrite/Nitrate	mg/L	< 0.5	<0.4	<0.4	< 0.4	1.4	< 0.4	<0.4	< 0.4	[4]
Selenium	mg/L	< 0.005	<0.002	<0.002	< 0.005	<0.005	< 0.002	<0.002	< 0.002	0.05
Sodium	mg/L	7	<5	11	12	10	< 5	8	8	[5]
Thallium	mg/L	< 0.002	<0.001	<0.001	< 0.002	<0.002	< 0.001	<0.001	< 0.001	0.002
Secondary Regulated[1]										
Chloride	mg/L	4	4	5	4	6	1	4	8	250
Iron	mg/L	< 0.1	<0.1	<0.1	< 0.1	<0.1	< 0.1	0.16	< 0.1	0.3
Manganese	mg/L	0.05	0.01	0.12	< 0.01	<0.01	< 0.01	0.59	< 0.01	0.05

TABLE 3-3 – (continued)

Groundwater Sources IOC Sampling Results

Sample Location		Well 1, Naches	Well 2	Well 3	Well 4	Well 5, Rainier School		Trail Well 2	Trail Wells 1 and 2	
Constituent	**Units**	**5/15/2007**	**6/21/2016**	**6/21/2016**	**7/29/2008**	**5/12/2010**	**8/19/2011**	**7/31/2013**	**12/28/2016**	**MCL**
Silver	mg/L	< 0.01	<0.01	<0.01	< 0.01	<0.01	< 0.01	<0.01	< 0.01	0.1
Sulfate	mg/L	9	6	9	9	36	2	15	14	250
Zinc	mg/L	< 0.2	<0.2	<0.2	< 0.2	<0.2	< 0.2	<0.2	< 0.2	5
Physical Characteristics(1)										
Color	CU	5	<5	<5	< 5	<5	< 5	5	< 5	15
Conductivity	µmhos/cm	196	134	199	167	170	51	256	260	700
Hardness	mg/L	99	55	81	78	88	27	133	126	(4)
Turbidity	NTU	0.9	0.7	0.2	1	0.3	0.3	3.8	< 0.1	(5)
Other Analyses(1)(7)										
Aluminum	mg/L					<0.05				(6)
Calcium	mg/L					4.1				
Magnesium	mg/L					0.71				

(1) Values preceded by < indicate that the chemical, if present, was lower than the detection limit indicated.
(2) Copper and Lead are regulated at the consumer's tap through the Lead and Copper Rule.
(3) Fluoride has two standards: A Primary Standard of 4 mg/L set for potential health impacts, and a secondary standard of 2 mg/L for potential aesthetic impacts.
(4) Nitrate, Nitrite, and Combined Nitrate and Nitrite are reported as equivalents of nitrogen.
(5) There is no MCL for sodium. However, EPA has established a "level of concern" of 20 mg/L for people on a restricted sodium diet.
(6) There is no MCL for hardness. Hardness ranges, expressed as mg/L as calcium carbonate, are generally accepted as follows: Soft 0-60; Moderately Hard 61-120; Hard 121-180; Very Hard ≥181.

In the groundwater sources, in addition to sodium and nitrate, low levels of arsenic and fluoride were also detected, also well below the MCLs. These are both naturally occurring minerals and not a concern so long as they remain well below the MCL. The level of fluoride detected is not enough to provide any significant dental benefit. Of secondary regulated chemicals, the groundwater sources had somewhat higher levels of chloride and sulfate, and, as mentioned above, manganese was found in Wells 1 and 2 at or above the secondary MCL. Conductivity of the groundwater sources is higher than the surface water, which is to be expected because water moving through the ground has more opportunity to dissolve minerals.

Volatile Organic Chemical (VOC) Monitoring

VOC monitoring since January 1, 2003, has been completed on all sources as shown in Table 3-4, below. The only VOCs detected over this period have been trihalomethanes (THMs), which have been found in the sources 1, 2, and 4, at levels below the MCL. Table 3-5 shows the VOCs detected since January 1, 2003. The highest level found over this time period was Total Trihalomethanes (TTHMs) of 21 µg/L at Source 01, South Prairie Creek. The MCL for TTHMs is 80 µg/L. THMs are known to form by the interaction of chlorine with organic matter in the water, so it is not unusual to find THMs in chlorinated water. The MCL for TTHMs is 80 µg/L, so detected levels have not exceeded the MCL at the source. THMs will be discussed further under the heading *Delivered Water Quality*.

TABLE 3-4

VOC Sampling Record

Year	South Prairie Creek	Well 1, Naches	Well 2	Well 4	Well 5, Rainier School
10/12/2004					X
10/26/2004		X			
3/15/2005		X			
3/16/2005	X				
2/14/2007			X		
10/11/2007					X
7/29/2008				X	
6/9/2009		X			
8/20/2009	X				X
3/26/2010	X				
8/19/2011	X				X
9/10/2013			X		
10/14/14				X	

TABLE 3-5

Summary of Detected VOCs

Source	Date	$CHCl_3$, µg/L	$CHCl_2Br$, µg/L	Total THMs, µg/L
South Prairie Creek	8/20/2009	19.2	1.8	21.0
Well 1, Naches	3/15/2005	16.2	1.0	17.2
	6/9/2009	2.7	ND(1)	2.7
Well 5, Rainier School	10/11/2007	0.53	ND(1)	0.53
	8/20/2009	1.8	ND(1)	1.8
	8/19/2011	2.0	ND(1)	2.0

(1) ND indicates "None Detected" at the State Reporting Level.

Synthetic Organic Chemical (SOC) Monitoring

Synthetic organic chemicals consist of various pesticides, insecticides and herbicides in various groups based on analytical procedures, including Dioxin, Endothal, Soil Fumigants, Glyphosate, Chlorophenoxy Herbicides, Carbamate Insecticides, Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenols (PCBs), General Pesticide Suite, Pesticide Suite 2, Pesticide Suite 5, Pesticide Suite 7, Pesticide Suite 8, Pesticides with Arochlors, Miscellaneous Pesticides, Phthalates, and Diquat and Paraquat. Many of these test procedures have been waived for certain regions where the specific types of SOCs has not been used. The only SOC tests on record for the City of Buckley water system are Chlorophenoxy Herbicides (HERB1), Carbamate Insecticides (INSECT1), and General Pesticide Suite (PEST1). Table 3-6 indicates what SOC samples have been taken from which sources, and when. No SOCs have been detected in any of the City of Buckley's sources.

TABLE 3-6

SOC Sampling Record

Date	South Prairie Creek	Well 1, Naches	Well 2	Well 4	Well 5, Rainier School
6/15/2006					HERB1 (1) PEST1 (2) INSECT1 (3)
7/29/2008				HERB1 (1) PEST1 (2) INSECT1 (3)	
12/17/2008					INSECT1 (3) (two samples)
6/9/2009		PEST1 (2) HERB1 (1)	PEST1 (2) HERB1 (1)		
8/20/2009	HERB1 (1) PEST1 (2) INSECT1 (3)				

(1) HERB1 is a test procedure that detects Chlorophenoxy Herbicides.
(2) PEST1 is a test procedure that detects a range of General Pesticides
(3) INSECT1 is a test procedure that detects Carbamate Insecticides

Radionuclide (RAD) Monitoring

Radionuclides consist of Cesium 134, Gross Alpha, Gross Alpha minus Uranium, Gross Beta, Iodine, Radium 226, Radium 228, Strontium 89, Strontium 90, Tritium, and Uranium. As with SOCs, certain radionuclides are not tested for in certain areas due to no evidence that they exist in the area. Table 3-7 summarizes RAD samples since January 2003. No radionuclides were detected in any samples.

TABLE 3-7

RAD Sampling Record

Date	South Prairie Creek	Well 1, Naches	Well 2	Well 4	Well 5, Rainier School
4/3/2003		Gross Alpha (Minus Uranium)			
4/4/2003	Gross Alpha (Minus Uranium)		Gross Alpha (Minus Uranium)		Gross Alpha (Minus Uranium)
6/10/2003				Gross Alpha (Minus Uranium)	
3/15/2005	Gross Alpha	Gross Alpha			Gross Alpha
3/16/2005			Gross Alpha		
5/2/2005	Radium 228				
5/3/2005					Radium 228
7/5/2005		Radium 228	Radium 228		
11/8/2005	Radium 228	Radium 228	Radium 228		Radium 228
7/28/2008				Radium 228	
8/20/2009	Gross Alpha Radium 228				Gross Alpha Radium 228
5/11/2010		Gross Alpha Radium 228	Gross Alpha Radium 228		
6/8/2010				Gross Alpha	

Surface Water Source Monitoring

Raw Water Quality

Monthly water treatment reports include basic raw water data, including fecal coliform counts, turbidity, temperature and pH. Table 3-8 summarizes high, low and average values for these parameters for the period from January 2008 through December 2016. These tests are conducted at the entry to the water treatment plant whether or not the water treatment plant is running, and may be different from water quality data directly from South Prairie Creek, due to water quality changes that may take place in the raw water pipeline.

TABLE 3-8

Raw Water Quality Data Summary, January 2008 – December 2016

Parameter	Turbidity, NTU	Temperature, Degrees Celsius	pH
Minimum	0.00	2	5.7
Maximum	27.65	16	8.0
Average	0.51	9.2	7.3
Highest Monthly Average	4.09	14	7.8
Lowest Monthly Average	0.00	4	6.6

Monthly minimum, maximum and average raw water turbidities are shown in Figure 3-1. Note that raw water turbidity is taken at the entrance to the water treatment plant whether or not the plant is running, as discussed above. The data show a regular pattern of higher turbidity in the winter, and lower turbidity in the summer months, with occasional turbidity spikes in the spring and early summer. Turbidity spikes to 15.51 on December 13, 2010, and to 27.65 NTU on February 22, 2012, each lasted less than a day. Between November 2015 and April 2016 the raw water transmission line was out of service, so there was no raw water turbidity data. The filter plant was fed with well water during that time period.

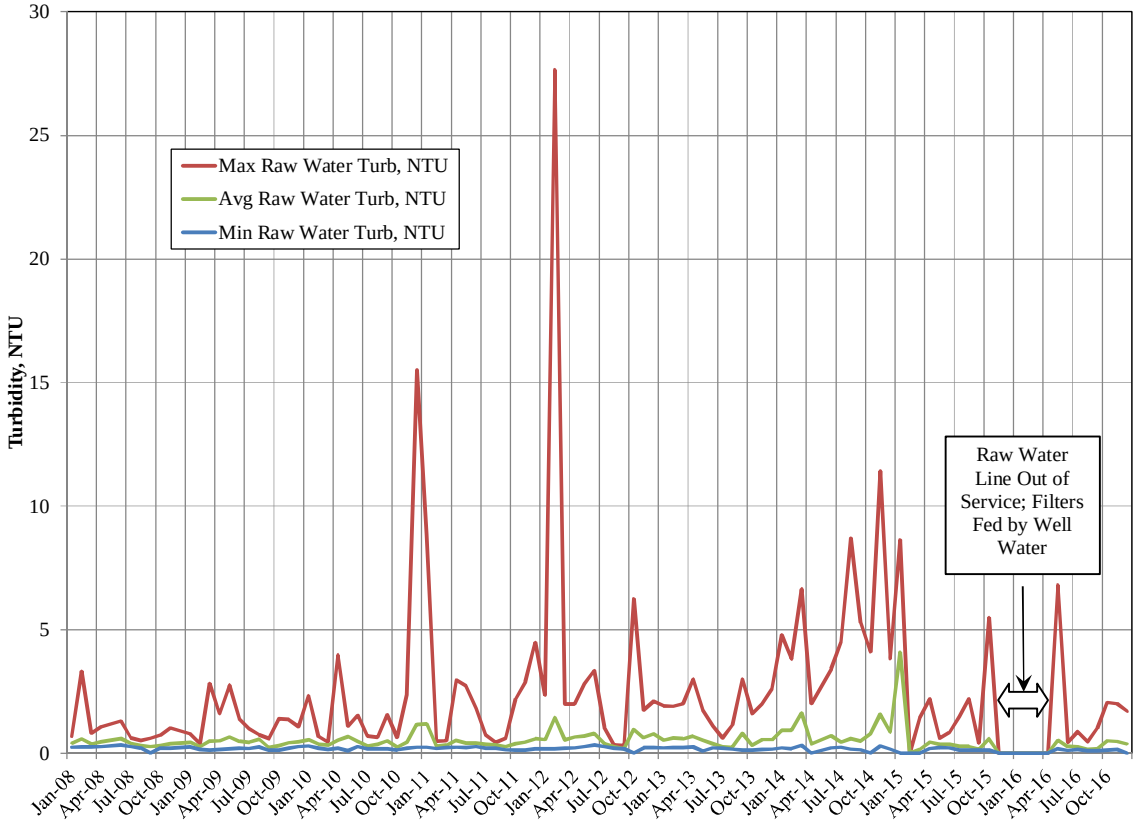


FIGURE 3-1

Raw Water Monthly Minimum, Maximum and Average Turbidity

Treated Water Quality

As stated above, finished water quality applies only to the surface water source, S-01, South Prairie Creek. In addition to source water quality monitoring, surface water sources must meet turbidity and disinfection standards.

Turbidity

Slow Sand Filtration Monthly Reports were reviewed for the time period from January 2008 through December 2016 to determine the monthly minimum, maximum and average finished water turbidities. Figure 3-2 shows these values for the data period. It can be seen that no finished water turbidity during the data period ever exceeded the limit of 1.0 NTU, and that maximum and average finished water turbidities were generally lower 0.1 NTU.

The highest recorded finished water turbidity was 0.69 NTU reported on January 23, 2012. It is not known what caused this relatively high turbidity that day. A

similar spike occurs in the raw water turbidity in Figure 3-1, however, that raw water turbidity spike occurred approximately one month after the finished water turbidity spike in Figure 3-2, and therefore is not related. Daily maximum finished water turbidity the day before the finished water turbidity spike was under 0.1 NTU, but averaged between 0.3 and 0.4 NTU for the three days following this event. The average finished water turbidity for the month of January 2012 was 0.114 NTU and the minimum was 0.042 NTU.

The second highest recorded finished water turbidity was 0.280 NTU reported on April 30, 2012. This event occurred the first day that the filter was put on line after a filter scraping. Turbidity for May 1, 2012 was reported as 0.06 NTU, so this event lasted less than a day.

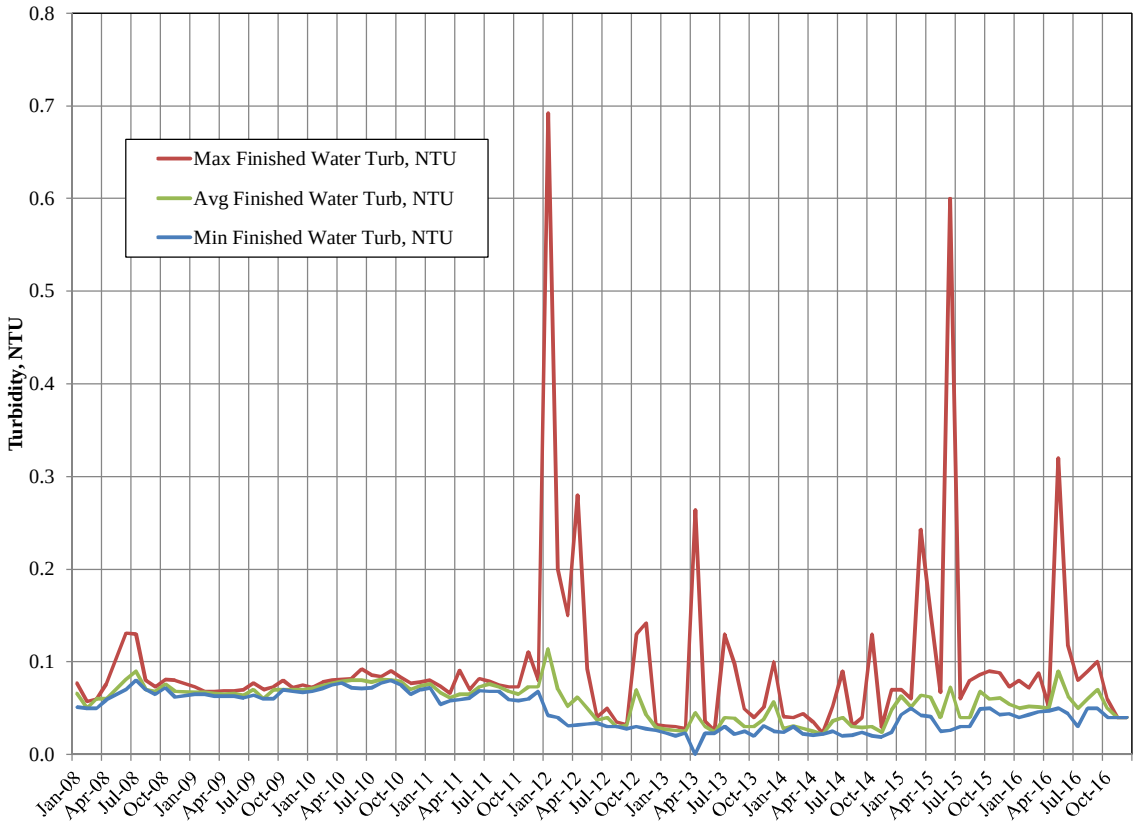


FIGURE 3-2

Finished Water Monthly Minimum, Maximum and Average Turbidity

Disinfection

Surface water disinfection effectiveness is measured by Inactivation Ratio. Inactivation Ratio is the ratio of the cumulative CT provided to the CT required, where CT is the

product of disinfectant concentration (C) and disinfectant contact time (T). The CT required is based on studies that have shown inactivation rates of various pathogenic micro-organisms in the presence of disinfectants. The CT required varies with water temperature, pH and disinfectant concentration as well as other treatment processes provided. Thus it is common to measure Inactivation Ratio in stages, using the CT required and the CT provided in each disinfection stage with the cumulative inactivation ratios of all stages representing the total Inactivation Ratio of the disinfection process. A minimum Inactivation Ratio of one is required.

The City of Buckley completes and submits to DOH the monitoring form, "Washington State Department of Health SWTR Disinfection Monthly Report." Copies of these reports from January 2008 through December 2016 were reviewed and are graphed in Figure 3-3 below. Inactivation ratios never fell below one, and generally averaged over four. The lowest inactivation ratio over the data period was 1.7, which occurred on June 28, 2011, due to a high peak hour flow that day reducing contact time. The inactivation ratio was 5.56 on June 27, and was 6.32 on June 29, 2011.

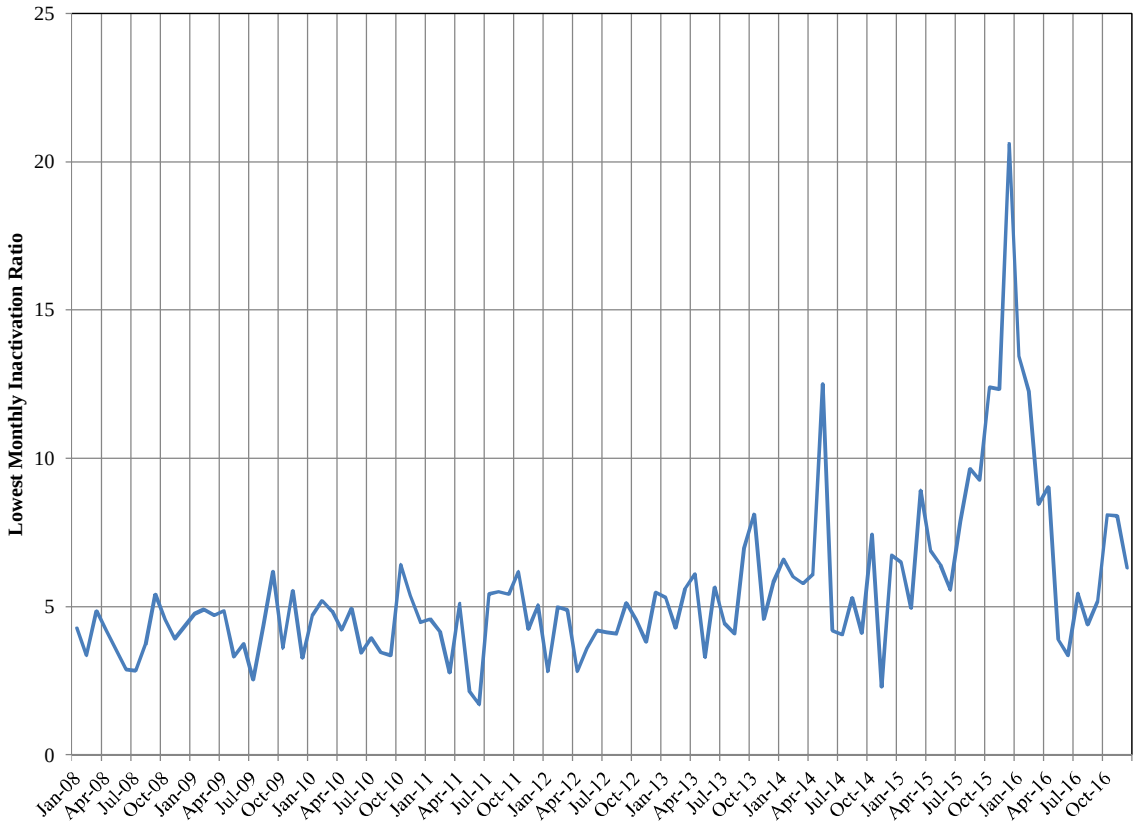


FIGURE 3-3

Minimum Disinfection Inactivation Ratios

DELIVERED WATER QUALITY

Delivered water quality applies to a number of water quality monitoring requirements applied to the water distribution system. Monitoring of delivered water quality is necessary because some water quality parameters have been demonstrated to change in the distribution system, or even in the plumbing of buildings. Chlorine residual decays in the distribution system, coliform bacteria can grow in, or can be introduced into the distribution system, disinfectant byproducts develop in the distribution system, asbestos can be released into the distribution system from asbestos-concrete pipes, and water that is excessively corrosive dissolves lead and copper from building plumbing. For these reasons distribution system, or delivered water quality monitoring is required. The following sections summarize delivered water quality monitoring by the Buckley Water System.

Coliform Bacteria Monitoring

WAC 246-290-300(3) sets distribution system coliform monitoring requirements, and WAC 246-290-310(2) sets coliform bacteria MCLs. In general, a coliform MCL violation is when two or more coliform samples in one sampling period have detectable coliform bacteria. An Acute MCL occurs if either sample is positive for Fecal Coliform or E. Coli, and a Non-Acute MCL is when no sample is positive for Fecal Coliform or E. Coli.

The City of Buckley is required to take five distribution system coliform samples per month. The City has taken all required samples, plus additional source samples, for a total of 753 coliform samples between January 1, 2008 and April 14, 2015. During that period the City has had only one total coliform positive sample, on August 12, 2008, and no fecal coliform or E.Coli positive samples. On August 12, 2008, the City took a total of eight samples of which only one was total coliform positive. Three follow-up samples on August 18, 2008 were all negative for coliform bacteria. Since only one sample was total coliform positive, and since all follow-up samples were coliform negative, the positive sample in August 2008 did not constitute a coliform MCL violation.

Distribution System Chlorine Residual Monitoring

WAC 246-290-300(7)(c) and WAC 246-290-664(6) require distribution disinfectant residual monitoring at representative points in the distribution system daily and at the same time and place as coliform sample collection, and WAC 246-290-451(3)(b) requires that a detectable disinfectant residual must be maintained in the distribution system at all times. The SWTR Disinfection Monthly Reports from January 2008 through December 2016 were reviewed and there were no days indicated during this time period without detectable chlorine residual. Monthly average chlorine residual is shown in Figure 3-4 below. Monthly average chlorine residual has remained mostly above 0.7 mg/L, and has rarely dropped below 0.5 mg/L.

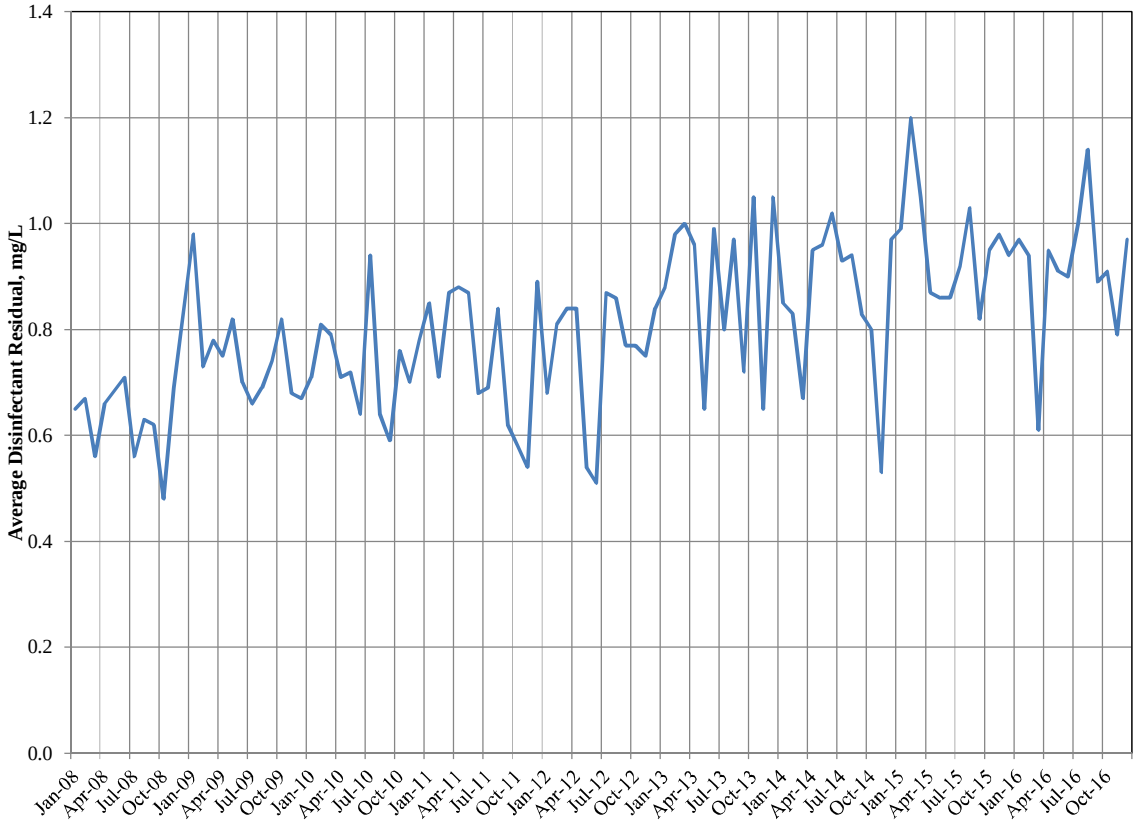


FIGURE 3-4

Monthly Average Chlorine Residual

Disinfectant Byproduct Monitoring

Disinfectant byproducts include four different species of Trihalomethanes (THMs), which are summed together as Total Trihalomethanes (TTHMs) and five different species of Haloacetic Acids (HAAs) which are summed together as Haloacetic Acids (Five) (HAA5). Samples are required to be taken for disinfection by-products at a variety of points in the distribution system. A copy of Buckley's Disinfectant Byproduct (DBP) Monitoring Plan is located in Appendix H.

Required sampling under the Stage 1 rule began in 2004. Under the Stage 1 rule, systems were able to average all sample locations in order to meet the MCL. The Stage 2 rule requires that each individual sample location must meet the running annual average MCL. The Stage 2 rule states the system must meet 80 µg/L and 60 µg/L as the Locational Running Annual Averages (LRAAs) for TTHMs and HAA5s, respectively. Systems were required (unless waived) to identify new high TTHM and HAA5 locations by conducting an Initial Distribution System Evaluation (IDSE). The rule also requires population-based monitoring for all systems, with an allowance for reduced monitoring if

initial monitoring averages less than half the MCLs for TTHM and HAA5. Buckley has a routine monitoring frequency of one sample per quarter at two designated sampling sites. The compliance date with the Stage 2 DBPR monitoring for systems serving less than 10,000 people was October 1, 2013.

From January 1 2005 through April 14, 2015, Buckley has sampled for DBPs, including 144 TTHM samples and 144 HAA5 samples. Samples were taken at ten different sites, including the following:

- 28233 Highway 410
- 240 River Avenue
- The Finished Water Reservoir
- 933 Main Street
- 520 McNeely Street
- 720 Spiketon Road
- The Sewer Treatment Plant
- A Well 2 tap
- A Well 5 tap
- A fire hydrant at 260 Hamilton Ct.

The Highway 410 site and the River Road site were sampled 50 times each for HAA5 and 50 times each for TTHM between January 1, 2005 and April 14, 2015. The reservoir site was sampled 23 times for HAA5, but not for TTHM, between January 27 and May 12, 2006. The Main Street, McNeely Street, Spiketon Road, and Sewer Treatment Plant sites were sampled five times each for TTHM and HAA5 between April 16, 2009 and April 15, 2010. The Hamilton Road site was sampled once on January 27, 2006 for HAA5 only. The Well 2 site was sampled for TTHM and HAA5, and the Well 5 site was sampled for TTHM only, on June 20, 2006. Through the IDSE the Highway 410 site and the River Road site have been established as the routine DBP monitoring sites.

Table 3-9 summarizes DBP sample results since January 1, 2005. Prior to October 1, 2013, data is system-wide running annual average. All distribution system samples are averaged for each calendar quarter, and the quarterly averages are averaged for a running annual average. After October 1, 2013 data is displayed as locational running annual average. Compliance, as well as criteria for reduced monitoring, is based on the running annual average at each sample site. Sample results from the Finished Water Reservoir, the Well 2 tap, the Well 5 tap are not included in Table 3-9, because those samples were investigative samples, and they were not distribution system samples.

From January 2005 through September 2013 the system-wide running annual averages never exceeded the 80 µg/L MCL for TTHM, but did exceed the 60 µg/L MCL for HAA5 for the running averages of April 2005 – March 2006, for July 2005 – June 2006, October 2005 – September 2006, and for July 2011 – June 2012. Since October 1, 2013, the LRAA values have not exceeded either MCL, and in fact have remained less than half of their respective MCLs.

TABLE 3-9

Distribution System Disinfectant Byproducts Monitoring

Compliance Period	Running Annual Average TTHM, µg/L	Running Annual Average HAA5, µg/L	Compliance Period	Running Annual Average TTHM, µg/L	Running Annual Average HAA5, µg/L
Phase 1 DBP Monitoring, System-Wide Running Annual Averages					
Jan 2005 - Dec 2005	32.6	55.8	Jan 2009 - Dec 2009	25.2	19.5
Apr 2005 - Mar 2006	46.6	60.9	Apr 2009 - Mar 2010	27.7	25.5
Jul 2005 - Jun 2006	48.6	75.6	Jul 2009 - Jun 2010	29.9	25.5
Oct 2005 - Sep 2006	49.2	73.2	Oct 2009 - Sep 2010	33.4	25.3
Jan 2006 - Dec 2006	44.3	54.4	Jan 2010 - Dec 2010	38.5	31.4
Apr 2006 - Mar 2007	32.1	46.1	Apr 2010 - Mar 2011	38.6	31.7
Jul 2006 - Jun 2007	26.4	29.7	Jul 2010 - Jun 2011	33.8	26.6
Oct 2006 - Sep 2007	25.1	25.4	Oct 2010 - Sep 2011	37.4	43.5
Jan 2007 - Dec 2007	18.2	18.4	Jan 2011 - Dec 2011	34.5	41.5
Apr 2007 - Mar 2008	10.5	28.1	Apr 2011 - Mar 2012	35.7	51.9
Jul 2007 - Jun 2008	11.0	30.6	Jul 2011 - Jun 2012	41.9	65.7
Oct 2007 - Sep 2008	15.2	30.9	Oct 2011 - Sep 2012	35.8	49.1
Jan 2008 - Dec 2008	20.5	32.7	Jan 2012 - Dec 2012	33.2	44.1
Apr 2008 - Mar 2009	26.5	14.6	Apr 2012 - Mar 2013	28.8	29.9
Jul 2008 - Jun 2009	30.2	19.5	Jul 2012 - Jun 2013	22.7	17.8
Oct 2008 - Sep 2009	25.7	19.6	Oct 2012 - Sep 2013	23.2	21.4
Phase 2 DBP Monitoring, Locational Running Annual Averages					
Location: 240 River Avenue			**Location: 28233 Hwy 410**		
Jan 2013 - Dec 2013	22.1	22.1	Jan 2013 - Dec 2013	27.9	23.5
Apr 2013 - Mar 2014	21.7	21.8	Apr 2013 - Mar 2014	27.0	22.1
Jul 2013 - Jun 2014	21.8	21.6	Jul 2013 - Jun 2014	28.3	16.6
Oct 2013 - Sep 2014	20.2	14.0	Oct 2013 - Sep 2014	28.9	18.4
Jan 2014 - Dec 2014	18.2	15.7	Jan 2014 - Dec 2014	36.0	26.6
Apr 2014 - Mar 2015	17.2	15.0	Apr 2014 - Mar 2015	38.8	25.2
Jul 2014 - Jun 2015	16.8	15.1	Jul 2014 - Jun 2015	38.4	30.7
Oct 2014 - Sep 2015	14.2	13.6	Oct 2014 - Sep 2015	34.1	26.5
Jan 2015 - Dec 2015	12.1	9.0	Jan 2015 - Dec 2015	25.6	18.5
Apr 2015 - Mar 2016	14.8	10.4	Apr 2015 - Mar 2016	22.7	19.1
Jul 2015 - Jun 2016	14.8	11.5	Jul 2015 - Jun 2016	19.6	13.4
Oct 2015 - Sep 2016	21.6	21.8	Oct 2015 - Sep 2016	25.9	25.7
Jan 2016 - Dec 2016	24.5	22.3	Jan 2016 - Dec 2016	28.7	28.7
Apr 2016 - Mar 2017	22.8	21.5	Apr 2016 - Mar 2017	27.8	29.2
Jul 2016 - Jun 2017	21.5	20.0	Jul 2016 - Jun 2017	26.9	28.7

System-wide running annual averages for TTHM and HAA5 are shown in Figures 3-5 and 3-6. Locational running annual averages are shown for 240 River Road and 28233 Hwy 410 in Figures 3-7 and 3-8.

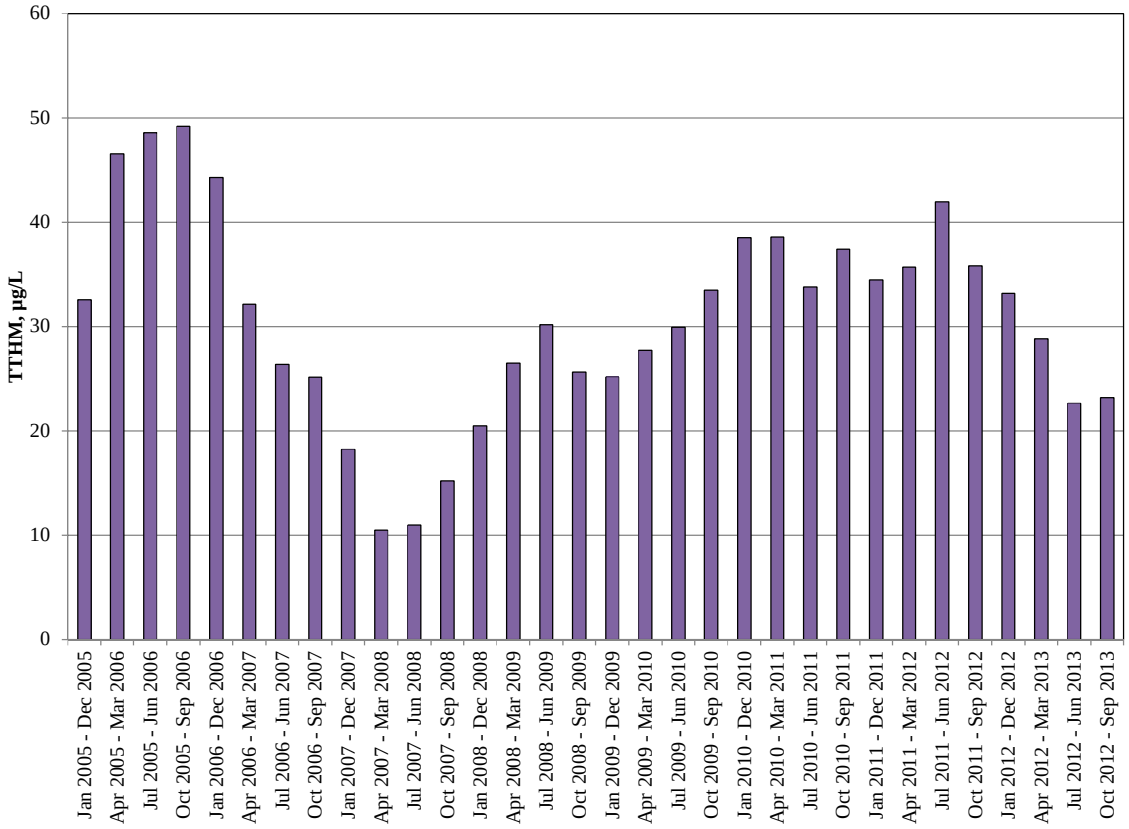


FIGURE 3-5

System-Wide Running Average TTHM

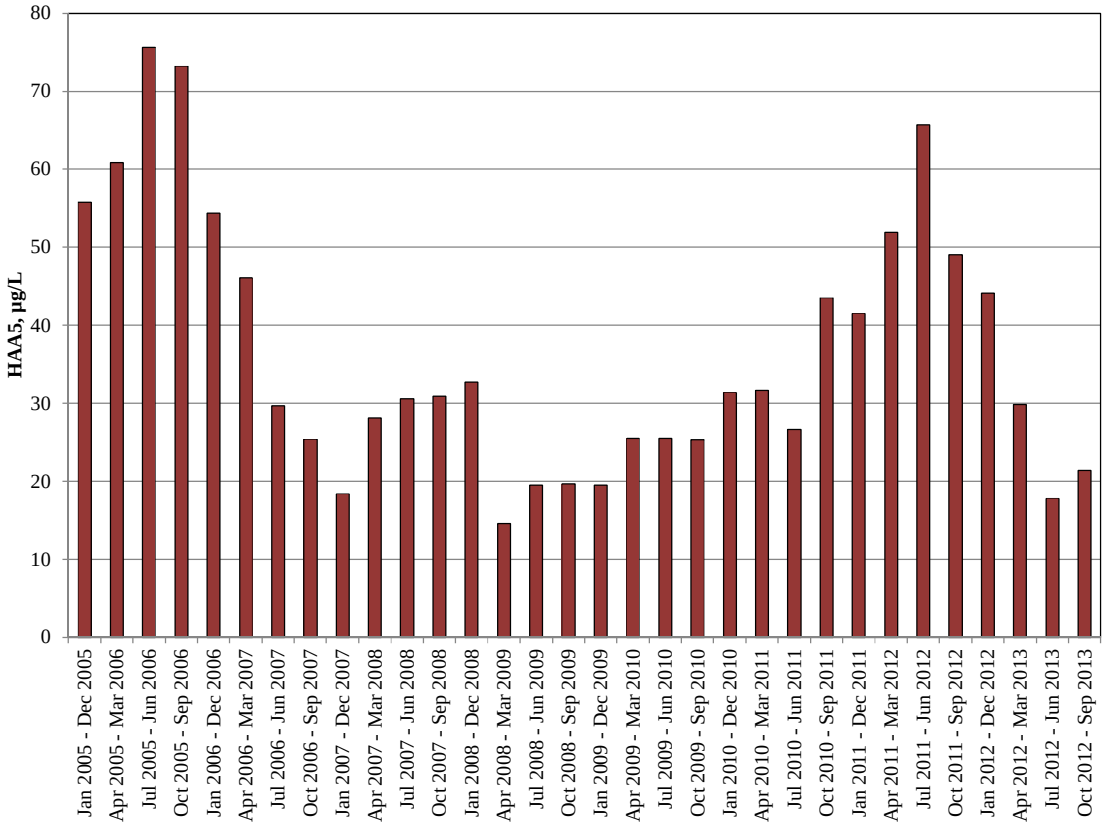


FIGURE 3-6

System-Wide Running Average HAA5

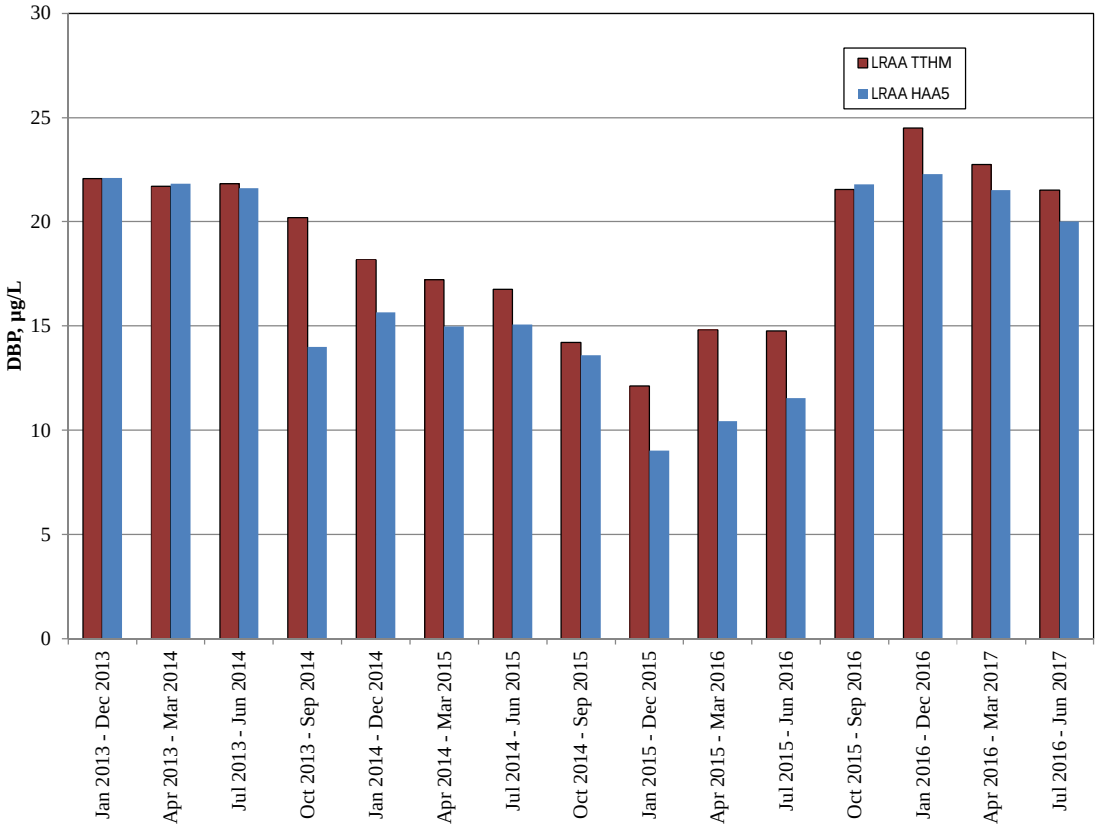


FIGURE 3-7

240 River Road LRAA DBPs

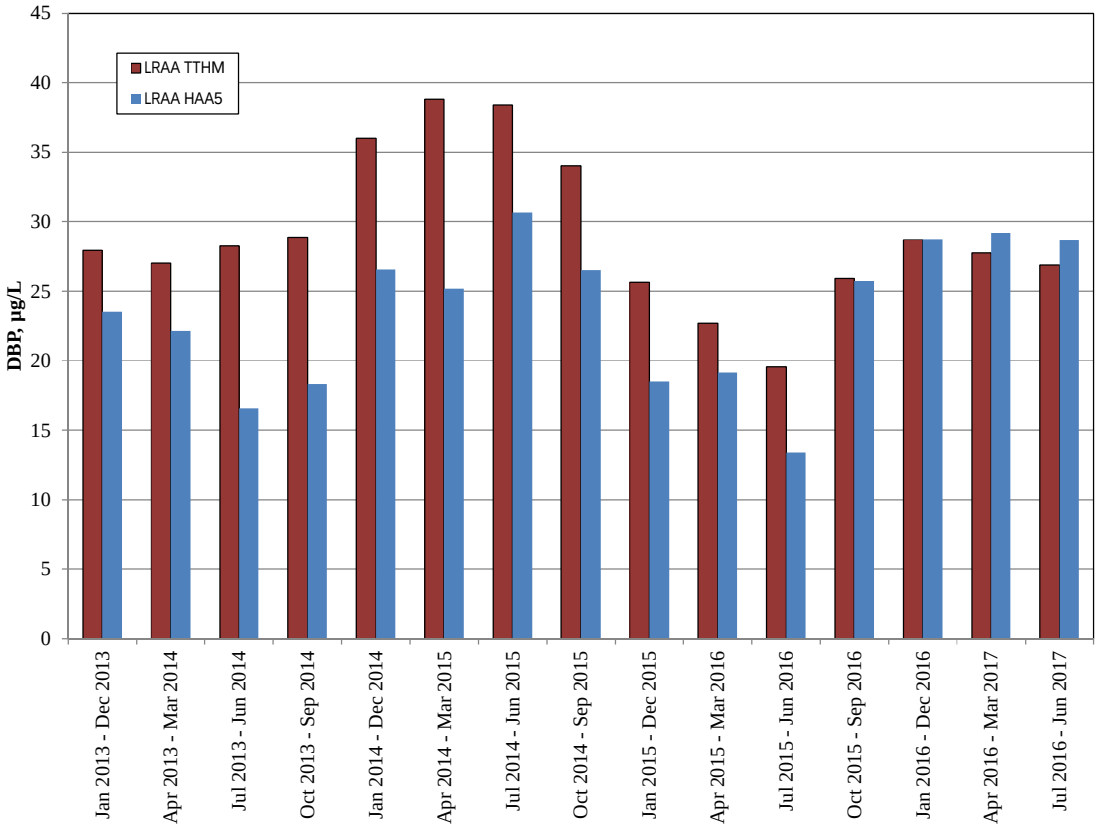


FIGURE 3-8

28233 Hwy 410 LRAA DBPs

Based on the above, it appears that the City of Buckley is in compliance with DBP monitoring requirement and MCLs. Following elevated results for HAA5 in 2007 and 2008, the City and Rainier School staff performed an investigation into the potential reasons for the sample results and enacted some operational practices to help reduce HAA5 formation. The higher HAA5 levels appeared to occur seasonally at times with higher organic loading from South Prairie Creek. Operational changes included reducing the target chlorine residual and blending with well water at certain times of the year. Based on an evaluation performed in 2011 following the operational changes, it was determined that the blending of the well was not directly attributable to the improvement in HAA5 concentrations. The lower target chlorine residual appears to be an effective operational change with respect to HAA5 levels.

Lead and Copper Monitoring

The City of Buckley has completed quarterly lead and copper monitoring and is currently on a reduced monitoring schedule. Table 3-10 summarizes the most recent three rounds

of lead and copper sampling. The annual lead and copper monitoring continues to demonstrate compliance with lead and copper rule.

TABLE 3-10

Lead and Copper Monitoring Summary

Year	Maximum Lead	90th Percentile Lead	Maximum Copper	90th Percentile Copper
2012	0.007	0.006	0.26	0.21
2013	0.017	0.009	0.55	0.51
2016	0.023	0.008	0.41	0.29
Action Levels		0.015		1.3

WATER QUALITY COMPLAINTS

Buckley handles water quality complaints pursuant to their policy for dealing with complaints as described in Chapter 1. Water quality complaints are usually regarding "dirty" water. In response the water crew will generally check out the validity of the complaint by an on-site investigation and flush water mains if appropriate. A routine water main flushing program generally keeps water quality complaints to a minimum.

SYSTEM COMPONENT ANALYSIS

The following sections evaluate the source, transmission, treatment, storage, and distribution components of the City of Buckley water system.

SOURCE OF SUPPLY ALTERNATIVES

In 2012 the City completed a study of long term water supply options, including following three options:

- Continue to operate and maintain the City's own sources together with sources jointly owned by the City and DSHS Rainier School and any future source development needs,
- Abandon the City's own sources and obtain all water supply for the City of Tacoma, or
- Maintain the City's existing sources and develop an active, full-time intertie with the City of Tacoma.

The report concludes that it may be marginally less costly to obtain all water from the City of Tacoma than to operate and maintain the City's own sources together with sources jointly owned by the City and DSHS Rainier School, and that it would be significantly more costly to both maintain the City's own water sources and obtain water from the City of Tacoma.

After hearing and considering the alternatives, the City Council voted to maintain the existing sources and expand sources as needed, rather than obtain water supply either wholly or partially from the City of Tacoma. The City of Buckley has constructed an emergency only intertie with the City of Tacoma. A copy of the report and minutes of the Council decision are included in Appendix Q.

SOURCE OF SUPPLY ANALYSIS

A description of the City's sources of supply was presented in Chapter 1. According to City policy, source production capacity must be sufficient to supply Maximum Day Demand (MDD) while replenishing fire suppression storage within 72 hours. Maximum Day and Average Day Demands must also comply with the maximum instantaneous and maximum annual withdrawal limitations of associated water rights. Analyses for these requirements are described below.

Water Rights Analysis

Water rights are presented in Chapter 1 and summarized in Tables 1-3 and 1-4. Following is a comparison to the City's existing water rights to historic and projected water usage and installed source capacities. Water right self assessment forms are included in Appendix E.

Installed Instantaneous Withdrawal Rates

Table 3-10 shows water rights associated with existing and proposed water sources, the total instantaneous withdrawal rates under the rights, and the existing and proposed installed pumping capacities. Under surface water rights S2-*01713 CWRIS and S2-*05389 CWRIS for South Prairie Creek, Table 3-11 shows all rights, including municipal and irrigation, because irrigation of lawns, gardens and parks is common practice under municipal water use. However, even without the irrigation right of 3 cfs (1,346 gpm) the remaining 2.5 cfs (1,122 gpm) is adequate to cover the existing filtration plant capacity of 725 gpm.

As shown in Table 1-3, water right G2-01024P covers Wells 1, 6, and 7. As of this writing, Wells 6 and 7 (known as the Trail Wells because they are next to the Foothills Trail) have been constructed and tested but have not yet been put into service. Design and construction of pumping, treatment and control systems, and a water transmission main are necessary before these wells can be put into service. However, the total installed pumping capacity under this right with these wells in service will exceed the instantaneous limits of the right. The City is working to acquire additional instantaneous water rights for these wells. Until the additional rights are secured, the City will operate the wells such that the instantaneous right is not exceeded.

Water rights G2-27595, G2-28335, and Claim 98-001750 all apply to Wells 2, 4 and 5. The combined instantaneous capacity of these rights is 585 gpm, while the combined installed pumping capacity of these wells is 640 gpm. Thus these wells operate within their applicable water rights.

TABLE 3-11

Instantaneous Water Rights and Installed Capacities

	Water Rights S2-*01713 CWRIS and S2-*05389 CWRIS, South Prairie Creek	**Water Right G2-01024P, Wells 1, 6, and 7**	**Water Rights G2-27595, G2-28335, and Claim 98-001750, Wells 2, 4 and 5**
Instantaneous Right (Qi), cfs (1)	2.0 + 0.5 + 3.0 = **5.5**	**1.0**	0.62 + 0.33 + 0.56 = **1.52**
Instantaneous Right (Qi), gpm (1)	898 + 224 + 1,346 = **2,469**	**450**	280 + 150 + 250 = **680**
Installed Capacity, gpm	**725**	260 + 85 + 215 = **560** (2)	130 + 240 + 215 = **585**

(1) 1 cfs is approximately 448.8 gpm. Conversely, 1,000 gpm is approximately 2.23 cfs.

(2) Existing plus planned installed capacity under water right G2-010245P exceeds the instantaneous permitted withdrawal rate. The City is working to increase the instantaneous withdrawal rate allowed under this right. The City will limit their use of these wells to stay within their instantaneous rights until the additional rights are secured.

Historical Annual Withdrawal Rates

Table 3-12 shows annual water rights compared to recent historical annual water withdrawal rates. As with Table 3-2 above, the annual water rights S2-*01713 CWRIS and S2-*05389 CWRIS for South Prairie Creek shown in Table 3-3 include the irrigation rights, because irrigation of lawns, gardens and parks falls within the realm of normal municipal water use. However, even without the 400 ac-ft/yr of irrigation right, the remaining 1,258 ac-ft/yr is adequate to cover all historical water withdrawals from South Prairie Creek. Historical water withdrawals from Well 1 are all within the 180 ac-ft/yr limit of water right G2-01024P. Combined historical water withdrawals from Wells 2, 4, and 5 are also within the 308.72 ac-ft/yr combined annual limits of water rights G2-27595, G2-28335, and Claim 98-001750.

TABLE 3-12

Annual Water Rights and Historic Withdrawals

Acre-feet per year[(1)]	**South Prairie Creek**	**Wells 1, 6 & 7**	**Wells 2, 4 & 5**
Annual Right	896 + 362 + 400 = **1,658**	**180**	36 + 242 + 30.7 = **308.7**
Withdrawals, 2008	499.9	27.6	150.1
Withdrawals, 2009	352.9	58.9	254.4
Withdrawals, 2010	360.6	23.6	160.5
Withdrawals, 2011	385.8	18.1	160.2
Withdrawals, 2012	416.1	28.8	125.5
Withdrawals, 2013	356.0	39.0	205.9
Withdrawals, 2014	336.4	87.8	205.6
Withdrawals, 2015	295.5	156.9	251.3
Withdrawals, 2016	322.3	106.5	228.9

(1) 1 ac-ft is 325,851 gallons. Conversely, 1 MG is 3.0689 ac-ft.
(2) Water Right Numbers are included in Table 1-4.

Projected Withdrawal Rates

Water resource requirements projected in Chapter 2 are compared here to existing water rights to determine if existing water rights are adequate to supply projected water demands. Annual water rights are compared to projected annual water demands, and instantaneous water rights are compared to projected source pumping capacity needs. Projected annual water demands are based on projected average day demand for 365 days per year, converted to ac-ft/yr. Projected source capacity needs are based on meeting projected maximum day demands within a reasonable number of hours of daily source operation. Table 3-13 compares existing annual water rights to projected annual water demands.

TABLE 3-13

Water Rights and Projected Demands

Year	Projected Annual Demand, ac-ft/yr	Projected Annual Water Right Surplus (Deficit), ac-ft/yr	Projected Minimum Source Capacity, gpm	Projected Instantaneous Water Right Surplus (Deficit), gpm
2017	700	1,447	1,445	2,153
2018	725	1,422	1,495	2,103
2019	749	1,397	1,547	2,051
2020	775	1,372	1,600	1,999
2021	802	1,345	1,656	1,943
2022	829	1,318	1,712	1,887
2023	858	1,289	1,770	1,828
2024	887	1,260	1,831	1,767
2025	917	1,229	1,894	1,704
2026	950	1,197	1,959	1,639
2027	982	1,164	2,027	1,572
2028	1,016	1,131	2,096	1,502
2029	1,051	1,096	2,169	1,430
2030	1,087	1,060	2,243	1,356
2031	1,103	1,043	2,278	1,321
2032	1,121	1,025	2,314	1,285
2033	1,138	1,009	2,350	1,249
2034	1,156	991	2,386	1,212
2035	1,174	973	2,424	1,174
2036	1,174	973	2,424	1,174

(1) Projected Annual Demand is taken directly from Table 2-12.

(2) Projected Annual Water Right Surplus (Deficit) is the total water right of 2,146.72 ac-ft/yr from Table 1-3 less Projected Annual Demand.

(3) Projected Minimum Source Capacity is the pumping rate in gpm necessary to meet Maximum Day Demand from Table 2-12 and replenish the maximum design fire storage volume within 72 hours, or meet system MDD within 18 hours, whichever is greater. In this case, the source capacity to meet MDD within 18 hours is greater.

(4) Projected Instantaneous Water Right Surplus (Deficit) is the total instantaneous water right of 3,599 gpm from Table 1-4, less the Projected Minimum Source Capacity.

Source Production Capacity Analysis

Source production capacity is analyzed relative to projected water demands to determine if additional source capacity is going to be required in the 20 year planning horizon in order to meet demands. Table 3-14 compares projected source capacity needs to existing installed source capacity. It can be seen from Table 3-14 that existing installed source

capacity is adequate to meet projected maximum day demands through 2024, but if demand projections are correct, the City will need additional source capacity by 2025.

TABLE 3-14

Source Production Capacity Analysis

Year	Projected Minimum Recommended Source Capacity, gpm[(1)]	Current Source Capacity, gpm[(2)]	Projected Source Capacity Surplus/(Deficit), gpm[(3)]
2017	1,445	1,865	425
2018	1,495	1,865	375
2019	1,547	1,865	323
2020	1,600	1,865	270
2021	1,656	1,865	214
2022	1,712	1,865	158
2023	1,770	1,865	100
2024	1,831	1,865	39
2025	1,894	1,865	(24)
2026	1,959	1,865	(89)
2027	2,027	1,865	(157)
2028	2,096	1,865	(226)
2029	2,169	1,865	(299)
2030	2,243	1,865	(373)
2031	2,278	1,865	(408)
2032	2,314	1,865	(444)
2033	2,350	1,865	(480)
2034	2,386	1,865	(516)
2035	2,424	1,865	(554)
2036	2,424	1,865	(554)

(1) Projected Minimum Recommended Source Capacity is from Table 3-13.
(2) Current Source Capacity is the total capacity of all sources from Table 1-3.
(3) Projected Source Capacity Surplus (Deficit) is Current Source Capacity minus the Projected Minimum Recommended Source Capacity.

Source Production Reliability Analysis

The 2009 DOH *Water System Design Manual* recommends the following criteria for insuring source reliability:

1. Two or more supply sources are available with a capability to replenish depleted fire suppression storage within 72-hours while concurrently supplying the MDD for the water system.

2. Combined source capacity for the water system is enough to provide the MDD in a period of 18 hours or less of pumping.

3. With the largest source out of service, the remaining source(s) can provide a minimum of ADD for the water system.

4. Pump stations have power connections to two independent primary public power sources, or have portable or in-place auxiliary power available.

5. The firm yield of surface water sources is consistent with the lowest flow or longest period of extended low precipitation on record.

The following sections evaluate source reliability relative to the above criteria.

1. Reservoir Replenishment

With an installed source capacity of 1,865 gpm, the City of Buckley can produce a maximum of 2,685,600 gpd. The maximum design fire flow, per Table 3-1, is 2,000 gpm sustained for two hours, for a design maximum total fire flow withdrawal of 240,000 gallons. To replenish this amount in 72 hours requires source production capacity of a minimum of 80,000 gpd in excess of MDD. Therefore, the existing 2,685,600 gpd source capacity can meet up to 2,605,600 gpd of system demand while still having reserve capacity to replenish the maximum design fire demand within 72 hours. The projected MDD for 2036 from Table 2-12 is 2,618,000 gpd. Therefore, the existing installed source capacity is approximately adequate to replenish depleted fire storage within 72 hours while simultaneously meeting projected 20-year MDD.

2. MDD in 18 Hours

Table 2-12 shows a projected 20-year MDD of 2,618,000 gpd. The existing installed source capacity of 1,865 gpm can produce 2,014,200 gallons in 18 hours, which will meet the projected MDD through 2025. The existing source capacity requires 23.4 hours to produce 2,618,000 gallons. If system demand develops as projected, the system will require additional source capacity after 2025 to meet MDD in 18 hours.

3. Largest Source Out

The City's largest source of supply is South Prairie Creek, with a capacity of 725 gpm. With this source out of service, the City has a combined remaining source capacity of 1,140 gpm. 1,140 gpm will produce a maximum of 1,641,600 gpd. The projected 20-year ADD is 1,048,000 gpd. Therefore, the City has adequate source capacity to meet 20-year ADD with the largest source out of service. In fact, 1,140 gpm will produce 1,048,000 gallons in under 15.3 hours.

4. Power Supply Reliability

   The City's main water supply source, South Prairie Creek, flows entirely by gravity. Power supply for this source is only required for system treatment, monitoring and control equipment. The City's wells require more power because they need to pump water from below ground to the reservoir's hydraulic gradeline. Portable backup power supply generators are available to keep the water system sources running in the event of an extensive power outage.

5. Firm Yield of Surface Water Sources

   USGS stream flow statistics for South Prairie Creek at South Prairie are available from 1949 through 2012. The annual data reports indicate that the lowest stream flow on record for that period was 26.4 cfs in October 1988. The City's and Rainier School's combined water rights for South Prairie Creek, as shown in Table 3-11, are 5.5 cfs, which is less than one fifth of the lowest observed stream flow. Note that this stream flow monitoring station is downstream from the City of Buckley diversion point, so whatever flow rate the City was diverting at that time had already been removed from the stream flow before it reached the monitoring point. Note also that the City's water treatment plant capacity of 725 gpm is just 1.68 cfs. Therefore the flow in South Prairie Creek appears to be adequate to reliably support the City's municipal water supply diversion.

Based on the foregoing, the City of Buckley water system meets the DOH source reliability criteria.

TRANSMISSION ANALYSIS

As noted in Chapter 1, the transmission main from South Prairie Creek to the slow sand filtration plant is 28,400 feet (5.38 miles) long. Table 1-7 shows the current transmission main materials. Figure 1-6 shows the transmission line route from South Prairie Creek to the filtration plant and Appendix R includes detailed information on segments of the transmission main. Significant repairs have been completed on the transmission line in recent years, but portions of the transmission main remain in need of improvement. The transmission main has a capacity of between 900 and 1,200 gallons per minute.

Transmission Deficiencies

City staff have identified deficiencies in the transmission main from South Prairie Creek. Segments of the pipeline have limited accessibility and are in need of replacement. Segments are identified in Appendix R and replacement segments are prioritized in the Chapter 8 Capital Improvement Program.

TREATMENT ANALYSIS

Slow Sand Filter

Description and Condition

The City of Buckley water system includes a slow sand filter water treatment plant (WTP) to provide surface water treatment. The WTP is operated by Rainier School staff in accordance with the operating agreement included in Appendix B. The filtration plant has an available filter surface area of 8,500 square feet. The plant is currently operated at a flow rate of 725 gpm, which is a filter-loading rate of 0.085 gpm/sq ft. The DOH document, "Slow Sand Filtration and Diatomaceous Earth Filtration for Small Water Systems" (DOH PUB. #331-204, April 2003) indicates that slow sand filtration rates can be as high as 0.1 gpm/sq ft. Therefore the Buckley slow sand filtration system is operating within the DOH guidance, and there may be room for increasing the production rate of this filter system to as high as 850 gpm.

There is a single filter basin that has historically been scraped once per year. This has not proved to be an issue for system capacity as the City is able to scrape the filter during low demand periods of the year and the City's other sources have been adequate to meet the system demands. This case should remain as the City brings other source capacity on-line in the future.

A comprehensive evaluation of the sand bed was completed in April 2013. Sand depth was evaluated at 20 locations throughout the filter. Sand depth ranged from 22 inches to 28 inches, with an average sand depth of 23.7 inches. Records indicate that the filter was originally constructed with 39 inches of sand in 1997. Therefore, the sand has been depleted an average of 0.96 inch per year. The DOH document, "Slow Sand Filtration and Diatomaceous Earth Filtration for Small Water Systems" recommends that 18-inches of sand remaining should be considered the minimum practical bed depth. At a 2013 average sand depth of 23.7 inches and a depletion rate of 0.96 inch per year, it is estimated that the sand filters will need to be re-sanded by 2018.

Long Term 2 Enhanced Surface Water Treatment Rule

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) requires that water systems must take additional untreated source water samples to determine susceptibility to contamination with the intestinal parasite, *cryptosporidium*. The minimum sampling requirement is one untreated water sample for E. coli every two weeks. The first round of sampling was to begin October 2008. Systems using a flowing surface water source, such as South Prairie Creek, (as opposed to a non-flowing source, such as a lake) that have mean annual raw water E. coli results greater than 50 E. coli per 100 mL were required to do cryptosporidium sampling. Systems with substantial raw water E. coli data prior to October 2008 could be grandfathered in based on existing data.

By 2008, the City of Buckley/Rainier School slow sand filtration plant had substantial raw water E. coli results. By letter dated July 7, 2008, existing raw water E. coli data was approved for purposes of grandfathering. The letter states that grandfathered samples averaged 4 organisms per 100 mL, that the initial classification was Bin 1, and that no additional monitoring or treatment for cryptosporidium was required at that time.

According to the EPA Publication, *LT2ESWTR Source Water Monitoring for Systems Serving Less Than 10,000 People Factsheet* (EPA 816-F-06-018, June 2006), a second round of source water monitoring for E. Coli is required starting October 1, 2017. Grandfathering is not available for the second round of samples. Samples for E. Coli will be required at that time once every two weeks for 12 months. As with the first round of sampling, if the mean E. Coli concentration is greater than 50 per 100 mL, then additional monitoring will be required for cryptosporidium.

Controls

Chlorine gas is utilized at the plant for disinfection, and the City's 2.3 MG reservoir provides the required disinfection contact time. The City installed sodium hydroxide (NaOH) feed facilities at the plant in 2004 to increase filtered water pH slightly. The City has also installed a new filtered water flow meter and a new raw water inlet weir for flow measurement. The plant's instrumentation and telemetry system includes raw water and filtered water turbidimeters, and a filtered water chlorine/pH analyzer. Telemetered Alarms call Rainier School staff. If Rainier School staff does not respond, the City's on-call staff member responds to alarm calls. Telemetered alarming is provided for turbidity, chlorine and pH measurements outside specific ranges. The currently telemetry and control system uses RUGID Programmable Logic Controllers and telemetry units. The City has had some difficulties getting service and support for these units. The City will consider upgrade of the telemetry and control system in the capital improvement plan.

Disinfection Contact Time

Disinfection contact time is required for systems that provide surface water treatment to ensure adequate inactivation of pathogenic microorganisms such as Giardia and viruses. Disinfection effectiveness is determined by comparing the actual disinfection conditions provided to the minimum required by DOH. The tool used to calculate this effectiveness is termed CT, which is the product of the disinfectant concentration (C) and the time (T) that the water is in contact with the disinfectant. EPA has published tables that list the required CT under various temperature, pH and disinfection dose conditions. For the City of Buckley, the worst case condition for disinfection, based upon historical data, would occur during summer peak flow conditions. These conditions are summarized below:

Minimum Water Temperature	= 10 degrees C
Maximum pH	= 8.0

Minimum Chlorine Residual = 1.0 mg/L

To obtain the required 1 log inactivation of Giardia cysts under the worst-case conditions shown above, a CT of 54 must be provided. To provide a CT of 54 at a chlorine residual of 1.0 mg/L requires a contact time of 54 minutes. To provide a contact time of 54 minutes at a flow rate of 725 gpm requires an effective contact volume of 39,150 gallons. For unbaffled reservoirs such as the City of Buckley's, the baffling efficiency is assumed to be 10 percent. At a 10 percent contact time efficiency, the required reservoir volume to provide an effective contact time of 54 minutes at 725 gpm is 391,500 gallons.

The CT provided is calculated by multiplying the minimum chlorine residual by the average time that the disinfectant is in contact with the water. The average contact time is calculated by dividing the storage volume by the peak hour flow through the storage volume and then multiplying the value by a correction factor for the reservoir's internal baffling efficiency

STORAGE ANALYSIS

Storage Standards for public water supply systems in the State of Washington are outlined in Chapter 9 of the DOH *Water System Design Manual*. Components of storage systems, according to this guidance document, consist of the following:

- Dead Storage
- Operational Storage
- Fire Suppression Storage
- Equalizing Storage
- Standby Storage

Below is a description of each of these storage components.

Dead Storage

Dead storage consists of any volume of a reservoir that cannot be used to store and retrieve water while complying with other applicable regulations and standards. Examples of this include, but are not necessarily limited to, the following:

Reservoir volume required to provide freeboard above high water level for maintenance, system control, and/or seismic design purposes.

Water below the lowest level at which water can flow from the reservoir at the design flow rate.

Water located below the level where minimum pressures cannot be supplied in the distribution system.

All reservoirs have some degree of the first two categories of dead storage. Reservoirs generally have an overflow that is below the top of the reservoir wall to prevent overflowing the reservoir wall. Source control systems generally shut off the source before the water level reaches the overflow to keep from routinely wasting water by overflowing. So reservoir volume between the source water off level and the top of the reservoir wall is dead storage.

Reservoirs also typically have a silt stop in the reservoir outlet to prevent any silt buildup on the reservoir floor from going out the reservoir outlet. When the water level drops to the top of the top of the silt stop, no water will flow from the reservoir. Depending on the size of the reservoir outlet and the maximum system demand, it may necessary to have several inches of water above the silt stop to achieve the design flow rate from the reservoir.

The third category of dead storage is generally applicable to tall reservoirs, where the reservoir height is intended to provide system pressure. In such a case, reservoir volume below the water level at which minimum pressure requirements are met is also dead storage, unless there is a pumping system available to meet pressure standards when the reservoir level is low.

Operational Storage

Operational storage is the volume of a reservoir required for system operation. This is typically the reservoir volume between source on and off levels in the reservoir. The differential between source on and off levels needs to be great enough such that level controls can reliably detect the difference between source on and off level, and the volume of water between source on and off level needs to be great enough such that the source water system does not need to be turned on and off too frequently.

Operational storage can also include volumes of water that must be retained in the reservoir for operational purposes. The City of Buckley uses its reservoir to provide disinfection contact for surface water treatment, so storage volume allocated for disinfection contact time is also operational storage. As described above, the maximum volume required in the reservoir for chlorine contact time is 391,500 gallons.

Equalizing Storage

Equalizing storage is typically used to meet diurnal demands that exceed the average day and maximum day demands. The volume of equalizing storage required depends on peak system demands, the magnitude of diurnal water system demand variations, the source production rate, and the mode of system operation. Sufficient equalizing storage must be provided in combination with available water sources and pumping facilities such that peak system demands can be satisfied.

Based on the DOH Water System Design Manual, equalizing storage is calculated using the following equation:

$$V_{ES} = (Q_{PH} - Q_S) \times 150 \text{ minutes}$$

Where: $\mathbf{V_{ES}}$ = Equalizing storage component (gallons)
$\mathbf{Q_{PH}}$ = Peak hourly demand (gpm)
$\mathbf{Q_S}$ = Total source capacity, excluding emergency sources (gpm)

Since equalizing storage varies with peak hour demand, which is a function of the number of ERUs, the required amount of equalizing storage will increase as ERUs increase.

Standby Storage

Standby storage is provided in order to meet demands in the event of a system failure such as a power outage, an interruption of supply, or break in a major transmission line. The amount of emergency storage should be based on the reliability of supply and pumping equipment, standby power sources, and the anticipated length of time the system could be out of service.

Standby storage for water systems with multiple sources of supply is calculated using the following equation:

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

Where: $\mathbf{SB_{TMS}}$ = Standby storage component for a multiple source system (gallons)
ADD = Average day demand for the system (gpd/ERU)
N = Number of ERUs
$\mathbf{Q_S}$ = Sum of all source capacities, except emergency sources (gpm)
$\mathbf{Q_L}$ = Capacity of largest source (gpm)
$\mathbf{t_m}$ = Time that sources are allowed to run per day with largest source out of service.

The DOH *Water System Design Manual* further recommends that standby storage volume be no less than 200 gallons per ERU. This can be expressed as follows:

$$SB_{TMS} \geq 200 \times N$$

The source capacity with the largest source out of service ($Q_S - Q_L$) is 1,200 gpm. With the largest source out of service, it will be assumed that the remaining sources can run 24 hours over the ensuing two days. 1,200 gpm for 24 hours is 1,728,000 gallons. From Table 2-13, the 20-year projected average day system demand is 806,000 gpd. Twice this amount is 1,612,000 gallons. Therefore, source capacity with the largest source off line

is more than enough to meet two days of average day demand in one day of source pumping. Therefore, the minimum of 200 gallons per ERU is the dominating factor in determining standby storage amounts for the Buckley reservoir.

Since standby storage varies as a function of the number of ERUs, the amount of standby storage required will vary with the projected number of ERUs.

Fire Suppression Storage

Fire suppression storage is provided to ensure that the volume of water required for fighting fires is available when necessary. Fire suppression storage also reduces the impact of firefighting on distribution system water pressure. The amount of water required for firefighting purposes is specified in terms of a rate of flow in gallons per minute (gpm) and an associated duration in minutes. Fire flows must be provided at a residual water system pressure of at least 20 pounds per square inch (psi).

Fire suppression storage is calculated using the following equation:

$$FSS = (FF)(t_m)$$

Where: **FSS** = Required fire suppression storage component (gallons)
FF = Required fire flow rate (gpm)
t_m = Duration of fire flow rate (minutes)

The City of Buckley has adopted a fire flow and duration standard of 2,000 gpm for a 2-hour duration. The required fire suppression storage component is therefore:

FSS = 2,000 gpm x 120 min = 240,000 gal

Effective Storage

Effective storage is defined as the gross volume of storage available, minus dead storage and operational storage. The effective volume available in a reservoir system must be large enough to accommodate the sum of Equalizing Storage, plus the greater of Standby Storage or Fire Suppression Storage requirements, unless nesting of Standby Storage and Fire Suppression Storage is not allowed, in which case the effective volume available must be large enough to accommodate the sum of Equalizing Storage, Standby Storage, and Fire Suppression Storage requirements. By policy, the City of Buckley provides additive Standby Storage and Fire Suppression Storage.

Storage Capacity Analysis

Based on drawings available, the City of Buckley's reservoir is rectangular basin, the top 2 feet of which have vertical sides, and the bottom 10 feet of which have sloping sides at a 1:1 slope. The interior dimensions at the top are approximately 182 feet length by

158 feet width. The elevation of the top of the wall is 883 feet, the elevation of the reservoir overflow is 882 feet, the elevation of the bottom of the reservoir is 871 feet. Table 3-15 summarizes the reservoir dimensions and shows the volumes of the reservoir between certain key water elevations

TABLE 3-15

Existing Reservoir Dimensions and Capacities

Parameter	Value
Top of Wall Length, feet	182.0
Top of Wall Width, feet	158.0
Base Length, feet	162.0
Base Width, feet	138.0
Top of Wall Elevation, feet	883
Top of Slope Elevation, feet	881
Base Elevation, feet	871
Gross Reservoir Volume, gallons(1)	2,337,000
Overflow Elevation, feet	882
Volume to Overflow, gallons(2)	2,122,000
Source Water-Off Elevation, feet	881.5
Volume to Source Water-Off, gallons(3)	2,014,000
Source Water-On Elevation, feet	880.5
Volume to Source Water-On, gallons(4)	1,800,000
Cycle Volume, gallons(5)	214,000
Outlet Elevation, feet	872.0
Volume to Outlet, gallons(6)	169,000
Minimum Level to Provide Required CT of 54, feet(7)	873.3
Volume in Reservoir at 873.3 feet, gallons(7)	397,000
Effective Storage Volume, gallons(8)	**1,403,000**

(1) Gross Reservoir Volume is the volume from reservoir floor to the top of the reservoir wall.
(2) Volume to Overflow is the reservoir volume from floor to top of the reservoir overflow.
(3) Volume to Source Water-Off is the volume from the floor of the reservoir to the source water off elevation of 881.5 feet.
(4) Volume to Source Water-On is the volume from the floor of the reservoir to the source water on elevation of 880.5 feet.
(5) Cycle Volume is the difference between Volume to Source Water-Off and Volume to Source Water-On.
(6) Volume to Outlet is the volume from the reservoir floor to the top of the reservoir outlet.
(7) Minimum Level to Provide Required CT is the level at which the volume retained in the reservoir is adequate to provide the maximum required CT to meet Surface Water Treatment Rule disinfection requirements. Note that the volume remaining in the reservoir at 873.3 feet if more than the maximum requirement of 391,500 gallons. The actual calculated level is 873.27111 feet, but for purposes of this evaluation 873.3 feet is close enough.
(8) Since the volume required to meet the CT of 54 is greater than the volume to the reservoir outlet, the lower reservoir operating limit is the level required to meet that CT of 54. Effective storage is the volume retained in the reservoir between the Source Water-On level of 880.5 feet and the level of 873.3 feet, required to provide CT of 54.

Projected Storage Requirements

Storage requirements based on the DOH Water System Design Manual criteria and compared to the available effective storage discussed above, are shown in Table 3-16 below.

TABLE 3-16

Projected Storage Requirements (gallons)

Year	Equalizing Storage(1)	Standby Storage(2)	Fire Storage(3)	Total Storage(4)	Storage Capacity Surplus (Deficit)(5)
2017	0	715,000	240,000	955,000	448,000
2018	5,000	739,000	240,000	984,000	419,000
2019	14,000	765,000	240,000	1,019,000	384,000
2020	23,000	791,000	240,000	1,054,000	349,000
2021	33,000	818,000	240,000	1,091,000	312,000
2022	44,000	846,000	240,000	1,130,000	273,000
2023	54,000	875,000	240,000	1,169,000	234,000
2024	65,000	905,000	240,000	1,210,000	193,000
2025	77,000	936,000	240,000	1,253,000	150,000
2026	89,000	969,000	240,000	1,298,000	105,000
2027	101,000	1,002,000	240,000	1,343,000	60,000
2028	113,000	1,036,000	240,000	1,389,000	14,000
2029	126,000	1,072,000	240,000	1,438,000	(35,000)
2030	140,000	1,109,000	240,000	1,489,000	(86,000)
2031	146,000	1,126,000	240,000	1,512,000	(109,000)
2032	153,000	1,144,000	240,000	1,537,000	(134,000)
2033	159,000	1,161,000	240,000	1,560,000	(157,000)
2034	167,000	1,180,000	240,000	1,587,000	(184,000)
2035	173,000	1,198,000	240,000	1,611,000	(208,000)
2036	173,000	1,198,000	240,000	1,611,000	(208,000)

(1) Equalizing Storage is based on the Equalizing Storage formula above, the PHD formula in Table 2-11, and the projected number of ERUs (N) in Table 2-12, rounded to the nearest 1,000 gallons. Equalizing storage is zero through 2019 because projected PHD through 2028 is less than the total source capacity of 1,865 gpm.

(2) Standby Storage is based on the Standby Storage formula, the ADD value of 175 gpd per ERU from Table 2-12, and the number of ERUs in Table 2-12, rounded to the nearest 1,000 gallons.

(3) Fire Storage is based on the Fire Suppression Storage formula above, and the Fire Flow Standard of 2,000 gpm, sustainable for two hours, from Table 3-1.

(4) Total Storage is the sum of Equalizing Storage, Standby Storage, and Fire Suppression Storage.

(5) Storage Capacity Surplus (Deficit) is the difference between Total Storage as shown in Table 3-16 and Effective Storage Volume as shown in Table 3-15.

Table 3-16 shows that existing storage capacity exceeds the DOH Water System Design Manual Standards through the year 2028, after which additional storage may be required if ERU values and growth rates remain as projected in Chapter 2 of this Plan.

Storage Deficiencies

Table 3-16 shows that the City of Buckley has adequate storage capacity at the projected growth rate through 2028. However, the water system is completely reliant on a single reservoir. Having only one reservoir makes it problematic to take the reservoir out of service for maintenance, and makes the system vulnerable to and failure of the reservoir. For these reasons, the City is interested in having a second reservoir for enhanced reliability and operations flexibility. The City would like to construct an additional reservoir with an effective storage capacity of approximately one million gallons.

The City's existing 0.75 MG reservoir, which is not currently used for potable water, is not suitable for use a secondary potable water reservoir. The reservoir is located somewhat lower than the 2.3 MG reservoir and is also not connected to the water system with appropriate intake and discharge lines. It is recommended this reservoir be dedicated to non-potable uses.

DISTRIBUTION ANALYSIS (HYDRAULIC MODEL)

This section presents information on the computer hydraulic model of the City's water system and the results of hydraulic analyses conducted to evaluate the existing and future capabilities of the water system.

The operation of a municipal water system involves dynamic interactions between various water system components, including supply wells, storage, and distribution system facilities. These interactions and their effect on the level of service provided to the City's customers are dependent on the distribution and magnitude of water demands within the system and the performance characteristics of the water system facilities. In addition, infrequent high water demand events, such as firefighting and other emergencies, can significantly alter the normal flow patterns and pressures in the municipal water system and its components. These factors must be considered in analyzing the ability of a water system to provide for future demands, while maintaining an adequate level of water service to customers.

The development of a computer hydraulic model, which can accurately and realistically simulate the performance of a water system in response to a variety of conditions and scenarios, has become an increasingly important element in the planning, design, and analysis of municipal water systems. The Washington State Department of Health's WAC 246-290 requires hydraulic modeling as a component of water system plans.

Hydraulic Modeling Software

The City's water system was analyzed using MWHSoft's H_2ONet hydraulic modeling software, which operates in an AutoCAD computer-aided design and drafting environment. The H_2ONet model was created using the City's water system base map. Reservoir elevations and well capacities were determined from existing planning documents and City records.

The H_2ONet model is configured with a graphical user interface. Each water system element (sources, pipes, control valves, and reservoir) is assigned a unique graphical representation within the model. Each element is assigned a number of attributes specific to its function in the actual water system. Typical element attributes include spatial coordinates, elevation, water demand, pipe lengths and diameters, and critical water levels for reservoirs. With attributes of each system element as the model input, the H_2ONet software produces the model output in the form of flows and pressures throughout the simulated water system.

Model Assumptions

Prior to the calibration of the hydraulic model, the basic layout of the water system is recreated within the model. The lengths, diameters, and connection points of system piping are assigned using an updated base map of the water system. The locations of normally closed valves and wells are found on water system base maps, while the critical elevations of the reservoirs are taken from the City's records. Chapter 1 provides a complete description of each system facility. The assumptions regarding the modeling of the system demands are included in the following sections.

System Demands

A key element in the hydraulic modeling process is the distribution of demands throughout the water system. Total demand on the system is based on the existing and projected demands from Chapter 2.

Five demand sets were used in the hydraulic analysis.

2014 Average Daily Demands: These demands were used while calibrating the model.

2020 Peak Hour Demands: These demands were used to verify the system is able to meet the DOH Standards to supply domestic water at a minimum system wide pressure of 30 psi within the 6-year planning period.

2020 Maximum Day Demands: These demands were used to evaluate the system's ability to meet the maximum day demands plus required fire flows at DOH's requirement of 20 psi within the 6-year planning period.

2034 Peak Hour Demands: These demands were used to verify the system is able to meet the DOH Standards to supply domestic water at a minimum system wide pressure of 30 psi within the 20-year planning period.

2034 Maximum Day Demands: These demands were used to evaluate the system's ability to meet the maximum day demands plus required fire flows at DOH's requirement of 20 psi within the 20-year planning period.

Model Calibration

The calibration of a hydraulic model provides a measure of assurance that the model is an accurate and realistic representation of the actual system. Since the City's distribution system has not changed substantively in the last 10 years, field measurements from April 2004 are used for the calibration process.

Fire Hydrant Tests

The H_2ONet hydraulic model of the City's water system was calibrated using data obtained from fire hydrant tests at various locations throughout the water system. Five fire hydrant tests were conducted, with the assistance of City personnel, on April 8, 2004. During these tests, static and residual pressures were recorded as City staff opened hydrants and recorded flow rates. Field results were used to calibrate the hydraulic model through verification of pipe type, size, and elevations and adjustment of pipe friction coefficients.

The testing locations include five points spread throughout the City's distribution system. A description of each testing location is presented in Table 3-17.

TABLE 3-17

Hydrant Testing Locations

Test Number	Time	Testing Location
1	8:30 a.m.	Rose Place and Bevlo Boulevard
2	8:50 a.m.	Shay Road
3	9:10 a.m.	Alfano Court and Trullinger Avenue
4	9:20 a.m.	Dundass Avenue, Cascade Street to Edith Street
5	9:40 a.m.	State Route 410, east of car wash

The reservoir level was 14.5 at 8:00 a.m., before hydrant testing began. Since the water treatment plant was in operation (and filling the reservoir), the tank did not drop its level during the five hydrant tests. Water consumption between 8:00 a.m. and 10:00 a.m. during a weekday is typically low.

Calibration Procedures

Using the system conditions for each hydrant test, the hydraulic model was used to generate static pressure and residual pressure at the measured hydrant flow rate. Model output was generated at points in the model equivalent to the locations of the hydrant tests.

Model output for static pressure was generated by running the model at one half of 2004 average day demands. Model output for residual pressure was generated at each hydrant test location by placing an added demand equal to the measured hydrant flow rate and recording the resulting pressure.

The system pressures and pipe flow rates determined in the hydraulic analysis are highly dependent on the friction loss characteristics established for each pipe. The friction losses occurring in lengths of pipe and various valves are accounted for in the hydraulic model.

Calibration Results

The friction factors for the pipes in the modeled system are adjusted throughout the calibration process until the model output best approximates the measured values. Hazen-Williams C-factors between 120 and 130 are used throughout the system. These friction factors are typical values for most pipe and are generally conservative. The friction factors for the pipe also compensates for system losses through valves and pipe fittings.

The model output was produced for two data comparisons, static pressure and residual pressure. The values measured in the hydrant flow tests were compared to the model output values in Table 3-18.

TABLE 3-18

Calibration Results

Test No.	Flow (gpm)	Static Pressure (psi)			Residual Pressure (psi)			DS – DR[(1)]
		Field	Model	Difference	Field	Model	Difference	
1	1,160	62	62	0	53	52	-1	1
2	1,190	58	58	0	52	52	0	0
3	1,190	68	67	-1	56	53	-3	2
4	1,160	70	70	0	58	55	-3	3
5	1,280	71	72	1	58	55	-3	4

(1) DS – DR is equal to the static pressure difference minus the residual pressure difference.

Calibration of the hydraulic model produced results that are within 1 psi of actual field test data for static pressure and from 0-3 psi of residual pressure. Hydraulic models are

required to be within 5 psi of measured pressure readings for long-range planning, according to the DOH Design Manual, Table 8-1.

Figure 3-9 is the pipe and node map representing the City's hydraulic model.

Distribution System Analysis

Peak Hour Analysis

According to WAC 246-290, a water system must maintain a minimum pressure of 30 psi in the distribution system under peak hour demand conditions. The City's existing distribution system has been modeled under 2014, 2020 and 2034 peak hour demand conditions. Results of these analyses are located in Appendix J.

Peak hour analysis for 2014, 2020 and 2034 revealed no system deficiencies. The 2014 peak hour minimum system pressure of 35.7 psi occurs at the southern end of Klink Street. The projected peak hour demand in 2034 is projected to cause a minimum system pressure of 32 psi at the south end of Klink Road.

Available Fire Flow Analysis

The DOH *Water System Design Manual* states that a water system should be designed to provide adequate fire flow under peak day demand conditions, while maintaining a minimum system pressure of 20 psi. The results of fire flow modeling are presented in Appendix J.

Table 3-19 lists the critical fire flow locations, their required flow, and their available flow during 2014, 2020 and 2034 maximum daily demand conditions. Figure 3-10, Figure 3-11, and Figure 3-12 show available fire flow under 2014, 2020, and 2034 maximum day demand conditions respectively. For 2020 and 2034 scenarios, the available fire flow assumes that all capital improvements have been made as recommended in Chapter 8 of this plan.

TABLE 3-19

Available Fire Flow Results for Critical Locations

Location	Required Fire Flow (gpm)	Available Fire Flow[(1)] (gpm)			Deficient?[(2)]
		2014	2020	2034	
Wastewater Treatment Plant (J-24)	1,500	2,383	2,190	2,041	No
Rainier School (J-174)	1,500	4,459	4,173	3,717	No
Wikersham Elementary School (J-79)	1,500	2,223	2,036	1,905	No
Elk Ridge Elementary School (J-57)	1,500	2,412	2,194	2,008	No
White River High School (J-64)	1,500	2,098	1,935	1,792	No

(1) Available fire flow is limited by a minimum system pressure of 20 psi, not specifically at the fire flow location.

(2) Refers to deficiency under 2014 demand conditions.

WATER SYSTEM CAPACITY LIMITS

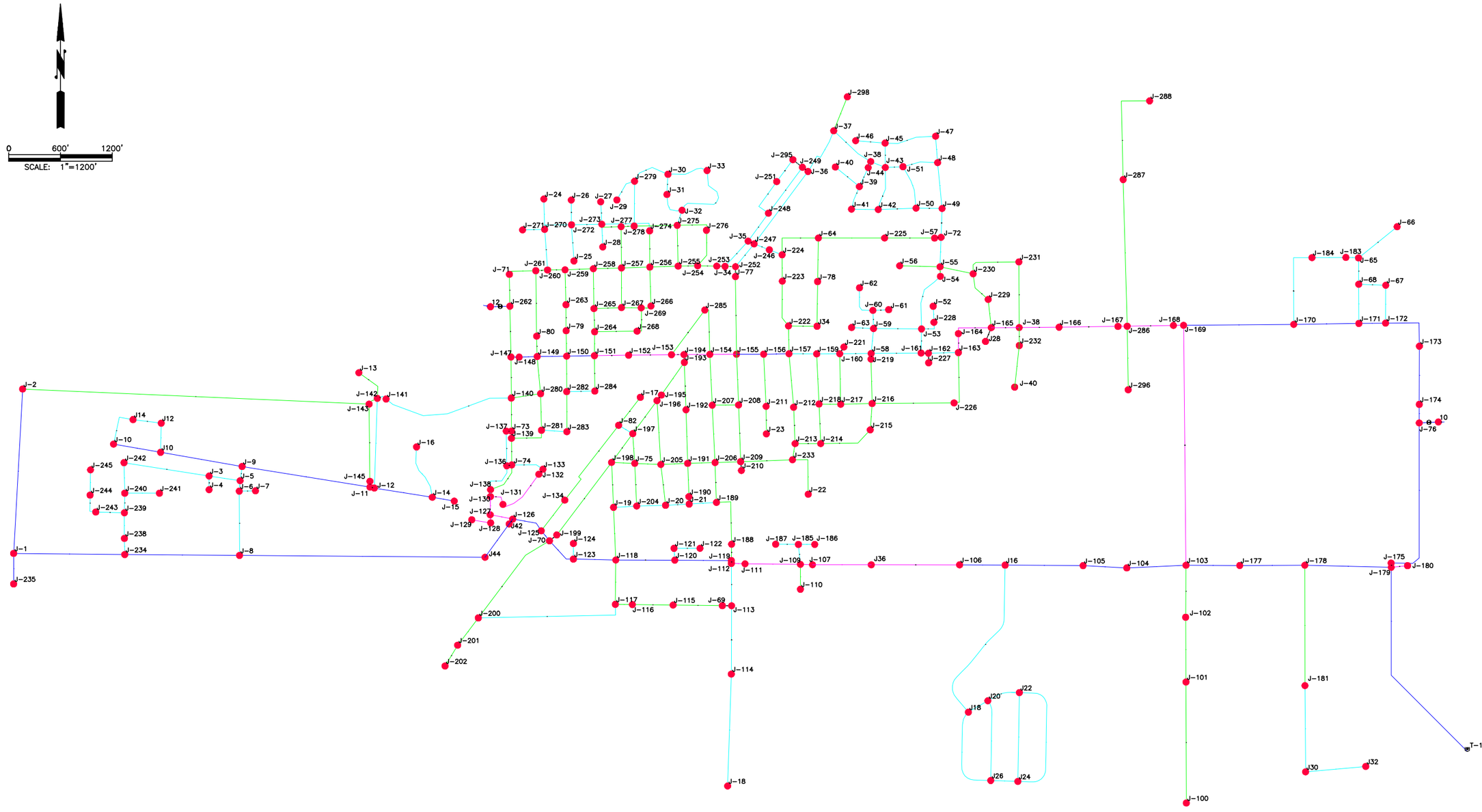
There are several factors that could limit water system capacity, including source capacity, instantaneous water rights capacity, annual water rights capacity, and storage capacity. These potential limiting factors are reviewed in the following sections.

SOURCE CAPACITY LIMIT

The City's source capacity goal, as shown in Table 3-1, is to meet system MDD within 18 hours per day of pumping, and to replenish fire suppression storage within 72 hours while meeting MDD with 24 hours per day of source production. In 18 hours per day at 1,865 gpm, the system sources can produce 2,014,200 gallons per day. In 24 hours per day at 1,865 gpm, the system sources can produce 2,685,600 gallons per day. To replenish the fire suppression storage volume of 240,000 gallons within 72 hours requires 80,000 gallons per day, leaving 2,605,600 gallons per day to meet system MDD while replenishing fire flow within 72 hours.

Since meeting system demand within 18 hours per day is more restrictive on source capacity than replenishing fire reserve storage within 72 hours, the source capacity limiting factor will be based on meeting system demand in 18-hours per day of source production. Therefore the ERU limit based on source capacity is as follows:

$$\text{ERU Limit based on Source Capacity} = \frac{2{,}014{,}200 \text{ gpd}}{437 \text{ gpd/ERU}} = 4{,}609 \text{ ERUs}$$



PIPE DIAMETER

- 4-INCH
- 6-INCH
- 8-INCH
- 10-INCH
- 12-INCH

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 3-9

HYDRAULIC MODEL PIPE AND NODE MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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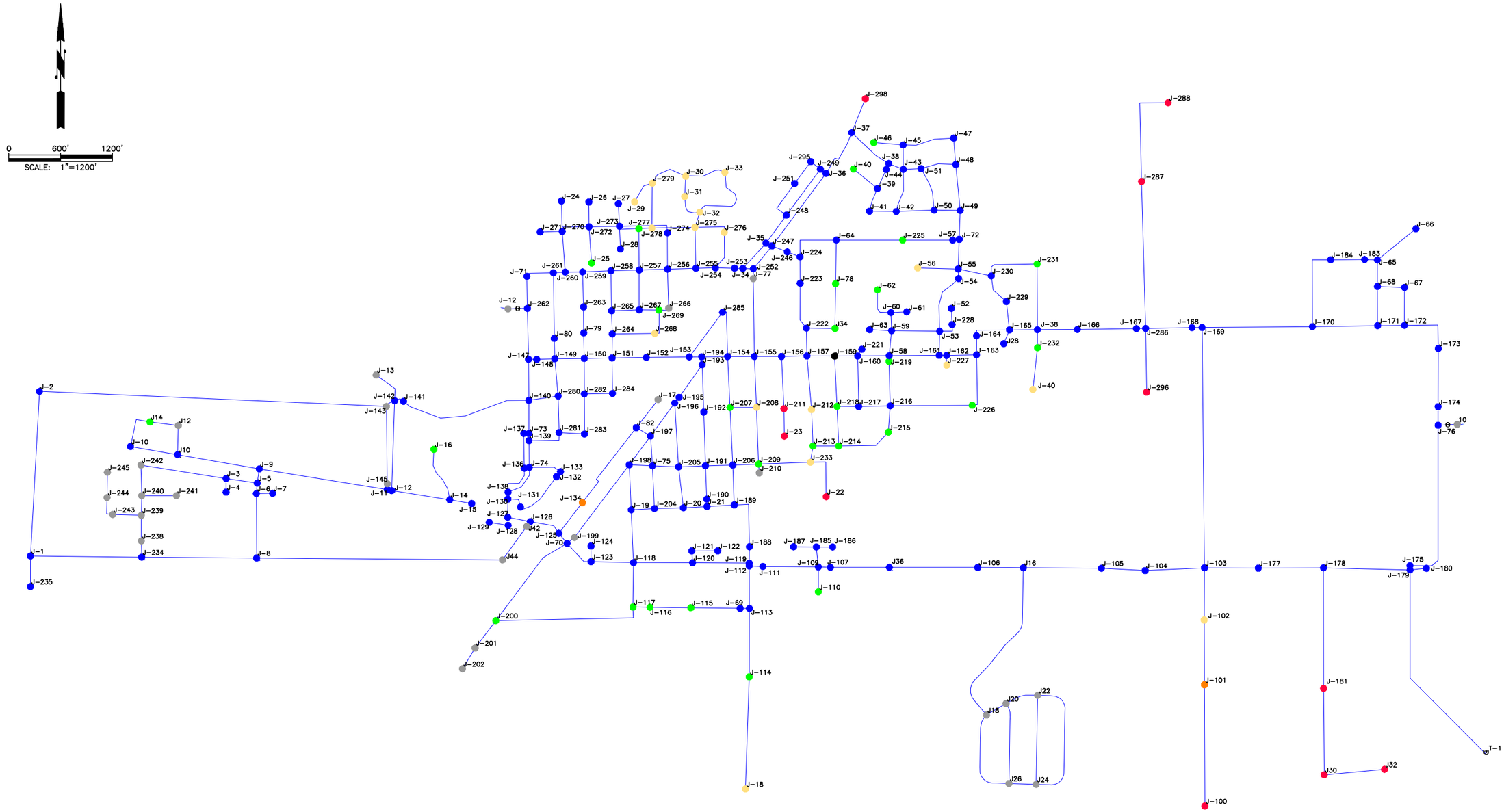

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 3-10

EXISTING FIRE FLOW AVAILABILITY MAP

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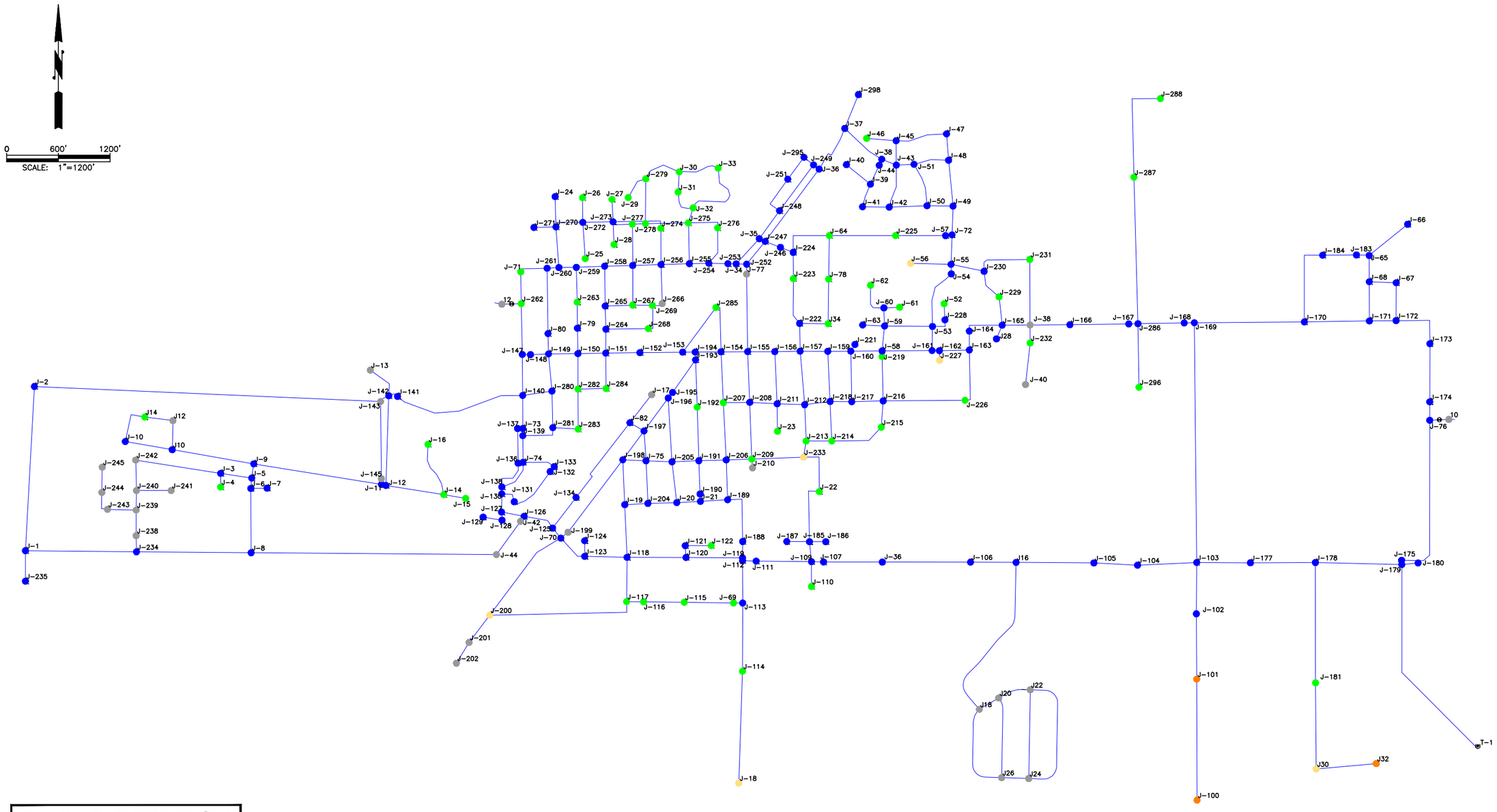

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 3-11

6-YEAR FIRE FLOW AVAILABILITY MAP

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CONSULTING ENGINEERS

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0 600' 1200'
SCALE: 1"=1200'

AVAILABLE FIRE FLOW (GPM)

- BELOW 750
- 750 TO 1,000
- 1,000 TO 1,500
- 1,500 TO 2,000
- ABOVE 2,000

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 3-12

20-YEAR FIRE FLOW AVAILABILITY MAP

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CONSULTING ENGINEERS

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INSTANTANEOUS WATER RIGHT CAPACITY LIMIT

From Table 1-3, Buckley has 3,599 gpm of instantaneous water rights. Applying the 18 hours per day reliability standard, the instantaneous water rights limit can be calculated as follows:

$$\text{ERU Limit based on Instantaneous Water Rights} = \frac{3{,}599 \text{ gpm} \times 1{,}080 \text{ min/day}}{437 \text{ gpd/ERU}} = 8{,}895 \text{ ERUs}$$

ANNUAL WATER RIGHT CAPACITY LIMIT

The annual water rights limit from Table 1-3 is 2,146.72 ac-ft/yr, and the Average Day Demand per ERU from Table 3-1 is 175 gpd. The limit on ERUs due to the annual water right limit can be calculated as follows:

$$\text{ERU Limit based on Annual Water Rights} = \frac{2{,}146.72 \text{ ac-ft/yr} \times 325{,}851 \text{ gal/ac-ft}}{175 \text{ gpd/ERU} \times 365 \text{ days/year}} = 10{,}951 \text{ ERUs}$$

STORAGE CAPACITY LIMIT

To find the number of ERUs supportable by existing storage it is necessary to calculate storage requirements for various numbers of ERUs until the required storage exceeds the existing effective storage. Table 3-20 shows storage requirements for 5,227 ERU, and 5,228 ERUs. The existing effective storage capacity has 266 gallons of surplus storage at 5,227 ERUs, but it is deficient by 8 gallons for 5,228 ERUs. Therefore, the existing storage is adequate for 5,227 ERUs.

TABLE 3-20

Storage Requirement Limit

ERUs	Equalizing Storage (1), gal	Standby Storage (2), gal	Fire Storage, gal	Total Storage (3), gal	Storage Capacity Surplus (Deficit) (4), gal
5,227	117,335	1,045,400	240,000	1,402,735	266
5,228	117,408	1,045,600	240,000	1,403,008	(8)

(1) Equalizing Storage is peak hour demand for the indicated number of ERUs, minus the existing source capacity of 1,865 gpm, times 150 minutes, rounded to the nearest 1,000 gallons.

(2) Standby Storage is two days of average day demand minus 24 hours of source capacity with the largest source out of service, or it is 200 gallons times the projected number of ERUs, whichever is greater, rounded to the nearest 1,000 gallons.

(3) Total Storage is the sum of equalizing, standby and fire suppression storage.

(4) Storage Capacity Surplus (Deficit) is Effective Storage Volume of 1,403,000 gallons from Table 3-15 minus Total Storage from Table 3-20.

SUMMARY OF SYSTEM ERU LIMITS

Table 3-21 summarizes system ERU limits based on the preceding sections.

TABLE 3-21

Summary of ERU Limits

Limiting Factor	System Capacity ERUs	Existing System Demand ERUs	Available ERUs
Installed Source Capacity	4,609	3,455	1,154
Storage Capacity	5,227	3,455	1,772
Instantaneous Water Rights	8,895	3,455	5,440
Annual Water Rights	10,951	3,455	7,496

CITY OF BUCKLEY SYSTEM DEFICIENCY SUMMARY

Existing and future system deficiencies of the City's water system are summarized below. Recommended projects to correct these deficiencies are outlined in Chapter 8.

SOURCE MAINTENANCE

The slow sand filter is due to be re-sanded by 2018. This is a requirement to keep the slow sand filter system operating. It is possible that with careful scraping and careful evaluation that the re-sanding may be delayed by a year or two, but re-sanding will be required soon.

SOURCE CAPACITY

Instantaneous and annual water rights are adequate to cover projected growth through 2036. Source capacity is adequate to serve projected growth through 2024. By 2036 it is projected that the system will need an additional 559 gpm to meet system demand in 18 hours per day of source production. The City plans to use raw water to serve irrigation demands for the farm areas around Rainier School. This would free up source capacity for potable water and extend the year that source capacity is reached.

STORAGE

Based on demand projections from Chapter 2, and fire flow standards storage analysis outlined in this chapter, the City has adequate storage capacity through the year 2033, but will need additional storage by 2034. However, based on system reliability criteria, it is recommended that the City construct a second reservoir sooner, such that if one reservoir is out of service for maintenance or repair, the system can still operate with the other reservoir.

TRANSMISSION

1. Segment 6 (See Appendix R)
2. Segment 13 (See Appendix R)
3. Segment 15 (See Appendix R)
4. Segment 16 (See Appendix R)
5. Segment 19 (See Appendix R)
6. Segment 21 (See Appendix R)

TREATMENT

1. Filter loading rate could be increased to gain more filtration capacity.
2. The filters will most likely need to be re-sanded in 2018.
3. The LT2SWTR will require additional raw water coliform sampling beginning in October 2017.
4. The City has had problems getting service for their RUGID programmable logic controllers and telemetry units, and may wish to replace them with new control units.

DISTRIBUTION

- Existing undersized lines, typically 4-inch or 6-inch, are inadequate to transmit commercial fire flow to existing and future commercial development. Many of these lines are also asbestos-cement (AC) pipe, which is in need of replacement. Some of these lines are dead-ends, where looping can substantially increase available fire flow.

- Existing undersized lines, typically 4-inch or 6-inch, are inadequate to transmit residential fire flow to existing and future commercial development. Many of these lines are also asbestos-cement (AC) pipe, which is in need of replacement. Some of these lines are dead-ends, where looping can substantially increase available fire flow.

- In various areas of the distribution system, main extensions are anticipated to be constructed by developers to serve new residential development. These projects may include upsizing existing lines in addition to the main extensions.

CHAPTER 4

WATER USE EFFICIENCY PROGRAM

OBJECTIVE

The objectives of this chapter are to identify the conservation and water use efficiency requirements pertaining to the City of Buckley water system, evaluate past conservation efforts, and describe City of Buckley Water System's water use efficiency plan for the next 6 years.

WATER USE EFFICIENCY PLANNING REQUIREMENTS

In 1989, the Washington Legislature passed the Water Use Efficiency Act (43.20.230 RCW), which directed DOH to develop procedures and guidelines relating to water use efficiency. In response to this mandate, Ecology, the Washington Water Utilities Council, and DOH jointly published a document titled *Conservation Planning Requirements* (1994). In 2003, the Municipal Water Supply – Efficiency Requirements Act (Municipal Water Law) was passed. This legislation amended RCW 90.03 to require additional conservation measures. The Municipal Water Law applies to all Municipal Water Suppliers. Among other things, the Municipal Water law directed DOH to develop the Water Use Efficiency Rule (WUE Rule), which was adopted January 22, 2007. In addition, DOH has developed a WUE Rule guidance document titled "Water Use Efficiency Guidebook" (WUE Guidebook) originally dated July 2007, and revised January 2011 (DOH Publication #331-375). The WUE Guidebook supersedes and replaces the 1994 Conservation Planning Requirements. Therefore, the WUE Rule and the WUE Guidebook now provide all the currently effective water use efficiency planning requirements.

WATER USE EFFICIENCY RULE

The WUE Rule consists of a series of amendments to existing sections and addition of new sections to WAC 246-290, the Group A Public Water System Regulations, and sets additional requirements for public water purveyors. The WUE Rule is comprised of four sections:

1. Planning requirements
2. Metering requirements
3. Distribution leakage standard
4. Goal setting and performance reporting requirements

The WUE Guidebook is intended to provide guidance and clarification on the requirements of the WUE Rule, and not to establish any additional requirements. The requirements of the WUE Rule are discussed in the following sections.

PLANNING REQUIREMENTS

The Planning Requirements of the WUE Rule include the following:

- Estimation of the amount of water saved through implementation of the system's WUE program over the past 6 years.
- Description of the water system's WUE goals.
- Select WUE measures.
- For each WUE measure selected, either:
  - Include a plan to implement the measure, or
  - Evaluate selected water use efficiency measures to show that they are not cost effective.

These WUE Rule planning requirements are addressed in the following sections:

ESTIMATION OF WATER SAVED

Monthly Total Water Consumption for the Buckley water system is shown in Figure 4-1, together with linear regression trend line and equation for the trend line. The units of water use rate are shown in million gallons (MG) per month, and the horizontal axis units are date codes which, even though they are displayed in months, the program from which this chart is created uses units of days. Therefore, the linear regression equation for the water use rate, $y = -0.0004x + 31.944$, says that the average monthly use rate declined daily by 0.0004 MG, or 400 gallons, per month, per day. At an average of 30.44 days per month, this is an average daily water use reduction of 13.14 gallons per day, every day over the data period. This means that, starting with the first day of the data period as a base, on the second day the system saved, on average, 13.14 gallons, on the third day the system saved, on average, 26.28 gallons, on the fourth day the system saved, on average, 39.42 gallons, and so on throughout the data period. With 2,891 days in the data period, by the end of the data period the use rate declined by 37,974 gallons per day, or about 1.15 MG per month. Adding up the daily savings, the system saved an estimated 54.89 MG over the data period, which is an overall savings of 6.94 MG per year, 0.578 MG per month, or 19,000 gallons per day.

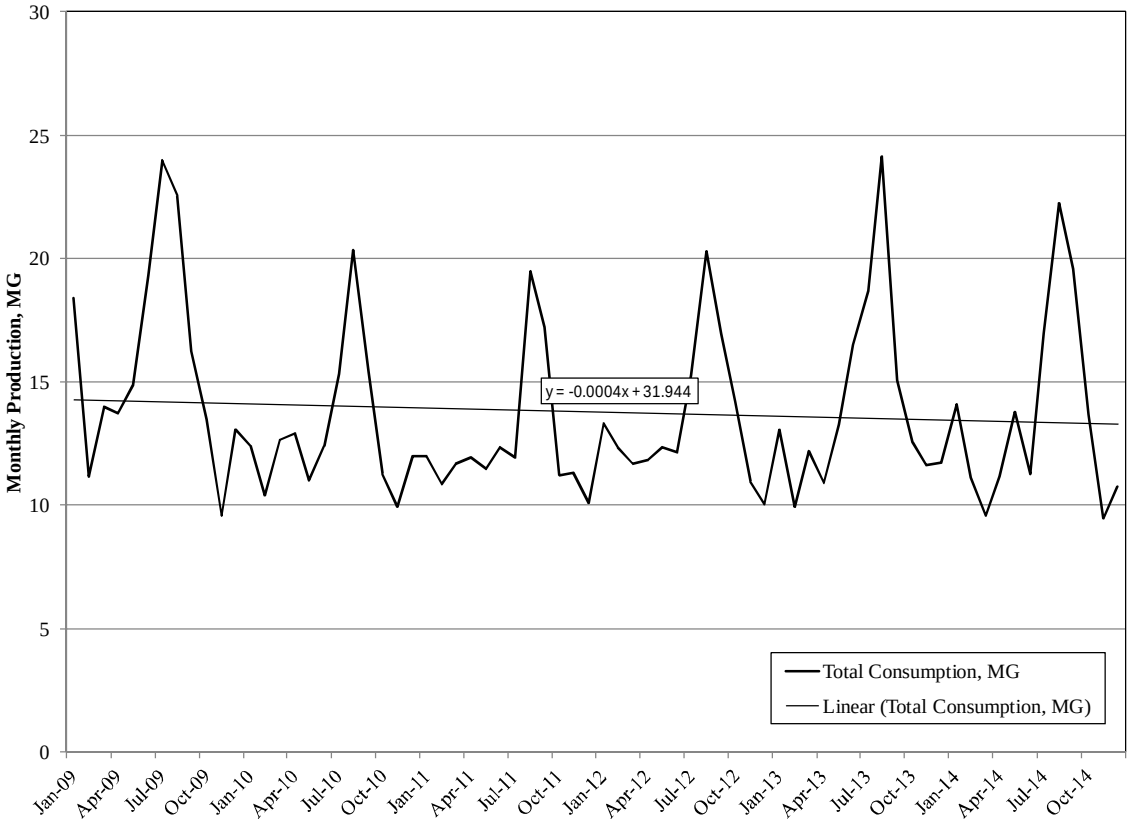

FIGURE 4-1

Water Use Trends

WATER USE EFFICIENCY GOALS

The WUE Rule requires that the "governing body of the public water system shall establish water use efficiency goals within 1 year of the effective date of this rule." The effective date of the rule was January 22, 2007, so the WUE Goals were to be adopted by the City of Buckley by January 22, 2008. The WUE Rule further requires that WUE Goals must "be set in a public forum that provides opportunity for consumers and the public to participate and comment on the water use efficiency goals." The WUE Goals adopted by City of Buckley and reported in the City's annual WUE Reports are as follows:

> *"Through the development of the Conservation Program outlined in the Water System Comp Plan, the City seeks to;*
>
> · Achieve an annual conservation goal of one percent for 10 years starting with the year 2005.

- Reduce peak daily, peak monthly, and total annual consumption
- Continue efforts with respect to reducing lost and unaccounted for water
- Promote long-term efficiency through short-term conservation measures
- Develop a program for public education and awareness."

With this Water System Plan update, the City revises its water use efficiency goals as follows:

Supply Side Goals

Reduce and maintain DSL to below 8.9 percent of total water production within the coming 6-year planning cycle. As tabulated from Table 2-8, 8.9 percent is the average DSL over the 8-year period of 2009 to 2016.

Demand Side Goals

Reduce water system use by all customer classes by 1 percent per year over the coming 6 year planning cycle.

SELECTED WATER USE EFFICIENCY MEASURES

The WUE Rule requires that water systems with from 1,000 to 2,499 service connections must implement or evaluate a minimum of five water use efficiency measures. The WUE Guidebook further states that water use efficiency measures that are required in other portions of the WUE Rule cannot be counted as measures to be selected under this requirement. Measures required in other portions of the WUE Rule include the following:

- Installation of source and service meters if meters are not already present;
- Regular calibration of meters;
- Development and implementation of a water loss control program if DSL exceeds 10 percent; and
- Education of consumers about water use efficiency practices once per year.

Measures that the WUE Guidebook suggests can count toward satisfying the required number of water use efficiency measures include the following:

- Implementation of a conservation rate structure.

- Implementation of a water reclamation program.
- Customer assistance in repair of leaks in customer service lines and in homes.
- Additional consumer education, such as student education and consumer education at fairs.
- Bills showing water consumption history.

Note that implementation of measures by customer class count as separate measures for each customer class for which they are implemented.

The City of Buckley has adopted the following WUE Measures:

Measures to Meet Supply-Side Goal

Adopted WUE measures to meet the supply-side goal and their implementation status as of October 31, 2013 are summarized in Table 4-1 below.

TABLE 4-1

WUE Supply Side Measures

Measure	Status
Leak Detection and Repair	Ongoing
Improved Source Metering	Ongoing
Improve Accounting for Unmetered Water Use	Ongoing

Measures to Meet Demand Side Goal

Adopted WUE measures to meet the demand side goal and their implementation status as of October 31, 2013 are summarized in Table 4-2 below.

TABLE 4-2

WUE Demand Side Measures

Measure	Status
Implement a Water Conservation Rate Structure	Ongoing
Provide assistance to customers in locating service line leaks.	Ongoing
Provide water billing with water use history	Ongoing

Buckley is currently implementing three supply-side WUE measures and three demand-side WUE measures. The demand side measures apply to all of the City's customer classes. Therefore, Buckley is implementing more than the minimum of five measures required by the WUE Rule based the current system size, and meets this requirement of the WUE Rule.

IMPLEMENT OR EVALUATE WATER USE EFFICIENCY MEASURES

Buckley is currently implementing more than the minimum required number of WUE Measures. Therefore, no evaluation of the cost effectiveness of conservation measures is required.

METERING REQUIREMENTS

The WUE Rule requires all sources and customer service connections be metered by January 22, 2007. Buckley currently meters all service connections and all water sources.

DISTRIBUTION SYSTEM LEAKAGE STANDARD

The WUE Rule set a DSL standard of 10 percent or less of finished water production. DSL is defined as the sum of all water metered into the distribution system over a 3-year time period, less the sum of all metered water uses, and known or credibly estimated unmetered uses, out of the distribution system over the same time period. Known or credibly estimated unmetered uses may include uses such as construction, fire fighting, water main flushing, and estimated leakage from leaks that have been repaired.

As shown in Table 2-8, the 3-year rolling average DSL for Buckley declined from 13.9 percent for 2009 to 2011, to 4.2 percent for 2014 to 2016

WAC 246-290-820 (4) and the WUE guidebook states that water systems that exceed the 3-year average 10 percent DSL standard must develop a Water Loss Control Action Plan (WLCAP). The WLCAP must include the following:

a) The control methods necessary to achieve compliance with the distribution system leakage standard;
b) An implementation schedule;
c) A budget that demonstrates how the control methods will be funded;
d) Any technical or economic concerns which may affect the system's ability to implement a program or comply with the standard including past efforts and investments to minimize leakage;
e) If the average distribution system leakage calculated under subsection (2) of this section is greater than 10 and less than 20 percent of total water produced and purchased, the water loss control action plan must assess data accuracy and data collection;

WATER LOSS CONTROL ACTION PLAN

Although the City for the years 2014, 2015 and 2016, has maintained a 3-year rolling average under 10 percent DSL, as shown in Table 2-8, the City will continue to implement a WLCAP to maintain its current, low DSL. The following sections of the City's Water System Plan are intended to satisfy the WLCAP requirement.

CONTROL METHODS

Because the City's three-year average DSL is greater than ten percent but less than twenty percent, WAC 246-290-820 (4)(e) requires that the City assess data accuracy and data collection. Therefore control methods will to be oriented to policies requiring evaluation of accuracy of existing meters, accurate accounting of unmetered water uses, and incorporation of data regarding unmetered water uses into the water accounting system.

Accuracy of Existing Service Meters

It is generally accepted that the most cost effective way to insure accurate service meters is to track service meter age and replace meters when they reach a designated age. The designated replacement age may vary by type and model of meter, but as a general rule, residential water service meters begin to lose accuracy after about ten years. Therefore, the installation date of all residential water meters will be tracked and water meters will be scheduled for replacement when they have been in place for 10 years, or the recommended life of the meter per the manufacturer's recommendations.

Tracking Unmetered Water Use

There are several categories of unmetered water use that may need to be tracked differently. These are as follows:

<u>Unmetered Sales through Fire Hydrants</u>

A typical scenario for this is a construction contractor who needs to fill a water truck for construction purposes such as dust control or landscape watering. The City will require contractors to use only designated hydrants through hydrant meters, the City will read the hydrant meters regularly, and the hydrant meter reads will be incorporated into the City's water sales data system. Alternatively, the City may estimate the amount of water used based on the volume of the tank filled and the number of times it is filled. The estimated usage will then be incorporated into the City's water sales data system.

<u>Unmetered Non-Sales through Fire Hydrants</u>

Some water use through fire hydrants is not billed for various reasons. For example water used to fill City Street Sweepers, for landscape irrigation, or for other City uses, or

for use by other entities that the City has chosen not to charge for the water. Even though this water use is not billed, it still needs to be accounted-for in the water use accounting system. The volume of water used for non-billed use will be metered or estimated by other means, and that volume will be included in the City's water accounting system.

Emergency and Maintenance Water Use

Water used for fire suppression and for water main flushing will also be accounted for in the water accounting system. When fighting a fire it is not usually possible to use a hydrant meter, and keeping track of flow time and rate is usually not a priority. Nevertheless, it is possible after a fire event is over to interview the fire fighting crew to estimate about how long the hydrant was flowed and at approximately what rate.

Water used for water main flushing can be estimated by the water operations crew based on estimated flushing rate and estimate flushing time, or a hydrant meter can be used for water main flushing. Similarly, water used for fire training can be metered or estimated based on flow rate and time. Records of these unmetered, unbilled water uses will be included in the City's water accounting system.

Regular Evaluation of Water Production and Usage

Accounting of water production, use and DSL will be evaluated on a monthly basis so that indications of excessive DSL or other accounting problems can be recognized early and dealt with in a timely manner.

IMPLEMENTATION SCHEDULE

The City is implementing the above measures on an ongoing basis. It is planned that by the end of 2017 all water uses will be included in the City's water accounting system.

BUDGET

From Table 2-10, the City has 1,473 water service connections. To replace 1,558 water service meters on a ten-year cycle requires that an average of 156 meters must be replaced per year, or 13 meters per month. At an estimated cost of $100 per meter, including materials and labor, the cost of replacing meters on a ten-year cycle is approximately $16,000 per year.

The cost to implement the above accounting measures consists of the cost to obtain and maintain hydrant meters, and staff time required to read hydrant meters, estimate non-metered use, record the readings and estimates, and include the readings and estimates in the water accounting system. Fire hydrant meters are available for approximately $800 each. Two hydrant meters would cost approximately $1,600, and should last approximately ten years, for an average annual cost of $160 per year.

Staff time required to read hydrant meters, estimate non-metered uses, record the data and include it in the water use tracking system is estimated at 8 hours per month. At a cost of $50 per hour for wages and overhead, it is estimated that the staff time will cost approximately $400 per month, or approximately $5,000 per year.

The total estimated cost to implement the water WLCAP is $21,000 per year

TECHNICAL AND ECONOMIC CONCERNS

There are no identified technical or economic concerns with implementing the WLCAP program.

ASSESSMENT OF DATA ACCURACY

Table 2-8 includes estimated unmetered water usage, such as firefighting, fire hydrant testing or water main flushing, and it includes water use data from hydrant meters for activities such as construction or street sweeping.

GOAL SETTING AND PERFORMANCE REPORTING

Pursuant to the WUE Rule, the City of Buckley must set water use efficiency goals and report progress annually. The City of Buckley's water use efficiency goals have been addressed in preceding sections of this chapter. The annual report must include the following:

- Total source production
- DSL in percentage and volume
- Goal description, schedule, and progress toward meeting goals

The City of Buckley has submitted annual WUE reports, including all of the above data, annually since reporting was required in 2008.

GOAL SETTING

The WUE Rule requires that water conservation goals must include a measurable outcome, address water supply or demand characteristics, and include an implementation schedule. The goal setting process must be held through a public forum and be re-evaluated every 6 years. The WUE Rule required that the first water use efficiency goals were to be set by January 22, 2008 for municipal water suppliers with 1,000 or more service connections, and by January 22, 2009 for municipal water suppliers with fewer than 1,000 service connections.

The City intends to adopt the new WUE goals listed above, together with adoption of this Water System Plan, after the initial review by DOH.

WATER USE DATA REPORTING

The WUE Rule requires annual reporting of water use data. The first annual reports were due July 1, 2008, for municipal water suppliers with 1,000 or more service connections, and by July 1, 2009, for municipal water suppliers with fewer than 1,000 service connections, and annually by July 1 each year thereafter. Table 4-3 summarizes the water use data collection requirements.

TABLE 4-3

Summary of Water Use Data Collection

Data Type	Unit of Measure	Collection Frequency	Comments
Water Production	Gallons	Monthly	Total by month and by year.
Interties	Gallons	Monthly	Water transferred through interties (Sales to County system.)
Water Sold	Gallons	Billing Period	Total sold by customer class for each billing period. (City billing periods are monthly.)
Estimated Unmetered Water Use	Gallons	Billing Period	Estimate and record unmetered water uses for each billing period.
Estimated Identified and Corrected Water System Leaks	Gallons	Billing Period	When leaks are discovered and repaired, the leakage rate and duration are estimated and the resultant leakage volume for the billing period is estimated and recorded.
Accounted-for Water	Gallons	Billing Period	The sum of Water Sold, Estimated Unmetered Water Use, and Estimated Identified and Corrected Water System Leaks.
DSL	Gallons	Billing Period	The difference between monthly Water Production and monthly Accounted-for Water.
Percent DSL	Percent	Billing Period	DSL divided by Water Production times 100 percent. Calculate for each billing period, for each year and for a 3-year running average. If 3-year running average exceeds 10 percent, further actions are required to reduce DSL.

The City of Buckley has been submitting annual water use efficiency reports to DOH and distributing water use efficiency reports to customers annually in conjunction with annual consumer confidence reports, including all applicable data required in Table 4-3.

WATER USE EFFICIENCY PROGRAM DEVELOPMENT AND LEVEL OF IMPLEMENTATION

The following sections describe the City of Buckley's water use efficiency goals, conservation measures, and the resulting water use projections.

REGIONAL CONSERVATION PROGRAMS

The effects of a customer conservation program extend beyond the water service area. For example, Seattle Public Utilities heavily promoted water conservation to its customers in 2001 and communities throughout Puget Sound experienced a decrease in consumption. As the WUE Rule takes effect, neighboring water systems will likely increase their conservation efforts, thus increasing awareness of the need to conserve. The City of Buckley may also be affected by regional water use efficiency promotion efforts.

TARGET WATER SAVINGS PROJECTIONS

In this section we estimate the projected water savings that may be realized by meeting the WUE goals. The revised WUE goals, as stated above, are to reduce water use by one percent per year, and maintain annual DSL at 8.9 percent or less, over the upcoming 6-year planning cycle. Table 4-4 shows how much water savings would be realized with these reduced ERU and DSL values. Based on this theoretical comparison, the water system would reduce water use by a total of 726 million gallons over 20 years.

It should also be noted that this water demand reduction could postpone the need to develop additional source capacity by five years, from 2024 as shown in Table 3-14 to 2029. A 5-year postponement of the need for additional source development can be a significant savings to the City, in both capital and operational costs.

TABLE 4-4

Projected Savings with Water Use Efficiency Measures

Year	Projected Consumption ERUs[(1)]	Projected ERU Value with WUE Goals, gpd[(2)]	Projected Average Day Consumption with WUE Goals, gpd[(3)]	Projected Percent DSL[(4)]	Projected Average Day Production with WUE Goals, gpd[(5)]	Projected Annual Savings with WUE Goals, MG[(6)]
2017	3,281	173	568,000	8.75%	622,000	1,095,000
2018	3,394	172	584,000	8.60%	639,000	2,920,000
2019	3,510	170	597,000	8.45%	652,000	6,205,000
2020	3,631	168	610,000	8.30%	665,000	9,855,000
2021	3,756	166	623,000	8.15%	678,000	13,870,000
2022	3,884	165	641,000	8.00%	697,000	15,695,000
2023	4,018	163	655,000	7.85%	711,000	20,075,000
2024	4,156	161	669,000	7.70%	725,000	24,455,000
2025	4,299	160	688,000	7.55%	744,000	27,375,000
2026	4,446	158	702,000	7.40%	758,000	32,850,000
2027	4,599	157	722,000	7.25%	778,000	36,135,000
2028	4,757	155	737,000	7.10%	793,000	41,610,000
2029	4,920	154	758,000	6.95%	815,000	44,895,000
2030	5,089	152	774,000	6.80%	830,000	51,100,000
2031	5,169	151	781,000	6.65%	837,000	54,020,000
2032	5,249	149	782,000	6.50%	836,000	60,225,000
2033	5,331	148	789,000	6.35%	842,000	63,510,000
2034	5,415	146	791,000	6.20%	843,000	68,985,000
2035	5,499	145	797,000	6.05%	848,000	73,000,000
2036	5,499	143	786,000	5.90%	835,000	77,745,000
20-Year Savings with Conservation Measures						725,620,000

(1) Projected Consumption ERUs is the total ERUs less DSL ERUs from Table 2-10, projected forward at the planning growth rate shown in Table 2-2, rounded to the nearest whole value.

(2) Projected ERU Value with WUE Goals is the ADD value of 175 gpd from Table 2-12 decreased by 1 percent each year for the six-year planning horizon, starting in 2016, rounded to the nearest whole value.

(3) Projected Average Day Consumption with WUE Goals is Projected Consumption ERUs times Projected ERU Value with WUE Goals, rounded to the nearest 1,000 gallons

(4) Projected Percent DSL is the 8-year average of 8.9 percent DSL reduced by even interval each year.

(5) Projected Average Day Production with WUE Goals is the production necessary to meet the Projected Average Day Consumption with WUE Goals at the Projected Percent DSL.

(6) Annual Savings with WUE Goals is Average Day Demand from Table 2-12 minus Projected Average Day Production with WUE Goals, times 365 days per year.

SOURCE OF SUPPLY ANALYSIS

OPTIMIZING USE OF CURRENT SUPPLIES

Buckley has increased the efficiency of its water system in the past by replacing problem water mains, finding and repairing water system leaks, by promoting water conservation amongst their customers, and by improved water accounting. The City plans to continue these efforts to further optimize current water supply. Buckley may be able to delay the expenses of additional source capacity, additional treatment capacity, additional storage capacity, and additional booster pump capacity by implementing water conservation measures.

ENHANCED CONSERVATION MEASURES

As technology for water leak detection and repair advances, and as more water efficient building fixtures and appliances become the standard, water conservation will be enhanced by implementation of standard building codes and replacement of aging fixtures and appliances with newer, more water efficient units.

WATER RIGHT CHANGES

Based on Table 1-3 the City of Buckley has water rights for an instantaneous rate of 8.02 cfs (3,599 gpm) and an annual volume of 2,146.72 ac-ft/yr. Based on Table 3-13 the City is well within the City's annual water rights. Therefore, the City has adequate water rights to meet projected demands, with or without the projected WUE savings, and no need for additional water rights is anticipated.

ARTIFICIAL RECHARGE

At this time there are no plans for any kind of artificial recharge of the aquifers in the Buckley area. The City has adequate water rights for the foreseeable future, so there is no water rights-driven incentive for developing a groundwater recharge system using reclaimed water at this time. The groundwater wells in the Buckley area show no signs of decline, so there is no water resources-driven incentive for groundwater recharge at this time either.

WATER RECLAMATION

Water reclamation is one way to improve water use efficiency by utilizing treated wastewater for some water supply needs. The WUE Rule requires that water utilities with more than 1,000 service connections include an evaluation of water reclamation and reuse opportunities in their water system plans. According to the WFI form updated October 22, 2014, the City of Buckley has 1,820 service connections. Therefore an

evaluation of water reclamation and reuse opportunities is required. The evaluation includes five elements:

1. Washington State requirements.
2. Identification of potential reclaimed water users.
3. Estimates of potable water savings if reclaimed water were available.
4. Financial feasibility of implementing reclaimed water projects.
5. Recommendations for implementing a reclaimed water program.

WATER RECLAMATION AND REUSE REQUIREMENTS IN WASHINGTON STATE

"Reclaimed water" is defined in RCW 90.46.010 as "effluent derived in any part from sewage from a wastewater treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for a beneficial use or a controlled use that would not otherwise occur, and is no longer considered wastewater."

In the State of Washington, any type of direct beneficial reuse of municipal wastewater is defined as water reuse or reclamation. The Departments of Health and Ecology have jointly issued *Water Reclamation and Reuse Standards (September 1997)*. This discussion is based on the current standards, which are adopted by reference in RCW Chapter 90.46, Reclaimed Water Use.

Washington State reuse standards are based on similar standards used throughout the United States. Washington's reuse standards for municipal wastewater can be grouped into four categories:

- Treatment Standards
- Permitted Uses of Reclaimed Water
- Use Area Requirements
- Operational and Reliability Requirements

Washington's reuse treatment standards call for *continuous* compliance, meaning that the treatment standard must be met on a constant basis or the treated water cannot be used as reclaimed water.

Treatment Standards

The State of Washington's standards for municipal wastewater reuse have four classifications based on the type of treatment provided. The classifications are summarized below in Table 4-5.

TABLE 4-5

State of Washington Reclaimed Water Treatment Standards

Reuse Class	Continuously Oxidized[1]	Continuously Coagulated[2]	Continuously Filtered[3]	Disinfection (Total Coliform Density)[4]	
				7-Day Median Value	Single Sample
A	Yes	Yes	Yes	≤2.2/100ml	23/100ml
B	Yes	No	No	≤2.2/100m1	23/100ml
C	Yes	No	No	≤23/100ml	240/100ml
D	Yes	No	No	≤240/100ml	no standard

(1) Oxidized wastewater is defined as wastewater in which organic matter has been stabilized such that the biochemical oxygen demand (BOD) does not exceed 30 mg/L and the total suspended solids (TSS) do not exceed 30 mg/L (monthly average basis), is non-putrescible (does not have a foul smell) and contains dissolved oxygen.

(2) Coagulated wastewater is defined as an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or an equally effective method.

(3) Filtered wastewater is defined as an oxidized, coagulated wastewater that has been passed through natural undisturbed soils or filter media, such as sand or anthracite, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time.

(4) Disinfection is a process which destroys pathogenic organisms by physical, chemical or biological means. The disinfection standards use coliform density as the measure of pathogen destruction. DOH recommends that a chlorine residual of 0.5 mg/L be maintained during conveyance from the reclamation plant to the use area to avoid biological growth in the pipeline and sprinkler heads.

Permitted Uses of Reclaimed Municipal Wastewater

Allowable water reuse methods within the State of Washington are presented in Table 4-4.

Most of the allowable reuse methods provide limited opportunity for reuse due to the relatively small quantities and seasonal nature of the reuse demand.

Two reuse methods that offer the potential for 100 percent reuse on a year-round basis are groundwater recharge and streamflow augmentation. A more detailed discussion of groundwater recharge and streamflow augmentation is provided after Table 4-4.

TABLE 4-6

Allowable Uses of Reclaimed Water

Use	Class of Reclaimed Water Allowed			
	Class A	**Class B**	**Class C**	**Class D**
Irrigation of Non-Food Crops				
Trees and fodder, fiber, and seed crops	YES	YES	YES	YES
Sod, ornamental plants for commercial use, pasture to which milking cows or goats have access	YES	YES	YES	NO
Irrigation of Food Crops				
Spray Irrigation:				
All food crops	YES	NO	NO	NO
Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents	YES	YES	YES	YES
Surface Irrigation:				
Food crops where there is no reclaimed water contact with edible portion of crop	YES	YES	NO	NO
Root crops	YES	NO	NO	NO
Orchards and vineyards	YES	YES	YES	YES
Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents	YES	YES	YES	YES
Landscape Irrigation				
Restricted access areas (e.g., cemeteries, freeway landscaping)	YES	YES	YES	NO
Open access areas (e.g., golf courses, parks, playgrounds, etc.)	YES	NO	NO	NO
Impoundments				
Landscape impoundments	YES	YES	YES	NO
Restricted recreational impoundments	YES	YES	NO	NO
Non-restricted recreational impoundments	YES	NO	NO	NO
Fish Hatchery Basins	YES	YES	NO	NO
Decorative Fountains	YES	NO	NO	NO
Flushing of Sanitary Sewers	YES	YES	YES	YES

TABLE 4-6 – (continued)

Allowable Uses of Reclaimed Water

Use	Class of Reclaimed Water Allowed			
	Class A	**Class B**	**Class C**	**Class D**
Street Cleaning				
Street sweeping, brush dampening	YES	YES	YES	NO
Street washing, spray	YES	NO	NO	NO
Washing of Corporation Yards, Lots, and Sidewalks	YES	YES	NO	NO
Dust Control (Dampening Unpaved Roads, Other Surfaces)	YES	YES	YES	NO
Dampening of Soil for Compaction (Construction, Landfills, etc)	YES	YES	YES	NO
Water Jetting for Consolidation of Backfill Around Pipelines				
Pipelines for reclaimed water, sewage, storm drainage, gas, electrical	YES	YES	YES	NO
Fire Fighting and Protection				
Dumping from aircraft	YES	YES	YES	NO
Hydrants or sprinkler systems in buildings	YES	NO	NO	NO
Toilet and Urinal Flushing	YES	NO	NO	NO
Ship Ballast	YES	YES	YES	NO
Washing Aggregate and Making Concrete	YES	YES	YES	NO
Industrial Boiler Feed	YES	YES	YES	NO
Industrial Cooling				
Aerosols or other mist not created	YES	YES	YES	NO
Aerosols or other mist created (e.g., cooling towers, spraying)	YES	NO	NO	NO
Industrial Process				
With exposure of workers	YES	NO	NO	NO
Without exposure of workers	YES	YES	YES	NO

Groundwater Recharge

Groundwater recharge with reclaimed water is permitted under the water reuse standards. Three categories of groundwater recharge are covered in the water reuse standards:

1. Direct Injection to a Drinking Water Aquifer,
2. Direct Injection to a Non-Drinking Water Aquifer, and
3. Surface Percolation.

Direct Injection to a Drinking Water Aquifer

Direct injection of reclaimed water to a drinking water aquifer must meet the water quality standards for primary contaminants (except nitrate), secondary contaminants, radionuclides and carcinogens contained in Table 1 of WAC 173-200, as well as maximum contaminant levels (MCLs) contained in the State Drinking Water Standards, WAC 246-290.

Additionally, for direct injection to a drinking water aquifer, preinjection treatment must include the following:

1. reverse osmosis treatment
2. turbidity $\leq$ 0.1 NTU (average) and $\leq$ 0.5 NTU (maximum)
3. total organic carbon levels $\leq$ 1.0 mg/L
4. total nitrogen $\leq$ 10 mg/L as N

Direct Injection to a Non-Drinking Water Aquifer

Direct injection of reclaimed water to a non-drinking water aquifer must meet Class A reclaimed water treatment standards as well as the following additional criteria:

1. $BOD_5 \leq 5$ mg/L
2. TSS $\leq$ 5 mg/L
3. any additional criteria deemed necessary by DOH or Ecology

Surface Percolation

Groundwater recharge using surface percolation requires at least Class A reclaimed water unless a lesser level is allowed under a pilot project status by DOH and Ecology. In addition to secondary treatment to provide oxidized wastewater, the process must include a "step to reduce nitrogen prior to final discharge to groundwater."

Streamflow Augmentation

For small streams where fish habitat has been degraded due to low instream flows, streamflow augmentation is an option allowed under the water reuse regulations and

standards. This reuse method requires an NPDES permit and adherence to the Surface Water Quality Standards (WAC 173-201A). However, the key difference between streamflow augmentation and surface water disposal is that a determination of beneficial use has been established based on a need to increase flows to the stream. To make this determination requires concurrence from the Washington State Department of Fish and Wildlife that the need exists for additional instream flows.

Other Uses

The water reuse standards allow for other uses that are not discussed in detail in this Chapter. However, the general basis for the reuse criteria is that when unlimited public access to the reclaimed water is involved the criteria will require Class A reclaimed water. Essentially, for a water reclamation project to have the flexibility to allow for relatively unrestricted use, the reclaimed water should meet the Class A reuse standard.

Use Area Requirements

The water reuse standards establish criteria for siting and identifying water reclamation projects and their facilities. Water reclamation storage facilities, valves, and piping must be clearly color-coded and labeled and no cross-connections between potable water and reclaimed waterlines are allowed. The potable water system manager must have an approved cross-connection control program pursuant to WAC 246-290-490.

Maximum attainable separation between reclaimed water lines and potable waterlines must be achieved. A minimum horizontal separation of 10 feet is required for buried lines, but when crossing is necessary, a minimum 18-inch vertical separation is required and the potable waterline must be above the reclaimed waterline.

Reclaimed water may be used to flush toilets in condominiums and apartment complexes as long as residents do not have access to plumbing systems for repairs or modifications.

Another key requirement for a water reclamation project is setback distance. Table 4-7 summarizes setback requirements for water reclamation facilities. In general, setback distances are minimized with higher levels of treatment and reliability. Class A reclaimed water requires no buffer between irrigated areas and public use areas.

TABLE 4-7

Setback Distances for Reclaimed Water in the State of Washington

Reclaimed Water Use/Facility	Distance (Feet)			
	Class A	Class B	Class C	Class D
Minimum Distance to Potable Water Well:				
Spray or Surface Irrigation	50	50	100	300
Unlined Storage Pond or Impoundment	500	500	500	1,000
Lined Storage Pond or Impoundment	100	100	100	200
Pipeline	50	100	100	300
Minimum Distance from Irrigation Areas to Public Areas	0	50	50	100

Operational and Reliability Requirements

Under the reuse standards, there are a number of operational and reliability requirements for a water reclamation plant. Several key requirements are summarized below.

- Minimum Class III Operator.
- Critical equipment and process failures must be signaled by an alarm.
- Emergency storage and disposal facilities in the event of equipment failure or the intermittent production of effluent that does not meet the reclaimed water standards.
- Operating records provided to DOH as well as Department of Ecology.
- No bypass of untreated or partially treated water.
- Either a standby power supply or long-term disposal or storage facilities for untreated wastewater.

POTENTIAL RECLAIMED WATER USERS

Large Water System Users

Table 2-11 shows the average water use per customer of various City of Buckley customer classes. It can be seen that the largest individual user is Rainier School, and the second largest user is WSU (i.e. the WSU Agricultural Facility). The City has no commercial or industrial users that use large amounts of water. Therefore, the greatest potential for water reuse would be by Rainier School or the WSU Ag Facility. Rainier School water use is essentially potable water supply for residents of the facility, and it is unlikely that Rainier School would accept using reclaimed water for potable water supply. The WSU Ag Facility is a potential use for reclaimed water. The City's Parks

and Recreation planning documents include conceptual plans for a regional park facility, including soccer and softball fields. Irrigation of the future park facilities is a feasible use for the reclaimed water.

To use reclaimed water at the WSU Buckley facility would require treatment to Class A Reclaimed Water Standards and construction of reclaimed water transmission piping. There is an existing dry line extending from River Road to the WSU Ag Facility that could possibly be used to transmit reclaimed water to the site.

Parks and Recreational Areas

In addition to the facilities identified in the previous section, the City of Buckley includes a middle school with athletic fields located inside the City limits that would be considered irrigable property. To irrigate the athletic fields with reclaimed water would require treatment to Class A Reclaimed Water Standards, and construction of minimal reclaimed water piping to the fields, as the existing dry line currently traverses the school property to the south of the athletic fields.

Flushing of Sanitary Sewers

The City of Buckley wastewater collection system could utilize Class D reclaimed water to flush wastewater collection piping.

Use at Wastewater Treatment Plant

The City of Buckley utilizes Class D Reclaimed Wastewater for wash down and for irrigation at the Wastewater Treatment Plant.

ESTIMATED WATER SAVINGS

From Table 2-7 for the period of 2014 to 2016, the School District has used average of 0.82 MG per year and WSU has used an average of 37.00 MG per year, for a combined total 37.82 MG per year. Estimating half of this water use could be replaced with reclaimed water, there may be a potential for saving 18.91 MG per year (58.03 ac-ft/yr). With a total system usage of 204.46 MG per year (737.94 ac-ft/yr), the potential water resources savings represents 7.9 percent of the City's annual water use.

Use of Class D wastewater for sewer jetting may save up to 100,000 gallons (0.3 acre-feet) per year. Wash down water and landscape irrigation at the wastewater treatment plant may already be saving 1 or 2 acre-feet per year. With a current total annual water rights of 2,146.72 ac-ft/yr (Table 1-3) and a projected 20-year water demand of 1,174 ac-ft/yr (Table 2-12), the benefit of savings of up to 3 ac-ft/yr does not justify the expense of additional treatment, storage, pumping and distribution piping necessary to utilize reclaimed wastewater for this purpose.

FEASIBILITY OF WASTEWATER REUSE

The City of Buckley has adequate water resources for the foreseeable future and limited potential for wastewater reuse at this time. The City will continue using reclaimed wastewater for wash down and irrigation at the wastewater treatment plant, and will consider using reclaimed wastewater for sewer jetting and cleaning, but construction of additional treatment, storage, and distribution facilities for wider use of reclaimed wastewater is not feasible for Buckley at this time.

RECOMMENDATIONS FOR WASTEWATER RECLAMATION

It is recommended that the City of Buckley continue using Class D Reclaimed water for wash down and landscape irrigation at the wastewater treatment plant, and consider using Class D Reclaimed water for sewer jetting. However, upgrades of the wastewater treatment plant to produce higher classes of reclaimed water and installation of storage and piping system necessary for greater reuse of reclaimed wastewater are not recommended at this time.

WATER SUPPLY CHARACTERISTICS

The WUE Guidebook indicates that a Water Use Efficiency Program should include a description of the water system source characteristics. The source characteristics for the City of Buckley water system are thoroughly described in Chapters 1 and 3 of this Plan.

CHAPTER 5

SOURCE WATER PROTECTION

OBJECTIVE

The objective of this chapter is to document the City's programs for wellhead protection and watershed control to protect and improve source water quality. These programs identify pollutant sources within a watershed or zone of contribution that may affect source waters. Protection of these sources can be accomplished through monitoring and limiting and controlling to the best extent possible all adverse effects. Specific criteria against which the adequacy of source water protection is measured are presented in Chapter 246-290-135, 668, and 690 WAC. Since the City of Buckley Water System utilizes both surface water and ground water, both a watershed control program and a wellhead protection program are required.

WELLHEAD PROTECTION PROGRAM

The City of Buckley intends to reduce the potential risk for contamination of groundwater within the identified wellhead protection area by implementing a wellhead protection program. The program identifies potential contaminant sources, describes procedures for notification, education and implementation of actions to protect the groundwater supply, and locally defined spill response procedures for spill incidents within the wellhead protection area.

PROGRAM DEVELOPMENT AND IMPLEMENTATION

The purpose of a wellhead protection program is to provide local utilities with a program for preventing groundwater contamination. A successful wellhead protection program consists of a number of components that must be developed before the plan can be fully implemented. The major components of the plan are described below and form the basis of the chapter that follows:

- A **Delineated Wellhead Protection Area** (WHPA) based on all reasonably available hydrogeologic information, including an assessment of susceptibility to contamination.

- An **Inventory** of all known and identifiable potential contamination sources within each wellhead protection area.

- A **Spill Response Plan** for each wellhead protection area containing documentation for coordination with local first responders (police, fire, HAZMAT team, etc.).

- **Contingency Plans** for providing alternate sources of drinking water in the event of contamination.

- A **Wellhead Protection Area Management Plan** to reduce the likelihood that potential contaminant sources will pollute the drinking water supply.

SUSCEPTIBILITY ASSESSMENT

Completion of a susceptibility assessment is an important initial step in selecting appropriate delineation methods to define wellhead protection area boundaries. Completion of the susceptibility assessment and submittal to the Department of Health allows for a susceptibility ranking. Sources that receive low susceptibility ratings may receive susceptibility waivers from DOH to reduce or waive the amount of required monitoring for volatile organic compounds (VOCs) and synthetic organic compounds (SOCs). Table 5-1 contains the susceptibility ratings for Buckley's and Rainier School's sources from the Year 2014 Water Quality Monitoring Reports included in Appendix J. The susceptibility assessment surveys completed for the Buckley wells developed a calculated fixed radius method for the protection area delineations. Groundwater flow directions were not accounted for in the assessments performed.

TABLE 5-1

Source Susceptibility Ratings

Source	DOH Source No.	Susceptibility Rating
Well 1 (Naches)	S-02	Moderate
Well 2	S-03	Moderate
Well 4	S-04	High
Well 5 (Rainier School)	S-05	High
Well 6 (Trail Well 1)	S-06	
Well 7 (Trail Well 2)	S-07	

Susceptibility ratings reflect the sensitivity of a water source to contamination from a variety of contaminant sources. The susceptibility rating is dependent upon factors such as well construction, hydrogeologic conditions, and distances to known or suspected contaminant sources. Drinking water wells vary in their susceptibility to contaminants discharged at the surface. Wells with poor construction or improper surface seals have an increased susceptibility to contaminant migration into the saturated zone of the well. In addition, wells located in unconfined aquifers typically have a higher degree of susceptibility than deep wells in confined aquifers.

WELLHEAD PROTECTION AREA

The purpose of delineating a wellhead protection area is to estimate the area capable of contributing contaminants to a pumping well. These areas are referred to as zones of contribution and provide a basis for focusing a community's groundwater protection efforts. Multiple methods are used to delineate zones of contribution, which predict the movement of groundwater. A groundwater model simplifies the characteristics of an aquifer in order to provide mathematical estimates of actual conditions. As the groundwater model is increasingly simplified, the model becomes easier to use, but the results become less accurate. The most commonly accepted groundwater models for delineating WHPA zones of contribution are the Calculated Fixed Radius, Analytical, and Numeric models.

The simplest groundwater model is based on the Calculated Fixed Radius method. In the Calculated Fixed Radius method, the delineations are concentric areas around each well calculated based on pumping data and known or assumed aquifer characteristics.

An Analytical model requires basic hydrological information including the direction of groundwater flow, gradient, and certain physical characteristics of the aquifer. These physical characteristics include the aquifer thickness, the rate at which the aquifer will transmit water (transmissivity), and whether the aquifer is confined or unconfined.

A Numeric model requires significantly more data than other methods. In Numeric modeling, a grid is superimposed over the study area. Each square in the grid, called a cell, is characterized by physical parameters that are estimated from data collected from a variety of sources. The sources may include well logs, geologic and hydrogeologic maps, geophysical data, groundwater elevation data, stream flow discharge, and meteorological data. The parameters used to define the hydrogeological characteristics of each cell in the study area include identification of the vertical relationship of each aquifer and confining layer, the transmissivity of each aquifer, the thickness of the fine grained materials which separate the aquifers, the annual recharge, the connection between surface water and groundwater, the relationship between the model area and the surrounding areas (boundary conditions), and lastly, the location and pumping rate of wells. The Numeric method generates more accurate results than the Fixed Radius or Analytical methods. However, Numeric models are relatively costly to develop. Consequently, Numeric models are more commonly used by large utilities, with complex aquifers, which have the resources to collect the extensive model input data required.

A Wellhead Protection Area (WHPA) is defined as the surface and subsurface area surrounding a groundwater source through which contamination can potentially travel and reach the source. WHPAs are based on zones of contribution (ZOCs) that are derived from the estimated time of travel required for a contaminant to move from the point of introduction into the water bearing formation to the source. The Washington

Department of Health Wellhead Protection Program requires a WHPA to be subdivided into five zones, which include:

- A sanitary control zone of at least a 100-foot radius, unless engineering justification supports a smaller area (WAC 246-290-135). No source of contamination may be constructed, stored, disposed of, or applied within the sanitary control zone without the permission of DOH and the water purveyor.

- Four primary zones based on 6 month, 1-year, 5-year, and 10-year time of travel boundaries. These zones are referred to as the zones of contribution of the WHPA. Within this report, these zones will be abbreviated as $ZOC_{½}$ (six-month zone of contribution), ZOC_1 (one-year), ZOC_5 (5-year zone of contribution), and ZOC_{10} (10-year zone of contribution).

- One buffer zone (if necessary) extending from ZOC_{10} to a groundwater divide and highlighting areas where the aquifer may be particularly susceptible or vulnerable to contamination.

The ZOC_{10} defines the boundary of the WHPA and defines the area to be inventoried and managed to reduce the risk of contamination.

ANALYSIS

The Calculated Fixed Radius Method was used to analyze the wellhead protection area zones of contribution for the Naches Street Well and Wells No. 2, 4, 6, and 7. This method is the minimum acceptable method of delineation for public water systems. The following equation is applicable:

$$r = \sqrt{\frac{Qt}{\pi nH}}$$

where

r = Radius of ZOC_t
Q = Volume of water withdrawal (cubic feet per year)
t = travel time (½, 1 ,5 and 10 years)
n = Porosity = 0.22 (default value)
H = well screen interval (ft)

This equation was used to calculate zone of contribution radii for the 6-month (½ year), 1-year, 5 year and 10 year time horizons for the City of Buckley wells. The value to be used for Q, the groundwater withdrawal rate, should be a value that will reflect the maximum annual withdrawal anticipated for each well. In most cases this will be the

annual water right withdrawal limit. However, in the case of the City of Buckley's Wells 6 and 7 (Trail Wells 1 and 2) it is anticipated that the City will be applying for additional water rights for these wells. At this time it is unknown what the amount of annual withdrawal will be for those water rights. Therefore, to be conservative on the side of protection for the Trail Wells, the preliminary wellhead protection area will be based on the maximum possible withdrawal from these wells, based on continuous pumping year-round from each well at its' planned pumping rate. Annual withdrawals and screened intervals for each well are detailed in Table 5-2.

TABLE 5-2

Current City of Buckley Water Rights

Source	Maximum Annual Withdrawals, Cubic Feet	Basis for Maximum Withdrawal	Screened Interval, Feet
Well 1 (Naches)	7,840,800	Q_a(1)	20
Well 2	12,109,680	Q_a(1)	15
Well 4	12,109,680	Q_a(1)	25.7
Well 5 (Rainier School)	12,109,680	Q_a(1)	10(2)
Well 6 (Trail Well 1)	21,078,750	Installed Capacity(3)	20
Well 7 (Trail Well 2)	21,078,750	Installed Capacity(3)	15

(1) Q_a is the combined annual withdrawal limit from all water rights applicable to this source.
(2) No well log is available for the Rainier School Well. A well screen interval of 10 feet is assumed.
(3) Maximum annual withdrawal for Wells Nos. 6 and 7 is based on installed pumping capacity pumped continuously. This is done because it is anticipated that additional water rights will be secured for these wells in the future.

ZOC radius values calculated for the various times of travel, based on annual withdrawals and screened intervals from Table 5-2, are presented in Table 5-3.

TABLE 5-3

City of Buckley Wellhead Protection Zones of Contribution (CFR Method)

Well	$ZOC_{½}$ Radius, feet	ZOC_1 Radius, feet	ZOC_5 Radius, feet	ZOC_{10} Radius, feet
1	533	753	1,684	2,382
2	764	1,081	2,417	3,418
4	584	826	1,846	2,611
5	936	1,324	2,960	4,186
6	873	1,235	2,761	3,905
7	1,008	1,426	3,188	4,509

The Wellhead Protection Area Map, Figure 5-1, shows the limits of the 6-month, 1-, 5-, and 10-year zones of contribution for each wellhead protection area. The wellhead protection area for Well 1 is centered on Well 1 with the ZOC radius dimensions for Well 1 in Table 5-3. The wellhead protection area for Wells 2, 4 and 5 is centered at the centroid of the triangle formed by the three wells, with the ZOC radius dimensions for Well 5. The withdrawals for the three wells are not added together because the total withdrawal of 278 ac-ft/yr is the total annual withdrawal limit for the water rights accessed by all three wells. The wellhead protection area for Wells 6 and 7 is centered half way between Wells 6 and 7, with the radius dimensions for Well 7, because that is the larger of the two calculated radii, due to the smaller screened interval.

CONTAMINANT SOURCE INVENTORY

An essential element of wellhead protection is an inventory of all potential sources of groundwater contamination in and around the delineated wellhead protection areas. The purpose of the inventory is to identify past, present, and proposed activities that may pose a threat to the well, spring, or surrounding area. Partial inventories may have already been conducted for other purposes, such as those discussed at the beginning of this chapter. For the inventory to be effective, a full accounting of all known and potential sources of contamination within the zones must be conducted and the information accurately mapped.

Other purposes for maintaining an inventory of potential contaminant sources are to help plan management strategies, establish a mailing list to notify businesses located within wellhead protection areas, and notification of agencies regarding inventory findings. An accurate description of inventory data sources is also necessary and can be used to update the Plan as required by WAC 246-290-135.

POTENTIAL CONTAMINANT SOURCES

Within a wellhead protection zone, there are many diverse activities that may contaminate an aquifer thereby jeopardizing the water supply. It is important that these activities are properly inventoried and, if necessary, regulated to prevent degradation of the groundwater supply. Relevant activities include land use and zoning practices, landfills, commercial and industrial operations, underground storage tanks, clandestine drug labs, septic systems, dry wells and catch basins, as well as known sites of contamination. A discussion of these practices, their potential effects on groundwater, and the regulatory requirements that may apply are included in the following sections.

Landfills

A landfill is a disposal facility in which solid waste is permanently placed and is not a land treatment facility. Landfills are regulated by the Washington State Department of Ecology under WAC 173-304, Minimum Functional Standards for Solid Waste Handling. These regulations set siting and closure criteria, performance standards, and operating

NATCHES WELL LOCATION

WELL NO. 2 & WELL NO. 4 LOCATION

RAINIER SCHOOL WELL LOCATION

TRAIL WELLS LOCATION

N

0 2,000 4,000 Feet

Legend

- WELL
- CITY LIMITS
- UGA

ZONES OF CONTRIBUTION:

- 6 MONTHS
- 1 YEAR
- 5 YEAR
- 10 YEAR

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 5-1

WELLHEAD PROTECTION MAP

Gray & Osborne, Inc.

CONSULTING ENGINEERS

requirements for landfills. The regulations are highly restrictive in that a proposed landfill site must meet a series of "fatal flaw" tests. A wellhead protection area would qualify as a fatal flaw, thereby prohibiting the construction of a new landfill.

Past landfill practices were not so restrictive, however. Abandoned and improperly maintained landfills and dump sites are often a major source of groundwater contamination. Leachate from landfills poses a threat to groundwater quality should it migrate to the water table. The Department of Ecology is responsible for mitigating dump site cleanup when potentially hazardous leachates are present.

No known landfills active or extinct are located within the City of Buckley wellhead zones of contribution.

Commercial and Industrial Activity

Areas of commercial and industrial land use are located within most wellhead protection boundaries. Businesses that may contribute contaminants to the groundwater include dry cleaners, gas stations and other businesses with fuel storage tanks, auto repair shops, metal plating facilities, asphalt and concrete facilities, and machine shops. Wastes generated at these businesses include substances such as petroleum products, solvents, surfactants, heavy metals, and other organic materials. These wastes can potentially enter the groundwater system through inadequate disposal practices or accidental spills. Table 5-4 presents typical commercial and industrial activities and the potentially hazardous chemicals that may be associated with them.

TABLE 5-4

Chemicals Associated with Commercial and Industrial Activities

Commercial/Industrial Activity	Potential Contaminants
Automobile/Truck Service	waste oils, solvents, acids, paints, soaps
Boat Yard/Marinas	detergents, gasoline, diesel fuels, batteries, oil, seepage from boat waste disposal areas, wood preservative and treatment chemicals, paints, waxes, varnishes, automotive wastes
Dry Cleaners	solvents (perchloroethelyene, petroleum solvents, Freon) spotting chemicals, (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Cemeteries	fertilizers, pesticides
Country Clubs/Golf Courses	fertilizers, herbicides, pesticides, swimming pool chemicals, automotive wastes

TABLE 5-4 – (continued)

Chemicals Associated with Commercial and Industrial Activities

Commercial/Industrial Activity	Potential Contaminants
Electric/Electronic Equipment Manufacturers	nitric, hydrochloric and sulfuric acid, heavy metal sludges, ammonium persulfate, cutting oil and degreasing solvent, corrosive soldering flux, waste plating solution, cyanide, methylene chloride, perchloroethylene, trichloroethane, acetone methanol
Furniture/Wood Manufacturing	paints, solvents, degreasing and solvent recovery sludge
Metal Plating Shops	sodium and hydrogen cyanide, metallic salts, alkaline solutions, acids, solvents, heavy metal contaminated wastewater/sludge
Lawns and Gardens	fertilizers, herbicides, pesticides
Printers, Publishers	solvents, inks, dyes, oils, miscellaneous organics, photographic chemicals
Sand and Gravel Mining	diesel fuel, motor oil, hydraulic fluids
Scrap, Salvage and Junkyards	used oil, gasoline, antifreeze, PCB contaminated oils, lead acid batteries

Underground Storage Tanks

Underground storage tanks (USTs) and leaking underground storage tanks (LUSTs) are a major threat to groundwater quality. Petroleum products which may contain impurities that are mobile in the groundwater system are the most commonly stored substances in USTs. The EPA estimates that 35 percent of all USTs could be leaking. The most common causes of leaks are structural failure, corrosion, improper fittings, and improper installation. Ecology regulates underground storage tanks in Washington State under WAC 173-360, Underground Storage Tank Regulations. The regulations require that owners and operators of underground storage tanks comply with the following sections of the regulations:

- Notification, reporting, and record keeping
- Performance standards and operating closure requirements
- Registration and licensing
- Financial responsibility

The WAC allows a number of exemptions including tanks whose capacity is 110 gallons or less, farm and residential tanks with less than 1,100 gallons, heating oil less than 1,100 gallons per premises, and septic tanks.

As of July 1, 1991, Owners and operators of all existing nonexempt underground tanks must have a permit from Ecology. A valid permit is a requirement for delivery of regulated substances. The permit must be updated annually. As a condition of the permit, the owner must have completed the following requirements:

- An assessment of the tank condition by an Ecology licensed tank service provider.
- Replacement of leaking tanks and site cleanup.
- Installation of leak detection devices.
- Proof of insurance to compensate a third party in the event of bodily injury or property damage resulting from a leaking tank. One million dollars insurance is required for petroleum marketing facilities.

By 1998, all existing nonexempt underground storage tanks must have provided cathodic protection and spill and overflow containment, in addition to the above requirements.

Installation and replacement of underground storage tanks must meet the specifications and performance and design standards identified in the WAC. Ecology follows the federal UST guidelines, which at this time do not require double wall vessels.

Underground storage tank inspections are performed by Ecology primarily through the information developed in the permitting process. Although routine annual inspections are not performed, Ecology inspectors do prioritize sites considered potentially hazardous. Technical assistance visits are also conducted at the request of the owner/operator. This provides another avenue in which Ecology can monitor the status of USTs.

Ecology maintains a file on all permitted USTs in Washington State, as required by RCRA, Subtitle 1. The file provides the site name and address, tank identification number, date of installation, size, tank status, and the substance stored at the site.

There are ten underground storage tank sites identified in the City of Buckley wellhead protection areas, including five that have been identified as leaking. Tanks identified as leaking are either cleaned up or in the process of cleanup

Clandestine Drug Labs

Clandestine drug labs have been becoming an increasing problem in many parts of the country. Labs that produce illicit drugs use a wide variety of solvents and toxic, caustic and acidic substances. Because their activities are strictly illegal, they rarely dispose of wastes in an environmentally friendly manner. Therefore, these sites are potentially sources of groundwater contamination. The Tacoma-Pierce County Health Department maintains a list of clandestine drug labs that have been discovered in the County. The list dated October 31, 2013, contains 1,318 sites, 22 of which list a Buckley address, and three of which are in the Buckley Wellhead Protection Areas. These are Sites 26, 29 and 30 in Table 5-5. The sites that are listed have been discovered and closed. In most cases

they have been cleaned up and are considered to no longer be a threat to the environment. Unfortunately there is no way to know the location of sites that have not been discovered and closed. Sites 29 and 30 are not on the Ecology website so probably do not involve soil or groundwater contamination. Site 26 is listed on the Ecology web site as having soils contamination and suspected groundwater contamination; apparently groundwater investigation has not yet begun at this site.

Septic Systems

Pierce County is responsible for regulating and permitting residential and small commercial on site sewage disposal systems within the county, excluding federal facilities. Contaminants associated with septic tank effluent include pathogenic organisms, toxic substances, and nitrogen compounds. Ammonia and nitrate nitrogen are highly soluble in water.

Pierce County will not allow septic systems for proposed residences if they are within 300 feet of a sanitary sewer. Old septic systems may remain in use as long as they are not in a utility local improvement district and are not failing. Septic system elimination incentives may provide assistance to residences currently using septic systems who wish to connect to an available sanitary sewer. Sanitary sewer service is available within the City limits of Buckley.

Storm Water

Storm water can contain many chemicals which are derived from road runoff. These include: heavy metals such as lead and zinc, oils and grease, pathogens and nutrients. Typically, the concerns regarding storm water are related to the impacts on surface water. However, groundwater can also be adversely impacted by storm water.

The City of Buckley is completed a Stormwater Management Comprehensive Plan in 2008. This plan sets forth a list of Best Management Practices to minimize the spill of contaminants and the response to be undertaken in the event of a spill. A storm water modeling study of the City of Buckley system was completed as part of the Storm Plan. This report estimated transit time of water in the storm drainage system from various inlets to the outlet for each major sub-basin. These estimates will allow the various response teams to refine the necessary response times should a spill occur.

Drywells, Catch Basins, and Improperly Sealed or Secured Wells

Stormwater serves as a source of groundwater recharge, but it can also be a source of groundwater contamination. Runoff from streets, parking lots and other impervious surfaces can contain heavy metals, hydrocarbons, petroleum products, pesticides, and animal wastes. Dry wells may be used for stormwater, septic waste, or other wastewater disposal at commercial, industrial, and multi-family residential sites. Dry wells and catch basins may be located along major transportation corridors. Contaminants generated

along transportation routes, such as Interstate 5 and railroad corridors, include petroleum products, lead, hazardous chemicals and other emission products. Dry wells and catch basins are potential sites of contamination because their intended use often discharges contaminants directly into the groundwater.

Accidental Spills

Accidental spills or releases of contaminants can potentially impact groundwater supplies. Potential sources of spills and leaks include underground storage tanks, accidents and poor disposal practices. State Route 410 and 165 both of which pass through the City's 5- and 10-year WHPAs for the Naches Street Well, are potential sources of hazardous materials. The Washington State Patrol (WSP) is the first responder for hazardous material spills on State Highways. WSP then notifies the Department of Ecology, who in turn authorizes an independent contractor to clean up the spill.

The City of Buckley Fire Department is the first responder to all other spills of hazardous material within their jurisdiction. Upon arrival at the spill site they will call in the appropriate teams to assist in or assume command of the cleanup.

Confirmed and Suspected Contamination Sites

Under WAC 173-340, Model Toxics Control Act - Cleanup, the Department of Ecology is responsible for ensuring all hazardous waste sites are properly remediated. This includes confirmed and suspected sites of contamination as well as Leaking Underground Storage Tanks (LUSTs). A separate inventory for each, which includes the status of cleanup efforts, is maintained by Ecology. Ecology conducts an initial site investigation within 90 days of learning of a potentially contaminated site. If this investigation shows that remediation action is required, the site will appear on the Confirmed and Suspected Contaminated Sites Report. The sites are also given a Washington Ranking Mode BIN number between 1 and 5. A ranking of 1 indicates the greatest assessed risk to human health and the environment. The contaminant type and the affected media, such as groundwater, is also noted. Once the remedial action has been completed, Ecology's Toxics Cleanup Program determines if the site can be removed from the list.

Table 5-5 lists all of the potential contaminant sources known within and near the 10-year zones of contribution for all the City of Buckley well sites.

TABLE 5-5

Potential Sources of Contamination in the City of Buckley Zones of Contribution

Site No.[(1)]	Site Name[(1)]	Ecology Identifier No.	Site Address	Brief Description
1	Viz Industries	75643972	38316 Hinkleman Rd.	Hazardous Waste Generator
2	1st Choice Chevron	31464175	29297 HWY 410 E	Underground Storage Tank
3	Buckley 76	66731328	29211 Hwy 410 E	Underground Storage Tank
4	DD Auto Electric	43944379	159 W Mason	Hazardous Waste Generator
5	Ronald J Van Sickle	46167769	287 Hwy 410 N	Underground Tank, Cleanup Site
6	Envirosolve LLC US DOJ DEA Perry Rd.	4694403	22611 S Perry Rd. E	Hazardous Waste Cleanup
7	QWEST Buckley	68615557	350 Jefferson St.	Hazardous Waste Generator
8	Buckley Automotive	2635449	336 S River Rd.	Hazardous Waste Generator
9	Buckley City UST 9114	34784215	240 River Road	Underground Storage Tank, Leaking Underground Storage Tank
10	Buckley Library	39884259	1 Main Street	Underground Storage Tank, Leaking Underground Storage Tank
11	Northwest Pipe Lot Cleaning	73368895	525 Ryan Rd.	Hazardous Waste Generator
12	WSU Buckley Dairy 2	1323	2000 Collins Rd.	Underground Storage Tank, Leaking Underground Storage Tank Hazardous Waste Generator, Hazardous Waste Cleanup
13	Jo Swanson Waste Oil Service	73678315	1766 Ryan Rd.	Hazardous Waste Generator
14	WA DSHS Rainier School	57228626	Ryan Rd.	Underground Storage Tank, Leaking Underground Storage Tank
15	Rainier State School	14796	396 Collins Ct.	Municipal NPDES Permit
16	WSU Buckley Dairy 1	96719514	Levesque Rd E Side 100 Yds S of Collins	Hazardous Waste Generator
17	Rainier School	67618291	2120 Ryan Rd.	Hazardous Waste Generator
18	Dave's Deals on Wheels	13858	27815 Hwy 410 E	Hazwaste Local Source Control
19	410 Auto Wrecking	9117017	27865 Hwy 410 E	Industrial SW GP, Local Source Control
20	Leon's Deli Express	28775471	27909 Hwy 410 E	Emergency/Haz Chem Rpt TIER2, Underground Storage Tank
21	Walt & Vern's Pickup Parts	89774765	28520 Hwy 410 E	Voluntary Site Cleanup, Hazardous Waste Management Activity
22	WA Military Dept Buckley	22971	455 N River Rd.	Hazardous Waste Generator
23	White River School Dist 416	34558882	240 N A St.	Underground Storage Tank, Leaking Underground Storage Tank
24	Buckley Head Works	13373653	N River St.	Underground Storage Tank
25	Buckley STP	13318	600 Hatch Ave.	Municipal NPDES Permit Biosolids

TABLE 5-5 – (continued)

Potential Sources of Contamination in the City of Buckley Zones of Contribution

Site No.(1)	Site Name(1)	Ecology Identifier No.	Site Address	Brief Description
26	Former Auto Wrecking & Drug Lab	14651	12124 SR-165	Toxics Cleanup
27	Stanley Plastics	17351795	28818 112th St. E	Hazardous Waste Generator
28	Adkins Residential Property	12556	515 Rosewood Ct S	Toxics Cleanup
29	Former Drug Lab	None	466 Main Street	Former Drug Lab, Closed
30	Former Drug Lab	None	28004 Hwy 410	Former Drug Lab, Closed

(1) Site numbers correspond to location shown on Figure 5-1 and listed in Table 5-6.

The siting and operation of facilities that use, treat, store, or dispose of hazardous waste are subject to the requirements of the Resource Conservation and Recovery Act (RCRA), Subtitle C. In Washington State, the Department of Ecology regulates facilities that generate more than 220 pounds of hazardous waste per month under WAC 173-303, Dangerous Waste Regulations. The regulations are significant in that they establish a number of requirements for these facilities including surveillance and monitoring, record keeping, performance and design criteria, and siting and closure procedures. Ecology divides the facilities into three levels of hazardous waste accumulation: Level 1 facilities generate 2,200 pounds of waste per month or more; level 2 facilities generate between 220 and 2,200 pounds per month; and level 3 facilities generate less than 220 pounds. Level 3 generators are exempt from the regulations. All level 1 and 2 facilities must initially file a report of their activities with Ecology and update those activities annually. From these reports, an identifier code is established for each facility. This code is required by a transporter to deliver or accept shipments. A summary of those activities are published annually by Ecology, thereby allowing water purveyors the opportunity to determine the types of activities present within their WHPA.

NOTIFICATION OF FINDINGS

The City of Buckley will notify State and local agencies of the wellhead protection program's findings, including the wellhead area boundaries. The City will notify residents and customers within the contribution radii with a letter discussing risks to the water system and actions to be taken in case of a spill or accidental contaminant application. Any residents with on-site sewage disposal systems will also be sent notification of precautions they can take to minimize impacts from on-site sewage disposal systems.

INVENTORY OF DATA SOURCES

The inventory of potential contaminant sources was compiled using various data sources. AutoCAD maps from the City of Buckley were used to locate the sewer lines and storm drain lines. Agencies such as Ecology and EPA maintain contaminant databases which list businesses that handle and store potential contaminants. In addition, the following databases were used to create the inventory for the City of Buckley's WHPAs:

- **Underground Storage Tank Report**
  The most recent version of the Underground Storage Tanks Report was obtained from Ecology's Toxics Cleanup Program. This list was used to locate the facilities that contain underground storage tanks and verify facilities located by field surveys of the wellhead protection areas. These facilities are summarized in the inventories and located on the maps.

- **Leaking Underground Storage Tank Report**
  The most recent Leaking Underground Storage Tank (LUST) Report was also obtained **from** Ecology's Toxics Cleanup Program. This report was used to locate the leaking underground storage tanks on the wellhead protection area maps and note the status of remedial action at the site. The LUST report lists the site name, address, age, volume, and status of sites that contain leaking underground storage tanks.

- **Dangerous Waste and Materials Generators**
  This program, the EPA's RCRA program, has been taken over by Ecology within the State of Washington and is regulated under the Dangerous Waste Regulations (173-303 WAC).

- **Title III Facilities**
  Title III facilities are identified as those which generate, treat, store, or dispose of hazardous materials in sufficient quantity to pose a threat to the community. There are several different types of Title III facilities depending upon the amount of and the nature of the material handled. All of these companies must report to the County on an annual basis. This reporting was a result of the 1986 Superfund Amendments and Reauthorization Act. Title III was subsequently renamed to the Emergency Planning and Community Right to Know Act (EPCRA).

- **Confirmed and Suspected Contaminated Sites Report**
  Ecology maintains the Confirmed and Suspected Contamination Sites Report. The list is updated continuously as new information becomes available. Each site is given a site status code indicating the status of the cleanup process.

- **Clandestine Drug Lab List**
  The Tacoma-Pierce County Health Department maintains a listing of clandestine drug labs that have been uncovered in the County. The list is update regularly and can be obtained from the Tacoma-Pierce County Health Department web site. When sites involve soil contamination and possible groundwater contamination, the Tacoma-Pierce County Health Department notifies the Department of Ecology, and the site is listed also on the Ecology web site.

- **Septic Systems**
  Pierce County issues permits for all septic systems within the county, except those on federal facilities.

- **Zoning and Land Use**
  Electronic files containing zoning designations were obtained from the City of Buckley.

- **Base Map File and City Sewer and Stormwater Information**
  The City of Buckley maintain AutoCAD file base maps with sewer and storm water overlays for their system.

Field surveys were conducted to verify, where practical, the potential contaminant sources indicated in the databases. Table 5-6 summarizes the potential sources of contamination found within the 6-month, 1-, 5-, and 10-year zones of contribution for all wells. Since Wells 2 and 4 are located within approximately 110 feet of each other, the wellhead protection zone of contribution summarized in Table 5-6 utilize the concentric zones which incorporate the larger of the two areas. These operations may pose a threat to groundwater if contaminants are spilled or leaked into the ground.

TABLE 5-6

Potential Contaminant Sources within Buckley's Wellhead Protection Areas

Source Name	$ZOC_{½}$	ZOC_1	ZOC_5	ZOC_{10}	Near WHPA (1)
Well 1, Naches(2)	4	None	3, 6, 7, 8, 9, 29	2, 10, 11	1, 5, 21, 22, 23, 24, 25, 26, 27, 28
Wells 2, 4 and 5(2)	16	None	13, 14, 15, 17	12	None
Wells 6 and 7(2)	None	None	2, 3, 7, 8, 11, 21, 26, 27	1, 4, 6, 9, 10, 29,30	5, 18, 19, 20, 22, 23, 24, 25, 28

(1) WHPA is Wellhead Protection Area
(2) Numbers in Table 5-6 correspond to site numbers in Table 5-5.

CONTINGENCY PLAN

Contingency planning is an important component of a wellhead protection program, however, planning alone cannot account for unanticipated incidents. A worst-case scenario would be a contamination event that would render all the wells unusable. This scenario is highly unlikely given the distances separating to two well field locations. Should this happen, the City would be forced to rely on its surface water source. If this occurred during a period of high demand, such as the drier summer season, the emergency intertie with the City of Tacoma could be utilized. An additional intertie exists with the Marion Water District.

SPILL RESPONSE PLANNING

Spill response planning is an important aspect of both an emergency management plan and a wellhead protection program. The release of hazardous materials in a wellhead protection area can create problems other than the initial contamination of soil and surface water. When the release occurs in either the one, five, or ten year zones of travel, there is the possibility that the spill will eventually contaminate aquifers that supply the City's drinking water. Planning for spill response should reflect the needs and concerns of the community while maintaining the quality of the groundwater. Gaining community support in the preparation of a spill response program is important. Coordination of Federal, State, and more importantly, local emergency response organizations is required as well.

Specific response procedures for wellhead protection areas must be determined prior to the occurrence of a contamination incident. The information obtained as a result of the susceptibility assessment and the wellhead protection area inventory can be used to determine what types of spill response measures are necessary for the protection of drinking water sources. In order to be accepted by local emergency responders, spill response procedures for wellhead protection areas should be realistic and easily implemented.

The following are examples of simple measures that can be taken during a spill/incident response to reduce the likelihood of groundwater contamination in a wellhead protection area.

- Attempt to contain hazardous liquid spills by using absorbents to reduce infiltration into the ground.
- Do not allow spills to be routed into drywells for cleanup.

In order for spill response procedures to be effectively executed, coordination, cooperation, and communication among the responding agencies, organizations, and individuals is imperative. There are many spill response organizations at the local, State, and Federal levels. Depending on the magnitude and type of the release, any of the

following organizations may be involved in a spill response for a wellhead protection area in Washington State.

- **Environmental Protection Agency (EPA)**
  The EPA is primarily responsible for all land spills including spills that occur on inland U.S. waters not under the jurisdiction of the United States Coast Guard.

- **City of Buckley**
  The City of Buckley Fire Department is the first responder to any spills or releases of hazardous materials into the environment in city limits. Upon arrival at the scene, they will conduct an appropriate survey of the situation and call for assistance from the necessary teams.

- **Fort Lewis Hazardous Materials Team**
  The Fort Lewis HAZMAT Team is available on an as needed basis but must be activated by the Fort Lewis Fire Department. They can provide assistance both at Fort Lewis and off-site as necessary.

- **Department of Ecology (Ecology)**
  Ecology's Spill Response Team is responsible for determining the source and cause of the release and the responsible party. If the responsible party is unknown, Ecology will investigate to determine who is responsible and ensure that containment, clean up, and disposal proceedings begin. Additionally, Ecology is the first responder to accidental spills of hazardous materials on roadways. They have a 24-hour on call HAZMAT team should a spill occur. The DOE Spill Response 24-hour Hotline number is (360) 407-6311.

- **Department of Health (DOH)**
  DOH provides advisory assistance in the event of a spill through a 24-hour hotline number (1-877-481-4901).

- **Washington State Department of Transportation (WSDOT)**
  WSDOT can provide spill response assistance through traffic control, equipment, and personnel for non-hazardous clean up activities on state and interstate highways.

- **Pierce County**
  The Pierce County Department of Emergency Management has developed a comprehensive spill response plan. This plan specifies who is in charge of spill response and the responsibilities of each state and local governmental agency which might be notified in the event of a spill.

- **Washington State Patrol**
  The Washington State Patrol is the "Incident Command Agency" for all spills on Interstate highways.

There are many spill response plans in existence in Washington State. These plans address specific geographical areas such as wellhead protection areas and types of materials such as oil discharges. Organizations involved in the storage and transport of hazardous substances have also been required to develop spill response plans. In addition, cleanup Contractors are on call 24 hours a day to respond to spills. These plans are designed to be consistent and compatible with each other to ensure that response efforts are carried out effectively. Examples of the types of federal and state plans are listed below:

- **Oil and Hazardous Substance Pollution Contingency Plan for Federal Region Ten**
  This plan divides responsibilities among federal, state, and local governments; provides procedures for establishing local contingency plans; and provides procedures for response actions in accordance with the Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act.

- **Washington Statewide Master Oil and Hazardous Substance Spill Contingency Plan**
  This plan provides a means for coordinating statewide response to spills by Ecology and other state agencies.

- **Wellhead Protection Program Guidance Document-Spill/Incident Response Planning**
  As stated previously, the public water system is required to coordinate with local emergency responders, Ecology's Spill Operations Section, the local health department, and any local emergency planning committee.

These and other similar documents were used for guidance in preparing a local spill response program for the City of Buckley.

SPILL RESPONSE PROGRAM

The City of Buckley has adopted the Pierce County Spill Response Plan. The Pierce County Plan outlines the general off-site emergency procedures as required by EPCRA and is included in Appendix K. Spills that occur within the property boundaries of a facility are handled according to that facility's plans.

Generally, under the County's plan, the Fire Dispatch Centers provide a single point of contact for spills. When a call is received regarding a spill, a Hazardous Materials Incident Notification worksheet, "Pink Sheet," is filled out based upon data gathered

from the field. The appropriate agencies and Hazardous Materials teams are notified based upon the data gathered for this worksheet. After being notified of a hazardous material incident, Dispatch Centers are responsible for making the following notifications:

- The fire district in which the incident occurred,
- Appropriate local law enforcement,
- Pierce County Fire Prevention Bureau,
- Tacoma-Pierce County Health Department,
- Pierce County Department of Emergency Management and,
- The State Division of Emergency Management Duty Officer.

If the spill were to occur on a State Route, a similar response program would be followed as outlined in the Pierce County program. However, the Washington State Patrol is the "Incident Command Agency" for all spills on State Highways.

It is important that the City also be notified of any spills that occur within the WHPA. To facilitate notification, the City must provide copies of the WHPA map to Pierce County and Ecology. Accompanying each map should be a letter requesting that the agency in question notify the City in the event of a hazardous materials spill.

WELLHEAD PROTECTION AREA MANAGEMENT STRATEGIES

Wellhead protection areas have been defined and potential sources of contamination have been identified. In order for this to result in actual protection for Buckley's wells, a management plan must be put into place. The goals of a management plan are to:

- Reduce the likelihood that potential groundwater contaminants will be disposed, spilled, leaked or otherwise discharged in the wellhead protection area such that they could contaminate groundwater.

- Increase the likelihood that any potential groundwater contaminants that do get disposed, spilled, leaked or otherwise discharged in the wellhead protection area will get cleaned up before they reach the public water supply wells.

- Detect any groundwater contamination that may occur before public health is affected.

- Develop a plan of action in the event that Buckley's water supply should become contaminated.

MINIMUM REQUIREMENTS

Minimum management requirements for wellhead protection plans are specified in WAC 246-290-135 (3)(c)(iv)-(vii). These requirements are as follows:

(iv) Notification to owners and operators of potential sources of contamination of the wellhead protection areas and the findings of the wellhead protection plan upon adoption of the plan and any time the plan is amended.

(v) Notification to regulatory agencies and local governments of the wellhead protection areas and the findings of the wellhead protection plan upon adoption of the plan and any time the plan is amended.

(vi) A contingency plan to assure water system customers will have an adequate supply of potable water in the event of temporary or permanent loss of the principal source of supply.

(vii) Documentation of coordination with local emergency incident responders including notification of wellhead protection area boundaries, results of susceptibility assessment, inventory findings and contingency plan.

NOTIFICATION

The following parties will be notified of wellhead protection area boundaries upon adoption of the plan and any time the plan is amended:

- Owners and operators of potential sources of contamination.
- Regulatory agencies.
- Local governments.
- Local emergency incident responders.

Notification to Owners of Potential Sources of Contamination

Several potential sources of contamination have been discussed above and listed in Table 5-5, including industrial and commercial activities, hazardous materials storage, underground storage tanks, septic tanks, accidental spills, and confirmed and suspected contamination sites. Information regarding the wellhead protection area must be provided to all property owners with potential sources of contamination located within the estimated 10-year ZOC. The City should consider providing the same information to all property owners in the 10-year ZOC, whether they are identified as having potential sources of contamination or not.

A map of the wellhead protection area and general information regarding proper disposal of potential groundwater contaminants will be distributed. Similar information will be

included in the City's annual Consumer Confidence Report. Tacoma-Pierce County Health Department and the Washington State Department of Health also have published materials that the City will distribute and/or make available at City Hall to water system customers.

Notification to Regulatory Agencies and Local Governments

It is required by regulation that notification be provided to regulatory agencies and local governments. The following regulatory agencies and local governments will be sent a copy of this Wellhead Protection Plan:

State Department of Health
Northwest Drinking Water Operations
20435 72nd Avenue South, Suite 200, K17-12
Kent, WA 98032-2358
Phone: (253) 395-6750
Fax: (253) 395-6760

Tacoma-Pierce County Health Department
Division of Environmental Health
3629 South D Street
Tacoma, WA 98418
Phone: (253) 798-6500
Fax: (253) 798-7663

Washington State Department of Ecology
Wellhead Protection Program Coordinator
P.O. Box 47775
Olympia, WA 98504-7775
Phone: (360) 407-6000
Emergency: 911

Washington State Department of Commerce
Office of Growth Management Services
1011 Plum Street SE
P.O. Box 42525
Olympia, WA 98504-2525
Phone: (360) 725-4000

Notification to Local Emergency Incident Responders

It is required by regulation that documentation of coordination with incident responders be provided. The following incident responders will be contacted and provided with information regarding this Wellhead Protection Plan:

Buckley Fire Department
611 South Division Street
Buckley, WA 98321
Phone: (360) 829-1441
Emergency: 911

Washington State Department of Ecology
Ron Holcomb, Spill Response Program
P.O. Box 47775
Olympia, WA 98504-7775
Phone: (360) 407-6373

Pierce County Sheriff
930 Tacoma Avenue South
Tacoma, WA 98402
Phone: (253) 798-4721
Emergency: 911

Pierce County Department of Emergency Management
2501 South 35th Street, Suite D
Tacoma, WA 98409
Phone: (253) 798-6595
Fax: (253) 798-3307
Emergency: 911

Washington State Patrol
Captain Ken Noland, District Commander
2502 112th Street East
Tacoma, WA 98445
Phone: (253) 538-3240
Emergency: 911

Pierce County Road Department
East County Maintenance Facility (ECMF)
11711 Prairie Ridge Drive East
Bonney Lake, WA 98391
Phone: (253) 798-6000

PUBLIC EDUCATION AND ASSISTANCE

Hazardous Waste

Management of hazardous waste is a responsibility of every citizen. Buckley's wells are susceptible to contamination from improper waste disposal into septic systems or directly into the ground. Pierce County operates a hazardous waste program that includes a hazardous waste collection center at the Tacoma Landfill, 3510 South Mullen Street. The county also operates a Hazardous Waste Hotline that can be reached at:

Hazardous Waste Hotline
Phone: (800) 287-6429
Email: hazardous_waste@co.pierce.wa.us

The Pierce County Solid Waste Division can be reached for questions at:

Pierce County Solid Waste Division
Phone: (253) 798-2179
Email: pcsolidwaste@co.pierce.wa.us

Septic Tank Management Assistance:

The Tacoma-Pierce County Health Department runs the county On-site Sewage System Program. They can provide assistance regarding proper septic system design, operation and maintenance as well as what not to put down septic systems. The On-Site Sewage System Program can be reached at:

On-Site Sewage System Program
Phone: (253) 798-6470

WATERSHED CONTROL PROGRAM

REGULATORY REQUIREMENTS/PROGRAM OVERVIEW

In Washington State, water supply systems using a surface water source must develop and implement a watershed control program in order to protect the water supply and the health of the water system customers. This plan has been prepared to fulfill the watershed control program requirements for a filtered system as described in WAC 246-290-668.

The Washington Department of Health (DOH) classifies source water based on both vulnerability and susceptibility. Vulnerability is the water source's potential for contamination and is composed of two factors: the physical susceptibility to the infiltration of contaminants; and the source's risk of exposure to contaminants. Susceptibility is determined by conditions that affect the movement of contaminants from

the land surface into a water supply. DOH classifies the City of Buckley's South Prairie Creek as high susceptibility. The high susceptibility rating is documented in the DOH Water Quality Monitoring Reports. This is principally due to the fact that this source, South Prairie Creek, is surface water. The DOH Watershed Microbial Risk Rating form classifies the Watershed Risk as low. A copy of this form is located in Appendix L.

WATERSHED DESCRIPTIONS/CHARACTERISTICS

The City of Buckley Watershed covers approximately 14,500 acres and is situated in: all or portions of Sections 26, 31, 33, 34, and 36 of Township 19 North, Range 7 East, all or portions of Sections 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 22, 23, and 24 of Township 18 North, Range 7 East, and portions of Sections 7, 18, and 19 of Township 18 North, Range 8 East. Figure 5-2 is a map of the Watershed. The Watershed covers the drainage basins of the east and south forks of South Prairie Creek in east Pierce County. The range in elevations lies between approximately 5,933 feet at Pitcher Mountain to approximately 1,421 feet at the City diversion facilities on South Prairie Creek. The Watershed is neither fenced nor posted.

Hydrologic data for South Prairie Creek and its tributaries is limited. The United States Geological Survey (USGS) recorded flows on the South Prairie Creek at two locations. The first station was located several miles downstream from the diversion headworks below the Highway 162 Bridge and recorded data between June 1949 and September 1971. Table 5-7 shows the data from this recording station.

TABLE 5-7

Highway 162 Bridge, Gage Years 1949 – 1971, cfs

	October	November	December	January	February	March	April	May	June	July	August	September
mean	161	309	382	409	352	267	292	263	229	113	68	79
max	349	665	728	683	656	527	371	463	439	246	193	233
min	34	35	62	126	133	157	192	150	112	51	37	35

The USGS records on the second gage, located approximately 400 feet upstream from the diversion headworks, recorded flow data between September 1963 and September 1968. Table 5-8 shows the data from this recording station.

SOUTH PRAIRIE CREEK

Wilkeson

Carbonado

BUCKLEY
DIVERSION
POINT

CEDAR
LAKE

SUMMIT
LAKE

COPLAY
LAKE

N

0 4,500 9,000
Feet

Legend

- WATERSHED BOUNDARY
- SOUTH PRAIRIE CREEK TRANSMISSION MAIN
- RIVERS, LAKES AND STREAMS

PARCEL OWNERS WITHIN WATERSHED:

- EDWARD HUDSON
- FRANK & MARINA WALLACE
- HANCOCK FOREST MGMT
- LONGVIEW TIMBERLANDS LLC
- MANKE TIMBER CO. INC.
- MUCKLESHOOT FEDERAL CORP.
- MUCKLESHOOT INDIAN TRIBE
- U.S. FORESTRY SERVICE

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 5-2

WATERSHED MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

TABLE 5-8

Diversion Structure, Gage Years 1963 – 1968 (cfs)

	October	November	December	January	February	March	April	May	June	July	August	September
mean	104	102	154	132	191	91	101	130	143	42	91	107
max	392	244	907	400	754	274	180	211	686	64	396	475
min	20	32	53	52	53	53	65	83	67	29	25	43

The Watershed area is situated between weather stations at Mud Mountain to the north and the Carbon River entrance of Mount Rainier National Park to the south. Precipitation in the watershed can be estimated from these two stations. The Mud Mountain Dam station is approximately 400 feet lower in elevation than the Rainier Carbon River entrance station.

Records were compiled at the Mud Mountain Dam Station from 1939 – 1960 with an annual average precipitation of 53 inches. Records at the Rainier Carbon River entrance station from 1931 – 1952 indicate an annual average precipitation of 69 inches. The elevation along the line that transects the watershed varies from approximately 5,440 feet to approximately 1,550 feet, and precipitation would vary accordingly.

A mixed deciduous and coniferous forest predominantly covers the area. The elevations below 4,000 feet include Douglas Fir, Western Hemlock, and Western Red Cedar. Typical ground vegetation include Salal, Oregon Grape, Western Swordfern, and huckleberry. In areas of recent logging activities, Red Alder have become established. Areas above 4,000 feet are predominantly forested by Pacific Silver Fir and Western Hemlock. Waterfalls located a few thousand feet downstream from the headworks apparently prevent salmon from migrating above the falls. There is, however, a resident trout population in South Prairie Creek.

IDENTIFICATION OF ACTIVITIES OR LAND USES DETRIMENTAL TO WATER QUALITY

Natural Events

Storm events are the most frequent activity in the watershed effecting water quality. During large storm events, the turbidity in South Prairie Creek can raise to levels that are not practical for filtration through the City's Slow Sand Water Treatment Plant. The City addresses this problem by utilizing their wells during periods of high turbidity. This has not been an issue historically, as these storm events typically occur during the low

demand periods of the year and the City's wells can provide the needed water production capacity.

Natural disasters like landslides, mudslides, earthquakes, or volcanic activity present a potential risk to water quality and quantity. None have yet disrupted water supply. Regular maintenance and flow monitoring will help the City with early detection. A water shortage plan would likely have to be implemented if water service from South Prairie Creek is disrupted as a result of this type of activity.

Wildlife population within the watershed also impacts water quality. There is a wide variety of wildlife, including deer, elk, black bear, cougar, and beaver, all of which can potentially introduce fecal coliforms into the watershed. Fecal coliforms, when present in sufficient numbers in drinking water, indicate an increased potential for a number of diseases. The distribution and activity of the larger mammals depends on the season. Deer and elk move to lower elevation during the winter months for food and protective cover. Black bears also move to lower elevations for winter denning and thermal cover. The potential impact of these large mammals to the City's water quality has been significantly reduced with the construction of the slow sand filtration plant.

Timber Activities

Logging activities also provide a potential threat to water quality. Road building increases runoff and therefore turbidity. Stripping away riparian vegetation affects water temperature and potentially increases the rate and frequency of bacteria growth. Regulation governing such activities, including the use of buffers, help prevent this harm. When logging occurs, skyline or cable harvesting is used in the higher elevations and skidding is practiced in the lower elevations. Roads and road drainage is to be designed and constructed in accordance with accepted Best Management Practices (BMPs). The Forest Service severely limits the use of pesticides and herbicides on a site-specific basis. Local logging companies, Champion International, the Weyerhaeuser Company, and Plum Creek Timber, follow requirements outlined in the Forest Practices Act.

Champion typically uses herbicides only on a site-specific basis. The herbicides used include 2-4-D at a quantity of ½ gallon of chemical to 9-1/2 gallons of water per acre of coverage, except near streams. The company occasionally uses Roundup or Triclopyr to address roadside brush and to control maples. Weyerhaeuser Company does not spray near streams. It sprays small amounts of alder with 2-4-D and Triclopyr in a mix that is 2 percent 2-4-D, 1 percent Triclopyr and 97 percent water in a 10 gallon solution per acre. Roadside brush eradication is carried out with a roadside sprayer at one half the concentration of the aerial sprayer. Weyerhaeuser also fertilizes a percentage of the second growth and older Douglas Fir stands every five years, with approximately 400 pounds of urea per acre. Plum Creek applies herbicides aerially. The mix is approximately two quarts 2-4-D to 10 gallons of water per acre. All aerial spraying typically occurs in the late spring.

Roads in the area are maintained by the timber companies or the Forest Service, depending on the location. Roads and road maintenance activities generate sediments that enter nearby streams, tending to increase turbidity.

Other Activities

Recreational activities within the National Forest include hunting, fishing, hiking, and backpacking.

Vandalism presents a potential problem in the watershed. There is limited access to the watershed from Wilkeson and from logging access roads. The timber companies typically patrol their lands to minimize trespassing and forest product theft.

WATERSHED MANAGEMENT AND CONTROL MEASURES

Land Ownership/Written Agreements

In 1975 the City of Buckley obtained agreements with the then existing landowners. The landowners agreed to refrain from wading, swimming, washing and cleaning fish and game animals in the streams and lakes, as well as camping, picnicking, and discharging or disposing of body waste within 200 feet of the shoreline of a stream or lake. In return, the City agreed to provide random inspection for fire patrol and to request the removal of unauthorized personnel from the lands. The agreements authorize the City to post signs reading "No Unauthorized Entry, City of Buckley Watershed."

The watershed is depicted in Figure 5-2, and includes watershed ownership. There are no residences or dwellings within the watershed. Table 5-9 details the City of Buckley watershed ownership.

TABLE 5-9

City of Buckley Watershed Ownership

Owner	Land Use
U.S. Forest Service	Dispersed recreational use; Timber Sales, Wilderness
Longview Timberlands LLC	Timber Resources (All)
Muckleshoot Federal Corporation	Timber Resources (All)
Muckleshoot Indian Tribe	Timber Resources (All)
Manke Timber Co.	Timber Resources (All)
Hancock Forest Management	Timber Resources (All)
Frank and Marina Wallace	No Use
Edward Hudson	No Use

Regulation of Agriculture, Timber Harvest and Construction Practices

The Washington State Forest Practices Act is the primary regulatory action affecting the City of Buckley Watershed. This act exerts control over timber harvesting and road

building activities with respect to riparian buffers and overall water quality. The City Public Works Director reviews any Forest Project Applications submitted to the Washington State Department of Natural Resources for projects in the City watershed. If the landowner is not aware of the use of the watershed as the drinking water source for the City, they will be informed by letter of this fact as well as any other specific concerns that the City may have regarding a particular project. The landowner will be provided key telephone numbers to contact City personnel in case of an emergency.

Inspection, Surveillance and Monitoring Programs

The activities of the private landowners of the City of Buckley Watershed represent the greatest threat to the source water quality for the City. City staff patrol the watershed perimeter and access roads at least once per week. The City will continue to monitor the watershed. All City staff that are responsible for monitoring activities in the watershed are knowledgeable about the watershed boundaries, access points, and the potential impacts that various activities can have on the Buckley Watershed.

Public Education

The City will conduct a public outreach program to notify current watershed users of the potential activities that might adversely affect the water supply and encouraging conduct that maintains water quality. In addition, the City should request notification from all landowners of any activities with potential impact on the water.

MONITORING PROGRAM

The City monitors water flows and water quality in accordance with the monitoring requirements in the Water Quality Analysis section of Chapter 3. The City also inspects the headworks approximately once a week during normal operations. The inspection frequency increases in the fall and during storm events.

The City will continue to use the results of the monitoring programs to assess the adequacy of watershed protection and control. Specific activities of concern include logging and road construction. Extraordinary activities of concern include floods, landslides and earthquakes. The City routine water quality monitoring and sampling locations, including parameters monitored, are described in Water Quality Sampling and Monitoring Requirements, included in Appendix J.

The City of Buckley monitors timbering within the watershed and provides comments supporting the requirement of Best Management Practices (BMPs) by foresters in the watershed. The City requires notice from the Department of Natural Resources (DNR) of logging proposed within the Watershed area and requires buffers along steam bed, and culverting of stream crossings.

The City monitors impacts of activities occurring within the watershed. It continues to monitor raw water turbidities and coliform counts.

SYSTEM OPERATION

The water flows by gravity through a transmission main extending approximately 5.5 miles from South Prairie Creek to the location of the City's water treatment plant. The water is treated with a slow sand filter and disinfected prior to entering the distribution system. When turbidities are high from the South Prairie Creek source, the City switches to use of its wells. The entire system is gravity fed. Disinfection facilities for the City are located in the chlorination house just outside the slow sand filter. Chlorine is discharged into the line connecting the filter with the reservoir. Please refer to Chapter 3, System Analysis, for more detailed information on system design and operation of the treatment facilities.

The City monitors turbidity continuously. The system contains a turbidity alarm which is monitored 24 hours a day at the Buckley Dispatching Center. Turbidities exceeding 2.0 NTU trigger the alarm. Once the alarm is activated, the dispatching center notifies the Public Works Superintendent who assesses the situation and bypasses the surface water source and begins well operations if necessary. Table 5-10 provides the Water System's response to Watershed events.

TABLE 5-10

City of Buckley Watershed Response

Emergency	Detection Method	Response
High turbidities in surface water	Turbidity monitoring alarm rings into Buckley Dispatching Center	The PWD is dispatched to bypass surface water and begin well operation
Landslide threatens transmission line	Discovered during routine transmission line inspection	Engineering work begins to design stabilization work, funding is procured and stabilization work commences
Landslide damages transmission line, affecting water supply	Water flow falls off and is observed in daily monitoring	Inspection is performed immediately to locate damage, engineering work begins to correct damage, funding is procured and remedial work undertaken
Forest fire in the Watershed	Notification from landowners or detected during inspection	Wells are used until water quality is verified; Raw water monitoring frequency is increased to ensure that water is not contaminated by forest fire fighting efforts
Toxic spill in Watershed	Notification from land owners	Wells are used until water quality is verified; Raw water monitoring frequency is increased to ensure water is not contaminated by the spill

PERIODIC WATERSHED EVALUATION/UPDATES

There are no noticeable trends in Water Quality. Completion of the slow sand filter project removes much of the risk associated with contamination of the raw water source with coliform. The City will continue to monitor contaminant levels for herbicides and pesticides to ensure the water remains safe for domestic use. The City will update its watershed agreements to cover all owners of land within the watershed.

CHAPTER 6

OPERATION & MAINTENANCE PROGRAM

OBJECTIVE

The objective of this chapter is to provide an evaluation of the City's operation and maintenance (O&M) program and its ability to assure satisfactory management of the water system operations in accordance with WAC 246-290 -100, -300, -310, -320, -440, -480, and -490, and WAC 246-292-020, -050, and -090. The City's Operation & Maintenance Manual and specific component related documentation are maintained by the City for use by operations personnel. Such detail is beyond the scope of this chapter. This chapter is intended only to summarize system operations and evaluate operations needs.

The O&M Program includes the following elements:

- Water System Management and Personnel
- Operator Certification
- System Operation and Control
- Comprehensive Monitoring Plan
- Emergency Response Program
- Safety Procedures
- Cross-Connection Control Program
- Customer Complaint Response Program
- Recordkeeping and Reporting
- O&M Improvements

The following comments are presented as an assessment of the adequacy of each section of the City's Operation and Management Program.

WATER SYSTEM MANAGEMENT AND PERSONNEL

The current Utilities Superintendent is Chris Banks. John Dansby, Brandon Balliet, Rick Rice, and Dale Stienmetz are City employees dedicated to the water system. Todd Collechi and Jamie Green of DSHS operate the Slow Sand Water Treatment Plant.

OPERATOR CERTIFICATION

Department of Health (DOH) requires all Group A systems to have at least one certified Water Distribution Manager (WDM) under WAC 246-292-050. The WDM must further be certified at a level equal to or higher than the water system's classification rating as described in Table 6-1 and in accordance with WAC 246-292-040.

TABLE 6-1

Water System Group Classification

Classification	Population Served
Group 1	Less than 1,500
Group 2	1,501 to 15,000
Group 3	15,501 to 50,000
Group 4	Greater than 50,000

Additionally, the City is required to develop a Cross-Connection Control (CCC) Program and must ensure that a Cross-Connection Specialist (CCS) is responsible for overseeing the program and for periodic inspections of premises for cross-connections. Finally, the City must ensure that a Backflow Assembly Tester (BAT) is responsible for inspecting, testing, and monitoring backflow prevention assemblies in accordance with WAC 246-290-490. The City can perform these tests or can allow the customers to have their device tested by an approved BAT. Table 6-2 provides a list of the maintenance personnel, positions and certifications.

TABLE 6-2

City of Buckley Personnel Certification

Staff	Position	Operator Number	Certifications
Chris Banks	Utilities Superintendent	009524	Water Distribution Manager 2 Basic Treatment Operator Cross-Connections Control Specialist
John Dansby	Public Works Supervisor	010688	Water Distribution Manager 2 Basic Treatment Operator Cross-Connections Control Specialist
Brandon Balliet	Utility Systems Technician		Water Distribution Manager 1-IT Water Treatment Plan Operator 1-IT
Rick Rice	Water Crew	009620	Water Distribution Manager 2 Basic Treatment Operator Cross-Connections Control Specialist
Dale Steinmetz	Water Crew	012388	Water Distribution Manager 1 Cross-Connections Control Specialist
Todd Collecchi (Rainier School)	WTP Operator	009440	Water Distribution Manager 2 Water Treatment Plant Operator 2
Jamie Green (Rainier School)	WTP Operator	013631	Water Distribution Manager 2 Water Treatment Plant Operator 2

PROFESSIONAL GROWTH REQUIREMENTS

In order to promote and maintain expertise for the various grades of operator certification, Washington State requires all certified operators meet professional growth requirements by completing no less than three continuing education units (CEUs) every 3 years. Programs sponsored by both Washington Environmental Training Resource Center (WETRC) and the American Water Works Association (AWWA) Pacific Northwest Subsection are the most popular sources of CEUs for certified operators in Washington State. The professional growth requirement may also be met by advancement by examination or certification in a different classification.

SYSTEM OPERATION AND CONTROL

The City staff is responsible for the daily operations of its wells, storage facilities, and distribution system. The Rainier School staff is responsible for the daily operations of the Slow Sand Filter Water Treatment Plant.

IDENTIFICATION OF MAJOR SYSTEM COMPONENTS

The City has various components in its water system. These components consist of the South Prairie Creek surface water source, six active wells, the slow sand treatment plant, the trail wells treatment facility, the transmission main from South Prairie Creek, one active reservoir, and the distribution system.

Figure 1-3 provides a schematic of the major system components.

Sources of Supply

South Prairie Creek

This is a surface water supply that can provide an intake flow of up to 1,000 gpm through the transmission main to the Buckley water system. The use of this supply is limited to 725 gpm by the treatment capacity of the treatment plant.

Well 1 (Naches Street Well)

This well has a 10-inch diameter casing and is finished to a depth of 130 feet below ground surface (bgs). The capacity of this well is 260 gpm. The water from this well is chlorinated with gas chlorine on site.

Well 2

This well has an 8-inch diameter casing and is finished to a depth of 170 feet bgs. The capacity of this well is 130 gpm. The water from this well is chlorinated with gas chlorine onsite.

Well (Not Active)

This well is currently used as an observation well. There are no plans to use this well as a water supply source for the City.

Well 4

This well has a 16-inch diameter casing and is finished to a depth of 70 feet bgs. The capacity of this well is 240 gpm and the water is chlorinated with gas chlorine onsite.

Well (Rainier School Well)

This well is finished to a depth of 180 bgs. The capacity of this well is 215 gpm. Chlorine disinfection is provided by blending with chlorinated water from other sources at the filtration plant.

Well 6 (Trail Well 1)

This well has a 6-inch diameter casing and is finished to a depth of 155 feet bgs. The capacity of this well is 90 gpm and the water is chlorinated with gas chlorine onsite.

Well 7 (Trail Well 2)

This well has a 12-inch diameter casing and is finished to a depth of 143 feet bgs. The capacity of this well is 205 gpm and the water is chlorinated with gas chlorine onsite.

Treatment

Water from South Prairie Creek is introduced into the equalization basin located in the chlorination building. The raw water is then distributed across the sand filter and treated by slow sand filtration. The filter has an available surface area of 8,500 square feet. The water is chlorinated with gas chlorine after filtration and before entering the on-site storage reservoir. Water produced from Wells 2, 4, and the Rainier School Well can be directed through the slow sand filter or pumped directly into the reservoir. The Naches Street Well has its own chlorination system and water from this well is pumped directly into the distribution system.

The slow sand water treatment plant is operated at a filter-loading rate of 0.085 gpm/sq ft. This provides an available treatment capacity of 725 gpm. The transmission main from South Prairie Creek to the plant has an approximate carrying capacity of 900 to 1,000 gpm.

Wells 2, 4, and the Naches Street Well are individually metered and chlorinated.

Water from Trail Wells 1 and 2 is treated with pyrolusite filter media to remove dissolved iron and manganese. The Trail Wells Treatment Facility includes five, 3-foot diameter vessels and has a design flowrate of 300 gpm and a design filter loading rate of 8.5 gpm/sq. ft. The raw well water is chlorinated with glass chlorine and sodium permanganate upstream of the filters. The treated water enters the distribution system near the intersection of Ryan Road and SR 165.

Storage

The system includes two storage reservoirs. Only one reservoir, located adjacent to the treatment plant is normally used. This reservoir has a capacity of 2.3 million gallons. The disinfection contact time (CT) for the filtration plant water is achieved in this reservoir.

A second reservoir with a capacity of 750,000 gallons is not active and is not connected to the distribution system. The piping to the reservoir can be modified to enable the reservoir to be used for raw water from South Prairie Creek.

South Prairie Creek Water Transmission Main

The transmission main conveying water from South Prairie Creek to the treatment plant is 29,200 feet (5.5 miles) long. Segments of the pipe are not accessible by road. The line has a capacity of between 900 and 1,200 gallons per minute.

WATER QUALITY MONITORING

The City receives a yearly statement from the Department of Health on which water quality tests are required and when they are required. The monitoring requirements are found in Appendix J. An analysis of the City's most current test results can be found in Chapter 3. The City is also required to publish a Consumer Confidence Report (CCR) every year to update customers on the status of the water system. A copy of the most recent CCR can be found in Appendix N.

PREVENTIVE MAINTENANCE

In order to lengthen the amount of service from the various components of the water system, various preventative maintenance tasks are performed on a regular basis.

Typical tasks that are performed on a daily, weekly, monthly, quarterly, or yearly basis are listed below.

Daily

- Respond to customer inquiries.
- On-call 24 hours per day.

- Respond to service requests.
- Monitor chlorine residuals.
- Monitor for leaks in the system.
- Monitor water level in the reservoirs.

Weekly

- Inspect the headworks. This is to be done twice a week during the fall and immediately following big storm events.
- Inspect the static water levels of the wells within the system.

Monthly

- Inspect the transmission line.

Quarterly

- Check alarms to ensure they are functioning properly. These alarms include chlorine residual, turbidity, pH, water level and wells.
- Inspect watershed for any illegal activities or contamination.
- Scrape the slow sand filter (twice per year).

Yearly

- Inspect all City-owned backflow prevention devices.
- Clean reservoirs.
- Inspect wellhead protection areas for contaminant sources.

EMERGENCY RESPONSE PROGRAM

Water utilities have the responsibility to provide an adequate and reliable quantity and quality of water at all times. To meet this requirement, utilities must reduce or eliminate the effects of natural disasters, accidents, and intentional acts. Although it is not possible to anticipate all potential disasters affecting the City's water system, formulating procedures to manage and remedy common emergencies is appropriate.

WATER SYSTEM PERSONNEL EMERGENCY CALL-UP LIST

Table 6-3 is the emergency phone list. In the event of a contaminant spill, the phone list provided in the City's Wellhead Protection Plan should also be consulted.

TABLE 6-3

Water System Emergency Phone List

Agency/Group/Business	Contact	Phone Number
Fire/Police Emergency	--	911
City of Buckley Police Department	--	(360) 829-3157
City of Buckley Fire Department	--	(360) 829-1441
Pierce County Sheriff	--	(253) 798-4721
Washington State Patrol	Pierce County	(253) 536-6210
Telemetry and Meter Calibration	Calvert Technologies	(509) 244-1839
Chemical Supplies	Jones Chemical	(253) 274-0104
Chemical Supplies	Univar	(253) 892-5075
Waterworks Supplies	HD Waterworks	(206) 722-4800
Testing Lab (Coliform)	Water Management	(253) 531-3121
Washington State Department of Health	NW Regional Office, John Ryding	(253) 395-6757
Washington State Department of Health	After-Hours Emergency Line	(877) 481-4901
Washington State	Emergency Management	(800) 258-5990
King County	Emergency Management	(206) 296-3830
Pierce County	Emergency Management	(253) 798-7470
State Wide One-Call	Utility Locates	(800) 424-5555
City of Buckley Public Works	Water System Superintendent	(360) 829-1631

EMERGENCY PROCEDURES

In the event that any of these situations should arise, the City has an emergency intertie with the City of Tacoma. The City may be able to receive water from this source while arrangements are being made to rectify the problem the City is experiencing with its water supply. Chapter 3 also discusses the possibilities of other sources of emergency water.

Contamination of Water Supply

Bacterial contamination of the water supply can result from such items as main breaks or pollution from an isolated source. Table 6-4 provides the appropriate action that will be taken in the event of the contamination of the water supply.

TABLE 6-4

Water System Contamination Response

Distribution System Contamination	
·	Perform chemical and free chlorine residual analysis at various locations within the system, including the reservoirs and at system extremities.
·	Disinfect distribution lines as dictated by the nature of the contamination.
Reservoir Contamination	
·	Isolate reservoir from system.
·	Re-sample to confirm contamination.
·	Check distribution system for presence of contamination.
·	Inspect vent screens, hatches, and piping to identify source of contamination.
·	If reservoir water is contaminated and therefore considered unsuitable for consumption, drain and clean reservoir.
·	Consider disinfecting reservoir if bacteriological standards are exceeded. Follow AWWA Standards. A 50 ppm chlorine solution in the reservoir can be obtained by adding 97 gallons of 5.25 percent chlorine bleach per 100,000 gallons of storage.

Bacteriological Presence Detection Procedure

Procedures for notifying system customers, the local health department, and DOH of water quality emergencies are an important component of an emergency response program. Many public water systems will occasionally detect positive coliform samples. A positive response is mainly a result of minor contamination in distribution mains or sample taps, or improper bacteriological sampling procedures. However, the persistent detection of coliforms in the water supply, particularly E. coli or fecal bacteria, may require issuing a "public boil water notice" to ensure the health and safety of the water customers. Emergencies such as floods, earthquakes, and other disasters can affect water quality as a result of damage to water system facilities. Under these circumstances, a boil water order would be warranted. A sample boil water notification is included in the Coliform Monitoring Plan in Appendix H. WAC 246-290-320 requires water utilities to follow specific procedures in the event coliform bacteria are detected in the water system.

VOC, SOC and Inorganic Chemical and Physical Characteristics Detection Procedures

WAC 246-290-320(6) requires follow-up monitoring to be conducted in accordance with the following:

(a) For VOCs, 40 CFR 141.24 (f)(11) through (15), and (22).

(b) For SOCs, 40 CFR 141.24 (b), (c), and (h)(7) through (11) and (20)

Power Failure

Various types of weather can cause a loss of power. These weather conditions include wind, lightning, freezing rain, or freezing snowstorm. Additionally, power can be lost through traffic accidents.

In the event of a power outage, public works staff will first check reservoir levels. The City will be contacted to determine the length of the power outage. The Customers will be notified of the emergency and water conservation will be requested through radio, television, newspaper and/or police loudspeaker.

The City has auxiliary power to run the water treatment plant. The auxiliary power is in the form of diesel generators.

Severe Earthquake

A severe earthquake can result in transmission line breaks, distribution system breaks and structural damage to the pump station, treatment facility, wells, reservoirs and vaults which house critical valving and meters.

Table 6-5 provides procedures to follow in the event of a severe earthquake.

TABLE 6-5

Severe Earthquake Response

System Component	Proposed Actions
Reservoirs	· Observe structures for visual signs of structural damage. · If structural damage is apparent, drain reservoir and inspect the interior of the tank · Check storm drainage system for significant flows · If leakage is suspected, isolate one reservoir at a time and monitor water level for at least 24 hours
Distribution Lines	· Close valves to isolate breaks · Check reservoir level · Notify water customers of emergency and request water conservation
Transmission Lines	· Shut down source pumps · Isolate break and check the base water system section maps for valve locations · Repair break · Disinfect isolated section
Booster Stations, Wells, Treatment Facilities & Meters	· Inspect for joint leakage and leaking storage tanks · Inspect wells for operation · Inspect well seals to prevent contamination from entering the wellhead · Inspect for alignment of pump column and casing · Inspect screen integrity
Supply Facilities	· Inspect for leakage or other structural damage

Major Fire

In the event of a major fire within the service area, low-pressure conditions could result in the extremities of the distribution system due to fire suppression demand. Proper functioning of pumps should offset this effect. In the event of fire or drastically low static pressures, the system set points of pumps and reservoirs.

Cold Weather Conditions

Extended cold weather conditions could cause freezing problems at shallow service connections, valve vaults without an insulating earth cover, reservoirs, and water supply and treatment facilities. Frozen lines can be wrapped with heat tape or space heaters can be used in large spaces such as at the treatment plant where a heater could be utilized to minimize damage to piping and electrical equipment.

Distribution System High/Low Pressure

The water surface elevation in the storage reservoirs and booster station settings control distribution system pressures. Under normal conditions, the reservoir overflow levels set the maximum pressure within the City. The following table proposes investigative and corrective actions for both low and high-pressure conditions.

Table 6-6 provides procedures to follow in the event of severe high or low pressures.

TABLE 6-6

Distribution System High/Low Pressure Response

System Component	Proposed Actions	
	High Pressure	**Low Pressure**
Reservoirs	· Check reservoir levels · Manually discharge valves on pump · Ensure the recirculation pipeline is clean and free of any obstructions	· Check reservoir levels · Check drain line · Check for leakage
Distribution and Transmission Lines	· Excess pressure may cause damage to some older pipes. Open hydrants at various locations to reduce system pressure	· Contact City Hall, Fire and Police Departments · Demands due to fires, open hydrant or peak demands may be the cause. · Check roads, storm drainage facilities and sewer manholes along distribution system for excessive flows that would indicate a broken main. · If distribution system pressure is below 20 psi, issue press release on City website identifying affected area. Isolate the low pressure area and perform sampling in accordance with the Coliform Monitoring Plan.

CROSS-CONNECTION CONTROL PROGRAM

The City's Cross-Connection Control Program was enacted through *Ordinances 05-03* and *07-03*. The specifics of this ordinance are set forth in the Buckley Municipal Code Chapter 14.05.040. A copy of the municipal code and the City's Cross-Connection

Control manual can be found at City Hall. A copy of the cross connection chapter from the municipal code can be found in Appendix F.

PRIORITY SERVICE LIST

There are three categories of business establishments that may pose a hazard to the water system. Category one services pose the highest degree of hazard and include the following facilities:

- Printers
- Medical laboratories
- Chemical companies
- Radiator shops
- Battery, fertilizer, and paint manufacturers
- Pest control businesses
- Janitorial companies

Category two services are considered less hazardous and include the following:

- Doctor, dentist, and veterinarians' offices
- Blood banks
- Drug rehabilitation centers
- Car washes
- Photo labs
- Commercial laundries
- Nursing homes and hospitals

The least hazardous service category includes the following types of businesses:

- Food processing facilities
- Dairy establishments
- Beverage and candy manufactures
- Massage and health spas
- Motels and schools with pool, spa, or sauna facilities

NEW AND EXISTING CROSS CONNECTION DEVICES

New and existing cross connection devices are catalogued and checked initially by City staff. It is the responsibility of the customer to ensure proper testing of the devices on an annual basis thereafter. Backflow prevention devices are required on all new cross connections. A condition for new services is an evaluation by the cross connection control certified City staff to determine what type of backflow device is needed.

CROSS-CONNECTION CONTROL PROGRAM RECORD KEEPING

A critical program element of a cross-connection control program is the maintenance of accurate records. The City has an existing database with a list of cross connection devices within the water system. This list is included in Appendix O.

PROGRAM SCHEDULING AND PERSONNEL REQUIREMENTS

Inspection of the cross connection control devices is done by independent private inspectors and paid for by the service customer.

OPERATION & MAINTENANCE IMPROVEMENTS

Currently, the staff at the Rainier School is responsible for the operation of the treatment plant. The City maintains the water distribution system and provides labor when the slow sand filter must be scraped. This division of responsibility can cause difficulties for the City because the City is the responsible party in charge of the water system according to DOH, yet the City is not in direct control of the operators of the water treatment plant. In order to assert more direct control over operations of the water treatment plant and consolidate operation and maintenance functions for the entire water system, the City will work with DSHS to discuss revisions to the current operating agreement that would put operation of the water treatment plant under the direct supervision of the City of Buckley.

CHAPTER 7

DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS

OBJECTIVE

The objective of this chapter is to document the City's design and construction standards to allow the City to obtain DOH approval to utilize the alternative review process for construction of new and replaced water distribution facilities. Through this process, a purveyor needs no further approval from DOH for distribution project reports, construction documents, or installation of distribution reservoirs and storage tanks, booster pump facilities, transmission mains, distribution mains, pipe linings, and tank coatings. Source of supply facilities are not eligible for the alternative review process

Thus chapter includes the following elements:

- System Standards, Policies and Procedures
- Project Review Procedures
- Policies and Requirements for Outside Parties
- Design Standards
- Construction Standards
- Construction Inspection Procedures

The majority of these items can be found in the City's *Development Guidelines and Public Works Standards,* Revision 5 dated February 2017, located in Appendix G.

SYSTEM STANDARDS, POLICIES AND PROCEDURES

The City has developed the construction standards, *Development Guidelines and Public Works Standards*, Revision 5 dated February 2017, for any improvements within the public right-of-way and/or public easements, all improvements required within the proposed right-of-way of new subdivisions, for all improvements intended for maintenance by the City, and for all other improvements for which the City Code requires approval from the Public Works Department.

PROJECT REVIEW PROCEDURES

Project reports and construction documents are submitted to the City Engineer for review and approval. Construction documents that do not meet the standards are returned for resubmittal if the deviation is significant, or returned with corrections noted if the deviation is minor. Construction may not proceed unless the City Engineer has stamped

and signed the drawings "approved." The City Engineer does not review any work designed by the City Engineer.

POLICIES AND REQUIREMENTS FOR OUTSIDE PARTIES

The policies and requirements for development within the City can be found in Appendix G. These are taken from the *Development Guidelines and Public Works Standards*, Revision 5 dated February 2017, Included in Appendix G are written descriptions of the policies regarding the water system and also standard details that show the requirements.

Any project that needs to be approved by the City has to meet these requirements.

DESIGN STANDARDS

Appendix G has copies of the water design standards from the City's *Development Guidelines and Public Works Standards,* Revision 5 dated February 2017. Any improvements not specifically covered by the City's Public Works Standards must meet or exceed the 2016 *Standard Specification for Road, Bridges, & Municipal Construction*, and any current amendments to said document.

CONSTRUCTION STANDARDS (MATERIALS AND METHODS)

Appendix G has copies of the water design standards from the City's *Development Guidelines and Public Works Standards*. Any improvements not specifically covered by the City's Public Works Standards must meet or exceed the 2016 *Standard Specification for Road, Bridges, & Municipal Construction*, and any current amendments to said document.

CONSTRUCTION INSPECTION PROCEDURES

City staff inspects all new construction during and after construction to ensure that projects are constructed in accordance with the construction standards. This inspection includes being present during pressure test procedures and, if applicable, disinfection procedures and water quality sampling procedures to ensure that all have been properly performed. As-builts of the final system are to be submitted for each project. Service will not be provided until all requirements are satisfied.

If a Construction Report is required for the project by WAC 246-290-040, the report is to be prepared by the developer for the new development and by the City Engineer for system improvements. New development Construction Reports are submitted to the City Engineer for review and approval. System Improvement Construction Reports are submitted to the Department of Health for review and approval.

CHAPTER 8

CAPITAL IMPROVEMENT PROGRAM

INTRODUCTION

This chapter presents a Capital Improvement Program (CIP) in accordance with the requirements of WAC 246-290. Recommended water system improvements, associated costs, and scheduling are presented in the following sections. These improvements are based on the deficiencies identified in Chapter 3, and noted elsewhere in this Plan. Financing of these improvements is discussed in Chapter 9.

In the future, other projects may arise that are not identified as part of the City's water system CIP. Such projects may be deemed necessary for ensuring water quality, preserving emergency water supply, accommodating transportation improvements proposed by other agencies, or addressing unforeseen problems with the City's water system. Due to budgetary constraints, the completion of these projects may require that the proposed completion date for the projects in the CIP be rescheduled. The City retains the flexibility to reschedule proposed projects and to expand or reduce the scope of proposed projects, as best determined by the City when new information becomes available for evaluation.

RECOMMENDED IMPROVEMENTS

WATER RIGHTS

The City has adequate instantaneous annual water rights through 2034. However, if the City is going to develop additional groundwater source capacity, it may be necessary to add points of withdrawal to existing water rights or convert some surface water rights into groundwater rights. If new groundwater resources are developed near existing points of withdrawal (i.e. within the same ¼-¼ section) that are not currently fully utilizing existing rights, then additional points of withdrawal may be added by a showing of compliance action, which is a simple notification to Ecology that the City is adding points of withdrawal. If, however, the City needs to develop groundwater resources at a location that is not near an existing point of withdrawal with excess water right capacity, then it may be necessary to file an application for change of an existing water right. The latter action can take up to several years to complete and can required significant research, public process, report preparation, and other documentation as required by Ecology.

SOURCE MAINTENANCE

Projects S-1 and S-2: Resand Slow Sand Filter

As discussed in Chapter 3, the slow sand filter will require re-sanding by 2018. It may be possible that the existing sand can be retained in the filter basin and additional sand brought in, however, it has been found in previous slow sand filter resanding projects that differences between old and new sand can lead to operational problems, and it is preferable to remove all the old sand and replace it with new sand. If the old sand is retained and new sand is imported, approximately 400 cubic yards of new sand would be required. However, if the existing sand is removed and all new sand is imported, then approximately 1,000 cubic yards of sand will be required. Either way, a pilot study will be required prior to resanding the filter to verify the effectiveness and loading rates of the new sand and to evaluate possible problems with using old sand with the new sand.

A pilot study will cost an estimated $30,000, will take 6 months to complete, and should therefore be started in early 2018. For planning purposes it will be assumed that all sand in the slow sand filter will need to be replaced. Based on costs of other recent slow sand filter resanding projects, it is anticipated that the cost of resanding the Buckley filter will be approximately $140,000. Engineering services for the filter re-sanding, including preparation of plans and specifications, managing the bidding and award of contract, and construction inspection and management services, is anticipated to cost approximately $40,000. Therefore, the total cost of resanding the filters is estimated at $210,000, and will consist of two phases: A pilot study in 2018 for an estimated cost of $30,000, and resanding the filters in 2018 at an estimated cost of $180,000.

Estimated Project Cost (2017 Dollars):

Project S-1 Slow Sand Filter Resand Pilot Study: $30,000 (2018)

Project S-2 Resand Slow Sand Filter: $180,000 (2018)

SOURCE CAPACITY

The City has adequate production capacity (when including the 300 gpm from the new Trail Wells) to meet maximum day demands through the year 2024. An additional 559 gpm of source capacity is projected to be required by 2034 to meet projected demands in 18 hours per day of source production. If water use is reduced as projected in Chapter 4 of this Plan, it is possible that no additional source capacity will be needed within the 20-year planning horizon.

However, if growth is greater than projected, or if water use efficiency measures do not result in the savings projected, or if for any other reason water system demand is greater than projected, or if source capacity of any existing sources declines, the following source projects could be implemented to increase source capacity. The following

projects have been identified to provide for source capacity increases if needed to meet increasing demands.

Project S-3: Expand Slow Sand Filter Water Treatment Plant

Due to projected increasing system demands, the City plans to increase the capacity of the existing slow sand water treatment plant. This project would include constructing additional filter bed area, expanded filter building, additional inlet and under-drain piping, site piping and controls.

Estimated Project Cost (2017 Dollars): $800,000 (2019)

Projects S-4 and S-5: Drill and Equip New Wells

The City may consider drilling additional wells if water system demand grows faster than projected in Chapter 2. Also, due to historic vulnerability issues with the South Prairie Creek water transmission line, it is prudent to have a backup water supply source. Several wells were drilled on the east side of town near Rainier School in the late 1980s and early 1990s, and most wells were low enough in production capacity to be not worth developing as water supply source. The wells that were developed in that area have good water quality, requiring minimal treatment, but development of additional source in that area may be limited due to aquifer transmission capacity.

The question of where to develop additional groundwater resources goes beyond the scope of this water system plan. Based on well drilling experience to date, the subsurface geology in the Buckley area is highly variable and unpredictable. Therefore it may be that the only way to find out if good groundwater is available at a given site is to drill a well and find out. This is risky because it costs the same amount to drill a well that does not produce as it does to drill a well that does produce.

The estimated cost of drilling a 12-inch production well is approximately $120,000 to $150,000, depending on the finished well depth, materials encountered in the drilling process, and characteristics of the productive water zone. And because of the uncertainty in the success of well drilling in the Buckley Area, it is prudent to have a hydro-geologic study completed to obtain recommendations of locations that would be most likely to support productive wells.

A hydro-geologic study should be able to be completed for approximately $25,000, and a test well should be able to be drilled and tested for about $150,000

Estimated Project Cost (2017 Dollars):

S-4: Hydro-Geologic Study: $ 25,000 (2020)

S-5: Equip New Well: $150,000 (2021)

Projects S-6 and S-7: Water Rights, Drill, Equip, and Treat New Wells

As evaluated in the City's Water Supply Study (see Appendix Q), the City plans to pursue new water rights for new wells as part of the Cascade Water Alliance (CWA) Agreement regarding White River basin water rights. The water rights new wells would have a combined capacity of 900 gpm, to replace the South Prairie Creek source. It is anticipated that these new wells would be drilled on City property near the south bank of the White River. The number of wells is assumed to be a minimum of two and it is assumed that the wells would be groundwater under the influence of surface water and require treatment via filtration.

The estimated cost for purchase of water rights under the CWA Agreement is about $1,500,000 based on the water right purchase price of $1,150,000 per MGD. Drilling wells, equipping the wells with pumps, and construction of a surface water treatment plant is estimated to cost $6,000,000.

Estimated Project Cost (2017 Dollars):

S-6: Water Rights for New Wells: $1,500,000 (20-Year)

S-7: Drill, Equip and Treat New Wells: $6,000,000 (20-Year)

TRANSMISSION

The following projects have been identified to replace broken or deficient segments of the South Prairie Creek Transmission Main.

Project T-1: Segment 6, End of Trenchless to North Slope

The City will replace 2,440 LF of Raw Water Transmission Main between Segment 5 (installed in 2012) and Segment 7 (the segment from the north bank of the Creek crossing to the top of the slope on the access road). The planned pipe material is 12-inch (inside diameter) HDPE.

Estimated Project Cost (2017 Dollars): $830,000 (2019)

Project T-2: Segment 8, Creek Crossing Restoration

The City installed a cable bridge across South Prairie Creek in 2016. The bridge span is approximately 200 LF. A segment of Raw Water Transmission Main was installed on the bridge such that the pipe is approximately 8 feet above the ordinary high water mark of the creek, in an effort to stay clear of large wood debris that may be carried down the Creek and that have damaged the pipe in the past. The pipe material is 12-inch ductile iron with restrained joints. To complete restoration along the south bank and to remove

the old pipeline and concrete encasement from the creek bed, an estimate of $50,000 will be expended.

Estimated Project Cost (2017 Dollars): $50,000 (2018)

Project T-3: Segment 13, Between Replacement Segments

The City will replace 260 LF of Raw Water Transmission Main between Segment 14 (installed in 2007) and Segment 16 (installed in 2014). The planned pipe material is 12-inch (inside diameter) HDPE.

Estimated Project Cost (2017 Dollars): $105,000 (2020)

Project T-4: Segment 15, End of Old Cable Bridge to Replacement Segment

The City will replace 1,135 LF of the Raw Water Transmission Main from the north end of the old cable bridge to connect the south end of the Segment 14 (installed in 2007). The planned pipe material is 12-inch (inside diameter) HDPE.

Estimated Project Cost (2017 Dollars): $390,000 (2020)

Project T-5: Annual Leak Detection

A leak detection and repair program for the South Prairie Creek Transmission Main is one of the terms of the City's August 2004 water rights settlement with the Department of Ecology. The City will continue an annual leak detection program to determine if there are any additional sections of the pipeline in need of repair.

Estimated Project Cost (2017 Dollars): $10,000 (Annual)

Project T-6: Segment 16, Existing Cable Bridge

The City will replace 200 LF of existing main crossing a creek gully suspended from a cable-stayed bridge system. The bridge system and water main need replacement, including new suspension bridge cables, to prevent significant failure along this section. The planned pipe material is 12-inch ductile iron with restrained joints.

Estimated Project Cost (2017 Dollars): $203,000 (20-Year)

Project T-7: Segment 19, Along Cliff Face

The City will replace 200 LF of existing main exposed along a cliff face. This section of the transmission main needs new pipe and cliff anchorage systems. The planned pipe material is 12-inch ductile iron with restrained joints.

Estimated Project Cost (2017 Dollars): $161,000 (20-Year)

Project T-8: Segment 21, Creek Bed to Headworks

The City will replace 1,000 LF of existing main located in the South Prairie Creek streambed near the headworks of the transmission main. This section of pipe has been exposed in areas and is in poor condition from scouring of the stream. The planned pipe material is 12-inch ductile iron with restrained joints.

Estimated Project Cost (2017 Dollars): $409,000 (20-Year)

TREATMENT

Project Tr-1: Upgrade System Telemetry

The City will upgrade its system-wide telemetry system to one of several, newer technologies for communication and control. This would allow the City to maintain more competitive service contracts for maintenance and repairs of its telemetry equipment.

Estimated Project Cost (2017 Dollars): $180,000 (2018)

STORAGE

Projects St-1 and St-2: New 1.0 MG Reservoir Siting Study and Construction

The City will construct a new 1.0 MG reservoir at a site to be determined to provide additional storage capacity and to provide water storage redundancy. The City will conduct a reservoir siting study to evaluate potential reservoir locations and configurations. Following completion of the study, the City plans to construct the reservoir, which is anticipated to be a welded steel tank.

Estimated Project Cost (2017 Dollars):

St-1: Reservoir Siting Study: $25,000 (2021)

St-2: Construct 1.0 MG Reservoir: $2,000,000 (2022)

DISTRIBUTION SYSTEM

The following projects have been identified to remedy fire flow deficiencies identified in Chapter 3. Projects are categorized as projects in developed areas that are likely going to have to be completed by the City, and projects in undeveloped or underdeveloped areas that are likely to be completed by Developers. Projects are further categorized by projects that remedy residential fire flow deficiencies and projects that remedy commercial and industrial fire flow deficiencies.

City Projects

Residential Fire Flow

Project D-1: Edith from Park to Dundass, Balm from 4th to Ewing, Ewing from Dundass to Balm, 3rd from Main to Mason

Replace 1,200 lineal feet (LF) of 4-inch water main with new 8-inch water main on Edith, on Balm, on Ewing and on 3rd.

Estimated Project Cost (2017 Dollars): $354,000 (2018)

Project D-2: Heather between Whitmore and Elk Ridge School

Replace 70 LF of 6-inch water main with new 8-inch water main on Heather Lane.

Estimated Project Cost (2017 Dollars): $29,000 (2019)

Project D-3: Mason from A to D, B south of Mason, Rainier from Main to Mason

Install 1,900 LF feet of 8-inch water main to replace existing 4-inch and 6-inch mains and to loop existing water mains on Mason, on B Street, and on Rainier.

Estimated Project Cost (2017 Dollars): $510,000 (2018)

Project D-4: A from Park to Main

Replace 8500 feet of 4-inch AC water main with 8-inch water main on A Street.

Estimated Project Cost (2017 Dollars): $250,000 (2019)

Project D-5: Division from Ryan to New Fire Station

Replace 360 feet of 6-inch water main with 8-inch water main on Division Street.

Estimated Project Cost (2017 Dollars): $99,000 (2021)

Project D-6: Jefferson from 3rd to Pearl, Pearl from Perkins to Ryan, Mill from Pearl to Jefferson

Install 2,080 LF feet of 8-inch water main to replace existing 4-inch and 6-inch mains and to loop existing water mains on Jefferson, on Pearl, and on Mill.

Estimated Project Cost (2017 Dollars): $583,000 (2020)

Project D-9: Sheets South of Ryan

Replace 600 LF of 6-inch water main with new 8-inch water main on Sheets.

Estimated Project Cost (2017 Dollars): $146,000 (20-Year)

Project D-10: Klink South of Ryan

Replace 1,400 LF of 6-inch water main with new 8-inch water main on Klink.

Estimated Project Cost (2017 Dollars): $334,000 (20-Year)

Commercial Fire Flow

Project D-7: Ryan from Spiketon to LDS Church, A from Jefferson to Spiketon

Replace 1,760 LF of 10-inch AC water main with 12-inch water main on Ryan Road and install 600 LF of 8-inch water main on A Street to replace 4-inch water main and to remove a dead-end.

Estimated Project Cost (2017 Dollars): $643,000 (2021)

Project D-8: Fulton and 4th

Replace 450 LF of 4-inch water main with new 8-inch water main on Fulton and on 4th.

Estimated Project Cost (2017 Dollars): $211,000 (2021)

Project D-11: SR 410 West to Mundy Loss Road

Install 1,100 LF of 8-inch water main from the end of the existing main to Mundy Loss Road.

Estimated Project Cost (2017 Dollars): $251,000 (20-Year)

Project D-12: Hinkleman Extension from SR 410 to 112th

Install 700 LF of 8-inch water main on the future Hinkleman Extension alignment between SR 410 and 112th Street.

Estimated Project Cost (2017 Dollars): $158,000 (20-Year)

Project D-13: Hinkleman Road from Hinkleman Extension to Mundy Loss

Install 4,200 LF of 12-inch water main on Hinkleman Road from Hinkleman Extension to Mundy Loss Road.

Estimated Project Cost (2017 Dollars): $1,071,000 (20-Year)

Developer Projects

All Developer projects are included in the 20-year planning horizon. Some of these projects may be completed sooner, however, the schedule is up to the Developers, and the funding will come from the Developers. By placing these projects in the 20-year planning horizon, the City does not need to include funding for these projects in their capital facilities budget.

Residential Fire Flow

Project D-14: McNeely north of Collins

Replace 2,200 LF of 4-inch water main with new 8-inch water main on McNeely from Collins to the north end of McNeely.

Estimated Project Cost (2017 Dollars): $523,000 (20-Year)

Project D-15: McNeely south of Collins

Replace 750 LF of 4-inch water main with new 8-inch water main on McNeely from Collins to the south end of McNeely.

Estimated Project Cost (2017 Dollars): $193,000 (20-Year)

Project D-17: Mason from Spruce to McNeely

Install 2,000 LF of 8-inch water main on Mason during construction of future development.

Estimated Project Cost (2017 Dollars): $475,000 (20-Year)

Project D-18: Dieringer from Sorensen to McNeely

Install 2,200 LF of 8-inch water main on Dieringer during construction of future development.

Estimated Project Cost (2017 Dollars): $545,000 (20-Year)

Commercial Fire Flow

Project D-16: River north of Dieringer

Install 450 LF of 8-inch water main on River.

Estimated Project Cost (2017 Dollars): $120,000 (20-Year)

SUMMARY OF RECOMMENDED IMPROVEMENTS

A prioritization schedule and cost summary for the recommended 6-year capital improvement projects are shown in Table 8-1. The remainder of the recommended capital improvement projects, scheduled over a 20-year planning horizon, are shown in Table 8-2. Detailed cost estimates for the transmission and distribution improvement projects are included in Appendix P. Figure 8-1 is a map illustrating the locations of the proposed distribution system improvements.

Based on the City's Agreement with DSHS regarding Rainier School (see Appendix B), DSHS is obligated to pay a share of source, treatment and transmission main projects that benefit Rainier School. The DSHS cost share of these improvements is based on the percent of water usage attributable to Rainier School versus the total usage in the City. Based on Table 2-7, the percentage has varied from a high of 27.3 percent in 2013 to a low of 20.5 percent in 2016. For budgeting purposes, a 20 percent DSHS share of the project costs of applicable projects is assumed, as noted in Tables 8-1 and 8-2.

LEGEND

- BUCKLEY CITY LIMITS AND EXISTING CITY OF BUCKLEY RETAIL WSA
- EXISTING WATER LINE
- PROPOSED IMPROVEMENT
- 58" TACOMA WATER LINE
- INTERTIE AND BOOSTER PUMP STATION
- EXISTING WELL

N

0 600' 1200'

SCALE: 1"=600'

CITY LIMITS

TACOMA EMERGENCY INTERTIE BOOSTER STATION

NACHES STREET WELL (WELL 1)

58" TACOMA WATER LINE

TRAIL WELLS

ELK HEIGHTS BOOSTER STATION

RAINIER SCHOOL WELL (WELL NO. 5)

WELLS NO. 2 AND 4

RAINIER SCHOOL

WATER TREATMENT PLANT AND STORAGE RESERVOIR

PROJECTS S-1, S-2, S-3

D-1 D-2 D-3 D-4 D-5 D-6 D-7 D-8 D-9 D-10 D-11 D-12 D-13 D-14 D-15 D-16 D-17 D-18

STATE ROUTE 410 · STATE ROUTE 165 · RIVER RD · WHITE RIVER PARK RD · MAIN ST · MASON AVE · COLLINS RD · RYAN RD · SPIKETON RD · 112TH ST · HINKLEMAN RD · HINKLEMAN EXT · MUNDY LOSS RD · WHEELER ST · JEFFERSON AVE · COULS AVE · ASHLEY CT · ROSE PL · MOUNTAIN VIEW AVE · HATCH ST · DUNDASS AVE · PARK AVE · N FOURTH AVE · SECOND AVE · THIRD AVE · FOURTH AVE · OLSEN ST · WHITEHOUSE ST · WHITMORE WAY · MELLISH PL · HAMILTON PL · MOUNTAIN CIR · ROSEWOOD CT · STP RD · AMMON ST · NORMA ST · FULTON ST · CASCADE ST · EDITH ST · NACHES ST · FOURTH ST · THIRD ST · SECOND ST · PEARL ST · PERKINS ST · CEDAR ST · COTTAGE AVE · MILL ST · FRANKLIN ST · RAINIER ST · ELSA ST · HEATHER LN · SHAMROCK CT · SPRUCE ST · VIEW PL · SERGEANT ST · HAMILTON CT · MONTE VISTA ST · TROLLINGER AVE · SORENSEN AVE · MCKINLEY ST · ISHAY RD · QUIMAULT CT · HARMON ST · RISCHERT LN · EVANS CT · LEVESQUE RD · KLINK RD · BEVLO BLVD · DAVIS ST · WESNER ST · SPAULDING CIR · GANERO ST · LUND ST · SHEETS ST · DIVISION ST

CITY LIMITS

CITY OF BUCKLEY

WATER SYSTEM PLAN

FIGURE 8-1

CAPITAL IMPROVEMENTS

Gray & Osborne, Inc.

CONSULTING ENGINEERS

L:\BUCKLEY\13229 Water Plan\Figures\Fig 8-1.dwg, 8/31/2017 10:12 AM, CHRIS GASKIN

TABLE 8-1

6-Year Capital Improvement Projects Costs and Schedule

Project No.	Project	Estimated Cost	2017	2018	2019	2020	2021	2022
S-1(1)	Slow Sand Filter Resand Pilot Study	$30,000		$30,000				
S-2(1)	Resand Slow Sand Filter at WTP	$180,000		$180,000				
S-3(1)	Expand Slow Sand Filter WTP	$800,000			$800,000			
S-4	HydroGeo Study for New Well	$25,000				$25,000		
S-5	Drill and Test New Well	$150,000					$150,000	
T-1(1)	Segment 6, Trenchless to North	$830,000			$830,000			
T-2(1)	Segment 8, Creek Restoration	$50,000		$50,000				
T-3(1)	Segment 13, Between Segments	$105,000				$105,000		
T-4(1)	Segment 15, Near Old Cable Bridge	$390,000				$390,000		
T-5(1)	Annual Transmission Leak Detection	$60,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Tr-1(1)	Upgrade System Telemetry	$180,000		$180,000				
St-1	Reservoir Siting Study	$25,000					$25,000	
St-2	Construct 1.0 MG Reservoir	$2,000,000						$2,000,000
D-1	Edith, Balm, Ewing and 3rd	$354,000		$354,000				
D-2	Heather near Elk Ridge School	$29,000			$29,000			
D-3	Mason, B Street and Rainier	$510,000		$510,000				
D-4	A from Park to Main	$250,000			$250,000			
D-5	Division from Ryan to Fire Station	$99,000					$99,000	
D-6	Jefferson, Pearl and Mill	$583,000				$583,000		
D-7	Ryan and A	$643,000					$643,000	
D-8	Fulton and 4th	$211,000					$211,000	
Totals		**$7,504,000**	**$10,000**	**$1,314,000**	**$1,919,000**	**$1,113,000**	**$1,138,000**	**$2,010,000**

(1) DSHS to contribute an estimated 20 percent of Project Costs.

TABLE 8-2

20-Year Capital Improvement Projects Costs

Project No.	Project	Estimated Cost
S-6	Water Rights for New Wells	$1,500,000
S-7	Drill, Equip, and Treat New Wells	$6,000,000
T-5(1)	Annual Transmission Main Leak Detection	$140,000
T-6(1)	Segment 16, Existing Cable Bridge	$203,000
T-7(1)	Segment 19: Along Cliff Face	$161,000
T-8(1)	Segment 21: Creek Bed to Headworks	$409,000
D-9	Sheets south of Ryan	$146,000
D-10	Klink south of Ryan	$334,000
D-11	SR 410 West to Mundy Loss	$251,000
D-12	Hinkleman Extension from SR 410 to 112th	$158,000
D-13	Hinkleman Road from Hinkleman Ext. to Mundy Loss	$1,071,000
D-14(2)	McNeely north of Collins	$523,000
D-15(2)	McNeely south of Collins	$193,000
D-16(2)	River north of Dieringer	$120,000
D-17(2)	Mason from Spruce to McNeely	$475,000
D-18(2)	Dieringer from Sorenson to McNeely	$545,000
Total		**$12,229,000**

(1) DSHS to contribute an estimated 20 percent of Project Costs.

(2) Developer Projects.

CHAPTER 9

FINANCIAL ANALYSIS

This chapter describes how the City can finance the water system improvements outlined in Chapter 8, Capital Improvement Program. The potential funding sources, financial status of the water utility, the funding required to pay for the scheduled improvements, and the impact of water improvements on water rates are presented herein.

FINANCIAL STATUS OF EXISTING WATER UTILITY

CURRENT WATER RATES

Water rates and charges for the City are specified by City Council resolution, pursuant to City of Buckley Municipal Code (BMC) 14.04.130. Current rates are set by Resolution No. 17-04. The City charges for water service on a monthly basis. Monthly water rates consist of a monthly base charge plus a consumption rate. The monthly base charge varies by meter size and covers usage up to 200 cubic feet (1,496 gallons) per month. The consumption rate applies to consumption in excess of 200 cubic feet per month, and increases with increasing consumption. This rate structure is an increasing block rate structure, where successive block of consumption are charged at increasing rates. Current water rates for the City of Buckley are shown Table 1-10.

CURRENT CONNECTION FEES

The City's general facilities charges are also specified by City Council resolution, as specified in BMC 14.04.320. Current charges are set by Resolution No. 17-04. These charges are applicable only to new customers connecting to the system and are intended to enable the utility to pay for growth related capacity costs. In addition to the general facility charge, a new customer is charged an installation fee and a meter fee to cover the cost of installing the service connection and meter. Connections charges and general facilities charges are summarized in Chapter 1 in the text following Table 1-10.

402 WATER SEWER OPERATING FUND

The City operates on a combined water and sewer utility operating fund (No. 402). For this analysis, water and sewer revenues and expenditures are separated in the following sections.

402 Water Sewer Operating Fund Revenues

The operating fund segregates revenues into several categories: Charges for Goods and Services, Intergovernmental Revenues, Miscellaneous Revenues, and Interfund Transfers In. Table 9-1 shows the historic water utility revenues for the years 2011-2016. Water

utility revenues are differentiated from sewer utility revenues. Revenues that are not specifically water or sewer are proportioned between water and sewer in proportion to the revenues that are clearly water or sewer revenues.

TABLE 9-1

Historic 402 Water Sewer Operating Fund Revenues

Item	2011	2012	2013	2014	2015	2016
Charges for Goods and Services – Water						
Water Sales	$620,823	$695,326	$723,784	$753,700	$789,356	$782,294
Water Sales Penalty	$1,381	$0	$781	$97	$6,598	$6,125
Water Connections	$2,181	$870	$2,425	$5,053	$2,213	$5,532
Total Charges for Goods and Services - Water	**$624,385**	**$696,196**	**$726,990**	**$758,850**	**$798,167**	**$793,951**
Total Charges for Goods and Services - Sewer	**$1,539,475**	**$1,692,263**	**$1,739,068**	**$1,808,629**	**$1,855,232**	**$1,911,583**
Total Charges for Goods and Services -Water + Sewer	**$2,163,861**	**$2,388,459**	**$2,466,058**	**$2,567,479**	**$2,653,400**	**$2,705,534**
Other Charges for Goods and Services - Water	$2,719	$1,684	$1,610	$677	$2,334	$18,398
Other Charges for Goods and Services - Sewer	$6,704	$4,094	$3,852	$1,614	$5,425	$44,296
Total Other Charges for Goods and Services	**$9,423**	**$5,779**	**$5,463**	**$2,291**	**$7,759**	**$62,694**
Total Charge for Goods and Services	**$2,173,284**	**$2,394,237**	**$2,471,521**	**$2,569,770**	**$2,661,159**	**$2,768,228**
Intergovernmental Revenues						
Disaster Assistance - Water	$0	$2,526	$0	$0	$0	$0
Disaster Assistance - Sewer	$0	$6,139	$0	$0	$0	$0
Total Disaster Assistance	$0	$8,665	$0	$0	$0	$0
Total Intergovernmental Revenues	**$0**	**$8,665**	**$0**	**$0**	**$0**	**$0**
Misc Revenues						
Misc Revenues - Water	$2,820	$296	$43,573	$18,500	$26,618	$25,348
Misc Revenues - Sewer	$6,954	$719	$104,233	$44,092	$61,870	$61,029
Total Misc Revenues	**$9,774**	**$1,014**	**$147,806**	**$62,592**	**$88,487**	**$86,377**
Nonrevenues						
Nonrevenues - Water	$1,459	$1,452	$2,154	$2,726	$1,449	$5,781
Nonrevenues - Sewer	$3,597	$3,528	$5,153	$6,497	$3,367	$13,920
Total Nonrevenues	**$5,056**	**$4,980**	**$7,307**	**$9,222**	**$4,816**	**$19,701**
Interfund Transfers In						
From 405 Sewer Ext & Replace	$0	$0	$0	$0	$0	$0
Total Interfund Transfers In	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total 402 Fund Water Revenues	$631,384	$702,153	$774,328	$780,753	$828,568	$843,478
Total 402 Fund Sewer Revenues	$1,556,730	$1,706,743	$1,852,306	$1,860,832	$1,925,894	$2,030,827
Total 402 Fund, Water/Sewer Revenues	**$2,188,113**	**$2,408,896**	**$2,626,634**	**$2,641,585**	**$2,754,462**	**$2,874,306**

402 Water Sewer Operating Fund Expenditures

Historic 402 Water Sewer Operating Fund Expenditures are shown in Table 9-2. Expense categories include Water Administration General, Water Maintenance, Sewer Administration General, Sewer Maintenance, Non-Expenditures, and Other Financing Uses. As with Water and Sewer Revenues in Table 9-1, Water and Sewer expenditures are segregated in Table 9-2.

TABLE 9-2

Historic 402 Water Sewer Operating Fund Expenditures

Item	2011	2012	2013	2014	2015	2016
Water Administration General						
Supplies	$401	$912	$617	$76	$5,922	$4,527
Professional Services	$66,439	$147,800	$62,223	$14,848	$19,452	$59,262
Professional Services "Farm"			$4,962	$0	$0	$0
Communication	$2,290	$2,162	$2,255	$1,372	$2,899	$3,049
Advertising	$0	$0	$0	$0	$0	$0
Public Utility Services	$3,257	$3,089	$4,109	$3,514	$3,037	$3,245
Repair & Maintenance	$1,219	$2,953	$1,190	$1,822	$2,484	$1,085
Miscellaneous	$918	$1,020	$1,035	$3,660	$2,100	$2,894
State of Washington Excise Taxes	$28,348	$35,486	$37,579	$39,319	$41,122	$42,811
City Utility Taxes	$64,761	$69,401	$72,380	$75,127	$78,936	$80,506
Permits & Fees	$4,782	$1,529	$2,697	$7,378	$2,505	$2,537
Total Water Admin General	**$172,414**	**$264,352**	**$189,047**	**$147,116**	**$158,457**	**$199,915**
Water Maintenance						
Salaries, Wages and Benefits	$217,775	$243,353	$262,411	$271,636	$303,145	$352,813
Supplies	$30,843	$37,732	$35,951	$56,165	$50,154	$67,250
Supplies "Farm"			$14,927	$157	$0	$0
Fuel For Pumping	$6,713	$14,078	$3,025	$2,532	$1,721	$474
Fuel for Vehicles	$2,706	$9,758	$5,577	$6,669	$3,020	$3,833
Small Tools	$0	$0	$0	$0	$344	$369
Professional Services	$7,386	$3,820	$30	$111	$2,665	$4,990
Prof Svcs Water Quality Test	$7,238	$7,404	$9,229	$9,733	$9,172	$16,468
Communication	$217	$841	$962	$1,411	$1,101	$1,046
Public Utility Services	$14,261	$14,334	$22,498	$15,870	$32,890	$33,752
Public Utility Services "Farm"			$7,434	$5,854	$0	$0
Repair & Maintenance	$3,783	$2,614	$35	$13,604	$1,761	$14,772
Miscellaneous	$86	$1,383	$275	$311	$1,184	$329
Total Water Maintenance	**$291,008**	**$335,316**	**$362,354**	**$384,052**	**$407,159**	**$496,096**
Total Water Utility Expenses	**$463,422**	**$599,668**	**$551,400**	**$531,168**	**$565,616**	**$696,011**

TABLE 9-2 – (continued)

Historic 402 Water Sewer Operating Fund Expenditures

Item	2011	2012	2013	2014	2015	2016
Sewer Expenditures						
Sewer Admin General	$214,418	$229,625	$232,960	$234,384	$252,181	$253,118
Sewer Maint	$479,573	$475,628	$510,122	$609,264	$669,645	$742,959
Total Sewer Utility Expenses	**$693,991**	**$705,252**	**$743,082**	**$843,648**	**$921,826**	**$996,077**
Non-Expenditures						
Misc Reimbursements	$735	$100	$0	$0	$0	$0
Utility Overpay, Water	$815	$242	$356	$943	$2,485	$2,313
Water Connection Fee Reimbursement	$135	$0	$0	$0	$0	$0
Utility Overpay, Sewer	$0	$0	$0	$1,510	$0	$0
Sewer Connection Fee Reimbursement	$65	$0	$0	$0	$0	$0
Water portion of Non-Expenditures	$1,638	$342	$356	$943	$2,485	$2,313
Sewer portion of Non-Expenditures	$112	$0	$0	$1,510	$0	$0
Total Non-Expenditures	**$1,750**	**$342**	**$356**	**$2,453**	**$2,485**	**$2,313**
Other Financing Uses						
Transfers Out						
To 001 C.E. Admin Water	$61,396	$62,654	$65,449	$79,664	$67,333	$59,709
To 308 Water Rights	$10,000	$0	$0	$0	$1,141	$0
To 001 Insurance Portion Water	$7,499	$7,874	$46,860	$8,521	$13,963	$14,661
To 406 Water Imp Fund	$100,215	$110,952	$105,893	$105,893	$331,893	$121,546
To 001 C.E. Admin Sewer	$54,413	$56,779	$61,716	$74,283	$70,709	$58,773
To 405 Sewer Imp Fund	$705,000	$750,000	$750,000	$750,000	$750,000	$750,000
To 001 Insurance Portion Sewer	$36,254	$38,067	$0	$41,197	$35,191	$36,951
To 308 Comp Plan	$0	$0	$0	$10,000	$15,000	$0
To 307 Cap Imp - PW Bldg	$0	$0	$10,000	$0	$0	$0
To 430 Util Equip	$12,000	$9,996	$10,000	$10,000	$10,000	$10,000
To Current Expense Dispatcher	$33,921	$34,599	$8,650	$8,650	$8,650	$6,500
Water Portion of Transfers Out	$187,548	$189,366	$224,272	$199,326	$425,307	$199,019
Other Portion of Transfers Out	$833,150	$881,555	$834,296	$888,882	$878,574	$859,121
Total Other Financing Uses	**$1,020,698**	**$1,070,921**	**$1,058,568**	**$1,088,208**	**$1,303,880**	**$1,058,140**
Total 402 Fund, Water/Sewer Expenditures						
Water Portion of 402 Fund Expenses	$652,608	$789,376	$776,029	$731,437	$993,408	$897,344
Sewer Portion of 402 Fund Expenses	$1,527,254	$1,586,808	$1,577,378	$1,734,040	$1,800,400	$1,855,198
Total 402 Fund Expenditures	**$2,179,862**	**$2,376,184**	**$2,353,407**	**$2,465,477**	**$2,793,807**	**$2,752,542**

402 Water Sewer Operating Fund Cash Flow

Tables 9-1 and 9-2 are summarized in Table 9-3. From Table 9-3 it is clear that the total 402 Water Sewer Operating Fund is solvent and is maintaining a significant balance.

TABLE 9-3

Historic 402 Water Sewer Operating Fund Cash Flow

Item	2011	2012	2013	2014	2015	2016
Total 402 Water Sewer Operating Fund Cash Flow						
Beginning Balance	$3,117	$11,369	$44,082	$317,309	$493,416	$454,071
Total Revenues	$2,188,113	$2,408,896	$2,626,634	$2,641,585	$2,754,462	$2,874,306
Total Expenditures	$2,179,862	$2,376,184	$2,353,407	$2,465,477	$2,793,807	$2,752,542
Ending Balance	$11,369	$44,082	$317,309	$493,416	$454,071	$575,835
Water Portion of 402 Water Sewer Operating Fund Cash Flow						
Beginning Balance	$28,793	$7,569	($79,654)	($81,355)	($32,039)	($196,879)
Total Revenues	$631,384	$702,153	$774,328	$780,753	$828,568	$843,478
Total Expenditures	$652,608	$789,376	$776,029	$731,437	$993,408	$897,344
Ending Balance	$7,569	($79,654)	($81,355)	($32,039)	($196,879)	($250,744)
Sewer Portion of 402 Water Sewer Operating Fund Cash Flow						
Beginning Balance	($25,675)	$3,801	$123,736	$398,664	$525,455	$650,950
Total Revenues	$1,556,730	$1,706,743	$1,852,306	$1,860,832	$1,925,894	$2,030,827
Total Expenditures	$1,527,254	$1,586,808	$1,577,378	$1,734,040	$1,800,400	$1,855,198
Ending Balance	$3,801	$123,736	$398,664	$525,455	$650,950	$826,580

406 WATERLINE REPAIR AND CONSTRUCTION FUND

Waterline repair and water facilities constructions are funded through the 406 Waterline Repair and Construction Fund.

406 Waterline Repair and Construction Fund Revenues

Historic revenues for the 406 Fund are summarized in Table 9-4. The primary revenues for the 406 Fund have been grants, loans and transfers from the 402 Fund.

TABLE 9-4

Historic 406 Waterline Repair and Construction Fund Revenues

Item	2011	2012	2013	2014	2015	2016
Intergovernmental Revenues						
State Grants						
Disaster Assistance	$8,421	$657,411	$161,335			
Disaster Assistance State (DEM)	$1,403	$152,310	$26,890			
EPA Booster Station Grant		$29,870	$106,143	$225,185		
Commerce (Grant) Stream Crossing					$152,164	$259,398
Total State Grants	**$9,824**	**$839,591**	**$294,367**	**$225,185**	**$152,164**	**$259,398**
Intergovernmental Service Revenues						
State of Washington DSHS		**$25,795**				
Total Intergovernmental Service Revenues	**$0**	**$25,795**	**$0**	**$0**	**$0**	**$0**
Total Intergovernmental Revenues	**$9,824**	**$865,386**	**$294,367**	**$225,185**	**$152,164**	**$259,398**
Miscellaneous Revenues						
Investment Interest	$476	$650	$638	$337	$803	$1,022
Facilities Charge	$18,261	$58,345	$61,750	$28,978	$115,829	$199,059
DSHS Share of Imps.						
Misc Revenues			$7,697	$8	$0	$0
Total Misc Revenues	**$18,737**	**$58,995**	**$70,085**	**$29,323**	**$116,632**	**$200,081**
Other Financing Sources						
Dept of Commerce (PWTF) Loan			$270,579	$457,969	$964,143	$0
Transfer In from 402 Water/Sewer	$100,215	$110,952	$105,893	$105,893	$331,893	$121,546
Total Other Financing Sources	**$100,215**	**$110,952**	**$376,472**	**$563,862**	**$1,296,036**	**$121,546**
Total 406 Fund, Waterline Repairs and Construct Revenues	**$128,776**	**$1,035,333**	**$740,924**	**$818,370**	**$1,564,832**	**$581,025**

406 Waterline Repair and Construction Fund Expenditures

Historic expenditures from the 406 Fund are summarized in Table 9-5. The majority of the fund is spent directly on capital improvements, however a portion also goes to administration and utilities operations expenses related to capital improvements.

TABLE 9-5

Historic 406 Waterline Repair and Construction Fund Expenditures

Item	2011	2012	2013	2014	2015	2016
Water Utilities						
Administration - General						
Audit (Federal)	$0	$0	$0	$0	$0	$0
Total Administration - General	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Operations General						
Supplies	$1,237	$559	$0	$0	$4,360	$0
Professional Services	$14,074	$1,796	$24,366	$27,864	$28,779	$13,363
Professional Services Base Mapping	$0	$962	$0	$0	$6,214	$3,157
Comp Water Plan Professional Services	$0	$0	$39,558	$16,987	$0	$0
Advertising	$0	$0	$414	$939	$0	$0
Total Operations General	**$15,311**	**$3,317**	**$64,338**	**$45,791**	**$39,353**	**$16,521**
Total Water Utilities	**$15,311**	**$3,317**	**$64,338**	**$45,791**	**$39,353**	**$16,521**
Nonexpenditures						
Other Nonexpenditures						
Impact Fee Reimbursement	$2,728	$3,489				
Total Other Nonexpenditures	**$2,728**	**$3,489**				
Total Nonexpenditures	**$2,728**	**$3,489**	**$0**	**$0**	**$0**	**$0**
Other Financing Uses						
Interest and Other Debt Service Costs						
PWTF - Int - Trail Well and Emergency			$291	$5,102	$17,704	$8,384
Total Interest and Other Debt Service Costs						
PWTF Principle, Trail Well and Emergency	**$0**	**$0**	**$291**	**$5,102**	**$17,704**	**$8,384**
Total Capital Expenditures				$26,214	$93,194	$99,152
Total Non-Capital Expenditures	**$68,590**	**$1,096,947**	**$617,589**	**$999,670**	**$1,179,276**	**$452,446**
Transfer Out	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Other Financing Uses					$17,622	$35,808
Total 406 Fund, Waterline Repairs and Construct Expenditures	**$68,590**	**$1,096,947**	**$617,880**	**$1,030,986**	**$1,307,796**	**$595,791**

406 Waterline Repair and Construction Fund Cash Flow

Beginning 406 Fund balances, total 406 Fund revenues, total 406 Fund Expenditures and resulting ending 406 Fund balances are summarized in Table 9-6.

TABLE 9-6

Historic 406 Waterline Repair and Construction Fund Cash Flow

Item	2011	2012	2013	2014	2015	2016
Beginning fund Balance	$286,712	$328,859	$260,439	$319,146	$60,739	$278,423
Revenues	$128,776	$1,035,333	$740,924	$818,370	$1,564,832	$581,025
Expenditures	$86,629	$1,103,753	$682,217	$1,076,777	$1,347,148	$612,311
Ending Fund balance	$328,859	$260,439	$319,146	$60,739	$278,423	$247,137

PROJECTED EXPENSES AND REVENUES

GROWTH AND INFLATION RATES

Projected growth is required to estimate future revenues as well as expenses associated with providing water. Chapter 2 projects 3.43 percent average annual water system growth through year 2030. Also, it is assumed that all expenses will grow at the projected rate of inflation. Inflation rate projections were obtained as estimated by three financial institutions, including International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD), and Economist Intelligence Unit (EIU). IMF and OECD provide inflations projections through 2019, while EIU provides a longer term an inflation projection through 2060. Inflation rate projections through 2019 are averaged from the three sources. Inflation rates after 2019 are strictly EIU projections. The various projected inflation rates and the average values used for this report are as shown in Table 9-4.

TABLE 9-7

Projected Expenses Inflation Rates

Year	2017	2018	2019	2020	2021	2022
IMF	2.21%	2.12%	1.99%	(1)	(1)	(1)
EIU	2.30%	2.50%	2.00%	(1)	(1)	(1)
OWED	1.90%	1.97%	2.01%	2.03%	2.04%	2.04%
Average	**2.14%**	**2.20%**	**2.00%**	**2.03%**	**2.04%**	**2.04%**

(1) IMF and EIU inflation projections end at 2019.

Revenues do not automatically change with inflation rate, so revenue rates will need to be adjusted to keep pace with inflation plus the need to fund capital improvements.

402 WATER OPERATING FUND PROJECTIONS

Projected 402 Water Operating Fund Water Revenues

Projected 402 Water Operating Fund water revenues are shown in Table 9-8. Water sales and connection fee rate adjustment are shown to cover inflation and capital improvements. The 2017 value for Water Sales per ERU is taken from total water sales for 2016 in Table 9-1 divided by the total ERUS for 2016 from Table 2-10. Projected ERUs are taken from Table 2-12. New ERUs are the difference between Projected ERUs from year to year. Note that ERUs and New ERUs are based on the projected system growth rate of 3.43 percent, which is based on the City's Comprehensive Plan growth projections. Other miscellaneous revenues shown in Table 9-1 are not included in this projection because they are generally relatively small and inconsistent. Other revenues in the future may decrease the need for some rate increases shown in Table 9-8.

TABLE 9-8

Projected 402 Water Revenues with Rate Increases

Item	2017	2018	2019	2020	2021	2022
Water Sales						
Rate Increase	0%	5%	5%	5%	5%	5%
Water Sales per ERU	$226	$237	$249	$261	$274	$288
Projected ERUs	3,573	3,696	3,823	3,955	4,091	4,231
Projected Water Sales	**$807,498**	**$875,952**	**$951,927**	**$1,032,255**	**$1,120,934**	**$1,218,528**
Water Connections						
Connection Fee Increase	0%	5%	5%	5%	5%	5%
Water Connection Fee per ERU	$800	$840	$882	$926	$972	$1,021
New ERUs	118	123	127	132	136	140
Projected Water Connection Fees	**$94,400**	**$103,320**	**$112,014**	**$122,232**	**$132,192**	**$142,940**
Total Projected 402 Fund Water Revenues	**$901,898**	**$979,272**	**$1,063,941**	**$1,154,487**	**$1,253,126**	**$1,361,468**

Projected 402 Water Operating Fund Water Expenditures

Projected 402 Water Operating Fund water expenditures are shown in Table 9-9. All expenses are increase annually by the inflation rates shown in Table 9-7. All expenses are also increased annually by the system annual growth rate of 3.43 percent based on the City's Comprehensive Plan growth projections, with the exceptions of Supplies "Farm," Public Utility Services "Farm."

TABLE 9-9

Projected 402 Water Operating Fund Water Expenditures

Item	2017	2018	2019	2020	2021	2022
Water Administration General						
Supplies	$2,100	$2,200	$2,300	$2,400	$2,500	$2,600
Professional Services	$50,000	$53,000	$56,000	$59,000	$62,000	$65,000
Communication	$2,300	$2,400	$2,500	$2,600	$2,700	$2,800
Public Utility Services	$3,800	$4,000	$4,200	$4,400	$4,600	$4,900
Repair & Maintenance	$2,500	$2,600	$2,700	$2,800	$3,000	$3,200
Miscellaneous	$2,800	$3,000	$3,200	$3,400	$3,600	$3,800
State of Washington Excise Taxes	$40,000	$42,000	$44,000	$46,000	$49,000	$52,000
City Utility Taxes	$78,000	$82,000	$87,000	$92,000	$97,000	$102,000
Permits & Fees	$5,400	$5,700	$6,000	$6,300	$6,600	$7,000
Total Water Admin General	**$186,900**	**$197,600**	**$208,500**	**$220,000**	**$232,200**	**$245,100**
Water Maintenance						
Salaries, Wages and Benefits	$353,000	$373,000	$394,000	$416,000	$439,000	$463,000
Supplies	$65,000	$69,000	$73,000	$77,000	$81,000	$85,000
Supplies "Farm"	$0	$0	$0	$0	$0	$0
Fuel For Pumping	$1,000	$1,100	$1,200	$1,300	$1,400	$1,500
Fuel for Vehicles	$4,000	$4,200	$4,400	$4,600	$4,900	$5,200
Small Tools	$400	$400	$400	$400	$400	$400
Professional Services	$5,000	$5,300	$5,600	$5,900	$6,200	$6,500
Prof Svcs Water Quality Test	$16,000	$17,000	$18,000	$19,000	$20,000	$21,000
Communication	$1,100	$1,200	$1,300	$1,400	$1,500	$1,600
Public Utility Services	$34,000	$36,000	$38,000	$40,000	$42,000	$44,000
Public Utility Services "Farm"	$0	$0	$0	$0	$0	$0
Repair & Maintenance	$8,000	$8,500	$9,000	$9,500	$10,000	$10,600
Miscellaneous	$600	$600	$600	$600	$600	$600
Total Water Maint	**$488,100**	**$516,300**	**$545,500**	**$575,700**	**$607,000**	**$639,400**
Total Water Utility Expenses	**$675,000**	**$713,900**	**$754,000**	**$795,700**	**$839,200**	**$884,500**
Other Financing Uses						
Transfers Out						
To 001 C.E. Admin Water	$60,000	$63,400	$66,900	$70,600	$74,500	$78,600
To 001 Insurance Portion Water	$14,000	$15,000	$16,000	$17,000	$18,000	$19,000
To 406 Water Imp Fund	$130,000	$180,000	$220,000	$270,000	$315,000	$370,000
To 308 Comp Plan	$1,000	$1,100	$1,200	$1,300	$1,400	$1,500
To 307 Cap Imp - PW Bldg	$1,100	$1,200	$1,300	$1,400	$1,500	$1,600
To 430 Utility Equipment	$2,000	$2,100	$2,200	$2,300	$2,400	$2,500
To Current Expense Dispatcher	$1,300	$1,400	$1,500	$1,600	$1,700	$1,800
Total Other Financing Uses	**$209,400**	**$264,200**	**$309,100**	**$364,200**	**$414,500**	**$475,000**
Total 402 Fund Water Expenditures	**$884,400**	**$978,100**	**$1,063,100**	**$1,159,900**	**$1,253,700**	**$1,359,500**

Projected 402 Water Operating Fund Water Cash Flow

Total 402 Water Operating Fund water revenues from Table 9-8, and total 402 Water Operating Fund water expenditures from Table 9-9 are summarized in Table 9-10. Beginning balance for 2017 is a proportion of the total 402 Water Sewer Operating Fund

ending balance from Table 9-3 based on the proportion of Water operating expenses to total Water Sewer Fund operating expenses.

TABLE 9-10

Projected 402 Water Operating Fund Water Cash Flow

Item	2017	2018	2019	2020	2021	2022
Beginning Water Portion Balance	$187,700	$205,198	$206,370	$207,211	$201,798	$201,224
Total Water Revenues	$901,898	$979,272	$1,063,941	$1,154,487	$1,253,126	$1,361,468
Total Water Expenses	$884,400	$978,100	$1,063,100	$1,159,900	$1,253,700	$1,359,500
Ending Water Portion Balance	$205,198	$206,370	$207,211	$201,798	$201,224	$203,192

406 WATERLINE REPAIR AND CONSTRUCTION FUND PROJECTIONS

Water System capital improvements are paid for through the 406 Waterline Repair and Construction Fund. Table 9-11 shows projected 406 Waterline Replacement and Construction Fund revenues, expenditures and balances. The initial balance is directly from Table 9-6. Revenues to the 406 Waterline Repair and Construction Fund include Transfers In from the 402 Water Sewer Operating Fund, as shown in Table 9-9, Intergovernmental Revenues, which consist of grant and loans from various government agencies, and Water Facilities Charges for new system connections. Expenditures from the 406 Waterline Repair and Construction Fund include Construction Operation Costs, Debt Service Costs, and Capital Improvements.

Transfers in from the 402 Water Sewer Operating Fund have been inserted to help with funding of capital improvements while maintaining a reserve in the water portion of the 402 Water Sewer Operating Fund. Capital facilities charges are calculated from the total number of new ERUs each year, based on ERU projections in Table 2-12. Facilities charges per ERU shown for 2017 are current rates, while Facilities Charges for 2018 through 2022 have been adjusted to improve funding for capital improvements. Operations costs related to Capital Improvements are presumed to be proportional to the cost of the capital improvements for each year in proportion to the operational costs and capital facilities costs from Table 9-5. Debt service costs are carried forward from Table 9-5, and increased in each year following acquisition of Intergovernmental Revenues, presuming the revenues are low interest loan funds repayable over 20 years at a two percent annual interest rate. Intergovernmental Revenue funds are projected as necessary in 2019 and 2022 to fund the capital improvement schedule. Capital improvements come directly from Table 8-1, with a reduction of 20 percent for projects to be partially funded by DSHS.

TABLE 9-11

Projected 406 Waterline Replacement and Construction Fund, with Capital Improvements and Facilities Charge Adjustments

Item	2017	2018	2019	2020	2021	2022
Balance Forward	$247,137	$752,422	$357,570	$396,417	$325,097	$195,577
Projected 406 fund Revenues						
Transfer In from 402 Water/Sewer	$130,000	$180,000	$220,000	$270,000	$315,000	$370,000
Intergovernmental Revenues			$750,000			$1,000,000
New ERUs	118	123	127	132	136	140
Facilities Charges per ERU	$4,091	$6,500	$6,500	$6,500	$6,500	$6,500
Facilities Charges	$482,738	$799,500	$825,500	$858,000	$884,000	$910,000
Total Projected 406 Fund Revenues	**$612,738**	**$979,500**	**$1,795,500**	**$1,128,000**	**$1,199,000**	**$2,280,000**
Projected 406 Fund Expenditures						
Operations Costs	$300	$51,200	$66,500	$42,300	$47,500	$84,000
Debt Service Costs	$99,152	$99,152	$99,152	$145,020	$145,020	$145,020
Capital Improvements	$8,000	$1,224,000	$1,591,000	$1,012,000	$1,136,000	$2,008,000
Total Projected 406 Fund Expenditures	**$107,452**	**$1,374,352**	**$1,756,652**	**$1,199,320**	**$1,328,520**	**$2,237,020**
Ending Fund Balance	**$752,422**	**$357,570**	**$396,417**	**$325,097**	**$195,577**	**$238,557**

COMPARISON OF WATER RATES

City of Buckley water rates are shown in Chapter 1 of this plan. A typical usage of 175 gpd equates to an average monthly use of 712 cubic feet (CF) per month. At current City of Buckley water rates, a typical Buckley water bill will be approximately $32.28 per month. Water rates for Buckley and other nearby cities are summarized in Table 9-12. All of the nearby utilities except Wilkeson utilize an inclining block rate structure, where the rate per unit volume increases with increasing use. However, all of the listed nearby utilities have a rate break point at a monthly usage that exceeds Buckley's average monthly usage. Therefore, only the applicable rate for the average Buckley usage is shown in Table 9-12.

TABLE 9-12

Monthly Water Rates for Nearby Utilities

Utility	Base Rate	Use Rate per CCF	Bill for 712 CF
Bonney Lake	$16.61	0 – 1,000 CF: $1.37	$26.36
Enumclaw	$14.63	0 – 800 CF: $2.07	$29.37
Buckley	$21.84	200-700 CF: $2.03 701 – 1,500 CF: $2.43	$32.28
Puyallup	$18.56	0 – 1,000 CF: $2.03	$33.01
Sumner	$22.34	0 – 1,000 CF: $1.96	$36.30
Wilkeson	$27.32	0 – 1,000 CF: $2.55	$45.48

RECOMMENDATIONS

Tables 9-8 indicates water revenue rate increases and water connection fee increases necessary to fund projected operations expenses and capital improvements. Water rates and connections would be increased by five percent per year beginning in January of 2018. Table 9-9 indicates transfers from the 402 Water Sewer Operating Fund to the 406 Waterline Repair and Construction Fund to fund the capital improvement schedule. Table 9-11 shows facilities charge increases and intergovernmental revenues necessary to fund the capital improvement schedule. Facilities charges are increased from $4,091 per ERU to $6,500 per ERU.

Table 9-11 indicates that intergovernmental revenues will be required to complete the capital improvements delineated in Chapter 8. This is particularly so in 2019 and 2022, when a total of $1,750,000 in intergovernmental funds is indicated. The need for these funds is largely driven by the projected costs to expand the slow sand filter treatment system in 2019, and to construct a second water reservoir in 2022, as shown in Table 8-1. Of the 6-year capital improvement plan total of $7,504,000, $525,000 is planned to be obtained from DSHS, $1,750,000 is planned from intergovernmental funds, which leaves the remaining $5,229,000 of the capital improvements are paid for out of revenues for water service, connections, and general facilities charges.