City of Black Diamond Water System Plan

SPRING 2020
FINAL XX 2020

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CERTIFICATE OF ENGINEER

"I hereby certify that this Water System Plan for the City of Black Diamond was prepared under the supervision and direction of the undersigned, whose seals as licensed professional engineers of the State of Washington are affixed below."

Signed: 3/18/2020

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EXECUTIVE SUMMARY

Green River Pipe Bridge

The City of Black Diamond's (City) 2020 Water System Plan (WSP) provides a long-term planning document for the City's water system. It evaluates the system over a 20-year planning horizon and develops a list of recommended project improvements with a 6-year financing plan. This WSP has been prepared in accordance with Washington State Department of Health (DOH) requirements as outlined in Washington Administrative Code (WAC) Chapter 246-290.

The City's water system is currently served by the Black Diamond Spring Field, located approximately 2 miles southeast of the City. Water from the Black Diamond Spring Field is pumped to a 4.3 million gallon (MG) Reservoir by a pump station located on the north side of the Green River. An additional source of water for the City is a wholesale intertie with the City of Tacoma from Tacoma Water's Second Supply Pipe Line (SSPL). It is anticipated that wholesale water will be the City's major source in the long-term future.

The City has two reservoirs that serve the City's water service area (WSA). The City's distribution system currently operates with three pressure zones – the upper pressure zone at a pressure head of approximately 965 feet, the middle pressure zone at a pressure head of approximately 850 feet, and the lower pressure zone at a pressure head of approximately 750 feet. Portions of the system operate with high pressures, so there are individual pressure reducing valves (PRVs) on most service connections throughout the WSA. The transmission and distribution system for the City consists of approximately 181,163 linear feet of pipe ranging from less than 2 inches to 20 inches in diameter.

The City currently serves approximately 1,268 connections, over 90 percent of which are single-family residences. Although growth in the WSA has been very slow, several large master planned communities are in the process of building out. Therefore, the City is preparing to serve substantial growth. The City's water system is expected to expand from serving 1,825 Equivalent Residential Units (ERUs) in 2019 to serving over 7,900 ERUs in 2035.

A complete hydraulic analysis of the system has been conducted and numerous projects are recommended to improve the system. Projects selected for the WSP are:

1. Growth-related projects associated with extensions to the existing system to serve proposed new master planned developments;
2. System improvements to address existing system deficiencies, such as inabilities to meet minimum fire flow requirements;
3. Projects to replace small waterlines that are 4 inches and smaller; and
4. Projects to replace waterlines constructed of asbestos cement (AC) or other substandard materials.

A 6-year funding program has been developed using three funding sources:

1. Projects to be funded outright by development as extensions to the system or a frontage fee;
2. Projects to be funded by connection charges to the existing system to address growth-related deficiencies; and
3. projects to be funded by customer rates to address existing system deficiencies.

In the past 20 years, the City has made tremendous improvements to the water system, including a new storage reservoir, new treatment systems, new chlorine disinfection systems, an intertie with the City of Tacoma providing greater reliability, replacement of half the old AC water mains, upgrades to the telemetry and controls system, purchasing new equipment, meeting new DOH requirements, improving fire flow, and meeting the demands of new growth.

The City has established a development agreement known as the Water Supply and Facilities Funding Agreement, or WSFFA, with the two major landowners in the City (now represented by Oak Pointe and Palmer Coking Coal) to fund the major needed water improvements and to secure the needed water supply for the future growth in the City. This agreement sheltered the current citizens from the impacts of growth but also provided for the water needs of the growing City.

It is anticipated that revenue from commodity sales will increase significantly with growth from the new developments, and that revenue will continue to increase with growth and outpace operation and maintenance expenses. In 2024, the City will retire a major debt obligation that will then put the water utility in the position to more easily fund additional maintenance projects that have been put on hold, like the painting of the 965 Pressure Zone Reservoir. If the trends described above continue, then no significant rate increases are projected over the next 6 years.

The City is committed to providing its customers with a safe and reliable source of drinking water. The City is anticipating substantial growth in population over the 20-year planning period and this WSP provides a means for ensuring that the City water system can accommodate current and future customers.

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1 | INTRODUCTION

Old Green River Bridge

LOCATION

The City of Black Diamond (City) is located approximately 30 miles southeast of Seattle, Washington. The City was established in 1880 and developed as a coal mining town over the next 50 years. The City was incorporated in 1959. The City is located along Highway 169 (also known as Maple Valley-Black Diamond Road), just west of the Cascade Mountains. **Figure 1.1, Vicinity Map (Washington State)** illustrates the location of the City in the State of Washington. **Figure 1.2, Vicinity Map (King County)** illustrates the location of the City within King County.

WATER SYSTEM OWNERSHIP

The City owns and operates a public water system. Water system data on file at the Washington State Department of Health (DOH) for the City's system is shown in **Table 1.1, Water System Ownership Information**.

Table 1.1
Water System Ownership Information

Information Type	Description
System Type	Community – Group A
System Name	Black Diamond Water Department
County	King
DOH System ID Number	07220 7
Owner Number	513
Address	PO Box 599 Black Diamond, WA 98010
Contact	Dan DalSanto
Contact Phone Number	(360) 851-4522

OVERVIEW OF EXISTING SYSTEM

A summary of water system data for the City's system and the number of customers served in 2019 is shown in **Table 1.2, Water System Summary**.

Table 1.2
Water System Summary

Description	Data (2019)
Total City Population	4,525 people
Population Served by City	3,025 people
Population Served by Covington Water District	1,500 people
Total Connections	1,269 accounts
Total Customers	1,822 ERU
Demand per Customer	180 gpd/ERU

A summary of the important characteristics of the City's existing water system facilities in 2019 is shown in **Table 1.3, Water System Description.**

Table 1.3
Water System Description

Description	Facilities
Number of Pressure Zones	3
Black Diamond Spring Field Annual Withdrawal	551 acre ft/year
Wholesale Intertie Production Capacity	807.4 MG/year
Number of Pressure Reducing Valves	4
Total Length of Water Main	181,163 linear feet

The location of the City is shown in **Figure 1.1, Vicinity Map (Washington State)** and **Figure 1.2, Vicinity Map (King County).**

Figure 1.1
Vicinity Map (Washington State)

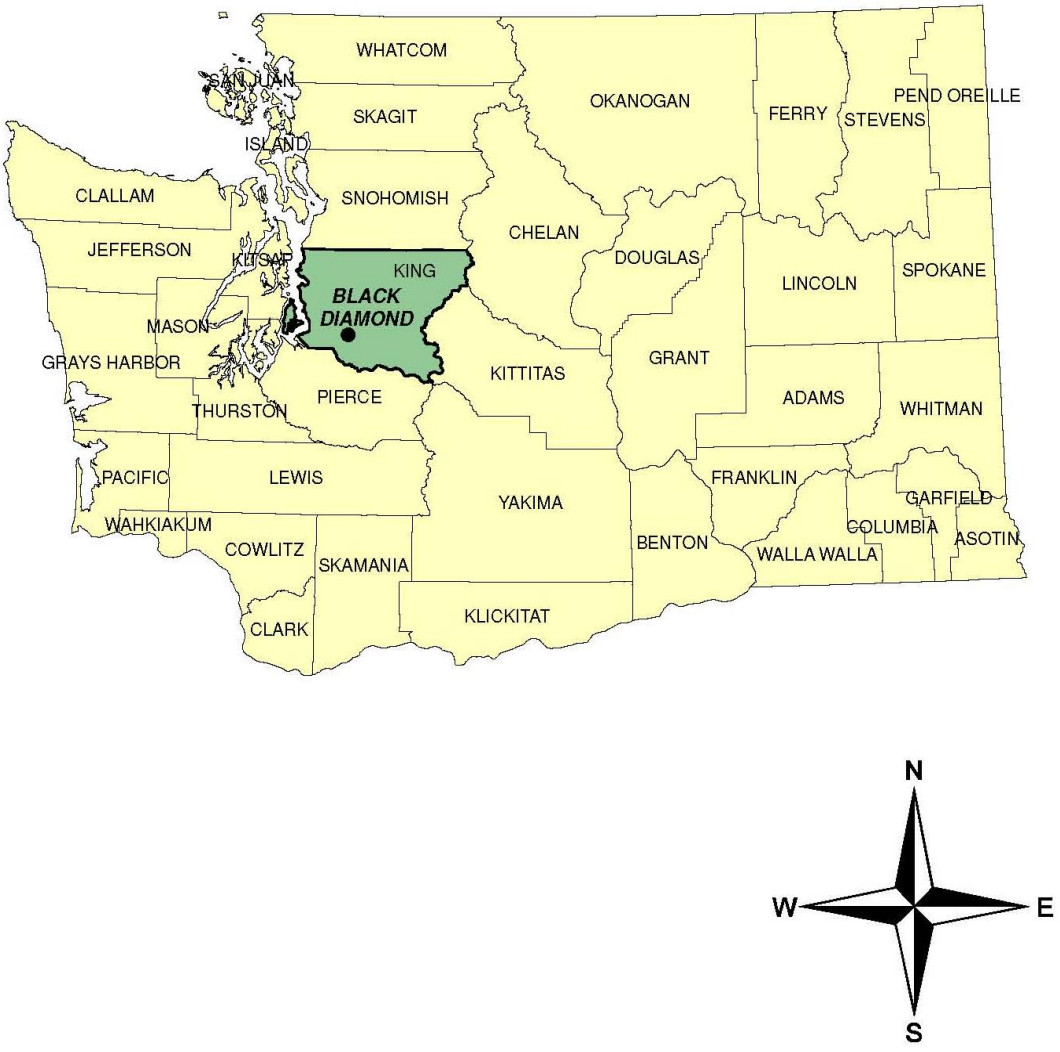
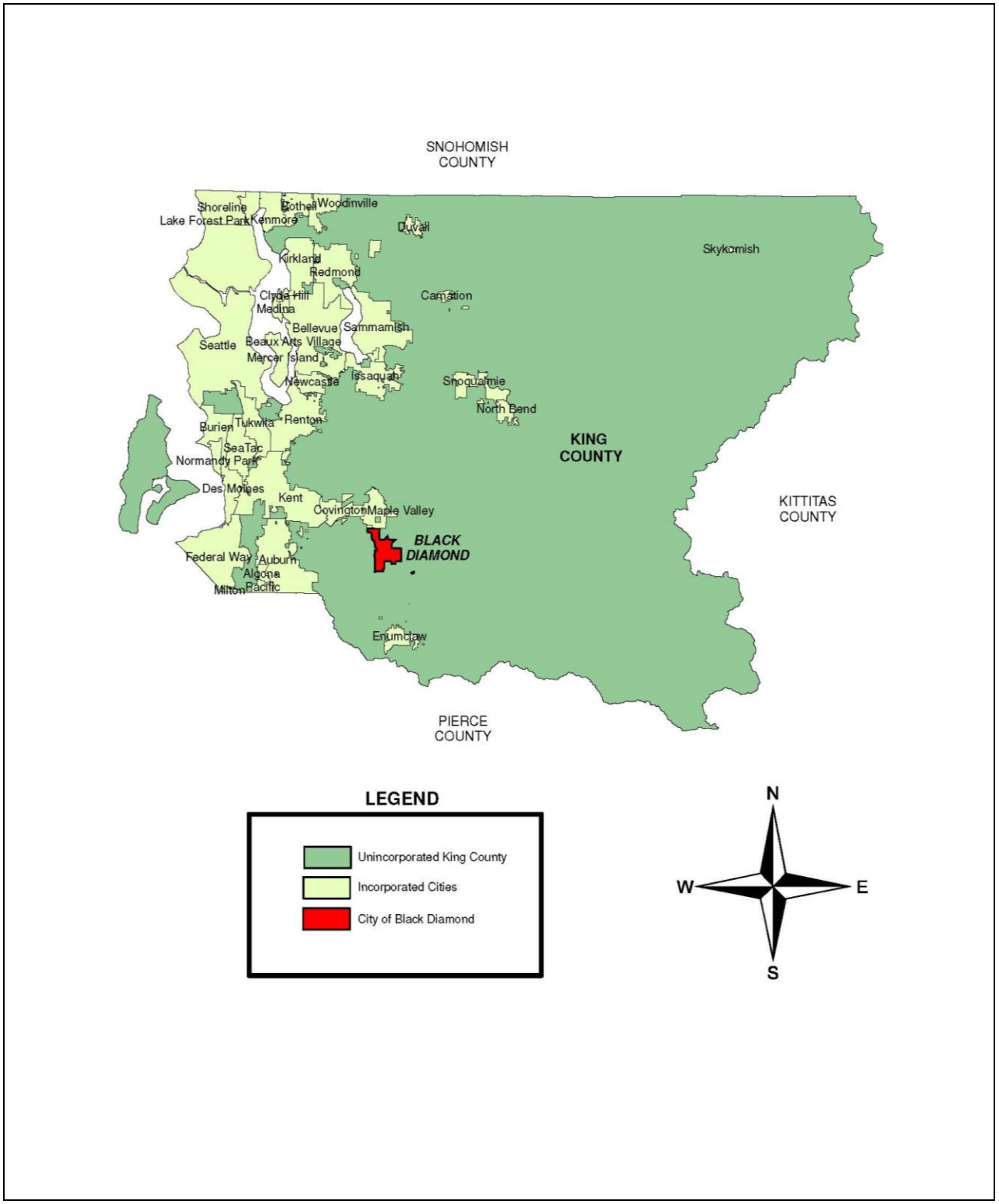


Figure 1.2
Vicinity Map (King County)



AUTHORIZATION AND PURPOSE

In June 2019, the City authorized RH2 Engineering, Inc., to prepare a Water System Plan (WSP) update as required by state law under Washington Administrative Code (WAC) 246-290-100. It is the City's intent to update its WSP and submit it to DOH every 10 years. The previous plan was approved and adopted in 2008, with an extension granted until 2020. The purpose of this updated WSP is as follows.

- To evaluate the existing water demand data and project future water demands.
- To analyze the existing water system to determine if it meets minimum requirements mandated by DOH and the City's own policies and design criteria.
- To identify water system improvements to resolve existing system deficiencies and accommodate future needs of the system for at least 20 years into the future.
- To prepare a schedule of improvements that meets the goals of the City's financial program.
- To evaluate past water quality and identify water quality improvements, as necessary.
- To document the City's operations and maintenance program.
- To prepare conservation, emergency response, cross-connection control, wellhead and watershed protection, and water quality monitoring plans.
- To comply with all other 2020 WSP requirements of DOH.

ORGANIZATION OF PLAN

A brief summary of the content of the chapters in the WSP is as follows.

- The **Executive Summary** provides a brief summary of the key elements of this WSP.
- **Chapter 1** introduces the reader to the City's water system, the objectives of the WSP, and the WSP organization.
- **Chapter 2** presents the water service area, describes the existing water system, and identifies the adjacent water purveyors.
- **Chapter 3** presents related plans, land use, and population characteristics.
- **Chapter 4** identifies existing water demands and projected future demands.
- **Chapter 5** presents the City's operational policies and design criteria.
- **Chapter 6** discusses the City's water sources and water quality.
- **Chapter 7** discusses the water system analyses and existing system deficiencies.
- **Chapter 8** discusses the City's operations and maintenance program.
- **Chapter 9** presents the proposed water system improvements, their estimated costs, and implementation schedule.

- **Chapter 10** summarizes the financial status of the water utility.
- The **Appendices** contain additional information and plans that supplement the main chapters of the WSP.

ACRONYMS AND ABBREVIATIONS

AC	asbestos cement
ADD	Average Day Demand
afy	acre feet per year
AWWA	American Water Works Association
BDUGAA	Black Diamond Urban Growth Area Agreement
BPS	Booster Pump Station
CIP	Capital Improvement Program
City	City of Black Diamond
cfs	cubic feet per second
County	King County
CT	Contact Time
CWSSA	Critical Water Supply Service Area
CWD	Covington Water District
DOH	Washington State Department of Health
DI	ductile iron
DSL	Distribution System Leakage
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential Unit
fps	feet per second
GMA	Growth Management Act
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HGL	Hydraulic Grade Line
hp	Horsepower
MCL	Maximum Contaminant Level

MDD	Maximum Day Demand
MG	million gallons
mg/L	milligrams per liter
MGD	Million Gallons per Day
MPD	master planned development
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
psi	pounds per square inch
RCW	Revised Code of Washington
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SKCCWSP	South King County Coordinated Water System Plan
SKCWUCC	South King County Water Utilities Coordinating Committee
SSPL	Second Supply Pipe Line (City of Tacoma)
Tacoma	City of Tacoma
TDH	Total Dynamic Head
UGA	Urban Growth Area
WAC	Washington Administrative Code
WSFFA	Water Supply and Facilities Funding Agreement
WSA	Water Service Area
WSP	Water System Plan

DEFINITION OF TERMS

Annual Demand: The total water system demand for one calendar year.

Average Day Demand (ADD): The total amount of water delivered to the system in a year divided by the number of days in the year. ADD is typically expressed as gallons per day per equivalent residential unit (gpd/ERU).

Consumption: The true volume of water used by the water system's customers. The volume is measured at each customer's connection to the distribution system.

Contaminant: A substance present in drinking water that may adversely affect the health of the consumer or the aesthetic qualities of the water.

Critical Water Supply Service Area (CWSSA): A geographical area that is characterized by a proliferation of small, inadequate water systems, or by water supply problems that threaten

the present or future water quality or reliability of service in a manner that efficient and orderly development may best be achieved through coordinated planning by the water utilities in the area.

Cross-Connection: Any physical connection, actual or potential, between a water system and any source of non-potable substance that presents the potential for contaminating the public water system.

Dead Storage: The volume of stored water not available to all consumers at the minimum design pressure.

Demand: The quantity of water required from a water supply source over a period of time necessary to meet the needs of domestic, commercial, industrial, and public uses, and to provide enough water to supply firefighting, system losses, and miscellaneous water uses. Demands are normally discussed in terms of flow rate, such as million gallons per day (MGD) or gallons per minute (gpm), and are described in terms of a volume of water delivered during a certain time period.

Demand Forecast: An estimate of future water system water supply needs assuming historically normal weather conditions and calculated using numerous parameters, including population, historic water use, local land use plans, water rates and their impacts on consumption, employment, projected water use efficiency savings from implementation of a water use efficiency program, and other appropriate factors.

Disinfection: The use of chlorine or other agent or process for killing or inactivating microbiological organisms, including pathogenic and indicator organisms.

Distribution System Leakage (DSL): The amount of water supply lost to leakage.

Equalizing Storage: The volume of storage needed to supplement supply to consumers when the peak hourly demand exceeds the total source pumping capacity.

Equivalent Residential Units (ERUs): One ERU represents the amount of water used by one single-family residence for a specific water system. The demand of other customer classes can be expressed in terms of ERUs by dividing the demand of each of the other customer classes by the demand represented by one ERU.

Fire Flow: The rate of flow of water required during firefighting, which is usually expressed in terms of gpm.

Fire Suppression Storage: The volume of stored water available during fire suppression activities to satisfy minimum pressure requirements.

Head: A measure of pressure or force exerted by water. Head is measured in feet and can be converted to pounds per square inch (psi) by dividing feet by 2.31.

Head Loss: Reduction in pressure resulting from pipeline wall friction, bends, physical restrictions, or obstructions.

Hydraulic Analysis: The study of a water system's distribution main and storage network to determine present or future adequacy for provision of service to consumers within the

established design parameters for the system under peak flow conditions, including fire flow. The analysis is used to establish any need for improvements to existing systems or to substantiate adequacy of design for distribution system components such as piping, elevated storage, booster stations, or similar facilities used to pump and convey water to consumers.

Hydraulic Elevation: The height of a free water surface above a defined datum; the height above the ground to which water in a pressurized pipeline would rise in a vertical open-end pipe.

Maximum Contaminant Level (MCL): The maximum permissible level of contaminant in the water that the purveyor delivers to any public water system user, measured at the locations identified under WAC 246-290-300, Table 3.

Maximum Day Demand (MDD): The maximum amount of water delivered to the system during a 24-hour time period of a given year.

Operational Storage: The volume of distribution storage associated with source or booster pump normal cycling times under normal operating conditions. Operational storage is additive to the equalizing and standby storage components, and to fire flow storage if this storage component exists for any given tank.

Peak Hour Demand (PHD): The maximum amount of water delivered to the system, excluding fire flow, during a one-hour time period of a given year. A system's peak hour demand usually occurs during the same day as the maximum day demand.

Potable: Water suitable for human consumption.

Pressure Zone: A portion of the water system that operates from sources at a common hydraulic elevation. For example, 748 Zone refers to a pressure zone that has water tanks with an overflow elevation of 748 feet.

Purveyor: An agency, subdivision of the State, municipal corporation, firm, company, mutual or cooperative association, institution, partnership, or persons or other entity owning or operating a public water system. Purveyor also means the authorized agents of such entities.

Reclaimed Water: 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 beneficial use or a controlled use that would not otherwise occur; it is no longer considered wastewater.

Standby Storage: The volume of stored water available for use during a loss of source capacity, power, or similar short-term emergency.

Supply: Water that is delivered to a water system by one or more supply facilities that may consist of supply stations, booster pump stations, springs, and wells.

Storage: Water that is "stored" in a reservoir to supplement the supply facilities of a system and provide water supply for emergency conditions. Storage is broken down into the following five components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage.

Water Right: A permit, claim, or other authorization, on record with or accepted by the Washington State Department of Ecology, authorizing the beneficial use of water in accordance with all applicable State laws.

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2 | WATER SYSTEM DESCRIPTION

North Bank Pump Station

WATER SYSTEM MANAGEMENT

The City of Black Diamond's (City) water system is operated and maintained by the City, a municipal corporation that is governed by a Mayor-Council form of government. The water system is operated and maintained by the City's Public Works Department. The Washington State Department of Health (DOH) water system identification number is 072207. A copy of the Water Facilities Inventory (WFI) Form is included in **Appendix A – Water Facilities Inventory (WFI) Form**.

DOH has oversight on the review and approval of the City's system and Water System Plan (WSP). Correspondence with DOH and copy of the WSP Checklist are included in **Appendix B – DOH Checklists and Correspondence**.

SYSTEM BACKGROUND

HISTORY OF WATER SYSTEM DEVELOPMENT AND GROWTH

The City's original water supply system was built prior to 1915 by the Pacific Coast Coal Company. The Pacific Coast Coal Company owned and operated the system until 1943. From 1943 to 1968, the system was owned and operated by King County Water District No. 66. In 1968, ownership was transferred to the City.

The City was established in the late 1800s as a coal mining town. The City has maintained a rural atmosphere and has a 2019 estimated population of 4,525. The City encompasses just over 4,250 acres, or 6.6 square miles, which includes the Lake Sawyer area that was annexed in 1998. The Lake Sawyer area is currently served by the Covington Water District (CWD) and is not included in the City's existing Water Service Area (WSA). Therefore, the City's water system only provides service to approximately 67 percent of the City's total population, with CWD serving approximately 1,500 people.

Growth and System Planning Efforts

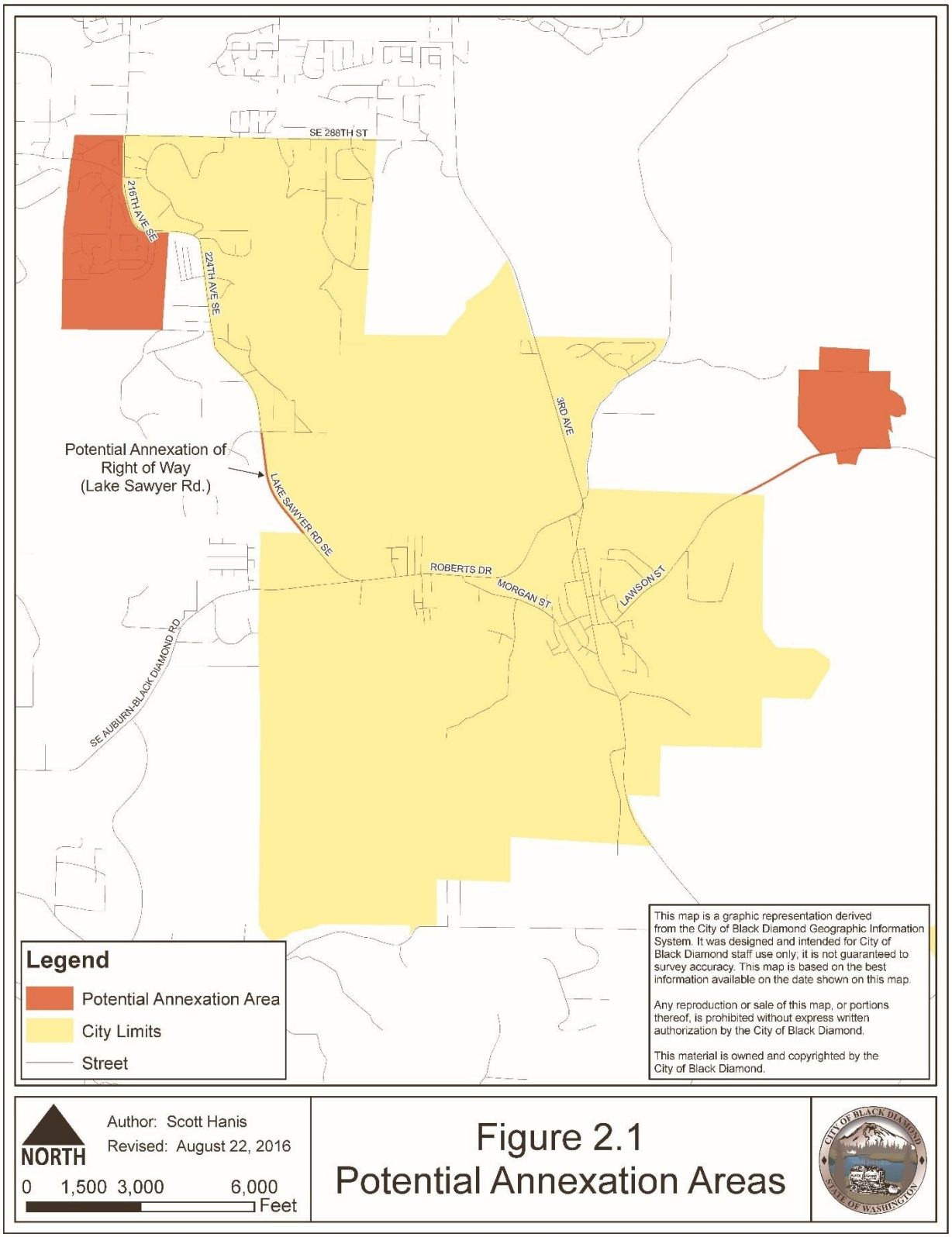
In 1996, the City entered into the Black Diamond Urban Growth Area Agreement (BDUGAA), which established much larger future City boundaries and put the City in charge of planning for the utilities to serve the area. Previously, the City did not have the water system source capacity to serve the larger new service area, was deficient in storage, delivery, and redundancy, and had health risk issues that needed to be addressed. Plum Creek Timber Company, Palmer Coking Coal Company, and Black Diamond Associates were the three major landowners of the vacant undeveloped land in the City. The City did not have the funding to meet the needs of future growth or the water system improvements needed to meet DOH requirements, and the large land owners could not develop their land without the water system capacity. The City and the landowners entered into the Water Supply and Facilities Funding Agreement (WSFFA). The WSFFA identified the water system improvement projects to be funded by the landowners and the water to be purchased from the City of Tacoma to serve the vacant land in exchange for credit on capital facility charges. The landowners have purchased the water needed, constructed an intertie, replumbed the City's water system into 3 pressure zones, replaced one third of the spring supply line with a larger main, installed transmission mains to serve the west portion of the City, and upgraded the disinfection system. The obligations that remain under this agreement are to complete the new supply line from the pump station to the City, upgrade the pump station to deliver the full water right from the springs, upgrade the spring collection system to meet DOH requirements, replace and upsize the pipes from the springs to the pump station, and conduct a final rate study to determine capital facility charge credit.

All the urban area identified in the BDUGAA (**Appendix C – Black Diamond Urban Growth Area Agreement**) has been annexed, except for the area around Lake 12 east of the City, as identified in **Figure 2.1, Potential Annexation Areas**.

There were two major annexations in 2009; the south annexation area by Ordinance No. 09-032; and the east annexation area by Ordinance No. 09-031.

The other area that could potentially still be annexed and served by the City's water utility is the area around Lake 12, east of the City. This area is somewhat remote and detached from the City, and to date, there has not been much interest in annexing this area, and no requests for annexation have been submitted. Consequently, the City has not developed plans to serve the area.

Figure 2.1
Potential Annexation Areas



The City is currently working with two large-scale developments within the City limits. One is Lawson Hills at Black Diamond. Lawson Hills at Black Diamond is a master planned community that is expected to include approximately 1,200 new residences, as well as retail development. It is located on 325 acres, east of Highway 169 and south of Lawson Street.

The second is Ten Trails, previously known as The Villages at Black Diamond. This master planned community is approved for 4,000 new residences, as well as retail space, office space, and other amenities. It is located primarily on 950 acres west of Highway 169 and south of Black Diamond-Auburn Road.

With the prospect of the City's population more than quadrupling in the near future, the City is facing unique challenges in ensuring that its water system will be prepared to accommodate such intense growth. Although the developers are responsible for implementing and funding the improvements necessary to serve them, the City will need to be prepared to meet the operational and maintenance demands as the water system grows. In the last two years the City has added two full-time employees to the Public Works Department.

ADJACENT PURVEYORS

The largest water system adjacent to the City's WSA is CWD. **Figure 2.2, Adjacent Water Systems** shows the location of water purveyors adjacent to the City's WSA. Adjacent purveyors have been afforded the opportunity to comment on this WSP. Comments received from adjacent purveyors have been included in **Appendix D – Agency Review Comments**.

Covington Water District

CWD is the purveyor for the areas to the north and west of the City. It has a service area of approximately 53 square miles and provides water to the Cities of Covington, Maple Valley, and portions of Black Diamond, as well as unincorporated areas of King County (County). CWD is a member of the Cascade Water Alliance, and its primary water supply comes from nine production wells located at two wellfield sites, in addition to a wholesale agreement with the City of Tacoma. CWD has 18 million gallons (MG) of storage in ground level steel tanks at five sites and 210 miles of pipeline. As previously mentioned, CWD is the current purveyor for the Lake Sawyer Area within the City limits. CWD and the City were in dispute over 94 acres in West Black Diamond, caused by conflicts between the *South King County Coordinated Water System Plan* map and other planning documents, including the BDUGAA, the City's approved WSP, and annexation ordinances. The service area dispute was resolved by an agreement between CWD and the Land Owner/Developer of the dispute area. CWD has relinquished claims to the dispute area.

Additional Systems

Additionally, there are several private wells and small public water systems served by wells located within the City as shown in **Table 2.1, Additional Water Systems.** The City desires to discontinue the use of such systems. The City's *Comprehensive Plan* outlined the City's policy to require any new developments to hook up to the municipal water system. Additionally, the

Comprehensive Plan outlines the City's policy to prohibit new private water systems within the City.

Figure 2.2
Adjacent Water Systems

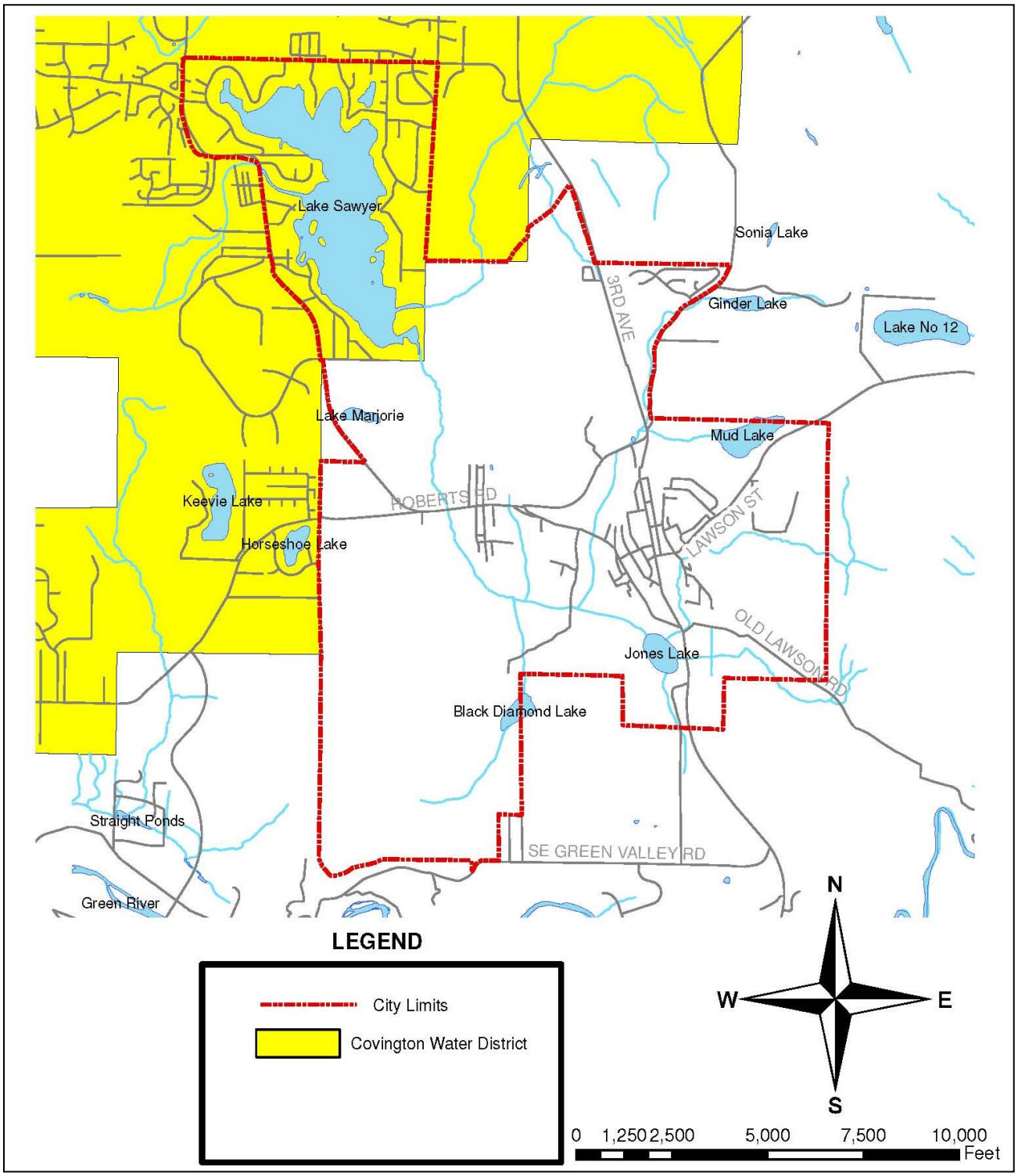


Table 2.1
Additional Water Systems

Water System Name	Water System ID	System Type	Number of Connections	Within City Limits	Type of Source
COVINGTON WATER DISTRICT	416508	A	18,188	Yes	Well Field
KENT WATER DEPARTMENT	381501	A	32,307	No	Well Field
SAWYERWOOD ESTATES WATER	76460N	A	22	Yes	Well
SAWYERWOOD WATER SYSTEM	76462P	A	11	Yes	Well
BEADLE-FRESHWATER	52331Y	B	3	No	Well
BLUM, E.	14321	B	4	No	Groundwater
BOONDOCKS TAVERN	07710L	B	2	No	Well
CALLERO, A.	10553H	B	4	No	Well
CAR	05259H	B	2	No	Well
COKE-LONEY	62136A	B	2	No	Well
DIAMOND ACRES	42240J	B	4	No	Well
DIAMOND RIDGE	23897	B	5	No	Well
GOLDSBERRY, P.	264442	B	2	Yes	Well
HENRY COMMUNITY WATER SYSTEM	06182L	B	2	No	Well
HOFMANN	26601Q	B	2	Yes	Well
JOHNSON, J.	44176D	B	2	Yes	Well
KNIGHT, T.	16453R	B	4	No	Well
MCLEAN	572906	B	2	No	Well
MORENO SUPPLY	561607	B	3	No	Well
MORRIS BROS.	56185A	B	5	Yes	Well
OOSTERINK WATER SYSTEM	284992	B	2	No	Well
PACIFIC COAST COAL COMPANY	05453N	B	1	No	Well
SAWYER GLEN	764550	B	8	No	Well
SHOPP G	42651U	B	3	No	Well
SMITH, CLAUDE	806001	B	3	No	Well
STUTH CO.	399525	B	3	No	Well
TOLLBER, R. M.	284277	B	6	No	Well
W & S #1	02451	B	5	No	Groundwater
WALTENBURG	07683U	B	2	No	Well
WILLIAMS, C.	01057Y	B	4	Yes	Well

INVENTORY OF EXISTING FACILITIES

This section provides a detailed description of the existing water system and the current operation of the facilities. The analysis of the existing water system is presented in **Chapter 7 – Water System Analysis**.

SYSTEM OVERVIEW

The City's water system is primarily served by the Black Diamond Spring Field, located approximately 2 miles southeast of the City above the south bank of the Green River. Water from the Black Diamond Spring Field is pumped to the 4.3 MG Reservoir by a pump station located on the north side of the Green River. An additional source of water for the City is a wholesale intertie with the City of Tacoma Second Supply Pipe Line (SSPL).

The City has two reservoirs that serve its water system. The City's distribution system currently operates with three pressure zones: the upper pressure zone at a pressure head of approximately 965 feet; the middle pressure zone at a pressure head of approximately 850 feet; and the lower pressure zone at a pressure head of approximately 750 feet. Portions of the City's system operate with high pressures, individual pressure reducing valves (PRVs) are required on all high pressure service connections throughout the WSA. **Figure 2.3, Existing Water System** illustrates the existing configuration of the City's water system.

SOURCES OF SUPPLY

Black Diamond Spring Field

Currently, the City's primary source of water is from a series of natural springs located approximately 2 miles southeast of the City on a large City-owned parcel. The springs water can be used for both domestic supply and power generation. Typical flow capacities for the different spring field collection areas are listed in **Table 2.2, Spring Capacity**.

Table 2.2
Spring Capacity

Spring Collection Area	Typical Capacity	
	(cfs)	(gpm)
Nos. 1 and 3	4.30	1,930
No. 2	1.90	853
No. 4 (Upper Area Only)	1.34	601
Total	**7.54**	**3,384**
Note: Only Springs Nos. 1 and 3 are connected to the City's system.		

Black Diamond Springs Collection Box No. 1

Water Rights

The City currently holds two surface water certificates on file with the Washington State Department of Ecology (Ecology). The source of water for both certificates is the Black Diamond Springs.

Surface Water Certificate No. 3580 was issued on May 19, 1950, with a priority date of August 22, 1949. Since this water right is for power production purposes, it has not been included in the City's calculations for its potable municipal water supply water rights for planning purposes.

Surface Water Certificate No. S1-00506C was issued on March 29, 1974, with a priority date of April 15, 1968. This water right meets the definition as being for municipal water supply purposes, provided under Revised Code of Washington (RCW) 90.03.15. These water rights are summarized in **Table 2.3, Water Rights.**

Table 2.3
Water Rights

Certificate Number	Priority Date	Source Type	Instantaneous Withdrawal (Qi)	Annual Withdrawal (Qa)
			(cfs)	(afy)
3580	August 22, 1949	Surface Water	2.93	0
S1-00506C	April 15, 1958	Surface Water	8.0	551

Interties

Water system interties are physical connections between two adjacent water systems. Interties are normally separated by a closed isolation valve or control valve. Emergency supply interties provide water from one system to another during emergency situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main and is unable to provide a sufficient quantity of water to its customers. Normal supply interties provide water from one system to another during non-emergency situations and are typically supplying water at all times.

City of Tacoma Intertie

The City negotiated a wholesale water agreement with the City of Tacoma (Tacoma) in 2003 wherein the two agencies agreed that Tacoma would supply wholesale water to the City. The supply quantities are outlined in **Table 2.4, Tacoma Wholesale Intertie Water Supply**.

Table 2.4
Tacoma Wholesale Intertie Water Supply

Agreement	Date of Agreement	Wholesale Supply Capacity (gpd)
Wholesale Water Agreement	August 1, 2003	1,712,000 for average day use 3,852,000 for maximum day use 3,659,400 for 4-day maximum use
Amendment No. 1	February 1, 2007	500,000 for average day use 1,125,000 for maximum day use 1,068,750 for 4-day maximum use
Amendment No. 2	Pending 2020	Second Intertie (Lake Sawyer Road SE)

The intertie connection to Tacoma's SSPL was constructed in 2005 at the City's 4.3 MG Reservoir site. Amendment No. 1 to the agreement was approved in 2007 and included the purchase of additional water. Amendment No. 2 to the agreement is being finalized in 2020 and is for a second intertie off Tacoma's SSPL at Lake Sawyer Road SE. Copies of the 2003 Wholesale Water Agreement and Amendment No. 1 have been included in **Appendix E – Tacoma Wholesale Agreement**.

PUMPING FACILITIES

The City currently operates and maintains two active pump stations. One is located on the northerly side of the Green River and the second is located at the 4.3 MG Reservoir site. Pump curves for the City's pumping facilities are located in **Appendix F – Pump Curves**.

North Bank Pump Station

The North Bank Pump Station was constructed in 1997 and replaced an older pump station that was located on the same property. The North Bank Pump Station has a maximum capacity of approximately 550 gallons per minute (gpm). The pump station operates two electric pumps with a standby generator system. The two pumps were designed to operate at 450 gpm each. A

water main varying from 8-inch-diameter asbestos cement (AC) to 12-inch-diameter ductile iron (DI) runs from the North Bank Booster Pump Station (BPS) to the 4.3 MG Reservoir.

North Bank BPS (Outside)

North Bank BPS (Inside)

4.3 MG Reservoir Pump Station

The pump station located at the 4.3 MG Reservoir site was constructed in 2006. This pump station operates two electric pumps with a standby generator system. The two pumps are operating at a capacity of 650 gpm each. An 8-inch-diameter water main runs from the 4.3 MG Reservoir Pump Station to the City's 0.5 MG Reservoir.

4.3 MG Reservoir Pump Station and Treatment Building

STORAGE

The City currently is served by two reservoirs. An overview of the City's reservoirs is provided in **Table 2.5, City of Black Diamond Reservoirs**.

Table 2.5
City of Black Diamond Reservoirs

Reservoir Name	Volume (MG)	Overflow Elevation (feet)	Material	Year Built
0.5 MG Reservoir	0.5	965	Steel	1986
4.3 MG Reservoir	4.3	850	Steel	2006

0.5 MG Reservoir

The 0.5 MG Reservoir is located on a City parcel that is approximately 1,200 feet easterly up a gravel road from the intersection of Botts Drive SE and SE Mountain View Drive. This reservoir was constructed in 1986 and has a capacity of 500,000 gallons. The 0.5 MG Reservoir is at an approximate elevation of 930 feet,[1] with an overflow elevation of approximately 965 feet.

[1] Prior reports, studies, and designs have shown the 0.5 MG Reservoir to be located at an approximate elevation of 915 feet with an overflow elevation of 950 feet. Physical topographic surveying completed for the City in 2004 resulted in the revised elevations.

0.5 MG Reservoir

4.3 MG Reservoir

The 4.3 MG Reservoir is located just north of the intersection of Lawson Street and SE Botts Drive on a City parcel. This reservoir was constructed in 2006 and has a capacity of 4.3 MG. The reservoir has an approximate elevation of 770 feet, with an overflow elevation of approximately 850 feet.

4.3 MG Reservoir

PRESSURE ZONES

The City's water system consists of three pressure zones. An existing system hydraulic profile is shown on **Figure 2.4, Existing Hydraulic Profile**. This figure shows the vertical relationship of the pressure zones and demonstrates how the water moves throughout the system. Additionally, **Figure 2.5, Existing Pressure Zones** shows the various pressure zones located within the City. These pressure zones have been defined through the use of PRVs and closed valves in the system. It should be noted that the 1175 Pressure Zone is a future pressure zone and is not part of the existing water system.

PRESSURE REDUCING VALVES

PRVs are installed between pressure zones to allow water from a higher level pressure zone to flow into the lower level pressure zone at reduced pressures. The PRVs hydraulically vary the flow rates to maintain a constant and preset pressure in the downstream or lower level pressure zone. This results in a safe range of pressures in the lower zone. The City has several PRVs installed throughout the system to help moderate pressures in the distribution system. Additionally, individual PRVs are installed on all service meters within the system to further control pressures.

Table 2.6, Pressure Reducing Valves summarizes the location and upstream and downstream pressure zones of the City's existing PRVs.

Table 2.6
Pressure Reducing Valves

PRV No.	Location	Elevation (feet)	Downstream Pressure Setting	Upper Pressure Zone	Lower Pressure Zone
			(psi)	(HGL)	(HGL)
1	Lawson Street	669	40.0	850	750
2	Railroad Avenue	634	53.0	850	750
3	Roberts Drive	612	65.0	850	750
4	Newcastle Drive	727	53.0	965	850
5	Temporary 4-inch	778	31.0	965	850

TRANSMISSION AND DISTRIBUTION

Pipes

The existing transmission and distribution system is shown in **Figure 2.3, Existing Water System**. The water system consists of approximately 181,163 linear feet of pipe, including approximately 10,500 linear feet of transmission mains. The existing transmission and distribution system consist of pipes ranging in size from 1.5 inches to 20 inches in diameter. The pipes are manufactured from various materials, including AC, DI, cast iron (CI), high density polyethylene (HDPE), and polyvinyl chloride (PVC). **Table 2.7, Pipe Inventory** shows a summary of the various pipe sizes and materials.

Table 2.7
Pipe Inventory

Diameter	Length (feet)	Percent of Total
4-inch or smaller	8,144	4%
6-inch	11,792	7%
8-inch	89,198	49%
12-inch	64,364	36%
16-inch	3,954	2%
20-inch	3,711	2%
Total	**181,163**	**100%**
Material	**Length (feet)**	**Percent of Total**
PVC	5,790	3%
HDPE	4,399	2%
Asbestos Cement	27,095	15%
Ductile Iron	143,771	79%
Cast Iron	108	0%
Total	**181,163**	**100%**

The size and material of the existing water mains are an important element when evaluating the City's water system. **Figure 2.6, Existing Pipe Sizes** shows the various pipe sizes of the City's water system. **Figure 2.7, Existing Pipe Materials** shows the various pipe materials of the City's water system.

Meters

One hundred percent of the City's connections are metered. There are currently 1,255 metered service connections within the City's WSA. Approximately 92 percent, or 1,148, of the connections are for single-family residences. The remaining meters are for public buildings and facilities, multi-family residences, irrigation, and commercial businesses.

TELEMETRY AND CONTROL SYSTEM

A telemetry and supervisory control system collects information and can efficiently control a water system by automatically optimizing facility operations. The telemetry and control system is capable of providing alarm notifications in the event of equipment failure, reservoir overflow, or other emergency situations. The City's telemetry and control system was first put into operation in 2006 and has been updated several times. The operation of the telemetry system is controlled onsite at the 4.3 MG Reservoir treatment building. The North Bank Pump Station is controlled via a radio read from the 4.3 MG Reservoir to the 0.5 MG Reservoir, then via coax cable from the reservoir to the North Bank Pump Station. Portions of the telemetry system computer and software were upgraded in 2018.

Control Panel

TREATMENT FACILITIES

The City's water system is currently disinfected via a hypochloride chlorination system that was installed in 2016 at the North Bank Pump Station. Corrosion treatment is provided at the pump station located at the 4.3 MG Reservoir site.

WATER SERVICE AREA

The boundaries of the City's WSA, retail service area, and potential service area are depicted in **Figure 2.8, Water Service Area**.

Retail Service Area

The Municipal Water Supply – Efficiency Requirements Act, Chapter 5, Laws of 2003 (Municipal Water Law) amended the Washington State Board of Health Code (Chapter 43.20 RCW) to require that municipal water suppliers provide water service to all new retail customers within a retail service area under certain conditions. A retail service area is the area within which water is or will be sold directly to the ultimate consumers.

According to the Municipal Water Law, a municipal water supplier has a duty to serve new water service within the identified retail service area if the utility:

- Can provide water service in a timely and reasonable manner;
- Has sufficient water rights, or uses water from a source that has a water right;
- Has sufficient capacity to serve the water in a safe and reliable manner as determined by DOH; and
- Is consistent with the requirements of any comprehensive plans or development regulations adopted under Chapter 36.70A RCW or any other applicable adopted comprehensive plans, land use plans, or development regulations.

PHYSICAL ENVIRONMENT

Planning for the future water system requires a basic understanding of the physical environment of the WSA. A working knowledge is useful in identifying any constraints that may affect the development of the water system. Physical characteristics that influence planning and design include topography, geology, soils, surface water, groundwater, and climate. Descriptions of these characteristics, as well as a summary of environmentally sensitive areas in the City, are as follows.

Topography

The City is situated on an upland plateau bounded on the south and southeast by the Green River and on the northeast by the Cascade Range. Depressions and hummocks characterize the rolling glacial terrain.

The plateau is dotted with lakes and cut by numerous streams that drain to the Green River. The plateau is deeply incised by the Green River gorge located approximately two miles south of the City. The descent to the river is steep, with a maximum slope of approximately 55 percent.

Elevations within the existing City limits vary between approximately 500 feet at Morganville to 1,000 feet at the eastern perimeter. Most of the existing buildings within the City are located at lower elevations, between approximately 500 and 700 feet.

Elevations within the study area range from approximately 300 feet in the southwestern corner of the study area near the banks of the Green River, to over 1,200 feet in the eastern part of the study area outside the City limits. Elevations of at least 1,000 feet also are found in the northeast corner of the study area, northeast of Lake No. 12.

Geology and Soils

The surficial geology and landforms in the Black Diamond area, located on the Covington Drift Plain, are the result of the most recent regional glaciation, the Vashon Stade of the Fraser glaciation. The Vashon ice sheet completely melted from the Black Diamond area approximately 10,000 years ago. During the maximum extent of the Vashon Stade, the planning area was covered with up to 2,000 feet of ice.

Since the last glaciation, urbanization, rural development, logging, gravel mining activities, erosion, and sedimentation have modified the land surface. Weathering and erosion of native soils has resulted in the development of topsoil and colluvium at the ground surface. The topsoil in undeveloped areas consists of a few inches of silt and sand with decayed roots and leaves. The weathered soils underlying the topsoil consists of silty sand and gravel with roots, generally extending 2 to 6 feet. Topographic depressions and low gradient stream channels have accumulated soft organic silt and peat. In general, the areas underlain by organic silt and peat are within wetland areas.

Vashon recessional outwash mantels the west portion of the City. The soil consists of sand and gravel with variable amounts of silt and cobbles deposited by the rivers emanating from the melting front of the Vashon ice sheet. This soil is considered a valuable gravel resource in this area depending on its thickness and silt content.

Vashon till is at the ground surface in some areas of the east portion of the City. Till consists of unstratified silt, sand, gravel, and cobbles that are in a very dense condition because of being overridden by the glacial ice. Till is usually 20 to 40 feet thick and probably underlies the recessional outwash, but till may be absent where eroded during deglaciation meltwater runoff episodes.

Pre-Vashon glacial and interglacial sediments underlie the Vashon till in the west portion of the City area where bedrock is deep. The pre-Vashon glacial and interglacial sediments consist of interbedded and/or stratified silt, gravel, and till. These soils are not exposed at the ground surface in the City, but are exposed in the upper walls of the Green River gorge, south of the City, and are penetrated by water wells in the west portion of the area.

Bedrock of the Puget Group underlies the City and surrounding area. The bedrock is locally exposed at the surface in the east portion of the area and in the walls of the Green River gorge. The bedrock consists of sedimentary sandstone, mudstone, shale, and coal. Based on elevations of surface exposures and the interpretation of well water logs by Icicle Creek Engineering, Inc., bedrock underlies the property at a depth of 200 feet or more in the west portion of the City.

Additional geological information is contained in **Appendix G – Soils Information.**

Surface Water

The City's WSA lies within the Duwamish/Green River drainage basin. A number of lakes, wetlands, and creeks lie within the service area.

Black Diamond Lake and Jones Lake are located in the southern part of the City limits. Ginder Lake and Lake No. 12 are located east of the City limits within the potential service area. Two

smaller lakes, Oak Lake and Horseshoe Lake, are located within the western part of the City limits. Lake Sawyer is one of the largest lakes in terms of size and volume in the Green River Basin and is located in the recently annexed portion of the City but outside the potential service area. It discharges to Covington Creek, which in turn discharges to Big Soos Creek. The Big Soos Creek flows into the Green River near the City of Auburn. Lake levels of Lake Sawyer are controlled by a privately owned and operated concrete dam at the entrance of Covington Creek.

Rock Creek is the principal drainage basin in the City and flows north to Lake Sawyer. Ginder Creek, Lawson Creek, and three smaller creeks drain into Rock Creek. Existing development in the City is located in the central portion of the drainage basin. All development within the Rock Creek basin (including that outside of the City limits) is preferred by King County and the City to be served by public sewer. Land use control within the basin also is viewed by the City as critical in order to promote open space and protect the drainage basin from future degradation.

The Green River originates in the western Cascade Range approximately 30 linear miles east of the City. Flows in the river result largely from rainfall runoff and snowmelt. Flows are regulated approximately 20 miles upstream of the City by a flood control structure operated by the US Army Corps of Engineers known as the Howard Hanson Dam.

Groundwater

Groundwater occurs in three aquifer systems beneath the service area. These aquifer systems include: a seasonal shallow, or perched, unconfined aquifer in the weathered soil and recessional outwash overlying till of bedrock; an intermediate depth, regional unconfined and confined aquifer system within the pre-Vashon glacial and interglacial sediments; and a confined regional aquifer system within the bedrock.

The shallow aquifer system is the primary water resource penetrated by most of the domestic wells in the WSA. At least seven water wells penetrate the intermediate depth aquifer in the area. The intermediate depth aquifer has potential for development as a water resource based on limited available information. The deep bedrock aquifer is controlled by fractures in the bedrock. Several domestic wells penetrate the bedrock aquifer in the east portion of the area, but are typically very low in yield.

A potential groundwater resource was recently identified in the southwest portion of the area on the Black Diamond Associates property. Preliminary studies of this groundwater resource by others indicate its potential to supplement the City's public water supply system, subject to securing water rights, which is very unlikely.

Groundwater Quality

The shallow aquifer is particularly vulnerable to contamination from the surface and may dry out seasonally in some areas. The intermediate depth aquifer is recharged over a very large area and is generally protected from contamination from the surface. The bedrock aquifer often contains water with elevated levels of minerals, such as iron and sulfur, that may affect water quality.

Groundwater Flow Patterns

Groundwater flow patterns have both horizontal and vertical components. In the Black Diamond area, the primary vertical component of flow is downward percolation from the shallow aquifer, through the underlying till or fractures in the bedrock, and into the intermediate or deep bedrock aquifer. Horizontal groundwater flow in the shallow aquifer discharges to the surface water features of Rock Creek, Ravensdale Creek, and Crisp Creek.

Groundwater Recharge

Groundwater recharge to the shallow aquifer is primarily from precipitation or infiltration of surface water runoff from adjacent areas. As precipitation falls on the ground surface, a portion infiltrates the soil. Precipitation that does not infiltrate remains on the surface, filling small depressions or moving downslope as surface runoff. Some shallow infiltrated water is used by plants and returns to the atmosphere by evapotranspiration. When the soil moisture content is high, such as occurs after a long period of rainfall, some water within the soil migrates downward. Downward percolation of water is impeded by relatively impermeable till or bedrock that underlies most of the area. Where water is concentrated within topographic low areas such as wetland or streams, there is generally more recharge than in topographic high areas, where the surficial aquifer is dry much of the time.

The intermediate depth and deep bedrock aquifer systems are recharged by infiltrating water over an area much larger than the City.

Information regarding groundwater wells in the area was collected from the Brown and Caldwell hydrogeology report of the Black Diamond Springs (1989) and well log information collected by Robinson and Noble, Inc., (1990) regarding well development in the southeastern corner of the City limits.

Climate

The Pacific Ocean and Puget Sound moderate temperature extremes in the region, while the Cascade Mountains influence the area's precipitation. Precipitation in the area occurs primarily due to cooling of moisture-laden air masses as they flow and rise over the Cascade Mountains.

Annual precipitation ranges from 45 to 70 inches, averaging approximately 55 inches. More than 80 percent of the precipitation occurs October through May, and 50 percent from November through February. Total evaporation averages approximately 25 inches per year, with approximately 75 percent occurring during the months of May through August. Precipitation and evaporation were measured at the Landsburg weather station located approximately 5 miles north northeast of the City.

Available temperature data is also from the Landsburg weather station. Low temperatures in December and January average 30 degrees to 33 degrees Fahrenheit and the highs range from 41 degrees to 46 degrees Fahrenheit. In July and August, the average low temperature is approximately 50 degrees Fahrenheit and the high is 75 degrees Fahrenheit. The lowest recorded temperature from 1976 to 1993 was 0 degrees Fahrenheit in February 1989, and the highest recorded temperature was 102 degrees Fahrenheit in August 1981 and May 1983.

Prevailing wind direction is from the south to the southwest during the rainy season and from the west or northwest in summer. Average wind velocity is less than 10 miles per hour.

Mining Activity

Abandoned coal mines underlie at least 50,000 acres in western and central Washington. Many of the abandoned, underground mines present in the Black Diamond area have been documented by the State. Applicants for building permits in abandoned coal mine areas are required to demonstrate the safety of the proposed project. Mitigation of a mine may be required, and a horizontal buffer of 500 feet from the vertical projection of the mine is required, regardless of depth, unless otherwise recommended by a geotechnical report by a professional engineer with expertise in geotechnical engineering. High hazard areas are typically those areas underlain by mine workings shallower than 200 feet or fifteen times the knees of the coal seam for gently dipping seams. Moderate hazard areas are areas where more workings are deeper than 200 feet or deeper than fifteen times the knees of the seam or workings for gently dipping seams. The study by professional engineers should detail the presence of surface openings, potential sinkholes, depth of working, and a detailed examination of historic mine maps and records.

Environmentally Sensitive Areas

The Black Diamond Municipal Code, Chapter 19.12 establishes regulations for development in environmentally sensitive areas. These regulations were developed to prevent action undertaken by any person or entity resulting in a substantial environmental alteration. Specific information on the location and extent of sensitive areas within the City can be obtained from the City, while sensitive areas information for other areas is available from King County. Any development should be coordinated with the City's Wellhead Protection Map.

Environmentally sensitive areas include wetlands, fish and wildlife habitat conservation areas, and geologically hazardous areas. Geologically hazardous areas include areas that are not suitable to development due to their susceptibility to erosion, sliding, earthquake, or other geological events. A geotechnical report prepared by a licensed professional engineer is required prior to any development in these areas.

Fish and wildlife conservation areas within the City include Rock Creek and Ginder Creek corridors, open water ponds, lakes and riparian forests. Geologically hazardous areas include steep slopes (greater than 25 percent) and past coal mine working areas. Development around wetland areas requires buffer zones to reduce or mitigate any adverse impact. Permitted activities within the buffer zones include passive recreation, parks, pedestrian and bicycle trails, and road and utility facilities when necessary.

LAND USE AND ZONING

Land use and zoning play an important role in determining growth patterns, and therefore, future water requirements. Future land use, variations in use, and changing population densities, as determined by applicable zoning ordinances, can significantly impact the City's

ability to provide adequate water service. Land use and zoning are discussed in more detail in **Chapter 3 – Land Use and Population**.

FUTURE SERVICE AREA

The City's future service area has been modified from the previous future water service area as identified in the *South King County Coordinated Water System Plan* (SKCCWSP). The SKCCWSP established future water service areas for the utilities that are included in the plan. A service area agreement was prepared by the South King County Water Utilities Coordinating Committee (SKCWUCC) and agreed to by the participating utilities. A copy of the Interlocal Agreement for Establishing Water Utility Service Area Boundaries as Identified by the South King County Coordinated Water System Plan has been included in **Appendix H – SKCCWSP Service Area Agreement**.

SERVICE AREA AGREEMENTS

All water purveyors located within a Critical Water Supply Service Area are required to have a water service area agreement that identifies the external boundaries of their water service area. The City has a service area agreement that was developed as part of the SKCCWSP. A copy of this agreement has been included in **Appendix H – SKCCWSP Service Area Agreement.** If SKCCWSP updates its plan, the City would like to participate in that process**.**

3 | LAND USE AND POPULATION

MDRT Planning Documents

Conceptual Ten Trails

RELATED PLANNING DOCUMENTS

The following related planning documents were examined in the preparation of the City of Black Diamond's (City) Water System Plan (WSP) to ensure consistency with the land use policies of all involved agencies. Comments received from these agencies have been included in **Appendix D – Agency Review Comments.** Comments and correspondence with Washington State Department of Health (DOH), including review checklists, are included in **Appendix B – DOH Checklists and Correspondence**.

CITY OF BLACK DIAMOND PLANNING DOCUMENTS

City of Black Diamond 2009 Water System Plan

This document, approved by DOH in 2009, presented system improvements and projects necessary to update and enhance the existing water system facilities.

The City's *Comprehensive Plan* document includes chapters regarding the City's urban growth area (UGA), population and employment characteristics, and land use. The City's *Comprehensive Plan* was adopted in 1996, and amended in 2001, 2009, and 2018.

REGIONAL PLANS AND DOCUMENTS

King County Comprehensive Plan

The *King County Comprehensive Plan* was adopted in 2004 and amended in 2006 and 2016. This document identifies the City as a Rural City. This document also includes the City within the UGA of King County for purposes of planning, land use, and facility needs. The City's WSP has been developed consistent with the *King County Comprehensive Plan*.

King County Code

The King County Code contains details in Chapter 13.24 regarding Water and Sewer Comprehensive Plans. A listing of the applicable code sections has been provided by King County and is included in **Appendix D – Agency Review Comments**. The City's WSP has been developed in conformance with these codes.

Regional Water Supply Planning – Climate Change Technical Memoranda

The Regional Water Supply Planning Group includes a technical committee to study the regional effects of climate change. They produced a series of technical memoranda outlining anticipated regional effects. Based on a review of the memoranda, it is not anticipated that there will be any significant impacts due to climate change during the planning period covered in this WSP. However, the City is committed to investigating potential impacts of future climate changes on its water system and proactively preparing for these impacts.

Water Resource Inventory Area (WRIA) 9 Plans

King County has produced several documents regarding watershed and salmon recovery issues such as the *Final WRIA 9 Near-Term Action Agenda for Salmon Habitat Recovery Planning* and *WRIA 9 Strategic Assessment Report – Scientific Foundation for Salmonid Habitat Conservation*. These plans address interim and long-term conservation plans for salmon habitat in the Green/Duwamish watershed. The City's WSP does not propose any improvements that are known to be in conflict with these planning documents.

South King County Groundwater Management Plan

The South King County Groundwater Management area encompasses nearly 260 square miles mostly within the Green/Duwamish Watershed. The City is located within the plan area, near the eastern boundary. The majority of the water in the South King County Groundwater Management Area is used for private, municipal, industrial, and agricultural purposes, and is provided by groundwater sources. The City recognizes the importance of protecting groundwater sources. The City's WSP does not propose any improvements that are known to be in conflict with groundwater management planning documents.

Cascade Water Alliance 2004 Transmission and Supply Plan

The Cascade Water Alliance was formed through an interlocal agreement by eight public water systems in King County (County) and serves as a regional water supplier to the City of Bellevue, City of Tukwila, City of Kirkland, City of Issaquah, City of Redmond, Covington Water District (CWD), Sammamish Plateau Water and Sewer District, and the Skyway Water and Sewer

District. In January 2004, the Cascade Water Alliance began delivering regional water supplies to its members.

The Transmission and Supply Plan meets the requirement of DOH for public water systems to prepare a water system plan every ten years. The *Cascade Water Alliance Transmission and Supply Plan* addresses water supply and transmission needs. Local distribution of the water supply is covered in the separate water system plans prepared by the members of the Cascade Water Alliance.

The Cascade Water Alliance plan was reviewed because one of the members of the Cascade Water Alliance, CWD, is an adjacent purveyor to the City and serves the Lake Sawyer area within the City's corporate limits. This WSP has been developed in consistency with the *Cascade Water Alliance Transmission and Supply Plan*.

Covington Water District Water System Plan Update

Covington Water District is an adjacent purveyor to the City. CWD's *Water System Plan Update* was prepared in 2016. The CWD's *Water System Plan Update* was revised in 2017 and is no longer in a service area conflict with the City's WSP. The City's WSP has been developed consistent with CWD's *Water System Plan Update*.

City of Tacoma Water Plan Update

The City negotiated a long-term supply of water with the City of Tacoma (Tacoma). Tacoma's *Water Plan Update* was approved by DOH in 2018. The City's WSP has been developed consistent with Tacoma's *Water Plan Update*.

LAND USE AND ZONING

Land use and zoning play an important role in determining growth patterns, and therefore, future water requirements. Future land use, variations in use, and changing population densities, as determined by applicable zoning ordinances, can significantly impact the City's ability to provide adequate water service.

Figure 3.1, City Land Use Designation is the proposed land use for the City as included in the City's *Comprehensive Plan*. This figure shows designated land use within incorporated Black Diamond and the portions of unincorporated King County that are within the City's Water Service Area (WSA). Current land uses are primarily residential uses, with some light industrial and commercial areas.

Figure 3.2, County Land Use Designation includes the designated land uses for the area of unincorporated King County within the City's WSA. **Figure 3.2, County Land Use Designation** includes the zoning designations as defined by the County.

PROJECTED POPULATION AND LAND USE

Population projections for the 20-year planning horizon were estimated for the City's WSA based on a moderate annual growth rate of 0.78 percent based on the County's Office of Financial Management OFM growth projections. An average household size of 2.68 persons per household was utilized in the population projections.

The City is expected to experience substantial growth in the near future due to the large-scale developments that are underway. Projected land uses are based on the City's Land Use map as shown in the City's *Comprehensive Plan* and has been included previously in this WSP as **Figure 3.1, City Land Use Designation**.

Assumptions included in this WSP for these large-scale developments are based on data from the development companies and are subject to change based on the actual rate at which development occurs. The Lawson Hills Development is assumed to consist of 1,200 residential units and be built at a rate of 200 units per year, with construction beginning in 2021, and new connections beginning in 2022. The Ten Trails Development is assumed to consist of 4,800 residential units and be built at a rate of 400 units per year. Construction began in 2016 with new connections beginning in 2018.

Population and equivalent residential unit (ERU) projections are included in **Table 3.1, Growth Projections (City Only)**. Population and ERU projections utilized do not include the population of approximately 1,500 persons within the Lake Sawyer area, as this area is currently being served by CWD, or the master planned developments. Projected ERUs also are included in **Table 3.1, Growth Projections (City Only)**.

Table 3.1
Growth Projections (City Only)

Year	Population	ERU
2019	4,525	1,825
2020	4,560	1,839
2021	4,596	1,853
2022	4,632	1,867
2023	4,668	1,882
2024	4,704	1,897
2025	4,741	1,912
2026	4,778	1,927
2027	4,815	1,942
2028	4,853	1,957
2029	4,891	1,972
2030	4,929	1,987
2031	4,967	2,002
2032	5,006	2,018
2033	5,045	2,034
2034	5,084	2,050
2035	5,124	2,066
2036	5,164	2,082
2037	5,204	2,098
2038	5,245	2,114
2039	5,286	2,130
2040	5,327	2,147

Population and ERU projections, including the master planned developments (MPDs), are included in **Table 3.2, Growth Projections (City with MPDs)**.

Table 3.2
Growth Projections (City with MPDs)

Year	Population	ERUs
2019	4,883	1,822
2020	5,698	2,126
2021	7,102	2,650
2022	9,016	3,364
2023	11,066	4,129
2024	13,250	4,944
2025	15,729	5,869
2026	18,074	6,744
2027	19,990	7,459
2028	20,875	7,789
2029	20,915	7,804
2030	20,955	7,819
2031	20,995	7,834
2032	21,038	7,850
2033	21,081	7,866
2034	21,124	7,882
2035	21,167	7,898
2036	21,210	7,914
2037	21,252	7,930
2038	21,295	7,946
2039	21,338	7,962
2040	21,384	7,979
2041	21,429	7,996
2042	21,475	8,013
2043	21,520	8,030
2044	21,566	8,047
2045	21,612	8,064
2046	21,657	8,081
2047	21,705	8,099
2048	21,754	8,117

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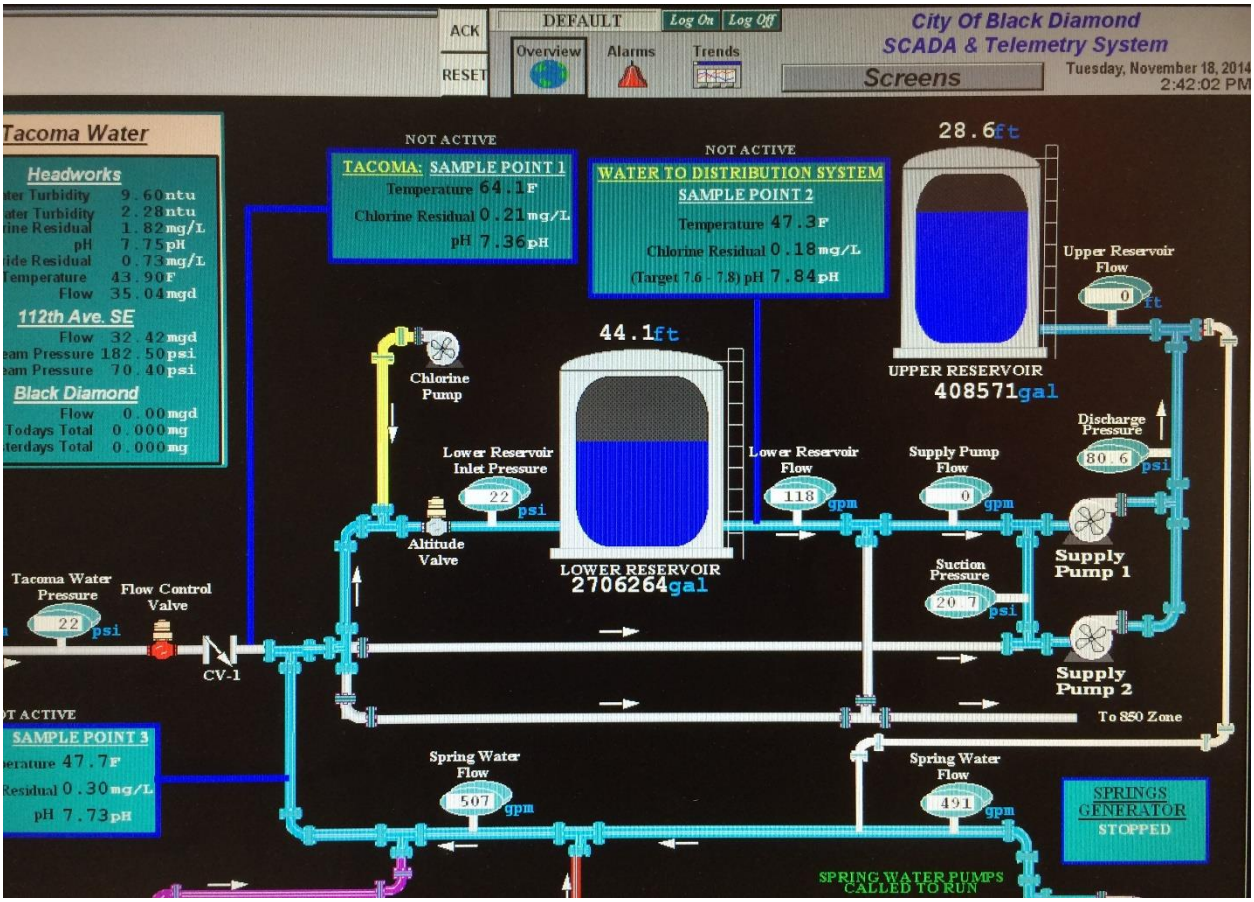
4 | WATER DEMANDS



SCADA and Telemetry System

INTRODUCTION

A detailed analysis of system demands is crucial to a water purveyor's planning efforts. A demand analysis first identifies current supplies and demands to determine if the existing system can effectively provide an adequate quantity of water to its customers under the most crucial conditions, in accordance with federal and state laws. A future demand analysis identifies projected supplies and demands to determine how much water will be needed to satisfy future water system growth while continuing to meet federal and state laws.

Water system demands determine the size of storage reservoirs, supply facilities, water mains, and treatment facilities. Several different types of demands were analyzed and are addressed in this chapter, including average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), fire flow demand, future demands, and a conservation demand reduction forecast.

The magnitude of water demands is typically based on three main factors: 1) population; 2) weather; and 3) water use classification. Population and weather have the two largest

impacts on water system demands. Population growth tends to increase the annual demand, whereas high temperatures tend to increase the demand over a short period of time. Population does not solely determine demand, because different populations use varying amounts of water. Use varies based on the number of users in each type of customer class, land use density, and irrigation practices. Water use efficiency efforts also will impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

CERTIFICATE OF WATER AVAILABILITY

In accordance with the requirements of the Growth Management Act (GMA), the City of Black Diamond (City) must identify that water is available prior to issuing a building permit. A Certificate of Water Availability is issued if there is sufficient water supply to meet the domestic water service and fire flow requirements of the proposed customer. The requirement for providing evidence of an adequate water supply was codified in 1990 under Revised Code of Washington (RCW) 19.27.097 in the Building Code section. To assist governments with implementing these requirements, the Washington State Department of Health (DOH) has developed a handbook titled *Guidelines for Determining Water Availability for New Buildings*.

WATER USE CLASSIFICATIONS

The City has divided its water customers into four different classes for billing purposes: 1) Single-Family; 2) Multi-Family; 3) Commercial; and 4) Irrigation and Hydrant Meters. For planning purposes in this Water System Plan (WSP), the water customers have been combined into six different groups: 1) single-family residential; 2) multi-family residential; 3) commercial; 4) government and public (which includes City and County government uses, schools, and churches); 5) irrigation and hydrant meters,; and 6) non-metered water and distribution system leakage (DSL).

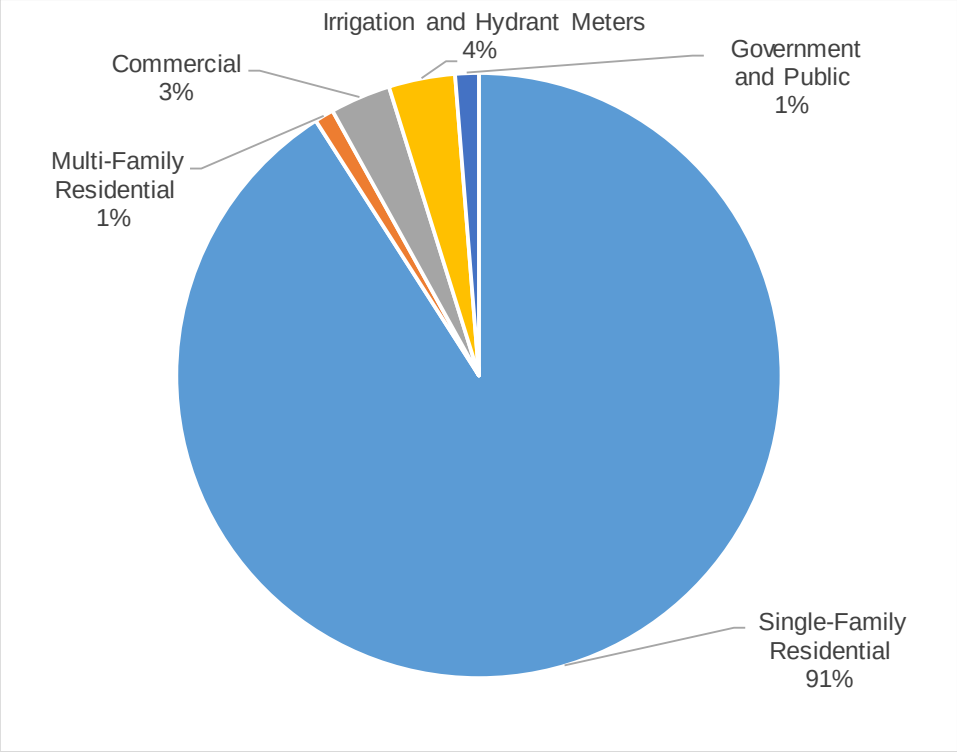
As shown in **Table 4.1, 2019 Service Connections by Customer Class** the City currently has 841 **active service connections.**

Table 4.1
2019 Service Connections by Customer Class

Customer Class	Accounts	
	(Meters)	(Percent)
Single-Family Residential	1,154	91%
Multi-Family Residential	13	1%
Commerical	41	3%
Irrigation and Hydrant Meters	45	4%
Government and Public	16	1%
Total (2019)	**1,269**	**100%**

Approximately 91 percent of these connections are for single-family residences as shown in **Chart 4.1, 2019 Service Connections by Customer Class**.

Chart 4.1
2019 Service Connections by Customer Class



EXISTING WATER CONSUMPTION

Water consumption is the amount of water used by all customers of the system, as measured by the customer's meters. Historical billed consumption for the City is shown in **Table 4.2, Historical Consumption.**

Table 4.2
Historical Consumption

Year	Billed Consumption	
	(CF/Year)	(MG/Year)
2014	8,825,280	66.0
2015	8,987,178	67.2
2016	9,100,279	68.1
2017	9,971,281	74.6
2018	11,548,410	86.4
2019	11,277,936	84.4

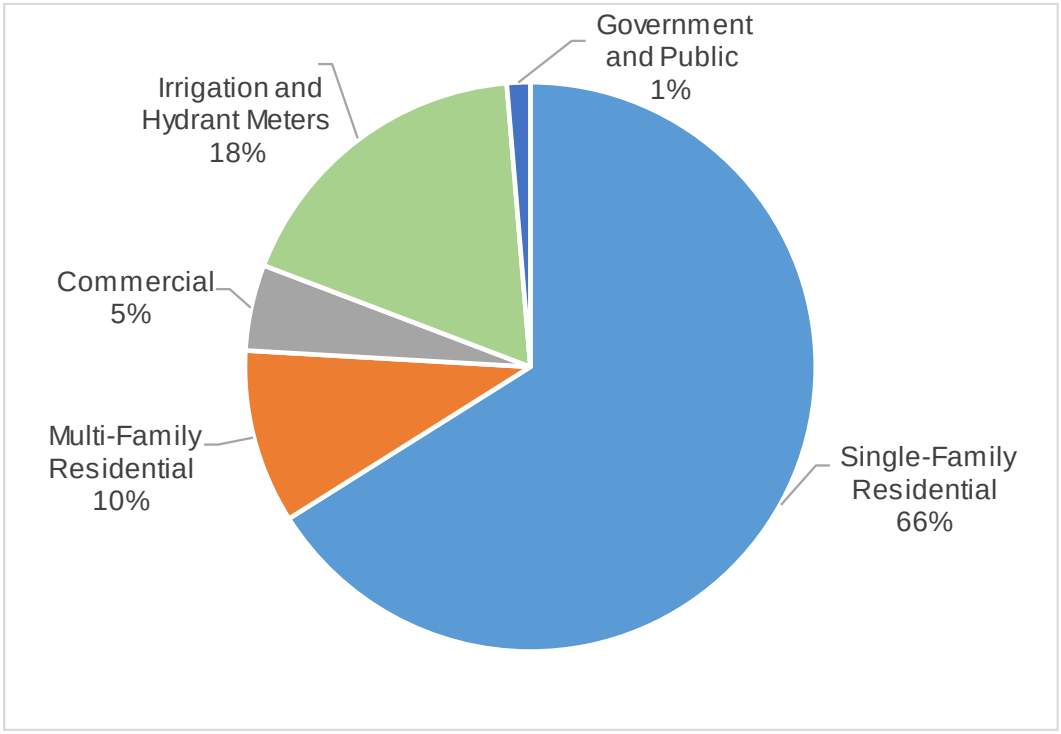
Meter data for the City is collected monthly. Recent consumption records based on customer billing records are included in **Table 4.3, 2019 Consumption by Customer Class**.

Table 4.3
2019 Consumption by Customer Class

Customer Class	Billed Consumption	
	(MG/Year)	(Percent)
Single-Family Residential	55.7	66%
Multi-Family Residential	8.3	10%
Commercial	4.1	5%
Irrigation and Hydrant Meters	15.1	18%
Government and Public	1.1	1%
Total (2019)	**84.4**	**100%**

Chart 4.2, 2019 Consumption by Customer Class indicates that roughly 66 percent of the consumption has been by the single-family residential customer class. Including multi-family customers, approximately 76 percent of the City's consumption could be classified as residential use.

Chart 4.2
2019 Consumption by Customer Class



EXISTING WATER DEMANDS

Equivalent Residential Units

The water used by each customer class can be expressed in terms of equivalent residential units (ERUs) for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by one single-family residence. An ERU is calculated by dividing the total volume of water utilized in the single-family customer class by the total number of single-family residential connections. The volume of water used by other customer classes can then be divided by this number to determine the equivalent residential units utilized by the other customer classes.

The ERU is meant to capture how much water a single-family household uses in a year. In planning for how many customers a water system has enough capacity to serve, it is helpful to know how many additional homes, or large new commercial businesses, are being proposed. Converting all customers, both residential and non-residential, to a common demand factor helps planners understand the relative usage of various types of accounts. For example, understanding how much water a food processing plant might use, compared to how many households could be served by that same amount of water, is useful information.

Calculating a representative ERU number for the City is complicated by the relatively large growth rate that City has experienced in the last several years. Therefore, instead of simply taking the total annual consumption in the single-family customer class and dividing it by the number of single-family accounts (as is typical for most systems), a different approach was taken for this WSP. Based on a review of the City's billing records, it was clear that many of the metered accounts were for home builders or houses that were not yet occupied. In fact, for 2019, approximately 24 percent of all metered accounts at the end of the year showed no water usage or less than 12 cubic feet (cf) of water usage, for the whole year. In order to calculate the ERU number for the City, only typical customers were used in the analysis. Based on billing records, only single-family accounts that used more than 12 cf per year were used to calculate the ERU number for each year.

The results of this analysis are shown in **Table 4.4, Historical Consumption per Typical Single-Family Customer and per Capita**. It is important to note that the consumption and the number of accounts shown in this table differ from previous tables in this WSP since the numbers in this table only represent the consumption of a typical, or fully occupied, household.

Table 4.4
Historical Consumption per Typical Single-Family Account and per Capita

Year	Consumption	Typical Customer[1]	Demand Per Customer	Demand Per Capita[2]
	(CF/Year)	(Accounts)	(gpd/ERU)	(gpd/Capita)
2014	6,563,259	768	175	65
2015	6,795,436	773	180	67
2016	5,935,743	778	156	58
2017	6,323,782	785	165	62
2018	6,271,011	768	167	62
2019	7,038,335	874	165	62
6-Year Average			**168**	**63**

[1]A typical customer represents a single-family home that is occupied year-round.
[2]Assumes 2.68 people per household

Table 4.4, Historical Consumption per Typical Single-Family Customer and per Capita shows that over the last 6 years, single-family residential customers used an average of approximately 168 gallons per day (gpd) per connection. The highest demand factor of 180 gpd/ERU was in 2015, which is typical for most water systems in the region as it was the hottest and driest summer in the last decade. **Table 4.4, Historical Consumption per Single-Family Customer and per Capita**, also shows that the amount of water used per person, or per capita, is approximately 63 gpd/Capita. This number assumes that approximately 2.68 people live in a single-family home as documented in the City's *Comprehensive Plan*.

Historical consumption and the number of customers by classification were used to calculate a demand factor per customer. These demand factors are used to convert the number of service meters within a customer class to ERUs, and are included in **Table 4.5, Demand Factors by Customer Class and Total ERUs**. The total number of 1,822 ERUs for 2019 represents the total number of customers the City has committed to serve; therefore, it includes all accounts, even homes that are not yet occupied. The numbers also are based on the ERU factor of 180 gpd/ERU, which represents the highest demand factor from the last 6 years (2015) as shown in **Table 4.4, Historical Consumption per Single-Family Customer and per Capita**.

Table 4.5
Demand Factors by Customer Class and Total ERUs

Customer Class	Total Customers Served (ERU)	Metered Connections or Units	Factor	Basis
Single-Family Residential	1,154	1,154 meters	1.0	Equal to the total customers connected to the system regardless if the homes are occupied yet or not.
Multi-Family Residential	132	188 units	0.7	Total number of multi-family units times a 70% ERU/MF factor.
Commercial	62	41 connections	1.5	Total number of commercial connections times the conversion factor based on annual consumption divided by 180 gpd/ERU.
Irrigation	230	45 connections	5.1	Total number of irrigation connections times the conversion factor based on annual consumption divided by 180 gpd/ERU.
Government/Other	18	16 connections	1.1	Total number of Government & Public connections times the conversion factor based on annual consumption divided by 180 gpd/ERU.
Non-Metered and DSL	228	15.0 MG/Year	180 gpd/ERU	Total annual consumption divided by 180 gpd/ERU.
Total Customers (2019)	**1,822**			

Largest Water Users

The 20 largest water users of the system, and their total amount of metered consumption for 2019 are shown in **Table 4.6, 2019 Largest Water Users**. The total water consumption of these 20 water accounts represented approximately 3.1 percent of the system's total metered consumption in 2019. The list of customer accounts in **Table 4.6, 2019 Largest Water Users** consists of water users from all customer classes except the single-family residential class, with most of the largest users considered irrigation customers. There are no very large single customer users in the City's system, and 3.1 percent is relatively small compared to other system's that have large industrial or commercial customers.

Table 4.6
2019 Largest Water Users

Rank	Account	Customer Class	Total Annual Consumption (gallons/year)	Percent of City-Wide Consumption
1	31108 3rd Avenue	Multi-Family Residential	764,182	0.9%
2	25123 Roberts Drive	Multi-Family Residential	207,032	0.2%
3	30628 3rd Avenue	Commercial	116,655	0.1%
4	30741 3rd Avenue	Commercial	64,315	0.1%
5	31114 3rd Avenue	Commercial	63,204	0.1%
6	32805 Railroad Aveune	Commercial	60,541	0.1%
7	Hydrant Meter at Oakpoint	Irrigation and Hydrant Meters	127,485	0.2%
8	Willow Avenue, SE Meter F	Irrigation and Hydrant Meters	126,950	0.2%
9	Village Parkway and Hemlock	Irrigation and Hydrant Meters	122,807	0.1%
10	NW Corner of Village Parkway SE & SE	Irrigation and Hydrant Meters	116,105	0.1%
11	Willow Avenue, SE Meter	Irrigation and Hydrant Meters	113,300	0.1%
12	SW Corner of Village Parkway and SE Cherry St.	Irrigation and Hydrant Meters	102,342	0.1%
13	Goodfellow Brothers, 6" Flush Meter	Irrigation and Hydrant Meters	91,803	0.1%
14	Willow Avenue, SE Meter H	Irrigation and Hydrant Meters	88,909	0.1%
15	Meter at J SW Corner of 1st and Maple Avenue	Irrigation and Hydrant Meters	87,049	0.1%
16	Villages Roundabout, Meter K	Irrigation and Hydrant Meters	85,252	0.1%
17	NE Corner of Villages Parkway SE and SE Fir St.	Irrigation and Hydrant Meters	81,077	0.1%
18	Willow Avenue, SE Meter G	Irrigation and Hydrant Meters	76,083	0.1%
19	Willow Avenue, SE Meter D	Irrigation and Hydrant Meters	68,447	0.1%
20	23601 Roberts Drive, #30	Irrigation and Hydrant Meters	57,037	0.1%
	Total		**2,620,575**	**3.1%**
	City-Wide Consumption		84,358,962	100.0%

Water Supply

Water supply, or production, is the total amount of water supplied to the system, as measured by the meters at each supply source. Water supply is different than water consumption in that water supply is essentially the recorded amount of water put into the system and water consumption is the recorded amount of water taken out of the system. The measured amount of water supply of any system is typically larger than the measured amount of water consumption due to non-metered water use and water loss (e.g., distribution system leakage).

The City's water system has two sources of supply – the Black Diamond Spring Field and the City of Tacoma Intertie. Supply meters are monitored and read three times a week by City personnel.

Historical production records have been included in **Table 4.7, Historical Production**. Up to this point, only the City's spring sources have been used to supply the City.

Table 4.7
Historical Production

Year	Annual Production (gallons/year)	Annual Production (MG/Year)	Annual Production (CF/Year)	Annual Production (afy)
2010	81,943,000	81.94	10,954,947	251.5
2011	73,451,000	73.45	9,819,652	225.4
2012	74,991,000	74.99	10,025,535	230.2
2013	75,894,997	75.89	10,146,390	232.9
2014	76,752,000	76.75	10,260,963	235.6
2015	71,888,000	71.89	9,610,695	220.6
2016	75,533,800	75.53	10,098,102	231.8
2017	84,472,000	84.47	11,293,048	259.3
2018	97,909,000	97.91	13,089,439	300.5
2019	99,623,000	99.62	13,318,583	305.8

Distribution System Leakage

An important factor in analyzing water system demands is knowing how much water is consumed knowingly by City customers (e.g., metered residential and non-residential accounts, operation and maintenance (O&M) uses, firefighting, water main flushing, etc.) and how much is consumed or lost unintentionally (e.g., theft, meter inaccuracies, and leaks). Water use efficiency programs developed under Washington Administrative Code (WAC) 246-290-810 require purveyors to track and report to DOH how much water is lost to system leakage. Total production (TP) can be divided into two categories: Authorized Consumption (AC) and Distribution System Leakage (DSL). WAC 246-290-820 defines DSL as the difference between total water produced and authorized consumption (DSL = TP – AC). Prior to water use efficiency programs, water was classified as accounted-for and unaccounted-for water. These terms are no longer used. AC includes metered consumption by all City customers, as tracked by the City's Finance Department, including metered consumption by the City's O&M staff for City uses and unmetered and known but estimated uses, such as firefighting and water main breaks. In a typical water system, there are several sources of water loss, or DSL, including water system leaks, inaccurate meters, and illegal water system connections or water use.

The Water Use Efficiency Rule, which became effective January 2007, sets a standard for DSL of less than 10 percent averaged over the last 3-year period. WAC 246-290-820(1)(b)(i) requires purveyors to implement a stricter water use efficiency program until their DSL 3-year average is less than 10 percent. To meet this standard, the City will continue to implement the measures discussed in the Water Use Efficiency Program. These measures include water main replacements, leak detection programs, system-wide service meter replacements, source meter calibration, and increased monitoring of water used for construction and firefighting.

Chart 4.3, Revenue and Non-Revenue Water Distribution shows the different classifications of all water produced. This chart divides all water into revenue generating water and non-revenue

generating water and shows the different components that make up DSL water. The chart also describes how the various categories, or classifications, are specific to the City's system.

Chart 4.3
Revenue and Non-Revenue Water Distribution

<table>
<tr><td rowspan="8">Total Water Produced (TP) (water supplied from all sources)</td><td rowspan="3">Own Sources: Black Diamond Spring Field</td><td>Exported Water</td><td rowspan="3">Authorized Consumption (AC) to customers, other purveyors, contractors, fire departments, and the City</td><td rowspan="2">Billed Consumption to customers, other purveyors, and contractors.</td><td>Billed Water Exported (none currently)</td><td rowspan="2">Revenue Water (money collected)</td></tr>
<tr><td rowspan="5">Water Supplied to the Black Diamond water system</td><td>Billed Metered Consumption (customers and contractors)</td></tr>
<tr><td>Billed Unmetered Consumption (currently not applicable)</td></tr>
<tr><td rowspan="5">Imported Water (from Tacoma wholesale interties)</td><td rowspan="2">Unbilled Consumption to the City and fire departments</td><td>Unbilled Metered Consumption City uses (i.e., flushing and street washing)</td><td rowspan="5">Non-Revenue Water (lost revenue)</td></tr>
<tr><td>Unbilled Unmetered Consumption (Firefighting and water main breaks)</td></tr>
<tr><td rowspan="3">Distribution System Leakage (DSL) or Unintentional losses</td><td>Apparent Losses and theft</td><td>Unauthorized Consumption (water theft)</td></tr>
<tr><td>Meter Inaccuracies & Data Errors (source & customer meters; accounting)</td></tr>
<tr><td rowspan="3">Real Losses or actual water loss through leaks</td><td>Leaks from Transmission and Mains (leaks from City owned water mains)</td></tr>
<tr><td>Leaks from Service Lines (leaks from service lines on City side of meter)</td></tr>
<tr><td>Leaks & Overflows from Storage Facilities (4.3 MG and 0.5 MG Reservoirs)</td></tr>
</table>

Since 2014, the amount of DSL has ranged between a high of 15.0 percent (2019) and a low of 3.6 percent (2015), as shown in **Table 4.8, Authorized Consumption and Distribution System Leakage**. The average amount of DSL over the last 3 years is 12.9 percent, which is higher than the preferred range of 5 to 10 percent; therefore, it is higher than the compliance standard of less than 10 percent. The City is actively investigating the reasons behind this upward trend in DSL and will continue to improve its recordkeeping for all known water uses.

Table 4.8
Authorized Consumption and Distribution System Leakage

Year	Annual Production (AP)	Annual Billed Consumption	Non-Billed Authorized Consumption	Total Authorized Consumption (AC)	Distribution System Leakage (DSL)		DSL 3-Year Average
	(MG/Year)	(MG/Year)	(MG/Year)	(MG/Year)	(MG/Year)	%	%
2014	76.75	66.01	4.77	70.78	5.97	7.8%	14.1%
2015	71.89	67.22	2.06	69.29	2.60	3.6%	9.4%
2016	75.53	68.07	0.01	68.09	7.45	9.9%	7.1%
2017	84.47	74.59	-0.13	74.46	10.02	11.9%	8.4%
2018	97.91	86.38	0.00	86.38	11.53	11.8%	11.2%
2019	99.62	84.36	0.30	84.66	14.97	15.0%	12.9%
3-Year Average							**12.9%**

Historical Customers Served

Determining the total number of customers served in any given year is based on both consumption and production data. Calculating the number of billed customers served is based on annual consumption per customer class and the amount of water used for non-billed purposes (i.e., municipal uses such as water main flushing) and lost to DSL. This analysis is represented in **Table 4.9, Total ERUs**. The City has grown by 38 percent since 2014, or by 453 ERUs. Most of this

growth is because of the large irrigation usage for the master planned developments and from increases in DSL.

Table 4.9
Total ERUs

Customer Classification	Number of ERUs					
	2014	2015	2016	2017	2018	2019
Single-Family	768	773	788	808	797	925
Multi-Family	34	32	233	258	256	138
Commercial	205	193	65	51	62	68
Irrigation	1	1	85	107	283	250
Government/Other	24	23	21	14	16	19
Non-Billed Authorized	75	31	0	-2	0	5
System Leakage (DSL)	93	40	131	166	189	248
TOTAL Customers (ERU)	**1,201**	**1,093**	**1,324**	**1,402**	**1,603**	**1,654**
ERU Demand Factor (gpd/ERU)	175	180	156	165	167	165
Total Production (MG/Year)	**76.75**	**71.89**	**75.53**	**84.47**	**97.91**	**99.62**

Note: The increase in Multi-Family in 2016 was because a mobile home park was moved into this classification from commercial. Decrease in Multi-Family consumption in 2019 was because a very large leak was fixed after the meter in the mobile home park.
The number of ERUs in this table differ slightly from those in Table 4.5 due to the difference in the 180 gpd/ERU demand factor used in that table and the actual demand factors used in this table.

DEMAND ANALYSIS

Demand Elements

Average Day Demand

ADD is the total amount of water delivered to the system in a year divided by the number of days in the year. ADD is determined from the system's historical water use data and can be used to project future demands. ADD data are typically used to determine standby storage requirements for water systems. Standby storage is the volume of a reservoir used to provide water supply under emergency conditions when supply facilities are out of service. Water production records from the City's wells, springs, and wholesale sources were reviewed to determine the system's ADD.

Maximum Day Demand

MDD is the maximum amount of water used throughout the system during a 24-hour time period of a given year. MDD is typically determined from the combined flow of water into the system from all supply sources and water reservoirs on the peak day. MDD typically occurs on a hot summer day when lawn watering is occurring throughout much of the system. In accordance with WAC 246-290-230 – Distribution Systems, the distribution system shall provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during MDD conditions. Supply facilities (i.e., wells, springs, pump stations, and interties) are typically designed to supply water at a rate that is equal to or greater than the system's MDD.

Peak Hour Demand

PHD is the maximum amount of water used throughout the system, excluding fire flow, during a 1-hour time period of a given year. PHD, like MDD, is typically determined from the combined flow of water into the system from all supply sources and water reservoirs. In accordance with WAC 246-290-230 – Distribution Systems, new public water systems or additions to existing systems shall be designed to provide domestic water at a minimum pressure of 30 psi during PHD conditions. Equalizing storage requirements are typically based on PHD data.

Maximum Month Demand

Maximum month demand is the maximum amount of water used over a 1-month period. It is expressed in terms of gallons per day, which is an average of the total demand in gallons over one month divided by the number of days in the month. This demand can be used to see how different summers compare from year to year and how peak MDD is compared to average summer usage.

4-Day Maximum Demand

4-Day Maximum Demand (4DMD) is the maximum amount of water used over a consecutive 4-day period. It is expressed in terms of gallons per day, which is an average of the total demand in gallons over the 4-day period divided by 4 days. This demand can be used to see how a MDD compares to a longer peak period. Also, it is used by Tacoma to track big peaks in a system and calculate wholesale water system development charges.

Demand Factor per Customer

An average demand per customer, or ERU, of 180 gpd per ERU is utilized in calculating projected water needs for all future growth in this WSP. This value is derived from the largest demand per customer factor calculated from the last 6years and occurred in 2015.

Fire Flow Demand

Fire flow demand is the amount of water required during firefighting as defined by applicable codes. Fire flow requirements are established for individual buildings and expressed in terms of flow rate (gpm) and flow duration (hours). Fighting fires imposes the greatest demand on the water system because a high rate of water must be supplied over a short period of time, requiring each component of the system to be properly sized and configured to operate at its optimal condition. Adequate storage and supply are useless if the transmission or distribution system cannot deliver water at the required rate and pressure necessary to extinguish a fire.

These minimum, or general, fire flow requirements were established for the different land use categories to provide a target level of service for planning and sizing future water facilities in areas that are not fully developed. The general fire flow requirement for each land use category is shown in **Table 4.10, General Fire Flow Requirements**. The water system analyses presented in **Chapter 7 – Water System Analysis** are based on an evaluation of the water system providing sufficient fire flow in accordance with these general fire flow requirements and the fire flow requirements of existing buildings. At a minimum, the City's general requirements are used, except for areas where the other land use agency's requirements are more stringent. The general requirements do not necessarily equate to actual existing or future fire flow needs for a

specific site. The values shown in **Table 4.11, General Fire Flow Requirements** are the minimums set by code.

Table 4.10
General Fire Flow Requirements

Land Use Category	Fire Flow Requirement (gpm)	Flow Duration (minutes)
Urban Reserve; Residential (Low Density)	1,000	120
Residential (Medium Density); Mixed Use; Neighborhood Commercial, Town Center; Community Commercial; MPD Overlay	2,500	120
Business Park; Light Industrial	3,000	120
Industrial; School	3,500	120

Peaking Factors

Telemetry data or daily production does not exist for the City, so typical peaking factors were utilized from other sources. A peaking factor of 2.5 was applied to the ADD to calculate MDD. PHD were calculated based on formulas presented in DOH's *Water System Design Manual* (Equation 3-1).

The values shown in **Table 4.11, Demand Factors and Peaking Factors** are the peaking factors for the City's water system based on the ADD, MDD, and PHD data presented earlier in this chapter. The MDD/ADD demand ratio of 2.5 is within the typical range of 1.2 to 2.5 for most systems. The estimated PHD/MDD ratio of 1.75 is within the typical range of 1.3 to 2.0 for most systems. These peaking factors will be used later in this chapter, in conjunction with projected ADD, to forecast future MDDs and PHDs of the system.

Table 4.11
Demand Factors and Peaking Factors

Demand Type	Demand Factors	
	(gpm/ERU)	(gpd/ERU)
Average Day Demand (ADD)	0.125	180
Maximum Day Demand (MDD)	0.313	450
Peak Hour Demand (PHD)	0.547	NA
Peaking Factors		
Maximum Day Demand/Average Day Demand (MDD/ADD)		2.50
Peak Hour Demand/Maximum Day Demand (PHD/MDD)[1]		1.75
Peak Hour Demand/Average Day Demand (PHD/ADD)		4.38
[1]Based on DOH Equation 3-1; value varies but shown for 2020 in this table.		

DEMAND PROJECTIONS

Demand projections for the next 20 years are presented in the next two tables. Due to the relatively large growth presented by the master planned developments (MPDs), resulting in an almost quadrupling of the number of customers served by the City, projected demands are shown for both City in-fill only and total City growth, including the MPDs. Based on projected development schedule of the MPDs, it is assumed that both MPDs will be built-out within the next 10-year period.

Table 4.12, Projected Water Demands (City In-fill Only) summarizes the projected water demands for future years and only includes growth in the City's Water Service Area without the MPDs.

Table 4.12
Projected Water Demands (City In-Fill Only)

Year	Customers (ERUs)	ADD (gpd)	MDD (gpd)	PHD[1] (gallons/hour)	PHD/MDD
2019	1,822	327,960	819,900	59,959	1.76
2020	1,836	330,480	826,200	60,379	1.75
2021	1,850	333,000	832,500	60,799	1.75
2022	1,864	335,520	838,800	61,219	1.75
2023	1,879	338,220	845,550	61,669	1.75
2024	1,894	340,920	852,300	62,119	1.75
2025	1,909	343,620	859,050	62,569	1.75
2026	1,924	346,320	865,800	63,019	1.75
2027	1,939	349,020	872,550	63,469	1.75
2028	1,954	351,720	879,300	63,919	1.74
2029	1,969	354,420	886,050	64,369	1.74
2030	1,984	357,120	892,800	64,819	1.74
2031	1,999	359,820	899,550	65,269	1.74
2032	2,015	362,700	906,750	65,749	1.74
2033	2,031	365,580	913,950	66,229	1.74
2034	2,047	368,460	921,150	66,709	1.74
2035	2,063	371,340	928,350	67,189	1.74
2036	2,079	374,220	935,550	67,669	1.74
2037	2,095	377,100	942,750	68,149	1.73
2038	2,111	379,980	949,950	68,629	1.73
2039	2,127	382,860	957,150	69,109	1.73
2040	2,144	385,920	964,800	69,619	1.73

[1]PHD is calculated using DOH's Water Sytem Design Manual Equation 3-1 which varies with system size.

Table 4.13, Projected Water Demands (City In-Fill with MPDs) summarizes the projected water demands for future years including the MPDs.

Table 4.13
Projected Water Demands (City In-Fill with MPDs)

Year	Customers (ERUs)	ADD (gpd)	MDD (gpd)	PHD[1] (gallons/hour)	PHD/MDD
2019	1,822	327,960	819,900	59,959	1.76
2020	2,126	382,680	956,700	69,079	1.73
2021	2,650	477,000	1,192,500	84,799	1.71
2022	3,364	605,520	1,513,800	106,219	1.68
2023	4,129	743,220	1,858,050	129,169	1.67
2024	4,944	889,920	2,224,800	153,619	1.66
2025	5,869	1,056,420	2,641,050	181,369	1.65
2026	6,744	1,213,920	3,034,800	207,619	1.64
2027	7,459	1,342,620	3,356,550	229,069	1.64
2028	7,789	1,402,020	3,505,050	238,969	1.64
2029	7,804	1,404,720	3,511,800	239,419	1.64
2030	7,819	1,407,420	3,518,550	239,869	1.64
2031	7,834	1,410,120	3,525,300	240,319	1.64
2032	7,850	1,413,000	3,532,500	240,799	1.64
2033	7,866	1,415,880	3,539,700	241,279	1.64
2034	7,882	1,418,760	3,546,900	241,759	1.64
2035	7,898	1,421,640	3,554,100	242,239	1.64
2036	7,914	1,424,520	3,561,300	242,719	1.64
2037	7,930	1,427,400	3,568,500	243,199	1.64
2038	7,946	1,430,280	3,575,700	243,679	1.64
2039	7,962	1,433,160	3,582,900	244,159	1.64
2040	7,979	1,436,220	3,590,550	244,669	1.64

[1]PHD is calculated using DOH's Water Sytem Design Manual Equation 3-1 which varies with system size.

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5 | POLICIES AND DESIGN CRITERIA

Large Diameter Water Main Installation

Regulatory Compliance

SERVICE AREA POLICIES

The service area policies for the City of Black Diamond's (City) water system have been developed to guide the development and financing of the infrastructure required to provide water service throughout its water service area (WSA). **Table 5.1, Service Area Policies** summarizes the City's policies.

Table 5.1
Service Area Policies

Policy Name	*Reference*
Wholesaling Water Policy	
It is the City's policy to not allow wholesaling of water from the City's water system.	***Water System Plan***
Wheeling Water Policy	
It is the City's policy to not allow wheeling of water through the City's water system.	***Water System Plan***
Annexation Policy	
It is the City's policy to ensure that development does not occur before it can be adequately served by public facilities, utilities, and services. Therefore, new development outside the City limits will be controlled by annexing designated expansion areas according to an identified timetable.	***Water System Plan***
Direct Connection and Satellite/Remote Systems Policy	
New development in the City limits and within the City's water service area shall be required to hook up to the municipal water system for water service. (Policy CF-5)	***Comprehensive Plan***
Prohibit new private water systems within the City. Existing development with private systems must connect to municipal water. (Policy CF-12)	***Comprehensive Plan***
Satellite management of other water systems is limited at this time due to current levels of staffing but could be accomplished depending on the timing and size of the proposed development. The City proposes to consider requests for service on a case-by-case basis, reserving the right for either system extension or satellite management.	***Water System Plan***
Design and Performance Standards Policy	
The City Water Ordinance (Black Diamond Municipal Code, Chapter 13.04) specifies regulations concerning service connections, metering, and billing.	***City of Black Diamond Municipal Code***
The City Water Ordinance is found in the Black Diamond Municipal Code, Chapter 13.04. The City Water Ordinance specifies regulations concerning service connections, metering, and billing. In addition, the City has developed draft Development Guidelines and Public Works Standards. These standards provide requirements for developers performing work within public rights-of-way or publicly owned easements.	***Water System Plan***
Upgrade existing deficiencies in water service (including fire flow). *(Policy CF-3)*	***Comprehensive Plan***

Table 5.1
Service Area Policies (continued)

Policy Name	*Reference*
Surcharge For Outside Customers Policy	
The minimum monthly water rates for all users outside the City limits shall be charged one hundred percent (or twice) the rate charged to users inside the City limits. In addition, in the event of a shortage of water, all water users within the City limits shall have a first priority over users outside the City limits.	***City Municipal Code 13.04.280***
Requests for service to areas outside the City limits and established potential annexation areas will be considered on a case-by-case basis. In general, it is the goal of the City to annex those areas to which public services are to be extended. However, this may not always be practical or possible, and in some instances an annexation, or other interlocal agreement may be required to serve these properties as development requires.	***Water System Plan***
It is recommended that the City establish a formal policy regarding extensions to the water system. This policy should cover a special rate structure for customers served by extensions to the system. The rates should be structured to cover operation and maintenance costs, as well as long-term replacement costs for extensions to the system. It is recommended that the rate structure be tiered based on the geographic location in relation to the core system.	
Formation of Local Improvement Districts Outside Legal Boundaries Policy	
It is the City's policy to only allow formation of Local Improvement Districts outside of its legal boundaries to relieve health hazard conditions.	***Water System Plan***
Design new development to allow for efficient and economical provision of water services, and require new development to pay its fair share of the cost of providing service. *(Policy CF-4)*	***Comprehensive Plan***
Late-Comers Agreements Policy	
The City does not currently have a formally adopted late-comer agreement policy. It is recommended that the City develop a policy that provides definitive guidance to developers.	
Oversizing Policy	
Ensure that the water service necessary to support development will be adequate to serve the development at the time the development is available for occupancy and use. *(Policy CF-2)*	***Comprehensive Plan***
Maintain an updated WSP that is coordinated with the Land Use Plan so that new development is located where sufficient system capacity exists or can be logically extended. (Policy CF-6)	
Cross-Connection Control Program Policy	
No service connection shall be allowed from the City mains to any premises supplied by water from any other source, unless special permission is given by the water superintendent, which special permission may be terminated at any time if in the judgment of the water superintendent the public interest so requires.	***City Municipal Code 13.04.090***
No cross-connection shall be made or maintained between any City service connection and pipe supplying water from any other source unless the water supplied from the other source, by tests of the State Board of Health, is shown to conform to the United States Bacteriological Standard for drinking water. The tests must be made by a professional tester and submitted to the City at least once a month.	
Extension Policy	
Where property is located within the City's WSA and within the City limits, and where there is no existing water main laid, or where the capacity of existing water mains is not sufficient to meet the demands of new construction, the installation and cost of a water main extension to service such property previously unserviced shall be the responsibility of the applicant.	***City Municipal Code 13.04.040***

Table 5.1
Service Area Policies (continued)

Policy Name	*Reference*
Additional System Policies	
Establish a reserve fund and pursue outside funding services to finance needed improvements to the water system. *(Policy CF-1)*	***Comprehensive Plan***
Ensure coordination between the City and adjacent water purveyors and municipal owned systems. (Policy CF-7)	
Encourage conservation efforts to address the need for adequate supply of water resources, and to protect natural resources. Efforts should include, but are not limited to, public education, water reuse and reclamation, use of native and/or drought resistant landscaping, low flow shower heads, conservation credits, and energy in new and existing buildings. *(Policy CF-9)*	
Reduce DSL and other unaccounted-for water loss. *(Policy CF-10)*	
Service area exchanges with neighboring purveyors may be required from time to time to best serve individual properties. Such exchanges will be considered on a case by case basis and interlocal service area exchange agreements will be required.	***Water System Plan***

SYSTEM DESIGN STANDARDS

Design standards were developed by the City to ensure the utility's ability to meet a minimum level of service for existing and future customers. The *City of Black Diamond Development Guidelines and Public Works Standards – Water System Standards* outlines the minimum system requirements. A copy of these standards has been included in **Appendix I – Black Diamond Public Works Standards**.

The standards included in the *City of Black Diamond Development Guidelines and Public Works Standards* are intended to represent the minimum standards for the design and construction of water system facilities. More stringent standards may be required by the City due to specific project conditions. All improvements to the existing water system shall be in compliance with the Washington State Department of Health (DOH) requirements as outlined in the *Washington State Department of Health Water System Design Manual*, dated December 2019. Additionally, the *South King County Coordinated Water System Plan* (SKCCWSP) established uniform minimum design standards to ensure compatibility between systems. A copy of these standards has been included in **Appendix J – SKCCWSP Design Standards**. A summary of many of the design standards is provided in **Table 5.2, Minimum Design Standards**.

Table 5.2
Minimum Design Standards

	MINIMUM DESIGN STANDARDS	
	Design Standard	**Reference**
ADD and MDD	ADD should be determined from previous actual water use. MDD is estimated at approximately 2 times the ADD if metered data is not available.	***DOH Design Manual***
	MDD = 2 x ADD, where MDD = Maximum Day Demand ADD = Average Day Demand	
PHD	Distribution pipelines must be able to sufficiently deliver water to meet peak hour demands at 30 psi at every existing and proposed service connection.	***DOH Design Manual***
	PHD = (MDD/1440)[(C)(N) + F] + 18 for residential demands, where PHD = Peak Hourly Demand (gpm) C = Coefficient associated with ranges of ERUs N = Number of service connections F = Factor associated with ranges of ERUs MDD = Maximum Day Demand (gpd/ERU)	
	If more than one pressure zone exists, each PHD value needs to be calculated separately for each zone and analyzed appropriately.	
Storage Requirements	For a given reservoir design, each of the five storage components must be considered. 1. Operational Storage 2. Equalizing Storage 3. Standby Storage 4. Fire Suppression Storage 5. Dead Storage	***DOH Design Manual***
Fire Flow Rate and Duration	Fire flow rate and duration requirements shall be determined by the local fire control authority.	***DOH Design Manual***
	If fire flow is to be provided, the distribution system shall be designed to provide the required fire flow at a pressure of at least 20 psi at the fire location, and positive pressure shall be maintained throughout the system during maximum instantaneous demand conditions.	***SKCCWSP Design Standards***

Table 5.2
Minimum Design Standards (continued)

	MINIMUM DESIGN STANDARDS	
	Design Standard	**Reference**
Minimum System Pressure	The system must be capable of delivering PHD at the required pressure of 30 psi at every existing and proposed service connection. If fire flow is to be provided, the distribution pipelines must also be capable of delivering the MDD rate, in addition to the fire flow, at the required pressure of 20 psi throughout the distribution system.	***DOH Design Manual***
	The City will require that its customers install pressure reducing valves in the water service pipe when the street main static pressure exceeds 80 psi.	***City Public Works Standards***
Minimum Pipe Sizing	Minimum water main size is 8 inches. Larger size pipe will be required if projected to be needed in the City's WSP or as deemed necessary based on the project demands. Verification of capacity by the developer's engineer may be required by the City.	***City Public Works Standards***
	Oversizing of water mains may be required to be installed per the City's WSP.	
	Pipes connecting hydrants to mains shall be at least 6 inches in diameter and not longer than 50 feet.	
Valve and Hydrant Spacing	All valves larger than 12 inches shall be butterfly valves. All valves 12 inches and smaller shall be resilient seat gate valves.	***City Public Works Standards***
	Sufficient valving should be placed to keep a minimum number of customers out of service when water is turned off for maintenance, repair, replacement, or additions. As a general rule, valves on distribution mains of 12 inches and smaller should be located such that the water main length of not more than 1,000 feet can be isolated by valve closure.	***DOH Design Manual***
	Fire hydrants are generally required approximately every 500 feet in residential areas, and every 300 feet in commercial areas. However, fire hydrants shall be furnished and installed at all locations as specifically mandated by the local fire marshal and/or per City Building Code.	***City Public Works Standards***
	Fire hydrants on dead-end streets and roads shall be located within approximately 300 feet from the frontage center of the farthest lot.	***City Public Works Standards***

Table 5.2
Minimum Design Standards (continued)

	MINIMUM DESIGN STANDARDS	
	Design Standard	**Reference**
Back-up Power Requirements	All source and booster pumping facilities required for primary supply in an emergency shall be equipped with auxiliary power.	***SKCCWSP Design Standards***
Additional Policies	Water mains shall be extended to the far property line(s) of the property being served.	***City Public Works Standards***
	Off-site extensions may be required to hydraulically loop existing and new systems.	***City Public Works Standards***
	Dead-end lines are not permitted except where the Developer can demonstrate to the City's satisfaction that it would be impractical to extend the line at a future date. Water mains on platted cul-de-sacs shall extend to the plat line beyond the cul-de-sac to neighboring property for a convenient future connection, and extended off site to create a hydraulic loop. Fire hydrants will be installed at or on the termination point.	***City Public Works Standards***
	All new construction shall comply with the accepted procedure and practice in Cross Connection Control Manual as published by the Pacific Northwest Section of the American Water Works Association, 1996, Sixth Edition, and current amendments thereto. A copy of such is available for review at the City office.	***City Public Works Standards***
	One water sampling station shall be provided for developments in size of five to ten lots. The water sampling shall be furnished and installed at a location determined by the City. One additional sampling station shall be provided for each additional 50 lots or portion thereof.	***City Public Works Standards***
	Pressure in the distribution system should not exceed 100 psi, unless the design engineer can justify the need for the excessive pressure (reduce pumping costs, fire flow reliability, etc.), and verify that the pipe material is appropriate for this use.	***DOH Design Manual***

Table 5.2
Minimum Design Standards (continued)

	MINIMUM DESIGN STANDARDS	
	Design Standard	**Reference**
Water Quality Parameters	Water quality must be proved to conform with Department of Social and Health Services (DSHS) criteria specified in Chapter 248-54 WAC and/or any additional requirements contained in King County Board of Health Rules and Regulations No. 9, South King County Department of Public Health (SKCDPH).	***SKCCWSP Design Standards***

PROJECT REVIEW PROCEDURES

The process by which the City will review all project documents related to the City water system has been clearly outlined in the City's water standards. Specific emphasis has been placed on distribution projects that will not need to be reviewed and approved by the Washington State Department of Health (DOH). A copy of the draft standards has been included in **Appendix I – Black Diamond Public Works Standards**.

POLICIES AND REQUIREMENTS FOR OUTSIDE PARTIES

Policies and requirements for outside parties, such as developers, including right-of-way and pipe looping requirements, have been addressed by the water standards, as well as the City's developer extension agreements and checklists that have been included in **Appendix K – Developer Extension Checklist and Agreement**. Various sections of these standards cover the requirements of a development project that will include City water system components.

The City's water standards cover the general design requirements for additions to the City's water system. Developer extension agreements cover the administrative and contractual requirements of outside parties constructing water projects to be included in the City's water system. These documents generally address the necessary applications, provisions for special circumstances, design standards, developer charges, and performance bonding for outside parties.

The City currently provides Water Investigation Certificates to developers inquiring about water availability. This practice is pursuant to the Growth Management Act (GMA) level of service standards for potable water. In 1990, the Washington State Legislature passed the GMA, which has been codified primarily in the Revised Code of Washington (RCW) Chapter 36.70A. The legislative intent of the GMA is to coordinate and plan growth so as to balance environmental, economic development, health, safety, and quality concerns in the use of the lands within the state.

The specific provision of the GMA regarding water availability has been codified in RCW 19.27.097(1), of the State Building Code Act. It provides as follows:

> Each applicant for a building permit of a building necessitating potable water shall provide evidence of an adequate water supply for the

> intended use of the building. Evidence may be in the form of a water right permit from the department of ecology, a letter from an approved water purveyor stating the ability to provide water, or another form sufficient to verify the existence of an adequate water supply. In addition to other authorities, the county or city may impose conditions on building permits requiring connection to an existing public water system where the existing system is willing and able to provide safe and reliable potable water to the applicant with reasonable economy and efficiency. An application for a water right shall not be sufficient proof of an adequate water supply.

It is recommended that the City revise and expand its current efforts to provide information to the public regarding its potable water availability. The Water Investigation Certificate format is recommended to include language regarding the guarantee of that availability as it is reliant on the ability of the applicant to obtain a building permit. This letter also should include reference to an expiration date of 1 year from the date of issuance.

It also is recommended that the City implement a documentation program for the availability of its water supply. This program should include up to date tracking of water system capacity and current water usage throughout the system. This data can then be weighed against those requests for future water service to project system capacity in support of development. This also can be used to assist in assessment of future capital facilities needs for the City's water system.

DESIGN STANDARDS

Design standards and sizing criteria for City water improvements are outlined in the water standards in **Appendix I – Black Diamond Public Works Standards**. All proposed water mains shall be sized by a professional engineer qualified to do so and licensed in the State of Washington. Minimum pipe size will be as specified in the water standards and this Water System Plan (WSP). Specific requirements regarding pipe sizing and performance are included in **Chapter 2 – Water System Description** and **Chapter 7 – Water System Analysis**.

CONSTRUCTION STANDARDS

Construction materials and methods for the City's water system have been addressed in detail in the City's water standards. The water standards include specific references to individual standards of pipe class, manufacturers, and construction specifications. A copy of this draft document has been included in **Appendix J – SKCCWSP Design Standards**.

CONSTRUCTION CERTIFICATION AND FOLLOW-UP PROCEDURES

The City is committed to ensuring that City water projects are constructed in accordance with the City's water standards. Specific design, approval, inspection, testing, acceptance, and contractor warranty requirements are included in the water standards. All these elements of the standards and procedures undertaken by the City work to ensure that water system facilities are installed to the standards set forth by the City, DOH, and Washington State Law.

Construction inspection procedures, including pressure testing, disinfection, and water quality sampling procedures are outlined in the City's water standards. Specific instruction and direction are provided to the contractor and City Inspector on the standards of testing required for construction certification by the City.

Procedures for final certification by the City also require the preparation and submittal of construction record drawings. DOH also requires the project to be documented through the submittal of a Construction Completion Report following Washington Administrative Code (WAC) 246-290-120(5), which states the following:

> (5) Purveyors shall submit a construction completion report (departmental form) to the department within sixty days of completion and before use of distribution-related projects in accordance with WAC 246-290-125 (3)(f), or other project approved for construction by the department. Exceptions to this requirement are projects listed in WAC 246-290-125(1). The form shall:
>
> > (a) Bear the seal, date, and signature of a professional engineer licensed in the state of Washington;
> > (b) State the project is constructed and is completed in accordance with department regulations and principles of standard engineering practice, including physical testing procedures, water quality tests, and disinfection practices; and
> > (c) Document system physical capacity to serve consumers if the project results in a change (increase or decrease) in physical capacity.

6 | WATER SOURCE AND QUALITY

Black Diamond Springs

INTRODUCTION

The two basic objectives of a water system are to provide a sufficient quantity of water to meet customer usage demands and to provide high quality water. **Chapter 7 – Water System Analysis** discusses the City of Black Diamond's (City) ability to supply a sufficient quantity of water and identifies future source requirements. This chapter discusses the City's existing water sources, water rights, water quality regulations, and water quality monitoring results.

EXISTING WATER SOURCES AND TREATMENT

Water Sources

The City's municipal water supply is provided by a spring field and interties with the City of Tacoma.

The Black Diamond Springs are located approximately 2 miles southeast of the City on a large City-owned parcel. Four major collection areas are associated with the Black Diamond Spring Field. Potable water supply is currently provided by the Black Diamond Spring Field Collection Area No. 1 (also known as the South Springs) and the Black Diamond Spring Field Collection Area No. 3 (also known as the North Springs). Black Diamond Spring Field Collection Area No. 2 (also known as the Middle Springs) is currently offline due to groundwater under the influence of surface water concerns. Black Diamond Spring Field Collection Area No. 4 (also known as the Palmer Spring Area) is not currently online.

Combined flow from the Black Diamond Springs varies from 3,150 to 18,400 gallons per minute (gpm) depending on the time of year, with the highest flows occurring in spring, and the lowest flows occurring in fall.

The minimum combined flow of the North and South Springs, as measured at the junction box during the fall of 2013, was approximately 1,930 gpm (4.3 cubic feet per second). This rate is the firm supply that can always be captured from the source for potable supply if the infrastructure from the junction box to the City was upgraded.

Water Treatment

The springs sources are currently disinfected with sodium hypochlorite generated onsite with a 12 pound per day system at the North Bank Pump Station. A solution of 0.8 percent sodium hypochlorite is added to the water to provide an initial dose of 1.0 milligrams per liter (mg/L).

Caustic soda is injected into the water supply in the form of 25-percent sodium hydroxide at the pump station located at the 4.3 million gallon (MG) Reservoir site to provide corrosion control for lead and copper rule compliance.

WATER RIGHTS AND INTERTIES

Overview

A water right is a legal authorization to use a specified amount of public water for specific beneficial purposes. The water right amount is expressed in terms of instantaneous withdrawal rate and annual withdrawal volume. Washington State law requires users of public water to receive approval from the Washington State Department of Ecology (Ecology) prior to actual use of the water. This approval is granted in the form of a water right permit, which is developed into a certificate. However, a water right is not required for certain purposes (typically individual residences) that use 5,000 gallons per day (gpd) or less of groundwater from a well.

The process of obtaining a water right involves submitting a water right application that is reviewed by Ecology. If the request is approved, a water right is issued to allow for water use to commence. A water right permit provides permission to construct the necessary wells or diversions, pumps, and pipes to start using water. The water right permit remains in effect until the permit holder determines that its project is complete, and they have used as much water as they will under the water right. At that time, the permit holder files a proof of appropriation

form, which attests to the rate and volume of water used under the water right. A water right certificate is issued by Ecology following a proof of examination and determination that the amount of water put to beneficial use is consistent with the amount and conditions indicated on the water right permit.

A water right permit can only be issued by Ecology if the proposed use meets the following requirements:

- Water will be put to beneficial use.
- There will be no impairment to existing or senior rights.
- Water is physically and legally available for appropriation.
- Issuance of the requested water right will not be detrimental to the public interest.

During preparation of the report of examination, Ecology considers existing basin management plans, stream closures, minimum instream flows, hydraulic continuity (surface water interconnected to groundwater), utilization of existing water sources, water conservation, and availability of alternative water supplies, among other things. The water right decision process is increasingly becoming more complex and time consuming, due to the many competing interests for water, environmental issues, and regulatory requirements.

Existing Water Rights and Interties

The City currently holds two surface water certificates on file with Ecology. The source of water for both certificates is Black Diamond Springs. The springs are in Water Resource Inventory Area (WRIA) 9 – Duwamish-Green. Each water right is discussed in more detail in the sections that follow. Copies of the water right documents discussed can be found in **Appendix L – Water Right Documents**. The City currently has no pending new water right applications and no pending water right change applications.

S1-00506C

Surface Water Certificate S1-00506C was issued on March 29, 1974, with a priority date of April 15, 1968. This water right certificate was granted to the Town of Black Diamond for the maximum use of 8.0 cubic feet per second (cfs) and 551 acre-feet per year (afy) for year-round municipal supply. The place of use on the water right certificate is defined as the "Area served by the Town of Black Diamond." This water right meets the definition as being for municipal water supply purposes, provided under Revised Code of Washington (RCW) 90.03.15.

There have been multiple water right actions taken since the certificate was issued, but they have all led to the certificate being the controlling water right document. The actions taken by the City and Ecology since issuance of the original certificate are described below.

On January 17, 1990, the City applied to Ecology to change the point of diversion from being identified as a surface water right, to a ground water right (water right tracking number CS1-00506C). Since no physical change to the point of diversion was occurring, Ecology denied this request in a report of examination for change dated April 29, 1992. In that denial, Ecology also recommended that the instantaneous rate authorized under the certificate be reduced

from 8 cfs to approximately 1.23 cfs to reflect the actual rate of water being diverted from Black Diamond Springs at that time.

On August 13, 1990, the City applied to Ecology to change its place of use to include areas served by neighboring water purveyors (water right tracking number CS1-00506C@1). Ecology partially approved this request and allowed for the City to serve water within the area served by Covington Water District in a report of examination for change dated June 30, 1993. In that approval, Ecology also recommended that the certificate should be reduced from 8 cfs to approximately 1.23 cfs to reflect the actual rate of water being diverted from Black Diamond Springs, at that time.

On March 9, 2012, Ecology issued Administrative Order No. 12WRNR-DE9035 related to both reports of examination for change (CG1-00506C and CG1-00506C@1). This order recognized that the 2003 Municipal Water Law had made the approved change application moot. This order also recognized that Ecology should not reduce the City's water right, since it is continuing to grow into the inchoate portions. This order had the impact of reinstating the original March 19, 1974, certificate as the controlling water right document.

Table 6.1, Potable Municipal Water Rights summarizes the potable municipal water right held by the City.

Table 6.1
Potable Municipal Water Rights

Water Right	Priority Date	Source	Instantaneous Rate (Qi) (cfs)	Annual Volume (Qa) (afy)
S1-00506C	April 15, 1958	Black Diamond Springs	8.0	551.0

Surface Water Certificate 3580

Surface Water Certificate 3580 was issued on May 19, 1950, with a priority date of August 22, 1949. This water right certificate was granted originally to King County Water District No. 66 for the maximum use of 2.93 cfs for year-round power production. No maximum annual volume was specified.

Since this water right is for power production purposes, it has not been included in the City's calculations for its potable municipal water supply water rights for planning purposes, as shown in **Table 6.1, Potable Municipal Water Rights**.

City of Tacoma Intertie

Water system interties are physical connections between two adjacent water systems. Interties are normally separated by a closed isolation valve or control valve. Emergency supply interties provide water from one system to another during emergency situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main and is unable to provide a sufficient quantity of water to its customers. Normal supply interties provide water from one system to another during non-emergency situations and are always typically supplying water.

The City negotiated a wholesale water agreement with the City of Tacoma (Tacoma) in 2003 wherein the two agencies agreed that Tacoma would supply wholesale water to the City. The supply quantities are outlined in **Table 6.2, Tacoma Wholesale Intertie Maximum Water Supply**. Under the terms of the agreement, the City is responsible for System Development Charges (SDCs) associated with the connection to Tacoma's system to be repaid over a ten-year period.

The intertie connection to Tacoma's Secondary Supply Pipe Line (SSPL) project was constructed in 2005. Amendment No. 1 to the agreement was approved in 2007 and included the purchase of additional water. Copies of the 2003 Wholesale Water Agreement and Amendment No. 1 have been included in **Appendix E – Tacoma Wholesale Agreement**.

Table 6.2
Tacoma Wholesale Intertie Maximum Water Supply

Agreement	Date of Agreement	Wholesale Supply Capacity (gpd)
Wholesale Water Agreement	August 1, 2003	1,712,000 for average day use 3,852,000 for maximum day use 3,659,400 for 4-day maximum use
Amendment No. 1	February 1, 2007	500,000 for average day use 1,125,000 for maximum day use 1,068,750 for 4-day maximum use
Amendment No. 2	Pending 2020	Second Intertie (Lake Sawyer Road SE)

Water Right and Intertie Summary

In anticipation of the large amount of growth that the City will experience with the construction of the master planned developments (MPDs), the City and the Partners secured enough water supply and water rights to meet demands well past the 20-year planning horizon. **Table 6.3, Water Right and Intertie Summary** documents the City's water rights capacity. An analysis of reliable supply capacity is presented in **Chapter 7 – Water System Analysis.**

Table 6.3
Water Right and Intertie Summary

Source	Peak Supply (Qi)		Annual Volume (Qa)	
	(gpm)	(gpd)	(afy)	(MG/Year)
Black Diamond Springs	3,590	5,170,176	551	179.5
Tacoma Wholesale Intertie	3,456	4,977,000	2,478	807.4
Total	**7,046**	**10,147,176**	**3,029**	**986.9**

DRINKING WATER REGULATIONS

Overview

The quality of drinking water in the United States is regulated by the Environmental Protection Agency (EPA). Under provisions of the Safe Drinking Water Act (SDWA), the EPA is allowed to delegate primary enforcement responsibility for water quality control to each state. In the State of Washington, DOH is the agency responsible for implementing and enforcing the drinking water regulations. For the State of Washington to maintain primacy (delegated authority to implement requirements) under the SDWA, the state must adopt drinking water regulations that are at least as stringent as the federal regulations. In meeting these requirements, the State, in cooperation with the EPA, has published drinking water regulations that are contained in Washington Administrative Code (WAC) Chapter 246-290.

Existing Regulations

The Federal SDWA was enacted in 1974, as a result of public concern about water quality. The SDWA sets standards for the quality of drinking water and requires water treatment if these standards are not met. The SDWA also sets water testing schedules and methods that water systems must follow. In 1986, the SDWA was amended as a result of additional public concern and frequent contamination of groundwater from industrial solvents and pesticides. The 1986 Amendments required water systems to monitor and treat for a continuously increasing number of water contaminants identified in the new federal regulations. The EPA regulated approximately 20 contaminants between 1974 and 1986. The 1986 Amendments identified 83 contaminants that EPA was required to regulate by 1989. Implementation of the new regulations has been marginally successful due to the complexity of the regulations and the associated high costs. To rectify the slow implementation of the new regulations, the SDWA was amended again and re-authorized in August of 1996.

In response to the 1986 SDWA Amendments, EPA established six rules, known as the Phase I Rule, Phase II and IIb Rules, Phase V Rule, Surface Water Treatment Rule, Total Coliform Rule, and Lead and Copper Rule. The EPA regulates most chemical contaminants through the Phase I, II, IIb, and V Rules. The City's active sources are affected by many of these rules.

The EPA set two limits for each contaminant that is regulated under the rules. The first limit is a health goal, referred to as the Maximum Contaminant Level Goal (MCLG). The MCLG is zero for many contaminants, especially known cancer-causing agents (carcinogens). The second limit is a legal limit, referred to as the Maximum Contaminant Level (MCL). MCLs are equal to or higher than the MCLGs; however, most MCLs and MCLGs are the same, except for contaminants that are regulated as carcinogens. The health goals (MCLGs) for carcinogens are typically zero, because they cause cancer and it is assumed that any amount of exposure may pose some risk of cancer. A summary of each rule follows.

To fully understand the discussion that follows, a brief definition of several key terms is provided below.

- Organic Chemicals – Animal or plant produced substances containing carbon and other elements such as hydrogen and oxygen.
- Synthetic Organic Chemicals (SOCs) – Man-made organic substances, including herbicides, pesticides, and various industrial chemicals and solvents.
- Volatile Organic Chemicals (VOCs) – Chemicals, as liquids, that evaporate easily into the air.
- Inorganic Chemicals (IOCs) – Chemicals of mineral origin that are naturally occurring elements. These include metals such as lead and cadmium.

Phase I Rule

The Phase I Rule, which was the EPA's first response to the 1986 Amendments, provided limits for eight VOCs that may be present in drinking water. VOCs are used by industries in the manufacturing of rubber, pesticides, deodorants, solvents, plastics, and other chemicals. VOCs are found in everyday items such as gasoline, paints, thinners, lighter fluid, mothballs, and glue, and are typically encountered at dry cleaners, automotive service stations, and elsewhere in industrial processes. The City currently complies with all contaminant monitoring requirements under this rule.

Phase II and IIb Rules

The Phase II and IIb Rules update and create limits for 38 contaminants (organics and inorganics). Some of the contaminants are frequently applied agricultural chemicals (nitrate), while others are more obscure industrial chemicals. The City currently complies with all contaminant monitoring requirements under this rule.

Phase V Rule

The Phase V Rule sets standards for 23 additional contaminants, of which 18 are organic chemicals (mostly pesticides and herbicides) and 5 are IOCs (such as cyanide). The City currently complies with all contaminant monitoring requirements under this rule.

Surface Water Treatment Rule

Surface water sources, such as rivers, lakes, and reservoirs (which are open to the atmosphere and subject to surface runoff), and groundwater sources under the influence of surface water (GWI) are governed by the Surface Water Treatment Rule (SWTR). The SWTR seeks to prevent waterborne diseases caused by the microbes *Cryptosporidium, Legionella,* and *Giardia lamblia*, which are present in most surface waters. The rule requires disinfection of all surface water and GWI sources. All surface water and GWI sources must also be filtered, unless a filtration waiver is granted. A filtration waiver may be granted to systems with pristine sources that continuously meet stringent source water quality and protection requirements. The City's water supply is classified as groundwater at all sources except for the Tacoma Regional Water Supply. Tacoma

Public Utilities is responsible for monitoring and satisfying the water quality requirements for the Tacoma Intertie Source.

Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) became effective concurrent with the Stage 1 Disinfectants/Disinfection Byproducts Rule. The rule primarily applies to public water systems that serve 10,000 or more people and use surface water or GWI sources. The rule also requires primacy agencies (i.e., DOH in Washington State) to conduct sanitary surveys of all surface water and GWI systems, regardless of size. The rule is the first to directly regulate the protozoan *Cryptosporidium* and has set the MCLG for *Cryptosporidium* at zero. The City's water supply is classified as groundwater at all sources except for the Tacoma Regional Water Supply. Tacoma Public Utilities is responsible for monitoring and satisfying the water quality requirements for the Tacoma Intertie Source.

Long Term 1 Enhanced Surface Water Treatment Rule

The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) addresses water systems using surface water or GWI sources serving fewer than 10,000 people. The rule extends protections against *Cryptosporidium* for smaller water systems. The City's water supply is classified as groundwater at all sources except for the Tacoma Regional Water Supply. Tacoma Public Utilities is responsible for monitoring and satisfying the water quality requirements for the Tacoma Intertie Source.

Revised Total Coliform Rule

The Total Coliform Rule (TCR) was published in the Federal Register on June 29, 1989, and became effective on December 31, 1990. The rule set both MCLGs and MCLs for total coliform levels in drinking water, and the type and frequency of testing that is required for water systems. The rule requires more monitoring than under prior requirements, especially for small systems. In addition, every public water system is required to develop a coliform monitoring plan, subject to approval by DOH.

On February 13, 2013, the EPA published revisions to the rule in the Federal Register, and the rule was renamed to the Revised Total Coliform Rule. This rule eliminated the coliform MCL, sets an MCL for *Escherichia Coli* (*E. coli*), and specifies the frequency and timing of coliform testing based on population served, public water system type, and source water type. When total coliform is detected, this is now known as a treatment technique trigger and public notice is no longer required. Instead, the water system must conduct an assessment of their water system facilities and operations and fix any sanitary defects. For confirmed *E. coli* incidents, now known as an *E. coli* MCL violation, the water system must perform a Level 2 assessment and provide public notice within 24 hours. If a positive sample is collected on a consecutive test sample, the City also will need to collect source samples.

Coliform are a group of bacteria that live in the digestive tract of humans and many animals and are excreted in large numbers in feces. Coliform can be found in sewage, soils, surface waters, and vegetation. The presence of any coliform in drinking water indicates a health risk and

potential waterborne disease outbreak, which may include gastroenteric infections, dysentery, hepatitis, typhoid fever, cholera, and other infectious diseases.

The rule established the health goal for total coliform at zero. To comply with the legal limit, systems must not find coliform in more than 5 percent of the samples taken each month. For systems like the City, which take 30 samples per month, having more than one sample that contains coliform would exceed the legal limit and trigger the follow-up sampling requirements.

The City's current water quality and chlorination practices have resulted in compliance with this rule.

Lead and Copper Rule

The Lead and Copper Rule identifies action levels for both lead and copper. An action level is different than an MCL. An MCL is a legal limit for a contaminant, and an action level is a trigger for additional prevention or removal steps. The action level for lead is greater than 0.015 mg/L. The action level for copper is greater than 1.3 mg/L. If the 90th percentile concentration of either lead or copper from the group of samples exceeds these action levels, a corrosion control study must be undertaken to evaluate strategies and make recommendations for reducing the lead or copper concentration below the action levels. The rule requires systems that exceed the lead level to educate the affected public about reducing its lead intake. Systems that continue to exceed the lead action level after implementing corrosion control and source water treatment may be required to replace piping in the system that contains lead sources. Corrosion control is typically accomplished by increasing the pH of the water to make it less corrosive, which reduces its ability to break down water pipes and absorb lead or copper.

Lead is a common metal found throughout the environment in lead-based paint, air, soil, household dust, food, certain types of pottery, porcelain, pewter, brass, and water. Lead can pose a significant health risk if too much of it enters the body. Lead builds up in the body over many years and can cause damage to the brain, red blood cells, and kidneys. The greatest risk is to young children and pregnant women. Lead can slow normal mental and physical development of growing bodies.

Copper is a common, natural, and useful metal found in our environment. It is also a trace element needed in most human diets. The primary impact of elevated copper levels in water systems is stained plumbing fixtures. At certain levels (well above the action levels), copper may cause nausea, vomiting, and diarrhea. It also can lead to serious health problems in people with Wilson's disease. Long-term exposure to elevated levels of copper in drinking water also could increase the risk of liver and kidney damage. The City currently complies with all contaminant monitoring and treatment requirements under this rule.

Radionuclides Rule

The EPA established interim drinking water regulations for radionuclides in 1976 under the SDWA. MCLs were established for alpha, beta, and photon emitters, and radium 226/228. Radionuclides are elements that undergo a process of natural decay and emit radiation in the form of alpha or beta particles and gamma photons. The radiation can cause various kinds of

cancers, depending on the type of radionuclide exposure from drinking water. The regulations address both man-made and naturally occurring radionuclides in drinking water.

The 1986 Amendments to the SDWA finalized the regulations for radionuclides by eliminating the term "interim." The amendments also directed the EPA to promulgate health-based MCLGs, as well as MCLs. The EPA failed to meet the statutory schedules for promulgating the radionuclide regulations, which resulted in a lawsuit. In 1991, the EPA proposed revisions to the regulations, but a final regulation based on the proposal was never promulgated. The 1996 Amendments to the SDWA directed the EPA to revise a portion of the earlier proposed revisions, adopt a schedule, and review and revise the regulations every 6 years, as appropriate, to maintain or improve public health protection. Subsequent to the 1996 Amendments, a 1996 court order required the EPA to either finalize the 1991 proposal for radionuclides or to ratify the existing standards by November 2000.

The final rule was published in the Federal Register on December 7, 2000, and became effective on December 8, 2003. The rule established an MCLG of zero for the four regulated contaminates and MCLs of 5 picocuries per liter (pCi/L) for combined radium-226 and radium-228, 15 pCi/L for gross alpha (excluding radon and uranium), 4 millirems per year (mrem/year) for beta particle and photon radioactivity, and 30 micrograms per liter (µg/L) for uranium. The City currently complies with all contaminant monitoring requirements under this rule.

Wellhead Protection Program

Section 1428 of the 1986 SDWA Amendments mandates that each state develop a wellhead protection program. The Washington State mandate for wellhead protection, and the required elements of a wellhead protection program, is contained in WAC 246-290-135, Source Protection, which became effective in July of 1994. In Washington State, DOH is the lead agency for the development and administration of the State's wellhead protection program.

A wellhead protection program is a proactive and ongoing effort of a water purveyor to protect the health of its customers by preventing contamination of the groundwater that it supplies for drinking water. All federally defined Group A public water systems that use groundwater as their source are required to develop and implement a wellhead protection program. All required elements of a local wellhead protection program must be documented and included in either the Water System Plan (applicable to the City) or a Small Water System Management Program document (not applicable to the City).

Consumer Confidence Report

The Consumer Confidence Report (CCR) is the centerpiece of the right-to-know provisions of the 1996 Amendments to the SDWA. The annual report must be updated and re-issued to all customers by July 1st of each year thereafter.

The CCR is a report on the quality of water that was delivered to the water users during the previous calendar year. The reports must contain certain specific elements but may also contain other information that the purveyor deems appropriate for public education. Some, but not all,

of the information that is required in the reports includes the source and type of the drinking water, type of treatment, contaminants that have been detected in the water, potential health effects of the contaminants, identification of the likely source of contamination, violations of monitoring and reporting, and variances or exemptions to the drinking water regulations.

Stage 1 Disinfectants/Disinfection Byproducts Rule

Disinfection byproducts (DBPs) are formed when free chlorine reacts with organic substances, most of which occur naturally. These organic substances (called precursors) are a complex and variable mixture of compounds. The DBPs themselves may pose health risks. Trihalomethanes (THM) are a category of DBPs that had been regulated before this rule. However, systems with groundwater sources that serve a population of less than 10,000 were not previously required to monitor for THM.

The rule applies to the City and most other water systems, including systems serving fewer than 10,000 people that add a chemical disinfectant to the drinking water during any part of the treatment process. The rule reduced the MCL for total THM, which are a composite measure of four individual THM, from the previous interim level of 0.10 mg/L to 0.08 mg/L. The rule established MCLs and requires monitoring of three additional categories of DBPs (0.06 mg/L for five haloacetic acids (HAA5), 0.01 mg/L for bromate, and 1.0 mg/L for chlorite). The rule established maximum residual disinfectant levels for chlorine (4.0 mg/L), chloramines (4.0 mg/L), and chlorine dioxide (0.8 mg/L). The rule also requires systems using surface water or groundwater directly influenced by surface water to implement enhanced coagulation or softening to remove DBP precursors, unless alternative criteria are met. The City currently complies with all contaminant monitoring requirements under this rule.

Unregulated Contaminant Monitoring Rule

The EPA established the Unregulated Contaminant Monitoring Rule (UCMR) to generate data on contaminants that are being considered for inclusion in new drinking water standards. The information collected by select public water systems will ensure that future regulations established by the EPA are based on sound science.

Three separate lists of unregulated contaminants are maintained under the UCMR: List 1; List 2; and List 3. Contaminants are organized on the tiered lists based on the availability of standard testing procedures and the known occurrence of each contaminant, with List 1 containing contaminants that have established standard testing procedures and some, but insufficient, information on their occurrence in drinking water. Monitoring for contaminants on the three lists is limited to a maximum of 30 contaminants within a 5-year monitoring cycle, and the EPA is required to publish new contaminant monitoring lists every 5 years. As new lists are published, contaminants will be moved up in the lists if adequate information is found to support additional monitoring. All public water systems serving more than 10,000 people and a randomly selected group of smaller water systems are required to monitor for contaminants. The City currently monitors for some unregulated contaminants.

Arsenic

Arsenic is highly toxic, affects the skin and nervous system, and may cause cancer. The Arsenic Rule sets the MCLG of arsenic at zero and reduces the MCL from the previous standard of 0.05 mg/L to 0.01 mg/L. Arsenic's monitoring requirements will be consistent with the existing requirements for other inorganic contaminants. The City complies with this rule since its sources have naturally low levels of arsenic that are below the MCL.

Filter Backwash Recycling Rule

Public water systems using surface water or groundwater under the direct influence of surface water that utilize filtration processes and recycling must comply with the Filter Backwash Recycling Rule. The rule aims to reduce risks associated with recycling contaminants removed during filtration.

The rule requires filter backwash water be returned to a location that allows complete treatment. In addition, filtration systems must provide detailed information regarding the treatment and recycling process to the state. The City's water supply is classified as groundwater at all sources except for the Tacoma Regional Water Supply. Tacoma Public Utilities is responsible for monitoring and satisfying the water quality requirements for the Tacoma Intertie Source.

Stage 2 Disinfectants/Disinfection Byproducts Rule

The EPA implemented the Stage 2 Disinfectants/Disinfection Byproducts Rule (Stage 2 D/DBPR) simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule.

Similar to the Stage 1 D/DBPR, this rule applies to most water systems that add a disinfectant to the drinking water other than ultraviolet light or those systems that deliver such water. The Stage 2 D/DBPR changes the calculation procedure requirement of the MCLs for two groups of disinfection byproducts, total THM (TTHM) and HAA5. The rule requires each sampling location to determine compliance with MCLs based on their individual annual average DBP levels (termed the Locational Running Annual Average), rather than utilizing a system-wide annual average. The rule also proposes new MCLGs for chloroform (0.07 mg/L), trichloroacetic acid (0.02 mg/L), and monochloroacetic acid (0.03 mg/L).

Additionally, the rule requires systems to document peak DBP levels and prepare an Initial Distribution System Evaluation (IDSE) to identify Stage 2 D/DBPR compliance monitoring sites. IDSEs require each water system to prepare a separate IDSE plan and report, with the exception of those systems who obtain a 40/30 Certification or a Very Small System Waiver. In order to qualify for the 40/30 Certification, all samples collected during Stage 1 monitoring must have TTHM and HAA5 levels less than or equal to 0.040 mg/L and 0.030 mg/L, respectively. The City currently complies with all contaminant monitoring requirements under this rule and has qualified for 40/30 Certification and does not require an IDSE plan.

Long Term 2 Enhanced Surface Water Treatment Rule

Following the publishing of the IESWTR, the EPA introduced the LT1ESWTR to supplement the preceding regulations. The second part of the regulations of the LT1ESWTR are mandated in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The final rule was implemented simultaneously with the Stage 2 D/DBPR described in the previous section. This rule applies to all systems that use surface water or GWI sources.

This rule establishes treatment technique requirements for filtered systems based on their risk level for contamination, calculated from the system's average *Cryptosporidium* concentration. Requirements include up to 2.5-log *Cryptosporidium* treatment, in addition to existing requirements under the IESWTR and LT1ESWTR. Filtered systems that demonstrate low levels of risk will not be required to provide additional treatment. Unfiltered systems under this rule must achieve at least a 2-log inactivation of *Cryptosporidium* if the mean level in the source water remains below 0.01 oocysts/L. If an unfiltered system's mean level of *Cryptosporidium* exceeds 0.01 oocysts/L, the LT2ESWTR requires the system to provide a minimum 3-log inactivation of *Cryptosporidium*. All unfiltered systems also are required to utilize a minimum of two disinfectants in their treatment process.

The LT2ESWTR also addresses systems with unfinished water storage facilities. Under this rule, systems must either cover their storage facilities or achieve inactivation and/or removal of 4-log virus, 3-log *Giardia lamblia,* and 2-log *Cryptosporidium* on a state-approved schedule. Lastly, the rule extends the requirement of the disinfection profiles mandated under the LT1ESWTR to the proposed Stage 2 D/DBPR. The City's water supply is classified as groundwater at all sources except for the Tacoma Regional Water Supply. Tacoma Public Utilities is responsible for monitoring and satisfying the water quality requirements for the Tacoma Intertie Source.

Groundwater Rule

The EPA promulgated the Groundwater Rule (GWR) to reduce the risk of exposure to fecal contamination that may be present in public water systems that use groundwater sources. The GWR also specifies when corrective action (which may include disinfection) is required to protect consumers who receive water from groundwater systems from bacteria and viruses. The GWR applies to public water systems that use groundwater and to any system that mixes surface and ground waters if the groundwater is added directly to the distribution system and provided to consumers without treatment equivalent to surface water treatment.

The rule targets risks through an approach that relies on the four following major components:

1. Periodic sanitary surveys of groundwater systems that require the evaluation of eight critical elements and the identification of significant deficiencies (such as a well located near a leaking septic system). DOH conducted its most recent sanitary survey of the City's water system on September 21, 2017, under the state's existing sanitary survey program.
2. Source water monitoring to test for the presence of *E. coli*, enterococci, or coliphage in the sample. There are two monitoring provisions.

- Triggered monitoring for systems that do not already provide treatment that achieves at least 99.99-percent (4-log) inactivation or removal of viruses and that have a total coliform positive routine sample under the Revised Total Coliform Rule sampling in the distribution system.
- Assessment monitoring is a complement to triggered monitoring. A state has the option to require systems to conduct source water assessment monitoring at any time to help identify high risk systems.

3. Corrective actions required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options: correct all significant deficiencies; eliminate the source of contamination; provide an alternate source of water; or provide treatment that reliably achieves 99.99-percent inactivation or removal of viruses.
4. Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves at least 99.99-percent inactivation or removal of viruses.

Future Regulations

Drinking water regulations are continuously changing in an effort to provide higher quality and safer drinking water. Modifications to the existing rules described above and implementation of new rules are planned for the near future. A summary of upcoming drinking water regulations that will most likely affect the City is presented in the following sections.

Radon

In July of 1991, the EPA proposed a regulation for radon, as well as three other radionuclides. The 1996 SDWA Amendments required the EPA to withdraw the 1991 proposal due to several concerns that were raised during the comment period. A new proposed regulation was published in the Federal Register on November 2, 1999. Comments on the proposed rule were due to the EPA by February 4, 2000. Final federal requirements for addressing radon were delayed until 2008 but have not yet been published. The rule proposes a 300 pCi/L MCL for community water systems that use groundwater or an alternative, less stringent MCL of 4,000 pCi/L for water systems where their state implements an EPA-approved program to reduce radon risks in household indoor air and tap water. It is not currently known when or what a radon regulation may require as adopted by the EPA or what the implementation schedule for the rule will be. Because the final radon rule requirements are uncertain, the impact of this rule on the City is unknown at this time.

Unregulated Contaminant Monitoring Rule Revisions

In accordance with the original UCMR, the EPA is proposing an updated contaminant monitoring list for the next 5-year monitoring cycle, in addition to other minor revisions to the UCMR. The proposed rule was published December 20, 2016, in the Federal Register. The revisions include a list of 30 chemicals that will be monitored during the 2018 through 2020 monitoring cycle. For this cycle, all community water systems and non-transient

non-community water systems serving more than 10,000 people will be required to monitor for contaminants. Large surface water and ground water under direct influence of surface water systems will monitor for 10 cyanotoxins and 20 additional contaminants (2 metals, 8 pesticides plus 1 pesticide manufacturing byproduct, 3 brominated haloacetic acid disinfection byproducts groups, 3 alcohols, and 3 semi-volatile organic chemicals). All large ground water systems will monitor for the 20 additional contaminants. Small water systems serving 10,000 or fewer people will be selected at random to monitor for cyanotoxins or the 20 additional contaminants.

Per- and Polyfluoroalkyl Substances

In 2016, the EPA established a health advisory level for per- and polyfluoroalkyl substances (PFAS) at 70 parts per trillion (ppt). The Washington State Department of Health proposed a regulation for PFAS in 2017, and this process will take about 2 years to complete. The primary source of PFAS contamination was historical use of PFAS-based firefighting foam used by the US military, local fire departments, and airports. It is not currently known when or what a PFAS regulation may require as adopted by the EPA or what will be the rule's implementation schedule. Since the final PFAS rule requirements are uncertain, the impact of this rule on the City is unknown at this time.

SOURCE WATER QUALITY AND PLANS

This section presents the current water quality standards for groundwater sources and the results of the City's recent source water quality monitoring efforts. A discussion of the water quality requirements and monitoring results for the City's distribution system is presented in the sections that follows.

The City's last sanitary survey was completed in 2017. The City is currently addressing minor deficiencies identified in this sanitary survey and complies with all other requirements of the rule. A copy of the City's most recent Sanitary Survey Report is contained in **Appendix M – Sanitary Survey**.

Drinking Water Standards

Drinking water quality is regulated at the federal level by the EPA and at the State level by DOH. Drinking water standards have been established to maintain high-quality drinking water by limiting the levels of specific contaminants (i.e., regulated contaminants) that can adversely affect public health and are known or likely to occur in public water systems. Non-regulated contaminants do not have established water quality standards and are generally monitored at the discretion of the water purveyor and in the interest of customers.

The regulated contaminants are grouped into two categories of standards – primary and secondary. Primary standards are drinking water standards for contaminants that could affect health. Water purveyors are required by law to monitor and comply with these standards and notify the public if water quality does not meet any one of the standards. Secondary standards are drinking water standards for contaminants that have aesthetic effects, such as unpleasant

taste, odor, or color (staining). The national secondary standards are unenforceable federal guidelines or goals where federal law does not require water systems to comply with them. However, states may adopt their own enforceable regulations governing these contaminants. The State of Washington has adopted regulations that require compliance with some of the secondary standards. Water purveyors are not required to notify the public if their water quality does not meet the secondary standards.

Source Monitoring Requirements and Waivers

The City is required to perform water quality monitoring at each of its active sources for inorganic chemical and physical substances, organic chemicals, and radionuclides. The monitoring requirements that the City must comply with are specified in WAC 246-290-300. A description of the source water quality monitoring requirements and procedures for each group of substances is contained in the City's Water Quality Monitoring Schedule, which is included as **Appendix N – Water Quality Testing**.

DOH has developed the Susceptibility Assessment Survey Form for water purveyors to complete in determining a drinking water source's potential for contamination. The results of the susceptibility assessment may provide monitoring waivers that allow reduced source water quality monitoring. Based on the results of the susceptibility assessment survey for each source, DOH assigned Source 04 (all spring sources) a High susceptibility rating.

Source Monitoring Results

The City's sources maintain a high level of water quality and have met or exceeded all drinking water standards since the previous Water System Plan Update in 2016. Source 04 was last monitored for IOCs in July 2017, VOCs in May 2016, nitrates in July 2019, herbicides and pesticides in August 2017, and radionuclides in May 2016. The spring sources have a 1-year waiver for nitrates, 9-year waiver for IOCs, 6-year waiver for VOCs, 9-year waiver for herbicides, 3-year waiver for pesticides, 3-year waiver for soil fumigants, and 6-year waiver for radionuclides.

The results of inorganic chemical (including nitrate), VOC, herbicides/pesticides, and radionuclides monitoring for the City's sources indicate that all primary and secondary standards were met.

Consumer Confidence Report

The Consumer Confidence Report (CCR) is the centerpiece of how the City demonstrates to its customers that it is complying with all State and Federal water quality requirements. A copy of the City's most recent CCR is contained in **Appendix N – Water Quality Testing**.

Wellhead Protection Program

The City is currently working to upgrade its springs collection sources to better protect them from surface water contamination. A copy of the City's Wellhead Protection Program is included in **Appendix O – Source Water Protection**.

DISTRIBUTION SYSTEM WATER QUALITY

Monitoring Requirements and Results

The City is required to perform water quality monitoring within the distribution system for coliform bacteria, disinfectant (chlorine) residual concentration, DBPs, lead and copper, and asbestos in accordance with Chapter 246-290 WAC. A description of the distribution system water quality monitoring schedule is contained in the City's Water Quality Monitoring Schedule. This schedule, along with recent testing results and Consumer Confidence Reports, is included in **Appendix N – Water Quality Testing**,

Since 2007, coliform monitoring regulations were met as samples did not test positive in more than 5 percent of the routine samples taken each month. All follow-up repeat samples were negative. The positive samples were likely due to error. Based on the City's current listed population of 2,251, a minimum of 2 coliform samples per month from different locations throughout the system are required to be collected. In the event that a sample tests positive for coliform, a repeat sample shall be taken at the same location as the suspect sample, and two additional samples shall be taken within five service connections upstream and downstream of the suspect sample. A description of coliform monitoring protocols, sample locations, and *E. coli* response and notification procedures are contained in the City's Coliform Monitoring Program, which is included in **Appendix P – Coliform Monitoring Plan**.

Disinfectant Residual Concentration Monitoring

Disinfection requirements applicable to the City are contained in WAC 246-290-310, which states that a disinfectant residual concentration of 0.2 mg/L shall be detectable in all active parts of the distribution system, and that the maximum residual disinfectant level shall be 4.0 mg/L for chlorine and chloramines. Handheld chlorine residuals must be recorded each time a coliform sample is collected; therefore, the City collects a minimum of 2 samples each month in addition to its online chlorine analyzers. At least 95 percent of the monthly samples must have detectable levels. In addition, disinfectant residuals within the distribution system shall be reported for every calendar day and cannot be undetectable.

Disinfectants/Disinfection Byproducts Monitoring

THM and HAA5 are DBPs that are formed when free chlorine reacts with organic substances (i.e., precursors), most of which occur naturally. Formation of THM and HAA5 are dependent on such factors as amount and type of chlorine used, water temperature, concentration of precursors, pH, and chlorine contact time. THM have been found to cause cancer in laboratory animals and are suspected to be human carcinogens. In response to the Stage 1 and Stage 2 D/DBPR, the City expanded its distribution system monitoring to include THM and HAA5. The City is required to collect four THM and four HAA5 samples on an annual basis. All recent samples show concentrations below both substances MCLs. Therefore, the City is in compliance with this regulation. The City's Disinfection Byproduct Monitoring Plan is included in **Appendix Q – Disinfection Byproducts Monitoring Plan**.

Lead and Copper Monitoring

Specific requirements are contained in Title 40, Parts 141.86, 141.87, and 141.88 of the Code of Federal Regulations (CFR). Every 3 years, the City must collect and report a minimum of 10 samples. All previous samples indicate the City is in compliance with these regulations.

Sample sites shall be selected based on the known existence of lead pipes, copper pipes, and copper pipes with lead solder (40 CFR 141.86(a)). All samples, except for lead service line samples, shall be first draw tap samples taken at a cold water tap from which water has not been drawn for at least 6 hours, but no more than 12 hours. Sample faucets shall be flushed with cold water the evening prior to collecting the sample. Lead service line samples shall be collected with one of three methods in accordance with 40 CFR 141.86(b). The locations of future sample sites shall be the same as past sample sites, unless unavoidable conditions prevent sampling at the same locations. The City has a bilateral compliance agreement with DOH which is contained in **Appendix R – Lead and Copper Bilateral Compliance Agreement**.

Cross-Connection Control Program

The City has developed a Cross Connection Control policy in order to prevent contamination of the City's water supply. A copy of the City's Cross Connection Control Program has been included in **Appendix S – Cross Connection Control Program.**

Fluoride Concentration

Specific requirements are contained in WAC 246-290-460 for systems that are fluoridating drinking water. Wholesale water purchased from other entities may be treated with fluoride, and it is the responsibility of those distributing entities to monitor the concentrations.

Asbestos

Asbestos monitoring is required if the sources are vulnerable to asbestos contamination or if the distribution system contains more than 10 percent of asbestos cement (AC) pipe. The City has a 9-year waiver with DOH for asbestos monitoring that expired in December 2019. The last time an asbestos sample was taken was in June 2013. This sample yielded a concentration of 0.123 million fibers per liter, whereas the current MCL for asbestos is 7 million fibers per liter and greater than 10 microns in length. When the City acquires its next asbestos waiver, the required sample must be taken during the first 3-year compliance period of the 9-year compliance cycle. The water sample must be taken at a tap that is served by an asbestos cement pipe under conditions where asbestos contamination is most likely to occur.

7 | WATER SYSTEM ANALYSIS

Chlorination System

INTRODUCTION

This chapter presents the analysis of the City of Black Diamond's (City) existing water system. Individual water system components were analyzed to determine their ability to meet policies and design criteria under existing and future water demand conditions. The policies and design criteria are presented in **Chapter 5 – Policies and Design Criteria**, and the water demands are presented in **Chapter 4 – Water Demands**. A description of the water system facilities and current operation is presented in **Chapter 2 – Water System Description**. The last section of this chapter presents the existing and projected system capacity analyses that were performed to determine the maximum number of equivalent residential units (ERUs) that can be served by the City's water system. These analyses are based on regulatory requirements for water system design and for maintaining an acceptable level of service. The City's primary goal is to have all its facilities in compliance with federal and state requirements; the secondary goal is to have all its facilities provide the ideal level of service as defined by the City's policies and design criteria.

DISTRIBUTION SYSTEM HYDRAULIC CAPACITY ANALYSIS

The City's transmission and distribution system consists of approximately 181,163 linear feet of pipe providing water to three pressure zones within the City. Specifics regarding pipe sizes and materials, as well as the pressure zones, have been documented previously in **Chapter 2 – Water System Description**. Portions of the system are generally considered in need of replacement as over 11 percent of the pipes are constructed of asbestos cement materials and there are areas where water mains are undersized and unable to provide sufficient flow to meet minimum fire flow requirements. It is recommended that these pipes be removed and replaced with more appropriately sized ductile iron materials. These projects have been included in the recommended projects listed in **Chapter 9 – Improvement Program**.

HYDRAULIC MODEL AND CALIBRATION

Description

A computer-based hydraulic model of the existing water system was created using version 8i (SELECTseries 6) of the WaterGEMS® program developed by Bentley Systems. All facilities and water mains in the City's water system, including dead-end mains, were modeled. The water mains were entered from the City's water system mapping database, as-built records, and information obtained through discussions with City staff.

Demand Data

The hydraulic model of the existing system contains 2019 average day demand (ADD) data. System-wide demands were allocated in the model as part of the Water System Plan (WSP) preparation and were scaled to match the system's demands as necessary. The peaking factors calculated in **Chapter 4 – Water Demands,** were used to analyze the system under maximum day demands (MDD) and peak hour demand (PHD) conditions.

The hydraulic model of the proposed system contains 10-year and 20-year demand levels that are projected for the years 2029, and 2039, respectively. The City's future demand distribution was based on a large concentration of growth occurring within the proposed mater planned development (MPD). The future demand allocations in each pressure zone are presented later is this chapter.

Facilities

The hydraulic model of the existing system for the pressure analysis contains active, existing system facilities. For the proposed system analyses in the years 2029 and 2039, the hydraulic model contained active, existing system facilities and proposed system improvements identified in **Chapter 9 – Water System Improvements**, and based on a general sense of what the MPD are proposing for their developments.

The facility settings for the pressure analyses correspond to a PHD event in the water system. All sources of supply that are currently available to the system, or will be available in the future, were operating at their normal summertime pumping rates during a peak period. The reservoir levels were modeled to reflect full utilization of operational and equalization storage. All active

pressure reducing valves (PRVs) were modeled as being in service and at their normal setpoints. The operational conditions for the pressure analyses are summarized in **Table 7.1, Hydraulic Model Calibration Results (Low Flow)**.

Separate fire flow analyses were performed on the system to size distribution system improvements and calculate fire flow availability. The hydraulic model for the fire flow analyses contained settings that correspond to MDD events. All sources of supply that are currently available to the system during a peak period were operating at their normal pumping rates with the largest pump at each facility offline. Reservoir levels were modeled to reflect full utilization of operational, equalizing, and fire flow storage based on the maximum planning-level fire flow requirement. Each pressure zone was modeled with the largest pump off during the fire flow analyses, consistent with Washington Administrative Code (WAC) 246-293-660. **Table 7.1, Hydraulic Model Calibration Results (Low Flow),** summarizes the operational conditions for the fire flow analyses for the existing and future systems.

Table 7.1
Hydraulic Model Calibration Results (Low Flow)

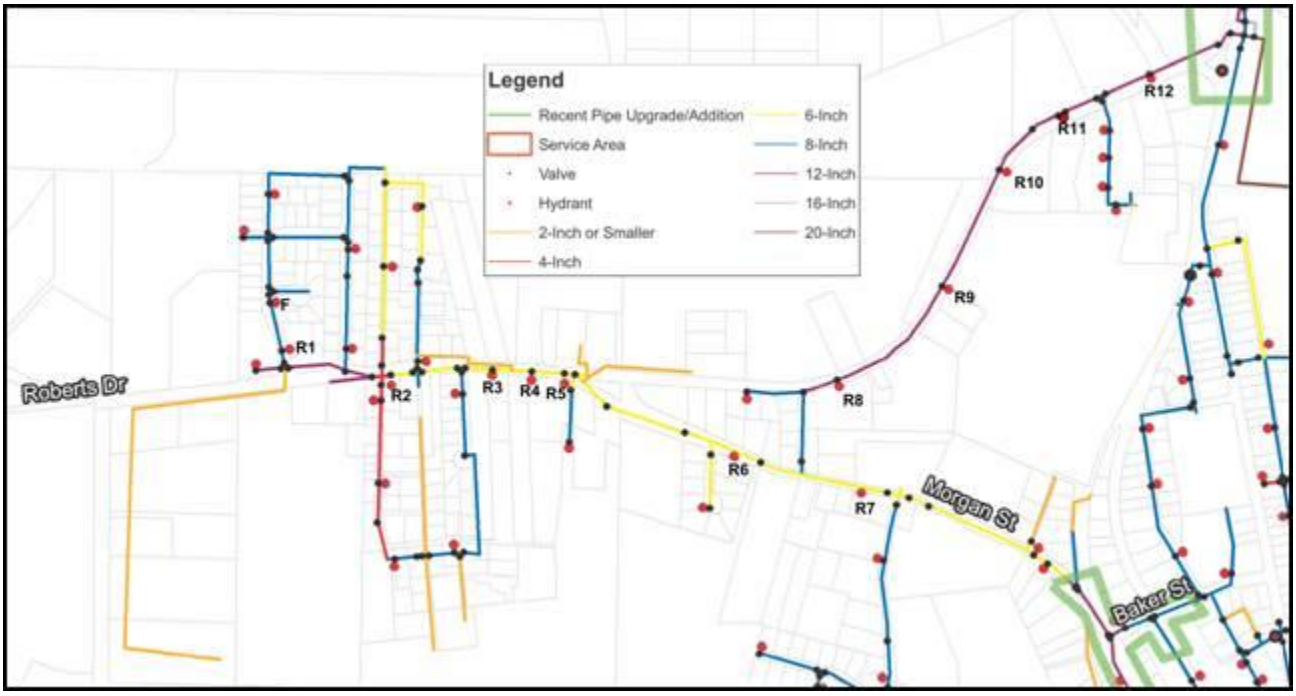
Hydrant Label	Junction Number	Static Pressure (psi)			Residual Pressure at 675 gpm (psi)					Residual Pressure at 855 gpm (psi)				
		Model	Field	Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference
F	J5324	87	---	---	46	---	---	---	---	25	---	---	---	---
R1	J5322	97	95	2	56	55	41	40	1	36	33	61	62	-1
R2	J5334	88	89	-1	50	50	38	39	-1	31	28	57	61	-4
R3	J5114	81	86	-5	47	52	34	34	0	31	32	50	54	-4
R4	J5342	85	86	-1	54	55	31	31	0	41	37	44	49	-5
R5	J5344	84	86	-2	56	59	28	27	1	44	43	40	43	-3
R6	J5120	81	82	-1	69	69	12	13	-1	65	62	16	20	-4
R7	J-28	82	83	-1	77	76	5	7	-2	76	74	6	9	-3
R8	J5224	77	78	-1	71	71	6	7	-1	71	68	6	10	-4
R9	J5346	75	76	-1	70	68	5	8	-3	70	66	5	10	-5
R10	J5348	75	80	-5	71	71	4	9	-5	70	70	5	10	-5
R11	J-27	75	78	-3	70	70	5	8	-3	70	69	5	9	-4
R12	J5188	72	75	-3	67	68	5	7	-2	67	66	5	9	-4

Hydrant Label	Junction Number	Static Pressure (psi)			Residual Pressure at 980 gpm (psi)					Residual Pressure at 1,000 gpm (psi)				
		Model	Field	Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference
F	J5324	87	---	---	9	---	---	---	---	6	---	---	---	---
R1	J5322	97	95	2	20	32	77	63	14	17	33	80	62	18
R2	J5334	88	89	-1	---	---	---	---	---	14	28	74	61	13
R3	J5114	81	86	-5	---	---	---	---	---	16	32	65	54	11
R4	J5342	85	86	-1	---	---	---	---	---	27	37	58	49	9
R5	J5344	84	86	-2	---	---	---	---	---	32	43	52	43	9
R6	J5120	81	82	-1	61	62	20	20	0	60	62	21	20	1
R7	J-28	82	83	-1	75	74	7	9	-2	75	74	7	9	-2
R8	J5224	77	78	-1	70	68	7	10	-3	70	68	7	10	-3
R9	J5346	75	76	-1	70	66	5	10	-5	---	---	---	---	---
R10	J5348	75	80	-5	70	70	5	10	-5	---	---	---	---	---
R11	J-27	75	78	-3	69	69	6	9	-3	---	---	---	---	---
R12	J5188	72	75	-3	67	66	5	9	-4	---	---	---	---	---

Model Calibration

Two field flow tests were performed in the western section of the 750 Pressure Zone on October 13, 2015. During each flow test, residual pressure data was recorded at eight other 750 Pressure Zone hydrants throughout the system using pressure data loggers set to record at 2-second intervals. Four residual pressure locations were duplicated for each flow test to ensure consistency between the tests, resulting in residual pressure data recorded at 12 locations, labeled 'R#' in **Figure 7.1, Hydrant Test Locations**. Each flow test included operating the flowing hydrant at two flow rates, one with a single 2½-inch hose port open, and one with two 2½-inch hose ports open.

Figure 7.1
Hydrant Test Locations



Residual pressure readings were recorded by the data loggers during the tests. These field-measured residual pressures were compared to the residual pressures calculated by the City's hydraulic model for each flow rate, the results of which are shown in **Table 7.1, Hydraulic Model Calibration Results (Low Flow)**. Water system demands were estimated to be equivalent to the 2019 ADD during all field flow tests and pressure measurements.

Based on the 2019 ADD, the field measurements and hydraulic model calculations only correlate well during the 675 gallons per minute (gpm) single-port flowing condition, as shown in **Table 7.1, Hydraulic Model Calibration Results (Low Flow)**, with pressure drop differentials less than 3 pounds per square inch (psi) between the field and model at 11 of the 12 residual pressure locations. The west portion of the City's 750 Pressure Zone has the best correlation during the 675 gpm single-port flowing condition.

During the 980 gpm and 1,000 gpm two-port flowing conditions, the field measurements and hydraulic model calculations do not correlate well throughout the 750 Pressure Zone. Sensitivity analyses were performed to locate partially or fully closed valves that should normally be open, analyze the impact of different PRV setpoints or whether PRVs opened correctly, and analyze the impact of different pipe roughness coefficients with consideration of published values. Some sensitivity analyses allowed some of the field measurements to match the model, but it was at the detriment to the accuracy of other tests.

Acknowledging that there is a discrepancy between the hydraulic model and the City's actual water system, two hydraulic model scenarios were prepared for use in identifying future water main improvements. One scenario is based on the west portion of the City's 750 Pressure Zone correlating well during the low flow (675 gpm single-port) flowing condition, as shown in **Table**

7.1, Hydraulic Model Calibration Results (Low Flow). The second scenario is based on the west portion of the City's 750 Zone correlating well during the high flow (1,000 gpm dual-port) flowing condition, the results of which are shown in **Table 7.2, Hydraulic Model Calibration Results (High Flow)**.

Additional hydraulic modeling information is contained in **Appendix T – Hydraulic Analysis**.

Table 7.2
Hydraulic Model Calibration Results (High Flow)

Hydrant Label	Junction Number	Static Pressure (psi)			Residual Pressure at 675 gpm (psi)					Residual Pressure at 855 gpm (psi)				
		Model	Field	Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference
F	J5324	87	---	---	52	---	---	---	---	25	---	---	---	---
R1	J5322	97	95	2	62	55	35	40	-5	36	33	61	62	-1
R2	J5334	88	89	-1	56	50	32	39	-7	31	28	57	61	-4
R3	J5114	81	86	-5	53	52	28	34	-6	31	32	50	54	-4
R4	J5342	85	86	-1	60	55	25	31	-6	41	37	44	49	-5
R5	J5344	84	86	-2	61	59	23	27	-4	44	43	40	43	-3
R6	J5120	81	82	-1	70	69	11	13	-2	65	62	16	20	-4
R7	J-28	82	83	-1	77	76	5	7	-2	76	74	6	9	-3
R8	J5224	77	78	-1	72	71	5	7	-2	71	68	6	10	-4
R9	J5346	75	76	-1	70	68	5	8	-3	70	66	5	10	-5
R10	J5348	75	80	-5	71	71	4	9	-5	70	70	5	10	-5
R11	J-27	75	78	-3	70	70	5	8	-3	70	69	5	9	-4
R12	J5188	72	75	-3	67	68	5	7	-2	67	66	5	9	-4
Hydrant Label	Junction Number	Static Pressure (psi)			Residual Pressure at 980 gpm (psi)					Residual Pressure at 1,000 gpm (psi)				
		Model	Field	Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference	Model	Field	Model Pressure Drop	Field Pressure Drop	Pressure Drop Difference
F	J5324	87	---	---	22	---	---	---	---	19	---	---	---	---
R1	J5322	97	95	2	33	32	64	63	1	30	33	67	62	5
R2	J5334	88	89	-1	---	---	---	---	---	27	28	61	61	0
R3	J5114	81	86	-5	---	---	---	---	---	28	32	53	54	-1
R4	J5342	85	86	-1	---	---	---	---	---	38	37	47	49	-2
R5	J5344	84	86	-2	---	---	---	---	---	41	43	43	43	0
R6	J5120	81	82	-1	64	62	17	20	-3	63	62	18	20	-2
R7	J-28	82	83	-1	75	74	7	9	-2	75	74	7	9	-2
R8	J5224	77	78	-1	71	68	6	10	-4	70	68	7	10	-3
R9	J5346	75	76	-1	70	66	5	10	-5	---	---	---	---	---
R10	J5348	75	80	-5	70	70	5	10	-5	---	---	---	---	---
R11	J-27	75	78	-3	69	69	6	9	-3	---	---	---	---	---
R12	J5188	72	75	-3	67	66	5	9	-4	---	---	---	---	---

PEAK HOUR DEMANDS

According to Washington State Department of Health (DOH) requirements, a water system must maintain a minimum pressure of 30 psi in the distribution system under peak hour demand conditions. In all modeling scenarios, all pressures throughout the distribution system exceeded the minimum system pressure of 30 psi. Additionally, DOH requires a maximum velocity of 8 feet per second (fps), not including fire flow. In all modeling scenarios, all pipe velocities throughout the distribution system are less than 8 fps.

FIRE FLOW ANALYSIS

A detailed fire flow analysis was completed for all hydrants within the City's water system. The analysis was conducted in conformance with DOH requirements that state a water system must provide adequate fire flow under maximum day demand conditions, while maintaining a

minimum system pressure of 20 psi. **Table 4.11, Fire Flow Requirements** provides the minimum fire flow requirements used by the City. They have been developed based on the land use classifications that are included in the City's *Comprehensive Plan*. These are the minimum fire flows to be considered in the design of system improvements. Actual fire flow requirements for proposed new structures will be as determined by the fire marshal.

DISTRIBUTION AND TRANSMISSION SYSTEM DEFICIENCIES

A summary of the primary system deficiencies is outlined as follows. **Chapter 9 – Water System Improvements** provides specifics on proposed improvement projects.

The existing transmission water mains from the Black Diamond Springs to the 0.5 million gallon (MG) Reservoir are deficient for the system due to pipe age and material, pipe size, and the location of pipelines on or adjacent to very steep slopes.

In its existing condition, the water system will be unable to serve the projected growth that the City is anticipating. However, only a few of the proposed improvement projects outlined in **Chapter 9 – Water System Improvements** are development-related projects that will be required based on the actual rate at which development occurs. Most improvements needed to serve the proposed developments will be funded by the MPDs. There are a few growth-related projects that are upsizing and improving to the existing water system to accommodate the future growth and are shown in **Chapter 9 – Water System Improvements** since they will be designed and constructed by the City even though they are funded by the MPDs.

There are existing deficiencies to the system, such as the inability to meet fire flow requirements. These deficiencies are eliminated through the upsizing of water mains or looping of the water system. Other deficiencies to the distribution system include water mains constructed of asbestos cement.

Selection and Justification of Proposed Improvements

Projects were selected for inclusion in the program based on the following criteria.

1. **Growth Related Projects (New Development) –** The City is anticipating significant development to occur within the next several years. The proposed Capital Improvement Program includes growth-related projects to serve these proposed new developments.
2. **Growth Related Projects (Existing System) –** These are proposed projects to upsize and improve portions of the existing system that will not be able to adequately serve the system with the anticipated growth.
3. **System Improvements –** These projects are included to address existing system deficiencies such as inabilities to meet minimum fire flow requirements. These projects include upsized lines and system looping improvements.
4. **Small Line Replacements –** Projects have been included to replace all water main that is 4 inches and smaller.

5. **Asbestos Cement Line Replacements –** Projects have been included to remove all asbestos cement lines and replace them with ductile iron materials.

SOURCE ANALYSIS

The City has two sources of supply for its municipal water system – the Black Diamond Spring Field and a wholesale water agreement with the City of Tacoma (Tacoma). Details regarding the capacity and allowable withdrawal rates have been included in **Chapter 2 –Water System Description**. Prior to the Tacoma Intertie, the springs were the only source of drinking water for the area since the early 1900s.

WATER SUPPLY EVALUATION

An evaluation of the City's existing water supply was performed to determine the sufficiency of the combined supply of the City's municipal water right and wholesale agreements with the Tacoma to meet both existing and future water demands. **Table 7.3, Existing Water Supply Evaluation** compares the combined maximum reliable water supply from the sources with the MDD of the system, and the combined maximum allowable annual water supply volume of the sources with the average day demand of the system. As shown in **Table 7.3, Existing Water Supply Evaluation**, the City has sufficient water rights and wholesale agreements to meet existing demand.

Table 7.3
Existing Water Supply Evaluation

Source	Peak Supply (Qi or Reliable Pumping Capacity)		Annual Volume (Qa)	
	(gpm)	(gpd)	(afy)	(MG/Year)
Black Diamond Springs	500	720,000	551.0	179.5
Tacoma Wholesale Intertie	3,456	4,977,000	2,478	807.4
Reliable Supply Available	**3,956**	**5,697,000**	**3,029**	**986.9**
Required Demand (2019)	569	819,900	367	120
Surplus or (Deficit)	3,387	4,877,100	2,662	867

Table 7.4, Future Water Supply Evaluation summarizes the results of the future water supply evaluation, which compares the combined supply of the City's municipal water right and wholesale agreements with the Tacoma with the system's future 20-year demand projections. The analyses considered future demand projections without water use reductions from the City's planned water use efficiency efforts. The only major increase in supply is from the upsizing of the pumps at the North Bank Pump Station, which will increase the reliable flow from the Springs from 500 gpm to 900 gpm when both pumps are running. The results of the future water supply evaluation indicate the City has sufficient water supply to meet the demands through the year 2039.

Table 7.4
Future Water Supply Evaluation

Source	Peak Supply (Qi or Reliable Pumping Capacity)		Annual Volume (Qa)	
	(gpm)	(gpd)	(afy)	(MG/Year)
Black Diamond Springs	900	1,296,000	551.0	179.5
Tacoma Wholesale Intertie	3,456	4,977,000	2,478	807.4
Reliable Supply Available	**4,356**	**6,273,000**	**3,029**	**986.9**
Required Demand (2039)	2,488	3,582,900	1,605	523
Surplus or (Deficit)	1,868	2,690,100	1,424	464

SUPPLY VULNERABILITY

Source Vulnerability

An engineering analysis was completed in 2003 of the Black Diamond Spring Field and the findings were documented in the *City of Black Diamond Springs – Vulnerability and Feasibility Study*. This study has been included in **Appendix U – Springs Vulnerability and Feasibility Study**. An additional study, *City of Black Diamond Spring Source Feasibility Analysis*, was completed in 2004 and presented a preliminary analysis of design alternatives for development of the springs. Most recently, a preliminary alternative analysis report was prepared in 2014 and is included in the appendix. This report was prepared by RH2 Engineering, Inc., to develop planning-level costs based on conceptual improvements required to improve reliability, better utilize the existing water rights, improve efficiency, reduce operating costs, and improve source quality protection of the City's existing water supply. The study shows that it may be more cost effective and more reliable to develop a new source on the north side of the Green River than to refurbish the existing facilities on the south side of the river and to provide adequate ground water under the influence of surface water (GWI) protections for the spring sources.

The intertie to the City of Tacoma was completed in 2006 and is expected to remain in service for at least the 20-year planning period covered by this WSP. At this time, the City has only used a minimal amount of water from this source – mostly only to flush the line to ensure the water remains fresh in case it is needed. This intertie was completed to plan ahead for the substantial population growth that the City is anticipating.

The City has sufficient capacity from the Spring Field and the Tacoma Intertie to accommodate current water demands, as well as projected water demands for the 6-year, 10-year, and 20-year periods. The existing transmission mains have sections that are undersized and constructed of asbestos cement (AC), so these sections will need to be upgraded.

Detailed information regarding the City's water rights has been presented in **Chapter 2 – Water System Description.** In addition, **Chapter 4 – Water Demands** includes calculations of projected water needs over the planning period. The City has sufficient water rights and reliable water

supply to service the projected growth that the City is anticipated to experience over the next 20 years.

Collection Vulnerability

Potential problems with the source collection areas are primarily associated with the risks of damage due to erosion/landslides and contamination or damage to the springs by human and/or animal vandalism. In particular, Spring No. 1 has been experiencing erosion to the bank downstream of the spring. Additionally, Spring No. 3 has experienced surface water runoff crossing over the top and center of the collection area and needs to be reconstructed to ensure the spring water is not contaminated. Spring 2 was taken offline because of GWI influence.

Transmission Vulnerability

On the south bank of the Green River, the spring transmission mains are old and undersized and are considered vulnerable to erosion, landslides, or flooding due to age and location on a very steep slope. The spring transmission main is exposed and cabled in some locations, which increases the chances of localized landslides. Additionally, tree uprooting, leaking, or natural ground erosion are concerns with this transmission main.

The transmission mains are attached to a footbridge, suspension bridge crossing the Green River. Bulkhead portions of the bridge are vulnerable to wash-out due to possible flooding of the river.

The Black Diamond Spring Field is located almost two miles southeast of the City's distribution system. Water is supplied via an existing 8-inch-diameter AC and 12-inch ductile iron (DI) transmission main to the 4.3 MG Reservoir. These lines are recommended to be upsized to accommodate future growth, and to be constructed of ductile iron materials.

TREATMENT CAPACITY ANALYSIS

CORROSION CONTROL

A 25-percent sodium hydroxide solution (caustic soda) is used to provide corrosion treatment for the City's water supply at the 4.3 MG Reservoir site.

DISINFECTION

Chlorination treatment for the City's water supply is provided at the North Bank Pump Station. The City produces sodium hypochlorite through the use of a 12 pound per day sodium hypochlorite generation system. This system was installed in 2016 and can be upgraded to a 24 pound per day system in the future.

STORAGE CAPACITY ANALYSIS

The City currently has two reservoirs for storage within the system. Details regarding these reservoirs have been provided in **Chapter 2 – Water System Description**. The 0.5 MG Reservoir was constructed in 1986 and is built of steel. The 4.3 MG Reservoir, also constructed of steel, was built in 2006. The 4.3 MG Reservoir is in good shape and considered to have sufficient

remaining life over the 20-year planning period of this WSP. The 0.5 MG Reservoir needs to be recoated. The City will evaluate whether to recoat this tank or rebuild it at a better hydraulic grade line location based on future growth in the area.

Water from the springs and intertie is currently directed to the 4.3 MG Reservoir. This reservoir then supplies the 0.5 MG Reservoir as needed. The 0.5 MG Reservoir provides distribution to the 965 Pressure Zone. The 4.3 MG Reservoir provides distribution to the 850 and 750 Pressure Zones.

It is anticipated that potentially two additional reservoirs will be required during the 20-year planning period. The need for this additional storage capacity will be to serve projected growth, help maintain constant flows from the interties, and create open, as opposed to closed, pressure zones in proposed higher pressure zones in the City. Preliminary sizing of the future reservoirs has been provided by developers. It is anticipated that an additional 3.0 MG Reservoir and pump station will be constructed to serve the proposed Lawson Hills Development to provide water at a sufficient pressure in the higher elevations of the eastern portion of the service area. It is anticipated that this proposed reservoir will serve a future 1175 Pressure Zone. Additionally, a 1.3 MG Reservoir may be constructed as an elective to create an open zone in the southern portion of the water service area to serve the higher elevations of the Ten Trails at Black Diamond planned development. This reservoir will serve the 850 Pressure Zone and is not required to meet storage requirements or fire flow.

ANALYSIS CRITERIA

The existing and proposed storage facilities have been analyzed to ensure that there is sufficient capacity to meeting the existing and future storage requirements of the system. Storage needs have been analyzed based on the projected distribution of ERUs throughout the system. **Table 7.5, ERU Distribution by Pressure Zone** includes the assumed distribution of ERUs throughout the pressure zones as included in the computerized hydraulic model of the City's water system.

Table 7.5
ERU Distribution by Pressure Zone

Pressure Zone	2019	2029	2039
	Existing	10-Year	20-Year
	(ERU)	(ERU)	(ERU)
750 Pressure Zones (4.3 MG Reservoir)	400	4,233	4,276
850 Pressure Zones (4.3 MG Reservoir)	1,312	2,184	2,226
965 Pressure Zone (0.5 MG Tank)	110	489	515
1175 Pressure Zone (future 3.0 MG Reservoir)	0	898	945
Total	**1,822**	**7,804**	**7,962**

Basic physical data for both existing and proposed storage reservoirs has been included in **Table 7.6, Storage Facility Data**.

Table 7.6
Storage Facility Data

Reservoir Data	0.5 MG (Existing)	4.3 MG (Existing)	3.0 MG (Future)
Main Pressure Zone(s) Served	965 PZ	750 & 850 PZ	1175 PZ
Base Elevation (Feet)	930	780	1080 (assumed)
Diameter (Feet)	50	102	73 (assumed)
Height (Feet)	35	71	95 (assumed)
Overflow Elevation (Feet) or HGL	965	851	1,175
Volume per Height (gallon per vertical foot)	14,680	61,090	31,291
Total Volume (MG)	0.51	4.34	2.97
Highest Service Elevation (MSL)	860	760	1,080
Bottom of Standby Storage[1] (MSL)	906	806	1,126
Total Usable Volume (MG)	**0.51**	**2.74**	**1.53**
Percent Usable to Total Volume	100%	63%	51%
[1]Calculated as the water surface elevation at which highest service elevation can be served with 20 psi.			

Storage capacity has been analyzed for the following components: 1) operational storage; 2) equalizing storage; 3) standby storage; 4) fire suppression storage; and 5) dead storage.

Operational Storage

Operational storage is the volume of the reservoirs used to supply the water system under normal conditions when the springs and/or intertie are not delivering water to the system. This volume is associated with the elevation difference required for the pump level sensors which is an operational distance of 3 feet for each of the reservoirs.

Equalizing Storage

Equalizing storage is the volume of water used to supply the system at a minimum pressure of 30 psi at all service connections under peak demand conditions and when the system demand exceeds the total rate of supply by the springs and/or intertie. The formula used for reservoirs with electronic level controls is:

ES = (PHD – Qs) * (150 min), but in no case less than zero

where, ES = Equalizing storage (gallons)

PHD = Peak Hourly Demand (gpm)

Qs = Sum of all active source of supply capacities, except emergency sources of supply (gpm).

Standby Storage

Standby storage is the volume of water used to supply the water system under emergency conditions when supply facilities are out of service due to equipment failures, loss of supply,

transmission main breaks, power outages, and any other situation that disrupts the supply source. Per DOH requirements, standby storage should never be less than 200 gallons per ERU.

For this WSP storage analysis, standby storage requirements were calculated with the 200 gallons per ERU equation.

Fire Suppression Storage

Fire suppression storage is the volume of storage used to supply water to the system at the maximum rate and duration required to extinguish a building with the highest fire flow requirement. Maximum fire flow requirements served by each of the reservoirs are outlined in **Table 7.7, Maximum Fire Flows by Reservoir**.

FSS = (FF) x (t)

Where, FSS = Fire Suppression Storage

FF = Required Fire Flow rate (gpm)

t = Duration of time when Fire Flow rate is required (minutes).

Table 7.7
Maximum Fire Flows by Reservoir

Reservoir	Maximum Fire Flow Rate (gpm)	Duration (minutes)
0.5 MG (existing)	2,500	120
4.3 MG (existing)	3,500	120
1.3 MG (future)	3,500	120
3.0 MG (future)	3,500	120

Dead Storage

Dead storage is the volume of water in the reservoir that cannot be used because it is stored at an elevation that does not provide system pressures that meet the minimum pressure requirements established by DOH without pumping. The City does not have any dead storage for the storage facilities due to their elevations within the water system.

STORAGE REQUIREMENTS

An analysis of the required storage components indicates that there is sufficient storage capacity within the system for existing conditions as summarized in **Table 7.8, Existing Storage Evaluation**. Future storage evaluations looked on the reliable supply and storage available to each pressure zone. The results for the 10-year planning period of 2029 are summarized in **Table 7.9, Future Storage Evaluation (2029)**; and for the 20-year planning period of 2039 are summarized in **Table 7.10 Future Storage Evaluation (2039)**.

Table 7.8
Existing Storage Evaluation

Storage Component	Total System[1] (gallons)	965 Pressure Zone (Served by 0.5 MG Reservoir) (gallons)	750 & 850 Pressure Zones (Served by 4.3 MG Reservoir) (gallons)
Operational Storage	227,300	44,000	183,300
Equalizing Storage	74,900	4,500	70,400
Standby Storage	364,400	22,000	342,400
Fire Suppression Storage	420,000	300,000	420,000
Total Storage Required	**1,086,600**	**370,500**	**1,016,100**
Total Storage Available	3,250,700	513,800	2,736,900
Surplus or (Deficit)	2,164,100	143,300	1,720,800

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones since fire flow suppression is not cumulative per pressure zone.

Table 7.9
Future Storage Evaluation (2029)

Storage Component	Total System[1] (gallons)	750 & 850 Pressure Zones (Served by 4.3 MG Reservoir) (gallons)	965 Pressure Zone (Served by 0.5 MG Reservoir) (gallons)	1175 Pressure Zone (Served by 3.0 MG Reservoir) (gallons)
Operational Storage	321,200	183,300	44,000	93,900
Equalizing Storage	0	0	0	0
Standby Storage	1,560,800	1,283,400	97,850	179,550
Fire Suppression Storage	420,000	420,000	300,000	420,000
Total Storage Required	**1,980,800**	**1,886,700**	**441,850**	**693,450**
Total Storage Available	4,777,700	2,736,900	513,800	1,527,000
Surplus or (Deficit)	2,796,900	850,200	71,950	833,550

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones.

Table 7.10
Future Storage Evaluation (2039)

Storage Component	Total System[1] (gallons)	750 & 850 Pressure Zones (Served by 4.3 MG Reservoir) (gallons)	965 Pressure Zone (Served by 0.5 MG Reservoir) (gallons)	1175 Pressure Zone (Served by 3.0 MG Reservoir) (gallons)
Operational Storage	384,600	246,700	44,000	93,900
Equalizing Storage	0	0	0	0
Standby Storage	1,592,400	1,300,400	103,000	189,000
Fire Suppression Storage	420,000	420,000	300,000	420,000
Total Storage Required	**2,012,400**	**1,967,100**	**447,000**	**702,900**
Total Storage Available	4,777,700	2,736,900	513,800	1,527,000
Surplus or (Deficit)	2,765,300	769,800	66,800	824,100

[1]Total system represents the system as a whole and is not equal to the sum of the volumes required by individual pressure zones.

OVERALL SYSTEM CAPACITY ANALYSIS

This section summarizes the various components of the water system that could limit the capacity of the City to serve future customers (e.g., supply, storage, and water rights) to determine the maximum number of ERUs it can serve. System capacity is useful in determining how much capacity is available in the water system to support new customers that apply for water service through the building permit process. The system capacity information, together with the projected growth of the system expressed in ERUs, as shown in **Chapter 4 – *Water Demands***, also provides the City with a schedule of when additional system capacity is needed.

ANALYSIS CRITERIA

The capacity of the City's system was determined from the limiting capacity of the reliable supply, water rights, and storage. The supply capacity analysis was based on the limiting capacity of the supply facilities and the system's MDD per ERU. The annual water rights capacity evaluation was based on the existing annual water rights, as summarized in **Chapter 6 – Water Source and Quality**, and the system's ADD per ERU. The instantaneous water rights capacity evaluation was based on the existing instantaneous water rights, as summarized in **Chapter 6 – Water Source and Quality**, and the system's MDD per ERU. The storage capacity analysis was based on the total capacity of the storage facilities and the computed storage requirement per ERU. The storage requirement per ERU was determined from the existing storage requirements presented previously in this chapter and the existing number of ERUs presented in **Chapter 4 – Water Demands**.

SYSTEM CAPACITY

A summary of the results of the existing system capacity analysis is shown in **Table 7.11, Existing System Capacity**. The results of the 2019 system capacity analysis indicate that the system can support up to a maximum of approximately 11,223 ERUs. The limiting component is storage.

Table 7.11
Existing System Capacity

System Component	Capacity (ERU)
Reliable Supply	12,660
Instantaneous Water Right (Qi)	22,549
Annual Water Right (Qa)	15,022
Storage	11,223

A summary of the results of the future system capacity analysis, both without and with water use efficiency planning efforts, is shown in **Table 7.12, Future System Capacity**. The results of the system capacity analysis indicate that the system can support up to a maximum of approximately 10,551 ERUs. The limiting component is storage. This analysis assumes that the North Bank Pump Station pumps will be upsized and that the 3.0 MG Reservoir will be constructed within the next 10 years; therefore, the results are the same for both the 10-year and 20-year horizons.

Table 7.12
Future System Capacity

System Component	Capacity (ERU)	
	Without WUE	With WUE
Reliable Supply	13,940	14,674
Instantaneous Water Right (Qi)	22,549	23,736
Annual Water Right (Qa)	15,022	15,812
Storage	16,776	17,009

In the future, the City's limiting capacity is reliable supply (pumps and pipes). With a 5 percent reduction in water usage per customer, or 171 gallons per day per ERU, the City will have the capacity to serve up to 14,674 ERUs. This total number of ERUs does include ERUs consumed by non-metered and distribution system leakage usage.

8 | OPERATION AND MAINTENANCE

Emergency Power Generator

Water Meters

WATER SYSTEM MANAGEMENT AND PERSONNEL

The City of Black Diamond (City) operates with a Mayor-Council form of government with the Mayor acting as the chief administrative official and the City Council acting as the legislative function. The Mayor is assisted with the administrative oversight by a City Administrator who performs the day to day management of the organization. The Public Works Department operates the City's water system and is led by a Director who is assisted as needed by two maintenance staff.

The Public Works Director is charged with the day to day operational responsibilities of the water utility. Those responsibilities include preventive maintenance, field installation and repair judgments, water quality monitoring, and management of the City's cross-connection control program.

The Public Works Superintendent is the initiator of the department's budget proposals, which are reviewed, modified as needed, and approved through the City's administrative review and Council adoption process. The Superintendent would also be the person who would most often respond to complaints.

On issues requiring more formal notification or responses to the public or press, the Public Works Superintendent would serve as a technical advisor to the City administration in formulating the appropriate responses/notifications to the public/press.

Utility billing for the system is accomplished through the field meter reading managed by the Public Works Superintendent, and the administrative function of creating bills and collecting payments that is provided through the City Clerk's office.

OPERATOR CERTIFICATION

The City has a responsibility to comply with regulations established by the Washington State Department of Health (DOH) Washington Administrative Code (WAC) Chapter 246-292. This requires the City to employ the services of a Water Distribution Manager (WDM) who is in responsible charge of the daily operational activities of the system. This position is required to maintain their currency in the field by obtaining not less than three continuing education units (CEUs) within a specified three-year time frame. Common sources of that training include seminars put on by the American Water Works Association (AWWA) or Washington Education and Training Resources Center (WETRC).

The City meets these requirements through the Superintendent position currently held by Mr. Dan Dal Santo. Mr. Dal Santo is certified as a WDM-2/CCS and is supported by the City's training budget to meet his department's ongoing training and education requirements.

It is important that anyone who assists the Public Works Superintendent be trained as well. At a minimum, the water maintenance staff should be trained in confined space, trenching and shoring, cross-connection control, asbestos cement pipe safety, and traffic flagging.

SYSTEM OPERATION AND CONTROL

MAJOR SYSTEM COMPONENTS

The water system map, included in **Figure 2.3 – Existing Water System**, provides the location of the City's major water system components. Each major component is listed below with a description of their normal operation procedures.

Black Diamond Spring Field

The City currently collects water from a hydraulically interconnected field of springs known as the Black Diamond Spring Field. The springs have two points of collection currently in use. This currently serves as the City's primary source of water. Refer to the description provided in **Chapter 2 – Water System Description** for a more detailed discussion of this facility.

City of Tacoma Intertie

The City also has a secondary source of water supplied by agreement from the City of Tacoma (Tacoma) by an intertie connection with Tacoma's Second Supply Pipe Line (SSPL). This will become a primary source when the City's growth exceeds the ability of the City's spring field to meet demands. Currently, this source is accessed only to ensure reliability; it is turned off and can only be turned on for emergences by calling Tacoma.

Storage Reservoirs

The City currently operates with two storage reservoirs. The first reservoir provides 0.5 million gallons (MG) of storage and provides service to the 965 Pressure Zone. The City's supervisory control and data acquisition (SCADA) system controls the pumping system and records the volume of water pumped to this reservoir. The second reservoir provides 4.3 MG of storage and provides direct service to the 850 Pressure Zone and via pressure reducing valves (PRVs) to the lower 750 Pressure Zone. It also serves as the source of supply to the 0.5 MG Reservoir via the pumps located at the 4.3 MG Reservoir site.

Pumping Facilities

The City has two active pumping facilities for moving water from its sources of supply to its reservoirs.

The first is the pumping facility located on the north bank of the Green River. It is fed by gravity from the springs, treated with chlorine, and then pumped to the 4.3 MG Reservoir in the 850 Pressure Zone. This pumping facility is equipped with emergency power generation capability.

The second pumping facility is located at the 4.3 MG Reservoir site. It is used to pump water from the 4.3 MG Reservoir to the 0.5 MG Reservoir in the 965 Pressure Zone. This pumping facility is equipped with emergency power generation capabilities.

Water Treatment Systems

The City currently has two water treatment facilities. The first is a chlorination system located at the North Bank Pump Station used for disinfection. The City produces sodium hypochlorite through the use of a 12-pound brine generating system. The second treatment facility is a corrosion treatment system located at the 4.3 MG Reservoir site. Corrosion treatment is provided through the use of a 25-percent sodium hydroxide solution (caustic soda).

Valves

The City currently operates with three pressure zones. These pressure zones are defined through the utilization of four PRVs throughout the system and the use of closed valves.

Additionally, there are numerous valves throughout the system to isolate segments of water main in the event of repairs, emergencies, and construction projects. There are also numerous hydrant valves throughout the system to control flow to fire hydrants.

ROUTINE SYSTEM OPERATION AND MAINTENANCE

Routine maintenance activities help to preserve the value of the water system and to ensure that the utility can continue to operate in an efficient manner. In a water system, maintenance is essential to ensure that the system can fulfill the safety and health requirements of the customers.

The City conforms to all recommended maintenance tasks as published by equipment suppliers as a minimum standard for maintenance activities. Regular operational tasks for City staff are

outlined in **Table 8.1, Routine Operations and Preventative Maintenance**. Sample forms to be used in documenting and recording maintenance activities have been provided in **Appendix V – Operations and Maintenance Forms**.

Table 8.1
Routine Operations and Preventative Maintenance

Facility	Activity	Frequency
Black Diamond Spring Field	Clean screens. Inspect for leaks and proper operation. Inspect for animal intrusion.	2-3 times per week
	Maintaining Access Roads	As Needed
	Clearing Brush from area of springs maintain perimeter fence	As Needed
City of Tacoma Intertie	Inspect for proper operation to ensure intertie is readily available as needed	Monthly
	Flushing Line	Semi-Annually
Reservoirs	Inspect exterior components of the reservoirs. Inspect for vandalism. Record levels.	Daily
	Inspect screens, vents, and hatch seals. Repair or replace screens and seals as needed	Monthly
	Operate reservoir drain and run reservoir to overflow. Inspect tank interior. Clean and/or repaint interior and exterior as needed.	Annually
Pumping Facilities	Inspect pump stations	Bi-weekly
	Inspect condition of pump motors and lubricate as necessary. Replace pump oil. Inspect pump station buildings and piping. Repaint and repair as needed.	Annually
Pressure Reducing Valves (PRV's)	Inspect for proper operation	Quarterly, or additionally as system pressures require
Distribution System Valves	Inspect valves for proper operation	Semi-Annually
Fire Hydrants	Inspect hydrants, exercise valves, and conduct flow testing	Annually (by Public Works)
Blowoff Assemblies	Flush lines to remove stagnant water and debris	Bi-Annually
Meters	Test and calibrate source meters	Every five years
	Replace worn or defective meters	As needed
Telemetry & Control Systems	Backup program and data	Daily
	Visually inspect cabinets and panels for damage, dust and debris. Test alarm indicator units. Clean and flush all pressure sensitive devices.	Semi-Annually

EQUIPMENT, SUPPLIES, AND CHEMICAL LISTING

The City utilizes the equipment included in **Table 8.2, Operation and Maintenance Equipment** to perform routine operation and maintenance of the water system.

Table 8.2
Operation and Maintenance Equipment

Equipment
2005 Dodge 4x4 Quad Cab Pickup Truck
2016 Dodge 3500 Pickup
2014 Chevy CK2500 Pickup Truck
2006 4500 Chevy Flat Bed Truck
2019 Dodge 4x4 Quad Cab
John Deere 50 Mini Traxhoe
Louisville 5-yard Dump Truck
2012 Vactor Trailer
1998 John Deere Backhoe
1974 John Deere Grader
Miscellaneous Tools, Etc.

Additionally, **Table 8.3, Chemical Supplies** lists chemicals that are maintained on hand in order to operate the system.

Table 8.3
Chemical Supplies

Chemical	Amount (gallons)
0.8% Sodium Hypochlorite	44
25% Sodium Hydroxide	1,200

COMPREHENSIVE MONITORING PLAN

The City conducts regular water quality testing to ensure that a safe product is being distributed to its customers in conformance with DOH regulations. A copy of the City's Coliform Monitoring Plan has been included in **Appendix P – Coliform Monitoring Plan**. Additionally, copies of recent water quality test results have been included in **Appendix N – Water Quality Testing**. Further details regarding water quality monitoring requirements have been included in **Chapter 6 – Water Source and Quality**.

EMERGENCY RESPONSE PROGRAM

Utility emergency planning can be defined as the activities that prepare a utility to respond to an emergency situation. Emergencies can be small or large with respect to their effects on utility operations and service.

Many utilities cope with smaller scale or routine emergency situations frequently, perhaps weekly or daily. Larger scale or "disaster emergency" situations occur far less frequently, but many aspects or effects of a disaster manifest themselves in the same way as the routine emergencies. In many respects, a disaster can be thought of as the simultaneous occurrence of many smaller scale emergencies. If a utility is well prepared to handle the routine emergencies, then they will be better prepared to handle the more serious ones as well.

PRIORITY SERVICES LIST

In certain instances, particularly during an emergency, it is not possible to provide advanced notice of a water shut down. However, there are certain water customers that must be notified in the event of a disruption of service. Critical among these in the City are kidney dialysis patients. A current list of customers with dialysis machines requiring an uninterrupted supply of water must be maintained. The list must be updated regularly by the City. Customers on the priority list are notified prior to emergency shut down of water service.

AFTER HOURS EMERGENCY CALLOUT

System operators are notified at home of an emergency condition after hours by either City staff directly or a call to the Public Works Utility Emergency cell phone. The situation is assessed by the operations staff person responding to the emergency, and the repairs are completed. As was previously indicated, there are sufficient materials available onsite to make the necessary repairs. An emergency call list has been provided in **Table 8.4, Emergency Call List**.

Table 8.4
Emergency Call List

Contact	Phone Numbers
Emergency Service	911
Public Works – Utility Emergency Phone	(253) 569-0525
City Hall	(360) 851-4500
Power: Puget Sound Energy and Gas	
Business & Power Outages	(800) 321-4123
Chemical Supplies	
All Pure Chemical	(360) 673-5215
Van Waters and Rogers	(800) 562-4860
Pipe and Fitting Suppliers	
H.D. Fowler	(800) 927-5699
H.D. Supply	(206) 722-4800
Testing Lab (Coliform)	
Department of Health	(206) 361-2800
Water Management Lab	(253) 531-3121
Telephone: CenturyLink Communications	
Business	(800) 603-6000
Repair	(800) 954-1211

In the event of a major disaster:

a. All staff should report to City Hall upon learning of the disaster.

b. During the ensuing survey of the system's facilities for damage, use of the radio should be kept to a minimum and limited to the transmitting of important information.

c. Upon a request to clear the air, all operators should standby for emergency instructions.

d. All contact with the media should be through the Mayor only. This is critical as it will minimize the amount of misinformation that typically accompanies such events.

e. It is important to stick to the task at hand until the damage to the system has been evaluated and City staff have declared that the water system emergency status has been terminated. The damage to the water system must be evaluated to prevent, where possible, loss of life, bodily injury, property damage, and contamination as a result of the damage to water system facilities. All City and King County forces will be overburdened at such times, but it is not the role of the City personnel to assist Police, Fire, or other personnel unless directed to do so or until released from the emergency work associated with the water system facilities.

EMERGENCY RESPONSE PLAN

Emergency responses for the springs, reservoirs, and distribution system have been identified for the following emergencies: power failure; severe earthquake; severe snowstorm; and contamination of water supply or spring field washout.

Power Failure

Various types of weather can cause loss of power (i.e., wind, lightning, freezing rain, and freezing snowstorm). Power is provided by Puget Sound Energy, and City staff report approximately one power outage per year. **Table 8.5, Power Failure Emergency Response**, summarizes action recommendations for a power failure event.

Table 8.5
Power Failure Emergency Response

System Component	Action
Pumps: Electric pump will shut off and system will automatically switch to backup power	Verify backup power is working.
Reservoirs: Water level may fall if system demand exceeds supply	Check reservoir level and notify customers to curtail water use if reservoir level continues to drop – increase pumping.
Distribution System: Pressure will drop if reservoir level drops	Continuously monitor reservoir level, implement water restrictions if needed.

Severe Earthquake

Although severe earthquakes are rare, the City may be vulnerable if facilities are damaged. The City should obtain the ability to procure trucked-in water. **Table 8.6, Severe Earthquake Emergency Response**, summarizes action recommendations for a severe earthquake event.

Table 8.6
Severe Earthquake Emergency Response

System Component	Action
Springs: Structural damage may have occurred and/or mechanical damage to pumps or piping may have occurred	Check pumps and mechanical piping.
Reservoirs: Reservoir may be leaking or structurally damaged	Check reservoir for structural damage and drain if necessary.
	Check reservoir for cracks and leaks and seal or drain as required.
	Bypass reservoir and run system from pumps only.
Distribution System: Distribution and transmission mains may be broken	Isolate broken sections and repair.

Severe Snowstorm

Heavy snowfall will bring motor vehicle traffic to a standstill. Employees will not be able to reach the problem area. Power outages may occur. Water supply should not be interrupted. **Table 8.7, Severe Snowstorm Emergency Response**, summarizes action recommendations for a severe snowstorm event.

Table 8.7
Severe Snowstorm Emergency Response

System Component	Action
Pumps and Springs	No immediate effect – snow may prevent access. Clear snow from access roads.
Reservoirs	No immediate effect – snow may prevent access. Clear snow from access roads.
Distribution System	Crew transportation to monitor system and to make repairs will be limited. City crews will plow important streets – contact State Highway Department to expedite plowing to any problem area under their jurisdiction. Have chains or other snow gear in readiness for maintenance equipment. Valve location maps should be made available for maintenance personnel and should be kept current. Clear snow from fire hydrants.

Contamination of Water Supply

Contamination of the water supply might occur due to main breaks or pollution from an isolated source. Redundant source capacity and the ability to isolate the reservoirs help to reduce the City's vulnerability. **Table 8.8, Contamination of Water Supply Emergency Response**, summarizes action recommendations for a contamination of the water supply event.

Table 8.8
Contamination of Water Supply Emergency Response

System Component	Action
Springs: Isolate source of contamination	Close valves as required and isolate source of contamination.
	Repair and/or otherwise remove source of pollution.
	Flush previously contaminated section and test until free of contamination prior to resumption of use.
Reservoirs: Chlorinate	Isolate contaminated reservoir from system and decide method of disinfection.
	Inspect vent screens, hatches, and piping to try and identify the source of contamination.
	If reservoir water is considered unsuitable for consumption due to stagnation, etc., consider draining, cleaning, and disinfecting reservoir.
	If water surface needs skimming, consider overflow reservoir and then disinfect contents.
	Disinfect reservoir with chlorine as required by AWWA standards – take bacteriological samples and return reservoir to service when results are satisfactory.
Distribution System: Isolate source of contamination	Close valves as required to isolate source of contamination. Repair and/or otherwise remove source of pollution.
	Flush previously contaminated section and test until free of contamination prior to resumption of use.

SAFETY PROCEDURES

Safety is the highest concern and responsibility of all water operations and maintenance staff. First aid kits are available at all Public Works buildings and in each maintenance vehicle. **Table 8.9, Safety Procedures** identifies safety procedures to be followed for operations and maintenance tasks that are associated with the City's water system.

Table 8.9
Safety Procedures

Hazardous Condition	Safety Procedure
Use of Chlorine and Chlorine Products	Handle with care, provide adequate ventilation, and wear safety glasses and rubber gloves. Detailed handling procedures are found in the respective Material Safety Data Sheets (MSDS).
Use of Sodium Hydroxide	Handle with care, provide adequate ventilation, wear safety goggles, apron, and rubber gloves. Keep container tightly closed, store in a dry, corrosion-proof area. Never return contaminated material to its original container. Immediately contact the chemical supplier / manufacturer for handling instructions if drums of caustic appear to be swollen. Detailed handling procedures are found in the respective MSDS.
Working in Confined Spaces	Follow State requirements for confined space entry.
Working around Heavy Equipment	Obtain proper training and follow all safety procedures. Use noise protection equipment.
Working in Traffic Areas	Wear proper clothing and provide adequate signage and flagging for work area. Refer to the Manual of Uniform Traffic Control Devices (MUTCD) for current requirements.
Working on or Around Water Reservoirs	Follow proper safety harness procedures for working on tall structures.
Working in or around Pump Stations	Obtain proper training and follow all safety procedures for working on pumps and electrical equipment. Use noise protection equipment.
Working on Asbestos Cement (AC) Water Main	Obtain proper training and follow all safety procedures for working with asbestos materials.

CROSS-CONNECTION CONTROL PROGRAM

The City has developed a Cross-Connection Control policy to prevent contamination of the City's water supply. A copy of the City's Cross Connection Control Program has been included in **Appendix S – Cross Connection Control Program**.

CUSTOMER COMPLAINT RESPONSE PROGRAM

The City has received few written complaints, and periodically receives telephone calls from customers with questions or concerns. Any comments or concerns are recorded by the utility clerk and written on a work order form for the utility department to address on a daily basis. The calls are typically infrequent and involve low impact issues. There does not appear to be a trend or pattern to the calls that have been received to date.

RECORDKEEPING AND REPORTING

The City maintains thorough records for water system related data such as customer billing records, source meter readings, and water quality testing. All records are annually stored onto electronic media (i.e., discs or CDs) that are kept in the Public Works office at City Hall. All test results are kept and filed in the Public Works utility file cabinet at City Hall.

9 | WATER SYSTEM IMPROVEMENTS

Tee and Valve Cluster

Black Diamond Springs

INTRODUCTION

This chapter presents proposed improvements to the City of Black Diamond's (City) water system that are necessary to resolve existing system deficiencies. It also gives overview of major projects that may be necessary to accommodate the projected growth of water customers. Most of the distribution-related improvements necessary to serve the master planned developments (MPDs) are being planned and constructed by the MPDs, and details of those projects are not included in this chapter.

Water system improvements were identified from an evaluation of the results of the water system analyses presented in **Chapter 7 – Water System Analysis**. Where applicable, the water system improvements were sized to meet both the existing and future demand conditions of the system.

A Capital Improvement Program (CIP) number, herein referred to as a CIP number, has been assigned to each improvement. The locations of major water system improvements are shown in **Figure 9.1, Proposed Water System Improvements**. The improvements also are illustrated in the hydraulic profile of the future water system, which is shown in **Figure 9.2, Proposed**

Hydraulic Profile. The improvements are organized and presented in this chapter according to the following categories.

- Water Main Improvements
- Supply Improvements
- Storage Improvements
- Facility Improvements
- System-Wide Improvements

The remainder of this chapter presents a brief description of each group of improvements, the criteria for prioritizing improvements, the basis for the cost estimates, and the schedule for implementation.

IDENTIFYING AND PRIORITIZING IMPROVEMENTS

This chapter presents the proposed projects and schedule for the City's 10-year CIP in accordance with the requirements of Washington Administrative Code (WAC) 246-290-100.

The projects were selected to address existing deficiencies and expected growth within the water system customer base. In identifying projects, the plan looked at the supply system, storage requirements, and transmission and distribution needs. The projects were evaluated considering health standards, land use, supply requirements, system reliability, capital investment requirements, consistency with regional plans, and environmental impacts, among others.

Projects were selected for inclusion in the program based on the following criteria:

1. **Growth-Related Projects (New Development) –** The City is anticipating significant development to occur within the next several years. The proposed CIP includes growth-related projects to serve these proposed new developments.
2. **Growth-Related Projects (Existing System) –** These are proposed projects to upsize and improve portions of the existing system that will not be able to adequately serve the system with the anticipated growth.
3. **System Improvements –** These projects are included to address existing system deficiencies, such as inabilities to meet minimum fire flow requirements. These projects include upsized lines and system looping improvements.
4. **Small Line Replacements –** These projects have been included to replace all water mains that are 4 inches and smaller.
5. **Asbestos Cement Line Replacements –** These projects have been included to remove all asbestos cement water mains and replace them with ductile iron materials.

FUNDING SOURCES

Four major funding sources have been identified for funding the proposed improvement projects: 1) system development charges; 2) commodity rates; 3) grants; and 4) MPD funds.

System development charges have been identified as a funding source for projects that are to be funded outright by developments as extensions to the system, but do not include the MPDs, as they have a separate funding agreement. Commodity rates and grants have been identified as a funding source for projects that address existing system deficiencies.

Additional discussion regarding the funding of improvements is included in **Chapter 10 – Financial Analysis**.

PROPOSED IMPROVEMENTS

This section provides general descriptions of the 10-year capital improvement projects and an overview of the deficiencies they will resolve. Several of the improvements are necessary to resolve existing system deficiencies. However, several improvements have been identified to illustrate the major facilities that will be required as development occurs. Additional developer-funded projects include localized, on-site water main improvements that are not associated with overall water distribution but are necessary when the property served by the water main is redeveloped or expanded. The costs associated with these improvements shall be borne by the developers, rather than the existing water customers.

CIP No. W1 – Springs and Transmission Reconstruction

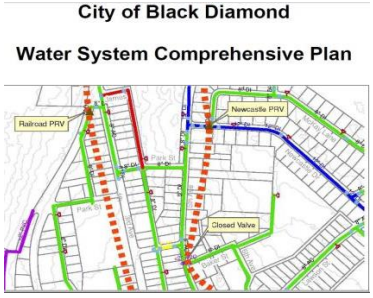
Description

This project will protect and rehabilitate the City's existing springs source, replace pipes, reconstruct the Green River crossing, and update facilities. This will include new pumps, replacing pipes on steep slopes, and replacing the transmission main from the pump station to the City's distribution system.

Background

In late 2013, the City contracted with RH2 Engineering, Inc., to study and compare two alternative concepts to improve and redevelop the springs to full water right capacity. The *Springs Alternative Analysis Study* recommended that the City pursue tapping an artesian spring on the north side of the river rather than reconstructing the spring collection system on the south side. After discussions with the Washington State Department of Health (DOH) and Department of Ecology, it was determined that it was infeasible for the City to transfer its water right to the north side of the Green River. Therefore, the City will improve the springs facilities at their current locations. This is a capacity and system reliability project funded by the Water Supply and Facilities Funding Agreement (WSFFA).

CIP No. W2 – Fire Flow Loop – North Commercial Area



Description

Replace 200 feet of 4-inch asbestos concrete (AC) pipe with 12-inch ductile iron water main across State Route (SR) 169 at the power substation; complete a 750-foot 12-inch ductile iron water main loop from Cedar Brook Mobile Home Park to the 6-inch AC water main behind Boots Tavern. Replace 1,200 feet of 8-inch AC water main on the west side of SR 169 from Ravensdale Road north to the existing 12-inch ductile iron water main. There will be 2,150 feet of new 12-inch water main in total.

Background

This is a capacity and system reliability project. Other commercial properties development along SR 169 also may be contributing or constructing portions of this project if required through the State Environmental Policy Act (SEPA) process. This project can be phased if funding is short. This project does not describe what may ultimately be needed to provide adequate fire flow and redundant service to the north triangle but does describe the minimum needed to provide a looped system for the north part of the City's existing system. This project should be done prior to installing the 12-inch water mains through the Roberts Drive and Ravensdale Road intersections and before the proposed roundabout projects are constructed.

CIP No. W3 – 4.3-Million Gallon Reservoir Maintenance and Repairs

Description

The 4.3 million gallon (MG) Reservoir will be 14 years old in 2020. The interior will need inspection. The exterior will need cleaning and potentially spot treatment where the coating is damaged.

Background

This project is a maintenance project and should extend the life of the coating by 10 years or more.

CIP No. W4 – Water System Plan Update

Description

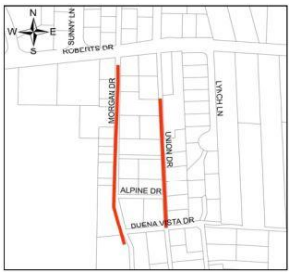
The DOH requires an update of the Water System Plan (WSP) every 6 to 10 years. The City received an extension of the previous WSP which moved the expiration date to February 15, 2020.

CIP No. W5 – Morganville South – AC Water Main Replacement

Description

Replace 4-inch AC and 2-inch cast iron water main on Morgan Drive from Roberts Drive to the south end of Morgan Drive, connecting to an existing 8-inch main on Buena Vista Drive, and on Union Street from Buena Vista Drive to approximately 230 feet south of Roberts Drive. A total of approximately 1,630 feet of water main will be replaced.

Background



This project will improve fire flows to the Morganville area and replace substandard pipe that is nearing its useful performance life. An income survey will be required to determine eligibility for additional Community Development Block Grant Funding. Further future study of the existing AC water mains may show that a different AC water main should be replaced earlier than this section of water main. Leak history, street reconstruction projects, pavement condition, developer improvements, and AC pipe strength tests may change the priority of this replacement.

CIP No. W6 – Morganville North – AC Water Main Replacement

Description

Replace 4-inch and 6-inch AC water main on Morgan Drive from Roberts Drive to the north end of Morgan Drive, east to Union Street, and then south 350 feet to the existing ductile iron pipe. A total of 1,600 feet of water main will be replaced.

Background

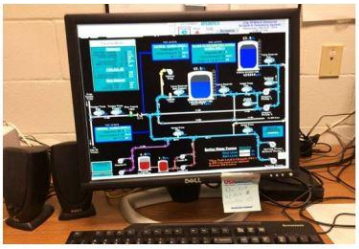
This project will improve fire flows to the Morganville area and replace substandard pipe that is nearing its useful performance life. An income survey will be required to determine eligibility for additional Community Development Block Grant Funding. Further future study of the existing asbestos water mains may show that a different AC water main should be replaced than this particular section of water main. Leak history, street reconstruction projects, pavement condition, developer improvements, and AC pipe strength tests may change the priority of this replacement.

CIP No. W7 – 0.5 MG Water Reservoir Recoat

Description

Repaint the 0.5 MG Reservoir inside and out. This project will add equipment for water mixing in the tank to eliminate stagnation and ensure chlorine residuals remain at optimum levels prior to distribution.

Background



The City drained and inspected the interior of the water tank in 2015. The interior coating has deteriorated to a point where total recoating is needed. If the Lawson Hills developer were to move forward with development above this reservoir, it may be a better solution to rebuild the storage capacity at a higher elevation. However, the lower reservoir would need to last until the higher one is built. This project may be pushed out a few more years while waiting for the development schedule for Lawson Hills in order to decide to defer the project for a few more years or move forward and paint the tank and preserve it.

CIP No. W8 – Pacific Street Water Main Loop

Description

Construct 1,200 linear feet of 8-inch ductile iron water main from the intersection with Pacific Avenue to Old Lawson Road to provide system looping.

Background

The homes on 5th Avenue, Pacific Avenue, Pacific Street, and Old Lawson are all on dead-end mains that can cause water quality issues, reduce fire flow availability, and cause interruption of service to more people when a water main needs to be shut down. Easements will be needed to complete the water main loop.

CIP No. W9 – Tacoma Wholesale Intertie No. 2

Description

Design and work with the City of Tacoma for a second intertie in the western portion of the City. Tap the Tacoma Second Supply Pipe Line and install an 8-inch meter, valves, vaults, and telemetry system along Lake Sawyer Road.

Background

As the Ten Trails area continues to grow, additional water transmission capacity will be needed to serve the western part of the City's system. This is a capacity and system reliability project funded by the WSFFA.

CIP No. W10 – SCADA System Improvements

Description

The City needs to update the supervisory control and data acquisition (SCADA) system for the water and sewer system. This project sets aside funds so that Public Works Operations staff can update software, computers, communication systems, or the Programmable Logic Controller as needed. This strategy will assist the City with the budgeting needs and keep the operations more reliable with lower malfunction risks.

Background

The City has a system of pump controllers, computers, software, and communication systems that operate, monitor, send alarms, and collect data on the City's water and sewer system. This project proposes to upgrade components of the overall system as needed going forward. Some years expenses may be minimal but as the funds are rolled over, the City will be able to afford the upgrades with less single-year budget impacts. In 2018, the City, in partnership with the Master Planned Developers, upgraded parts of the SCADA system to accommodate a new sewer pump station for the Ten Trails area. The City's existing system that was outdated and utilized software and hardware that was no longer supported, also was upgraded.

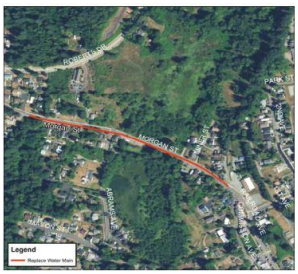
CIP No. W11 – Morgan Street – AC Water Main Replacement

Description

Replace 1,155 feet of 6-inch AC water main from Miner Avenue to the Arboretum Short Plat with a 12-inch ductile iron water main.

Background

The City recently completed the downtown water main improvement project, and this would continue improvements down Morgan Street. The remainder of Morgan Street will be completed in the future.



CIP No. W12 – 3.0 MG Reservoir for 1175 Pressure Zone

Description

New developments to the east of the City's existing water system will require service to an upper pressure zone. A 3.0 MG Reservoir will be required to provide open pressure zone service to the area.

Background

The increase in development to the east of the City's existing water system will require service to an upper pressure zone that will serve the Lawson Hills development. Future design and engineering will be necessary to determine the size and location of the reservoir. This is a capacity and system reliability project funded by the WSFFA.

CIP No. W13 – Booster Pumps to 1175 Pressure Zone

Description

New developments to the east of the City's existing water system will require service to an upper pressure zone. A booster pump station will be required to provide service to the area.

Background

The increase in development to the east of the City's existing water system will require service to an upper pressure zone that will serve the Lawson Hills development. Future design and engineering will be necessary to determine the exact size and location of the booster pumps. This is a capacity and system reliability project funded by the WSFFA.

CIP No. W14 – Springs Power Turbine

Description

Upgrade the City's existing power generated turbine facility located on the Green River at the Black Diamond Springs site.

Background

The City has an existing non-consumptive water right at the Springs site for power generation. The existing facility is outdated and currently offline. This project will replace the turbine equipment and upgrade the existing facility. Power generated will be used to run the North Bank Pump Station or be sold to the power grid to generate money for the water utility.

CIP No. W15 – Rates Study

Description

Conduct a rate study to re-evaluate the City water utilities' financial situation to ensure that commodity rates and capital facility charges can adequately fund the operation and maintenance of the City's water system.

Background

The current rate study specifically evaluated the financial viability of the next six years of the water utility and its ability to fund the 10-year CIP. Updating the rate study should be done periodically to reflect current growth rates, financial markets, and fund balances.

CIP No. W16 – Leak Detection Program

Description

Prepare and implement a leak detection program to identify, monitor, and reduce non-billed and unauthorized water uses.

Background

Over the last three years, the City's unauthorized and/or distribution system leakage has increased substantially. This program will conduct a leak detection program and develop improved ways to monitor and reduce unauthorized uses.

CIP No. W17 – O&M Programs

Description

Develop various programs to help operate and maintain the City's water system.

Background

Prepare and implement various programs as needed, including a unilateral flushing program, fire hydrant and valve programs, a meter replacement and calibration program, and other projects to facilitate the effective operation of the City's water system.

The proposed improvement projects are presented in **Table 9.1, Proposed 10-Year CIP.**

Table 9.1
Proposed 10-Year CIP

CIP No.	Description	Catergory	Size	Estimated Total Project Cost	City's Share of Cost	Year
W1	Springs Source Improvements	Water Main , Source, and Facility	3 projects	WSFFP	$ 0	2020
W2	Fire Flow Loop - North Commecial Area	Water Main	2,150 LF	$ 835,000	$ 362,400	2020
W3	4.3 MG Reservoir Recoat	Storage	spot repairs	$ 35,000	$ 35,000	2020
W4	Water System Plan Update	System-Wide	1 each	$ 98,000	$ 98,000	2020
W5	Morganville South - Water Main Replacement	Water Main	1,630 LF	$ 562,200	$ 86,200	2021
W6	Morganville North - Water Main Replacement	Water Main	1,600 LF	$ 528,000	$ 52,000	2023
W7	0.5 MG Reservoir Recoat	Storage	entire tank	$ 235,000	$ 235,000	2025
W8	Pacific Street Water Main Looping	Water Main	1,200 LF	$ 240,000	$ 240,000	2023
W9	Tacoma Wholesale Intertie No. 2	Supply	1 each	WSFFP	$ 0	2023
W10	SCADA Improvements	System-Wide	1 each	$ 60,000	$ 60,000	2020
W11	Morgan Street - Water Main Replacement	Water Main	1,155 LF	$ 440,000	$ 440,000	2024
W12	3.0 MG Reservoir 1175 Pressure Zone	Storage	3.0 MG	WSFFP	$ 0	2021
W13	Booster Pumps to 1175 Pressure Zone	Supply	1,000 gpm	WSFFP	$ 0	2021
W14	Springs Power Turbine	System-Wide	1 each	$ 40,000	$ 40,000	2021
W15	Rate Study	System-Wide	1 each	$ 20,000	$ 20,000	2026
W16	Leak Detection Program	System-Wide	annually	$ 5,000/year	$ 5,000/year	2020-2029
W17	O&M Programs	System-Wide	annually	$ 10,000/year	$ 10,000/year	2020-2029

Planning, prioritizing, scheduling, and funding capital improvements for the next 10 years after the 10-Year CIP projects have been completed is more speculative, and many adjustments and additions to the 20-year CIP are to be expected. The 20-year CIP included in this plan is mainly meant to help the City plan for future repair and replacement projects. The proposed improvement projects for potential projects in the years 2029 to 2039 are presented in **Table 9.2, Proposed 20-Year CIP**.

Table 9.2
Proposed 20-Year CIP

CIP No.	Description	Category	Size	Estimated Project Cost	Year
W18	Water System Plan Update	System-Wide	1 each	$ 200,000	2029
W19	SCADA Improvements	System-Wide	per year	$ 50,000	Annual
W20	3rd Ave and Lawson St to Lawson St and Newcastle Dr Water Main Replacement	Water Main	2,000 LF	$ 800,000	2031
W21	5th Ave and Lawson St to 5th Ave and Baker St Water Main Replacement	Water Main	1,000 LF	$ 400,000	2032
W22	Pacific Street Water Main Replacement	Water Main	1,050 LF	$ 400,000	2033
W23	3rd Ave and Park St to 3rd Ave and Roberts Dr Water Main Replacement	Water Main	1,300 LF	$ 500,000	2034
W24	3rd Ave and Black Diamond Ravensdale Road Water Main Replacement	Water Main	1,600 LF	$ 600,000	2035
W25	3rd Ave Chapel Wood Baptist Church Water Main Replacement	Water Main	1,000 LF	$ 400,000	2036
W26	3rd Ave and SE 332nd St to 3rd Ave and Lawson St Water Main Replacement	Water Main	3,300 LF	$ 1,300,000	2037

ESTIMATING COSTS OF IMPROVEMENTS

Project costs for the proposed improvements were estimated based on costs of similar, recently constructed water projects in Black Diamond and around the Puget Sound area and are presented in 2019 dollars. The cost estimates include the estimated construction cost of the

improvement and indirect costs estimated at 35 percent of the construction cost for engineering preliminary design, final design, and construction management and contract administration services, permitting, legal, and administrative services. The construction cost estimates include a 10-percent contingency and sales tax.

The unit costs for each water main size are based on estimates of all construction-related improvements, such as materials and labor for the water main installation, water services, fire hydrants, fittings, valves, connections to the existing system, trench restoration, asphalt surface restoration, and other work necessary for a complete installation. Additional costs were added to some water main improvements to cover anticipated increased costs related to the project location and degree of difficulty.

All cost estimates shown in the tables are presented in year 2019 dollars. Therefore, it is recommended that future costs be adjusted to account for the effects of inflation and changing construction market conditions at the actual time of project implementation. Future costs can be estimated using the Engineering News Record (ENR) Construction Cost Index for the Seattle area, or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.

10 | FINANCIAL ANALYSIS

Green River Pipe Bridge

INTRODUCTION

Washington Administrative Code (WAC) 246-290-100 requires a demonstration of financial viability as part of a Water System Plan. This chapter includes a summary of the income and expenses for the past six years. Also included is the current budget and current status of outstanding debt for past improvement projects.

One of the City of Black Diamond's (City) most important objectives is to ensure that the investment required to support the expected high rate of growth is captured appropriately from the new customer base. This will include direct funding of required capital improvements and payment of the City's general facility charge. The increase of the customer base is expected to allow the City to improve its current ability to operate and maintain the utility.

The City has entered into several agreements with large developers that outline specific water system improvement projects and funding participation details. Copies of these agreements are included in **Appendix W – Water Supply and Facilities Funding Agreements**.

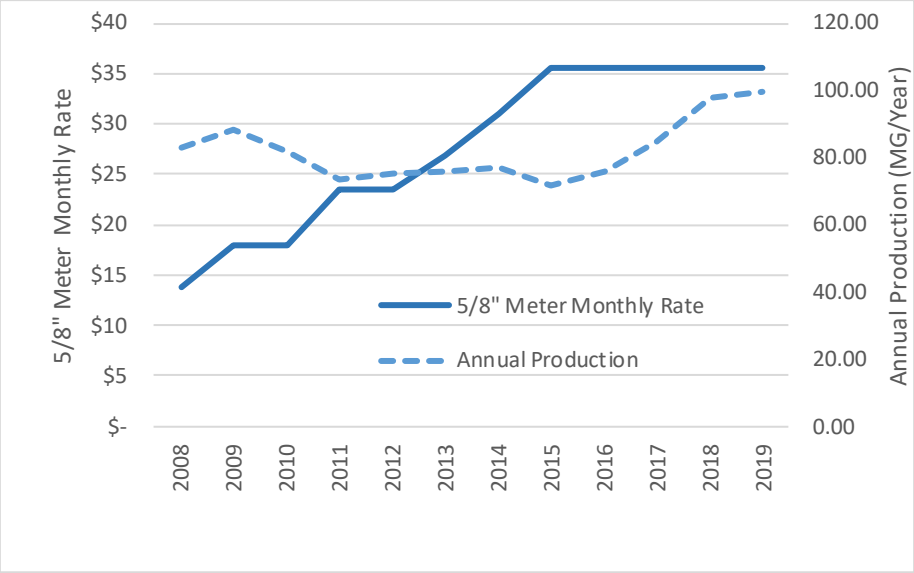
RECENT HISTORY

2008	• City had healthy levels of cash reserves
2009	• 30-percent rate increase • Added a ¼ full-time employee (FTE) to the water utility, administrative assistant position in Public Works • Virtually no growth
2010	• Very low growth and high vacancy rates
2011	• 31-percent rate increase and started tiered rates • Very low growth and high vacancy rates
2012	• Very low growth
2013	• 15-percent rate increase in September • Very low growth
2014	• 15-percent rate increase January • Very low growth
2015	• 15-percent rate increase January • Very low growth
2016	• Very low growth
2017	• Master Planned Development Construction started
2018	• Growth from the Master Planned Development continued • Significant revenue from high irrigation water for new landscape areas and construction water • Added an additional utility worker (shared position with the other utilities) to the Public Works crew
2019	• Continued higher levels of growth from the Master Planned Development. • Significant growth is starting in other areas in the City • Added an administrative support position to the Public Works office staff, a shared position with the other utilities

In the years after the housing recession (2008 through 2013), the City replaced and upgraded the water mains in the old downtown area ahead of a major street improvement project. This project was funded with City capital reserves. The City raised rates in 2009 by 30 percent and in 2011 by 31 percent to stabilize the water fund but not by enough to start funding pipe replacement projects.

The City was anticipating significant growth with the Master Planned Developments (MPDs) having been recently approved by the City. However, appeals and court cases delayed their start. With rising operational costs and continued slow growth in new customers, the City raised the water rates in 2013, 2014, and 2015 by 15 percent for each of the three years. **Chart 10.1, Historical Water Rates and Water Production**, shows historical meter rates compared to annual water production.

Chart 10.1
Historical Water Rates and Water Production



Even though growth continued at a very slow pace from 2015 through 2017, the water fund stabilized, and the City was able to increase cash reserves for the utility. In 2018, growth from the MPDs increased and had a notable affect in higher revenues for 2018 and 2019. The Water Utility was able to double fund balances over the last 6 years, as shown in **Table 10.1, Historic Revenue and Expenditures**.

Table 10.1
Historic Revenue and Expenditures

	2014	2015	2016	2017	2018	2019
Beginning Balance	**$626,999**	**$649,246**	**$572,582**	**$645,954**	**$827,039**	**$1,183,559**
REVENUES						
Charges for Services	$634,044	$752,436	$754,120	$764,719	$864,715	$937,947
Developer Contributions	$243,621	$145,957	$329,928	$418,015	$571,253	$874,085
Grants	$0	$33,829	$187,580	$0	$0	$0
Miscellaneious Revenue	$26,064	$732	$36,010	$0	$0	$2,165
Total Revenue	*$903,729*	*$932,954*	*$1,307,638*	*$1,182,734*	*$1,435,968*	*$1,814,197*
EXPENDITURES						
Utilities	$414,993	$474,356	$526,679	$507,699	$613,740	$829,987
Debt Service	$381,672	$378,292	$320,429	$318,896	$317,362	$315,828
Capital Expenditures	$69,817	$146,880	$367,158	$155,055	$138,346	$515,037
Transfer to Equipment Reserve	$15,000	$10,000	$20,000	$20,000	$10,000	$10,000
Total Expenditures	*$881,482*	*$1,009,528*	*$1,234,266*	*$1,001,650*	*$1,079,448*	*$1,670,852*
Ending Balance	**$649,246**	**$572,672**	**$645,954**	**$827,038**	**$1,183,559**	**$1,326,904**

CURRENT RATES

The City charges its water customers a base charge, or a water availability charge, regardless of the amount of water used. In addition, the City has a tiered commodity rate for each unit (one hundred cubic feet [CCF]) of water used per month. A customer shall be assessed the base rate depending on meter size and a cost for each unit of water used per month. The City's current base rates and commodity rates are summarized in **Table 10.2, Rate Schedule.**

Table 10.2
Rate Schedule

Meter Size (inches)	Meter Rate[1]	Commodity Charge		
		(0 to 600 cf)	(601 to 1,200 cf)	(>1,200 cf)
5/8 or 3/4	$35.63	$2.76	$3.17	$3.65
1	$45.05	$2.76	$3.17	$3.65
1.5	$48.59	$2.76	$3.17	$3.65
2	$84.80	$2.76	$3.17	$3.65
3	$102.89	$2.76	$3.17	$3.65
4	$193.22	$2.76	$3.17	$3.65
6	$499.96	$2.76	$3.17	$3.65

[1]Each additional dwelling unit or business served from a meter shall be charged $22.74 for inside the City limits and $54.48 for outside the City limits.

Prior to being allowed to physically connect a property or properties to the City's water system for the first time, a customer shall be assessed a water system capital facilities charge. The City's current capital facilities charges are summarized in **Table 10.3, Capital Facilities Charge.**

Table 10.3
Capital Facilities Charge

Type of Use	Rate
Single-Family	$5,976.39
Duplex	$11,952.78
Multi-Family	$5,976.39/ERU
Trailer Park	$5,976.39/ERU
Other	$5,976.39/ERU

FINANCIAL OUTLOOK

In 2019, the City had Peninsula Financial group evaluate the future financial projections for the City's water utility. The major issues that are affecting the future finances include the following.

1. Starting in 2020, the City of Tacoma restructured its wholesale water rate ordinance to begin charging a fixed base rate to all wholesale customers based on the total amount of water allocated per their wholesale agreements. This new base will be phased in over two years. The base rate is charged whether the City is using wholesale water or not. This will cost the City $75,000 in 2020 and $150,000 per year starting in 2021.
2. New revenue from customer growth is increasing significantly.
3. New revenue from irrigation meters and construction will remain high as the MPDs continue to build out.
4. In 2024, $215,000 per year of debt service will end.

5. The City plans to add another shared Public Works employee in 2022.
6. The costs of the major capital improvement projects (CIPs) that will increase reliability, meet higher health standards, and increase the capacity of the City's springs sources will be paid for by the MPDs, per the pre-established funding agreements attached as **Appendix W – Water Supply and Facilities Funding Agreements.**

The City Council determined that with the reasonable level of cash on hand, minimal unfunded capital needs, and growing revenues, the City could tolerate a short dip in the balance sheet as the City absorbs the additional expenses of the City of Tacoma wholesale base rate. Therefore, no rate increases were recommended for the next few years, as the City Council chooses to re-evaluate finances and rates in 2 years.

Since the City has secured enough supply for the projected 20-year future and has no planned debt service after 2024, it is anticipated that growth will continue to increase revenues faster than increases in operation and maintenance expenses; thereby allowing the City to begin setting aside cash reserves to begin replacing the remaining asbestos cement and undersized water mains in the water system and fund other needed improvements.

A copy of the City's current budget and other financial information has been included as **Appendix X – Financial Information**.

CAPITAL IMPROVEMENT PROJECT FINANCING

Project funding sources for both the City's Capital Improvement Program and for major system-wide improvements funded by the MPDs have been identified in **Table 10.4, Proposed Capital Project Funding Sources**.

Water rate revenue is the primary source of funding for the system management and maintenance activities. Water rate revenue also is the source for funding non-growth-related system improvements.

Growth-related capital improvements are categorized in two ways. One is extensions to the water system based on private development projects that are expected to be funded privately as a condition of approval. Secondly, growth-related projects that are improvements to the existing system such as replacing existing lines with larger lines to provide increased flow capacity to the new growth areas. These projects may or may not be sufficiently associated with a particular development proposal. It is anticipated that these projects also may be funded from general facility connection charge revenue.

Table 10.4
Proposed Capital Project Funding Sources

CIP	Project	Funding Sources
W1	Springs and Transmission Recontruction	WSFFA
W2	Fire Flow Loop - North Commecial Area	Rates & Developers
W3	4.3 MG Reservoir Maintenance and Repairs	Rates
W4	Water System Plan Update	Rates
W5	Morganville South - AC Water Main Replacement	Rates & Grant
W6	Morganville North - AC Water Main Replacement	Rates & Grant
W7	0.5 MG Reservoir Recoat	Interfund Loan
W8	Pacific Street Water Main Loop	Rates
W9	Tacoma Wholesale Intertie No. 2	WSFFA
W10	SCADA System Improvements	Rates
W11	Morgan Street - AC Water Main Replacement	Rates & Grant
W12	3.0 MG Reservoir for 1175 Pressure Zone	WSFFA
W13	Booster Pumps to 1175 Pressure Zone	WSFFA
W14	Springs Power Turbine	Rates
W15	Rates Study	Rates
W16	Leak Detection Program	Rates
W17	O&M Programs	Rates

The projected financial performance of the water system was based on the City's 2019 budget and the capital improvement plan. Given that the capital funding plan does not contemplate any new debt issuance to fund the CIP, the forecasted debt service cost is based on the City's existing debt service retiring by 2025. **Table 10.5, Projected Financial Performance**, summarizes the water utilized projected revenues and expenditures.

Table 10.5
Projected Financial Performance

	2020	2021	2022	2023	2024	2025
Beginning Balance	$950,000	$729,200	$595,600	$212,400	$244,600	$296,200
REVENUES						
Charges for Services	$1,043,500	$1,083,700	$1,142,400	$1,200,800	$1,259,400	$1,318,100
Developer Contributions	$29,900	$23,900	$23,900	$23,900	$23,900	$23,900
Grants	$0	$499,900	$362,500	$0	$0	$0
Miscellaneious Revenue	$12,600	$9,900	$6,100	$3,400	$4,100	$6,500
Total Revenue	*$1,086,000*	*$1,617,400*	*$1,534,900*	*$1,228,100*	*$1,287,400*	*$1,348,500*
EXPENDITURES						
Utilities	($825,000)	($906,400)	($967,000)	($982,200)	($1,023,300)	($1,062,800)
Debt Service	($218,800)	($217,300)	($215,700)	($202,900)	($201,500)	$0
Capital Expenditures	($263,000)	($627,300)	($735,400)	($10,800)	($11,000)	($11,300)
Total Expenditures	*($1,306,800)*	*($1,751,000)*	*($1,918,100)*	*($1,195,900)*	*($1,235,800)*	*($1,074,100)*
Ending Balance	**$729,200**	**$595,600**	**$212,400**	**$244,600**	**$296,200**	**$570,600**

AVAILABLE FUNDING SOURCES

Locally generated revenues have been most heavily relied upon for purposes of financial planning for the implementation of this plan. However, alternative funding sources have been identified below that should be pursued as available, and as appropriate to the improvement project.

GRANTS

Grant programs are becoming more and more competitive, and typically less funding is available than historically was available.

Community Development Block Grant

There are several grant programs available through the Community Development Block Grant (CDBG) Program, including general purpose grants, planning only grants, imminent threat grants, and community investment fund grants. Grants are awarded annually through a competitive process. The Washington State CDBG Program is funded by the U.S. Department of Housing and Urban Development (HUD). The purpose of the state CDBG Program is to improve and maintain the economic and physical environment of eligible, non-entitlement cities and counties in order to enhance the quality of life for low- and moderate-income residents and, as a result, benefit the entire community.

King County Department of Community Development

King County annually receives Community Development Block Grant (CDBG) funding from the HUD. The primary objective of the CDBG program is “the development of viable urban communities, by providing decent housing and a suitable living environment and expanding economic opportunities, principally for persons of low and moderate income.” Water infrastructure improvements may be eligible for grant funding and should be evaluated as a possible alternate funding source to augment local funds.

USDA Rural Development Water and Waste Disposal Grants

The City may be competitive in applying for a grant from the United States Department of Agriculture (USDA). Cities with a population less than 10,000 are eligible, with priority being given to communities with a population of less than 5,500. Grants can be used to construct, extend, enlarge, or otherwise improve water facilities. Engineering and right-of-way acquisition also are eligible activities.

Community Economic Revitalization Board Grants

The City of Black Diamond may wish to consider submitting for grant funding from the Community Economic Revitalization Board (CERB). Typically, grants through CERB are for improvement projects that support economic development in the community, and specifically support industrial sector business growth and job creation or retention.

Water System Acquisition and Rehabilitation Program

If the City chooses to pursue taking over the portion of the Covington Water District that encompasses the Lake Sawyer area within the City, the City should investigate eligibility for grants from the Water System Acquisition and Rehabilitation Program (WSARP). DOH, the Public Works Board, and the Department of Community, Trade, and Economic Development (CTED) jointly administer the WSARP program. Municipal Group A water systems with projects that will acquire other public water systems that have water quality problems or deteriorated drinking water infrastructure may be eligible for WSARP grants.

LOANS

There are several loan programs that the City may wish to consider in evaluating funding options for its capital improvement program. Loan programs are becoming more common with the reduction in available grant funding.

Drinking Water State Revolving Fund Loan

The City of Black Diamond may wish to pursue a low-interest loan through the Drinking Water State Revolving Fund (DWSRF) Loan. These loans are designed to fund projects that increase public health protection through improvements to the City's drinking water system. This loan program is sponsored by DOH, the Public Works Board, and the CTED. Low interest rates (typically 0 to 1.5 percent) are an advantage of this program, along with no required local financial match.

USDA Rural Development Water and Waste Disposal Loans

The City may be competitive in applying for a loan from the USDA. Cities with a population less than 10,000 are eligible, with priority begin given to communities with a population of less than 5,500. Loans can be used to construct, extend, enlarge, or otherwise improve water facilities. Engineering and right-of-way acquisition also are eligible activities.

Community Economic Revitalization Board Loans

The City may wish to consider submitting for a low-interest loan from CERB. Typically, loans through CERB are for improvement projects that support economic development in the community, and specifically support industrial sector business growth and job creation or retention.

BONDS

There are two standard types of bond financing that the City may wish to consider in order to augment local funding sources—general obligation bonds or revenue bonds.

Revenue Bonds

Revenue bonds are a common source of funding for major utility construction projects. Revenue bonds are issued by the City and are typically repaid from rate revenues. In order to qualify to sell revenue bonds, the City must demonstrate that its net water utility operating income is equal to or greater than a coverage factor, multiplied by the annual revenue bonded debt.

General Obligation Bonds

Voters may elect to issue general obligation bonds to finance projects of benefit to the City. The bonds are typically paid through assessments levied against all privately owned properties within the City. The City also may wish to consider repayment from user rates. General obligation bonds usually have a low interest rate; however, obtaining voter approval may be a time consuming process. Additionally, the City should be aware of any limits imposed on the City as to its total allowable amount of general obligation debt. Financing large capital improvements through general obligation bonds reduces the ability to issue future debt.

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