

FREELAND WATER & SEWER DISTRICT
Water System Plan

G&O #17570
April 2019
Revised February 2021

Gray & Osborne, Inc.

FREELAND WATER & SEWER DISTRICT

ISLAND COUNTY **WASHINGTON**

WATER SYSTEM PLAN

2-25-2021

G&O #17570
APRIL 2019
REVISED FEBRUARY 2021

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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Acronym	Definition
AC	Asbestos Cement
AC-FT/YR	Acre-feet per Year
A-COMM	Group A Community Water System
ADD	Average Day Demand
AG	Air Gap
ANSI	American National Standards Institute
A-NTNC	Group A Non-Transient Non-Community Water System
A-TNC	Group A Transient Non-Community Water System
AWWA	American Water Works Association
BAT	Backflow Assembly Technician
BTO	Basic Treatment Operator
CCC	Cross Connection Control
CCR	Consumer Confidence Report
CCS	Cross Connection Specialist
CEU	Continuing Education Unit
CF	100 cubic feet
CFR	Code of Federal Regulations
CFR	Calculated Fixed Radius
CIP	Capital Improvement Plan
CPI	Consumer Price Index
CU	Color Unit
CWSP	Coordinated Water System Plan
DBP	Disinfectant Byproduct
DI	Ductile Iron
DOE	Washington State Department of Ecology
DOH	Washington State Department of Health
DSL	Distribution System Leakage
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
FF	Fire Flow Rate, gpm
FPS	Feet per Second
FWSD	Freeland Water & Sewer District
GPD	Gallons per Day
GPM	Gallons per Minute
GROUP A	Group A Water System
GROUP B	Group B Water System
HAA5	Haloacetic Acids
HDPE	High Density Polyethylene
HERB1	General Herbicide

Acronym	Definition
HGL	Hydraulic Grade Line
HH	Harbor Hill Water System
HHC	Harbor Hills Community Water System
ICCP	Island County Comprehensive Plan
IOC	Inorganic Chemical and Physical
LID	Local Improvement District
LRAA	Locational Running Annual Average
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level
MDD	Maximum Day Demand
MFL	Millions of Fibers per Liter
MG	Million gallons
mg/L	Milligrams per Liter
MTCA	Model Toxics Control Act
N	Number of ERUs for Design
NMUGA	Non-Municipal Urban Growth Area
NSF	National Sanitation Foundation
NTU	Nephelometric Turbidity Unit
O&M	Operation and Maintenance
pCi/L	Picocuries per Liter
PEST1	General Pesticide
PGG	Pacific Groundwater Group, Inc.
PHD	Peak Hour Demand
PLC	Programmable Logic Controller
PM	Preventative Maintenance
PRV	Pressure Reducing Valve
PSI	Pounds per square inch
PVC	Polyvinyl Chloride
PWTF	Public Works Trust Fund
Q_a	Maximum annual withdrawal allowed under a water right
Q_i	Maximum instantaneous withdrawal rate allowed under a water right
Q_L	Capacity of Largest Single Source, gpm
Q_{PH}	Peak Hourly Demand, gpm
Q_S	Total Source of Supply Capcity (excluding emergency supplies), gpm
R	Rural
RA	Rural Agriculture
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RF	Rural Forest
ROW	Right-of-Way
RPBA	Reduced Pressure Backflow Assembly

Acronym	**Definition**
RPDA	Reduced Pressure Detector Assembly
SCADA	Supervisory Control and Data Acquisition
SMA	Satellite Management Agency
SOC	Synthetic Organic Chemical
SR525	State Route 525
SVF	Sunny View Farms
TTHM	Total Trihalomethanes
ULID	Utility Local Improvement District
UST	Underground Storage Tank
V_{ES}	Equalizing Storage, gallons
V_{FSS}	Volume of Fire Suppression Storage, gallons
VOC	Volatile Organic Chemical
V_{SB}	Total Standby Storage, gallons
WAC	Washington Administrative Code
WDM	Water Distibution Manager
WETRC	Washington Environmental Training Resource Center
WFI	Water Facilities Inventory
WHPA	Wellhead Protection Area
WLCAP	Water Loss Control Action Plan
WSDOT	Washington State Department of Transportation
WSP	Water System Plan
WTPO	Water Treatment Plant Operator
WUE	Water Use Efficiency
WWS	Whidbey Water Services, LLC
ZOC	Zones of Contribution (aka "Capture Zones")

CHAPTER 1

WATER SYSTEM DESCRIPTION

OBJECTIVE

SCOPE OF WORK

This Water System Plan (WSP) is an update of previous WSPs prepared for, and adopted by, the Freeland Water and Sewer District (FWSD) in accordance with requirements set forth in Chapter 246-290 WAC (Water Regulations). Previous WSPs include a 2004 WSP, and a 2011 WSP by Davido Consulting Group. This WSP is intended to meet all requirements of Part 246-290-100 WAC, as well as the needs and concerns of the FWSD. Pursuant to Water Regulations, this WSP must receive approval of the Washington State Department of Health (DOH) and be adopted by FWSD.

CHAPTER OBJECTIVE

The objective of this chapter is to present background information for the District's WSP. Subjects covered include the following:

- Ownership and Management
- System Background
- Existing System
- Related Planning Documents
- Service Area Characteristics
- Water System Policies

Later chapters of this WSP assess the projected water system demands in Chapter 2, and current water system capabilities and limits relative to projected demand and regulatory requirements in Chapter 3. Chapter 4 addresses water use efficiency (conservation) requirements, Chapter 5 addresses water source protection requirements, Chapter 6 addresses water system operations program requirements, and Chapter 7 addresses water system design standards. The final chapters of the WSP evaluate capital and non-capital improvement options for the District water system, and present a schedule for completing the preferred improvement options in Chapter 8, and evaluate the cost impact of the improvement schedule on the District budget and water rates, and present a financing plan for implementing the WSP in Chapter 9.

OWNERSHIP AND MANAGEMENT

SYSTEM NAMES AND DOH ID NUMBERS

The FWSD owns and operates three water systems. The names and ID numbers of the water systems on the DOH data system are *"FREELAND WATER AND SEWER DISTRICT,"* (hereinafter, FWSD water system) DOH public water system ID number

264508, *"HARBOR HILLS COMMUNITY WATER SYSTEM,"* (hereinafter HHC water system) DOH public water system ID number **33860V**, and "*SUNNY VIEW FARMS WATER SYSTEM,"* (hereinafter, SVF water system) DOH public water system ID number **01072W**. This water system plan update addresses only the FWSD water system and the SVF water system. An update for the HHC water system is being completed by another party. It should be noted FWSD refers to the water district, a political entity that owns the FWSD water system, as well as the HHC water system and the SVF water system, whereas FWSD water system refers to one of the water systems owned by FWSD. It should also be noted that there is another water system with a similar name to HHC water system bordering FWSD water system on the southeast called Harbor Hill (singular) water system, which will be referred to as HH water system, to distinguish it from the HHC water system.

TYPE OF OWNERSHIP

FWSD is a Water and Sewer District organized under Title 57 RCW, and is a political subdivision of Island County (the County). FWSD is headed by three Commissioners chosen by general election of registered voters in the FWSD boundaries. Decisions regarding FWSD management, operation, policies, rates and budget, are made by the Commissioners.

MANAGEMENT STRUCTURE

The FWSD is directed by a board of three elected commissioners, who have approval authority over District budget and operations. The current FWSD Board members are as follows:

Board President ....Eric Hansen
Board Vice President ....Lew Randall
Board Secretary/Treasurer .... Chad Gladhart

The water system has no direct employees, but is managed by a private company, Whidbey Water Services LLC, (WWS). WWS is an approved Satellite Water System Management Agency, SMA #136, owned and operated by Andy and Terri Campbell, whose positions are as follows.

WWS Manager .... Andy Campbell
WWS Financial Manager/Administration................ Terri Campbell

WATER FACILITIES INVENTORY FORMS

Copies of Water Facilities Inventory (WFI) forms for FWSD's three water systems, all three updated April 13, 2017, are included in Appendix A. The following summarizes the information of these forms.

Freeland Water and Sewer District, DOH ID No. 264508

The FWSD water system WFI indicates 370 full-time single-family residential connections, 7 apartments, condos, or duplexes with 138 full-time residential units, and 101 institutional, commercial/business, school, day care, or industrial service connections, for a total of 609 service connections. The WFI indicates that the system serves an estimated full-time population of 1,252, and an estimated transient population of 350 every month.

Sunny View Farms, DOH ID No. 01072W

The SVF water system WFI indicates 6 full-time single-family residential connections, no apartments, condos, or duplexes, and no institutional, commercial/business, school, day care, or industrial service connections, for a total of 6 service connections. The WFI indicates that the system serves an estimated full-time population of 9, and no transient population.

CONTACTING FWSD

FWSD's current mailing address and telephone number is:

> Freeland Water & Sewer District
> PO Box 222
> Freeland, WA 98249
> Phone: (360) 331-5566

In addition, Whidbey Water Services LLC's current mailing address and telephone number is:

> Whidbey Water Services LLC
> PO Box 1201
> Freeland, Washington 98249
> Phone: (360) 579-1956

SYSTEM BACKGROUND

HISTORY OF WATER SYSTEM DEVELOPMENT AND GROWTH

Initial System: FWSD was formed in 1964. Well 1 was initially drilled in December 1965 for "Freeland Water District," and completed in October 1967, with a completed depth of 252 feet and a tested capacity of 300 gpm. Water Right Certificate 5825-A was issued September 1967 for 250 gpm and 168 ac-ft/yr from Well 1. The original water system included a 100,000-gallon wood stave water storage reservoir located at the Well 1 site.

Well 2: The well log for Well 2 indicates it was drilled in 1980 with a completed depth of 200 feet and a tested capacity of 42 gpm. It is not clear from the record when this well was acquired by, and put into service for, FWSD; however, Certificate of Change for Water Right 5825-A was issued December 1985, adding Well 2 as a second point of withdrawal.

Wood-Stave Reservoir Replaced: FWSD constructed a new 200,000-gallon concrete storage reservoir in 1990 to replace the wood stave tank, which was converted into a District maintenance workshop building, which is still in use. The district is currently installing an iron and manganese treatment system in the building that was the old wood stave reservoir.

Data System Improvements and System Expansion: In 1991 the District established a computerized system for tracking both well withdrawal and individual user consumption data, which aids in leak detection. Also, in 1991/1992, the District extended its boundaries pursuant to an annexation petition and almost tripled its area. Water Right Application G1-29039, dated June 1999, indicates that FWSD was serving an area of 1,029.6 acres using two wells and a 200,000-gallon water storage tank. Amended Water Right Application G1-29039, dated October 2002, indicates that at that time the system was serving 376 ERUs.

Well 1 Rehabilitated: In 1999 Well 1 was rehabilitated to remove mineral buildup from the well screen. Testing and analysis at the time recommended a maximum pumping rate of 180 gpm.

Well 3: The well log for Well 3 indicates that it was completed in August 2000, with a completed depth of 368 feet and a tested capacity of 90 gpm. The well was acquired by the District in 2002 and put into service in 2009. Amended water right application G2-28039 is dated October 2002. Water from this well has excessive iron and manganese, so use of this well was limited until a treatment system was installed in 2011.

2004 Water System Plan Update: FWSD completed and received approval for their 2004 WSP update.

New Pump Station: FWSD constructed a new pump station in 2003 that provided the minimum system pressures required for the customers on the west end of Bercot Road near the intersection with Honeymoon Bay Road. That pump station has since been removed and the area is now pressurized by an intertie with the HHC water system.

Cameron Road Extension: The Cameron Road loop was completed in 2004 with an 8-inch main extension crossing State Route 525 (SR 525) and connecting with an existing water main on Cameron Road approximately 300 feet south of SR 525.

Stewart Road Water Main Replacement: The existing 6-inch AC water main along Stewart Road was replaced with a new 8-inch HDPE water main in 2004.

Purchased the Harbor Hills Water System: In 2007 FWSD purchased the HHC water system. The HHC water system is roughly the same size as the FWSD water system, serving approximately 400 homes in the Holmes Harbor Golf & Yacht Club Subdivisions. The HHC water system is located on the west side of Holmes Harbor, just north of the FWSD water system. In 2014 FWSD constructed an intertie between the FWSD and the HHC water systems. The hydraulic gradeline (HGL) of the HHC water system is higher than the HGL of the FWSD water system, so at present the intertie can only serve from HHC water system to the FWSD water system, and not from the FWSD water system to the HHC water system.

Purchased the Sunny View Farm Water System: In 2008 FWSD purchased the SVF water system. The SVF water system currently serves only six residential connections. The purchase of the water system included the acquisition of the SVF water system Water Right G1-27463 for 100 gpm and 80 acre-feet/year. The SVF water system is not currently connected to the FWSD water system.

Second Reservoir: In 2007, a second 200,000-gallon concrete storage reservoir was constructed at the Well 3 site. This site is approximately 80 feet higher than the existing reservoir located at the Well 1 site.

Completed Fletcher Annexation: The Fletcher Annexation in 2010 included a water right place of use expansion, which was approved by Island County Board of Commissioners' Resolution No. C-88-10 dated November 22, 2010.

2011 Water System Plan Update: FWSD completed and received approval for their 2011 WSP update.

Water Treatment System at Well 3: In 2011 a treatment system was installed at Well 3 to remove iron and manganese from the water.

Joanne Drive Water Line Replacement: In 2014 an existing 2-inch galvanized water main on Joanne Drive between Myrtle Ave and Freeland Avenue was replaced with a new 6-inch PVC water main.

Second Well 1 Rehabilitation: Well 1 was again rehabilitated in 2017.

LOCATION

The FWSD water system serves the unincorporated community of Freeland and surrounding community, located approximately 30 miles NNW of Seattle Washington, at the south end of Holmes Harbor near the south end of Whidbey Island in Island County, Washington. The location of FWSD is shown in Figure 1-1. The FWSD Service Area is shown in Figure 1-2. FWSD can be accessed from the mainland at Mukilteo via the

Clinton-Mukilteo ferry and SR 525, or over the Deception Pass bridge at the north end of Whidbey Island near Anacortes, following SR 20 and SR 525.

GEOLOGY

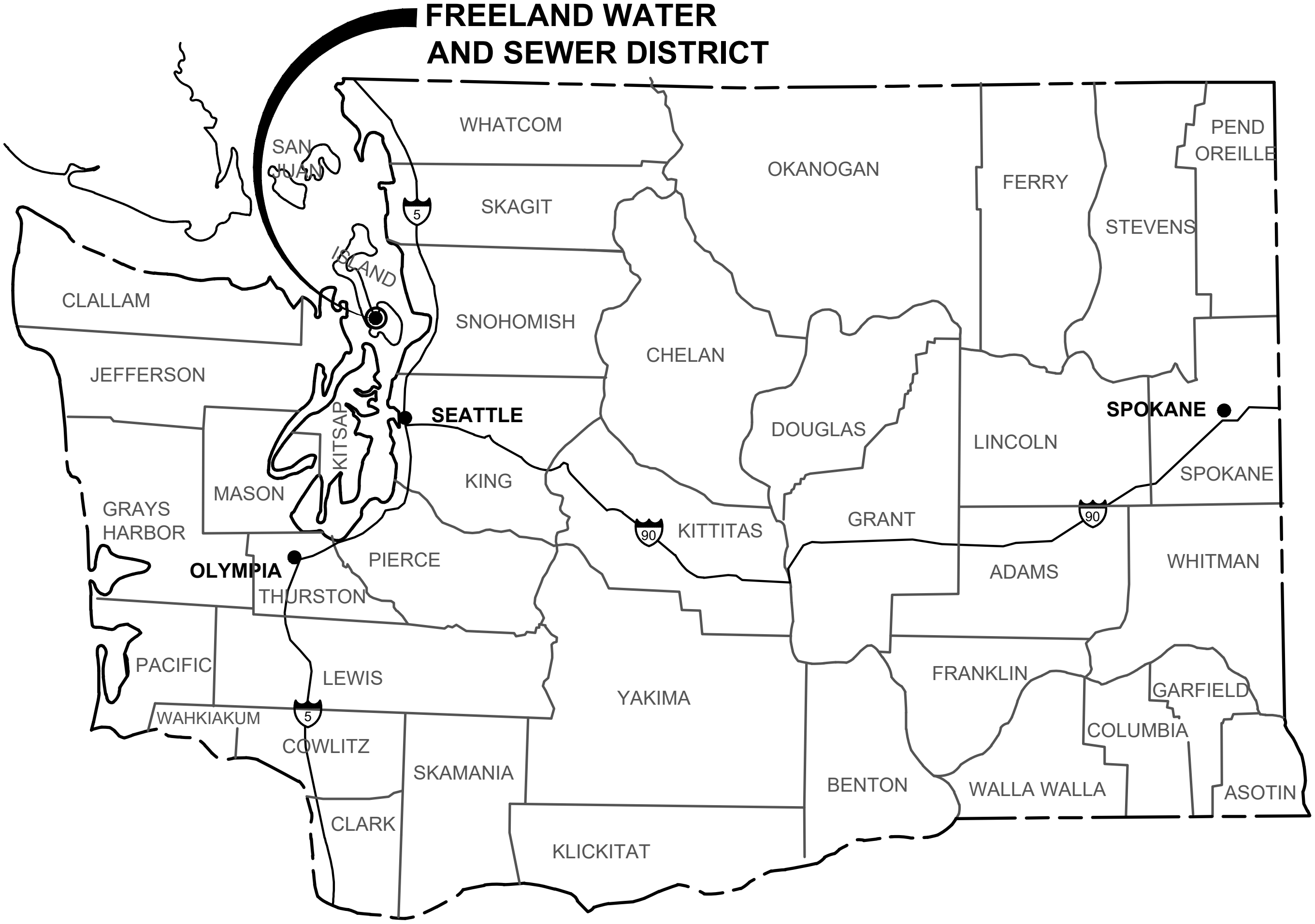
The geology of the Freeland area is described on the Geologic Map of the Freeland and Northern Part of the Hansville 7.5-minute Quadrangles, Island County, Washington, by Michael Polenz, Henry W. Schasse, and Bradley B. Petersen, June 2006. (Washington Division of Geology and Earth Resources, Geologic Map GM-64.) The text on the map begins with the following statement: "The map area is covered by 800 to 2,500 feet of glacial and nonglacial sediment above Miocene bedrock.[1]" So in essence the Freeland area is all unconsolidated sediment, and bedrock is 800 to 2,500 feet deep. The majority of the Freeland area is mapped as $Qgdm_e$, signifying Everson Glaciomarine Drift. This geologic unit is described as follows:

> **Everson Glaciomarine Drift**—Clayey to silty diamicton[2] with variable amount of gravel clasts; also includes silt, clay, and sand; contains sparse shells, generally marine; dark gray where unweathered; weathers mostly to buff, but ranges to olive gray, ash gray, or white; commonly forms a dry, vertical face with failure-prone, vertical desiccation cracks with dark-brown staining; massive to rhythmically bedded, commonly with sharp upper and lower, unit-bounding unconformities; mostly loose and soft but locally hard and compact; may resemble till, but in general, till lacks fossils, and glaciomarine drift has a finer-grained, smoother-feeling matrix, is less compact, and is more likely to be stratified; composed of sea-floor sediment and mostly consists of glacial flour, its textural diversity reflecting proximity of the ice front.

The geologic units mapped in the vicinity of the FWSD wells include Qgo_f (Recessional Outwash) and $Qgas_v$ (Advance Outwash Sand). These are described as follows:

> **Recessional Outwash**—Mostly sand, but includes lenses and beds of pebble gravel and silt, sparse clasts of diamicton, and minor clay and peat; mapped as unit $Qgof_f$ where mostly clay; gravelly facies tend to occur lower in the unit; loose; variably rounded; poorly to well sorted in most exposures; structureless to moderately stratified with medium to thick beds; mostly forms either valley fill in relict, late-glacial meltwater valleys or terraces above Everson Interstade[3] marine shorelines; interfingers with adjoining Everson marine deltaic deposits (unit $Qgom_e$). This unit is assigned to the broader Fraser glacial period because some deposits appear to (1) post-date the elevated Everson sea level; (2) fill closed

[1] References have been removed from the text for ease of reading.
[2] Diamicton: Sediment resulting from dry-land (non-marine) erosion that is unsorted to poorly sorted and contains particles ranging in size from clay to boulders, suspended in a matrix of mud or sand.
[3] Interstade: A period of temporary retreat of ice during a glacial stage; a warming period.



VICINITY MAP

NOT TO SCALE

FREELAND WATER AND SEWER DISTRICT

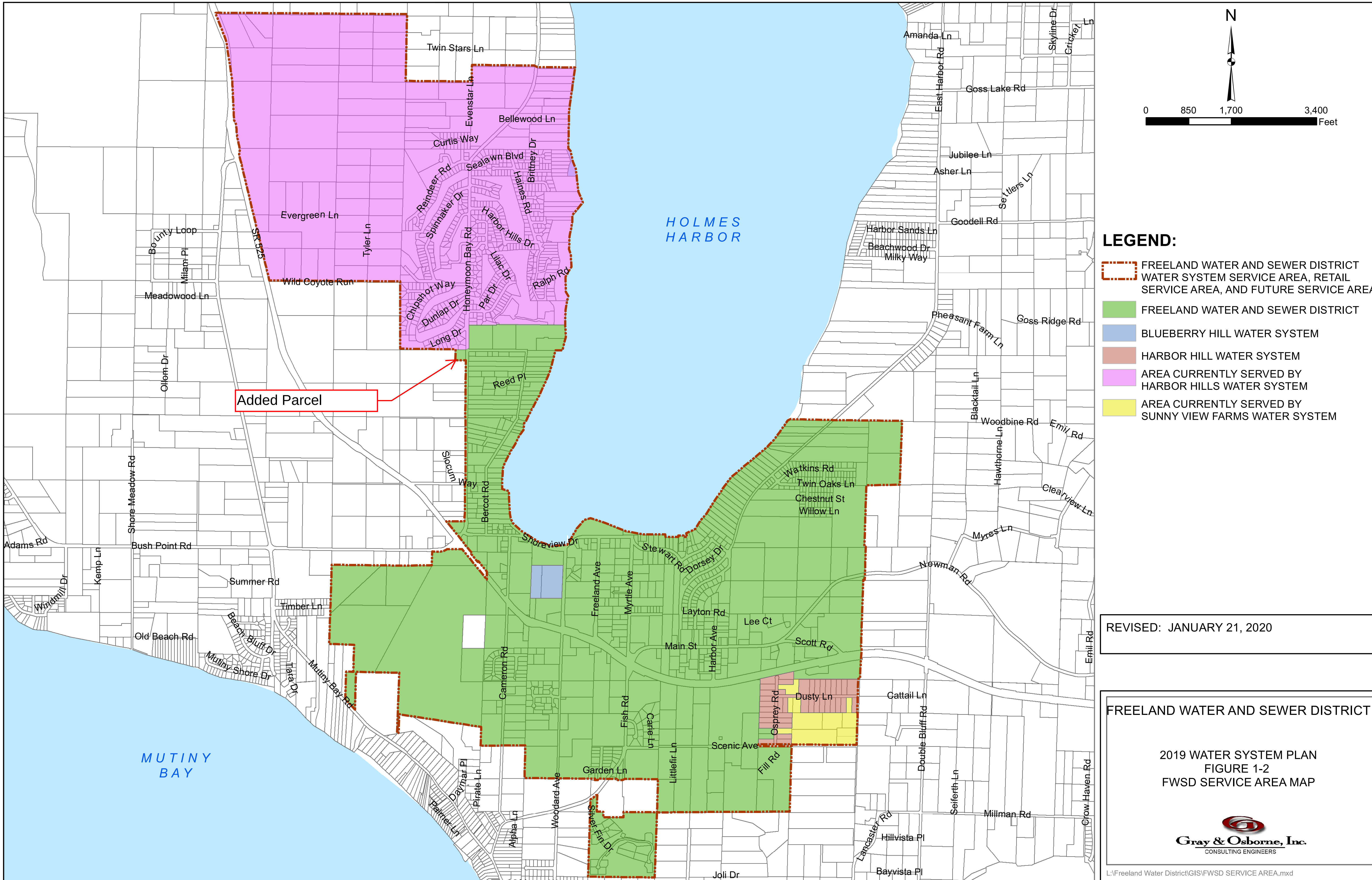
2019 WATER SYSTEM PLAN

FIGURE 1-1

LOCATION MAP

Gray & Osborne, Inc.

CONSULTING ENGINEERS


N
0
850
1,700
3,400
Feet
LEGEND:
FREELAND WATER AND SEWER DISTRICT WATER SYSTEM SERVICE AREA, RETAIL SERVICE AREA, AND FUTURE SERVICE AREA
FREELAND WATER AND SEWER DISTRICT
BLUEBERRY HILL WATER SYSTEM
HARBOR HILL WATER SYSTEM
AREA CURRENTLY SERVED BY HARBOR HILLS WATER SYSTEM
AREA CURRENTLY SERVED BY SUNNY VIEW FARMS WATER SYSTEM
REVISED: JANUARY 21, 2020
FREELAND WATER AND SEWER DISTRICT
2019 WATER SYSTEM PLAN
FIGURE 1-2
FWSD SERVICE AREA MAP
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\Freeland Water District\GIS\FWSD SERVICE AREA.mxd
HOLMES HARBOR
MUTINY BAY
Added Parcel
Twin Stars Ln
Evenstar Ln
Bellewood Ln
Curtis Way
Sealawn Blvd
Brittney Dr
Reindeer Rd
Spinnaker Dr
Haines Rd
Harbor Hills Dr
Evergreen Ln
Tyler Ln
SR 525
Honeymoon Bay Rd
Lilac Dr
Ralph Rd
Wild Coyote Run
Chipshot Way
Dunlap Dr
Par Dr
Long Dr
Bounty Loop
Milam Pl
Meadowood Ln
Ollom Dr
Reed Pl
Slocum Way
Bercot Rd
Shore Meadow Rd
Adams Rd
Bush Point Rd
Kemp Ln
Windmill Dr
Summer Rd
Timber Ln
Old Beach Rd
Beach Bluff Dr
Mutiny Shore Dr
Tara Dr
Mutiny Bay Rd
Shoreview Dr
Stewart Rd
Dorsey Dr
Freeland Ave
Myrtle Ave
Layton Rd
Lee Ct
Main St
Harbor Ave
Scott Rd
Cameron Rd
Dusty Ln
Osprey Rd
Fish Rd
Carrie Ln
Littlefir Ln
Scenic Ave
Fill Rd
Garden Ln
Woodard Ave
Silver Fir Dr
Alpha Ln
Daymar Pl
Pirate Ln
Palmer Ln
Manor Way
Joli Dr
Watkins Rd
Twin Oaks Ln
Chestnut St
Willow Ln
Amanda Ln
East Harbor Rd
Goss Lake Rd
Skyline Dr
Cricket Ln
Jubilee Ln
Asher Ln
Settlers Ln
Goodell Rd
Harbor Sands Ln
Beachwood Dr
Milky Way
Pheasant Farm Ln
Goss Ridge Rd
Blacktail Ln
Woodbine Rd
Emil Rd
Hawthorne Ln
Clearview Ln
Myres Ln
Newman Rd
Cattail Ln
Double Bluff Rd
Seiferth Ln
Crow Haven Rd
Millman Rd
Lancaster Rd
Hillvista Pl
Bayvista Pl

depressions above the Everson glaciomarine limit; (3) form small kame[4] terraces; or (4) be graded to pre-Everson glaciolacustrine[5] base levels.

Advance Outwash Sand—Mostly lacustrine[6] sand with layers of silt; locally grades upward into gravel; thick and extensive, with maximum observed thickness of greater than 170 feet; commonly forms angle-of-repose slopes along drainages and coastal bluffs; includes Lawton Clay and Esperance Sand (bluff section A). Widespread, relict valleys in southern Whidbey Island are deeply incised into unit Qgasv and typically lack modern streams, due to high permeability in the unit.

ADJACENT AND NEARBY PURVEYORS

A listing of public water systems in the FWSD water system area was obtained from the DOH SENTRY database system. Systems were determined to be in the vicinity of the Freeland water system based on the township, range and section being near or within the service area of the FWSD water system. A total of 16 Group A water systems and 44 Group B water systems were determined to be in the vicinity of the FWSD water system, not counting FWSD or Harbor Hills water systems. The largest water system near FWSD is the Bayview Beach Water District, ID #05535A, which serves 451 total connections and is approved by DOH to serve up to 550 connections. The second largest is W&B Waterworks 1, ID #466703, which serves 442 connections and is approved by DOH to serve up to 451 connections. The third largest is Harbor Hills Community Water System, ID #33860V, which is owned by FWSD, serves 411 connections, and is approved by DOH to serve up to 550 connections. The fourth largest water system is Honeymoon Lake water system, ID #34005X, which currently serves 83 connections and is approved by DOH to serve up to 151 connections. The remaining 12 Group A water systems in the vicinity of Freeland serve a total of 371 connections with approval by DOH to serve up to a total of 388 connections. Two of these systems are Group A Non-community systems. A list of existing Group A water systems in the vicinity of FWSD water system is shown in Table 1-1. The SVF Water System, ID #01072W, which is a group B water system, is also included in Table 1-1 because it is owned by FWSD.

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[4] Kame: A glacial landform, an irregularly shaped hill or mound composed of sand, gravel and till that accumulates in a depression on a retreating glacier, and is then deposited on the land surface with further melting of the glacier.
[5] Glaciolacustrine: Sediments deposited into lakes that have come from glaciers.
[6] Lacustrine: Relating to or associated with lakes.

TABLE 1-1

Group A Water Systems in the Vicinity of FWSD

ID Number	System Name	Type(1)	Total Conn	Approved Conn	Location
05535A	Bayview Beach Water District	A Comm	451	550	Shore Avenue, Useless Bay
278497	Bayview Meadows Water System	A Comm	14	16	Hillvista Place, Bayvista Place
179859	Blueberry Hill	A TNC	1	1	Gordon's on Blueberry Hill Restaurant
08123P	Bradshaw Addition Water System	A TNC	15	0	Bradley Lane off Harbor Hills Drive
18575K	Del Bay	A Comm	36	43	Timber Lane off Mutiny Bay Road
31003P	Harbor Hill	A Comm	15	0	Osprey Road and Dusty Lane
33860V	Harbor Hills Community Water System	A Comm	411	550	Immediately north of FWSD on the west side of Holmes Harbor
34005X	Honeymoon Lake	A Comm	83	151	Honeymoon Lake Road, Walden Loop
511156	Maple Glen Community Association	A Comm	56	75	Maple Glen Road, Myres Lane, Weatherside Lane, Hawthorne Lane, Clearview Lane
57740J	Mutiny Bay Park Water Association	A Comm	41	43	Bounty Loop, Meadowood Lane off Mutiny Bay Road
57775W	Mutiny Bay Riviera	A Comm	30	33	Mutiny Bay Riviera Condos, Old Beach Road
57900R	Mutiny Sands Club	A Comm	65	78	Mutiny Shore Drive, Mutiny Bluff Drive
57930J	Mutiny View Manor Community Club	A Comm	74	99	Woodard Ave, Manor Lane, Channel View Lane, Mountain View Lane, Sundown Lane, Mutiny View Place
96000N	Ships Pass Water Association	A Comm	19	0	Fish Road, Cameron Road, Pirate Lane
01072W	Sunny View Farms Water System	B	6	6	North of Scenic Drive, South of Dusty Lane, and east of Osprey Road
466703	W&B Waterworks 1	A Comm	442	451	Mutiny Bay Road
00912E	Whidbey Island Eagles #3418	A TNC	5	0	SR 525 Approx 0.3 mile east of Double Bluff Road

(1) Water system types are A-Comm (Group A Community Water System), A-TNC (Group A Transient Non-Community Water System), A-NTNC (Group A Non-Transient Non-Community Water System) and Group B (Group B Water System).

There are also a total of 44 Group B water systems serving a total of 195 connections and approved by DOH to serve up to a total of 155 connections. Fifteen of these have never been approved by DOH, and therefore have zero approved connections.

It is reasonable to assume that all water systems in the FWSD service area are likely to eventually be replaced with FWSD water supply. It is also possible that other water systems near the FWSD service area may eventually request FWSD water service. It should also be noted that if and when FWSD eliminates any small water system by providing FWSD water service, the water rights of the eliminated system may be incorporated into FWSD's water rights pursuant to RCW 90-44-105 through a water rights change process.

EXISTING SYSTEM

FWSD currently owns three separate water systems, including FWSD water system, HHC water system, and SVF water system. This WSP is only addressing the FWSD water system and SVF water system. A description of the FWSD and SVF water system facilities is provided in the following sections. Figure 1-3 shows the existing FWSD and SVF facilities.

SOURCES OF SUPPLY

FWSD has three wells, identified on the FWSD water system WFI as Well A, Well B, and Well 3. However, FWSD refers to these wells as Well 1, Well 2 and Well 3, respectively. As noted in the previous section titled, "History of Water System Development and Growth," Well 1 was completed in October 1967. FWSD Well 1 (DOE ID #AGA907) is an 8-inch well drilled to a depth of 260 feet and screened between 242 and 252 feet depth with an 8-inch 0.40-slot stainless steel screen. Well 1 had a static water level 243 feet below land surface, and was pump tested at 300 gpm with 14 feet of drawdown after four hours of pumping. Based on well run-time hours pumped and metered water production between January 2011 and August 2017, Well 1 pumps at an average rate of approximately 163 gpm.

FWSD Well 2 (DOE ID #AGA908)[7] was completed in December 1980. It is an 8-inch well drilled to a depth of 200 feet and screened between 185 and 200 feet depth with an 8-inch, 0.10-slot, stainless steel screen. Well 2 had a static water level 164 feet below land surface, and was pump tested at the time of construction at 42 gpm with 3 feet 1 inch drawdown after four hours of pumping. Based on well run-time hours pumped and metered water production between January 2011 and August 2017, Well 2 pumps at an average rate of approximately 184 gpm. FWSD Wells 1 and 2 are designated as a wellfield with DOH source number S03.

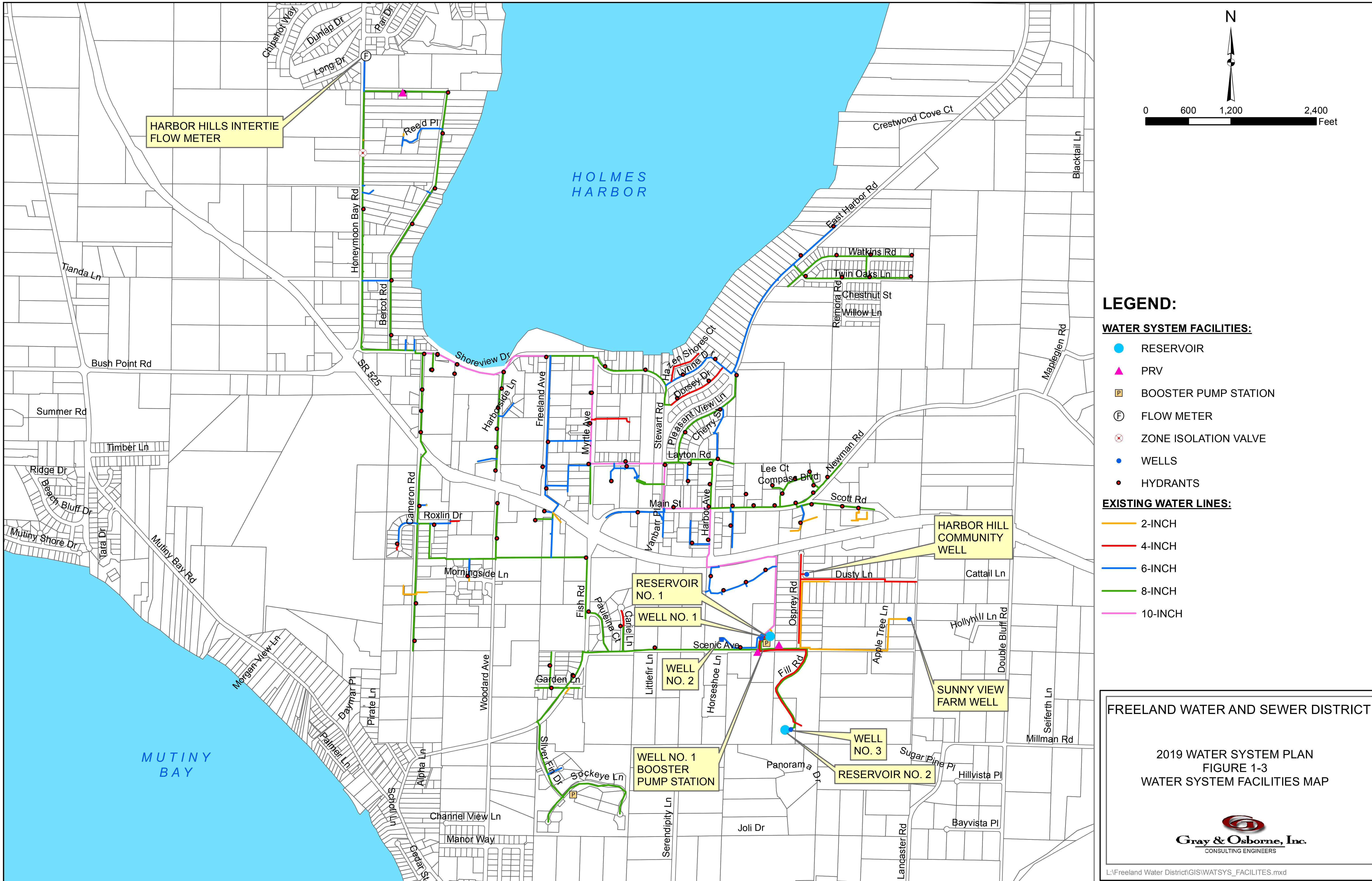
[7] The name on the Well 2 log is H. W. Stonebridge.

FWSD Well 3 (DOE ID #AFJ868)[8] was completed in July 2000. It is a 6-inch well drilled to a depth of 369 feet with a 6-inch 0.30-slot stainless steel screen between 357 and 368 feet depth. At the time it was drilled it had a static water level 321.5 feet below land surface and was pump tested at 90 gpm with 13 feet of drawdown after four hours of pumping. Well 3 has elevated levels of iron and manganese, which cause staining of household fixtures and laundry. For this reason Well 3 was used only minimally until 2011 when a treatment system was installed at the well site. Based on well run-time hours pumped and metered water production between January 2011 and August 2017, Well 3 pumps at an average rate of approximately 124 gpm.

FWSD also has an intertie with HHC water system. The intertie presently supplies water on a continuous basis to six FWSD residential customers that otherwise would experience low water pressure and could supply water on an emergency basis (e.g., fire flow) through a pressure reducing valve station to the FWSD system. The HHC water system operates at a higher HGL than the FWSD water system at the point of the intertie, and there is no pumping system at the intertie, so the intertie transfers water only from HHC water system to FWSD, but not vice versa.

SVF water system has one well, identified as SVF Well (DOE ID #ALQ382)[9]. SVF Well was completed in August 1994. It is a 6-inch well drilled to a depth of 235 feet and screened between 220 and 235 feet depth with a 6-inch, 0.10-slot, stainless steel screen. SVF Well had a static water level 203 feet below land surface, and was pump tested at the time of construction at 10 gpm with 5 feet of drawdown after two and a half hours of pumping. Metered production and run time data are not available for the SVF well. The production capacity of the SVF well is reported by FWSD to be 40 gpm.

[8] The name on the Well 3 log is David McClellan.
[9] The name on the SVF Well log is Steve Arnold.



FREELAND WATER AND SEWER DISTRICT

2019 WATER SYSTEM PLAN
FIGURE 1-3
WATER SYSTEM FACILITIES MAP

TABLE 1-2

Existing Water Sources

Source Name	DOH Source ID No.	DOE Well ID Tag No	Open Interval, Feet	Total Depth, Feet	Installed Pumping Capacity, gpm	Date Drilled	Applicable Water Rights
Well 1	S01 (1)	AGA907	242 – 252	260	163	1967	5825-A, G1-28039
Well 2	S02 (1)	AGA908	185 – 200	200	184	1980	5825-A, G1-28039
Well 3	S04 (1)	AFJ868	357 – 368	369	124	2000	G1-28039
HH Intertie	S05	N/A	N/A	N/A	Unknown	Completed 2014	N/A
Subtotal, FWSD Water System Source Capacity					**471**		
SVF Well	SVF S01	ALQ382	220 – 235	235	40	1994	G1-27463
Total Installed Capacity, FWSD and SVF Water Systems					**511**		

(1) Wells 1 and 2 are classified as wells in a wellfield. The wellfield, consisting of Wells 1 and 2, is identified as Source S-03.

Well logs for all of the above wells are included in Appendix B.

TREATMENT

All three FWSD water system wells are chlorinated. In addition, all three wells are filtered to remove manganese and iron. Wells 1 and 2 are chlorinated at the Well 1 well site. Well 3 is chlorinated at the Well 3 treatment building. Chlorination equipment consists of a chlorine feed tank and a chemical metering pump that feeds sodium hypochlorite into the water line when each well runs. The chlorination goal is a residual of 0.3 mg/L at the entry to the distribution system.

The SVF Well is not chlorinated and has no other form of water treatment.

WATER RIGHTS

The FWSD water system's current water rights documents are listed in Table 1-3. It should be noted that FWSD also owns the water rights for HHC; however, the place-of-use for the HHC water rights is restricted to the HHC service area until such time that an expanded place-of-use is approved by DOH and Ecology. The specific water rights for HHC are not discussed herein. Copies of the water rights documents can be found in Appendix C. Water right 5825-A is FWSD water system's oldest active water right with a priority date of September 20, 1965. This right was originally issued in 1967 for a well located within Lot 6 of the plat of Sunny View Farms, Section 14, Township 29 N, Range 2 E WM. In 1985 a certificate of change added a second well, and identified the wells as Well 1 and Well 2. Water right 5825-A allows withdrawal of up to 250 gpm and 168 ac-ft/yr from Wells 1 and 2.

Water right G1-27463 was issued in 1994 for the SVF water system with a priority date of May 4, 1994. FWSD purchased the SVF water system in 2008 and transferred this water right to FWSD in 2009. The SVF well is still the only point of withdrawal permitted under this right, and the SVF well is not currently connected to the FWSD water system. Water right G1-27463 allows withdrawal of up to 100 gpm and 80 ac-ft/yr from the SVF well.

Water Right G1-28039 was issued to FWSD in 2012 with a priority date of June 10, 1999. This right allows for withdrawal of up to 285 gpm and 262 ac-ft/yr from four wells, identified as Wells 1, 2, 3, and 4. The described location of Well 4 corresponds to the location of the SVF Well.

TABLE 1-3

Freeland Water and Sewer District Water Rights

Water Right Number	Priority Date	Points of Withdrawal	Location	Qi, gpm(1)	Qa, ac-ft/yr(1)(2)
5825-A(3)	9/20/1965	Well 1 and Well 2	Well 1: 600' E and 1,150' S Well 2: 1,200' E and 1,150' S from the NW corner of Sect. 14, T29N R2E	250	168
G1-28039	6/10/1999	Four Wells(4)	Well 1: NW 1/4 NW 1/4 Well 2: NE 1/4 NW 1/4 Well 3: SE 1/4 NW 1/4 Well 4 (SVF Well): NW 1/4 NE 1/4 All in Sect. 14, T29N R2E	285	262
Subtotal, FWSD Water System Rights				**535**	**430**
G1-27463(5)	5/4/1994	SVF Well	NW 1/4 NE 1/4, Sect. 14, T29N R2E	100	80
Total, FWSD plus SVF Water Rights				**635**	**510**

(1) Qi is the maximum instantaneous withdrawal rate allowed under the water right. Qa is the maximum annual withdrawal rate allowed under the water right.

(2) Ac-ft/yr is "Acre-feet per year." One acre-foot is the volume of water to cover an area of one acre to a depth of 1 foot, approximately 325,851 gallons.

(3) Water right certificate 5825-A was issued for a single well located at Lot 6, plat of Sunny View Farms, Section 14, T26N R2E. Certificate of change dated 12/10/1985 added a second well and specified the locations shown in Table 1-3.

(4) Water Right G1-28039 refers to four wells, however FWSD currently has only three wells. Well 4 refers to the Sunny View Farms well, which is currently not connected to the FWSD water system.

(5) Water Right G1-27463 was originally issued to Mr. Steve Arnold for Sunny View Farms (SVF) water system. This right is now owned by FWSD, although the SVF water system is not currently connected to the FWSD water system.

STORAGE

FWSD owns and operates two reservoirs. Both reservoirs are round, cast-in-place concrete. Reservoir 1 is 30 feet inside diameter by 39.15 feet tall, located north of Scenic Avenue near Well 1, at a ground elevation of approximately 245 feet. Reservoir 2 is 42-feet inside diameter by 20-feet tall, located south of Scenic Avenue near Well 3, at a ground elevation of approximately 320 feet. A summary of FWSD's water storage facilities is presented in Table 1-4. Further evaluation of effective reservoir capacity is included in Chapter 3.

TABLE 1-4

Storage Facilities

Name	Diameter, feet	Height, feet	Base Elevation, feet MSL(2)	Overflow Elevation, MSL	Date Constructed	Location	Nominal Capacity, gallons(1)
Reservoir 1	30	40	247	286.15	1990	Well 1 Site	212,000
Reservoir 2	42	20	325	344.5	2009	Well 3 Site	207,000
						Total	419,000

(1) Nominal capacity is the size of the reservoir used for reference purposes, and is approximately the total volume of the reservoir from floor to top of wall. The effective storage capacity of the reservoirs is less than the nominal capacity, as discussed in Chapter 3.
(2) MSL refers to elevation above Mean Sea Level.

TRANSMISSION AND DISTRIBUTION SYSTEM

The FWSD water distribution system consists of approximately 16.1 miles of water main ranging in size 2-inch to 10-inch diameter. The system is primarily one pressure zone, although there are actually two gravity pressure zones, two small boosted pressure zones, and a small zone pressurized from the HHC water system, in addition to the main zone. This is discussed in the following sections.

Pipe Inventory

The distribution system consists of a variety of pipe materials and sizes, including Asbestos Cement (AC), also known as "Transite" pipe, Polyvinyl Chloride (PVC), and High Density Polyethylene (HDPE), and sizes from 2-inch to 10-inch. A summary of pipe by size and material is shown in Table 1-5. The largest pipe size component by length is 8-inch pipe at 56.6 percent. The second largest component is 6-inch pipe at 24.2 percent. By material, the largest portion of the system PVC pipe at 83.3 percent, followed by AC pipe at 12.3 percent. The total estimated pipe length is 84,924 feet, which is approximately 16.1 miles of water main. A map of the water distribution system by piping material is presented in Figure 1-4.

TABLE 1-5

Existing Water Mains

Pipe Size, inches	AC, feet	PVC, feet	HDPE, feet	DI, feet	Totals, feet	Percent
2	35	2,534	0		2,569	3.0%
4	900	3,863	0		4,763	5.6%
6	3,260	17,325	0		20,585	24.2%
8	1,961	42,374	3,667	95	48,097	56.6%
10	4,274	4,636	0		8,910	10.5%
Totals, feet	10,430	70,732	3,667	95	84,924	100.0%
Percent	12.3%	83.3%	4.3%	0.1%	100.0%	

Pressure Zones

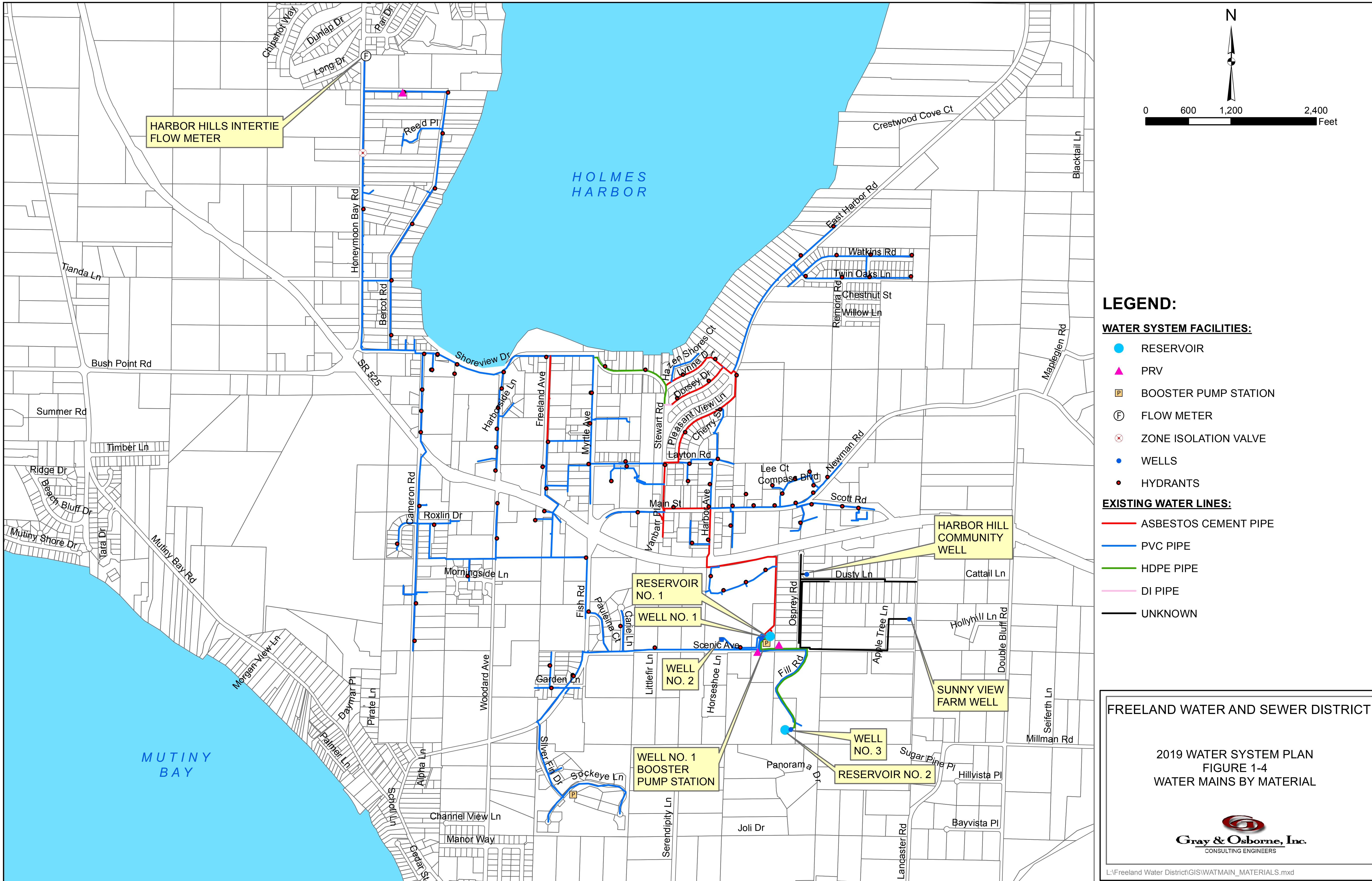
The FWSD water system operates primarily on a single pressure zone controlled by the water elevation in Reservoir 1. The overflow elevation of Reservoir 1 is 286.15 feet, so this main zone is referred to as the 286-foot pressure zone, although the operational water level in Reservoir 1 fluctuates between 284 and 285 feet during normal operation.

There are four additional small pressure zones. The first additional pressure zone is the area fronted by the water line between Reservoir 2 and Reservoir 1. With a Reservoir 2 overflow elevation of 344.5 feet, we will refer to this as the 344-foot pressure zone. This zone is fed by Well 3. This zone feeds the 286-foot pressure zone through a pressure reducing valve. There are currently no services on the 344-foot pressure zone.

A second additional pressure zone consists of a pump station located at the Well 1 site and a four-inch water main extending from the pump station to a house located immediately adjacent to Reservoir 2. The house is at an elevation of approximately 320 feet. If the district is maintaining a pressure of 50 psi at this house, then the Hydraulic Grade Line (HGL) for this zone is 435 feet. There are two residential services on this 435-foot pressure zone.

A third additional pressure zone is the higher elevations of the Fish Forest community, located off from Fish Road at the south end of the water system. The pump station is located at the intersection of Silver Fin Drive and Sockeye Lane, and boosts pressure for the six lots located on the northeast branch of Sockeye Lane. The highest elevation served by this pump station is approximately 230 feet. To maintain a minimum service pressure of 50 psi, the HGL for the Sockeye Lane pressure zone is 345 feet.

A fourth pressure zone is the north end of Honeymoon Bay Road and the west end of Bercot Road east of Honeymoon Bay Road. This section of the FWSD water system is isolated from the main system by a closed gate valve on Honeymoon Bay Road approximately 900 feet south of Bercot Road, and by a pressure reducing valve on Bercot



FREELAND WATER AND SEWER DISTRICT

2019 WATER SYSTEM PLAN
FIGURE 1-4
WATER MAINS BY MATERIAL

Road approximately 550 feet east of Honeymoon Bay Road. This zone is fed through a master meter from the HHC water system.

Pump Stations

The FWSD water system includes two pump stations: The Well 1 pump station and the Silver Fin Drive pump station.

Well 1 Pump Station

The Well 1 pump station, located at the Well 1 site, serves two residences on the 435-foot pressure zone described above. The elevation at the Well 1 site is approximately 246 feet. Therefore, to maintain a pressure of 50 psi at the house adjacent to Reservoir 2, the pump output pressure should be approximately 82 psi.

Silver Fin Drive Pump Station

The Silver Fin Drive pump station is located at the intersection of Silver Fin Drive and Sockeye Lane at an elevation of approximately 135 feet. The pump station consists of three pumps, controlled by a variable frequency drive. The system currently serves three residences, and has the potential to serve up to six total residences. The highest elevation served by this pump station is approximately 230 feet. To maintain a pressure of 50 psi at the highest water service, the HGL is 345 feet. The system must maintain a minimum output pressure of approximately 91 psi to maintain a HGL of 345 feet.

Pressure Reducing Stations

There are two pressure reducing stations in the FWSD water system. One is located at Reservoir 1, is solenoid activated, and allows water to flow from Reservoir 2 to Reservoir 1 when activated. The other is located at the north end of the system on Bercot Road, and allows water to flow from the HHC water system to the FWSD water system in the event of low pressure on the FWSD water system.

BACKUP POWER

A propane powered generator and manual transfer switch are located outside the Well 1 well house. The generator set is capable of providing the power needed for Well 1, the Well 1 booster pump system, the system telemetry, and the solenoid valve in the PRV station allowing water to be drawn from Reservoir 2 as needed in the event of a power outage. A separate backup power supply is also located at the Silver Fin Drive pump station.

RELATED PLANNING DOCUMENTS

The following documents were consulted in the preparation of this WSP:

State of Washington, Department of Water Resources, Water Supply Bulletin No. 25, Pleistocene Stratigraphy of Island County and Groundwater Resources of Island County, 1968

This document describes the geology and water resources of the Island County, including maps and geologic cross sections.

Davido Consulting Group, Inc., Comprehensive Water System Plan Update, December 2011

This document is the most recent complete water system plan prepared for the FWSD.

Island County Community Development, and Environmental Science Associates, Inc., Island County Comprehensive Plan, December 2016

This document makes official growth projections and evaluates resource needs to accommodate that projected growth.

Island County Coordinated Water System Plan

The Island County Coordinated Water System Plan was developed jointly by Island County water utilities. This document lays out general mutual goals of the water utilities, establishes water service areas for participating utilities, and outlines general procedures for revising service areas.

SERVICE AREA

Washington State Drinking Water Regulations, WAC 246-290, define three types of service areas as follows:

WAC 246-290-010 (218): **"Retail service area"** means the specific area defined by the municipal water supplier where the municipal water supplier has a duty to provide service to all new service connections as set forth in RCW 43.20.260.

WAC 246-290-010 (232): **"Service area"** means the specific area a water system currently serves and areas where future water service is planned. A wholesale system may include areas where it provides wholesale water to other public water systems in its service area.

> WAC 246-290-010 (115): **"Future service area"** means a specific area a water system in a Critical Water Supply Service Area plans to provide water service as determined by a written agreement between purveyors under chapter 70.116 RCW and chapter 246-293 WAC.

In the case of the FWSD water system, there are no wholesale water customers, so "water service area" and "retail water service area" are the same area.

The entirety of Island County has been declared a critical water supply service area, so FWSD Water System has a signed water service area agreement. The service area was most recently amended in December, 2010. A copy of that signed service area agreement is included in Appendix D. The map in the signed service area agreement indicates that HHC water system is owned by and is in the future water service area of FWSD water system, and also indicates the proposed Fletcher annexation. Therefore, it appears from the agreement that both HHC water system and the Fletcher annexation can be considered part of the FWSD water system service area agreement, and therefore part of the FWSD water system future service area. The map, however, does not indicate that either SVF water system or HH water system is in the existing or future FWSD water service area.

RETAIL SERVICE AREA

FWSD provides retail water service to FWSD water system, HHC water system, and SVF water system. However, since this water system plan is for only the FWSD water system and the SVF water system, the retail service area for this plan will be only the service areas of the FWSD water system and the SVF water system. Those areas are as shown in Figure 1-2. Since FWSD does not wholesale water to any other entity, the retail water service area is the same as the Service Area.

SERVICE AREA

As described above, the combined FWSD water system and SVF water system service area is the same as the combined FWSD water system and SVF water system retail service area, because FWSD does not wholesale water to any other water utility.

FUTURE SERVICE AREA

The future service area for FWSD consists of the service area in the 2010 CWSP water service area agreement, which includes the Fletcher Annexation and the HHC water system as indicated on the service area agreement map. Note that this area does not include the SVF water system, even though that area is in the retail water service area and in the service area. This indicates that the service area agreement needs to be updated to include the SVF water system.

SERVICE AREA CHARACTERISTICS

FWSD water system is located on Whidbey Island in Island County, at the south end of Holmes Harbor. Based on mapping available, the water service area is estimated at approximately 3.4 square miles. The district extends approximately 1.4 miles up the west side of Holmes Harbor and approximately 0.5 mile up the east side of Holmes Harbor, and it extends approximately 1.25 mile south of the south end of Holmes Harbor. The area is characterized as hilly lowlands. The highest point in the service area is the Reservoir 2 site at approximately 330 feet. The lowest elevation is sea level.

The center of Freeland between SR 525 and Holmes Harbor may be characterized as urban, with shopping centers, business parks, and suburban style housing. The remainder of the service are may be characterized as semi-rural to rural with lots ranging from 1 to 10 acres in size.

ZONING AND FUTURE LAND USE

A revised zoning map, dated June 18, 2019 was received from Island County Planning Department by email on December 30, 2020 and is included in Appendix E. The revised Table 1-6 shows the total land area within the FWSD service area by zoning category. The largest zoning category by area is Rural at 53 percent of the total service area. Zoning within the Freeland service area is shown in the new Figure 1-5 .

TABLE 1-6

REVISED Existing Zoning

Zoning	Area, Acres	Percent
Business General	95.43	7.10%
Business Village	56.14	4.17%
Light Industrial	11.8	0.88%
Low Density Residential	111.34	8.28%
Medium Density Residential	72.99	5.43%
Non-Residential Mixed Use	81.89	6.09%
Parks	9.73	0.72%
Rural	710.24	52.82%
Rural Agricultural	103.69	7.71%
Rural Forest	91.45	6.80%
Total	**1344.7**	**100%**

The new Figure 1-5 also shows the new Freeland urban growth boundary. In 2019, the Freeland Non-Municipal Urban Growth Area (NMUGA) was reduced to 439 acres, encompassing only typical urban land uses, as identified in the revised Table 1-7.

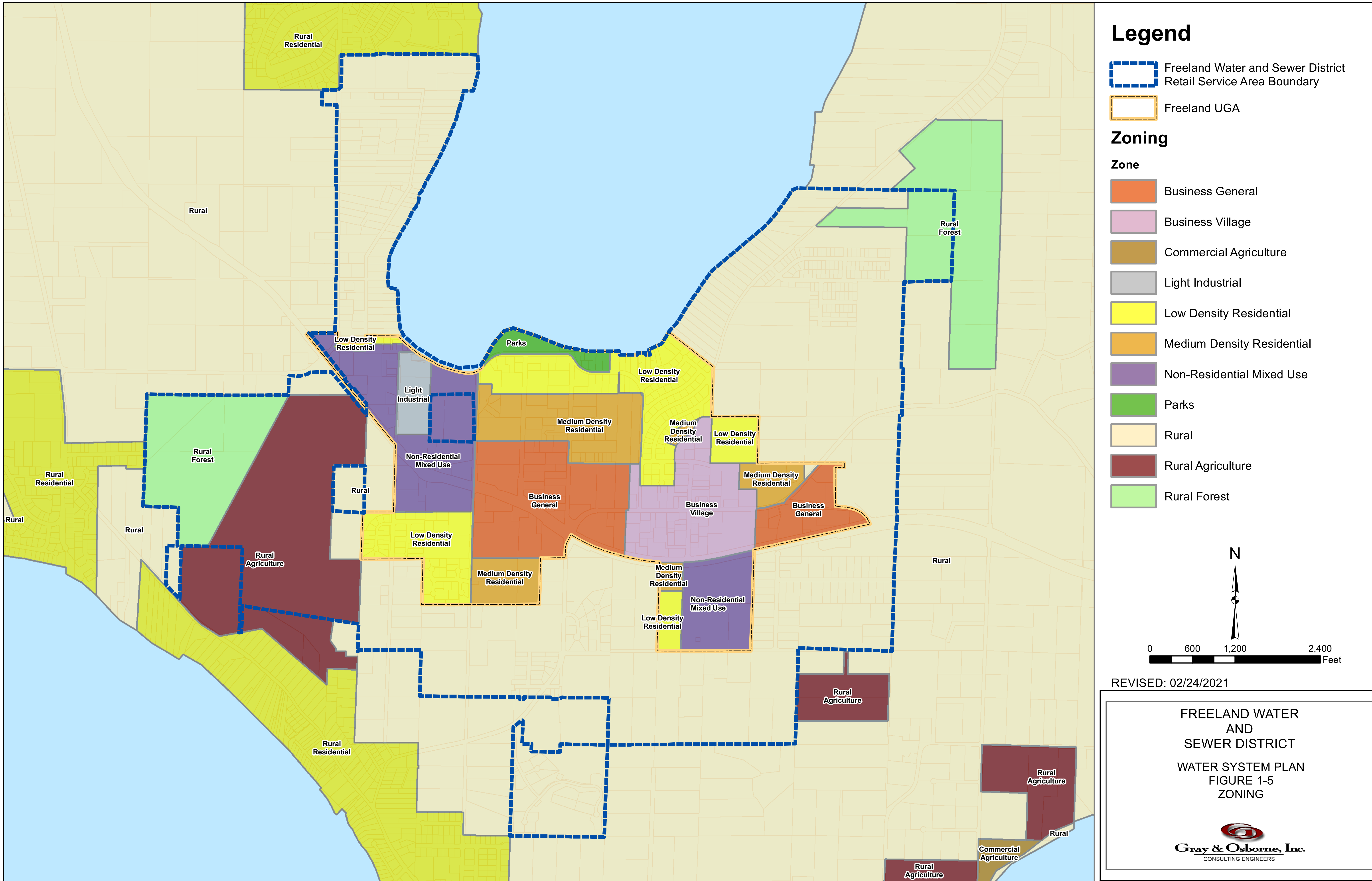


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TABLE 1-7

REVISED Future Land Use within the Freeland NMUGA

Future Land Use	Area, Acres	Percent
Business General	95.43	22%
Business Village	56.14	13%
Light Industrial	11.8	3%
Low Density Residential	111.34	25%
Medium Density Residential	72.99	17%
Non-Residential Mixed Use	81.89	19%
Parks	9.73	2%
Total	**439.32**	**100%**

SERVICE AREA POLICIES

ANNEXATION

The FWSD annexation policies are detailed in the District's Resolution No. 2013-02-008 dated February 11, 2013, a copy of which is included in Appendix F. In addition, because the Water Utility Coordination Act is in place in Island County, annexations outside the Service Area designated in the signed service area agreement will require a revised service area agreement. If the annexation is outside the District's current service area agreement, then the service area agreement must be amended through the Water Utility Coordination Act Process. Resolution No. 2013-02-008, Section 5.02 - General Facilities Charge reads, in part as follows:

> "If any property or parcel, regardless of zoning, is not within the District Boundaries, then an additional General Facilities Charge of $3,000 is required above the normal General Facilities Charge for each service connection. …"

Also, the fourth paragraph under Section 5.04 – Water Use Rates, reads as follows:

> "In addition, the monthly or periodic regular base rate and consumption charges for new service to properties outside the District Boundaries shall be three times the amount applicable to properties within the boundaries of the District. Any service to properties outside the boundaries of the District shall be at the sole discretion of the District and may only be approved by the District Board at a public meeting. In all such cases the owners of the applicable properties shall submit a signed annexation petition and/or agreement in such form as acceptable to the District."

In summary, the District will provide service outside its legal boundaries provided that the new service is within the area designated in the District's current signed service area agreement, agrees to petition to be annexed, and that they are subject to additional fees until they do annex.

With approval of this Water System Plan, the District has adequate water available for forecasted growth within the service area for at least the next 20 years. District Regulation 1.03 identifies the forms and approvals that may be required for new hookups to an existing water main, for developer extension agreements where an existing main is not available, and for service outside the District boundaries. New connections are authorized after completion of a Water Application Agreement form; in most cases, connections are approved within two weeks.

Developer extensions, including provisions for repayment of initial investment by subsequent connections, are subject to approval of the Developer Extension request. Developer extension approvals may take several months, depending how completely plans are presented and the degree to which they comply with District technical specifications. Forms are available on the District website that identify the conditions and responsibilities that apply to new connections and developer extensions.

CROSS-CONNECTION CONTROL

A Cross-Connection Control Program is required by regulation (WAC 246-290-490) to reduce the potential for system contamination through backflow from potential contaminant sources. The Cross-Connection Control Program is addressed in Chapter 6 of this WSP. All new water service connections are required to sign a cross connection control agreement as part of their service connection application. A copy of the FWSD Application for Water Service is included in Appendix F. A copy of the FWSD Cross Connection Control resolution is included in Appendix N. Cross connection control is discussed further in Chapter 6 of this Water System Plan.

DIRECT CONNECTION POLICY

FWSD currently owns three separate water systems: FWSD water system, HHC water system, and SVF water system. FWSD may consider acquiring other existing water systems on a case by case basis in the future if it serves FWSD's interests. However, FWSD does not plan to own or operate any new satellite water systems for serving new subdivisions. New water services must be connected directly to one of FWSDs existing water systems.

PRIVATE OR PUBLIC WELLS

As a special purpose district, FWSD does not have authority to control construction of new wells within or near their service area. That authority rests with the Island County planning, health, and building departments. Provisions of the Water Utility Coordination

Act, which has been adopted for the entirety of Island County, limit the ability to form new public water systems within or near the water service area of an existing water system and allow the District to have the first right of refusal to provide service. Well sanitary control area requirements, septic tank and drainfield setback requirements, and requirements for reserve drainfield areas limit the ability to drill private wells on lots smaller than about one acre. On-site soil conditions, slopes, and other factors, as well as number of bedrooms in a house affect the required drainfield and reserve drainfield area, and therefore, the minimum lot size required for a private well. But if an individual property owner has adequate property to meet the setback, drainfield and reserve drainfield requirements, there is no other rule that would prevent private wells from being drilled within the FWSD service area.

DESIGN AND PERFORMANCE STANDARDS

The District will follow the DOH Water System Design Manual as minimum standards. Distribution improvements are to be designed in accordance with the policies and standards identified in Chapter 7 of this water system plan.

FORMATION OF LOCAL IMPROVEMENT DISTRICT

The District does not engage in nor approve the formation of ULIDs outside its boundaries. The District considers this to be contrary to state law, and therefore, inconsistent with the District's Rules and Regulations. See the "District Rules and Regulations" document included in Appendix F.

LATECOMER AGREEMENTS

The District's Rules and Regulations in Appendix F provide for the execution of "Recovery Contracts" between the District and Developer/Owners making capital improvements such as main extensions within the District Boundaries. Such contracts provide for the collection and disbursement of fair pro-rata costs from present or future owners of non-participating benefiting properties for a period not to exceed 15 years. Developer owners wishing to execute recovery contracts with the District must submit proposals for same within 90 days after final conveyance and acceptance of a project by the District.

INDIVIDUAL BOOSTER PUMPS

Although the District does not allow the installation of individual booster pumps, state regulations allow individual booster pumps for existing properties along existing distribution mains, where the main has a normal operating pressure in excess of 30 psi. In this case, the property owner shall be responsible for all costs of the booster pump system and shall be required to install a backflow prevention device on the private side of the service meter. The backflow device must then be tested on an annual basis in accordance with the District's Cross Connection Control Program. Where operating pressure is below 30 psi, WAC 246-290-230(8) requires the District to own and operate individual booster pumps on an interim basis until such a time that operating pressures can be brought into compliance. Properties within new developments can utilize private individual booster pumps if the new distribution main along the frontage of the property is designed to provide 30-psi at Peak Hour Demand. The backflow prevention requirements apply to these cases as well.

OVERSIZING

The District Rules Section 2.02 contain provisions to permit the District to require sizing of mains and facilities beyond that normally required for the project at hand. "Over-sizing" may also include the provision of additional storage or other facilities and/or easements as needed. When over-sizing benefits more of the District than just the developer/owner project lands, the rules provide for the District to pay the difference in costs associated with such over-sizing.

REMOTE SYSTEMS

The District currently owns three separate water systems, but acquired two of these systems after they were constructed and in operation for many years.

SURCHARGE FOR OUTSIDE CUSTOMERS

As discussed under Annexation Policy FWSD has a higher connection fee rate for new services outside the District boundaries, and has a higher water use rate for existing connections outside District boundaries.

UNDERSIZED MAIN REPLACEMENT

If a District owned water main is identified as deficient (through modeling or flow tests), FWSD assumes responsibility for upsizing the main as required for sufficient flow capacity. The prioritization of undersized main replacement projects (when applicable) is identified in the WSP Capital Improvement Program (CIP) based upon overall benefit to customers as well as level of inadequacy of the flow condition.

WATER WHEELING

Water wheeling is the practice of selling or buying water to or from a water system by using the piping network of a third water system. There is no potential for water wheeling in the Freeland area.

WHOLESALING OF WATER

Routine wholesale of water to existing water systems is not anticipated due to the relative proximity of other water systems.

COMPLAINTS

Policy for Dealing with Complaints

Complaints are forwarded to the District administration for investigation. The District administration makes contact with the complainant, when necessary, investigates the complaint, resolves the complaint when possible, or recommends a solution to the Board of Commissioners. The District Manager is responsible for resolving the complaint, contacting the complainant regarding the resolution of the complaint, and recording the resolution of the complaint in the complaint log. Complaints unresolved by the District Manager may be appealed to the Board of Commissioners.

Complaint Record Keeping

All complaints are promptly referred to and handled by Whidbey Water Services. A log of complaints is kept at Whidbey Water Services Business Office. If necessary, the system operator is dispatched to investigate the complaint. However, most contacts are in regard to billing matters.

CHAPTER 2

BASIC PLANNING DATA

OBJECTIVE

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

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

HISTORIC AND PROJECTED POPULATION

The Island County Comprehensive Plan (ICCP), updated December 13, 2016, includes population allocations to Freeland Non-Municipal Urban Growth Area (NMUGA) in Appendix B of that plan. Table B-30 indicates a planned population increase of 144 people from a population of 514 in 2010 to a population of 658 in 2036, an average annual growth rate of 0.95 percent per year. However, the NMUGA as shown in Map 1I of the ICCP does not include all of the FWSD water service area, and the WFI for FWSD water system, updated 4-13-2017, indicates a population served of 1,252, over double the ICCP estimate of 514 in the Freeland NMUGA as 2010. Therefore, to establish a grow rate for the FWSD water system it will be necessary to estimate the growth rate of the population served by the FWSD water system outside the Freeland NMUGA and add this to the population inside the Freeland NMUGA.

Using the ICCP estimate of a population of 514 in the Freeland NMUGA in 2010 and a 0.95 percent annual growth rate, the 2017 population of Freeland NMUGA is estimated at 549. Subtracting that number from the total population served, as stated in the current FWSD WFI, leaves an estimated population of 703 served by FWSD water system outside the Freeland NMUGA in 2017. Exhibit 3-1 of the ICCP projects a population increase in the South Whidbey Planning Area from 13,630 in 2010 to 14,841 in 2036, an annual growth rate of 0.33 percent. Applying this growth rate to the estimated population of 703 served by FWSD water system outside the Freeland NMUGA in 2017 yields an estimated population of 748 to be served by the FWSD water system outside the Freeland NMUGA by the year 2036. Adding this to the projected population of 658 within the Freeland NMUGA in 2036 yields an estimated population of 1,406 to be served by the FWSD water system in 2036. An increase from the 2017 population of 1,252 to a projected population of 1,406 served in 2036 is a total population increase of 154, and an average annual growth rate of 0.61 percent. This population growth rate estimate is summarized in Table 2-1.

TABLE 2-1

Projected Service Area Population and Growth Rate

Source	Year	Estimated Population
ICCP[1], Appendix B, Table B-30, Freeland NMUGA[2] population.	2010	514
ICCP, Appendix B, Table B-30, Freeland NMUGA population.	2036	658
Annual Growth Rate within Freeland NMUGA based on above.	2010 – 2036	0.95%
Estimated population within Freeland NMUGA population based on above.	2017	549
FWSD Water Facilities Inventory form updated 4-13-2017.	2017	1,252
Estimated population served by FWSD water system outside the Freeland NMUGA.	2017	703
ICCP Exhibit 3-2 Island County Planning Area Population Growth – Baseline/Alternative 1, South Whidbey planning area.	2010	13,630
ICCP Exhibit 3-2 Island County Planning Area Population Growth – Baseline/Alternative 1, South Whidbey planning area.	2036	14,841
South Whidbey planning area average annual growth rate based on above.	2010 – 2036	0.33%
Estimated population served by FWSD water system outside the Freeland NMUGA based on 2017 population and 0.33 percent annual growth rate.	2036	748
Total estimated population served by FWSD Water System.	2036	1,406
Estimated annual growth rate for FWSD Water System to increase from 1,252 in 2017 to 1,406 in 2036.	**2017 – 2036**	**0.61%**

(1) ICCP is Island County Comprehensive Plan 2016 Periodic Review.
(2) NMUGA is Non-Municipal Urban Growth Area.

Based on this analysis, an estimated **annual growth rate of 0.61 percent** will be applied to future population, number of water services, and water demands for projecting system needs into the future. Projected population inside and outside the Freeland NMUGA, and total projected population are shown in Figure 2-1.

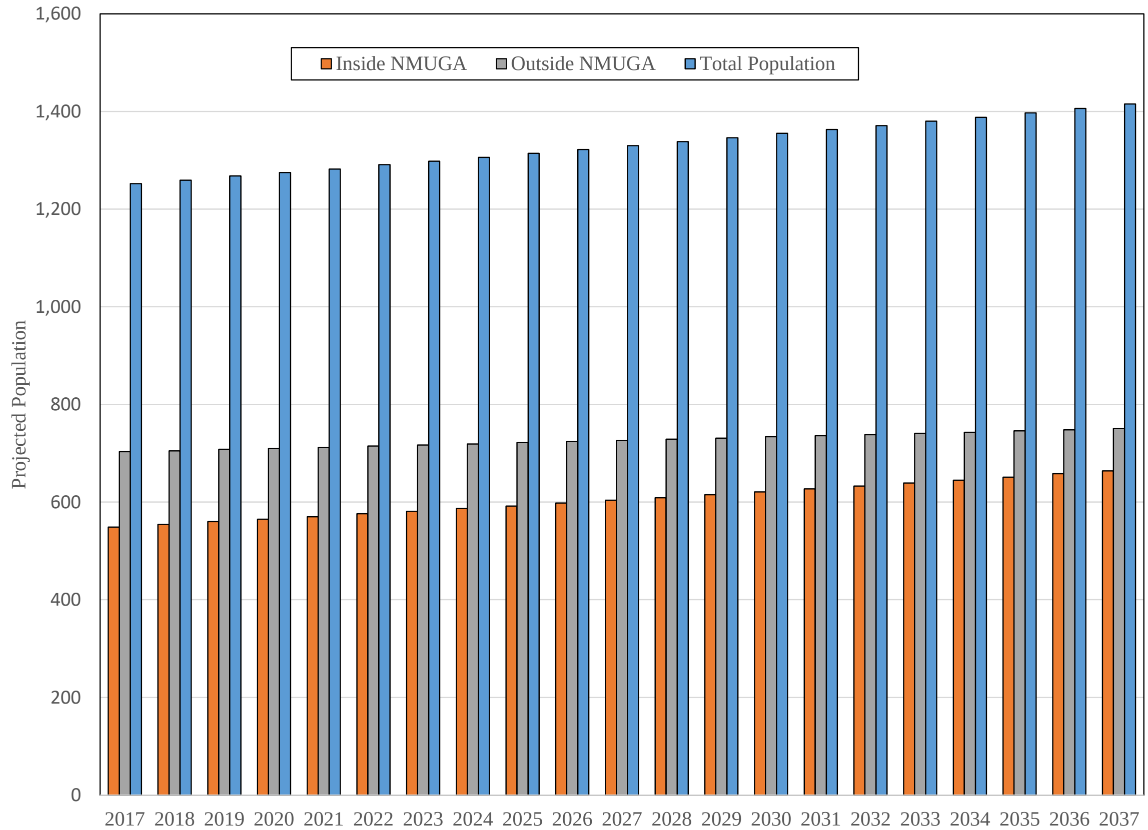


FIGURE 2-1

Projected Service Area Population

CURRENT SERVICE CONNECTIONS

During 2017, FWSD served a total of 587 active service connections including 486 active residential connections and 101 active commercial connections.

TABLE 2-2

FWSD Active Service Connections in 2017

Customer Description	Active Service Connections	Percent of Total
Residential	486	82.8%
Commercial	101	17.2%
Total Active Connections	**587**	**100.00%**

WATER PRODUCTION

MONTHLY PRODUCTION BY SOURCE

Monthly water production by source is shown in Figure 2-2. It can be seen that the distribution of production between the wells varied over time. On the average Well 1 produced approximately 44 percent of the total, Well 2 produced approximately 32 percent of the total, and Well 3 produced approximately 24 percent of the total. However, it can be seen that the production of Well 1 dropped off from late 2016 through the middle of 2017, and picked again up after that. As stated in Chapter 1, Well 1 was rehabilitated in 2017, which corresponds with this temporary reduction in production from Well 1.

The data shows a clear increase in water production beginning in summer 2015 and continuing through the end of the data period. The reason for this increase is not known.

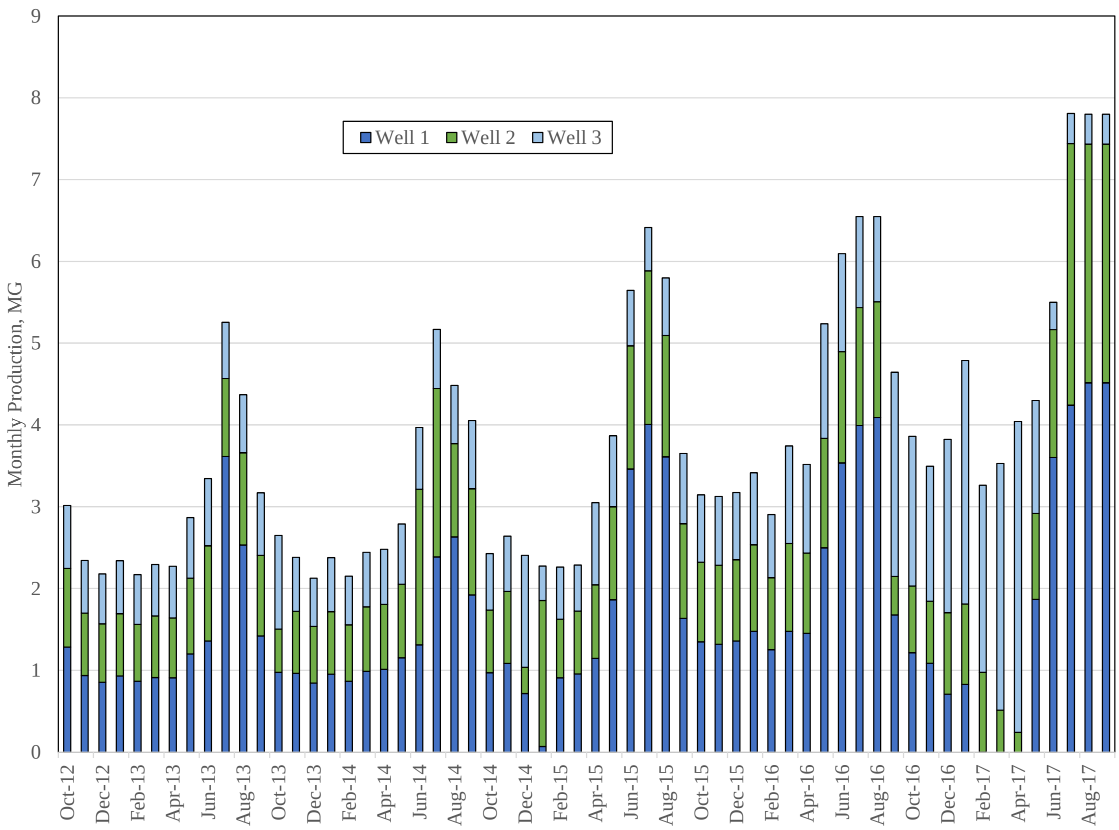


FIGURE 2-2

Monthly Water Production by Source

TOTAL ANNUAL PRODUCTION

Annual water production is summarized in Table 2-3. The table shows a steady increase in total production from 2011 through 2017. The lowest production year was 2011, and the highest production year was 2017.

TABLE 2-3

Annual Water Production Records

	Well 1		Well 2		Well 3		Totals	
Year	**MG**	**Ac Ft**	**MG**	**Ac Ft**	**MG**	**Ac Ft**	**MG**	**Ac Ft**
2011	10.75	32.99	17.38	53.32	4.56	14.00	32.69	100.32
2012	15.23	46.73	11.73	35.98	7.69	23.60	34.65	106.32
2013	16.52	50.71	10.07	30.91	8.63	26.49	35.23	108.12
2014	15.99	49.07	12.30	37.76	9.10	27.91	37.39	114.74
2015	21.68	66.54	14.26	43.76	8.75	26.84	44.69	137.14
2016	24.46	75.05	12.59	38.64	16.78	51.50	53.83	165.20
2017	24.08	73.91	17.28	53.04	15.26	46.84	56.63	173.79
Minimum	10.75	32.99	10.07	30.91	4.56	14.00	32.69	100.32
Maximum	24.46	75.05	17.38	53.32	16.78	51.50	56.63	173.79
Average	18.39	56.43	13.66	41.92	10.11	31.03	42.16	129.37
Percent	44%		32%		24%		100%	

(1) MG is million gallons produced for the indicated year.
(2) Ac-Ft is Acre-feet produced for the indicated year. One ac-ft is approximately 325,851 gallons.

MAXIMUM DAY PRODUCTION

Monthly water production records are available, as shown in Figure 2-2, but daily production records are not available. Based on the December 2009 edition of the DOH Water System Design Manual, Section 5.2.1, when daily water production data is not available, maximum day demand in Western Washington is to be estimated as 1.7 times maximum month demand. Maximum month and average month production, maximum month to average month ratio, and estimated maximum day to average day ratio based on the 1.7 factor from the DOH Water System Design Manual, are shown in Table 2-4. Annual maximum day to average day ratios based on this methodology range from 2.48 to 3.04. Since the purpose of the estimated maximum day demand is to size equipment and facilities to meet system demands at critical times, the highest maximum demand in Table 2-4 will be used to represent the maximum day to average day water demand ratio for the FWSD water system. **Maximum Day to Average Day Ratio is Estimated at 3.04.**

TABLE 2-4

Estimated Average Day to Maximum Day Ratio

Year	Maximum Month, MG	Average Month, MG	Maximum Month to Average Month Ratio	Estimated Maximum Day to Average Day Ratio (1)
2011	4.68	2.72	1.72	2.92
2012	4.22	2.89	1.46	2.49
2013	5.26	2.94	1.79	3.04
2014	5.17	3.04	1.70	2.89
2015	6.41	3.72	1.72	2.93
2016	6.55	4.49	1.46	2.48
2017	7.81	4.72	1.65	2.81
			Maximum	**3.04**

(1) Estimated Maximum Day to Average Day Ratio is 1.7 times Maximum Month to Average Month Ratio.

WATER USE

WATER SALES BY CUSTOMER CLASS

FWSD has two water customer classes; residential and commercial. FWSD also keeps monthly records of water used for miscellaneous purposes such as water main flushing, construction work, hydrant testing, and firefighting. Until 2018, FWSD read residential water service meters and billed for water service on a trimonthly schedule, and read commercial water meters and billed for commercial water use on a bimonthly schedule. All meters are now read and billed trimonthly. Billing periods are January – March, April – June, July – September, and October – December. Historical monthly residential and commercial water use are estimated in Figure 2-3 by proportioning the trimonthly and bimonthly billing totals to the monthly water production records, and monthly miscellaneous water uses are added to the estimated water sales data. Estimated monthly water sales by customer class are shown in Figure 2-3 for the period of October 2012 through September 2017.

Comparing Figure 2-3 to Figure 2-2, Figure 2-3 does not show a water use increase in 2016 and 2017 corresponding to the water production increase for 2016 and 2017 apparent in Figure 2-2. The cause for this increase in water production relative to water use is not entirely known. It is known that there was a malfunction in the Well 3 control that resulted in an overflow at Reservoir 2 that lasted for several months, and would have contributed to this discrepancy between production and usage for at least part of this time. Other possibilities that could contribute to this discrepancy include replacement of a source meter resulting in an increase of previously under-reported water production, or that the distribution system has developed a new leak that has not been located.

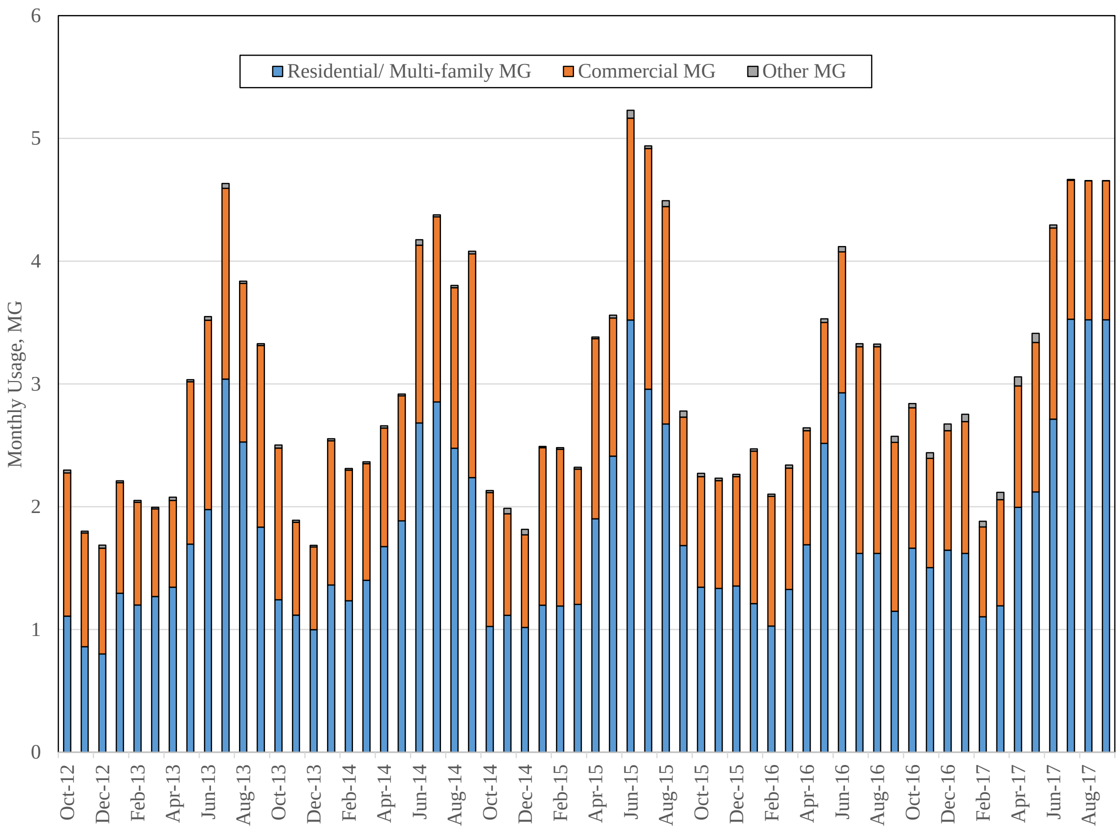


FIGURE 2-3

Water Use by Customer Class

Annual water usage and percent by customer class are shown in Table 2-5 for 2013 through 2017.

TABLE 2-5

Annual Water Usage by Customer Class

Year	Residential Use, MG	Percent Residential	Commercial Use, MG	Percent Commercial	Other Use, MG	Percent Other	Total Use, MG
2013	19.53	59.6%	13.02	39.7%	0.24	0.7%	32.79
2014	20.96	59.6%	13.93	39.6%	0.28	0.8%	35.17
2015	22.77	59.2%	15.35	39.9%	0.32	0.8%	38.44
2016	19.89	57.9%	14.10	41.0%	0.39	1.1%	34.38
2017(1)	26.12	66.2%	12.84	32.5%	0.49	1.2%	39.44

(1) At the time of this writing water use data for October through December 2017 was not yet available. Therefore, water sales for 2017 are based on data from October 2016 through September 2017.

Average Residential Water Use Rate

Total annual residential water use and average number of active residential connections for 2013 through 2017 are shown in Table 2-6. Table 2-6 summarizes average day residential water use. Note that the number of residential service connections in Table 2-6 is the annual average number of active residential service connections, which is not the same as the year-end service connections shown in the Water Facilities Inventory. Average number of connections is used in Table 2-6 because it better relates to the total year water use. Average day residential water use ranged from 128 gpd per connection in 2016 to 160 gpd per connection in 2015. The average from 2013 through 2017 is 149 gpd per connection. **The average use rate of 149 gallons per connection per day is the current calculated equivalent residential unit (ERU) value for the FWSD water system.**

TABLE 2-6

Average Single-Family Residential Water Use

Year	Residential Use, MG	Average Active Residential Connections	Days	Average Day Water Use, gpd per Connection
2013	19.53	356	365	150
2014	20.96	364	365	158
2015	22.77	389	365	160
2016	19.89	424	366	128
2017	26.12	483	365	148
			Average	**149**

MAXIMUM DAY DEMAND PER ERU

As discussed above under the heading, *Maximum Day Production*, the estimated maximum day to average day ratio for the FWSD water system is 3.04. With an average day demand per ERU of 149 gpd per residential connection, the **maximum day demand is estimated at 453 gpd per ERU.**

PEAK HOUR DEMAND

Peak Hour Demand (PHD) is a value that applies to the system as a whole, not to any individual service, and is estimated using Equation 5-3 from the Water System Design Manual. This formula estimates peak hour system demands, *not including fire flow*:

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

Where

PHD = Peak Hour Demand, gallons per minute
C = Coefficient from Water System Design Manual Table 5-1
N = Number of ERUs served
F = Factor from Water System Design Manual Table 5-1
MDD = Maximum Day Demand per ERU, gpd

For a system with more than 500 service connections, C and F are: 1.6 and 225, respectively. As derived above, MDD for the FWSD water system is 453 gpd per ERU. Inserting these numbers into the above equation yields the following:

PHD = (453/1440)[(1.6)(N)+225]+18

This equation simplifies to the following:

PHD = 0.50 x N + 89

Water system demand factors are summarized in Table 2-7.

TABLE 2-7

Summary of Water Demand Factors

Demand Factor	Value
Average Day Demand per ERU, gpd	149
Maximum Day Demand per ERU, gpd	453
Maximum Day to Average Day Factor	3.04
Peak Hour Demand, gpm System-Wide	PHD = 0.50 x N + 89

DISTRIBUTION SYSTEM LEAKAGE

The difference between metered water production and accounted-for water is *Distribution System Leakage* (DSL). Distribution System Leakage was previously referred to as “Lost and Unaccounted-for Water,” a term that acknowledges the uncertainty regarding the cause for the difference between metered water production and total accounted-for water. Lost and unaccounted-for water includes water leakage, unmetered water use that is not accurately estimated or recorded, metering errors due to inaccurate water service meters, accounting errors, and water taken from the system without authorization (water theft). By the Municipal Water Supply Efficiency Requirements Act of 2003, Washington State Legislature defined the difference between metered water production and metered and otherwise accounted-for water use as *Distribution System Leakage*. For consistency with State statute, we will use the term *Distribution System Leakage*¸ or DSL, for the remainder of this document.

Monthly production, sales and DSL are depicted in Figure 2-4. The blue bars represent water sales and the gold bars represent DSL. The overall height of each blue and gold bar stack represents water production for each billing period. Gold bars appearing below the blue bars represent negative DSL, which occurs when metered water sales exceed metered water production. This can occur if there are sources contributing to the water system that are not accounted for, if source meters are under-reading, or if there are problems with the water accounting system. Note that all instances of negative DSL occurred prior to May 2015.

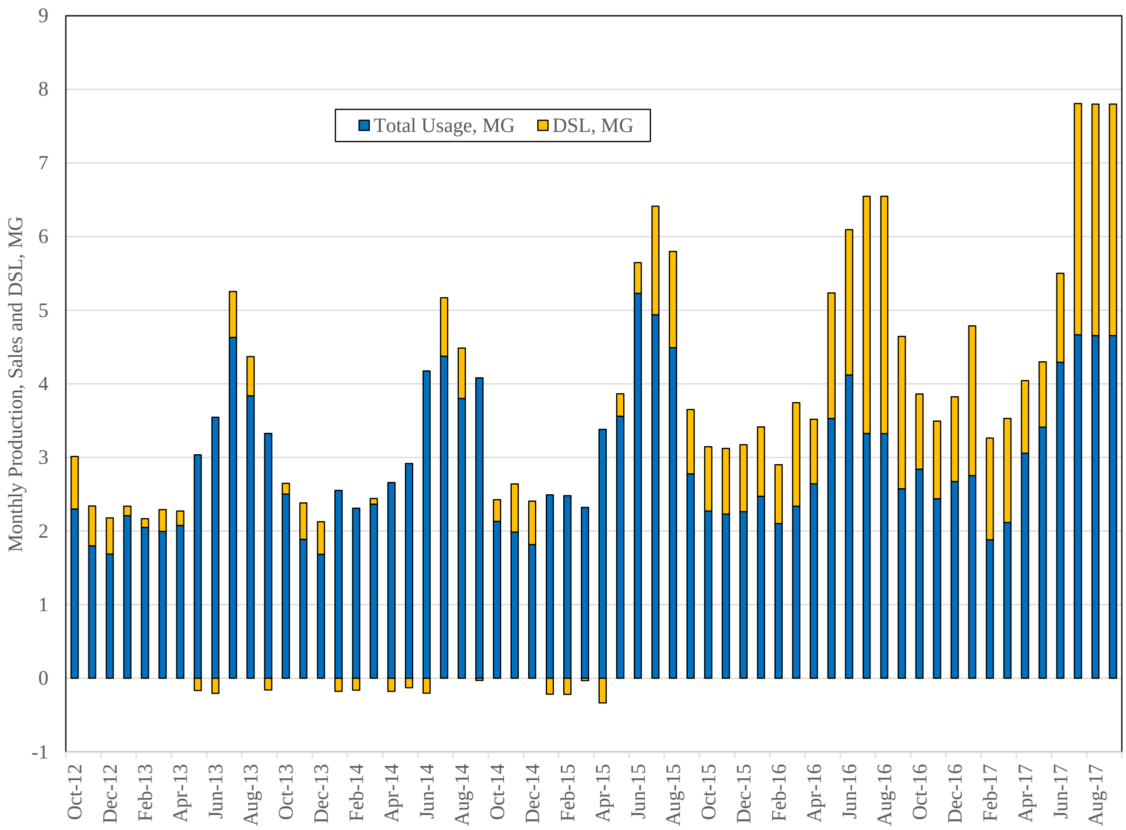


FIGURE 2-4

Water Production, Sales and DSL

Annual DSL is summarized in Table 2-8. DSL has varied over the data period from a low of 2.22 MG per year in 2014 to a high of 19.45 MG per year in 2016. Percent DSL varied from a low of 5.93 percent in 2014 to a high of 36.13 percent in 2017. The 3-year average percent DSL has varied from 9.30 percent for 2013 through 2015, to a high of 27.64 percent for 2015 through 2017.

TABLE 2-8

Annual Distribution System Leakage

Year	Production, MG	Sales, MG	DSL, MG	Annual Percent DSL	3-Year Percent DSL
2013	35.23	32.79	2.44	6.94%	
2014	37.39	35.17	2.22	5.93%	
2015	44.69	38.44	6.25	13.99%	9.30%
2016	53.83	34.38	19.45	36.13%	20.54%
2017	56.63	39.44	17.19	30.35%	27.64%

EQUIVALENT RESIDENTIAL UNITS

As described above under the heading *Average Residential Water Use Rate*, the value of an ERU for the FWSD water system for the current planning period is 149 gallons per day, based on the average use per residential connection over a five-year period. For single-family residential water connections, each active meter represents one ERU served, regardless of actual water use for a given year. From Table 2-2, there were 486 residential connections, and, therefore, 486 residential ERUs in 2017.

For non-residential water use, the number of ERUs represented is determined by dividing the annual average day water demand by the ERU value of 149 gpd per ERU. Table 2-5 shows 12.84 MG of commercial water use in 2017, which is an average of 35,178 gallons per day of commercial water use. Dividing this by 149 gpd per ERU yields 236 commercial ERUs for 2017. Thereby, the 101 commercial connections shown in Table 2-2 represent 236 ERUs, and the total metered water use represents 722 ERUs.

Table 2-5 shows 0.49 MG of other water use. This includes water main flushing, hydrant testing, construction water use, and firefighting. A volume of 0.49 MG for the year is an average of 1,342 gpd. Dividing this by 149 gpd per ERU yields 9 ERUs of miscellaneous water use.

Table 2-3 shows a total of 56.63 MG of water production in 2017. Table 2-5 shows a total of 39.44 MG of water use in 2017. Table 2-8 shows that the difference between these two is 17.19 MG, which is defined as Distribution System Leakage, or DSL. 17.19 MG for the year 2017 is an average of 47,096 gpd. Dividing this by 149 gpd per ERU yields a DSL equivalent of 316 ERUs.

Adding the 486 residential ERUs, the 236 commercial ERUS, the 9 miscellaneous ERUs, and the 316 DSL ERUS yields a total of 1,047 ERUs of water produced by the system in 2017. 2017 ERUs are summarized in Table 2-9.

TABLE 2-9

Equivalent Residential Connections for 2017 Water Use

Customer Class	2017 Average Daily Water Use, gallons	2017 Average Number of Active Services	2017 Average Gallons per Service per Day	2017 ERUs
Metered Water Use				
Residential[(1)]	71,567	486	147	486
Commercial	35,167	101	348	236
Subtotal, Metered Water Use	106,733	587	182	722
Estimated Unmetered Water Use				
Other Use	1,329	0	NA	9
Total Usage	**108,062**	**587**	**184**	**731**
Estimated Non-Use				
DSL	47,085	0	NA	316
Totals	**155,147**	**587**	**264**	**1,047**

(1) Residential services are always one ERU per service, regardless of individual usage rates or changes in usage rate from year to year. From Table 2-6 it can be seen that the average day residential usage for 2017 was 148 gpd per connection, which is less than the five-year average ERU value of 149 gpd per ERU.

FUTURE SYSTEM DEMANDS

As shown in Table 2-1 and Figure 2-1, the FWSD water system service area population is projected to grow by an overall average of 0.61 percent per year. For purposes of water demand projections we will assume that residential and commercial water use ERUs will increase at the same rate. Therefore, the system ERUs are projected to grow at a rate of 0.61 percent per year. If actual growth of either residential or commercial ERUs is different from this growth projection, then facilities needed to accommodate the growth may need to be rescheduled accordingly in later water system plan updates.

PROJECTED ERUS AND SOURCE REQUIREMENT

To estimate future system demands, it is assumed that the 316 DSL ERUs will remain constant and the 731 non-DSL ERUs will increase at the system growth rate of 0.61 percent per year. In Chapter 4 of this plan an evaluation will be provided of system demand if DSL is reduced. Based on projected ERUs, water system demands are estimated using the water demand factors from Table 2-7. Projected ERUs and system demands are shown in Table 2-10.

TABLE 2-10

Projected ERUs and System Demands

Year	Projected ERUs[(1)]	Average Day Demand, gpd[(2)]	Maximum Day Demand, gpd[(3)]	Peak Hour Demand, gpm[(4)]	Annual Demand, ac-ft/yr[(5)]
2017	1,047	156,000	474,000	613	175
2018	1,051	157,000	476,000	615	176
2019	1,056	157,000	478,000	617	176
2020	1,060	158,000	480,000	619	177
2021	1,065	159,000	482,000	622	178
2022	1,070	159,000	485,000	624	178
2023	1,074	160,000	487,000	626	179
2024	1,079	161,000	489,000	629	180
2025	1,083	161,000	491,000	631	180
2026	1,088	162,000	493,000	633	181
2027	1,093	163,000	495,000	636	183
2028	1,098	164,000	497,000	638	184
2029	1,102	164,000	499,000	640	184
2030	1,107	165,000	501,000	643	185
2031	1,112	166,000	504,000	645	186
2032	1,117	166,000	506,000	648	186
2033	1,122	167,000	508,000	650	187
2034	1,127	168,000	511,000	653	188
2035	1,131	169,000	512,000	655	189
2036	1,136	169,000	515,000	657	189
2037	1,141	170,000	517,000	660	190

(1) ERUs are projected forward from the total ERUs shown in Table 2-9. Non-DSL ERUs are increased at the system growth rate of 0.61 percent, based on meeting the County's Comprehensive Plan growth rate as shown in Table 2-1. DSL ERUs are held constant for this analysis. The effect of reducing DSL is addressed in Chapter 4 of this plan.

(2) Average day demand is the Average Day Demand value of 149 gpd per ERU from Table 2-7 times the projected number of ERUs, rounded to the nearest 1,000 gallons.

(3) Maximum day demand is the Maximum Day Demand value of 453 gpd per ERU from Table 2-7 times the projected number of ERUs, rounded to the nearest 1,000 gallons.

(4) PHD is calculated using the PHD formula from Table 2-7 and the projected ERUs rounded to the nearest one gpm.

(5) Annual demand in Acre-Feet per Year is average day demand times 365 days per year and divided by 325,851 gallons per acre-foot.

EFFECTS OF WATER CONSERVATION

It is anticipated that the value of an ERU and the amount of DSL will change as the system grows. With promotion of water conservation, the water usage represented by an ERU may go down, and with active leak detection and distribution system replacement

DSL is likely to go down. These factors will be more thoroughly discussed in Chapter 4 of this plan. However, for projection of water system needs it is more conservative not to assume that water usage per ERU or DSL will decrease.

WATER RATES AND RATE IMPACTS ON WATER DEMAND

The FWSD residential water rate includes a base fee of $40.31 per quarter, with no minimum usage, and usage rates of $1.35 for every 100 cubic feet, or part thereof, up to 1,500 cubic feet, $1.70 per 100 cubic feet, or part thereof, for 1,501 to 3,000 cubic feet, $2.05 per 100 cubic feet, or part thereof, for 3,001 to 4,500 cubic feet, $2.45 per 100 cubic feet, or part thereof, for 4,501 to 6,000 cubic feet, and $2.85 per 100 cubic feet, or part thereof, for everything over 6,000 cubic feet per quarter. This rate structure provides an incentive to conserve by increasing rates as usage increases. Rates are summarized in Table 2-11.

TABLE 2-11

FWSD Residential Water Rates

Cost Factor	Amount	Units
Base Rate, No Minimum Usage	$40.31	per Quarter
Usage Rate, 0-1,500 CF per Quarter	$1.35	per 100 CF(1)
Usage Rate, 1,501-3,000 CF per Quarter	$1.70	per 100 CF(1)
Usage Rate, 3,001-4,500 CF per Quarter	$2.05	per 100 CF(1)
Usage Rate, 4,501-6,000 CF per Quarter	$2.45	per 100 CF(1)
Usage Rate, > 6,000 CF per Quarter	$2.85	per 100 CF(1)

(1) Billed amounts are per 100 cubic feet or portion thereof, such that anything over 100 CF is billed as 200 CF, anything over 200 CF is billed as 300 CF, etc.

At the average day use rate of 149 gpd per ERU, the average usage would be 13,596 gallons, which is 1,818 cubic feet, per quarter. The quarterly bill for the average use rate would be as follows:

Base Rate $40.31
1,500 CF @ $1.35 per 100 CF $20.25
<u>400 CF @ $1.70 per 100 CF ....$6.80</u>
Total Average Quarterly Bill $67.36
Monthly Bill Equivalent $22.45

CHAPTER 3

WATER SYSTEM ANALYSIS

OBJECTIVE

The objective of this chapter is to determine if system improvements are necessary to meet water quality standards and projected demands. This chapter includes the following elements:

- System Design Standards
- Water Quality Analysis
- System Facilities Analysis
- Water System Capacity Limits
- Summary of System Needs and Concerns

SYSTEM DESIGN STANDARDS

The Standards for planning and design for the FWSD water system are based on commonly accepted standards including the following:

<u>WAC 246-290, Group A Public Water Systems</u>, Washington State Board of Health (March 2012)

This is the primary drinking water regulation used by DOH. It sets basic standards to assess capacity, water quality, and system reliability.

<u>Water System Design Manual</u>, Washington State Department of Health (December 2009)

These standards serve as guidance for the preparation of plans and specifications for Group A public water systems in compliance with WAC 246-290.

<u>Standard Specifications for Road, Bridge and Municipal Construction</u>, Washington State Department of Transportation, American Public Works Association (Current Edition)

These standards include detailed specifications for materials and workmanship for a wide variety of public works projects, including installation of public water supply facilities and restoration of facilities impacted by water main construction and repair.

<u>Freeland Water and Sewer District Technical Specifications</u>

The Freeland Water and Sewer District Technical Specifications include water distribution system construction specifications and design details applicable to developers installing water mains intended to be owned by FWSD, including 1) detailed specifications for materials and workmanship for installation of water main extensions, and 2) piping installation details, thrust blocking, in-line valves, fire hydrants, air release valves, service connections of various types, backflow preventions devices, and blow offs. These standards are in Appendix G.

WATER QUALITY STANDARDS

The FWSD water system is a public water supply system regulated by Washington State Department of Health Drinking Water Regulations, WAC 246-290, as well as sections of Code of Federal Regulations (CFR) Title 40, Parts 141 and 143, adopted by reference in WAC 246-290. FWSD has a groundwater supply, so only groundwater supply regulations apply.

SYSTEM CAPACITY STANDARDS

General Design Standards

FWSD uses the DOH Water System Design Manual as a guide for establishing water system capacity standards. Table 3-1 lists the recommended standards from the DOH Manual and the FWSD policies regarding each standard for general facility design.

TABLE 3-1

General Facilities Requirements

Standard	DOH Water System Design Manual (December 2009)	FWSD Water System Standard
Average Day and Maximum Day Demand	Average day demand should be determined from previous metered water production and consumption data. Maximum day demand is estimated at approximately 2.0 times the average day production requirement if metered data is not available.	Average day consumption per ERU is **149 gpd.** The maximum day to average day factor is 3.04, and the maximum day consumption per ERU is **453 gpd**, as developed in Chapter 2 of this Plan.
Peak Hour Demand	Peak hour demand is determined using the following equation: PHD = (MDD/1440)((C)(N) + F) + 18 C = Coefficient from DOH Water System Design Manual Table 5-1 N = Number of connections, ERUs F = Factor from DOH Water System Design Manual Table 5-1	Peak hour demand is determined by applying the DOH Water System Design Manual Formula where MDD = 453, C=1.6 and F = 225, which simplifies to the equation: **PHD = 0.50 x N + 89**

TABLE 3-1 – (continued)

General Facilities Requirements

Standard	DOH Water System Design Manual (December 2009)	FWSD Water System Standard
Minimum and Maximum System Pressure	WAC 246-290-230(5) requires that water systems meet a minimum pressure of 30 psi under peak hour demand conditions under normal operating conditions. WAC 246-290-230(6) requires that water systems that provide fire flow must maintain a minimum of 20 psi under fire flow plus MDD conditions. Regulations do not address maximum system pressure. The Water System Design Manual, Chapter 8, part 8.1.7, recommends that pressures should not exceed 100 psi.	Facilities should be designed and located to permit static pressures ranging from 40 psi to 90 psi and in no case produce static pressure below 30 psi or above 110 psi. The system must be designed to meet a minimum pressure of 20 psi during fire flow or other emergency events.
Minimum Pipe Sizes	The diameter of a transmission line shall be determined by hydraulic analysis. The minimum size distribution system line shall not be less than 6-inches in diameter, except for dead end lines not providing fire flow and only as justified by a hydraulic analysis.	Same as DOH Water System Design Manual.
Valve Spacing	Sufficient valving should be placed to keep a minimum number of customers out of service when water is turned off for maintenance or repair.	Valves every 1,000 feet at a minimum, two gate valves at every tee and three at every cross unless otherwise directed by FWSD. Valves on each end of a water main in an easement.
Source Reliability	18 hours of source pumping to meet maximum day demand. Source capacity to replenish fire storage capacity within 72 hours while meeting maximum day demand. Redundancy in all critical pumping systems. Backup power supply for all critical pumping systems.	Same as DOH Water System Design Manual.

Fire Suppressions Standards

WAC 246-293, Water System Coordination Act, Part III, Fire Flow, sets state minimum fire flow standards for water systems located within a critical water supply service area. The entirety of Island County is a critical water supply service area, so this regulation applies to FWSD. The fire flow standards as specified in WAC 246-293 are summarized in Table 3-2.

TABLE 3-2

Fire Flow Standards

Land Use Designation	Minimum Standard[1]			FWSD Fire Flow Standard		
	Flow, gpm	Duration, minutes	Maximum Hydrant Spacing, feet	Flow, gpm	Duration, minutes	Maximum Hydrant Spacing, feet
Rural (> 1 acre)	Not Addressed			None	None	None
Residential	500	30	900	500	30	600
Commercial and Multifamily	750	60	900	750	60	300
Industrial	1,000	60	900	1,000	60	300

(1) Minimum Standard established by WAC 246-293 Water System Coordination Act, Part III, Fire Flow.

Storage Standards

The nominal volume of a water reservoir is generally the name given to a reservoir based on an approximation of the gross volume the reservoir, which is the amount of water the reservoir could hold if filled all the way to the top of the reservoir wall. However, practically speaking, a reservoir cannot be filled to the top of the wall, and a reservoir also often cannot, under normal operational conditions, be drained completely while meeting system demand. For purposes this Water System Plan we will define *effective* storage as the amount of water that is reliably available from the reservoir to meet various system demands while meeting all pressure and water quality requirements.

The DOH Water System Design Manual identifies the following components of reservoir storage volume:

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

A reservoir's effective storage volume is the gross volume less operational storage and dead storage. This volume must be large enough to accommodate the requirements for equalizing storage, standby storage and fire suppression storage.

<u>Operational Storage</u>

Operational storage is the amount of water that flows in and out of a reservoir during normal system control cycling. Reservoirs typically operate with a maximum water level at which all source pumps are turned off, and a minimum level at which all source pumps are turned on. The amount of water that flows into and out of the reservoir between these two levels is operational storage, and depends upon the operational control levels and the dimensions of the system's reservoirs.

Equalizing Storage

Equalizing storage is the amount of water needed to meet peak system demand for a period of time when the system demand exceeds the system source capacity. The DOH Water System Design Manual recommends that this volume be estimated as PHD minus source capacity for 150 minutes, but not less than zero.

Standby Storage

Standby Storage is water held in reserve for emergency situations, such as temporary loss of a water source. The DOH Water System Design Manual recommends that this volume be estimated as two days of average day demand for the water system, less the amount of water that can be produced by the water system in 1 day with the largest source of supply out of service, but not less than 200 gallons per ERU.

Fire Suppression Storage

Fire Suppression Storage is the maximum fire flow rate standard times the maximum fire flow duration standard for the water system. For example, 1,000 gallons per minute sustained for 60 minutes would be a fire suppression storage standard of 60,000 gallons.

Dead Storage

Dead storage is the volume of the reservoir that either cannot be utilized for storage because it is above the maximum operational water level of the reservoir, or cannot be withdrawn from the reservoir at the required rates while maintaining the minimum required system pressure or other required operating parameter, such as chlorine contact time. The amount of dead storage existing in a system depends on storage system dimensions, elevations, pumping systems, outlet design, and possibly other requirements such as disinfectant contact time.

Effective Storage

The amount of effective storage a water system needs will be referred to as the *Effective Storage Requirement*. The Effective Storage Requirement is based on equalizing, standby, and fire suppression storage, and will depend on whether or not "Nested Storage" is allowed. "Nested Storage," pursuant to WAC 246-290-010, means one component of storage is contained within the component of another. WAC 246-290-235 states, "Standby and fire suppression storage volumes may be nested with the larger of the two volumes being the minimum available, provided the local fire protection authority does not require them to be additive." Therefore, the Effective Storage Requirement will be either the sum of equalizing, standby and fire suppression, if nesting of standby and fire suppression storage is *not* allowed, or it will be the sum of equalizing storage plus the greater of either standby or fire suppression storage if nesting of standby and fire storage *is* allowed.

For the FWSD water system, no local ordinance or authority has required fire storage to be additive, so nesting of standby and fire storage is allowed. Table 3-3 summarizes the total effective storage requirements as they apply to the FWSD water system.

TABLE 3-3

Effective Storage Requirement

If Nesting Is Not Allowed by Local Fire Authority	If Nesting Is Allowed by Local Fire Authority	Standard Applicable to FWSD Water System
The sum of: Equalizing Storage, plus Standby Storage, plus Fire Suppression Storage.	The sum of: Equalizing Storage, plus the Greater of either Standby Storage, or Fire Suppression Storage.	The FWSD standard is based on nesting of standby and fire suppression storage.

Figure 3-1 illustrates an elevation view of a typical reservoir indicating dead storage, operational storage and effective storage volumes.

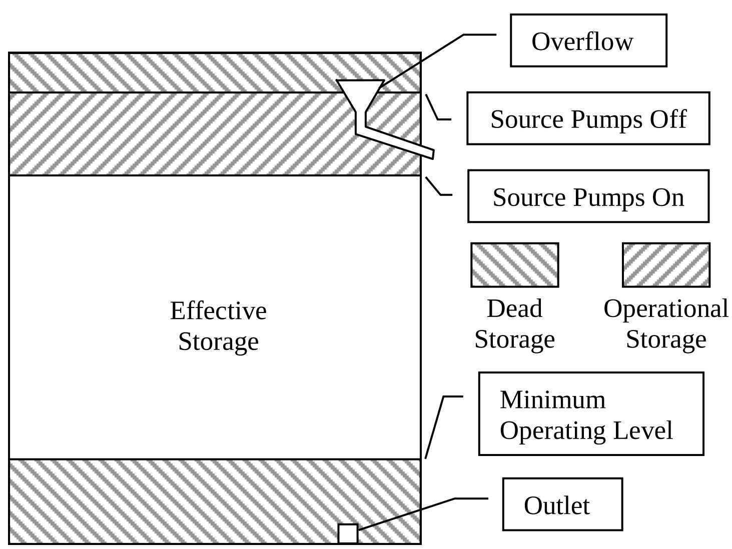


FIGURE 3-1

Typical Storage Reservoir Effective Capacity

WATER QUALITY ANALYSIS

The following sections evaluate the record of water quality for the FWSD water system. Water quality analysis is divided into the categories of Source Water Quality, Delivered Water Quality, Water Quality Reporting, and Water Quality Complaints. Water quality standards that apply to the water distribution system, including coliform, lead and copper, disinfectant byproducts, and asbestos, are discussed under the heading of Delivered Water Quality. A review of water quality monitoring requirements relative to water quality monitoring completed is included under the heading Water Quality Reporting, and a review of water quality problems and complaints is included under the heading Water Quality Complaints.

SOURCE WATER QUALITY

As described in Chapter 1, the FWSD water system has three active wells, plus the SVF well, which is currently not connected to the FWSD water system. The three FWSD wells are all treated with chlorine to protect against contamination and bacterial growth in the distribution system. Well 3 is currently filtered for the purposes of iron and manganese removal, and a similar treatment system exists at the Well 1 site to treat water from Wells 1 and 2.

Inorganic Chemical and Physical Water Quality

General IOC Tests

Inorganic chemical and physical (IOC) water quality monitoring results are summarized in Table 3-4. No IOC data is available for the SVF water system well, because as a Group B Water system, no routine IOC monitoring is required. A "less-than" sign (<), indicates that if the sample has any of the indicated analyte present, it is below the value indicated, which is the analytic method detection limit. The Maximum Contaminant Level (MCL) for each inorganic chemical and physical water quality parameter for which there is an MCL, or other regulatory or advisory level as footnoted, is listed in the right hand column. Detected values shown in **bold** exceed the MCL or other regulatory or advisory level.

TABLE 3-4

Inorganic Chemical Sampling Results

Analyte Name	Units	Well 1		Well 2		Blended Wells 1 and 2			Blended Wells 1, 2, and 3	Well 3		MCL[1]
		10/16/1995	6/6/2017	10/16/1995	6/6/2017	12/9/1998	12/12/2001	12/7/2004	7/22/2015	11/27/2012	6/6/2017	
Primary Regulated Chemicals[2]												
Antimony	mg/L[3]	<0.005	<0.006	<0.005	<0.006	<0.005	<0.005	<0.005	<0.006	<0.006	<0.006	0.006
Arsenic	mg/L[3]	<0.01	0.0043	<0.01	0.0036	<0.01	<0.005	0.004	0.0024	0.0032	0.0039	0.0104
Barium	mg/L[3]	<0.1	<0.4	<0.1	<0.4	<0.02	<0.02	<0.02	<0.4	<0.4	<0.4	2
Beryllium	mg/L[3]	<0.002	<0.0008	<0.002	<0.0008	<0.002	<0.002	<0.002	<0.0008	<0.0008	<0.0008	0.004
Cadmium	mg/L[3]	<0.002	<0.002	<0.002	<0.002	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002	0.005
Chromium	mg/L[3]	<0.01	<0.02	<0.01	<0.02	<0.005	<0.005	<0.005	<0.02	<0.02	<0.02	0.1
Copper	mg/L[3]	<0.02	<0.02	<0.02	<0.02	0.032	<0.005	<0.005	0.2	<0.02	<0.02	1.3[4]
Cyanide	mg/L[3]	<0.1	<0.01	<0.1	<0.01	<0.02	<0.05	<0.05	<0.01	<0.01	<0.01	0.2
Fluoride	mg/L[3]	<0.5	0.6	<0.5	0.48	<0.2	<0.2	0.3	<0.5	<0.5	0.48	2, 4[5]
Lead	mg/L[3]	<0.002	<0.001	<0.002	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.015[4]
Mercury	mg/L[3]	<0.0005	<0.0004	<0.0005	<0.0004	<0.0005	<0.0005	<0.0005	<0.0004	<0.0004	<0.0004	0.002
Nickel	mg/L[3]	<0.04	<0.1	<0.04	<0.1	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	0.1
Nitrate + Nitrite	mg/L[3]	2.4	2.9	2.8	4.6	3.2	3.4	3	2.9	2.1	<0.5	10
Nitrate-N	mg/L[3]	2.4	2.9	2.8	4.6	3.2	3.4	3	2.9	2.1	<0.2	10
Nitrite-N	mg/L[3]	<0.5	<0.2	<0.5	<0.2	<0.5	<0.5	<0.5	<0.2	<0.2	<0.2	1
Selenium	mg/L[3]	<0.005	<0.01	<0.005	<0.01	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	0.05
Sodium	mg/L[3]	19	19	17	17	15	15	15	16	14	14	20[6]
Thallium	mg/L[3]	<0.001	<0.002	<0.001	<0.002	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Turbidity	NTU[7]	0.2	0.19	0.2	0.23	0.1	<0.1	0.6	<0.1	0.4	**1.8**	1[8]
Secondary Regulated Chemicals[9]												
Chloride	mg/L[3]	<20	<20	<20	<20	17	17	18	<20	<20	<20	250
Color	CU[10]	<5	<15	<5	<15	5	<5	10	<15	<15	<15	15
Conductivity	µmhos/cm[11]	410	470	320	410	382	380	410	440	360	400	700
Hardness	mg/L[3]	210	200	160	170	150	170	190	200	190	180	500[12]
Iron	mg/L[3]	<0.05	0.15	<0.05	<0.1	0.02	<0.021	0.036	<0.1	<0.1	**0.57**	0.3
Manganese	mg/L[3]	<0.083	0.047	<0.01	<0.01	<0.01	<0.005	0.018	<0.01	<0.01	**0.19**	0.05

TABLE 3-4 – (continued)

Inorganic Chemical Sampling Results

Analyte Name	Units	Well 1		Well 2		Blended Wells 1 and 2			Blended Wells 1, 2, and 3	Well 3		MCL[1]
		10/16/1995	6/6/2017	10/16/1995	6/6/2017	12/9/1998	12/12/2001	12/7/2004	7/22/2015	11/27/2012	6/6/2017	
Silver	mg/L[3]	<0.01	<0.1	<0.01	<0.1	<0.002	<0.002	<0.002	<0.1	<0.1	<0.1	0.1
Sulfate	mg/L[3]	27	<50	21	<50	21	22	21	<50	<50	<50	250
Zinc	mg/L[3]	<0.05	<0.2	<0.05	<0.2	0.026	<0.025	0.066	<0.2	<0.2	0.25	5

(1) MCL is Maximum Contaminant Level
(2) Primary Contaminants are contaminants that are determined to have an impact on public health if exceeding the MCL.
(3) mg/L indicates milligrams per liter. One mg/L is equivalent to one part per million (ppm).
(4) The standards for Lead and Copper are distribution system action levels based on 90th percentile distribution sample values.
(5) Fluoride has both a primary MCL of 4 mg/L and a secondary MCL of 2 mg/L. Concentrations above the secondary MCL cause aesthetic problems, while concentrations above the primary MCL are a public health concern.
(6) Sodium does not actually have an MCL, but EPA has established a level of 20 mg/L as a level of concern for individuals on low sodium diet.
(7) NTU is Nephelometric Turbidity Unit, a measure of the turbidity, or cloudiness, of the water.
(8) The turbidity MCL applies only to surface water sources.
(9) Secondary Contaminants are contaminants that are determined not to have an impact on public health but have other impacts such as causing stains, tastes, or odors if exceeding the MCL.
(10) CU is Color Unit, a standardized measure of the amount of color in the water.
(11) A µmho is a micro-mho, or 1 millionth of a mho, a unit of electrical conductance.
(12) There is no MCL or health advisory for hardness. Water with less than 60 mg/L of hardness (as calcium carbonate) is generally considered to be soft water. Water with 61 to 120 mg/L of hardness is generally considered to be moderately hard water. Water with 121 to 180 mg/L of hardness is generally considered to be hard water. Water with greater than 181 mg/L of hardness is generally considered to be very hard water.

MCL Exceedances

The only MCL exceedances shown in Table 3-4 are Iron, Manganese and Turbidity in Well 3 on June 6, 2017. A previous sample from Well 3 taken on November 27, 2012 did not exceed the MCL on any of these constituents. Treatment for removal of iron and manganese is in place at Well 3. The 2012 sample report indicates that the sample was taken after treatment, whereas the 2017 sample report indicates that the sample was taken prior to treatment. Therefore it is not surprising that the 2017 sample exceeded the MCLs for iron and manganese. The exceedance for turbidity is likely related to the exceedances for iron and manganese. When iron and/or manganese levels in water are excessive, the iron and/or manganese often precipitate out of solution, and the resulting small particles of iron and/or manganese create turbidity.

Iron and Manganese are secondary contaminants, meaning that they are regulated for reasons other than public health. Iron and manganese are regulated due to their tendency to precipitate out of solution in the presence of oxygen and form particulates that make the water look murky (turbid), and stain household fixtures and laundry. As stated previously, a treatment process is in place to remove iron and manganese from the water from Well 3 so that water from this source does not cause staining problems in the water distribution system. A similar treatment system exists for water from Wells 1 and 2 so that when the water is blended together in the reservoirs and distribution system it will all have received similar treatment.

<u>Annual Nitrate Tests</u>

Additional IOC samples include annual nitrate samples. Separate sampling for nitrate is required in years when complete inorganic chemical samples are not required. Table 3-5 summarizes additional nitrate monitoring results. All nitrate test results are well below the MCL of 10 mg/L. Well 1 appears to be showing an increasing level of nitrate. Well 2 appears to have reached a maximum level of nitrate in 2012 and the level has since declined. Nitrate in Well 3 has always been below the reporting limit. The SVF well has the highest level of nitrate in any of the wells, at slightly over half of the MCL, but the most recent sample show a decrease in Nitrate at the SVF well.

TABLE 3-5

Nitrate Monitoring Results[(1)]

Sample Date	Well 1	Well 2	Blended Wells 1 and 2	Well 3	SVF Well
5/6/1996	2.2	2.8			
4/2/2001			3.4		
4/8/2002				<0.5	
6/2/2003					5.7
6/22/2005			3.1		
12/12/2006			2.3		
4/9/2007			2.0		
9/19/2007			3.0		
12/3/2008			3.2		
12/1/2009				<0.5	
12/30/2009					5.1
9/28/2010			1.8	<0.5	
12/22/2010				<0.5	
11/29/2011			2.6	<0.5	
10/31/2012	2.2	4.0			
12/17/2012		4.1			
12/19/2012		4.1			
12/26/2012					5.4
9/25/2013	2.5	3.7		<0.2	
12/23/2014	2.7	4.0		<0.2	
12/30/2015					3.8
11/1/2016				<0.2	
8/24/2017	4.75	3.0		<0.2	

(1) All sample results are mg/L. The MCL for Nitrate is 10 mg/L. Samples were also analyzed for Nitrite, and all results for Nitrite were <0.1 mg/L.

Radionuclides

Results of all radionuclide testing since 1980 are shown in Table 3-6. All radionuclide samples are well below their respective standards. There is no radionuclide data available for the SVF well because, as a Group B water system, SVF is not required to monitor for radionuclides.

TABLE 3-6

Test Results for Radionuclides

Sample Date	Source[1]	Radium 228, pCi/L[2]	Gross Alpha, pCi/L[1]	Gross Beta, pCi/L[1]
11/1/2016	S03, S04	0.5	<3	NA
10/27/2015	S03, S04	0.5		
10/7/2015	S03, S04	1		
6/10/2015	S03, S04		<3	
12/23/2014	S03	1.7		
12/23/2014	S04	1.4		
11/27/2012	S01	1.3		
12/1/2009	S03	<1	1.3	
12/12/2007	S03	<1		
6/22/2005	S03	<1		
12/7/2004	S03	<1		
12/12/2001	S03		ND	3
12/20/2000	S04		ND	5
11/7/1980	Dist		<2	
	MCL	5	15	50

(1) Sources are identified as indicated on the DOH WFI form included in Appendix A and in Table 1-2. Source S01 is Well 1. Source S02 is Well 2. Source S03 is a wellfield consisting of Wells 1 and 2. Source S04 is Well 3. Samples indicated as sources S03 and S04 are a blend of all three wells.

(2) pCi/L is picocuries per liter.

Volatile Organic Chemicals

Volatile Organic Chemical (VOC) samples since 1991 were collected on the dates indicated in Table 3-7. Multiple samples in a year are indicated by multiple X's. No VOCs were detected in any of the source VOC samples. There is no VOC data available for the SVF well because, as a Group B water system, SVF is not required to monitor for VOCs.

TABLE 3-7

VOC Sampling History

Sample Year	Well 1	Well 2	Blended Wells 1 and 2	Well 3
2016			X	
2015	X			
2011				XX
2009			X	
2007			X	
2004			X	
2001			X	
2000				X
1998			X	
1995	X	X		
1991	X	X		

Synthetic Organic Chemicals

Synthetic Organic Chemical (SOC) samples since 2009 were collected for general herbicide (HERB1) and general pesticide (PEST1) analyses in the years indicated in Table 3-8. No SOCs were detected in any of the source SOC samples. There is no SOC data available for the SVF well because, as a Group B water system, SVF is not required to monitor for SOCs.

TABLE 3-8

SOC Sampling History

Sample Year	Blended Wells 1 and 2		Well 3	
Sample Suite	PEST1	HERB1	PEST1	HERB1
2009	X	X		
2012			X	X

DELIVERED WATER QUALITY

Delivered water quality applies to a number of water quality monitoring requirements of the water distribution system. Monitoring of delivered water quality is necessary because some water quality parameters have been demonstrated to change in the distribution system, or even in the plumbing of buildings. Locations of distribution system monitoring vary depending on the monitoring program. Coliform monitoring locations are distributed about the system so as to effectively monitor all portions of the system. Lead and copper sampling locations are based on areas that have vulnerable types of service lines and/or plumbing. Disinfection byproducts monitoring locations are based on maximum distribution system retention time and a history of previous monitoring that has indicated where maximum concentrations have been previously found. Asbestos monitoring is directed to portions of the system where asbestos cement pipe is in prevalent use. The following sections summarize delivered water quality monitoring by FWSD.

Coliform Bacteria Monitoring

WAC 246-290-300(3) sets distribution system coliform monitoring requirements. The number of coliform samples required per month is based on the population served during the month. The FWSD water system is currently required to take two distribution system coliform samples per month, year round. Sampling locations are rotated around the distribution system as designated in the FWSD coliform monitoring plan, a copy of which is included in Appendix H of this Water System Plan, and which is subject to approval by DOH. As the population grows, the required number of coliform samples will also increase.

WAC 246-290-310(2) sets E. coli bacteria maximum contaminant levels. An E. coli MCL violation occurs each month in which a system is required to monitor for total coliforms when there is:

(i) E. coli presence in a repeat sample following a total coliform presence routine sample;

(ii) Total coliform presence in any repeat samples collected as a follow-up to a sample with E. coli presence;

(iii) The system fails to take all required repeat samples following an E. coli presence routine sample; or

(iv) The system fails to test for E. coli when any repeat samples test positive for total coliform.

The coliform monitoring record since 1996 was reviewed for this report. Only one sample from the FWSD water system since January 1996 has been positive for coliform bacteria. That sample, taken on September 13, 2004, was positive for total coliform, and negative for E. Coli. Four repeat samples taken on September 22, 2004 were all negative for coliform bacteria. Since no follow-up samples were positive for coliform bacteria, this event did not constitute a coliform MCL violation.

As a Group B water system, the SVF water system is only required to take one coliform sample per year. Sample results were reviewed from 2002 through 2017 and no coliform bacteria is reported in any sample on record.

Disinfectant Byproduct Monitoring

Disinfectant Byproduct (DBP) stage 2 water quality standards are based on a Locational Running Annual Average (LRAA) for total trihalomethanes (TTHMs) and five species of haloacetic acids (HAA5). The MCL for TTHMs is 80 µg/L[1] and the MCL of HAA5 is 60 µg/L. If the LRAA at any sampling site exceeds one of these limits, that exceedance would constitute a DBP MCL violation. Exceedance of a DBP MCL triggers a public notification requirement, and continued DBP MCL violations will trigger a requirement to provide treatment to reduce DBPs.

The FWSD water system has a total of 22 DBP water quality samples on record on the DOH water quality database, including 11 pairs of samples for TTHM and HAA5. TTHM and HAA5 samples were taken in 2004, 2005, 2006, 2009, 2010, 2012, 2013, 2014, 2015, and 2016. In 2012 two sets of samples were taken at different locations on the same day. In all other years in which samples were taken, only one set of samples was taken per year. TTHM and HAA5 for each year in which samples were taken are summarized in Table 3-9. The two 2012 sample results were THMs of 20.5 and 29.9 and HAA5 of 6.9 and 7.8. These results were averaged to give the results shown in Table 3-9.

TABLE 3-9

Disinfectant Byproduct Monitoring Results

Date	TTHM	HAA5
8/18/2004	<0.5	<1.0
9/30/2005	1.8	<1.0
8/30/2006	0.6	<15
8/26/2009	17.0	<15
9/28/2010	37.1	<15
9/26/2012	25.2	7.35
9/17/2013	23.3	6.2
12/23/2014	21.1	5.3
9/16/2015	27.7	6.2
11/1/2016	24.1	5.6
MCL	80	60

Asbestos

Asbestos fibers are measured as millions of fibers per liter greater than 10 micrometers in length (MFL>10 µm). The MCL is 7 MFL>10 µm. WAC 246-290-300(2)(b)(v) requires distribution system monitoring for asbestos in accordance with Federal regulation 40 CFR 141.23(b). The federal regulation requires 1 sample during the first 3 years of

[1] µg/L is "micro-grams per liter." One µg/L is essentially the same as one part per billion.

each 9-year sampling cycle, unless the state grants a waiver to asbestos sampling based on a demonstrated lack of vulnerability to asbestos in both the source water and the distribution system. If an asbestos sample is required, it is to be taken under conditions where asbestos contamination is most likely to appear.

There are no asbestos samples on the DOH water quality database for FWSD water system. According to the DOH Water Quality Monitoring Schedule for 2017, the FWSD water system has a nine-year waiver from asbestos monitoring from January 2011 through December 2019.

Lead and Copper Monitoring

Lead and copper monitoring is to determine if lead or copper are leaching out of customer service lines at a rate that produces concentrations that are a health concern. The rule requires that 90 percent of the representative samples do not exceed the action levels for lead or copper. If more than the allowable number of samples exceed the action level for either lead or copper, then the water system owner must take action to reduce the corrosivity of the water, or take other actions such as water service line replacement, to reduce the level of lead and copper at the tap. The action level for lead is 0.015 mg/L and the action level for copper is 1.3 mg/L.

Lead and copper sample results for FWSD water system were reviewed from 2010 to the present. Rounds of ten samples each were collected in 2010, 2013 and 2016. The highest level of lead in all samples was 0.007 mg/L in 2013, and the highest 90th percentile value for lead was 0.0051 mg/L also in 2013. The highest level of copper was 0.560 mg/L in 2010 and 2013, and the highest 90th percentile value for copper was 0.430 mg/L in 2010. No samples exceeded either the lead or copper action level, even at the highest levels found.

Table 3-10 summarizes FWSD water system's lead and copper monitoring results. The data shows that FWSD water system is in compliance with the lead and copper standards. According to the DOH Water Quality Monitoring Schedule for 2017, the FWSD water system is on a 3-year monitoring schedule for lead and copper monitoring, so the next samples are due in 2019.

TABLE 3-10

Lead and Copper Monitoring Results

	Lead, mg/L		Copper, mg/L	
Date	**Highest Level**	**90th Percentile**	**Highest Level**	**90th Percentile**
2010	0.002	0.001	0.560	0.430
2013	0.007	0.0051	0.560	0.360
2016	0.0027	0.0016	0.350	0.200
Action Level		0.015		1.3

WATER QUALITY REPORTING

FWSD water system has obtained several water quality monitoring waivers, which affect the monitoring requirements. Table 3-11 summarizes FWSD water system's monitoring requirements as shown on the Water Quality Monitoring Schedule for the Year 2017 (Copy included in Appendix H).

TABLE 3-11

System Monitoring Requirements and Waivers for 2015

Monitoring Parameter	Sampling Requirement	Sampling Location
Coliform	Two per month.	Distribution system
Lead and Copper	One set of 10 samples every 3 years. Last Samples were taken 11/1/2016.	Distribution system
Asbestos	On nine-year waiver.	Distribution system
Disinfectant Byproducts (TTHM and HAA5)	Reduced sampling schedule; 1 per year	Distribution system
Nitrate	One per year per source (1)	All sources(2)
Complete Inorganics (IOC)	Source S03 is on a 9-year waiver. Last sample was taken 7/22/2015.	Blended Wells 1 and 2
	Source S04 is on a 3-year schedule. Last Sample was taken 6/6/2017.	Well 3
Volatile Organic Contaminants	Source S03 is on a 6-year waiver. Last Sample was taken 11/1/2016.	Blended Wells 1 and 2
	Source S04 is on a 6-year waiver. Last Sample was taken 12/30/2011	Well 3
Herbicides, SOC 515.2	Source S03 is on a 9-year waiver. Last Sample was taken 12/1/2009.	Blended Wells 1 and 2
	Source S04 is on a 9-year waiver. Last Sample was taken 11/27/2012.	Well 3
General Pesticides, SOC 525.2	Source S03 is on a 3-year waiver. Last Sample was taken 12/1/2009.	Blended Wells 1 and 2
	Source S04 is on a 3-year waiver. Last Sample was taken 11/27/2012.	Well 3
Soil Fumigants, SOC 504	All sources on 3-year waivers.	None Scheduled
Gross Alpha	All sources on 6-year waivers. Last sample was taken 11/1/2013.	All sources (2)
Radium 228	All sources on 6-year waivers. Last sample was taken 11/1/2013.	All sources (2)

(1) In years when complete inorganic chemical samples are required, a separate nitrate test is not required because nitrate is part of the complete inorganic chemical test.

(2) The Water Quality Monitoring Schedule lists monitoring requirements for sources S03 and S04. S03 is a wellfield designation for Wells 1 and 2, so S03 samples are blended samples from Wells 1 and 2. Source S04 is Well 3.

WATER QUALITY COMPLAINTS

FWSD handles water quality complaints pursuant to their policy for dealing with complaints as described in Chapter 1. In response to water complaints, the water operator will generally check out the validity of the complaint through an on-site investigation and flush water mains if appropriate.

SYSTEM FACILITIES ANALYSIS

The following sections evaluate the existing water system facilities in terms of their capacities, physical conditions, and performance capabilities. Facilities are evaluated relative to existing and projected requirements based on growth and demand projections from Chapter 2.

SOURCES

The FWSD water system wells and water rights are described in Chapter 1. Table 1-2 shows a total combined source capacity of 471 gpm from Wells 1, 2 and 3, and 40 gpm for the SVF well, for a combined total of 511 gpm. Table 1-3 shows a total water right capacity of 535 gpm and 430 ac-ft/yr for the FWSD wells, and 100 gpm and 80 ac-ft/yr for the SVF well, for a combined total of 635 gpm and 510 ac-ft/yr, including the SVF well. The following sections compare existing source capacity and existing water rights as outlined in Chapter 1 to projected water system demands as developed in Chapter 2.

Source Condition

A Sanitary Survey by DOH personnel, completed on March 17, 2016 indicates that the well houses at Wells 1 and 2 were in poor condition and in need of improvement. The Well 1 pump power supply conduit was not secured in place, and the power supply penetration through the well cap was poorly sealed. There was standing water on the floor and a screened inverted vent was needed at Well 2. Well 1 was rehabilitated in 2017, which corrected the identified problems at Well 1. All wellhead repairs have been completed. No information is available regarding the condition of the SVF well facilities. DOH does not perform sanitary survey of Group B water systems, and we are not aware of any sanitary surveys performed by Island County.

There is no system in place to routinely monitor water levels (depth to water) in any of the system wells. Routine monitoring of water levels in wells can help to identify source problems early so that they can be corrected before sources fail.

Source Capacity Analysis

The source capacity of the FWSD water system is compared to projected water system demands in this section. From Table 1-2, the existing wells have a combined withdrawal capacity of 471 gpm, not including the SVF water system well. In consideration of conservative design, it is assumed that source production should be limited to something less than continuous, 24 hours per day operation. Therefore, projected demands are compared with the volume of water that the wells can produce in 22 hours per day of operation. Table 3-12 compares existing FWSD water system source capacity to projected water system demands. Based on projected demands at current water usage rates, FWSD has adequate source capacity to meet 20-year projected water demands in 22 hours per day of source production, with 79 gpm of source capacity to spare.

TABLE 3-12

Projected Water Demands and Source Capacity

Year	Existing Reliable Source Capacity, gpm(1)	Recommended Source Capacity, gpm(2)	Source Capacity Surplus/(Deficit), gpm
2017	471	359	112
2018	471	361	110
2019	471	362	109
2020	471	364	107
2021	471	365	106
2022	471	367	104
2023	471	369	102
2024	471	370	101
2025	471	372	99
2026	471	373	98
2027	471	375	96
2028	471	377	94
2029	471	378	93
2030	471	380	91
2031	471	382	89
2032	471	383	88
2033	471	385	86
2034	471	387	84
2035	471	388	83
2036	471	390	81
2037	471	392	79

(1) Existing Reliable Source Capacity does not include the 40 gpm capacity of the SVF Well because that well is currently not connected to the FWSD water system.

(2) Recommended source capacity is the minimum source capacity necessary to meet projected Maximum Day Demand, from Table 2-10, in 22 hours per day of pumping. Projected demands do not include SVF water system.

Water Rights

Current and Historic Withdrawals

The FWSD water system water rights are summarized in Table 1-3. FWSD has a total water right capacity of 635 gpm and 510 ac-ft/yr, including the SVF water system water right, or 535 gpm and 430 ac-ft/yr not counting the SFV water system water right. Installed source capacities of all wells are summarized in Table 1-2. FWSD water system has a combined installed pump capacity of 471 gpm, which is well within the limits of FWSD water system's instantaneous water rights. From Table 2-3 it can be seen that FWSD water system's maximum annual usage since 2011 has been 173.79 ac-ft/yr. **Therefore, FWSD water system's current instantaneous and annual usage rates are well within their water rights limits**.

Projected Withdrawals

Projected withdrawal rate requirements are compared to current water rights in Table 3-13. Recommended Source Capacity is the source capacity necessary to meet the maximum day demand from Table 2-10 in 22 hours per day of source production, as with Table 3-12. Annual Water Demand projections come directly from Table 2-10. Table 3-13 shows that FWSD water system has adequate instantaneous water rights through the 20-year planning horizon, not including the SVF water system water right. **FWSD water system has adequate instantaneous and annual water rights to meet projected 20-year demands.**

TABLE 3-13

Projected Water Rights Status

Year	Recommended Source Capacity, gpm(1)	Instantaneous Water Rights Surplus/(Deficit), gpm(2)	Projected Annual Water Demand, ac-ft/yr(3)	Annual Water Rights Surplus/(Deficit), ac-ft/yr(4)
2017	359	176	175	255
2018	361	174	176	254
2019	362	173	176	254
2020	364	171	177	253
2021	365	170	178	252
2022	367	168	178	252
2023	369	166	179	251
2024	370	165	180	250
2025	372	163	180	250
2026	373	162	181	249
2027	375	160	183	247
2028	377	158	184	246
2029	378	157	184	246
2030	380	155	185	245
2031	382	153	186	244
2032	383	152	186	244
2033	385	150	187	243
2034	387	148	188	242
2035	388	147	189	241
2036	390	145	189	241
2037	392	143	190	240

(1) Recommended source capacity is the minimum source capacity necessary to meet projected Maximum Day Demand, from Table 2-10, in 22 hours of pumping.

(2) Instantaneous Water Rights Surplus/(Deficit) is the total available instantaneous water rights of 535 gpm from Table 1-3 (not including the SVF water system water right), less the Recommended Source Capacity.

(3) Projected Annual Water Demand is Annual Demand from Table 2-10.

(4) Annual Water Rights Surplus is the total available annual water rights of 430 ac-ft/yr from Table 1-3 (not including the SVF water system water right), less the Projected Annual Water Demand from Table 2-10.

WATER TREATMENT

There are two iron and manganese treatment systems, one at the Well 1 site that treats water from Wells 1 and 2, and one at Well 3. The treatment system consists of chlorine injection into the water prior to filtration, followed by filtration through a granular pyrolusite medium. The treated water then enters the reservoirs.

STORAGE

The existing system has two reservoirs. These are described briefly in Chapter 1. The two reservoirs are approximately one quarter mile from each other and are at different elevations. Reservoir 1 has base elevation of 247 feet and a top of wall elevation of 287 feet. Reservoir 2 has a base elevation of 325 feet and a top-of-wall elevation of 345 feet. Reservoir 1 is the main system reservoir. The water level in Reservoir 1 controls the water pressure throughout most of the FWSD water system. Wells 1 and 2 feed into Reservoir 1. Reservoir 2 is fed by Well 3, and feeds into Reservoir 1 via an 8-inch water main and a pressure reducing station. There are currently no services served directly from Reservoir 2, but it provides supplemental storage capacity for Reservoir 1 and the main system pressure zone.

General Condition

Reservoir 1 is a cast-in-place concrete reservoir constructed in 1990. This reservoir is now 27 years old and is in good condition. Reservoir 2 is a cast-in-place reservoir constructed in 2007. This reservoir is now 10 years old and is in good condition.

Storage Capacity Analysis

<u>Existing Effective Storage</u>

As described earlier in this chapter, the effective storage capacity is that capacity of a reservoir that is reliably available in the reservoir and capable of being withdrawn from the reservoir at the rates and pressures required for the water use purposes, and meeting all other regulatory requirements associated with the reservoir. Details regarding dimensions and capacities of the FWSD reservoirs are presented in Table 3-14. Based on the operational dimensions and water levels in Table 3-14 it is estimated that the total effective storage capacity for the FWSD water system reservoirs is 352,000 gallons.

TABLE 3-14

Reservoir Dimension and Capacity Details

Parameter	**Reservoir 1**		**Reservoir 2**	
Nominal Capacity, Gallons	212,000		207,000	
Diameter, feet	30		42	
Gallons per foot of water depth	5,288		10,364	
Wall Height, feet	40		20	
Gross Capacity, gallons	211,507		207,277	
Total Gross Volume, gallons	418,783			
Elevations, feet	Above Sea Level	Above Base	Above Sea Level	Above Base
Base	247	0	325	0
Top of Outlet	247.5	0.5	325.5	0.5
Minimum Operating Level	247.75	0.75	325.75	0.75
All Source Pumps On	284.5	37.5	341	16
All Source Pumps Off	285.5	38.5	344	19
High Level Alarm	286	39	344.25	19.25
Overflow	286.15	39.15	344.5	19.5
Top of Wall	287	40	345	20
Pump Cycle Volume, gallons	5,288		31,091	
Effective Storage Volume, gallons	194,322		158,048	
Total Effective Storage Volume, gallons	352,000			

<u>Effective Storage Standards</u>

Storage standards for FWSD water system are based on recommendations of the Department of Health Water System Design Manual. The Design Manual recommends an effective storage standard, where nesting is allowed, based on the sum of the following:

- Equalizing Storage, plus the greater of:
  - Standby Storage, or
  - Fire Suppression Storage

Equalizing Storage

Equalizing storage is used to meet peak hour demands that exceed the installed system source capacity. The volume of equalizing storage recommended depends on peak hour system demands, the length of time the peak hour demands persist, the source production rate, and the mode of system operation. Sufficient equalizing storage must be provided in combination with available water sources and pumping facilities such that peak system demands can be satisfied.

The Water System Design Manual recommends that equalizing storage be calculated using the following equation, but in no case should it be less than zero:

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

Where

V_{ES} = Equalizing storage component, gallons
Q_{PH} = Peak hourly demand, gpm
Q_S = Total source of supply capacity, excluding emergency sources, gpm

Q_{PH} is the Peak Hour Demand from Table 2-10. Q_S is the installed well source capacity of 471 gpm. Recommended equalizing storage capacities for years 2017 through 2037, based on the DOH Water System Design Manual, are shown in Table 3-15.

Standby Storage

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

The Water System Design Manual recommends that standby storage be calculated using the larger of the following two equations:

$$V_{SB} = 2(ADD)*(N)-T_m*(Q_S-Q_L)$$

Or

$$V_{SB} = 200 \text{ gallons} \times N$$

Whichever is greater, where

V_{SB} = Total standby storage component, gallons
ADD = Average daily demand per ERU, gpd per ERU
N = Number of ERUs for the design year
Q_S = Total source of supply capacity, excluding emergency sources, gpm
Q_L = Capacity of the largest single source serving the system, gpm
T_m = Maximum time remaining sources will be allowed to pump per day, minutes.

The recommended standby storage capacity for FWSD water system is calculated according to the above formulas based on projected ERUs in Table 2-10. Q_S minus Q_L is the total source capacity of 471 gpm minus the largest source capacity of 184 gpm, from Table 1-2, or 287 gpm. T_m is 22 hours per day of source pumping. Recommended standby storage capacity for years 2017 through 2037, based on the DOH Water System Design Manual, are shown in Table 3-15, rounded to the nearest 100 gallons.

Fire Suppression Storage

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

Fire suppression storage is calculated using the following equation:

$$V_{FSS} = FF*T_m$$

Where

V_{FSS} = Volume of fire suppression storage component, gallons
FF = Fire flow rate, gpm
T_m = fire flow duration, minutes

FWSD water system's maximum fire flow standard, as shown in Table 3-2, is 1,000 gpm for 60 minutes. The associated fire suppression storage for this fire flow standard is 60,000 gallons. The recommended fire suppression storage volume of 60,000 gallons is shown in Table 3-15.

Total Recommended Effective Storage

The total recommended effective storage capacities are summarized in Table 3-15 together with Existing Effective Storage as calculated in Table 3-14, and the projected storage surplus or deficit. Table 3-15 shows that **FWSD water system has adequate water storage capacity to meet projected growth for the 20-year planning horizon.**

TABLE 3-15

Projected Effective Storage Capacity Recommendations

Year	Recommended Effective Storage, gallons				Existing Effective Storage, gallons[4]	Storage Surplus/ (Deficit), gallons
	Equalizing[1]	Standby[2]	Fire Suppression	Total[3]		
2017	21,200	209,400	60,000	230,600	352,000	121,400
2018	21,500	210,200	60,000	231,700	352,000	120,300
2019	21,900	211,200	60,000	233,100	352,000	118,900
2020	22,200	212,000	60,000	234,200	352,000	117,800
2021	22,600	213,000	60,000	235,600	352,000	116,400
2022	23,000	214,000	60,000	237,000	352,000	115,000
2023	23,300	214,800	60,000	238,100	352,000	113,900
2024	23,600	215,800	60,000	239,400	352,000	112,600
2025	23,900	216,600	60,000	240,500	352,000	111,500
2026	24,300	217,600	60,000	241,900	352,000	110,100
2027	24,700	218,600	60,000	243,300	352,000	108,700
2028	25,100	219,600	60,000	244,700	352,000	107,300
2029	25,400	220,400	60,000	245,800	352,000	106,200
2030	25,700	221,400	60,000	247,100	352,000	104,900
2031	26,100	222,400	60,000	248,500	352,000	103,500
2032	26,500	223,400	60,000	249,900	352,000	102,100
2033	26,900	224,400	60,000	251,300	352,000	100,700
2034	27,200	225,400	60,000	252,600	352,000	99,400
2035	27,500	226,200	60,000	253,700	352,000	98,300
2036	27,900	227,200	60,000	255,100	352,000	96,900
2037	28,300	228,200	60,000	256,500	352,000	95,500

(1) Equalizing Storage is peak hour demand from Table 2-10, minus the existing source capacity of 471 gpm, times 150 minutes, but no less than zero.

(2) Standby Storage is two days of average day demand, minus 22 hours of pumping at the existing source capacity with the largest source out of service or 200 gallons times the projected number of ERUs, whichever is greater. Total source capacity from Table 1-2 is 471 gpm. The largest source is Well 2 at 184 gpm. Therefore the source capacity with the largest source out of service is 287 gpm.

(3) Total Recommended Storage is the sum of equalizing, plus the greater of either standby or fire suppression storage, since nesting is allowed.

(4) Existing Effective Storage Capacity is from Table 3-14.

PUMP STATIONS

The FWSD water system has two pump stations, the Well 1 Pump Station and the Silver Fin Drive Pump Station, as described in Chapter 1: The Well 1 Pump Station is at the Well 1 and Reservoir 1 site, and pumps from the main, gravity-controlled 286-foot pressure zone to the small 435-foot pressure zone, which currently has only two water services connected to it.

The Silver Fin Drive Pump Station is at the intersection of Silver Fin Drive and Sockeye Lane in the Fish Forest subdivision. The station pumps from the main, gravity-controlled 286-foot pressure zone to the small 345-foot pressure zone, which currently has three water services on it, and has the potential for up to six water services.

CONTROL SYSTEM

There is no centralized control system. There are separate control systems at Reservoir 1, Reservoir 2 and at each pump station. The control system at Reservoir 1 controls Well 1, Well 2, the PRV station allowing water to flow from Reservoir 2, and an autodialer. The lead source call rotates among the three sources, and the lag source call activates the remaining sources. The control system activates the autodialer in the event that the reservoir level rises above the sources off level or drops below the all sources on level, or in the event of a power outage. The autodialer then automatically calls a list of pre-programmed phone numbers until the call is answered and acknowledged by the operator.

The control system at Reservoir 2 controls Well 3. When the water level in Reservoir 2 falls to the Well 3 on level it turns Well 3 on, and when the water level rises to the Well 3 off level it turns Well 3 off. In the event that Well 3 does not turn on or shut off at the appropriate time, or if the reservoir level is not within the normal operating range, there is no system alarm or other feedback such as an autodialer.

Control systems at the two pump stations are controlled locally by the pump station discharge pressure. There are no autodialers activated by the pump stations.

DISTRIBUTION SYSTEM

The water distribution system includes all the piping distributing water from the source and storage facilities to the water customers. The following sections evaluate the general condition and the hydraulic capacity of the water distribution system.

General Description and Condition

<u>Water Mains</u>

The FWSD water distribution system is described in general terms in Chapter 1 under the heading *Transmission and Distribution System*. The water distribution system has water mains of various ages, materials and sizes. Per Table 1-5, the system has approximately 16.1 miles of water main. Approximately 83.3 percent of the water main is PVC pipe, approximately 12.3 percent is AC pipe, approximately 4.3 percent of the pipe is HDPE pipe, and approximately 0.1 percent of the pipe is DI. Approximately 91.4 percent of the system is 6-inches in diameter or larger, 5.6 percent is 4-inch, and 3.0 percent is 2-inch. The district was first created in 1964, so no piping is older than about 54 years.

AC pipe, PVC pipe, and HDPE pipe are not subject to corrosion, and good quality DI pipe includes corrosion resistant coatings that result in long life expectancy for DI pipe. However, the life expectancy of any pipe depends on the quality of the pipe and the methods used to install the pipe, as well as soil and water conditions. Gasket jointed C-900 PVC pipe, for example, has a longer life expectancy than glue joint Schedule 40 PVC pipe. There were also various grades of AC pipe that were on the market in the 1960s, some more resilient than others. Some grades of AC pipe can be subject to softening by gradual leaching of carbonate from the pipe matrix in an acidic environment. AC pipe also can be more brittle than other types of pipe and subject to cracking if the ground around the pipes settles excessively or unevenly.

No information is available as to what grades of PVC and AC pipe were installed or how the pipes were installed. Statements have been made by the water system operator that some of the PVC pipe is Schedule 40, glue-joint pipe, although it is not known how much of this lower grade pipe has been installed or where it may be located. The AC pipe and Schedule 40 PVC pipe may have a life expectancy of approximately 50 years, whereas the C-900 PVC pipe, the HDPE pipe and the DI pipe may have a life expectancy more on the order of 100 years or more.

Water mains are generally the most expensive part of a water system. Water main replacement costs in 2018 dollars can be expected to range from approximately $0.5 to $1.0 million or more per mile of water main. Based on Table 1-5, replacement of the entire distribution system could be expected to cost between $8 and $16 million. Since the FWSD water mains were installed over a period of time beginning in about 1964, and since various water main materials and classes have different life expectancies, the mains can also be expected to require replacement over a wide time span. Some of the water mains installed shortly after incorporation of FWSD, that may have used lower grade materials, may be reaching the end of their useful life now. Water mains installed more recently, and with higher grade materials, may not reach the end of their life expectancy for another 50 to 100 years, or longer.

To avoid having water mains failing in the future and having inadequate funds to replace the water mains it is recommended that FWSD budget to replace water mains. To budget to replace all water mains on a 100-year schedule, the replacement cost of approximately 1/100th of the water mains would be set aside per year for a water main replacement fund. If the total cost of replacing all water mains is about $12 million, then approximately $120,000 should be set aside per year for a water main replacement fund.

Hydraulic Capacity Analysis – Modeling

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

<u>Hydraulic Modeling Software</u>

The District's water system has been analyzed using Innovyze's InfoWater hydraulic modeling software, which operates in a GIS based environment. The InfoWater model was created from the District's previous WaterCAD model developed by Davido Consulting Group, and updating using the District's water system base map.

The InfoWater model is configured with a graphical user interface. All water system elements, including pipes, control valves, pumps, and reservoirs were assigned a unique graphical representation within the model. Each element was assigned a number of attributes specific to its function in the actual water system. Typical element attributes include spatial coordinates, elevation, water demand, pipe lengths and diameters, pipe friction coefficients and critical water levels for reservoirs. For mechanical components (pumps and valves) operation parameters were specified. With attributes of each system element as the model input, the InfoWater software produces the model output in the form of flows and pressures throughout the simulated water system.

<u>Model Assumptions</u>

The hydraulic model used for this analysis was derived from the District's existing hydraulic model which was developed by Davido Consulting Group. The physical parameters of the model were imported from the previous model and then updated based on system improvements that have been implemented since the last Water System Plan. A map of the modeled system is shown in Figure 3-2. A map of the water system model, including pipe and node identifications, is shown Appendix I. Tables of pipe and node attributes are also included in Appendix I. The assumptions regarding the modeling of all sources of supply and system demands are included in the following sections.

Source

The District's water wells were not included in this analysis since all three wells pump directly into storage reservoirs, which regulate the pressure in the system. In a steady state analysis it is unnecessary to model wells that pump into reservoirs.

System Demands

A key element in the hydraulic modeling process is the distribution of demands throughout the water system. Total demand on the system is based on the projected demands from Table 2-10, *Projected ERUs and System Demands*. Existing and future demands were evenly distributed to each node, excluding nodes surrounding pump stations and valves.

The following demand scenarios were set up to model future demands on the system.

- 2017 Average Daily Demands: These demands were used while calibrating the model.

- 2023 Maximum Day Demands: These demands were used to evaluate the system's ability to provide fire flow during the projected 2023 maximum day demand at the DOH system-wide minimum pressure of 20 psi.

- 2023 Peak Hour Demands: These demands were used to verify the system is able to meet the DOH standards to supply domestic water at a minimum system wide pressure of 30 psi.

- 2037 Maximum Day Demands: These demands were used to evaluate the system's ability to provide fire flow during the projected 2036 maximum day demand at the DOH system-wide minimum pressure of 20 psi.

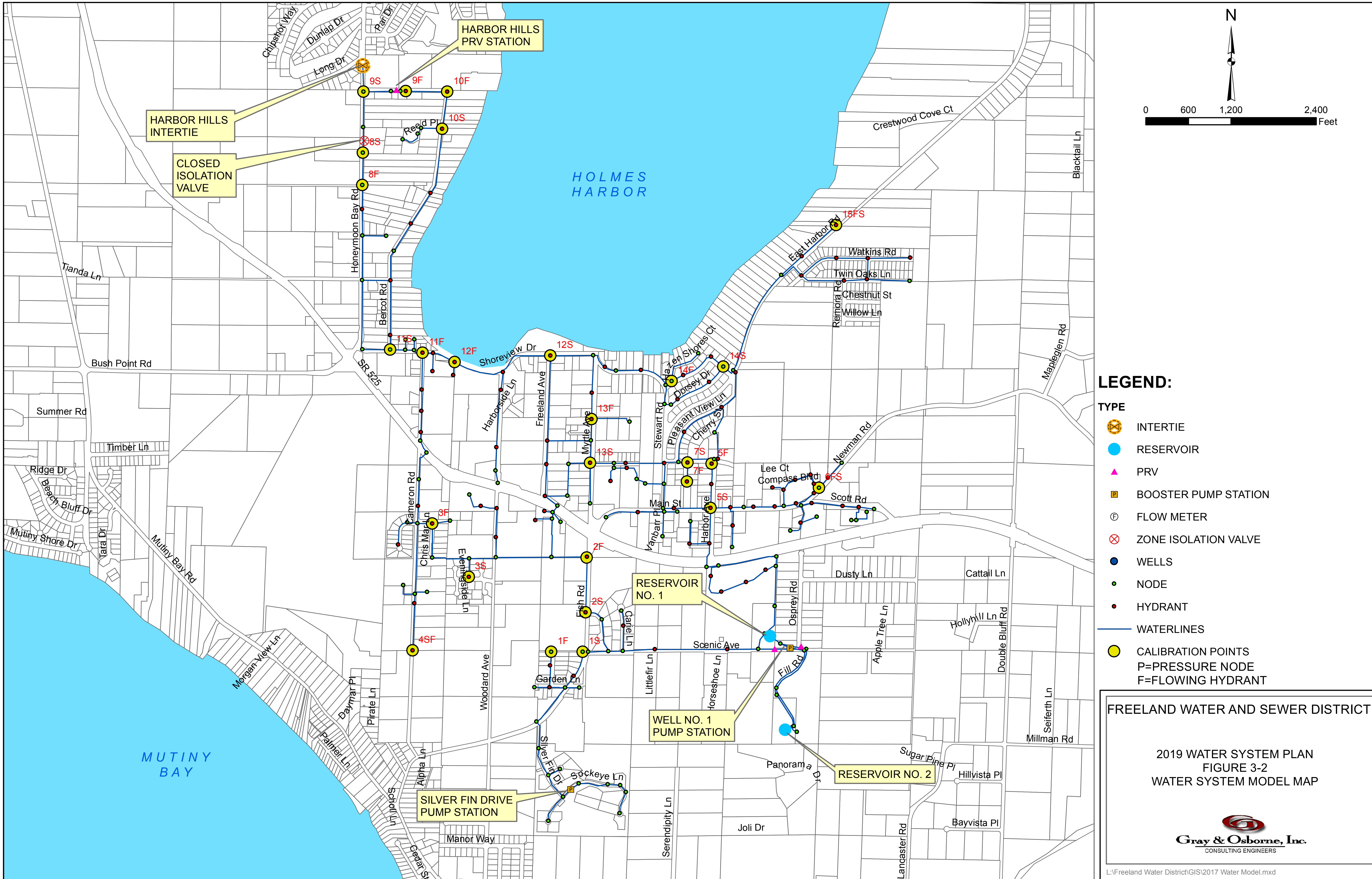
- 2037 Peak Hour Demands: These demands were used to verify the system is able to meet the DOH standards to supply domestic water at a minimum system wide pressure of 30 psi.

Model Calibration

The calibration of a hydraulic model provides a measure of assurance that the model is an accurate and realistic representation of the actual system. The hydraulic model of the District's water system was calibrated using data obtained from fire hydrant flow tests at various locations throughout the water system in 2002.

Calibration Flow Tests

Since the hydraulic model was derived from the model developed in 2002, the hydrant tests from the initial model calibration were used to verify that the InfoWater model still accurately represented the system. Fifteen fire hydrant tests were conducted on July 8, 2002. During these tests, static and residual pressures were recorded as hydrants were opened and flow rates recorded. Model conditions were set to replicate the way the system was configured in 2002. Field results were used to attempt to calibrate the



FREELAND WATER AND SEWER DISTRICT

2019 WATER SYSTEM PLAN
FIGURE 3-2
WATER SYSTEM MODEL MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\Freeland Water District\GIS\2017 Water Model.mxd hydraulic model through verification and adjustment of pipe type, size, roughness coefficients, and nodal elevations.

The testing locations include multiple points within the system. A description of each testing location is presented in Table 3-16 and shown on Figure 3-2.

TABLE 3-16

Hydrant Testing Locations

Test Number	Pressure Hydrant Location	Flow Hydrant Location
1	Fish and Scenic	Sylvan
2	Paulina and Fish	Shell
3	Morningside	Roxlin and Chrismar
4	2nd Hydrant North on Cameron	South End Cameron
5	Harbor & Main	Harbor/Layton and Main
6	Newman at Senior Housing	Last Hydrant on Newman
7	Topaz and Layton	South End Topaz
8	End of Line Honeymoon Bay Road	Honeymoon Bay Road at Street Augustines
9	End of Line Bercot Road	Bercot Road, East of Honeymoon Bay Road
10	First Hydrant South	5107 Bercot Road/Holly Farm
11	Shoreview Honeymoon Bay Road	Cameron and Shoreview
12	Shoreview and Freeland Avenue	Shoreview East of Cameron Road
13	Myrtle and Dutch Hollow Road	5335 Myrtle Avenue
14	Vinton Avenue	1647 Lynn Drive
15	2nd Hydrant from End East Harbor Road	End Main East Harbor Road

The system conditions at the time of testing were replicated in the hydraulic model during the calibration process, based on records available of distribution system improvements that have been completed since 2002. The connection that now exists under SR 525 at Cameron Road was closed, the closed isolation valve on Honeymoon Bay Road was opened, the PRV on East Bercot Road was bypassed, and the intertie with Harbor Hills was closed. The water main on Joanne Drive between Freeland Avenue and Myrtle Avenue was closed, and pipe sizes on Stewart Road and other locations around the system were adjusted to reflect the sizes in the system in 2002.

Calibration Results

Using the system conditions for each hydrant test, the hydraulic model was used to generate static pressure and residual pressure at the measured hydrant flow rate. The total system demand used to calibrate the model was the estimated average day demand for 2017. Model output was generated at points in the model equivalent to the locations of the hydrant tests. Model output for residual pressure was generated at each hydrant test location by placing an added nodal demand equal to the measured hydrant flow rate and recording the resulting pressure at the pressure hydrant.

The system pressures and pipe flow rates determined in the hydraulic analysis are dependent on the elevations established in the model for each node and the friction loss characteristics established for each pipe. The friction factors for the pipes also compensate for system pressure losses through valves and pipe fittings. The friction factors for the pipes in the modeled system were adjusted throughout the calibration process, with the goal for the model output to best approximate the measured values and be within the DOH specified limits of plus or minus 5 psi. Hazen-Williams C-factors between 100 and 150 were used throughout the system. Larger friction factors represent lower pipe friction, and smaller frictions factors represent higher pipe friction. These friction factors are typical values for most pipes of this age and materials.

The field values measured in the static and hydrant flow tests are compared to the model output values in Table 3-17. Tests number 4, 6, and 15 were disregarded because the static and residual pressures were assigned to the same node in the 2002 analysis. The static pressures at these nodes were useful, but residual pressure during the hydrant opening were left out of this analysis.

TABLE 3-17

Calibration Results

Test No.	Flow, gpm	Static Pressure, psi			Residual Pressure, psi		
		Field	Model	Difference	Field	Model	Difference
1	1,282	82	84	-2	62	57	5
2	1,355	91	91	0	64	64	0
3	1,181	69	70	-1	39	34	5
4	1,157	95	96	-1	50	-	-
5	1,334	75	75	0	66	67	-1
6	1,238	76	78	-2	54	-	-
7	1,215	76	76	1	65	65	0
8	989	39	38	1	15	0	**15**
9	989	22	22	0	0	-17	**17**
10	1,314	99	100	-1	73	35	**38**
11	1,623	95	98	-3	70	58	**12**
12	1,598	92	93	-1	71	67	4
13	1,536	95	95	0	74	79	-5
14	1,157	100	97	3	84	79	5
15	901	71	72	-1	33	-	-

The DOH Design Manual, Table 8-1 recommends that, for long-range planning purposes, hydraulic models be within 5 psi of measured pressure readings. All 15 static pressures were calibrated to within 3 psi of the observed field measurements. Four out of the 12 hydrant tests exceeded 5-psi difference for residual pressure. All four of these tests were in the northwest section of the system. The operation of the District's water system in this area has changed dramatically since 2002, with the addition of an intertie with Harbor Hills, a PRV on East Bercot Road which serves FWSD from the Harbor Hills system during high demand events, and the closing of the isolation valve on Honeymoon Bay Road. We are confident that the updated model reflects the current operation of the system in this area, even though this area could not be calibrated to 2002 conditions.

Model Input

Model input assumptions have significant impacts on peak hour and fire flow results. Table 3-18 provides the reservoir levels modeled for each scenario.

During peak hour scenarios, all reservoir levels are assumed to have been depleted of operational and equalizing storage to simulate critical design conditions. During fire flow scenarios, operational, equalizing, and fire suppression storage is removed from both reservoirs.

TABLE 3-18

Reservoir Levels During Model Scenarios

	Peak Hour		Fire Flow	
Water Level (feet)	**2023**	**2037**	**2023**	**2037**
Reservoir 1	35.9	35.4	30.2	29.7
Reservoir 2	15.4	15.2	12.5	12.3

Peak Hour Demand Modeling Results

Pursuant to WAC 246-290-230 (5), a water system must maintain a minimum pressure of 30 psi in the distribution system under peak hour demand conditions. The District's existing distribution system has been modeled under 2023 and 2037 peak hour demand conditions and all demand nodes were found to have pressures above 30 psi. No deficiencies are noted for the peak hour demand scenarios. Results for all model nodes are included in Appendix I.

Fire Flow Modeling Results

Pursuant to WAC 246-290-230 (6) a water system must be designed to provide adequate fire flow under maximum day demand conditions, while maintaining a minimum system pressure of 20 psi.

Fire flow demands were assigned in accordance with the requirement for differing residential, commercial, and industrial fire flows. To model these differing requirements, hydrants were assigned fire flow demands within the model depending upon which zoning they were located in; 500 gpm in residential areas, 750 gpm in commercial and mixed-use areas, and 1,000 gpm in industrial areas.

There was one node that was shown to be incapable of providing the required 500 gpm residential fire flow – located at the east end of Sockeye Lane. This node is located at the top of the small boosted 345 zone. Technical performance information regarding the booster pump was not available to include in the hydraulic model, however the District has stated that the booster pump system is designed to provide a minimum 500 gpm fire flow to this area. All other nodes were capable of meeting the assigned fire flow rates under the modeled system conditions. The existing fire hydrants on Watkins Road and Twin Oaks Lane in the Whispering Firs subdivision were capable of meeting the 500 gpm residential fire flow standard. However, it is apparent that, due to elevation, service to the Remora Road, Chestnut Street and Willow Lane future portions of the Whispering Firs subdivision will require improvements to boost pressure.

Different sized water mains were modelled on East Harbor Road to explore alternatives to improve fire flow and pressure within the Whispering Firs subdivision. Currently, available fire flows, at minimum DOH requirements, are between 550 gpm and 577 gpm at existing hydrants in the existing subdivision. By increasing the 6-inch water main on East Harbor from Vinton Avenue to Twin Oaks Lane, fire flows would be increased to 833 gpm at the higher elevation hydrants to 952 gpm at the lower elevation hydrants. A 12-inch water main would bring the flow rates available from all the existing hydrants up above 1,000 gpm. The model further predicts that with a 500 gpm fire flow applied at the intersection of Twin Oaks Lane and Remora Road, the residual pressure at that location would be 34 psi. Increasing the size of the water main on East Harbor Road from 6-inch to 8-inch results in a predicted pressure increase by 12 psi to 46 psi, at the same location and under the same conditions. Further increasing the water main size on East Harbor Road to 12-inch would only increase the pressure by another 3 psi to 49 psi.

Based on mapping available, the elevation at the intersection of Twin Oaks Lane and Remora Road is approximately 150 feet. The highest elevation in the Whispering Firs subdivision expansion area to the south is approximately 210 feet. The 60-foot increase in elevation would reduce pressure by approximately 26 psi. Applying that pressure drop, it appears that the system might be capable of providing a 20 psi residual at the highest elevation in the subdivision while meeting a 500 gpm fire flow event if the water main on East Harbor Road were to be replaced with an 8-inch water main. However, at 210 feet elevation, the hydraulic gradeline at the location would have to be 280 feet to provide the minimum required 30 psi, and would have to be 302 feet to provide the FWSD goal of 40 psi. From Table 3-14 it can be seen that the normal operating range for Reservoir 1 is between 284.5 and 285.5 feet elevation. This is not adequate to provide the FWSD goal of 40 psi, and only leaves 4.5 feet available for head loss and reservoir drawdown to meet the DOH minimum of 30 psi. Under normal operations the system will not be capable of reliably meeting the minimum pressure requirements in the Whispering Firs subdivision expansion area without a booster pump station.

A full fire flow node report is available in Appendix I.

Distribution Improvements

Capital improvements will be discussed in more detail in Chapter 8 of this Plan.

WATER SYSTEM CAPACITY LIMITS

The capacity of the FWSD water system is evaluated in this section. Note that this analysis does not include the SVF water system. There are several factors that could limit water system capacity, including source capacity, instantaneous water rights capacity, annual water rights capacity, and storage capacity. These factors are evaluated in the following sections.

SOURCE CAPACITY LIMIT

Installed pump capacity must be capable of meeting maximum day demand. From Table 3-12 it can be seen that the existing installed source pumping capacity, not including the SVF water system well, exceeds the recommended capacity to meet estimated maximum day demand within 22 hours (1,320 minutes) of pumping through the year 2037. In 22 hours per day at 471 gpm the system sources can produce 621,720 gallons per day. From Table 2-10 it can be seen that the 2037 projected maximum day demand is 517,000 gallons.

To get the ERU limit based on 22 hours per day of source capacity, excluding the SVF water system well, we take the estimated maximum day water demand per ERU and divide that into production capacity in 22 hours per day of production. From Table 2-7, the maximum day demand is 453 gpd per ERU. Therefore, the source capacity limit to ERUs is calculated as follows:

$$\text{Source Capacity Connections Limit excluding SVF water system well} = \frac{621{,}720 \text{ gpd}}{453 \text{ gpd per ERU}} = \mathbf{1{,}372\ ERUs}$$

If the additional 40 gpm of source capacity available from the SVF water system well is included, the total source capacity becomes 511 gpm, the production in 22 hours becomes be 674,520 gallons, and the total supportable ERUs becomes as follows:

$$\text{Source Capacity Connections Limit including SVF water system well} = \frac{674{,}520 \text{ gpd}}{453 \text{ gpd per ERU}} = 1{,}489 \text{ ERUs}$$

INSTANTANEOUS WATER RIGHT CAPACITY LIMIT

Similar to source capacity, instantaneous water rights must be adequate to meet maximum day system demand. Currently the SVF water system water right (G1-27463) is not available to the FWSD water system because the SVF well is not connected to the FWSD water system, and none of the FWSD wells are included as points of withdrawal for the SVF water right. From Table 1-3, FWSD water system has 535 gpm of instantaneous water rights, not including the SVF water right. Based on existing water rights currently available to FWSD water system, the instantaneous water right limitation on FWSD water system connections is as follows:

$$\text{Instantaneous Water Rights Connections Limit excluding SVF Water Right} = \frac{535 \text{ gpm} \times 1{,}320 \text{ min/day}}{453 \text{ gpd per ERU}} = \mathbf{1{,}558 \text{ ERUs}}$$

If the SVF water right can be made available to the FWSD water system, either by connecting the systems together or by adding one or more FWSD wells to the SVF water right, then the available instantaneous water right would be 635 gpm, and the instantaneous water rights limit would be calculated as follows:

$$\text{Instantaneous Water Rights Connections Limit including SVF Water Right} = \frac{635 \text{ gpm} \times 1{,}320 \text{ min/day}}{453 \text{ gpd per ERU}} = 1{,}850 \text{ ERUs}$$

ANNUAL WATER RIGHT CAPACITY LIMIT

As with instantaneous water rights, the system capacity limit based on annual water rights depends on which annual water rights are available to the FWSD water system. Currently the SVF water system water rights are not available to the FWSD water system. Therefore, from Table 1-3, the current annual water rights available to the FWSD water system are 430 ac-ft/yr. The annual water right limit is based on average day demand. An acre-foot is approximately 325,851 gallons. Therefore the current water system capacity limit based on annual water rights is as follows:

$$\text{Annual Water Rights Connections Limit Excluding SVF Water Right} = \frac{430 \text{ ac-ft/yr} \times 325{,}851 \text{ gal/ac-ft}}{149 \text{ gpd per ERU} \times 365 \text{ days/year}} = \mathbf{2{,}576 \text{ ERUs}}$$

If the SVF water rights are made available to the FWSD water system, either by connecting the water systems or by adding one or more FWSD wells to the SVF water right, then the total annual water right available to the FWSD water system would be 510 ac-ft/yr, and the system capacity limit based on annual water rights would be as follows:

$$\text{Annual Water Rights Connections Limit Including SVF Water Right} = \frac{510 \text{ ac-ft/yr} \times 325{,}851 \text{ gal/ac-ft}}{149 \text{ gpd per ERU} \times 365 \text{ days/year}} = 3{,}055 \text{ ERUs}$$

STORAGE CAPACITY LIMIT

Table 3-15 projects that installed storage capacity is adequate through 2037. To find the number of ERUs supportable by existing storage it is necessary to calculate storage requirements for various numbers of ERUs until the required storage exceeds the existing effective storage. Table 3-19 shows storage requirements for 1,488 ERUs and for 1,489 ERUs. The existing effective storage capacity is adequate for 1,488 ERUs, but it is 200 gallons deficient for 1,489 ERUs. Therefore, the existing storage is adequate for 1,488 ERUs.

TABLE 3-19

Storage Requirement Limit

ERUs	Required Effective Storage, gallons				Existing Effective Storage, gallons(4)	Storage Surplus/ (Deficit), gallons
	Equalizing(1)	Standby(2)	Fire Suppression	Total(3)		
1,488	54,300	297,600	60,000	351,900	352,000	100
1,489	54,400	297,800	60,000	352,200	352,000	(200)

(1) Equalizing Storage is peak hour demand for the indicated number of ERUs based on the PHD formula in Table 2-7, minus the existing source capacity of 471 gpm, times 150 minutes, but not less than zero.

(2) Standby Storage is two days of average day demand for the indicated number of ERUs, minus 22 hours of pumping at the existing source capacity of 287 gpm from Table 1-2 with the largest source (184 gpm) out of service, or it is 200 gallons times the projected number of ERUs, whichever is greater.

(3) Total Recommended Storage is the sum of equalizing, plus the greater of either standby or fire suppression storage.

(4) Existing Effective Storage Capacity is from Table 3-14.

SUMMARY OF SYSTEM CAPACITY FACTORS

The water system capacity limits derived above are summarized in Table 3-20. Note that these system limiting factors apply to the FWSD water system and do not include facilities of the SVF water system. The most limiting factor is installed source, which limits the system to 1,372 ERUs. This is an additional 325 ERUs above the 1,047 ERUs represented by 2017 water use data, as shown in Table 2-9. With additional source capacity, the system could expand to the storage capacity limit of 1,488 ERUs, or an additional 441 ERUs. With additional storage capacity, the system could expand to the instantaneous water rights limit of 1,558 ERUs, or an additional 511 ERUs. With additional instantaneous water rights, the system could expand to the annual water rights limit of 2,576 ERUs, or an additional 1,529 ERUs.

TABLE 3-20

Water System Capacity Limits

Limiting Factor	System Capacity, ERUs(1)	Existing Demand, ERUs(1)	Available ERUs(1)
Installed Source Capacity	1,372	1,047	325
Storage Capacity	1,488	1,047	441
Instantaneous Water Rights	1,558	1,047	511
Annual Water Rights	2,576	1,047	1,529

(1) Note that capacity limits shown in Table 3-20 are based on capacities and records of demands of the FWSD water system, and do not include the SVF water system. If the SVF water system were to be combined with the FWSD water system, the total source capacity and water rights capacity would be increased resulting in additional ERUs supportable by source capacity and water rights. However, since no water production or sales data is available for the SVF water system, the SVF water system is left out of the water system capacity limits evaluation.

SUMMARY OF SYSTEM NEEDS AND CONCERNS

From the foregoing discussions, the following are the identified water system deficiencies. No attempt is made here to prioritize the deficiencies. Improvements to correct identified system deficiencies will be prioritized in Chapter 8, Capital Improvements.

SOURCE

The FWSD water system has adequate source capacity to meet the 20-year projected system demands. Facilities at Well 2 are still in poor condition and in need of rehabilitation. It would be beneficial to have water level monitoring and recording equipment installed at each well to help identify source problems early so that they can be corrected before sources fail.

WATER RIGHTS

This analysis indicates that the FWSD has adequate annual and instantaneous water rights to meet projected system demands.

WATER STORAGE

The storage facilities are in good condition, and the existing storage capacity is adequate to meet projected demands throughout the 20-year planning horizon.

CONTROL SYSTEM

The existing control system is adequate and functions reasonably well. It would be beneficial to have a central location were all of the most pertinent system information can be accessed.

WATER DISTRIBUTION SYSTEM

Leak Detection and Repair

Water production and water sales records analyzed in Chapter 2 indicate an excessive amount of DSL. It is not clear how much DSL is actual system leakage, how much may be accounting errors, and how much may be under-reading service meters, and other unaccounted water use. However, as will be discussed in Chapter 4, the Water Use Efficiency Rule requires that any system with in excess of ten percent leakage must institute a Water Loss Control Action Plan (WLCAP). Routine leak detection and repair is generally a major component of a WLCAP.

Water Meter Replacement

Water service meters are generally accurate for about ten years, after which it is recommended that they either be tested to see if they are still accurate or replaced. Most utilities have found that it is more cost effective to simply replace water meters approximately every 10 years. It is recommended that all water service meters should be replaced every ten years. With 587 currently active water services, an average of 59 meters would need to be replaced per year.

Fire Flow Deficiencies

There are no areas served by the District which cannot provide minimum fire flow.

Pressure Reducing Stations

The setting at the Bercot Road pressure reducing station should be periodically checked and adjusted as needed. In addition, it is recommended that a flow meter be installed at the pressure reducing station so that it can be known if, and how much, water flows from the HHC water system to the FWSD water system through this pressure reducing station. Currently, the District compares master meter readings with the consumption readings to determine flow through the PRV, but does not report this information.

PUMP SYSTEMS

No pump system deficiencies have been identified.

BACKUP POWER SUPPLY

The existing propane powered generator at the Well 1 site is capable of powering the telemetry control system at the Well 1 site, Well 1, the Well 1 booster pump station, and the solenoid that activates the PRV allowing flow from Reservoir 2 to Reservoir 1. There is no backup power for Well 2 or Well 3. A backup power system is in place for the Silver Fin Drive pump station. With most of the system pressurized by gravity from Reservoir 1, and Reservoir 2 capable of supplementing Reservoir 1 in the event of a power outage, the existing backup power system is capable of keeping the system in service through an extended power outage.

CHAPTER 4

WATER USE EFFICIENCY PROGRAM

OBJECTIVE

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

WATER USE EFFICIENCY PLANNING REQUIREMENTS

In 1989, the Washington Legislature passed the Water Use Efficiency Act (43.20.230 RCW), which directed DOH to develop procedures and guidelines relating to water use efficiency. In response to this mandate, Ecology, the Washington Water Utilities Council, and DOH jointly published a document titled *Conservation Planning Requirements* (1994). In 2003, the Municipal Water Supply – Efficiency Requirements Act (Municipal Water Law) was passed. This legislation amended RCW 90.03 to require additional conservation measures. The Municipal Water Law applies to all Municipal Water Suppliers. Among other things, the Municipal Water law directed DOH to develop the Water Use Efficiency Rule (WUE Rule), which was adopted January 22, 2007. In addition, DOH has developed a WUE Rule guidance document titled "Water Use Efficiency Guidebook" (WUE Guidebook) originally dated July 2007, and most recently revised January 2017 (DOH Publication #331-375). The WUE Guidebook supersedes and replaces the 1994 Conservation Planning Requirements. Therefore, the WUE Rule and the WUE Guidebook now provide all the currently effective water use efficiency planning requirements.

WATER USE EFFICIENCY RULE

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

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

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

PLANNING REQUIREMENTS

The Planning Requirements of the WUE Rule include the following:

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

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

ESTIMATION OF WATER SAVED

The FWSD water system WUE goal, as stated in their 2011 Water System Plan, is "One percent reduction in customer consumption per day by 2015." Since June 2016 the FWSD annual WUE reports have stated that the FWSD WUE goal is to reduce water usage by one percent, per connection, by 2021. This goal is not clear as to the baseline for the one percent reduction. Also, since this goal is related to usage only, it does not relate to water production or DSL.

Monthly average water use per connection for both residential and for commercial connections is shown in Figure 4-1 together with lineal regressions of both data sets. The linear regressions indicate that commercial water use has increased at a rate of 0.0118 gpd per connection per day (4.3 gpd per connection per year) and that residential water use has increased at a rate of 0.0024 gpd per connection per day (0.88 gpd per connection per year). Based on these statistics it is difficult to say how much water has been saved over the past 6 years.

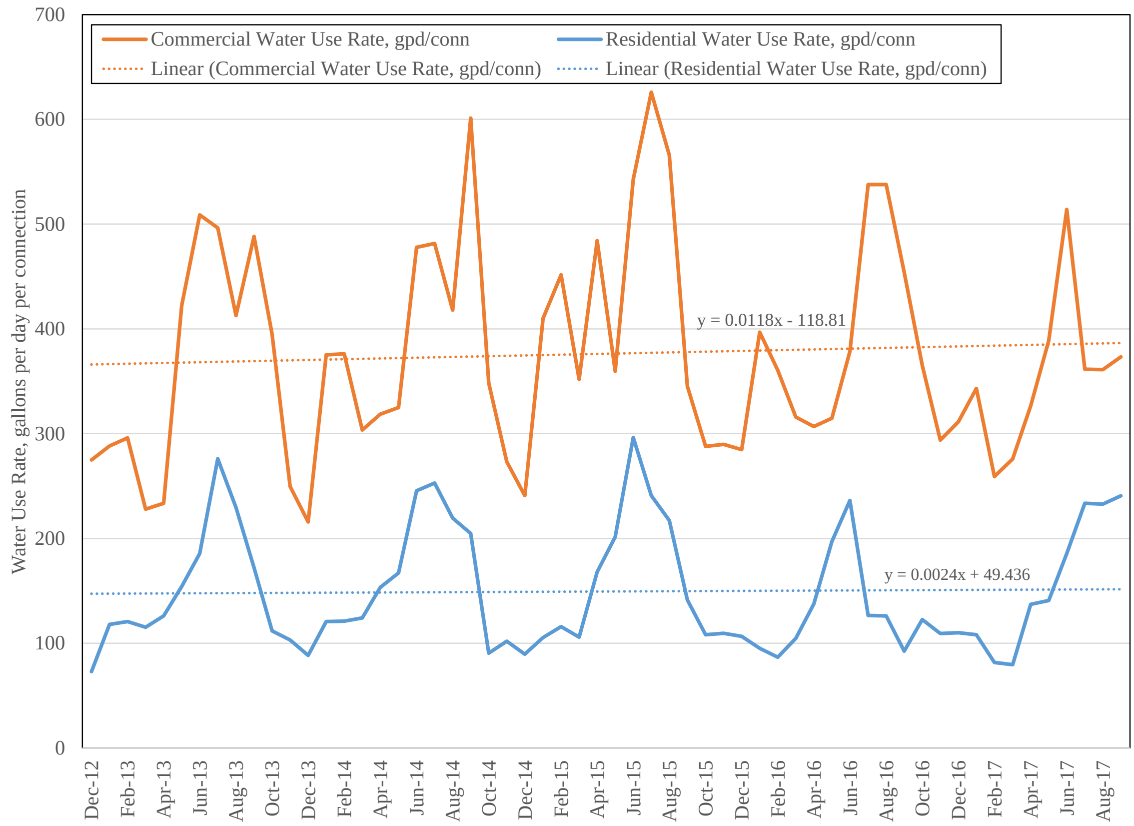


FIGURE 4-1

Water Use Per Connection

While water production, total water use, DSL, and water use per connection all increased over the past 6 years, it is possible that one or more of these factors might have increased by a greater amount if FWSD had not implemented their WUE program. If water use was in fact reduced by one percent over what it would have been in the absence of a WUE program, then we can estimate what that savings might have been. From Table 2-5, the total water use for the period 2013 through 2017 was 180.22 MG. If this is one percent less than what would have been used if FWSD had not implemented their WUE program, then usage over the same period without the WUE program would have been 182.04 MG. Therefore, if the 180.22 MG used from 2013 through 2017 is a one percent reduction from what it might have been, then the water use savings would be 1.82 MG over 5 years, or approximately 364,000 gallons per year.

WATER USE EFFICIENCY GOALS

The WUE Rule requires that the “governing body of the public water system shall establish water use efficiency goals within 1 year of the effective date of this rule.” The effective date of the rule was January 22, 2007, so the WUE Goals were to be adopted by the FWSD by January 22, 2008. The WUE Rule further requires that WUE Goals must "be set in a public forum that provides opportunity for consumers and the public to participate and comment on the water use efficiency goals," and further requires that the goals must include a measurable outcome in terms of water production or consumption, address water supply and forecasted demand characteristics, and include an implementation schedule for meeting the goals.

Previous WUE Goals

Previous Water System Plan

As stated above, the 2011 FWSD water system plan included a WUE goal of a one percent reduction in consumption by 2015. As discussed above, the water use on both an absolute basis and on a per connection basis has increased over the past 5 years. Also the goal does not set a baseline usage rate to act as a basis for comparison. Therefore it is difficult to conclude that FWSD has met their previous WUE goal.

Current WUE Goals

The WUE guidebook recommends that water purveyors set both supply-side and demand-side goals. A supply-side goal relates to the efficiency with which water is transmitted to the water system users, and may relate to systems concerns such as leakage rates and/or system supply capacity. A demand side goal relates to customer demand factors such as average day, maximum day and/or peak hour demand. With this Water System Plan update, the FWSD water system revises its water use efficiency goals as follows:

Supply Side Goal

As shown in Figure 2-4 and Table 2-8, the FWSD water system has had a DSL of over 36 percent in 2016, over 30 percent in 2017, and over 27 percent average over the past three years. Also, as shown in Table 2-9, DSL in 2017 accounts for 316 ERUs. The level of DSL is likely to limit FWSD's ability to acquire any more water rights until the DSL level can be reduced significantly. Therefore, the supply side goal of the FWSD water system is as follows:

- Reduce DSL to 10 percent or less of total water production by the end of 2027.

Demand Side Goals

As shown in Table 2-6, the annual average residential water use rate has varied from 128 gpd per connection in 2016 to 160 gpd per connection in 2015, with a 5-year average of 149 gpd per connection. Table 2-9 shows the 2017 average commercial water use rate was 348 gpd per connection. The average residential water use rate of 149 gpd per connection is quite modest, so it is unlikely that this can be reduced by very much more. It is more difficult to evaluate how much the commercial water use rate of 348 gpd per connection can be reduced, because commercial water use rates can vary widely depending on the nature and size of the commercial operation. However, from Figure 2-4 and from Tables 2-8 and 2-9 it is evident that FWSD water system's primary WUE issue is DSL rather than consumption rates. Therefore, FWSD adopts a modest water use reduction goal based on the previous goals of reducing usage by one percent. A one percent reduction in average day water use would reduce average day residential water use from the current 149 gpd per connection to 148 gpd per connection and would reduce average day commercial water use from 348 gpd per connection to 345 gpd per connection. Therefore, the new demand-side WUE goal for the FWSD water system is as follows:

- Reduce average day residential water use to no greater than 148 gpd per connection, and
- Reduce average day commercial water use to no greater than 345 gpd per connection.

To determine progress toward meeting these goals, the FWSD management will need to:

- Compare total annual production to total annual water use to determine annual percent DSL;
- Divide total annual residential and commercial water sales by the total number of active residential and commercial water services and the number of days in the year and;
- Compare those resultant use rates to these use rate goals.

SELECTED WATER USE EFFICIENCY MEASURES

The WUE Rule requires that water systems with from 500 to 999 service connections must implement or evaluate a minimum of four water use efficiency measures. The WUE Guidebook further states that water use efficiency measures that are required in other portions of the WUE Rule cannot be counted as measures to be selected under this requirement. Measures required in other portions of the WUE Rule include the following:

- Installation of source and service meters if meters are not already present;
- Regular calibration of meters;
- Development and implementation of a water loss control program if DSL exceeds 10 percent; and

- Education of consumers about water use efficiency practices once per year.

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

- Implementation of a conservation rate structure.

- Implementation of a water reclamation program.

- Customer assistance in repair of leaks in customer service lines and in homes.

- Additional consumer education, such as student education and consumer education at fairs.

- Bills showing water consumption history.

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

Measures to Meet Supply-Side Goal

Measures that the FWSD water system intends to implement to meet the supply-side goal of "Reduce DSL to 10 percent or less of total water production by the end of 2027," include the following:

- Periodic leak detection and repair.
- Improve water use accounting.
- Periodic water meter replacement.
- Improve monitoring, control, and data acquisition systems

Measures to Meet Demand-Side Goal

Measures that the FWSD water system intends to implement to meet the demand-side goals of "Reduce average day residential water use to no greater than 148 gpd per connection," and "Reduce average day commercial water use to no greater than 345 gpd per connection," include the following:

- Implement a conservation water rate structure;
- Customer assistance in identifying leaks and providing billing reduction for leaks that are repaired by the customer; and
- Customer water use auditing.

Required Number of WUE Measures

As listed above, FWSD Water System will implement five supply-side WUE measures and three demand-side WUE measures. The supply side measures are all related to reducing DSL, and as such constitute the FWSD water system's water loss control program. Therefore, as noted above, these measures are mandatory and do not count toward meeting the minimum number of WUE Measures.

The demand side measures apply to both of FWSD water system's customer classes, Residential, and Commercial. Since each action counts as one measure for each customer class to which it applies, the two WUE measures identified above constitute six measures, which meets the minimum number of WUE measures required.

IMPLEMENT OR EVALUATE WATER USE EFFICIENCY MEASURES

FWSD intends to implement the minimum required number of WUE Measures. Therefore, no evaluation of the cost effectiveness of conservation measures is required.

METERING REQUIREMENTS

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

Fire hydrants and fire sprinkler line connections are typically not metered because fire flows are typically high rate flows requiring large meters, and fire flow lines are used infrequently, so that a large expensive meter would be required for a flow that rarely occurs. And because they are used infrequently, their accuracy when they are used may not be reliable. However, dedicated fire lines that go to building fire sprinkler systems require a flow detector system to detect any leaks in building fire control systems, and to prevent either inadvertent or intentional theft of water through the building fire line. All new fire sprinkler lines require a bypass meter to detect leakage and an in-line swing check valve.

DISTRIBUTION SYSTEM LEAKAGE STANDARD

The WUE Rule set a DSL standard of ten percent or less of finished water production. DSL is defined as the sum of all water metered into the distribution system over a 3-year time period, less the sum of all metered water uses, and known or credibly estimated unmetered uses, out of the distribution system over the same time period. Known or credibly estimated unmetered uses may include uses such as construction, firefighting, and water main flushing.

As shown in Table 2-8, the 3-year rolling average DSL for FWSD water system has ranged from 5.93 percent in 2014 to 36.13 percent in 2016, with the most recent three-year average at 27.64 percent. This DSL rate is in excess of the ten percent standard specified in the WUE Rule. Therefore, the FWSD water system is required to implement a Water Loss Control Action Plan.

The District has identified significant leakage from several older hydrants, and also hydrants that are not properly closed. A March 2019 leak audit of the District's hydrants identified 26 hydrants that are leaking, damaged, difficult to operate, or in need of repair and/or replacement. Hydrants with severe leakage have been shut off and taken out of service. Further inspections will likely result in the discovery of additional leaking hydrants.

WATER LOSS CONTROL ACTION PLAN

The FWSD water system intends to implement a Water Loss Control Action Plan consisting of the Supply side WUE measures outlined above. These measures include the following:

- Asbestos Cement (AC) Water Main Replacement: As shown in Table 1-5 the FWSD water system has an estimated 10,430 feet of 4-inch to 10-inch AC water pipe, constituting approximately 12.3 percent of the water distribution system. It is possible that these AC pipes are contributing significantly to the FWSD water system's excessive DSL rate. Since the District has not experienced any known significant leakage from AC pipes, AC pipe will be replaced only as needed.

- Periodic Leak Detection and Repair: The FWSD water system will perform regular leak detection activities to locate water main leaks and will repair all water main leaks that are located.

- Improve Water Use Accounting: FWSD will continue to improve their system for water use accounting, including tracking non-billed and non-metered water use on a regular basis and regularly comparing water production records with water use records.

- Water Meter Replacement: FWSD will routinely test and replace as necessary water meters 1 inch or smaller in size, and will regularly test and repair or replace as necessary all larger meters.

- Improve water system monitoring, control and data acquisition capabilities as appropriate based on conditions that indicate possible water loss such as overflowing reservoirs or failing control systems.

- Fire Hydrant Operating Procedures: The District has provided the Fire District with hydrant use forms and requested monthly reporting of the location of hydrants and quantity of water used by the Fire District. The District will be reminding the Fire District if reports are not submitted.

- Fire Hydrant Replacement: The District will be replacing the 26 fire hydrants mentioned above in 2019. In addition, the District will add a new capital project to annually inspect and repair or replace leaking fire hydrants.

GOAL SETTING AND PERFORMANCE REPORTING

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

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

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

GOAL SETTING

The WUE Rule requires that water conservation goals must include a measurable outcome, address water supply or demand characteristics, and include an implementation schedule. The goal setting process must be held through a public forum and be re-evaluated every 10 years. The WUE Rule required that the first water use efficiency goals were to be set by January 22, 2008 for municipal water suppliers with 1,000 or more service connections, and by January 22, 2009 for municipal water suppliers with fewer than 1,000 service connections.

FWSD has authorized submittal of this Water System Plan, including these WUE Goals, and will adopt these WUE goals in a public forum together with adoption of this Water System Plan after the initial review by DOH.

WATER USE DATA REPORTING

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

TABLE 4-1

Summary of Water Use Data Collection

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

FWSD has been submitting annual water use efficiency reports to DOH and distributing water use efficiency reports to customers annually in conjunction with annual consumer confidence reports, including all applicable data required in Table 4-1.

WATER USE EFFICIENCY PROGRAM DEVELOPMENT AND LEVEL OF IMPLEMENTATION

The following sections describe the FWSD water system's water use efficiency goals, conservation measures, and the resulting water use projections.

REGIONAL CONSERVATION PROGRAMS

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

TARGET WATER SAVINGS PROJECTIONS

In this section we estimate the projected water savings that may be realized by meeting the WUE Goals. The revised WUE Goals, as stated above, are to reduce DSL to 10 percent or less, to reduce residential average day water usage from 149 gpd per ERU to 148 gpd per ERU, and reduce average day commercial usage from 348 gpd to 345 gpd, by the year 2027.

Commercial water use is represented by an equivalent number of residential units, or ERUs. Thus, when the value of an ERU is reduced in demand projections, that reduction also results in a proportional reduction in non-residential usage as represented by non-residential ERUs. From Table 2-9, 101 commercial connections was equivalent in 2017 to approximately 236 ERUs, which is an average of approximately 2.34 ERUs per commercial connection. Thus a reduction of the ERU value from 149 gpd to 148 gpd represents a reduction in average commercial use from 348 gpd to approximately 345 gpd, which is the 10-year WUE goal for commercial water use.

Table 4-2 shows how much water savings would be realized by meeting the WUE Goals. Based on this theoretical comparison, the water system would reduce water use by a total of 404.37 acre feet (132 MG) over 20 years.

TABLE 4-2

Projected Savings with WUE Measures

Year	Projected Usage ERUs(1)	Projected DSL ERUs with WUE Goals(2)	Total ERUs with WUE Goals(3)	Projected Value of ERU with WUE Goals, gpd(4)	Average Day Demand with WUE Goals, gpd(5)	Average Day Demand from Table 2-10, gpd(6)	Average Day Savings with WUE Goals, gpd(7)	Annual Savings with WUE Goals, gallons(8)	Annual Savings with WUE Goals, ac-ft/yr(9)
2017	731	316.0	1,047	149	156,000	156,000	0	0	0.00
2018	735	304.8	1,040	149.0	154,900	157,000	2,100	766,500	2.35
2019	740	293.6	1,034	148.9	153,900	157,000	3,100	1,131,500	3.47
2020	744	282.4	1,026	148.9	152,800	158,000	5,200	1,898,000	5.82
2021	749	271.1	1,020	148.8	151,800	159,000	7,200	2,628,000	8.07
2022	754	259.9	1,014	148.8	150,800	159,000	8,200	2,993,000	9.19
2023	758	248.7	1,007	148.7	149,700	160,000	10,300	3,759,500	11.54
2024	763	237.5	1,000	148.7	148,700	161,000	12,300	4,489,500	13.78
2025	767	226.3	993	148.6	147,600	161,000	13,400	4,891,000	15.01
2026	772	215.1	987	148.6	146,600	162,000	15,400	5,621,000	17.25
2027	777	203.8	981	148.5	145,700	163,000	17,300	6,314,500	19.38
2028	782	192.6	975	148.5	144,700	164,000	19,300	7,044,500	21.62
2029	786	181.4	967	148.4	143,600	164,000	20,400	7,446,000	22.85
2030	791	170.2	961	148.4	142,600	165,000	22,400	8,176,000	25.09
2031	796	159.0	955	148.3	141,600	166,000	24,400	8,906,000	27.33
2032	801	147.8	949	148.3	140,700	166,000	25,300	9,234,500	28.34
2033	806	136.5	943	148.2	139,700	167,000	27,300	9,964,500	30.58
2034	811	125.3	936	148.2	138,700	168,000	29,300	10,694,500	32.82
2035	815	114.1	929	148.1	137,600	169,000	31,400	11,461,000	35.17

TABLE 4-2 – (continued)

Projected Savings with WUE Measures

Year	Projected Usage ERUs(1)	Projected DSL ERUs with WUE Goals(2)	Total ERUs with WUE Goals(3)	Projected Value of ERU with WUE Goals, gpd(4)	Average Day Demand with WUE Goals, gpd(5)	Average Day Demand from Table 2-10, gpd(6)	Average Day Savings with WUE Goals, gpd(7)	Annual Savings with WUE Goals, gallons(8)	Annual Savings with WUE Goals, ac-ft/yr(9)
2036	820	102.9	923	148.1	136,600	169,000	32,400	11,826,000	36.29
2037	825	91.7	917	148.0	135,700	170,000	34,300	12,519,500	38.42
Total Savings Projected 20-year savings with WUE Goals(10)								**131,765,000**	**404.37**

(1) *Projected Usage ERUs* is the Projected ERUs from Table 2-10 minus the DSL ERUs from Table 2-9.

(2) *Projected DSL ERUs with WUE Goals* is a straight line interpolation from years 2017 to 2027, using the 2017 DSL ERUs from Table 2-9 and ten percent of *Total ERUs with WUE Goals* for 2027 DSL ERUs.

(3) *Total ERUs with WUE Goals* is *Projected Usage ERUs* plus *Projected DSL ERUs with WUE Goals.*

(4) *Projected Value of ERU with WUE Goals* is a straight line interpolation from 2017 to 2027, using the ADD value of 149 gpd from Table 2-7 for 2017, and 148 gpd for 2027 ADD.

(5) *Average Day Demand with WUE Goals* is *Total ERUs with WUE Goals* times *Projected Value of ERU with WUE Goals* rounded to the nearest 100 gpd.

(6) *Average Day Demand from Table 2-10* is Average Day Demand from Table 2-10.

(7) *Average Day Savings with WUE Goals* is *Average Day Demand from Table 2-10* minus *Average Day Demand with WUE Goals.*

(8) *Annual Savings with WUE Goals, gallons* is *Average Day Savings with WUE Goals* times 365 days per year.

(9) *Annual Savings with WUE Goals, ac ft/yr* is *Annual Savings with WUE Goals, gallons* converted to acre-feet.

(10) *Total Savings Projected 20-year savings with WUE Goals* is the sum of the projected annual savings.

SOURCE OF SUPPLY ANALYSIS

OPTIMIZING USE OF CURRENT SUPPLIES

As shown in Tables 3-12 and 3-13, FWSD water system has adequate source of supply and adequate water rights for the 20-year planning horizon, even without implementing WUE measures. However, pumping the additional water required due to the excessive DSL costs FWSD in terms of electrical power and wear and tear on pumping systems. Reducing DSL and water demand will reduce power costs and extend the life of pumping equipment. This will result in a savings to FWSD and their customers.

ENHANCED CONSERVATION MEASURES

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

WATER RIGHT CHANGES

Based on Table 3-12 the FWSD water system has adequate water rights through the 20-year planning horizon. However, as demands on water resources increase, the unused portions of existing water rights (inchoate rights) are coming increasingly into question. It is prudent that FWSD make continuous good faith efforts to utilize their water rights as efficiently as practical to justify any requests for additional water rights in the future.

ARTIFICIAL RECHARGE

Currently, all wastewater in the area is infiltrated into the ground via onsite sanitary septic treatment systems. This is essentially artificial groundwater recharge. However there is concern regarding the impact of this infiltration on groundwater quality, particularly on nitrate. FWSD has been planning a wastewater treatment facility to serve the Freeland commercial core, and for the treated effluent to be infiltrated into the ground in the Freeland area. The treatment would remove some of the nitrate and other wastewater constituents that negatively impact groundwater, alleviating some of the current concern with septic systems. Once constructed and in operation this system would effectively be an artificial recharge groundwater system. However, due to the estimated high cost of the treatment facility and collection system, and failure to identify a suitable disposal method, the project is currently on hold.

WATER RECLAMATION

The WUE Rule requires that water utilities with more than 1,000 service connections include an evaluation of water reclamation and reuse opportunities in their water system plans. Since the FWSD water system has fewer than 1,000 service connections and is not projected to reach 1,000 services within the 20-year planning horizon, it is not required that FWSD water system provide an evaluation of water reclamation and reuse opportunities at this time.

WATER SUPPLY CHARACTERISTICS

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

CHAPTER 5

SOURCE PROTECTION PROGRAM

OVERVIEW

Water from underground aquifers, commonly referred to as groundwater, is the primary source of drinking water for an estimated 65 percent of Washington state residents. The FWSD water system relies solely on groundwater. Groundwater is pumped from three wells to serve the FWSD water system; a fourth well serves only the SVF water system only. All four wells are located in the same general vicinity in the southeast portion of the FWSD water system service area. Well 2 is approximately 360 feet west from Well 1. Well 3 is approximately 1,340 feet south southeast from Well 1. The SVF well is approximately 2,140 feet east from Well 1. The distance from Well 2 to the SVF well is approximately 2,500 feet, just under a half mile. The location of each of the wells is shown on Figure 1-3.

To protect groundwater supplies, the Environmental Protection Agency (EPA) and the Department of Health (DOH) require public water utilities to develop wellhead protection programs as a component of their water system plans. The purpose of a wellhead protection program is to provide local utilities with a pro-active program for preventing groundwater contamination. A successful wellhead protection program consists of a number of components that must be developed before the plan can be fully implemented. The major components of the plan are described below and form the basis of this chapter.

- *Geology* of the area, describing the groundwater source and any natural protection provided by geologic structures.
- *Susceptibility Assessments* determining the susceptibility to contamination of each source.
- A *delineated Wellhead Protection Area (WHPA)*, based on all reasonably available hydrogeologic information, including the Susceptibility Assessment.
- An *inventory* of potential sources of contamination within each WHPA.
- A *spill response plan* for each WHPA containing documentation for coordination with local first responders.
- *Contingency plans* for providing alternate sources of drinking water in the event that contamination does occur and management recommendations to reduce the likelihood that potential contaminant sources will pollute the drinking water supply.

GEOLOGY

The geology of the FWSD water system area is summarized in Chapter 1, and further described on the Geologic Map of the Freeland and Northern Part of the Hansville 7.5-minute Quadrangles, Island County, Washington, by Michael Polenz, Henry W. Schasse, and Bradley B. Petersen, June 2006. (Washington Division of Geology and Earth Resources, Geologic Map GM-64) The area is generally described as 800 to 2,500 feet of unconsolidated sediment on top of underlying bedrock. While there are local deposits of clay, silt and till that are low permeability to groundwater flow, there are no extensive aquitards that would create clearly defined and separate aquifers in the area. Therefore, all of the FWSD wells can be considered as withdrawing from essentially the same aquifer.

Well logs of the FWSD and SVF wells are included in Appendix B of this water system plan together with a profile of the wells showing the vertical relationship of strata identified in the well logs and of the screened intervals of the wells. The wells all access a sandy to sandy-gravelly aquifer in the range of 8 feet above sea level (top of screen in Well 2) to 39 feet below sea level (bottom of screen in Well 3).

SUSCEPTIBILITY ASSESSMENT

Completed susceptibility assessment forms for the FWSD and SVF water system wells are included in Appendix J. Drinking water supplies vary in their susceptibility to contaminants discharged at the surface. Wells that have been poorly constructed or have been improperly cased have an increased susceptibility. Additionally, shallower wells located in an aquifer with no confining layer (layer of low permeability) between the aquifer and surface have a much higher susceptibility than those drawing water from confined aquifers deeper below the ground surface.

After review of the susceptibility assessments, the Department of Health determines susceptibility ratings. Table 5-1 lists the susceptibility ratings for the FWSD water system wells as determined by the Department of Health.

TABLE 5-1

DOH Susceptibility Ratings

DOH Source ID Number	Source Name	Susceptibility Rating	Treated?
FWSD Sources			
S-01	Well 1	Moderate	Yes
S-02	Well 2	Moderate	Yes
S-04	Well 3	Moderate	Yes
SVF Sources			
S-01	Well 4	Not Rated	No

The SVF well has not received a susceptibility rating because it is serving as a Group B water system. DOH has only made susceptibility ratings for Group A water system wells. However, it is likely to be similar to Wells 1 and 2 because it is in a similar geologic strata and it is of similar construction.

WELLHEAD PROTECTION AREA DELINEATIONS

The first step in developing a wellhead protection program is to establish the land areas around each well from which groundwater may be flowing to the well. These areas which most likely contribute pollutants to the groundwater are referred to as Zones of Contribution (ZOCs). The 6-month, 1-year, 5-year and 10-year ZOCs, combined, constitute the Wellhead Protection Area (WHPA) for each well. WHPAs require proper land use management to minimize the possibility of contaminants affecting groundwater sources. The most commonly accepted tools for delineating ZOCs are the calculated fixed radius method, analytical models, and numerical models. These methods are discussed below.

METHODS OF DELINEATION

Calculated Fixed Radius Method

The simplest groundwater model is the Calculated Fixed Radius (CFR) method. In this method, ZOCs are delineated by concentric areas around each well, usually 100 feet or more. In the Calculated Fixed Radius method, the delineations are calculated based on projected pumping rates and known or assumed aquifer characteristics. This method is the minimum acceptable interim method of delineation for public water systems.

Analytical Models

The analytical model requires the incorporation of basic hydrological information and certain physical characteristics of the aquifer and well. Major assumptions and simplifications to the hydrogeologic regime occur in analytical modeling, but the incorporation of the hydraulic gradient and hydrogeologic boundaries allows for a more realistic representation of the groundwater flow regime than in the calculated fixed radius method.

Numeric Method

The Numeric method requires significantly more data. In numeric modeling, a grid is superimposed over the study area. Each square in the grid, called a cell, is characterized by physical parameters, which are estimated from data collected from a variety of sources. The sources may include well logs, geologic and hydrogeologic maps, geophysical data, groundwater elevation data, stream flow discharge and meteorological data.

The Numeric method generates more accurate results than the Fixed Radius or Analytical methods. However, Numeric models are very costly to develop. Consequently, Numeric models are more commonly used by large utilities with complex aquifers who have the resources to collect the extensive model input required.

ANALYSIS

An analytical model was completed in 2013 by Pacific Groundwater Group (PGG) during evaluation of a fuel spill at the Whidbey Marine site. A copy of the 2013 PGG Freeland Water & Sewer District Well Capture Zone Analysis is included in Appendix J. The capture zones as developed in the PGG report are shown in Figure 5-1.

CONTAMINANT SOURCE INVENTORY

INVENTORY DATA SOURCES

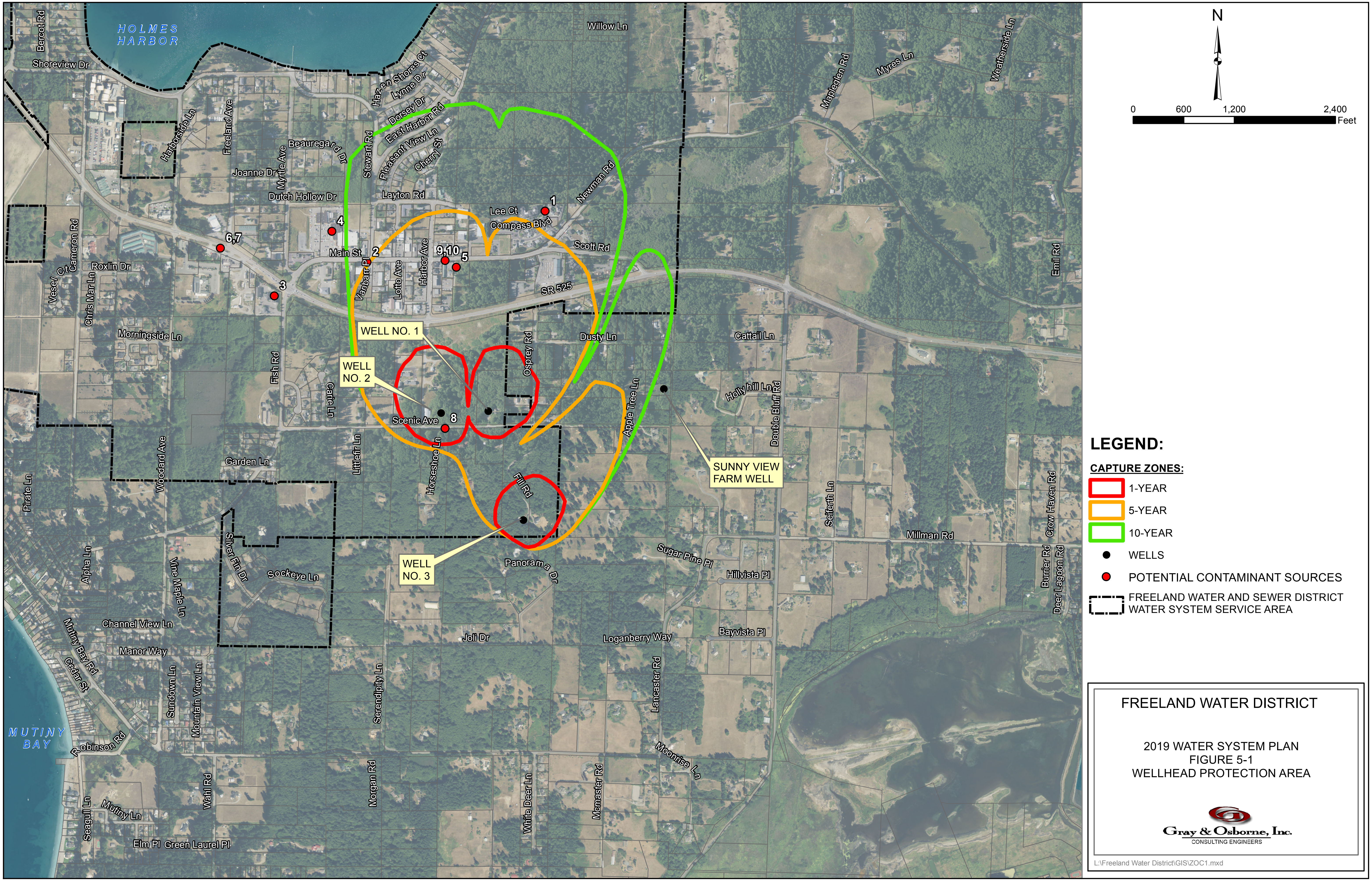
An essential element of wellhead protection is an inventory of all potential sources of groundwater contamination in and around the delineated WHPAs. The purpose of the inventory is to identify past, present and proposed activities that may pose a threat to the well or surrounding area. The inventory can also help to plan management strategies and establish a mailing list to notify businesses located within the WHPAs.

The inventory of potential contaminant sources from the 2011 water plan was updated using the Department of Ecology Facilities Site Atlas. The Facility/Site Atlas provides interactive mapping of Washington Department of Ecology's regulated facilities and Washington Department of Health's regulated public water systems. This mapping application was designed to support drinking water source protection by providing public access to information showing the proximity of public drinking water sources to regulated facilities. The map can be accessed at the following web site:

https://fortress.wa.gov/ecy/facilitysite/MapData/MapSearch.aspx

The web site links to the following databases:

- Underground Storage Tank Program, including records of registered underground storage tanks and underground storage tanks that are known to have leaked.
- The Dangerous Waste and Materials Generators program, including locations of registered dangerous waste and materials handlers.
- Title III Hazardous Materials sites, including locations of regulated facilities that treat, store or dispose of hazardous materials in sufficient quantity to pose a threat to the community.



FREELAND WATER DISTRICT

2019 WATER SYSTEM PLAN
FIGURE 5-1
WELLHEAD PROTECTION AREA

- Regulated Waste Dischargers.
- Confirmed and Suspected Contamination Sites.

POTENTIAL CONTAMINANT SOURCES

Within a WHPA, there are many diverse activities that may contaminate an aquifer, thereby impacting the water supply. A discussion of these activities, their potential effects on groundwater, and the regulatory requirements that may apply are included in the following sections. Locations of potential contaminant sources within the WHPA for the FWSD wells are shown on Figure 5-1. The names and types of the sources are listed in Table 5-2. FWSD will provide notification to businesses that are potential contaminant sources for its wells.

TABLE 5-2

Potential Contaminant Sources

Map ID	Site ID Number	Site Name	Site Address	Regulated Activity
1	1746	Amerigas Village at Maple Ridge	1967 Alliance Ave, Freeland	Tier 2 Hazardous Chemical Reporter
2	41898821	Corey Oil Cardlock UST 2969	1650 Main Street, Freeland	Underground Storage Tank, Tier 2 Hazardous Chemical Reporter
3	6999163	Freeland Shell Station	5618 Fish Road, Freeland	Underground Storage Tank, Hazardous Waste Generator
4	8351	Rite Aid 6722	1609 East Main Street, Freeland	Hazardous Waste Generator
5	2242550	Scottys Service	1690 East Main Street, Freeland	Underground Storage Tank
6	52297857	Short Stop Freeland	1504 East Hwy. 525, Freeland	Leaking Underground Storage Tank
7	4671872	Texaco Freeland	18205 SR 525, Freeland	Enforcement, Final
8	4023143	Verizon Wireless Freeland	1730 Scenic Avenue, Freeland	Tier 2 Hazardous Chemical Reporter
9	17222251	Whidbey Marine & Auto Supply	1692 Main Street, Freeland	Leaking Underground Storage Tank, Tier 2 Hazardous Chemical Reporter
10	3223	Whidbey Marine & Auto Supply Site	1692 E Main Street, Freeland	Under-ground Injection Control

Landfills

A landfill is a disposal facility in which solid waste is permanently placed. Minimum functional standards for solid waste hauling are regulated by the Washington State Department of Ecology under WAC 173-304. These regulations set siting and closure criteria, performance standards, and operating requirements for landfills. Abandoned and improperly maintained landfills and dumpsites can be a major source of groundwater contamination. Leachate from landfills poses a threat to groundwater quality should it migrate to the water table. The Department of Ecology is responsible for mitigating dumpsite cleanup when potentially hazardous leachates are present.

There are no identified active landfills within the FWSD WHPA.

Commercial and Industrial Activity

Areas of commercial and industrial land use may be located within WHPAs. Businesses that may contribute contaminants to the groundwater include dry cleaners, gas stations and other businesses with fuel storage tanks, auto repair shops, metal plating facilities, asphalt and concrete facilities, and machine shops. Wastes generated at these businesses include substances such as petroleum products, solvents, surfactants, heavy metals, and other organic materials. These wastes can potentially enter the groundwater system through inadequate disposal practices or accidental spills. Table 5-3 presents typical commercial and industrial activities and the potentially hazardous chemicals that may be associated with them.

TABLE 5-3

Chemicals Associated with Commercial and Industrial Activities

Commercial/Industrial Activity	Contaminants
Automobile/Truck Service	waste oils, solvents, acids, paints, soaps
Dry Cleaners	solvents (perchloroethelyene, petroleum solvents, Freon) spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Cemeteries	fertilizers, pesticides
Country Clubs/Golf Courses	fertilizers, herbicides, pesticides, swimming pool chemicals, automotive wastes
Electric/Electronic Equipment Manufacturers	nitric, hydrochloric and sulfuric acid, heavy metal sludges, ammonium persulfate, cutting oil and degreasing solvent, corrosive soldering flux, waste plating solution, cyanide, methylene chloride, perchloroetheylene, trichloroethane, acetone methanol
Furniture/Wood Manufacturing	paints, solvents, degreasing and solvent recovery sludge
Metal Plating Shops	sodium and hydrogen cyanide, metallic salts, alkaline solutions, acids, solvents, heavy metal contaminated wastewater/sludge
Lawns and Gardens	fertilizers, herbicides, pesticides
Painters, Publishers	solvents, inks, dyes, oils, miscellaneous organics, photographic chemicals
Sand and Gravel Mining	diesel fuel, motor oil, hydraulic fluids
Scrap, Salvage and Junkyards	used oil, gasoline, antifreeze, PCB contaminated oils, lead acid batteries

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

The FWSD water system WHPA encompasses six RCRA sites, as listed in Table 5-3, including the following:

- Amerigas Village at Maple Ridge
- Corey Oil Cardlock UST 2969
- Freeland Shell Station
- Rite Aid 6722
- Verizon Wireless Freeland
- Whidbey Marine & Auto Supply

Underground Storage Tanks

Underground storage tanks (USTs) and leaking underground storage tanks (LUSTs) can be a major threat to groundwater quality. Petroleum products, which typically contain components that are mobile in the groundwater system, are the most commonly stored substances in USTs. The EPA has estimated that 35 percent of all USTs could be leaking. The most common causes of leaks are structural failure, corrosion, improper fittings, and improper installation.

Ecology regulates underground storage tanks in Washington State under WAC 173-360. The regulations require that owners and operators of underground storage tanks comply with the following sections of the regulations:

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

As of July 1, 1991, owners and operators of all existing non-exempt underground storage tanks were required to have a permit from Ecology. A valid permit is a requirement for delivery of regulated substances. The permit must be updated annually.

Underground storage tank inspections are performed by Ecology primarily through the information developed in the permitting process. Ecology maintains a file on all permitted USTs in Washington State, as required by RCRA, Subtitle 1. The file provides the site name and address, tank identification number, date of installation, size, tank status, and the substance stored at the site.

The FWSD water system's WHPA encompasses five sites with underground storage tanks and two sites that have been identified as leaking underground storage tanks, as follows:

Underground Storage Tanks

- Corey Oil Cardlock UST 2969
- Freeland Shell Station
- Scottys Service

Leaking Underground Storage Tanks

- Short Stop Freeland
- Whidbey Marine & Auto Supply

Septic Systems

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

FWSD does not yet have a sanitary sewer service available to customers within the Freeland NMUGA. All developed properties outside the NMUGA will continue to utilize on-site sewage disposal. A list of all known properties utilizing on-site sewage disposal systems within the 1-year travel time of the individual wells and combined wellhead protection area has been obtained from the Island County Health Department and is included in Appendix J.

Accidental Spills

Accidental spills or releases of contaminants can potentially impact groundwater supplies. Potential sources of spills and leaks include underground storage tanks, accidents and poor disposal practices. Accidental spills are a concern along major public rights-of-way. State Route 525 passes through the 1-year, 5-year and 10-year time of travel zones for the combined wellhead protection area.

Confirmed or Suspected Contamination Sites

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

The Whidbey Marine site, sites 12 and 13 in Table 5-3 and in Figure 5-1, is a confirmed contaminated sites within FWSD's WHPA. This site is currently in cleanup phase.

SPILL/INCIDENT RESPONSE PROGRAM

Spill response planning is an important aspect of both an emergency management plan and a wellhead protection program. Specific response procedures for WHPAs must be determined prior to the occurrence of a contamination incident. The information obtained as a result of the susceptibility assessment and the WHPA inventory can be used to determine what types of spill response measures are necessary for the protection of drinking water sources. In order to be accepted by local emergency responders, spill response procedures for WHPAs should be realistic and easily implemented.

In order for spill response procedures to be effectively executed, coordination, cooperation, and communication among the responding agencies, organizations, and individuals is imperative. Depending on the magnitude and type of the release, any of the following organizations may be involved in a spill response for a WHPA in Washington State.

- *Department of Ecology (Ecology):* The Spill Response Team is responsible for determining the source and cause of the release, and responsible party. If the responsible party is unknown, Ecology will investigate to determine who is responsible and ensure that containment, clean up, and disposal proceedings begin. Ecology's 24 Hour Spill Response can be contacted at **1-800-OILS-911** (1-800-645-7911).

- *Department of Health (DOH):* The Department of Health is developing a set of standard operating procedures, in conjunction with organizations such as Ecology's Spill Operations Section and the Association of Fire Chiefs that first responders can use in WHPAs, critical aquifer recharge areas, and other sensitive groundwater areas. DOH also provides assistance through laboratory support and services, if necessary to the cleanup effort. Office of Drinking Water emergency hotline is 1-877-481-4901.

- *Department of Transportation (DOT):* The Washington State DOT can provide spill response assistance through traffic control, equipment, and personnel for non-hazardous cleanup activities on state and interstate highways. State Patrol: The state patrol is responsible for managing spills on interstate and state highways. To report an emergency spill call 911. To discuss a non-emergency spill call (425) 649-7000.

- *Fire Department:* Initial response to a hazardous spill will most likely be from Lewis County Fire District No. 5. The Fire District should be notified of the WHPA boundaries. For non-emergencies contact the South Whidbey Fire District at 360-321-1533. For emergency response call 911.

CONTINGENCY PLANNING

Contingency planning is an important component of a wellhead protection program. In the event that any wells need to be taken offline due to contamination, a contingency plan provides immediate mitigation. A properly prepared and updated contingency plan helps ensure the water system, and local officials, are prepared to respond to emergency situations. Contingency planning also includes provision of alternative sources of drinking water. The following steps are necessary for the development of an effective contingency plan:

- Identify maximum capacities of the existing system as to source, distribution system and water rights restrictions. Assume loss of well and re-evaluate.
- Evaluate the expansion options of the existing system's capacities relative to existing water rights.
- Identify existing or potential interties with other public water systems.
- Evaluate current procedures and make recommendations on contingency plans for emergency events.

Existing Capacity

The maximum capacity of the FWSD water system was discussed in Chapter 1 and evaluated in Chapter 3. As indicated in Table 3-12, existing installed source capacity is adequate to meet projected system demands through the 20-year planning horizon with 79 gpm of source capacity to spare. As shown in Table 1-2, the lowest capacity well is 124 gpm and the largest well is 184 gpm. Therefore, loss of any well would limit the FWSD water system's capacity to meet maximum day demand, and could necessitate water use restrictions until the lost capacity can be restored.

Water Rights

The FWSD water rights were discussed in Chapter 1 and evaluated in Chapter 3. As indicated in Table 3-13, the FWSD water system has adequate water rights for the 20-year planning horizon. If one or more sources should be contaminated, it may be possible to construct replacement points of withdrawal under existing water rights.

Interties

The FWSD water system has an intertie with HHC water system through a master meter and pressure reducing valve. Analysis of the HHC system by another engineer preparing the HHC Water System Plan, shows that it can supply 500 gpm fire flow to the FWSD system; this is the same fire flow standard provided in the HHC system. The 4-inch main line PRV has a pressure sustaining pilot to limit flow to maintain a minimum of 30 psi in all portions of the HHC system. If the FWSD water system pressure were to drop below 30 psi at the PRV, the pressure reducing valve would open and allow flow from HHC water system to FWSD water system. In the event of a loss of source, the pressure reducing valve could be adjusted to allow flow from HHC water system to FWSD water system at a higher pressure until a replacement source can be constructed. Further analysis is needed to determine the flow and pressure that will be available to supply a greater fire demand or a continuous demand during maximum day demand conditions.

RECOMMENDATIONS

POTENTIAL CONTAMINANT SOURCES

FWSD notifies annually, by letter, all owners of potential contaminant sources within the District's WHPA to ensure they are aware of the WHPA and the importance of protecting this resource. Sample notification letters are included in Appendix J.

CONTINGENCY PLANNING

The following items are recommended contingency planning efforts that FWSD will consider implementing.

- Develop emergency procedures for implementing water conservation measures should one or more of the District's wells become contaminated.

- Identify the closest water purveyor that may be available to truck water from and research the availability of trucks that could be used for this purpose.

- Developing another water source that is located outside the same general area as the other four wells owned and operated by the District.

CHAPTER 6

OPERATION & MAINTENANCE PROGRAM

INTRODUCTION

The objective of this chapter is to provide an evaluation of FWSD's operation and maintenance (O&M) program and its ability to assure satisfactory management of the water system operations in accordance with WAC 246-290. FWSD's Operation and Maintenance Manual and specific component related documentation are maintained by FWSD for use by operations personnel.

The O&M Program includes the following major elements:

- Water System Management and Personnel
- System Operation and Control
- Emergency Response Program
- Cross-Connection Control Program
- Customer Complaint Response Program
- Recommended O&M Improvements

WATER SYSTEM MANAGEMENT AND PERSONNEL

FWSD is governed by a three-member board of commissioners. All water system operations are contracted out to Whidbey Water Services, a private operations company.

OPERATOR CERTIFICATION

Certification Requirements

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

TABLE 6-1

Water System Group Classification

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

FWSD serves fewer than 1,500 people on a full time basis, and therefore is required to have a WDM Level I. Additionally, FWSD is required to have a Cross-Connection Control (CCC) Program and must ensure that a Cross Connection Specialist (CCS) is responsible for overseeing the program and for periodic inspections of premises for cross connections. Finally, FWSD must ensure that a Backflow Assembly Tester (BAT) is responsible for inspecting, testing, and monitoring backflow prevention assemblies in accordance with WAC 246-290-490. FWSD can have a CCS on staff or have an outside CCS specialist review their CCC program and perform cross connection inspections. FWSD can also have a BAT on staff to perform the backflow assembly tests or can allow the customers to have their device tested by an independent certified BAT.

FWSD Water Operations Staff Certifications

FWSD contracts with Whidbey Water Services LLC (WWS) for all of its water system operations and maintenance needs. WWS is an approved Satellite Water System Management Agency, SMA #136, owned jointly by Andy and Terri Campbell. Table 6-2 lists the Whidbey Water Services maintenance personnel, positions and certifications. FWSD does not have a certified BAT. Water customers who are required by FWSD to maintain backflow prevention assemblies are required to hire their own independent BAT to provide testing and certification of backflow prevention assemblies.

TABLE 6-2

FWSD Water System Personnel and Certifications

Staff	Position	Operator No.	Certifications
Andy Campbell	Manager	006432	WDM 2, BTO, WTPO 1, CCS
Terri Campbell	Financial Manager and Administration	-	-

PROFESSIONAL GROWTH REQUIREMENTS

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

WWS is contractually responsible for providing a certified operator for FWSD water system operations.

SYSTEM OPERATION AND CONTROL

MAJOR SYSTEM COMPONENTS

Descriptions of major system components are included in Chapter 1, and further discussed Chapter 3. The locations of the major system components are shown on Figure 1-3, the system facilities map. A description of the normal operation of each facility is given in the following sections.

Source of Supply

FWSD obtains its water from three wells, Well 1, Well 2, and Well 3. Wells 1 and 2 pump into the main 286-foot pressure zone controlled by Reservoir 1. Well 3 pumps into the 344-foot pressure zone controlled by Reservoir 2, which feeds into the 286-foot pressure zone via a solenoid activated pressure reducing valve.

The intertie with HHC water system is also a water source for the system, although it is controlled by a pressure reducing valve that is adjusted such that it only supplies the FWSD water system if the pressure in the FWSD water system falls well below its normal operating pressure (30 psi). Thus it acts as an automatic emergency-only intertie.

Treatment

Water from Wells 1 and 2 is chlorinated and filtered to remove iron and manganese at the Well 1 site prior to discharging into Reservoir 1. Water from Well 3 is chlorinated and filtered to remove iron and manganese prior to discharging into Reservoir 2.

The chlorination systems require regular maintenance to keep the chlorine feed tanks filled and to observe whether or not the feed pumps appear to be operating properly. Regular checking of chlorine residual will tell if the pumps are adjusted properly. Spare parts are kept on hand to repair or replace feed pumps in a timely manner as needed. The iron and manganese treatment systems are backwashed regularly. Backwash is automatic based on elapsed time and pressure drop across the filter. Pressure drop across should be filters is checked regularly. If pressure drop is excessive, the filters are backwashed. If backwashing does not reduce the pressure drop to normal then it is possible that the filter underdrain is becoming plugged, or the filter media may need replacing. The filter manufacturer’s O&M manual is consulted and/or the filter manufacturer’s representative is contacted to assist with filter system troubleshooting.

Reservoirs

As described in Chapter 1, FWSD owns and operates two reservoirs. The reservoirs are described in Chapter 1 and further analyzed in Chapter 3 as to their effective capacity.

Water reservoirs provide water storage to meet maximum water system demands and emergency situations, and provide system pressure based on the elevation of the water in the reservoir. Water level in the reservoirs is used to turn wells on and off, and the reservoirs provide a place for water to go when source output exceeds system demand.

Reservoirs require minimal maintenance but are inspected regularly for signs of intrusion. The water level indicator on the reservoirs is checked to make sure it is sliding freely on the gage board. The vents on the tops of the reservoirs are inspected every six months to make sure that the vent screen is intact so that insects, birds, and bats cannot enter the reservoirs, and are unobstructed so that air can move freely into and out of the reservoirs.

Pump Stations

The FWSD water system has two pump stations: the Well 1 pump station and the Silver Fin Drive pump station are described in Chapter 1. The Well 1 pump station currently serves two water customers and the Silver Fin pump station currently serves three water customers with a potential to serve up to six water service connections.

System Control

The control system is described in Chapter 3. There is no central monitoring or control system. Wells 1 and 2 and the solenoid activated PRV from the 344-foot pressure zone to the 286-foot pressure zone are all controlled by the water level in Reservoir 1. Well 3 is controlled by the water level in Reservoir 2. Low water level at Reservoir 1 will trigger an autodialer to notify the system operator. The Well 1 pump station and the Silver Fin Drive pump station are each controlled locally by pump station output pressure.

The control systems require minimal maintenance. Control systems are inspected regularly to assure that they are working correctly. If any of the control systems do not seem to be maintaining reservoir levels or systems pressures within the normal operating range it may be necessary to have an electrician check and repair the control system as necessary.

Distribution System

As shown in Table 1-5, FWSD maintains approximately 16 miles of water main, which interconnect the wells and storage with consumer service connections. As shown in Table 1-5, approximately 8.6 percent of the pipe is 4-inch diameter or smaller. An estimated 12.3 percent of the pipe is asbestos cement.

Maintenance of water distribution system consists of exercising valves, flushing water mains, and finding and repairing leaks. Required water main flushing frequency is location dependent. Water mains that have significant regular flow do not require flushing as frequently as dead end water mains and water mains in areas with little flow.

Water main flushing may be triggered by inadequate chlorine residual in routine samples and by water taste, odor, and color complaints. When flushing water mains in one area, it is possible that increased flow may stir up sediments in water mains in other areas, leading to dirty water complaints. Therefore, it is important to review the water main flushing plan and possibly close some key valves prior to flushing to avoid creating additional problems.

Finding water main leaks can be a difficult task. Clues that there may be new water main leaks include sudden unexplained increases in daily water production, increases in the difference between water production and water sales, and surfacing water. Many areas within the FWSD water service area have porous ground such that water main leaks percolate and do not show at the ground surface. Water main leaks may be located using leak detection equipment, which primarily uses sonic detection techniques.

Water systems with greater than 20 percent leakage are required to implement a Leak Detection and Repair program. Leak detection and repair is routinely performed when leaks are suspected. In addition, the District has experienced problems due to hydrant valves not being completely closed. The District has recently implemented a program to verify and document that hydrant valves are adequately closed after flushing, fire response, and other activities where water is drawn from hydrants.

Under-reading water meters are a common contributor to excessive water system DSL. As water meters age, their mechanical parts move less freely, and they tend to under-register the amount of water that passes through them. While not strictly leakage, this can be thought of as leakage through the water meter to the customer. The result is that actual water use is underestimated and apparent leakage appears higher than actual. Under-reading water meters also create lost revenue, since water customers with under-reading service meters only pay for a portion of the water that they actually use. Currently, the District replaces about 30 meters per year, based upon meter reading anomalies or meters reaching 1 million gallons.

Water service meters are generally accurate for about thirteen years, after which their loss of accuracy may become significant, for standard 3/4-inch to 1-inch residential water meters. Table 2-2 indicates that the FWSD water system has approximately 587 water service connections. Water meters are replaced as needed. Water meters cost between $60 and $150 each, depending on the brand, size, and remote read features. Labor required to replace water meters is relatively minimal and includes physical replacement of the meter and entering the new meter data into the billing system. For budgeting purposes it is estimated that meter replacement costs approximately $400 per meter, including parts and labor. Therefore, the cost of replacing 30 meters per year is estimated at $12,000 per year. For budgeting purposes it is recommended setting aside $12,000 per year for water meter replacement.

Pressure Reducing Stations

The FWSD water distribution system has two pressure reducing valve (PRV) stations: the Well 1 PRV Station and the Bercot Road PRV Station, described in Chapter 1. The Well 1 PRV station is activated (opened) via a solenoid valve when Well 3 is called, and allows water from Reservoir 2 (the 344-foot pressure zone) to flow to Reservoir 1 and the 286-foot pressure zone. The Bercot Road PRV station allows flow from the HHC water system to the FWSD water system if the pressure in the FWSD water system falls below 30 psi at the PRV outlet. The Bercot Road PRV station pressure setting is set low enough such that it only opens if there is a water emergency or hydrant use in the FWSD water system that causes pressure to fall significantly below normal operating pressure.

PRV stations are checked for output pressure annually and adjusted as necessary. Pressure control line strainers are cleaned annually or more frequently as needed.

WATER QUALITY MONITORING

FWSD receives an annual statement from DOH that indicates which water quality tests are required and when they are required. The monitoring requirements for 2018 are provided in Appendix H. An analysis of FWSD's most current water quality test results can be found in Chapter 3. FWSD is also required to publish a Consumer Confidence Report (CCR) every year to provide customers with water quality data and to explain any challenges the water system may have. A copy of the most recent CCR can be found in Appendix K.

FWSD has a current Coliform Monitoring Plan, a copy of which is located in Appendix H.

PREVENTIVE MAINTENANCE

The most cost-effective method for maintaining a water system is to provide a planned Preventive Maintenance (PM) program. The following PM program provides the optimum level of maintenance activities for the least total maintenance cost. Routine maintenance procedures for each system component follow.

Reservoirs

Improperly maintained reservoirs can cause contamination in public water systems. This can result from contaminants entering the reservoir through cracks or openings at the vent, overflow or drain screens. Deteriorating hatch covers and vandalism can also compromise reservoir water quality. Poorly designed and maintained reservoirs can hamper the emergency operation of a water system. If reservoir drains are not functioning properly, it may be difficult to purge a contaminant from the system. Written documentation of reservoir maintenance must be completed with each inspection and repair, and a copy of the report retained on file.

Periodic Maintenance

As described in Chapter 1, Reservoir 1 was constructed in 1990 and Reservoir 2 was constructed in 2007. These reservoirs are cast-in-place concrete and do not require painting. Periodic maintenance of the reservoirs will include the following:

- Vent screens and the integrity of the access hatch and other openings into the reservoir are inspected twice a year.
- Any opening that may allow the entry of insects or small animals is either sealed or screened accordingly.
- Reservoirs are inspected inside every five years and cleaned of sediment as needed.

Distribution System Valve Maintenance

Good preventative maintenance dictates that all valves be exercised regularly. FWSD currently exercises valves in the system annually. Records should be kept of valve maintenance. A sample valve maintenance form is in included in Appendix L. Valves that do not close tightly should be removed, repaired, or replaced. An important aspect of distribution system valve maintenance and record keeping is to ensure distribution valves are completely open. A partially closed valve can seriously reduce peak day operation and fire flow supply.

PRV Station Maintenance

PRV stations require regular maintenance. PRV pilot lines can become plugged with silt, preventing proper operation. Valve guides can become worn and stick, preventing free movement of the main valve disk. Valve membranes can tear, effectively rendering the valve inoperable. Valve pilot lines should be flushed, pilot strainers cleaned, and valve pressure settings checked and adjusted as needed at least annually. The entire valve should be rebuilt or replaced every five to ten years.

Hydrant Maintenance

Fire hydrants in the system are exercised and flushed annually. Hydrants should be repaired if necessary. It is important to maintain good records of hydrant maintenance. A sample hydrant maintenance form is included in Appendix L.

Water Main Flushing

The entire water system can be systematically flushed. This may be accomplished by using directional flushing. It requires almost 400,000 gallons and several days to flush the entire distribution system, using directional flushing.

<u>Flushing Procedures</u>

Before initiating a comprehensive flushing program, staff will need to review distribution maps and preplan each month's flushing. The following procedures are adapted from guidance provided by the AWWA:

Determine the initial source of clean flushing water, sections of mains to be flushed at a given time, the valves to be used in each case, and the order in which the sections will be flushed. Start at or near one of the sources and work outward so as not to disturb sediments in unflushed portions of the system. If possible, schedule work so that each zone can be completed by the end of the day or so that a natural stopping point is reached. If this is not done, fire protection may be severely restricted. Ensure that all flushing water used comes from areas previously cleaned or from mains large enough to resist sediments being stirred up by the flow. Keep the length of main being flushed as short as possible, especially on small pipes. This will minimize pressure losses in the system and the length of time each customer may be delivered dirty water.

Assure that an adequate amount of flushing water at sufficiently high pressure is available and that it can be disposed of safely. Use a rate of flow required to produce a velocity of 2.5 fps in pipes as follows:

Pipe Diameter, inches	2	3	4	6	8	10	12
Flow Rate for 2.5 fps, gpm	25	56	98	221	392	612	882

Hydrant pressure or pitot gauges are useful in determining flushing rates.

- Do not flush a large main supplied by a single smaller main; the volume available is usually inadequate for flushing.
- Prior to flushing, notify the following parties:
  - Fire department
  - Other utilities, such as, electric, and telephone companies, who may have underground facilities in the area
  - All water system customers
- Isolate the section to be flushed from the system. Close valves slowly to prevent water hammer.
- Open the fire hydrant or blowoff valve slowly until the desired flow rate is obtained. When flushing from a dry-barrel fire hydrant, use the gate valve upstream of the hydrant for throttling purposes. Open the hydrant valve fully to prevent water from escaping into the ground through the fire hydrant barrel drain.

- Direct flushing water away from traffic, pedestrians, and private land. Ensure that flushing water drains to an appropriate storm sewer or watercourse without causing excessive flooding of streets, underground utility vaults, or private property - the District may be held responsible for any accidents or damage related to the released water.

- Prevent heavily contaminated water from discharging to sensitive natural watercourses - flushing into a tanker truck may be necessary.

If water contains chlorine, dechlorinate waters discharging to sensitive natural watercourses. Following are the steps of dechlorination:

- Estimate the rate of flushing. This may be estimated from previous hydrant flow tests or flushing data. If no data if available, open flushing valve just long enough to take a pitot gauge measurement. Calculate the flushing rate using a formula from the AWWA guidance manual.

- Determine the chlorine residual in the main using a suitable field test kit.

- Prepare a dechlorinating agent solution to be pumped into the flushing discharge using a positive displacement chemical feed pump.

- Simultaneously flush main and pump dechlorinating agent into the discharge.

- Check system pressure at a nearby hose bib. If pressure is less than 20 psi, throttle the flow through the hydrant. When possible, check system pressures in higher or remote areas of the pressure zone to ensure that pressures do not drop below 20 psi. This may necessitate a two-man crew with radios.

- Record the date, time, location, pressure zone, size and length of main; and estimate the flushing flow rate and velocity, and time required to clear. Take samples noting the water's odor, color, turbidity, and the presence of any visible objects or organisms.

- When the flushing water is clear, close the hydrant or blowoff valves slowly.

- Keep records of which valves are opened and closed. If, at the end of a day's work, valves normally open are left closed, alert the fire department.

- Proceed to the next section to be flushed and repeat these procedures.

Dead-End Waterlines

Dead-end waterlines are susceptible to water quality problems and should be flushed regularly to remove stagnant water. FWSD currently flushes dead-end mains on an annual basis.

Pump Stations

Pump stations need to be visited weekly to assure that they are running properly. Records should be kept of pump output pressure, flow meter readings and power usage. If the pump system is not maintaining the design output pressure, or if the power required for the amount of water provided shifts significantly, these may indicate problems with the pump system. Probably the most important observation is the sound of the pump system. If the sound of the pump system changes significantly that may be an indication of a problem with the system. Squealing, rattling, or other noises out of the ordinary for the system may be indicators of serious problems with the pumps or motors.

Wells

Routine maintenance for the wells includes keeping records of water meter totalizer and flow rate readings for each well, discharge pressures, periodic sounding of the static and pumping water levels in each well, and keeping the facilities clean. Water quality samples must be taken at each well as required by the Washington State Department of Health. Summaries of the total monthly production of each well should be maintained. Records should be maintained of the original well construction, any modifications to the well construction, all equipment installed in each well and all service performed on the equipment.

Meters

Accurate water metering is an essential financial and conservation-oriented component of water system infrastructure. A substantial amount of revenue may be lost through inaccurate metering of residential, commercial, and industrial accounts. Without accurate master or source meter readings, the water utility cannot assess productivity of sources or determine distribution system leakage rates.

FWSD has six master water meters: one at each well, one at the intertie with HHC water system, and one at each pump station. These meters are checked monthly to ensure accurate source data. In addition to flow meter data, FWSD keeps run time data on all pumps. Flow meter reads in gallons should be divided by run time meter reads in minutes to check the actual gallons per minute each pump is producing. These values should be fairly consistent over time for each pump. If the numbers change significantly for any pump that may signal problems with the pump or with the flow meter.

OPERATIONS AND MAINTENANCE SCHEDULE

A general schedule for routine operations and maintenance activities is summarized in Tables 6-3 and 6-4.

TABLE 6-3

Operations Schedule

Daily • Inspect and adjust treatment systems. • Record well production and chemical feed data. • Inspect facilities.
Monthly • Collect and submit required water samples to lab. • Analyze well production and flows.
Yearly • Inspect all backflow prevention device reports.
Other (as needed) • Leak detection and repair. • Respond to inquiries.

TABLE 6-4

Maintenance Schedule

Monthly • Inspect and adjust booster pumps and pressure reducing valves. • Mow and trim facility sites. • Exercise emergency generator at Well 1.
Quarterly • Read residential meters. • Read commercial meters. • Maintain water meter boxes, as needed.

TABLE 6-4 – (continued)

Maintenance Schedule

Yearly • Flush distribution system dead ends. • Inspect and flush vacuum-air release valves. • Inspect treatment plant media. • Inspect and exercise hydrants and valves. • Service emergency generator at Well 1.
Other (as noted) • Inspect reservoir vents and seals (every spring and fall). • Clean and re-paint hydrants (every 5 years). • Clean inside of reservoirs (every 5 years). • Clean reservoirs (every 5 years).

EMERGENCY RESPONSE PROGRAM

Water utilities have the responsibility to provide an adequate quantity and quality of water in a reliable manner at all times. To do this, utilities must reduce or eliminate the effects of natural disasters, accidents, and intentional acts.

WATER SYSTEM PERSONNEL EMERGENCY CALL-UP LIST

An important element of an emergency response program is to maintain a list of emergency contacts. Table 6-5 provides phone numbers for emergency contacts including response agencies, governments, and material suppliers.

TABLE 6-5

Emergency Phone List

Agency/Group	Contact	Phone Number
Fire/Police	Emergency	911
Sheriff, South Whidbey Office	Business	(360) 321-5113 ext. 7310
South Whidbey Fire/EMS	Business	(360) 321-4400
Puget Sound Energy	Business	(888) 225-5773
Washington State Department of Ecology	Emergency Spill Response	(800) 645-7911

TABLE 6-5 – (continued)

Emergency Phone List

Agency/Group	Contact	Phone Number
Island County	Emergency Management	(360) 321-5111
	Public Works	(360) 321-5111
	Environmental Health	(360) 679-7350
Island County Roads	South Whidbey Office	(360) 321-5111
Edge Analytical Testing Lab	Burlington	(800) 755-9295
	Bellingham	(888) 725-1212
Statewide One Call Before You Dig	Utility Locations	811
Water System Equipment and Supplies	H.D. Fowler, Inc., Marysville	(360) 651-2400
Whidbey Water Services	System Operations	(360) 579-1956
FWSD	General Information	(360) 331-5566
	Emergency	(425) 335-9396
Washington State Dept. of Health, Division of Drinking Water, NW Regional Office	24-Hour Emergency	(877) 481-4901
	Coliform Program	(253) 395-6775
	Regional Engineer	(253) 395-6764
	General Information	(253) 395-6750
Gray & Osborne, Inc., Consulting Engineers	Arlington Number	(360) 454-5490
	Seattle Number	(206) 284-0860

EMERGENCY PROCEDURES

Although is not possible to anticipate all potential disasters affecting FWSD's water system, formulating procedures to manage and remedy several common emergencies is appropriate. Following is a summary of standard response procedures to typical emergency situations.

Contamination of Water Supply

Bacterial contamination of the water supply can occur from such items as main breaks, reservoir intrusion, flooding, or pollution from an isolated source. Table 6-6 provides the appropriate action that will be taken in the event of the contamination of the water supply.

TABLE 6-6

Water Contamination Response

Distribution System Contamination
Notify customers of contamination.
Contact the Washington State Department of Health Coliform Program Manager or Regional Engineer.
Perform coliform, chemical, and free chlorine residual analysis at various locations within the system, including the reservoirs and the system extremities.
Flush and disinfect distribution lines as dictated by the nature of the contamination.
Reservoir Contamination
If possible, isolate reservoir from system.
Re-sample to confirm contamination.
Check distribution system for presence of contamination.
Inspect vent screens, hatches, and piping to identify source of contamination.
If reservoir water is contaminated and therefore considered unsuitable for consumption, drain and clean reservoir.
Disinfect reservoir if bacteriological standards are exceeded.

Bacteriological Presence Notification Procedure

Notification procedures for notifying system customers, the local health department, and DOH of water quality emergencies are an important component of an emergency response program. Many public water systems will occasionally detect positive coliform samples, mainly as a result of minor contamination in distribution mains or sample taps, or improper bacteriological sampling procedures. However, the persistent detection of coliforms in the water supply, particularly E. Coli or Fecal Coliform bacteria, may require issuing a public boil water notice to ensure the health and safety of the water customers. Emergencies such as floods, earthquakes, and other disasters can affect water quality as a result of damage to water system facilities, thereby warranting a boil water order in advance of supply. A suggested boil water notification is included in Appendix M. WAC 246-290-320 requires water utilities to follow specific procedures in the event coliform bacteria are detected in the water system.

Health advisory notifications are hand delivered if needed to all affected customers. All information required is in the notification. The District has pre-printed door hangers as well for quick distribution in localized events. Local and state health will be notified, by the District, in the event of a water quality or pressure issue.

Power Failure

Various types of weather can cause loss of power, such as wind, lightning, freezing rain, and snowstorms. Additionally, power can be lost through traffic accidents and power company equipment failure. During an area-wide power outage, standby storage is designed to provide water reserves for two days of average demand. In addition, FWSD has a backup power supply capable of running Well 1, the Well 1 booster pump system, and the Well 1 site control equipment. A telephone pager system at Reservoir 1 will notify of a power outage or low reservoir condition. The pager has a backup battery power source. FWSD personnel check reservoir levels visually on a reader board at the reservoirs. *Puget Sound Energy will be contacted at (888) 225-5773* to determine the estimated length of the power outage. Customers will be notified of the emergency and water use curtailment will be requested through door hangers with appropriate information for the customers.

Severe Earthquake

A severe earthquake could result in transmission line breaks, distribution system breaks and structural damage to the reservoirs, wells, and to vaults which house critical valving and meters. Also severe earthquakes tend to be followed by aftershocks that can exacerbate damage caused by the initial earthquake. Table 6-7 addresses the possible emergency events and response actions that will be taken in the event of an earthquake.

TABLE 6-7

Earthquake Emergency Response Actions

System Component	Action
Transmission and distribution lines (The nature of the emergency would depend on the area of the transmission system in which the break occurred.)	• Close valves to isolate breaks in water mains. • Check reservoir levels. • Notify water customers of emergency and request customers to conserve water. • Shut down source pumps if appropriate. • Isolate break, check the base water system section maps for valve locations. • Repair break. • Disinfect isolated section.
Reservoirs: May be leaking or structurally damaged.	• Observe structures for visual signs of structural damage, leakage, cracks, etc. Typical damage is to hold down saddles or straps at base of reservoir wall. Also check storm drainage system in the vicinity for significant flows. • If non-observable leakage is suspected, isolate one reservoir at a time and monitor water level for at least 24 hours. • If structural damage is apparent, take the appropriate actions
Pumping stations, critical valves, and meters	• All meter and valve vaults will be inspected following an earthquake to check for joint leakage caused by earth movements.
Supply facilities	• Inspect all supply facilities for leakage or other structural damage.

Severe Snowstorm

Heavy snowfall may bring motor vehicle traffic to a standstill and FWSD operations staff may not be able to reach problem areas. Heavy snowfall may also cause falling branches and trees, further blocking roadways and causing power outages. See discussion under Power Outage. Table 6-8 addresses the possible emergency events and response actions that will be taken in the event of a severe snowstorm.

TABLE 6-8

Severe Snowstorm Emergency Response Actions

System Component	Action
Distribution System: Transportation to monitor system and make repairs will be limited.	Contact Island County Public Works, Roads Division, to expedite plowing to any problem area. Have chains and snow gear ready for maintenance equipment and vehicles. Chainsaw may be necessary for removal of down branches and trees. Valve locations will be made available for maintenance personnel and kept current.
Reservoirs: No immediate effect. Snow may prevent access.	Request to County to clear snow from roads to critical infrastructure.

CROSS-CONNECTION CONTROL PROGRAM

A Cross-Connection Control Program is a required element of an operations program under WAC 246-290-490. The purpose of a cross connection program is to protect public health from the potential for water contamination through back-flow, back-pressure, or back-siphonage through a cross-connection with a non-potable liquid.

The FWSD Cross-Connection Control Program was included in the 2011 FWSD Water System Plan, and is included in Appendix N of this Water System Plan.

PROGRAM ELEMENTS

WAC 246-290-490 (3) establishes the minimum requirements for a cross-connection control program. The regulation identifies ten elements that must be addressed. These elements are addressed in the following sections:

Element 1: Instrument of Legal Authority to Implement Program.

FWSD's Cross-Connection Control Program was enacted under Resolution 01-1 on March 8, 2001. A copy of Resolution 01-1 is located in Appendix N. Also, when applying for water service, customers sign an agreement titled "Prevention of Contamination Cross Connection Control Owner Agreement" as part of their application for water service, in which the applicant agrees to abide by the District's cross connection control rules. A copy of the application form is included in Appendix F.

Element 2: Procedures and Schedules for Evaluating Service Connections.

New construction must be inspected, particularly as plumbing is being installed, to assure that there are not cross connections installed during construction. In addition, facilities must be inspected when permits are requested for changes in existing business activities. Andy Campbell is a certified Cross-Connection Control Specialist, qualified to perform these inspections.

Element 3: Procedures and Schedules for Eliminating and Controlling Cross Connections.

If during inspection a cross connection or potential cross-connection is noted, the Owner must be notified that the cross connection has been identified in the inspection process, and that the cross connection must be eliminated to FWSD's satisfaction, or a backflow preventer must be installed and approved by FWSD. No water service connection will be allowed until the cross connection concern has been addressed.

Element 4: Qualified Personnel to Implement Program.

Andy Campbell is a certified Cross-Connection Control Specialist. FWSD does not have a certified Backflow Assembly Tester (BAT). Owners of cross connection control devices are required to hire a certified backflow assembly tester at their own expense and submit a satisfactory test report to FWSD on an annual basis.

Element 5: Ensure that Approved Backflow Operating Correctly.

FWSD's cross connection control ordinance Section 3 requires that all installed backflow prevention assemblies be tested annually by a certified BAT. Owners of water services with cross connection control devices are required to hire an independent certified BAT to test their device and provide a certification to FWSD that the device is working properly. FWSD provides notifications to customers that their BAT certification is due, and if the certification is not provided within the required time, FWSD is authorized to shut off the service until the BAT certification is provided. If FWSD shuts off the service for lack of a BAT certification, then the customer must pay an additional fee to have water turned on again.

Element 6: Ensure that Backflow Preventers Are Tested Properly.

FWSD requires that all BATs doing business with FWSD maintain current certifications in their areas of specialty. FWSD requires copies of current certificates and requires updates of these certificates when they expire.

Element 7: Procedures for Responding to Backflow Incidents.

It is not always immediately evident when a backflow incident has occurred. If routine testing or customer complaints lead to detection of a contaminant in the water distribution system, it may not be determined immediately that the contaminant entered the distribution system by way of a cross connection or backflow event. If a contaminant is detected in the distribution system, FWSD customers will be immediately notified that the water may not be fit to drink and advised not to drink the water until the nature and degree of threat of the contaminant can be determined.

Even if it is concluded that the contaminant must have entered the distribution system through a cross connection, the location and nature of the cross connection may or may not ever be determined. When a cross connection event is identified, FWSD staff will inspect the facility to determine if the cross connection can be eliminated. If there is no acceptable means to eliminate the cross connection, then FWSD will shut off the water service to the customer with the cross connection, and notify the customer that a backflow preventer must be installed to the satisfaction of FWSD before service will be restored. The customer will be required to pay a service restoration fee before service will be restored.

Element 8: Consumer Education.

FWSD provides customer education material regarding cross-connection control in annual consumer confidence reports.

Element 9: Cross-Connection Control Record Keeping.

FWSD maintains records of installed cross-connection control devices, records of the testing of these devices, records of certified BATs, and records of inspection reports by the CCS and BATs. A copy of the most current records is kept at the FWSD office.

The District maintains a comprehensive list of 41 sites that are equipped with backflow devices (see list in Appendix N). All devices are tested by a certified Backflow Assembly Tester annually, hired by the property owner. Test reports are sent to the District where they are reviewed, logged, and filed. The District follows up with customers who don't report test results.

The District also has installed single check valves on all other services, on the meter setters. A customer survey is sent out every few years and will be sent again with our July 2019 billing. The District contacts all customers who fail to respond to the survey. The District's policy is to discontinue water service after 90 days if a customer fails to have their device tested or fails to have a device installed after being required by the District, based on information gained from the survey results or a site inspection by District staff.

Element 10: Additional Requirements if Reclaimed Water is Used.

Reclaimed water is not used, nor is there any plan to use reclaimed water at FWSD. Therefore, Element 10 is not applicable to FWSD.

PRIORITY SERVICE LIST

The DOH Cross Connection Control Manual for Small Water Systems (DOH publication No. 331-234) (CCC Manual) identifies three priority levels for cross connection control assessment, including High Priority, Medium Priority, and Low Priority as follows:

1. High Priority: Customers of the type listed on Table 9 of WAC 246-290-490 as a high health hazard requiring premises isolation by an Air Gap (AG) or Reduced Pressure Backflow Assembly (RPBA) (mandatory premises isolation);

2. Medium Priority: Customers included in the purveyor's supplemental list for mandatory premises isolation; and

3. Low Priority: The remaining customers.

High Priority

Table 9 of WAC 246-290-490 lists the following as Severe and High Health Cross-Connection Hazard Premises Requiring Premises Isolation by AG or RPBA:

- Agricultural (farms and dairies)
- Beverage bottling plants
- Car washes
- Chemical plants
- Commercial laundries and dry cleaners
- Premises where both reclaimed water and potable water are provided
- Film processing facilities
- Food processing plants
- Hospitals, medical centers, nursing homes, veterinary, medical and dental clinics, and blood plasma centers
- Premises with separate irrigation systems using the purveyor's water supply and with chemical addition
- Laboratories
- Metal plating industries
- Mortuaries
- Petroleum processing or storage plants
- Piers and docks
- Radioactive material processing plants or nuclear reactors
- Survey access denied or restricted
- Wastewater lift stations and pumping stations
- Wastewater treatment plants
- Premises with an unapproved auxiliary water supply interconnected with the potable water supply

Note that the above examples are for illustration only and are not intended to be comprehensive. Other types of business or activity at the water service location may also be deemed to be high priority. In general any type of business or activity that includes use of non-potable water in proximity with potable water may be considered High Priority. High priority services require an AG, an RPBA, or a Reduced Pressure Detector Assembly (RPDA) type backflow preventer.

Medium Priority

The CCC Manual identifies Medium Priority as Customers included in the purveyor's supplemental list for mandatory premises isolation.

Low Priority

The CCC Manual lists all remaining customers as Low Priority for cross connection control. Low priority services are not generally required to have cross connection control devices. The water purveyor could still require backflow prevention devices at some or all low priority services at the purveyor's discretion.

NEW AND EXISTING CROSS-CONNECTION DEVICES

Resolution 01-1 requires that new and existing cross connection devices be catalogued and checked initially. It is the responsibility of the customer to ensure proper testing of the devices on an annual basis thereafter. Backflow prevention devices are required on all new cross connections. A condition for new service is an evaluation by FWSD's certified cross-connection control specialist to determine what type of backflow device is needed. This review is coordinated with the County building inspector.

CUSTOMER COMPLAINT RESPONSE PROGRAM

When complaints are received, they are logged in at FWSD office and a water system operator is sent to investigate the complaint. Depending on the findings of the complaint investigation, appropriate actions are taken to resolve the complaint. If a customer feels that their complaint is not being addressed properly, all customers of the water system have access to the FWSD Board at regularly scheduled meetings to be heard regarding their complaints.

RECOMMENDED O&M IMPROVEMENTS

This section reviews operations and maintenance activities, schedules and needs as identified in the first part of this chapter and identifies possible operations or system changes that could improve or streamline operations.

WATER SYSTEM MANAGEMENT AND PERSONNEL

FWSD contracts with Whidbey Water Services (WWS) for all of its water systems operations and customer billing. WWS is a DOH-approved Satellite Water System Management Agency, SMA #136. WWS is wholly owned and operated by Andy and Terri Campbell. Andy Campbell is a certified waterworks operator, number 006432, with certifications of WDM 2, BTO, WTPO 1, and CCS, as shown in Table 6-2. Terri Campbell is a general public accountant and handles the company financial and accounting functions. WWS has certified operators of nearby water systems available as needed to assist with system operations.

OPERATOR CERTIFICATION

FWSD currently has adequate operator certification. From Table 6-1 it can be seen that the minimum required certification is WDM-1. Mr. Campbell currently has a WDM 2 certification plus BTO, WTPO 1, and CCS certifications. In the event that something should happen to Mr. Campbell such that he would be incapable of providing operations leadership, other staff at WWS would be capable of operating the system until such time that WWS can hire another water system operator with adequate certifications.

SYSTEM OPERATION AND CONTROL

The operation and control system is relatively simple and functions adequately. The system currently operates with local controls at each reservoir and pump station with auto dialers to call the operations office if the power goes out or the reservoir levels are outside normal operating range. One improvement might be to have all water system monitoring data, such as reservoir levels and pump run status, telemetered to the WWS operations office. Another might be to install water level monitoring on all wells. Given the large DSL, regular checking of water production and water sales data could help to identify causes of excessive DSL. Also systems to monitor and record well water levels could be useful to improve well performance and detect well problems before wells fail. However, none of these suggestions are essential to system operation.

WATER QUALITY MONITORING

The District is currently in compliance with the DOH-issued Water Quality Monitoring Schedule. The District Board of Commissioners reviews the required monitoring to confirm compliance at every monthly meeting.

PREVENTIVE MAINTENANCE

Preventive maintenance is part of the water system normal operations. A sanitary survey dated March 23, 2016, conducted by DOH Regional Engineer Virpi Salo-Zieman, identified a need for a screened inverted vent on Well 2, and verification of an adequate vent screen on Reservoir 1. The report further identified a need to better secure the power cable conduit to the wellhead of Well 1, improve Well 1 and Well 2 well houses, improve security at well sites, and obtain approval for the system intertie with HHC water system.

In response to the Sanitary Survey report, FWSD has completed the following improvements:

- Installed a screened inverted vent on Well 2.
- Verified an adequate vent screen on Reservoir 1.
- Secured the power cable conduit to Well 1.

EMERGENCY RESPONSE PROGRAM

No deficiencies in the District Emergency Response Program have been identified.

CROSS-CONNECTION CONTROL PROGRAM

FWSD’s cross-connection control program and rules appear to be comprehensive. The new water service application includes an agreement to allow for site inspections for cross connections. FWSD has a current list of cross-connection control devices and records of when they were tested. No improvements to the FWSD cross-connection control program are recommended at this time.

CUSTOMER COMPLAINT RESPONSE PROGRAM

No deficiencies in the Customer Complaint Response Program have been identified.

SUMMARY OF RECOMMENDED O&M IMPROVEMENTS

- A system to regularly monitor well static and pumping water levels would be beneficial to detect problems with wells before serious source problems develop.
- A centralized facilities monitoring and alarm system would improve system monitoring and control.

CHAPTER 7

DISTRIBUTION FACILITIES
DESIGN AND CONSTRUCTION STANDARDS

OBJECTIVE

The objective of this chapter is to document FWSD's design and construction standards to allow FWSD to retain DOH approval to utilize the alternative review process for construction of new and replacement of existing water distribution facilities. Through this process, a purveyor needs no further approval from DOH for distribution project reports, construction documents, or installation of distribution mains.

WAC 246-290-100(5) states that Purveyors intending to implement the project report and construction document submittal exceptions authorized under WAC 246-290-125 for distribution mains must include the following elements in their water system plan:

(i) Description of project report and construction document internal review procedures, including engineering design review and construction completion reporting requirements;

(ii) Construction-related policies and requirements for external parties, including consumers and developers;

(iii) Performance and sizing criteria; and

(iv) General reference to construction materials and methods.

The following sections will first describe the FWSD water main construction standards and developer agreement forms, then how the FWSD standards and forms address the requirements of 246-290-100(5).

FWSD WATER MAIN EXTENSION STANDARDS AND POLICIES

WATER MAIN STANDARDS

FWSD has developed a comprehensive document titled *Freeland Water District Technical Specifications*. The document is divided into four chapters and an appendix as follows:

- Chapter 1: General Considerations
- Chapter 2: Materials
- Chapter 3: Construction

- Chapter 4: Testing
- Appendix A: Standard Plans

A copy of Freeland Water District Technical Specifications are included in Appendix G of this Plan. In the case where FWSD constructs water mains, FWSD follows these standards.

DEVELOPER EXTENSIONS

In the case where a developer proposes to install a water main extension, The District has four other applicable forms, including the following:

- The Freeland Water and Sewer District Preliminary Services Agreement, Owner/Developer Extension

- The Freeland Water and Sewer District Developer Extension Agreement

- Freeland Water and Sewer District Recovery Contract

- Construction Completion Report

The Preliminary Services Agreement lays out the financial responsibilities and relationship between the Owner/Developer and FWSD through the design, approval, construction and final acceptance process. The Developer Extension Agreement addresses criteria for plans approval, construction, testing, fees and charges, easements, and final transfer of ownership of the facilities to FWSD. The Recovery Contract is for reimbursement to the Owner/Developer in the event that other parties not involved in the water main construction later connect to the water main installed by the Developer (commonly referred to as a "Latecomers Agreement"). The Construction Completion Report is for the Owner/Developer's engineer to certify to the District that all construction and testing has been completed in conformance with the District's standards and the approved plans. Copies of the above forms are also included in Appendix G.

REGULATORY REQUIREMENTS

INTERNAL REVIEW PROCEDURES

The FWSD Preliminary Services Agreement establishes that all costs involved in planning, design, permitting, FWSD review and approval, and any and all other costs associated with the water main extension approval process shall be borne by the Owner/Developer. All plans, specifications, permits, easements, right of way permits, and any and all plans and permits for construction of the water main extension must be approved by FWSD prior to beginning any construction on the water main extension project.

The FWSD Developer Extension Agreement reiterates the requirements of the Preliminary Services Agreement, and also establishes that all inspection, testing, certification, professional and legal consultation costs shall also be borne by the Owner/Developer.

CONSTRUCTION-RELATED POLICIES

All construction is subject to approval of FWSD, as well as by owners of the rights of way and/or easements in which the construction is located. The Owner/Developer is required to provide proof of insurance to cover all liabilities he may incur during the construction process, and agree to indemnify and hold FWSD harmless for any claims, demands, actions or liabilities that may be incurred by the Owner/Developer. FWSD will not accept ownership of any of the facilities constructed by the Owner/Developer until all permitting, construction, testing, record drawings, acceptance by ROW and easement owners, all materials suppliers and subcontractors have been paid, and all outstanding debts to FWSD have been paid.

PERFORMANCE AND SIZING CRITERIA

Performance and design criteria are as laid out in Chapter 3 of this water system plan. Facilities should be designed and located to permit static pressures ranging from 40 psi to 90 psi and in no case produce static pressure below 30 psi or above 110 psi. The system must be designed to meet a minimum pressure of 20 psi during fire flow or other emergency events. Valves every 1,000 feet at a minimum, two gate valves at every tee and three at every cross are required unless otherwise directed by FWSD, as are valves on each end of a water main in an easement. Fire flows and hydrant spacing shall be as per Table 3-2.

CONSTRUCTION MATERIALS AND METHODS

Construction materials and methods are as specified in the FWSD Technical Specifications. Part 2 of the Technical Specifications specifies that “All materials shall conform to the ANSI/NSF Standard 61.” Water mains shall be AWWA C151 Ductile Iron, AWWA C900 PVC, or AWWA C901 and AWWA C906 HDPE pipe. Water main fittings shall be AWWA C153 Ductile Iron. Restrained joint pipes shall be TR Flex as manufactured by U.S. Pipe, or equal.

Joint restrainers shall be Megalug Series 1100 or equal. Gate valves shall meet AWWA C509 and be manufactured by a standard manufacturer. Marker posts are to be placed indicating the location of valve boxes. Fire Hydrants as specified as Clow Model F2500 or equal, conforming to AWWA C502. Pipe bedding, trench backfill, marking tape, tracer wire, and trench patching materials are also specified.

Construction methods include trench excavation, trench base stabilization, bedding of pipe, backfilling of trenches, compaction of backfill, and trench asphalt patching. Part 3.4 addresses installation and disinfection of new water mains. Part 4 of the Technical Specifications addresses testing of water mains, including hydrostatic pressure testing, disinfection, and bacteriological testing.

Water facilities construction details are shown in 15 figures in Appendix A of the Technical Specifications.

CHAPTER 8

IMPROVEMENT PROGRAM

OBJECTIVE

The objective of this chapter is to present the FWSD Water System Improvement Program, which is composed of projects identified in the previous chapters. These improvements are assessed and prioritized for implementation over 10- and 20-year planning periods. The Improvement Program has been developed in conjunction with FWSD's financial capabilities and recommendations as presented in Chapter 9, Financial Program.

This chapter includes capital improvement projects for source of supply, storage, distribution, system monitoring and control, and other identified capital improvements, and non-capital improvements, including operational and administrative measures necessary to comply with regulatory requirements. The chapter provides cost analyses, identifies the preferred alternatives for each project, and recommends a schedule for the improvements. Detailed cost estimates are included in Appendix O.

CAPITAL IMPROVEMENTS

This section addresses Capital Improvements, or improvements and additions to physical facilities. Improvements to operations, management or planning are addressed in the section titled *Non-Capital Improvements*. All project cost estimates include 20 percent construction contingency and 25 percent engineering design and construction management/administration cost. Opportunity projects are defined as those projects that may be of lower priority, but if an opportunity arises (i.e., county road improvement project, developer frontage improvements, available grant funding, etc.) the District would save money by utilizing the opportunity or piggy-backing onto another project.

DISTRIBUTION SYSTEM IMPROVEMENTS

Distribution system improvements can be recommended for a variety of different purposes, including leakage reduction, fire flow improvement, service improvement, and expansion of service to growth areas. WAC 249-290 defines actions to reduce distribution system leakage under the water use efficiency program as a *Water Loss Control Action Plan (WLCAP).* Water main improvements are sorted into these categories in the following sections. In addition, improvements to existing pressure reducing stations and booster pump stations are included herein.

Water Loss Control Action Plan (WLCAP)

As shown in Table 2-8, the FWSD water system has been leaking at approximately 30 percent of water production between 2016 and 2017. With Distribution System Leakage (DSL) that high, FWSD is required to develop a WLCAP. This section of Capital Improvements is intended to meet the requirements for a WLCAP. It is not known for certain where the leakage is occurring. Possible contributors may include under-registering water service meters, unchecked water spills and overflows, water distribution leakage, and water theft.

Project D-01: Leak Detection and Repair

Water systems with greater than 20 percent leakage are required to implement a Leak Detection and Repair program. Leak detection and repair is implemented as part of routine operation and maintenance of the water system (see Chapter 6). FWSD has access to leak detection equipment through its operator.

Project D-02: Water Meter Replacement

Under-reading water meters are a common contributor to excessive water system DSL. Water meters in FWSD are routinely tested and replaced as needed (see Chapter 6).

Project D-03: AC Pipe Replacement

As shown in Table 1-5 the system has approximately 10,430 feet of AC pipe (also known as “Transite” pipe) comprising approximately 12.3 percent by length of the distribution system. AC Pipe was phased out of production in the 1970s due to health effects on factory workers breathing asbestos fibers, so it is likely that the existing AC pipe is some of the original water system pipe installed in the 1960s, and is now between 50 and 60 years old. The life expectancy of AC pipe can vary widely depending on water and soil characteristics, as well as the quality of the pipe, but is generally estimated to be 50 to 75 years. Acidic water and soil conditions tend to shorten the life of AC pipe, and soils and water in western Washington tend to be mildly acidic. Aging AC pipe tends to get soft and develop leaks.

The oldest water mains in the district are AC pipe. Historically, the District has not experienced leak problems regarding AC pipe, and therefore, does not have specific plan to remove and replace it. Through the course of routine maintenance, service connections or repairs, and other work that might expose AC pipe, the District will opportunistically remove samples of AC pipe for calcium leaching testing. Should AC pipe failure develop into a significant problem, the District will update its policy regarding AC pipe replacement. Locations, lengths and sizes of AC water mains are listed in Table 8-1, and shown in Figure 1-4.

TABLE 8-1

AC Water Main Inventory

Location	Existing diameter, inches	Replacement Diameter, inches	Length, feet
Well Site to SE Harbor Road and Layton Road(1)	10	12	4,470
Pleasant View Lane and Layton Road, Harbor Road to East Harbor Road	8	8	1,990
Lynn Drive, Stewart Road to East Harbor Road	6	6	1,220
Dorsey Drive, Stewart Road to Lynne Drive(2)	4	6	1,050
Freeland Avenue, Joanne Drive to Shoreview Drive	6	6	1,260
VanBarr south of Main Street	6	6	440
Totals			**10,430**

(1) When replaced, it is proposed that existing 10-inch AC pipe be replaced with 12-inch PVC, HDPE, or Ductile Iron pipe because 12-inch pipe, fittings and valves are more common sizes, and the cost difference between 10-inch and 12-inch pipe is small.

(2) When replaced, it is recommended that the existing 4-inch AC pipe on Dorsey Drive be replaced with a new 6-inch PVC, HDPE, or Ductile Iron pipe to support fire flow at hydrants on Dorsey Drive.

The estimated total cost of AC water main replacement is summarized in Table 8-2. Detailed cost estimates are included in Appendix O. The estimated total of $2.74 million, if spread out evenly over 10 years, would be approximately $274,000 per year of AC water main replacement work in 2018 dollars. The amount of AC water main to be replaced each year, and which AC water mains are the highest priority for replacement will depend on the results of leak detection work, future water main break occurrences, and other FWSD priorities. The District maintains a minimum reserve fund of $750,000 for unforeseen capital and maintenance projects, including pipe replacement and repair.

TABLE 8-2

Estimated Total Cost of AC Water Main Replacement

Size, Inches	Length, feet	Fire Hydrants	Gate Valves	Service Connections	Connect to Existing	Estimated Cost
6	3,970	9	13	40	10	$928,000
8	1,990	5	7	25	5	$559,000
12	4,470	9	12	22	7	$1,250,000
Totals	**10,430**	**24**	**34**	**95**	**22**	**$2,737,000**

Project FH-01: Replace Leaking Fire Hydrants

The District has identified 26 older fire hydrants that are leaking or otherwise in need of replacement. It is believed that these are a significant source of the District's DSL. This project will replace all of the identified hydrants with new hydrants at an estimated cost of $5,000 each, or ***$130,000*** for 2019. In addition, the District has budgeted ***$25,000*** per year from 2020-2024 to inspect, repair, and/or replace leaking or damaged fire hydrants.

Project C-01: Monitoring, Control and Alarm Improvements

The District has experienced problems with reservoir controls failing to shut off sources resulting in extended periods of reservoir overflow, which has contributed to DSL. The controls were repaired in 2017 and the District has implemented more frequent and more stringent inspections of the reservoirs to prevent these types of losses. Improvements in system monitoring and alarms may be helpful in preventing, reducing and/or limiting such events in the future. Improvement in the high reservoir level alarm system, and perhaps in some other alarm systems as yet undetermined, together with telemetering system data and alarms to a central monitoring location, would help to eliminate or reduce water loss due to unchecked spills and overflows. If a programmable logic controller (PLC) were to be installed at each reservoir site and at the FWSD office, together with sensor inputs and programmed alarm outputs, the cost is likely to range from $50,000 to $100,000. For budgeting purposes, ***$100,000*** will be inserted in for control and alarm improvements.

TABLE 8-3

Summary of WLCAP Projects

Project Number	Project Description	Estimated Budgetary Cost
D-01	Leak Detection and Repair: O&M	N/A
D-02	Water Meter Replacement: O&M	N/A
D-03	AC Pipe Replacement: as needed	N/A
FH-01	Fire Hydrant Replacement	$255,000
C-01	Monitoring, Control and Alarm Improvements	$100,000
Total	**WLCAP Projects**	**$355,000**

Fire Flow Improvements

As discussed in Chapter 3, the FWSD water system provides the required minimum fire flow at all served locations in the District, and therefore, no capital improvements to improve fire flow are needed.

Elimination of Dead-End Lines

From the Water System Facilities Map, Figure 1-3, it can be seen that there are several locations where water mains are dead-end lines. In some cases, there are no really good options for eliminating dead end lines, such as the line on East Harbor Road beyond the Whispering Firs subdivision. In other cases future development may eliminate some dead end lines. Those cases will be discussed under the heading "Expansion of Service to Growth Areas." The following projects will eliminate dead-end water mains that are not likely to be constructed as part of system expansion projects.

Project D-04: State Route 525 Crossing at Woodard Avenue.

Connecting the water main across State Route 525 at Woodard Road would eliminate two dead-end lines. It would also create a fourth tie between the water source and storage facilities located south of SR 525 and the majority of the water users located north of SR 525, and improve transmission capacity to the northwest portions of the water service area. Based on available mapping, the connection would require approximately 470 feet of 8-inch water main. It is likely that WSDOT will require that the water main be installed using trenchless technology such as directional drilling, and that they will require the water main to be installed in a casing. This proposed crossing is in an area that has been filled over the years and may require soils testing as part of the design. A detailed cost estimate for an 8-inch HDPE pipe installed in a 14-inch HDPE casing, installed by directional drilling, is included in Appendix O. The estimated cost for project D-04 is ***$191,000.***

Project D-05: West End of Main Street to South End of Myrtle Avenue

As an opportunity project, connecting the west end of the 6-inch water main on Main Street to the south end of the 8-inch water main on Myrtle Avenue would eliminate two dead ends and improve flow to the south end of Myrtle Avenue. This is a distance of approximately 450 feet. In addition, the water main on Main Street from East Harbor Road to the end of the line (approximately 850 feet) is constructed of glued PVC pipe and fittings, and the District has experienced several failures with this type of construction in this and other areas. Therefore, this project also includes replacing the glued PVC pipe on Main Street, for a total of approximately 1,300 feet. Replacement on Main Street may require utilizing ductile iron pipe for a portion of the project, since it is reported that the road in this location was constructed in fill material over a wetland and settlement is expected. The new water main would be 8 inches in diameter. A detailed cost estimate for Project D-05 is included in Appendix O. The estimated cost for this water main connection is ***$369,000***.

Long-Term System Viability

Project D-06: Water Main Replacement

Aside from AC water main replacement for purposes of leak control, water main replacement for purposes of maintaining the water system in a manageable condition into the future includes routine water main replacement. The life expectancy of water mains can vary widely, depending on the type and class of water main installed, the methods and materials used in water main installation, the properties of the water transmitted through the water mains, and the properties of the soil in which the water mains have been installed. In general, water main life expectancy is considered to be in the neighborhood of 100 years. Therefore, to make the water distribution system sustainable, the system should budget to replace water mains on approximately a 100-year cycle. That means budgeting to replace one one-hundredth of the water distribution system per year. Table 1-5 shows that the FWSD water system has approximately 85,000 feet, including the AC mains, or approximately 16.1 miles of water main. To replace this much water main on a sustaining basis would require replacement of, on average, approximately 850 feet of water main per year, however, such projects should be packaged for economy of scale.

All water main replacement identified under the heading D-03 AC Pipe Replacement, and in Table 8-1, contributes toward annual water main replacement. Water main replacement priorities are:

1. Water mains with frequent leaks or breaks.
2. Under-sized water mains.
3. Oldest water mains

The cost to replace 850 feet of water main will vary considerably depending on the size of the water main, the number of valves, hydrants, service connections and interconnections with other water mains, and the number of other underground utilities in the construction area. As stated under Project D-03, the District maintains a reserve fund of $750,000 for unforeseen capital and maintenance projects, including pipe replacement and repair, so no separate budget is provided. Pipe replacement will be addressed as failures occur or as information identifies pending problems.

Expansion of Service to Growth Areas

As shown in Figure 1-3, there are undeveloped portions of the FWSD service area that currently do not have water service. These include the area west of Cameron Road on the west side of the service area, and the area between Twin Oaks Lane to the north and SR 525 to the south, on the east side of the service area. These unserved areas are not extensive, and there are no known active plans at this time to develop these areas, except the platted area immediately south of Twin Oaks Lane. In addition to these areas, the Sunny View Farm (SVF) Water System, which is owned by FWSD, remains separate from the FWSD water system, and, while it has an obligation to serve several lots in the Harbor Hill (HH) subdivision, it does not have pumping capacity or distribution piping to do so. When service is desired in this area, extension of the water system will be provided by a developer extension or through ***a Utility Local Improvement District (ULID).***

Project D-07: Sunny View Farms and Harbor Hill

FWSD owns the SVF Water System, and the SVF water system water service area includes the HH Subdivision. Neither the SVF water system nor the HH water system have capacity to serve any additional lots within either the SVF subdivision or the HH Subdivision.

A study report regarding consolidation of the FWSD, SVF and HH water systems, titled, *Harbor Hill Community Association Water System Consolidation Study Report* was completed in April 2017. Cost estimates from that report are included in Appendix O. The report recommends extending a water main from the existing water main connected to Reservoir 2, through the Harbor Hill Subdivision to the east end of Dusty Lane, and north across SR 525. The highest portions along Osprey Road between Scenic Avenue and Dusty Lane would be served by an extension from an existing boosted pressure water main that currently serves two houses along the access road to Reservoir 2. Expansion of the booster pump station is included in the project cost estimate. These recommendations are identified in the Consolidation Report as projects 18Ra, estimated at $570,000, 18Rb, estimated at $180,000, and 29R, estimated at $364,000, for a combined estimated cost of $1.11 million. Funding for the project is designated as being developer or ULID funded. The property owners in Harbor Hill voted not to participate in the consolidation project. FWSD has the first right of refusal to provide water to this area, if FWSD refuses or fails to provide water service to this area property owners have the right to develop alternative water sources.

Project D-08: Scenic Avenue to Cameron Road and Woodard Avenue

Between the west end of Scenic Avenue and the south end of Cameron Road there is an undeveloped area of approximately 70 acres that is zoned Rural. At 5 acres per lot this area could potentially develop into as many as 14 new residential services. If and when this area develops, it would be beneficial to have the developer install a water main from the intersection of Fish Road and Scenic Avenue, west approximately 2,400 feet, across Woodard Avenue, connecting to the water main on Cameron Road. This should also connect to the north end of the water main on Sylvan Drive north of Garden Lane approximately 450 feet west of the west end of Scenic Avenue. In addition, a water main would be extended from the south end of the existing water main on Woodard Avenue to connect with this water main. This project would be developer-funded. A cost estimate of $756,000 for project D-08 is included in Appendix O.

Extension to West Side Undeveloped Area

The area west of Cameron Road is currently used as farm land and forestry land, and is currently zoned as Rural Agriculture (RA), and Rural Forest (RF). This land was annexed into the District in 2010, commonly known as the Fletcher Annexation. Per Island County Resolution C-88-10, the land owner committed to constructing homes only along Bush Point Road; and therefore, it is unlikely that water service will be needed in this area in the near future. The RA and the RF zoning both limit development to no greater than one residence per 10 acres. The combined RA and RF zoned areas total approximately 172 acres. Therefore, unless zoning is changed or exceptions are granted to the zoning, the maximum development that can be expected in that area is 17 residences. This could be developed as either 17 ten acre lots or as a cluster development of 17 smaller lots, with the remaining area protected from further development, or some combination thereof.

The size of water main required to serve this area will depend on whether fire hydrants will be provided. In rural areas, no fire protection standard applies. Therefore, it is not necessary to install fire hydrants in this area. If no fire hydrants are to be installed, then the area can probably be served by 4-inch water mains. However, if the zoning is later changed, or if the residents of the area want fire hydrants even though they are not required, then the minimum water main size serving the area would be 6-inch.

The length of water main required to serve this area will depend on how the area develops, if and when it does. For example, if the area develops as clustered development near Cameron Road or SR 525, far less water main would be required than if the area is developed as seventeen ten acre lots.

Based on the capacity analysis in Chapter 3, as summarized in Table 3-24, no additional source or storage capacity is required to serve this area. Therefore, the only requirement will be water main extensions.

Given the uncertainty of how this area might develop in the future, if and when it ever does, it is impossible to develop a meaningful estimate of the cost to serve this area at this time. Any water main extensions necessary to serve the area will be installed at a developer’s expense, and at no expense to FWSD, and it is therefore not necessary to include a cost estimate for FWSD budget projection purposes. For these reasons, no cost estimate is provided for future water service to this area.

Extension to East Side Undeveloped Area

The east side undeveloped area is approximately 142 acres of land zoned as Rural (R). The R zoning limits development to no more than one residence per 5 acres. The capacity analysis in Chapter 3, as summarized in Table 3-24, shows that the existing source and storage capacity are adequate to serve this many additional residences.

However, this area is higher in elevation than other portions of the service area, with a maximum elevation of about 210 feet.

The existing Reservoir 1 has a pumps-on elevation of approximately 284.5 feet, which would provide a maximum static pressure of only about 32 psi at the highest elevations, and would provide less than that with reservoir draw-down and piping head losses. That pressure range is not adequate to serve the area. However, Reservoir 2 has a pumps-on elevation of 341 feet, and a base elevation of 325 feet. If a water main were extended from Reservoir 2 to serve this area, the maximum static pressure at the highest elevation would be about 56 psi, and the minimum static pressure, with the reservoir almost empty, would be about 50 psi. This static pressure range would allow for piping head losses to serve this area and still maintain adequate pressure, even at the highest elevations.

The Harbor Hill Community Association Water System Consolidation Study Report included in Appendix O outlines a recommended approach to serving the Harbor Hill subdivision at the southeast corner of the FWSD water service area. That plan would extend water mains from the existing water main connected to Reservoir 2, through the Harbor Hill Subdivision to the east end of Dusty Lane, and north across SR 525. If completed, that would put the water main connected to Reservoir 2 at the southeast corner of the eastern undeveloped service area. That line could then be extended and looped north into the east side undeveloped area, thereby maintaining adequate water pressure throughout the area without the need for any additional storage or pumping systems. At the north end, this water main could also tie into the water mains in the Whispering Firs subdivision on Twin Oaks Lane and Watkins Road, thus improving pressure and fire flow capacity within that subdivision. The distance from the north side of SR 525 to the east end of the Whispering Firs water main is approximately 3,800 feet.

The Harbor Hill Community Association Water System Consolidation Study Report indicates the water line through the Harbor Hill subdivision to a pressure reducing station located on the south side of SR 525. However, in order to utilize the higher hydraulic gradeline from Reservoir 2 to serve the higher elevations on the east side of the FWSD service area, it would be preferable for the pressure reducing station to be located on the north side of SR 525. A tee would be installed upstream from the pressure reducing station such that the higher pressure line could be tapped in the future to provide service to the higher elevations on the east side of the service area.

If it is not possible to extend a water main through the Harbor Hill subdivision and up the east side of the eastern undeveloped area, then it will be necessary to build a booster station to serve the east side undeveloped area, or provide a new source situated in the east side. Serving the area from Reservoir 2 as described above is preferred due to higher reliability and lower maintenance requirements of gravity pressure service.

As with the west side undeveloped area, the cost of facilities to serve this area will depend on how the area is developed and whether fire flow is provided. Also, as with the west side undeveloped area, the cost will be borne by developers. Therefore, there is no need to include that cost in the FWSD budget projections, and no cost estimate for service to this area is included in this water system plan.

SOURCE IMPROVEMENTS

Project S-01: New Source

As shown in Table 3-12, FWSD has adequate source capacity to meet maximum day demands through the ten-year planning horizon. However, as shown in Table 3-5, nitrate levels in Wells 1 and 2 have been increasing over the years, and the most recent tests have been close to half of the MCL. It is not known if these levels will continue to rise, how quickly they will rise, or how much they will rise. If the nitrate levels continue to rise, it might be necessary to drill and equip one or more new wells at a different location.

The cost of developing a new well at a different location is highly dependent on the location. Variables such as depth to groundwater, productivity of the aquifer, number of wells required to replace the lost capacity of the existing wells, length of water main required to connect the new well to the existing water distribution system, and distance to electrical power cannot be determined until the new well location is determined. And even then depth to groundwater, number of wells required, and water quality of the new well or wells cannot be known until the new well is actually drilled and tested. In 2017, the District purchased a parcel of land located at the southwest corner of Honeymoon Bay Road and Bercot Road, as a potential site for a new well and/or reservoir. The new parcel is close to electrical power and the District's existing water mains.

Steps necessary to put a replacement well into service include the following:

- Review records of nitrates in existing wells in the FWSD area to determine the location of a well with minimal chance of nitrate problems.
- Obtain property for the new well.
- Obtain approval to transfer the necessary water rights to the new well location.
- Drill and test a new well for production capacity and water quality.
- Drill additional wells if needed to obtain the desired capacity.
- Extend power supply to the well site and install a power service.
- Construct a well control and water treatment building.
- Install water treatment facilities. Since the existing wells all require iron and manganese removal, it is likely that a new well will require similar treatment.
- Install a pump in the well.
- Install site piping, valves and flow meter.
- Install a water main from the well to the existing distribution system.
- Install telemetry controls to turn the well on and off based on reservoir level, and to send alarms to a central location for system monitoring.

The cost to complete all the above steps is highly variable, and depends on many factors which are not currently known. The time required to complete all these steps is likely to be two years or longer. For budget purposes it is recommended that FWSD have approximately ***$1,150,000*** set aside to develop a new well in the event that the nitrate level in one or more of the existing wells approach the nitrate MCL of 10 mg/L.

Alternatives to developing a new well for the purpose of reducing nitrate in the water supply include providing treatment for removal of nitrate, and blending the higher nitrate sources with lower nitrate sources to maintain the nitrate level below the MCL level of 10 mg/L. Treatment systems currently available for removing nitrate from drinking water include ion exchange, reverse osmosis, and dialysis. These treatment technologies are relatively expensive and involve the production of a concentrated nitrate waste stream that requires disposal. Ion exchange also involves disposal of a salt brine solution. Since there is no sewer system in the area, disposing of the concentrated nitrate waste stream would require hauling the waste to a disposal site.

Blending involves mixing water from a higher nitrate source with water from a lower nitrate source in proportions that result in a blended water that does not exceed the nitrate MCL level. Currently Well 3 is much lower in nitrate than either Wells 1 or 2. To blend water from multiple sources to meet a primary MCL, facilities would need to be in place to assure that the water from the source that exceeds the MCL will always be blended with water that does not exceed the MCL, such that the resultant blended water does not exceed the MCL. It should be noted, however, that nitrate levels in Wells 1 and 2 in the most recent tests, as shown in Table 3-5, have been less than half of the MCL. Therefore, no treatment or blending is proposed at this time.

STORAGE IMPROVEMENTS

Project ST-01: New Reservoir

As shown in Table 3-15, FWSD has adequate storage to meet system needs through the ten-year planning horizon. Therefore no storage projects are planned. However, if a new well is installed, the new well site could potentially be used for a new storage tank. The estimated cost to construct a new 240,000 gallon tank at the new well site is ***$600,000***. Also, it is possible that the solution to providing adequate pressure in the upper elevations of the Whispering Firs subdivision south of Twin Oaks Lane could involve a small water reservoir. But if a small reservoir is included in that project, the reservoir would be planned, designed and paid for by the developer, and would not impact the FWSD budget.

CAPITAL IMPROVEMENTS SCHEDULES

10-YEAR CAPITAL IMPROVEMENTS

An overall capital improvement schedule for the ten-year planning horizon is summarized in Table 8-4. The total estimated cost of all recommended capital improvements for the ten-year planning horizon is $915,000. It should be noted that from time to time the County completes road improvement projects in the Freeland area. A significant portion of many of the water main improvements cost is surface restoration, particularly if the water mains are under paved roadways. To the extent that water main improvements can be coordinated with County road improvement projects, there are possible cost savings that may be realized.

TABLE 8-4

10-Year Capital Improvement Schedule

Project Number	Project Title	Purpose	Estimated Cost	Financing Source	Year
D-01[1]	Leak Detection and Repair	DSL Reduction	N/A	Water Sales Revenues and Reserves	2018 – 2027
D-02[2]	Water Meter Replacement	DSL Reduction and Revenue Enhancement	N/A	Water Sales Revenues and Reserves	2018 – 2027
D-03[3]	AC Water Main Replacement	Extend life of distribution system and reduce leakage	N/A	Water Sales Revenues and Reserves	2020 – 2029
FH-01[4]	Fire Hydrant Inspection and Replacement	Reduce leakage, replace aging infrastructure	$255,000	Water Sales Revenues and Reserves	2019-2024
C-01	Monitoring, Control and Alarm Improvements	Improve system control and reduce water loss	$100,000	Water Sales Revenues and Reserves	2019
D-04	State Route 525 Crossing at Woodard Avenue	Eliminate dead ends, improve connectivity, improve hydraulics	$191,000	Water Sales Revenues and Reserves	2024
D-05	West End of Main Street to South End of Myrtle Avenue	Eliminate dead ends, improve hydraulics	$369,000	Water Sales Revenues and Reserves	Opportunity Project
Total 10-Year Capital Improvements			**$915,000**		

(1) Project D-01 is included in routine maintenance and no separate budget amount is provided.
(2) Project D-02 is included in routine maintenance and no separate budget amount is provided.
(3) Replacement of AC water mains will occur as needed. The District has reserved $750,000 for unforeseen maintenance, including pipe replacement and repair.
(4) Replacement of hydrants after 2019 will occur over a 5 year period at $25,000 per year.

20-YEAR CAPITAL IMPROVEMENTS

Twenty-year capital improvements are improvements that either will be completed beyond the 10-year planning horizon of this Water System Plan, or are improvements that will be completed by developers at no direct cost to FWSD, and independently from FWSD's improvement schedule. Twenty-year capital improvements are summarized in Table 8-5.

TABLE 8-5

20-Year Capital Improvement Schedule

Project Number	Project Title	Purpose	Estimated Cost	Financing Source
D-06[1]	Water Main Replacement	Maintain manageable water distribution system age by replacing approximately 850 feet of water main per year.	N/A	Water Sales Revenues
D-07	Service to Sunny View Farms and Harbor Hill	Provide service to area with substandard service	N/A	ULID/ Developer Extension
D-08	Scenic Avenue to Cameron Road and Woodard Avenue	Serve future growth, eliminate dead ends, improve system hydraulics	N/A	Developer Extension
S-01[2]	New Well	Replace well with excessive nitrate	$1,150,000	Water Sales Revenues
ST-01	New Reservoir	Storage for Project S-01	$600,000	Water Sales Revenues
Totals			**$1,750,000**	

(1) Replacement of water mains will occur as needed. The District has reserved $750,000 for unforeseen maintenance, including pipe replacement and repair.

(2) Project S-01 is required only if nitrate levels in Well 1 and/or Well 2 continue to rise to the point that they are likely to exceed the MCL of 10 mg/L.

(3) Project ST-01 is required only if Project S-01 is completed.

NON-CAPITAL IMPROVEMENTS

There are system needs identified in earlier chapters of this plan that are not capital facilities improvements, but are needed to meet regulatory requirements for water resources, water conservation, and source protection. These improvements are summarized below.

WATER USE EFFICIENCY MEASURES

WUE-1: Water Use Efficiency Program Promotion

Water Use Efficiency program promotion, as required by the Water Use Efficiency Rule discussed in Chapter 4, is an ongoing effort for FWSD. Regular distribution of water conservation guidelines and publication of articles promoting conservation through FWSD's annual Consumer Confidence Reports will continue. The estimated cost for program promotion, including printing, handling, and postage costs, is estimated at $1,000 per year.

PLANNING MEASURES

WSP-1: Update Water System Plan

The water system plan will be due for update again in another ten years. Assuming that professional services costs will continue to increase, the FWSD system will become more complex as it grows, and planning requirements will continue to become more comprehensive, planning costs are expected to increase. For planning purposes at this time, it is recommended that FWSD budget ***$50,000*** for the next water system plan update.

RS-1: Rate Study

It is appropriate to routinely review water rates and charges. The rate study would provide a basis for a new capital facilities charge plus new base rates and commodity charges to fund capital projects of all kinds, including growth-related projects, improvements to existing facilities, and repair and replacement. For planning purposes at this time, it is recommended that FWSD budget ***$25,000*** for the next rate study.

SUMMARY OF NON-CAPITAL IMPROVEMENTS

Non-Capital Improvements identified above are summarized in Table 8-6, below.

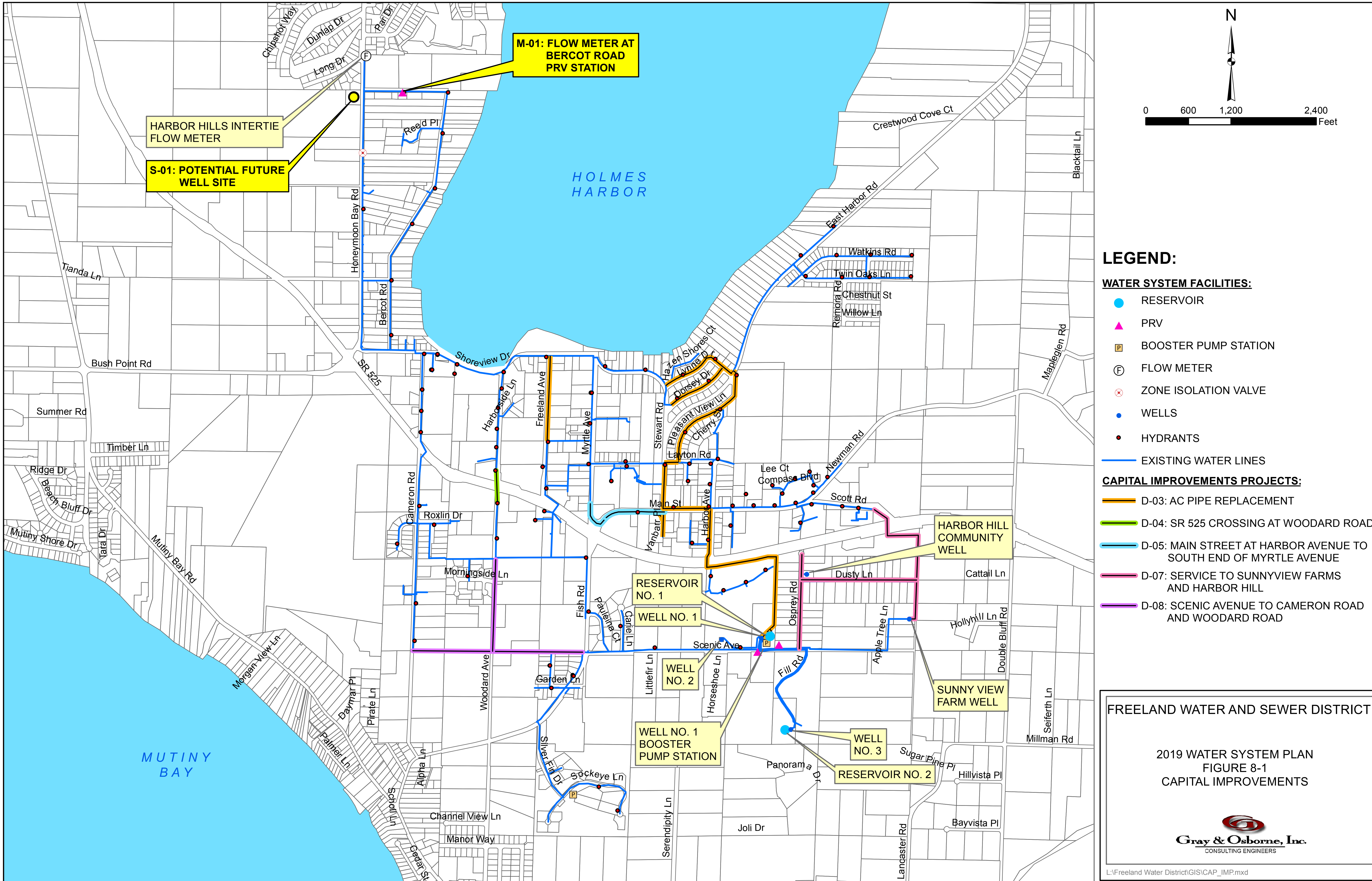
TABLE 8-6

10-Year Non-Capital Improvement Schedule

No.	Project Title	Description	Cost Estimate	Financing Source	Year
WUE-1[(1)]	Water Use Efficiency Program Promotion	Distribute Water Use Efficiency Program Promotion Literature	$10,000	Rates and Fees	Annually
WSP-1	Water System Plan	Update Water System Plan	$50,000	Rates and Fees	2028
RS-1	Rate Study	Update Rates and Charges	$25,000	Rates and Fees	2019
Total 10-Year Non-Capital Improvements[(1)]			**$85,000**		

(1) Project WUE-1 is estimated at $1,000 per year over 10 years for a total of $10,000.

FWSD's historic revenues, operating expenses, capital reserves, existing rates, and rate adjustments that may be necessary to support these recommended capital and non-capital improvements are discussed in Chapter 9.



M-01: FLOW METER AT BERCOT ROAD PRV STATION
HARBOR HILLS INTERTIE FLOW METER
S-01: POTENTIAL FUTURE WELL SITE
HOLMES HARBOR
MUTINY BAY
RESERVOIR NO. 1
WELL NO. 1
WELL NO. 2
WELL NO. 1 BOOSTER PUMP STATION
HARBOR HILL COMMUNITY WELL
SUNNY VIEW FARM WELL
WELL NO. 3
RESERVOIR NO. 2
Honeymoon Bay Rd
Bercot Rd
Reed Pl
Long Dr
Dunlap Dr
Chipshot Way
Par Dr
Tianda Ln
Bush Point Rd
Summer Rd
Timber Ln
Ridge Dr
Beach Bluff Dr
Mutiny Shore Dr
Tara Dr
Mutiny Bay Rd
Morgan View Ln
SR 525
Shoreview Dr
Harborside Ln
Freeland Ave
Myrtle Ave
Stewart Rd
Hazen Shores Ct
Lynne Dr
Dorsey Dr
Pleasant View Ln
Cherry St
Layton Rd
Main St
Vanbarr Pl
Harbor Ave
Cameron Rd
Roxlin Dr
Morningside Ln
Fish Rd
Paulette Ct
Carrie Ln
Scenic Ave
Littlefir Ln
Horseshoe Ln
Osprey Rd
Fill Rd
Dusty Ln
Apple Tree Ln
Cattail Ln
Hollyhill Ln
Double Bluff Rd
Lee Ct
Compass Blvd
Newman Rd
Scott Rd
East Harbor Rd
Watkins Rd
Twin Oaks Ln
Chestnut St
Willow Ln
Remora Rd
Crestwood Cove Ct
Blacktail Ln
Mapleglen Rd
Woodard Ave
Garden Ln
Silver Fir Dr
Sockeye Ln
Alpha Ln
Daymar Pl
Pirate Ln
Palmer Ln
Scholl Ln
Cedar St
Channel View Ln
Manor Way
Serendipity Ln
Joli Dr
Panorama Dr
Sugar Pine Pl
Hillvista Pl
Bayvista Pl
Lancaster Rd
Seiferth Ln
Millman Rd
N
0
600
1,200
2,400
Feet
LEGEND:
WATER SYSTEM FACILITIES:
RESERVOIR
PRV
BOOSTER PUMP STATION
FLOW METER
ZONE ISOLATION VALVE
WELLS
HYDRANTS
EXISTING WATER LINES
CAPITAL IMPROVEMENTS PROJECTS:
D-03: AC PIPE REPLACEMENT
D-04: SR 525 CROSSING AT WOODARD ROAD
D-05: MAIN STREET AT HARBOR AVENUE TO SOUTH END OF MYRTLE AVENUE
D-07: SERVICE TO SUNNYVIEW FARMS AND HARBOR HILL
D-08: SCENIC AVENUE TO CAMERON ROAD AND WOODARD ROAD
FREELAND WATER AND SEWER DISTRICT
2019 WATER SYSTEM PLAN
FIGURE 8-1
CAPITAL IMPROVEMENTS
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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CHAPTER 9

FINANCIAL PROGRAM

OBJECTIVE

The objective of this chapter is to analyze FWSD's total costs of providing water service, review the current rate structure to ensure that rates are adequate to cover the costs of operation and maintenance, and ascertain FWSD's financial capability to implement the 10-year Capital Improvement Plan outlined in Chapter 8.

PAST AND PRESENT FINANCIAL STATUS

This section reviews historic revenues and expenses, recent rate changes, and current FWSD rates.

WATER RATES

FWSD Resolution 2013-02-008 sets water rates in Exhibit A, Freeland Water and Sewer District Rules and Regulations, Article V, Rates and Charges. Base rates increase every year on January 1st, based on the previous years' December Consumer Price Index for the Seattle-Tacoma-Bremerton Washington area for All Urban Consumers (CPI-U). Freeland water system rates are summarized in Table 9-1.

TABLE 9-1

FWSD Water Rates

Base Rates, per quarter	
Freeland Residential	$41.95
Commercial 3/4 – 1-Inch Meter	$104.88
Commercial 1-1/2-Inch Meter	$209.76
Commercial 2-Inch Meter	$335.63
Commercial 3-Inch Meter	$671.25
Commercial 4-Inch Meter	$1,048.82
Commercial 6-Inch Meter	$2,097.63
Commercial 8-Inch Meter	$3,356.22

TABLE 9-1 – (continued)

FWSD Water Rates

Quarterly Residential Water Usage Rates	
Consumption	**Usage rate per 100 CF per quarter**
0 - 1,500 CF	$1.35
1,501 - 3,000 CF	$1.70
3,001 - 4,500 CF	$2.05
4,501 - 6,000 CF	$2.45
> 6,000 CF	$2.85
Quarterly Commercial Usage Rates	
Consumption	**Usage rate per 100 CF per quarter**
0 - 1,500 CF	$1.35
1,501 - 3,000 CF	$1.70
3,001 - 4,500 CF	$2.05
4,501 - 6,000 CF	$2.45
> 6,000 CF	$2.85

NEW WATER SERVICE FEES

FWSD Resolution 2013-02-008 also sets General Facilities Charges for new water services as summarized in Table 9-2.

TABLE 9-2

General Facilities Charges

Meter Size	Charge
5/8 x 3/4-Inch Meter	$7,140.00
1-Inch Meter	$17,850.00
1-1/2-Inch Meter	$35,700.00
2-Inch Meter	$57,120.00
3-Inch Meter	$114,240.00
4-Inch Meter	$178,500.00

HISTORIC REVENUES AND EXPENDITURES

This subsection provides a review of FWSD's records of water system revenues and expenditures, and estimate historic water utility cash flow. The intent is to use this information in the following sections to project future revenue needs to cover operations and capital improvements costs.

FWSD maintains several different funds for various purposes, and transfers money between those funds as needed. Funds include the 702 Operations and Maintenance Fund, the 742 Capital Improvements Fund, the 622 PWTF Reserve Fund, and the 621 Emergency Reserve Fund. FWSD also maintains other funds not related to the FWSD and SVF water systems, including funds related to the Harbor Hills water system and the planning and design work related to a future FWSD sewer system. For purposes of this water system plan, only the FWSD and SVF 702, 742, 622 and 621 funds will be reviewed, and will be treated as a combined fund, focusing on revenues into and expenditures out of this combined fund. Table 9-3 summarizes the historic revenues related to the FWSD and SVF water systems.

TABLE 9-3

Summary of Historical Water Utility Revenues

Year	2013	2014	2015	2016	2017
Water Service and Sales	$222,324	$174,616	$259,098	$188,863	$275,914
New Hookups	$79,993	$209,924	$98,549	$101,413	$88,544
Other Revenues	$74,254	$38,107	$37,419	$44,085	$58,149
Total Revenues	**$376,571**	**$422,647**	**$395,066**	**$334,362**	**$422,607**

Table 9-4 summarizes the historic operating expenses related to the FWSD and SVF water systems.

TABLE 9-4

Summary of Historical Non-Capital Water Utility Expenditures

Year	2013	2014	2015	2016	2017
General Expenses(1)	$-	$21,017	$13,691	$21,779	$15,914
Maintenance and Operations(1)	$161,967	$25,210	$20,412	$18,361	$45,377
Labor and Services(1)	$-	$60,447	$67,719	$78,120	$84,590
Debt Service	$37,234	$37,061	$36,887	$36,714	$36,540
Total Expenses	$199,201	$143,735	$138,710	$154,974	$182,421

(1) General Expenses, Maintenance and Operations Expenses, and Labor and Services Expenses for 2013 are lumped together as "Maintenance and Operations Expenses."

Based on financial records available, it appears that the combined operating, capital improvement, and emergency reserve funds had a total value of roughly $1.62 million as of the end of 2017.

PROJECTED FUTURE FINANCIAL STATUS

This section provides an estimate of future water utility cash flow, assuming rates increase as currently scheduled (5-year average CPI of 1.81 percent), assuming growth occurs as projected (0.61 percent), and assuming expenses increase based on currently anticipated inflation rates (2.24 percent). Projected revenues, expenditures and cash flow without the capital improvements identified in Chapter 8 are reviewed first, and then required revenue to fund the capital improvements is reviewed.

PROJECTIONS WITHOUT CAPITAL IMPROVEMENTS

Projected Water Service and Sales revenues are based on 2017 Water Service and Sales, and projected to grow at the system growth rate, plus the scheduled rate increases. Projected New Hookups revenues are based on average water hookup revenues over the historic data period shown in Table 9-3, and assumed to grow at the projected system growth rate. Projected Other Revenues are based on the averages from Table 9-4, but not projected to grow.

Projected General Expenses, Maintenance and Operations Expenses, and Labor and Services expenses are based on average expenses over the data period, and are projected to grow at the system growth rate plus the projected inflation rate. The projected Debt Service expenses are based on the FWSD debt service payment schedule, assuming that no additional debt will be incurred.

Projected revenues, expenses, and fund balance without capital improvements are shown in Table 9-5. It can be seen that revenues remain well above expenses and the fund balance increases throughout the 10-year projection period. This projection shows that FWSD water system revenues will produce over $3.2 million in excess of operating expenses over the coming 10 years. These funds, as well as existing reserves, can be assumed to be available for capital improvements

TABLE 9-5

Projected Revenues, Expenses and Reserves without Capital Expenses

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Revenue											
Beginning Fund Balance(1)	$1,615,731	$1,907,264	$2,203,071	$2,503,151	$2,807,605	$3,116,732	$3,430,332	$3,748,407	$4,071,257	$4,415,341	$4,764,117
Water Service and Sales(2)	$282,600	$289,500	$296,500	$303,700	$311,100	$318,600	$326,300	$334,200	$342,400	$350,700	$359,200
New Hookups(3)	$116,400	$117,100	$117,800	$118,500	$119,300	$120,000	$120,700	$121,500	$122,200	$122,900	$123,700
Other Revenues(4)	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400	$50,400
Total Revenues	$449,400	$457,000	$464,700	$472,600	$480,800	$489,000	$497,400	$506,100	$515,000	$524,000	$533,300
Expenses											
General Expenses(5)	$18,600	$19,200	$19,700	$20,300	$20,800	$21,400	$22,100	$22,700	$23,300	$24,000	$24,700
Maintenance and Operations(5)	$28,100	$28,900	$29,800	$30,600	$31,500	$32,400	$33,300	$34,300	$35,200	$36,300	$37,300
Labor and Services(5)	$74,800	$76,900	$79,100	$81,400	$83,700	$86,100	$88,600	$91,100	$93,800	$96,400	$99,200
Debt Service	$36,367	$36,193	$36,020	$35,846	$35,673	$35,499	$35,326	$35,149	$18,616	$18,525	$18,433
Total Expenses	$157,867	$161,193	$164,620	$168,146	$171,673	$175,399	$179,326	$183,249	$170,916	$175,225	$179,633
Net Revenue	$291,533	$295,807	$300,080	$304,454	$309,127	$313,601	$318,074	$322,851	$344,084	$348,775	$353,667
Ending Fund Balance	$1,907,264	$2,203,071	$2,503,151	$2,807,605	$3,116,732	$3,430,332	$3,748,407	$4,071,257	$4,415,341	$4,764,117	$5,117,784

(1) Fund balance as of December 31, 2017.
(2) Based upon 2017, projected to grow at system growth rate plus scheduled rate increases.
(3) Based upon 5-year average, projected to grow at system growth rate.
(4) Based upon 5-year average, no growth projected.
(5) Based upon 5-year average, projected to grow at system growth rate, plus inflation.

PROJECTED CAPITAL IMPROVEMENTS COSTS

From Tables 8-4 and 8-6, the estimated total cost of the ten-year Capital and Non-Capital Improvement Schedule is $1,000,000. Table 9-5 shows total projected revenue exceeding expenses through 2028, as indicated by a continuing positive net revenue. Without capital expenditures the FWSD capital reserves are projected to reach in excess of $5.1 million by 2028.

Table 9-6 shows that all ten-year capital and non-capital improvements can be completed with an estimated ending capital reserve of over $4.2 million. Construction costs are inflated by 3 percent annually.

TABLE 9-6

Cash Flow with Financing of Selected Capital Improvements

Project No.	Year	Estimated Cost	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Capital Improvements													
FH-01	Varies	$255,000		$130,000	$25,750	$26,500	$27,300	$28,100	$29,000				
C-01	2019	$100,000		$103,000									
D-04	2024	$191,000							$228,000				
D-05	2026	$369,000									$467,500		
Total 10-Year CIP		$915,000	$0	$233,000	$25,750	$26,500	$27,300	$28,100	$257,000	$0	$467,500	$0	$0
Non-Capital Improvements													
WUE-1	Annual	$10,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
WSP-1	2028	$50,000											$67,000
RS-1	2020	$25,000		$25,000									
Total 10-Year Non-CIP		$85,000	$1,000	$26,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$68,000
Total CIP plus Non-CIP		$1,000,000	$1,000	$259,000	$26,750	$27,500	$28,300	$29,100	$258,000	$1,000	$468,500	$1,000	$68,000
Beginning Fund Balance			$1,615,731	$1,906,264	$1,943,071	$2,216,401	$2,493,355	$2,774,182	$3,058,683	$3,118,757	$3,440,608	$3,316,192	$3,663,967
Projected Net Revenue from Table 9-5			$291,533	$295,807	$300,080	$304,454	$309,127	$313,601	$318,074	$322,851	$344,084	$348,775	$353,667
Total Annual Improvements			$1,000	$259,000	$26,750	$27,500	$28,300	$29,100	$258,000	$1,000	$468,500	$1,000	$68,000
Ending Fund Balance			**$1,906,264**	**$1,943,071**	**$2,216,401**	**$2,493,355**	**$2,774,182**	**$3,058,683**	**$3,118,757**	**$3,440,608**	**$3,316,192**	**$3,663,967**	**$3,949,634**

(1) Capital construction costs are inflated by 3 percent per year.

RATE STRUCTURE ANALYSIS

The FWSD current rate structure includes both a base rate that is based on customer class and meter size, and a commodity rate that is based on water consumption. At an average day demand of 149 gpd per ERU, an average residence uses approximately 1,818 cubic feet per quarter. From Table 9-1, the first 1,500 cubic feet per quarter is charged at $1.35 per 100 cubic feet. The next 318 cubic feet is charged at $1.70 per 100 cubic feet. Therefore, the total average quarterly commodity charge is ($1.35 x 15) + ($1.70 x 3.18) = $25.66. The base rate is $41.95, for a total quarterly charge of $67.61. The increasing commodity rate provides an incentive for water users to conserve, while the base rate provides a reliable income for operation and maintenance of the water system. According to *2015 Utility Rate Data* maintained by the Association of Washington Cities, of the 55 water agencies reporting utility rates, the average base charge was $25.01 per month and the average commodity charge was $2.67 per hundred cubic feet. The FWSD base rate of $41.95 per quarter, or $13.98 per month, is below average. The FWSD commodity rate, which varies from $1.35 to $2.85 per hundred cubic feet increasing with increasing usage, straddles the average. The FWSD rate structure appears to be working well for FWSD. Capital reserves are currently substantial and adequate to complete all capital improvements while still building additional capital reserve. Therefore, no changes to the rate structure are recommended in this plan.

CONCLUSIONS AND RECOMMENDATIONS

Based on the review of FWSD water utility finances and planned capital improvements, the rate structure is sufficient to fund operations and planned capital improvements over the entire 10-year planning period with no foreseeable need for additional rate increases. However, the District will complete a rate study in 2019.