2022 ANNUAL DRINKING WATER DISTRIBUTION REPORT

City of Victoria and Township of Esquimalt Water System

Water System Owner: City of Victoria

Contents

A. Executive Summary

The purpose of this report is to fulfill the requirements set out in the British Columbia Drinking Water Protection Act (DWPA)[1] by publishing the results of water quality monitoring efforts, and to provide a general overview of the City of Victoria and Township of Esquimalt Water System for the 2022 calendar year, including infrastructure upgrades, regular system operations, and maintenance programming.

The Capital Regional District (CRD) supplies water for the Greater Victoria Drinking Water System from a protected watershed called the Greater Victoria Water Supply Area. The City of Victoria is responsible to deliver safe drinking water and provide reliable fire protection to residents of the City of Victoria and Township of Esquimalt as a part of its core services. The quality and reliability of water supply has a direct impact on public health and the City of Victoria takes this responsibility very seriously.

The City of Victoria owns, operates and maintains 348 km of water distribution mains. Approximately 2.5 km of watermains are upgraded or rehabilitated annually by City forces or private contractors. Additionally, Underground Utilities Operations staff complete regular scheduled preventive maintenance programs on a variety of distribution appurtenances such as fire hydrants, control valves and pump stations. Water service connections feeding residential and commercial properties are maintained through leak detection and repaired or replaced as required. All staff that perform work on the drinking water distribution system is either certified or work under the direction of staff certified by the Environmental Operator's Certification Program (EOCP).

Twice a year, in spring and fall, operations staff carry out a proactive watermain flushing program to maintain high water quality in the distribution system. During this time, approximately ¼ of the total system is flushed to remove accumulated sediment from source supply and to eliminate stagnant water in larger diameter mains where flows are lowest. Since 2019, the City has been operating a new unidirectional flushing program.

In 2019, the City of Victoria started providing an Annual Report, as stipulated in the Water System Operating Conditions for City of Victoria and Township of Esquimalt Water System. The CRD regularly samples, monitors and reports drinking water quality information to Island Health. The Greater Victoria Drinking Water Quality 2022 Annual Report has been posted on the CRD's website. Information pertaining to the Victoria and Esquimalt water systems is contained within this report.

To protect the quality of the water distributed, the City minimizes the risk of backflow occurrence in the system by ensuring that adequate pressure is maintained above 40 psi during peak demand conditions and above 20 psi during emergency conditions, including fires and watermain breaks.

Furthermore, the City implements the Cross-Connection Control Program established by the CRD in 2008. All new bulk meters and park irrigation services have backflow preventers installed based on BC Building Code requirements. These devices are tested annually by certified backflow testers and reports are sent to CRD.

The Drinking Water Protection Act requires water utilities to have "emergency response and contingency plans". In case of an emergency, the City of Victoria will enact a Water Utility Emergency

[1] http://www.bclaws.ca/Recon/document/ID/freeside/00_01009_01

Response Plan.

The City of Victoria remains committed to maintaining its water distribution system to high quality standards and to ensuring the delivery of high-quality water to the City's residents, businesses and visitors.

B. System Overview

The City's water is supplied by the Capital Regional District's (CRD) Water Services Department from its Sooke Lake Reservoir. The reservoir is fed from an 11,000-ha watershed, which is located about 30 km northwest of the City and is protected from public access and industrial activities. The Sooke Reservoir is the primary water supply reservoir, providing 90% of the water storage to the CRD system. The reservoir has been in active use since 1915.

Raw water from the Sooke Reservoir runs underground through the Kapoor tunnel for 8.8 km where it connects to the Japan Gulch Disinfection Facility. The raw water is treated with chlorine and ultraviolet light to eliminate harmful bacteria and viruses. Ammonia is added to the residual chlorine to provide a secondary disinfectant in the distribution system.

The City of Victoria water utility owns and operates the distribution systems for both the City of Victoria and the Township of Esquimalt. The distribution system is composed of approximately 348 km of pipe. The system can be classified into two primary systems: the regulated system, which serves the majority of domestic demands; and the un-regulated system, which provides fire protection to the downtown core and services a small number of domestic customers, generally at higher elevations.

The water system, illustrated in Figure 1, consists of the following:

- 8 pressure zones
- 348+ kilometres of pipes (Victoria – 289 km and Esquimalt – 59 km)
- 3,476+ water main pipes
- 3,688+ system valves (Victoria – 3,105 and Esquimalt – 583)
- 1,857 fire hydrants (Victoria – 1,511 and Esquimalt – 280)
- 8.5 kilometres of large diameter supply main
- 20,937+ service connections (Victoria – 16,087 and Esquimalt – 4,850)
- 700 fire services
- 10 PRV stations (Victoria – 7 and Esquimalt – 3)
- 2 pressure release valve (Victoria – 2)
- 1 pump station
- A storage tower and altitude valve (not in current use)

The City currently funds its water capital and operating program as a utility established through bylaws. Funding comes from billing based on metered water consumption.

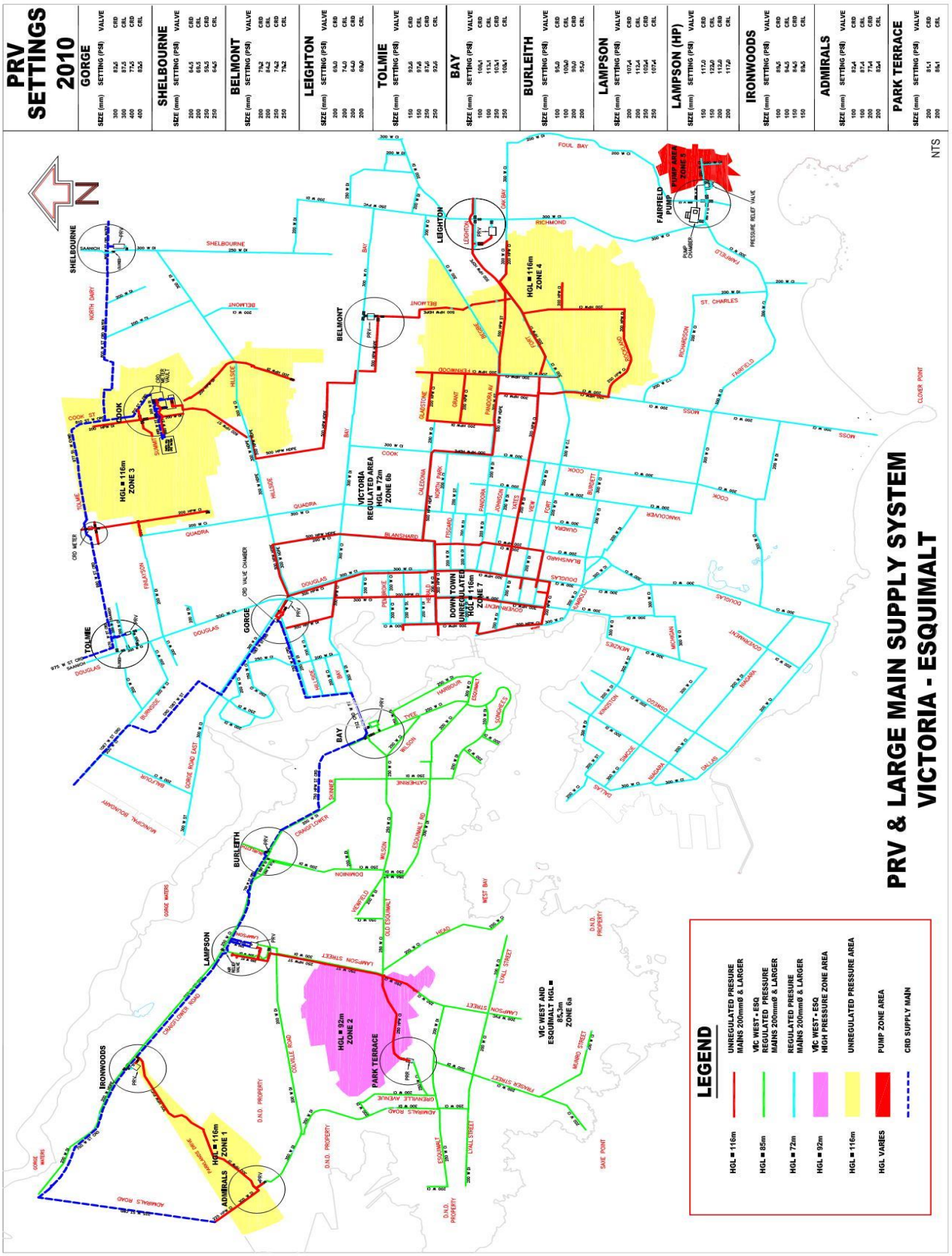

Figure 1: Drinking water distribution system for Victoria and Esquimalt

The City of Victoria's infrastructure is amongst the oldest in Canada and has been constructed from many different pipe materials. Steel was used in the early years, and on mains larger than 300mm diameter. Cast iron (pit cast) was used until the time of the Second World War, at which point spun cast pipe was introduced. For the two decades spanning 1960 and 1970, asbestos cement pipe was used moderately. There is very little asbestos cement pipe still in use today. Since the early 1980s, the City has installed mostly ductile iron pipe, along with some polyvinyl chloride (PVC) and PVCO (molecularly oriented). Recent trenchless projects have also included lining large diameter steel mains with high density polyethylene pipe and lining smaller diameter pipes with a spray-in-place product. These different pipe materials have varying service lives, ranging from 50 to 100 years. In many cases, the infrastructure is nearing or has exceeded the end of its lifecycle and is in need of rehabilitation or replacement.

A core objective for Victoria's water utility is to maximize the life of existing assets, while cost-effectively accommodating new customers and businesses. To provide adequate levels of service for water distribution system infrastructure, the City developed a Water System Master Plan as a guiding document. The master plan is updated every 5 – 7 years.

In 2018, the City of Victoria submitted to the Government of Canada a proposal for the funding of the Climate and Seismic Resilient Underground Infrastructure Project. In 2019, City of Victoria was awarded over 15 million dollars as a part of the Government of Canada $2 billion Disaster Mitigation and Adaption Fund (DMAF). The objective of the Climate and Seismic Resilient Underground Infrastructure project is to improve resiliency of the city's underground infrastructure to natural hazards such as earthquakes, tsunamis and liquefaction as well as climate change impacts including sea level rise, extreme storms and prolonged droughts. The City is addressing these by using the DMAF funding to accelerate underground adaptation and mitigation projects, including water distribution, over and above the city's existing annual capital program, operations and maintenance projects.

C. System Upgrades

Every year, the City renews watermains which have been identified as a system deficiency, having inadequate capacity, contributing to poor water quality or having served well beyond its life expectancy.

In 2022, the City renewed 1.85 km of the water distribution system, including 1,605m of trenchless rehabilitation.

D. System Operations and Maintenance

The City of Victoria has a team of 22 personnel that operate and maintain the water distribution system, including pressure reducing stations and pump stations and 23 construction crew personnel that install, repair and replace watermains. The Underground Utilities Operations organizational structure is shown in Figure 2.

The City crews perform the following duties:

1. Installation, repair and replacement of water services throughout the system.
2. Maintenance and leak repair, including emergency repairs.
3. Installation and pressure testing of new watermains, including tie-ins to the existing system.
4. Pressure testing and disinfection of new installations.
5. Monitoring private contractor installations and connections to the live system.
6. Chlorine residual testing, scheduled and on-demand watermains flushing, and on-demand sampling
7. Fire hydrants - Pressure testing, painting, physical inspection and preventative maintenance

(annually); data reported to fire department
8. Valve exercising - Open/close all system valves to confirm accessibility and operation.
9. Inspection and maintenance of pressure reducing stations
10. Monitoring of and adjustments to the mechanical and electrical controls of the water pump station and pressure reducing stations
11. Replacement and repair of water meters

Operations staff is required to be Certified Operators by the Province through the EOCP. All staff that maintains and works on the water distribution system is certified by EOCP or managed by staff certified by EOCP.

Twice a year, section staff conduct flushing programs that average approximately 1/4 of the total inventory, to remove accumulated sediment from source supply and to turn over water in larger diameter mains where flows are lowest. In general, flushing proceeds from flushed to unflushed pipes, and from larger to smaller water mains, moving from the source out to the ends of the system.

Dead-end mains and parts of the system with the stagnant water are flushed more often. Blow-off valves were installed on all remaining dead-end mains to assist with removing aged water.

In 2019, the City started implementing unidirectional flushing program based on the City's hydraulic water model. Flush and pressure zones are shown in Figure 3.

The scheduled flushing program is carried out during the low demand season of the year. All flushed water is treated with a dechlorinating agent to ensure compliance with Ministry of Environment guidelines for water entering streams.

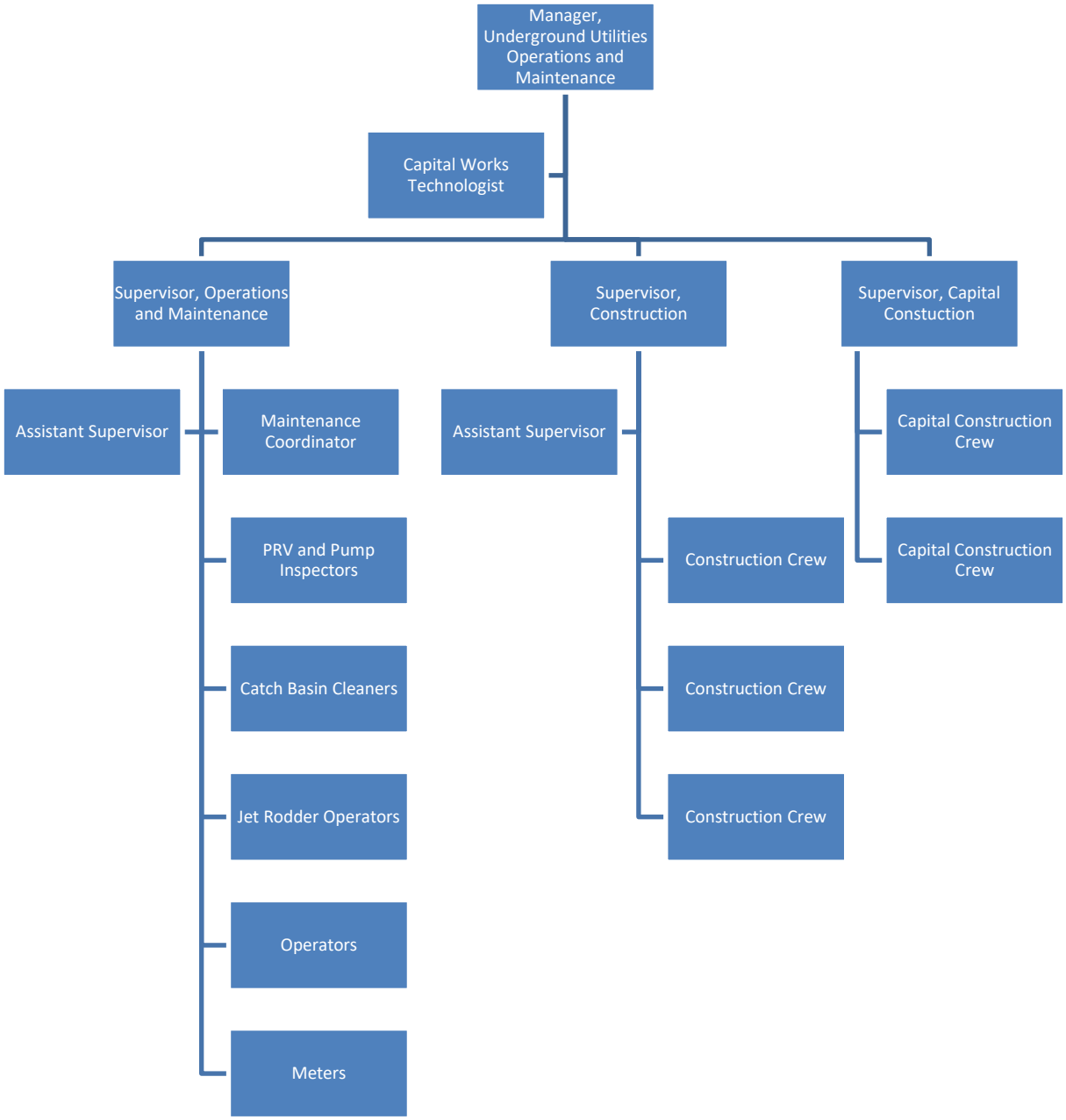

Figure 2: Underground Utilities Operations Organization Structure

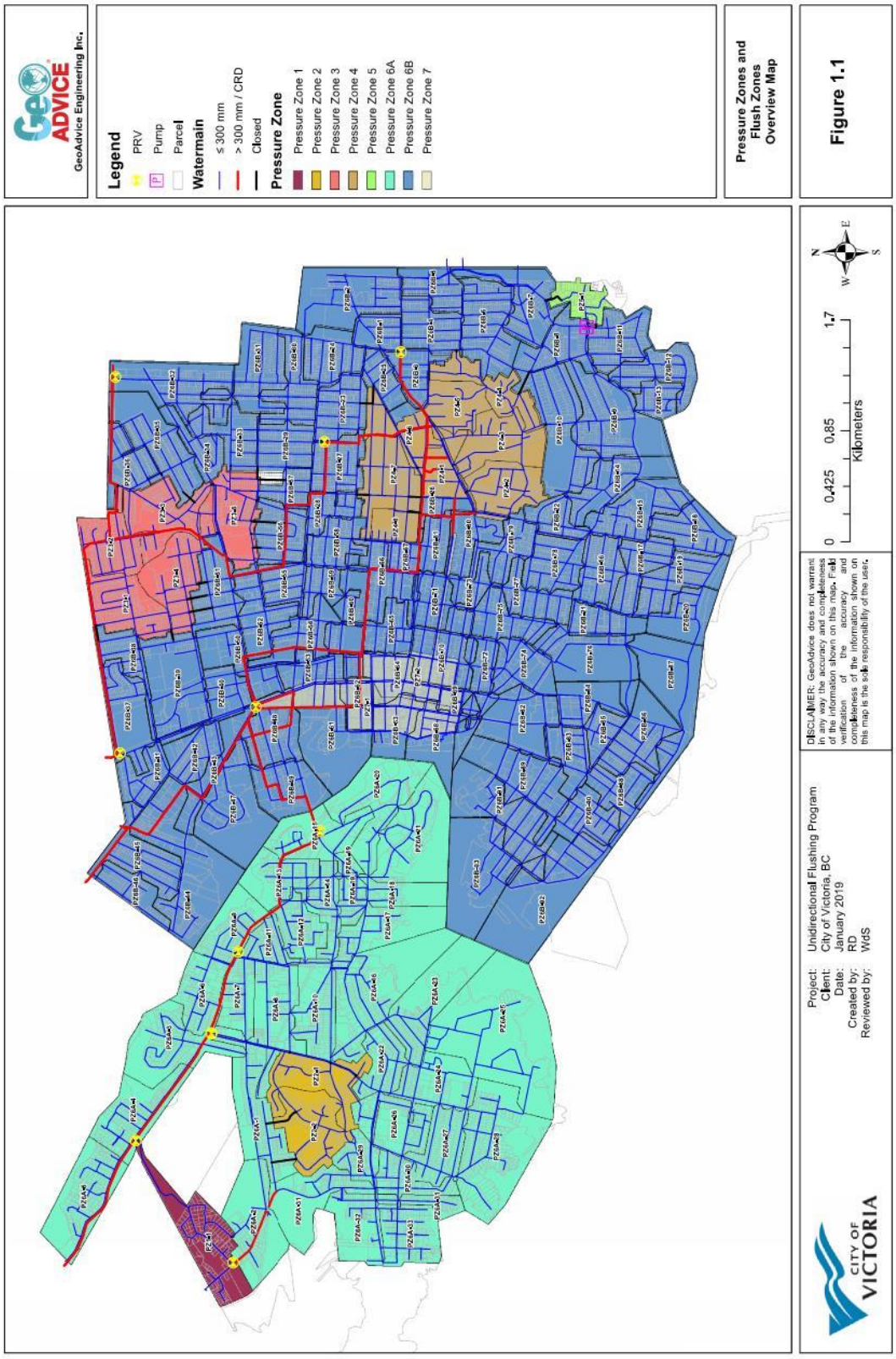

Figure 3: Pressuze Zones and Flush Zones

E. Water Quality Monitoring

From Greater Victoria Drinking Water Quality 2022 Annual Report:

In 2022, 16 sampling locations were used by the CRD Water Quality Monitoring program to monitor the bacteriological quality of the water in the Victoria/Esquimalt Distribution System. Victoria/Esquimalt sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2022, 1,213 bacteriological and 220 water chemistry samples were collected from the Victoria/Esquimalt Distribution System (Table 1). Based on the current population data for Victoria and Esquimalt, 92 samples are required for bacteria testing each month. Table 1 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. Nine total coliform-positive results were recorded throughout the year. All resamples were negative, so there were no consecutive positive samples in 2022. A sample collected in June and one collected in August exceeded the 10 CFU/100 mL total coliform concentration limit. This system complied with the 10% total coliform-positive limit for all months. The annual total coliform percentage positive was well below the 10% limit at only 0.2% (Table 1).

No E. coli was detected in any sample in 2022 (Table 1).

Chlorine Residual: The annual median chlorine residual in the Victoria/Esquimalt Distribution System was 1.43 mg/L (Table 1). The lowest monthly median was in August (1.31 mg/L) and the maximum monthly median was in December (1.62 mg/L) (Figure 4).

Water Temperature: The annual median water temperature in the Victoria/Esquimalt Distribution System was 12.1°C, with monthly medians ranging between 6.4°C (January) and 18.8°C (September) (Table 1).

Table 1 2022 Bacteriological Quality of Victoria Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	96	0	0.0	0	0	0	8	0	1.61	6.4
FEB	94	0	0.0	0	0	0	8	0	1.49	7.1
MAR	111	0	0.0	0	0	0	7	0	1.43	8.2
APR	95	0	0.0	0	0	0	8	0	1.43	10.0
MAY	96	0	0.0	0	0	0	9	0	1.43	12.2
JUN	110	2	1.8	0	1	0	10	0	1.45	14.5
JUL	98	5	5.1	0	0	0	8	0	1.40	17.0
AUG	111	2	1.8	0	1	0	9	0	1.31	18.3
SEP	106	0	0.0	0	0	0	7	0	1.37	18.8
OCT	95	0	0.0	0	0	0	7	0	1.34	17.2
NOV	107	0	0.0	0	0	0	10	0	1.53	10.9
DEC	94	0	0.0	0	0	0	6	0	1.62	7.5
Total:	1213	9	0.7	0	2	0	97	0	1.43	12.1

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts: No data for 2022.

Physical/Chemical Parameters: The drinking water in the Victoria/Esquimalt Distribution System had the following physical and chemical characteristics in 2022:

- Median pH: 7.5
- Median Alkalinity: 16.60 mg/L
- Median Turbidity: 0.25 NTU
- Median Conductivity (25ºC): 52 µS/cm
- Median Colour: 3.00 TCU

The system experienced occasional elevated turbidity in certain dead-end pipe sections, which were addressed with regular or ad hoc flushing at those locations.

Metals: No data in 2022.

The Greater Victoria pH & Corrosion Study completed in 2021 concluded that metal corrosion and lead leaching in the public piping systems, as well as in the vast majority of private plumbing systems, is not an issue in the Greater Victoria Drinking Water System.

Compliance Status: The Victoria/Esquimalt Distribution System was in compliance with the BC Drinking Water Protection Act and Drinking Water Protection Regulation except for June and August, with one total coliform-positive result each in exceedance of 10 CFU/100 mL. Immediate resamples confirmed the safety of the drinking water.

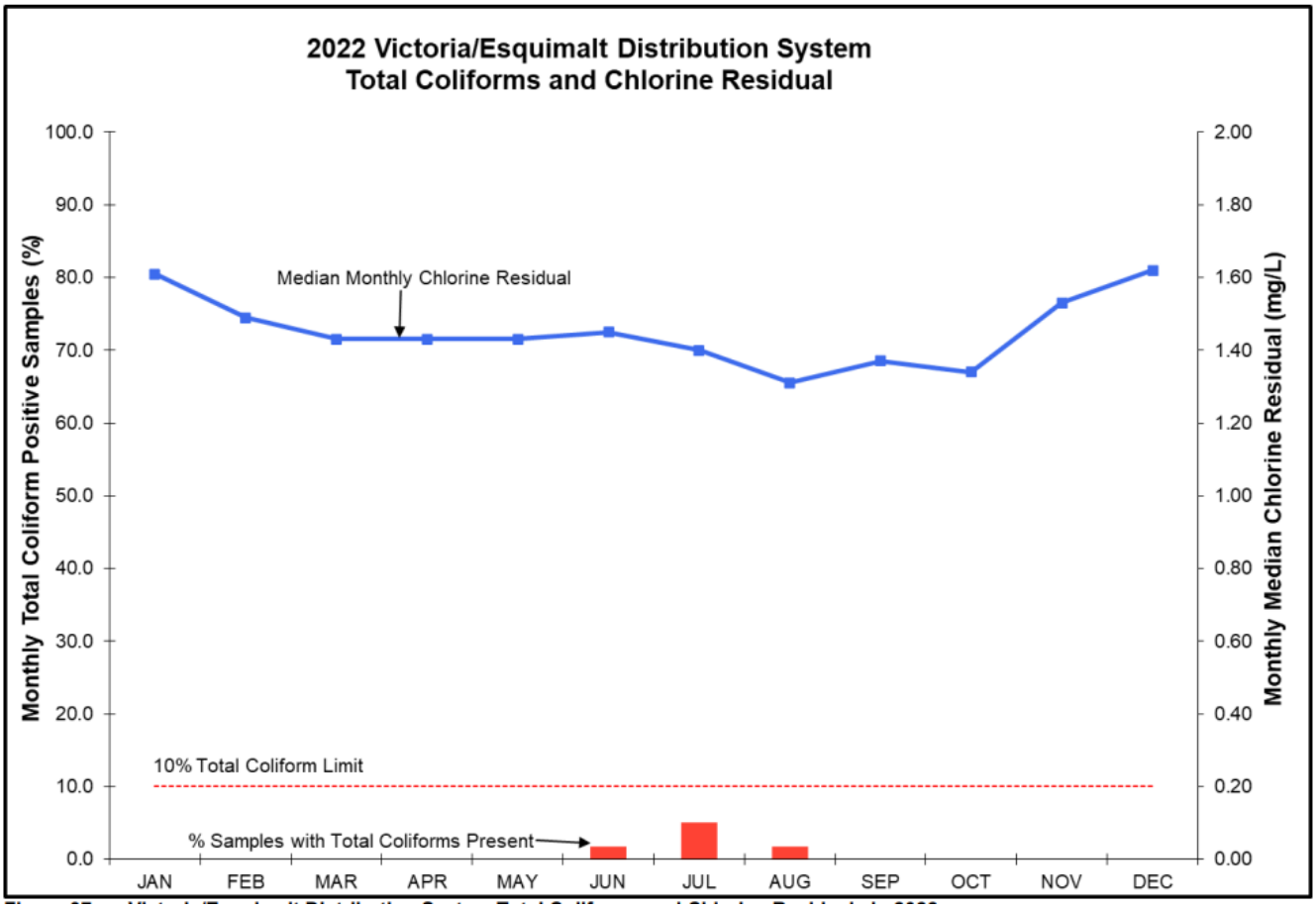

Figure 4: Victoria/Esquimalt Distribution System Total Coliforms and Chlorine Residual in 2022

F. Water System Security:

A combination of measures is utilized to provide security for the distribution system. The pump station and PRV stations utilize external security lighting and have locked access doors and/or ground hatches that are surrounded by security fencing. They also have intrusion alarms which are monitored by the City's SCADA system. There were no reported incidences of tampering or vandalism with the City's water system in 2022.

G. Backflow Prevention and Cross Connection Control:

In 2008, CRD implemented a regional Cross Connection Control Program, including Cross Connection Control Bylaw 3516, to safeguard drinking water system from contaminated water flowing backwards into the public water supply and distribution system.

The City of Victoria requires installation of backflow preventers for all new construction through the plumbing permit process.

Annual testing of all backflow preventers is performed by the CRD.

H. Water Emergency Response Plan:

Water utilities, regardless of their size and location, have a legal responsibility to provide clean, safe drinking water to their customers, in accordance with the BC Drinking Water Protection Act even if supplying water under emergency conditions.

The water distribution system is vulnerable to threats such as natural disasters or man-made incidents that may disrupt normal operations. Disruptions to the water distribution system can impact communities in many ways, such as limiting the availability of water for firefighting and essential health care functions, as well as providing potable water for consumption and sanitation purposes. A negative impact to the community resulting from an emergency will be greatly reduced when these services can return to their normal state in an expeditious manner.

The Engineering & Public Works Department is responsible for emergency response events associated with the water distribution system.

The City's Water Utility Emergency Response Plan is used in combination with the Engineering & Public Works Emergency Operations Plan

Appendix A

Permit to Operate City of Victoria and Township of Esquimalt Water System

island health

HEALTH PROTECTION

PERMIT

to OPERATE

A WATER SUPPLY SYSTEM

Water System Name:	**CITY OF VICTORIA & TOWNSHIP OF ESQUIMALT WATER SYSTEM**
Premises Number:	64000762
Premises Address:	417 Garbally Road Victoria, BC V8T 2J9
Water System Owner:	City of Victoria - Waterworks Yard

City of Victoria - Waterworks Yard is hereby permitted to operate the above potable water supply system and is required to operate this system in accordance with the Drinking Water Protection Act and in accordance with the conditions set out in this operating permit and conditions established as part of any construction permit.

The water supply system for which this operating permit applies is generally described as:

Service Delivery Area:	City of Victoria & Municipality of Esquimalt Water System
Source Water:	Capital Regional District
Water Treatment methods are:	None
Water Disinfection methods are:	Chlorine & Ultraviolet
Number of Connections	> 20000 (DWP)

Operating conditions specific to this water supply system are in Appendix A.

Date: June 1, 2018

Issued By:
Environmental Health Officer

This permit must be displayed in a conspicuous place and is not transferable