western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

Source Water Protection Plan: Cowichan Bay Waterworks District, Cowichan Bay, BC

Prepared for:

Cowichan Bay Waterworks District
1760 Pavenham Rd
Cowichan Bay, BC V0R 1N1

Prepared by:

Western Water Associates Ltd.
(EGBC Permit to Practice number 1001419)
301 – 1095 McKenzie Ave
Victoria, BC V8P 2L5

January 12, 2023
Project: 22-092-01VC

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Environmental Science

January 12, 2023 FILE: 22-092-01VC

Cowichan Bay Waterworks District
1760 Pavenham Rd
Cowichan Bay, BC V0R 1N1
Attention: Cheryl Wirsz, District Administrator

Re: Source Water Protection Plan: Cowichan Bay Waterworks District, Cowichan Bay, BC

Western Water Associates Ltd. is pleased to provide this report outlining a Source Water Protection Plan for the Cowichan Bay Waterworks District's groundwater supply wells (Well 13088, Well 38473, Well 13060 and Well 13062).

We trust that the professional opinions and advice presented in this document are sufficient for your current requirements. Should you have any questions, or if we can be of further assistance in this matter, please contact the undersigned.

WESTERN WATER ASSOCIATES LTD.
(EBGC Permit to Practice 1001419)

Report by:

Natasha Neweduk, B.Sc., GIT
Environmental Geoscientist

PROFESSIONAL GEOSCIENTIST
PROVINCE OF BRITISH COLUMBIA
C. W. PETERSMEYER
#32140

Chad Petersmeyer, M.Sc., P.Geo.
Senior Hydrogeologist

TABLE OF CONTENTS

List of Tables

List of Figures (in text)

List of Figures (attached)

List of Appendices

1. INTRODUCTION

Western Water Associates Ltd. (WWAL) has developed a Source Water Protection Plan (SWPP) for the Cowichan Bay Waterworks District (CBWD). The purpose of this study is to provide an assessment of the four community water supply wells (Valleyview Wells 1 and 2, Pavenham Well and Kidd Well) and the source aquifers to: define proposed groundwater protection areas, identify potential threats to the delivery of safe drinking water, and establish a framework and strategies for source water protection. The scope of work and methodology for this project are outlined below.

1.1 Assessment Structure and Guiding Documents

This SWPP incorporated the principles and procedures of several guidance documents, most notably the Comprehensive Drinking Water Source to Tap Assessment Guideline (S2TAG) as published by the BC Ministry of Healthy Living and Sport (British Columbia Ministry of Healthy Living and Sport, 2010).

The S2TAG provides a structured and consistent approach to evaluating risks to drinking water. It serves as a tool to develop a comprehensive understanding of the risks to drinking water safety and availability and provides a framework on how to operate effectively and produce the best possible water quality. The S2TAG consists of eight modules:

Module #1 - Delineate and characterize drinking water sources
Module #2 - Conduct contaminant source inventory
Module #3 - Assess water supply elements
Module #4 - Evaluate water system management, operation and maintenance practices
Module #5 - Audit water quality and availability
Module #6 - Review financial capacity and governance of water system
Module #7 - Characterize risks from source to tap
Module #8 - Recommend actions to improve drinking water protection

Modules #1 through #6 are hazard identification modules, and Modules #7 and #8 focus on risk characterization and risk management. Depending on the size and complexity of the water system, typically some or all of the modules are completed for a SWPP. Modules #3 through #6 are not within WWAL's hydrogeologic expertise, therefore, this assessment is focused on Modules #1, 2, 7 and 8 while aspects of the other modules were also discussed.

Components of another Provincial guidance document, the Well Protection Toolkit (British Columbia Ministry of Environment, 2006) were also used in this assessment. Methodologies for delineating well capture zones outlined in the Toolkit were used for this project, and tables outlining potential groundwater contaminants were reviewed.

1.2 SWPP Process

The general process for completing the SWPP was iterative and incorporated input and feedback from the Technical Advisory Committee (TAC) members listed below. The process included the following steps (steps 5 and 6 to be completed after issuing this draft SWPP):

1. Reviewed existing background information on the wells and land use in the project area. Reviewed historical aerial photos, contaminated sites databases, and water quality data.
2. Completed a site reconnaissance of the area.
3. Established a TAC to guide the SWPP process.
4. Provided a draft SWPP for the TAC's review.
5. Met with the TAC.
6. Obtained and incorporated comments from the TAC into a final report.

The SWPP received input from the following individuals, as formal members of the TAC:

- Cheryl Wirsz, RPP, MCIP, RI, District Administrator (CBWD);
- Calvin Slade, Director (CBWD);
- Chad Petersmeyer, P.Geo., Senior Hydrogeologist (Western Water);
- Adam Knight, Site Manager (Valleyview Centre);
- Mike Seymour, P.L.Eng. (MSR Solutions Inc.); and,
- Sarah Gilchrist, Environmental Health Officer (Island Health).

2. SETTING

2.1 Physiography, Climate, and Surrounding Land Use

The general location of the project site is shown in Figure 2.1. The Cowichan Valley Regional District (CVRD) electoral districts, surface water, and well locations are shown in Figure 2.2. The project site is located within the CVRD and is primarily comprised of the southern portion of Electoral Area D and the northwestern portion of Electoral Area C. It is located east of the Trans-Canada Highway and extends north to approximately the intersection of Cowichan Bay Road and Lochmanetz Road, and south to the intersection of Cowichan Bay Road and Cobble Hill Road.

The project site mainly consists of low density residential and agricultural developments. Topography in the area grades towards sea level to the north and east, with a maximum elevation of approximately 120 m above sea level (asl) in the southern portion of the community. The Pavenham Well and Valleyview Wells are located at approximately 60 m asl while the Kidd Well is situated at 2 m asl. The Cowichan Bay community borders the Cowichan Estuary, which acts as a vital ecological transition zone between land and water.

The Pavenham Well and Kidd Well are located within residential and agricultural areas of the Cowichan Bay community (Electoral Area D), while the two Valleyview Wells are located approximately 850 m south of the Electoral Area D border, in the commercial Cobble Hill Valleyview Centre (Electoral Area C). The Valleyview Centre consists of small retail stores, groceries stores, and various offices. Dougan Lake is located approximately 265 m northwest of the Valleyview Wells.

Based on Environment Canada Climate Normals (1981 – 2010) for Duncan Kelvin Creek station (#1012573) located ~7 km northwest of the project area, the average annual temperate and precipitation are on the order of 10.1°C and 1361.2 mm, respectively (Environment Canada, 2022). Typical of this region, most of the precipitation falls as rain between the months of November and March, followed by relatively warm dry summers. Table 2.1 below provides an overview of the climate normal data for the Duncan Kelvin Creek Station. The majority of the Cowichan Bay community is located at an elevation lower than the Duncan Kelvin Creek climate station. Therefore, Cowichan Bay may experience a slightly different climate (e.g. warmer temperatures and less snow) than what is reported in Table 2.1.

Table 2.1. 1981-2010 Climate Normal Data for Duncan Kelvin Creek Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	225.2	125.9	125.9	82.6	49.1	36.7	22.3	33.2	31.6	119.1	219.7	218.0	1289.2
Snowfall (cm)	23.0	13.2	9.6	0.1	0.0	0.0	0.0	0.0	0.0	0.4	8.3	17.6	72.0
Precipitation (mm)	248.3	139.1	135.4	82.6	49.1	36.7	22.3	33.2	31.6	119.4	227.9	235.6	1361.2
Daily Average (°C)	3.6	4.4	6.3	9.1	12.4	15.3	17.9	17.8	15.2	10.1	5.8	3.3	10.1

2.2 Geological Setting

Surficial geology mapping by Blythe et al. (1993) shows that the surficial sediments underlying the majority of the Cowichan Bay area are comprised of hummocky till blankets and silty glaciolacustrine deposits overlying glaciofluvial sand and gravel fan deposits. Adjacent to the Cowichan Bay Estuary, surficial sediments encompass fluvial silt, sand, and gravel fan deposits.

The bedrock in the project area is mapped as being part of the Nanaimo Group, described as Upper Cretaceous-age boulder, cobble and pebble conglomerate, coarse to fine sandstone, siltstone, and shale (Massey, 1994).

2.3 Hydrogeological Setting

2.3.1 Cherry Point Aquifer 197

According to the Ministry of Environment and Climate Change Strategy (ENV) Water Resources Atlas (WRA) (ENV, 2022a), both Valleyview Wells and the Pavenham Well are completed in the provincially mapped Cherry Point Aquifer 197. Cherry Point Aquifer 197 is a confined glacio-fluvial sand and gravel aquifer classified by the Province as having a moderate productivity and demand (ENV, 2019a). Based on the presence of an aerially extensive confining layer of low permeability till and/or clay, which acts as a barrier to the downward migration of contaminants, the majority of the aquifer is considered moderately vulnerable to surface contamination. Aquifer 197 is approximately 49 km^2 in size, extending north towards Duncan and south towards Mill Bay (ENV, 2022b). Recharge to the aquifer is likely from infiltration of precipitation and mountain block recharge.

A regional groundwater flow direction has not been determined for this study, but based on a hydrogeological study completed by WWAL in 2018, the groundwater flow direction in the Fisher Road area, approximately 2 km southeast of the Valleyview Wells, is towards the north-northwest with a gradient of approximately 0.004 (0.4%) (WWAL, 2018).

2.3.2 Lower Cowichan A Aquifer 186 and Lower Cowichan C Aquifer 188

Two Provincially mapped fluvial sand and gravel aquifers are in the vicinity of the Kidd Well: Lower Cowichan River A Aquifer 186 and Lower Cowichan River C Aquifer 188. Both aquifers extend northwest from the floodplains of the Cowichan and Koksilah Rivers and the Cowichan Bay Estuary.

The Lower Cowichan A Aquifer 186 is unconfined and classified by the Province as having a high productivity, high demand and high vulnerability to surface contamination due to its unconfined nature and shallow water table (ENV, 2020a). Recharge to Aquifer 186 is presumed to be from precipitation, and a likely hydraulic connection to the Cowichan River (ENV, 2020a).

The Lower Cowichan River C Aquifer 188 is confined and characterized by the Province as having a high productivity and low vulnerability to surface contamination due to a confining silt and/or till layer (ENV, 2020b). Based on a silt layer reported from ~22 m to ~32 m depth in the Kidd Well's drill log, the well is interpreted to be completed in Aquifer 188. The primary sources of recharge to Aquifer 188 are likely groundwater inflow locally from the Koksilah River and upgradient from the Cowichan River (ENV, 2020b). The coastal setting of Aquifer 188 makes it vulnerable to seawater intrusion.

The direction of groundwater flow in Aquifer 186 and Aquifer 188 has not been provincially mapped but is inferred to follow topography, with ambient groundwater flow towards the southeast (similar to the direction of river flow).

3. COWICHAN BAY WATERWORKS DISTRICT SYSTEM

The CBWD service area primarily encompasses the Cowichan Bay community located within Electoral Area D and extends south into the northwestern corner of Electoral Area C. A recent extension was also completed to supply water to the Tommy Road region of the Cowichan Tribes' Est-Patrols IR No. 4. In 2021, the Cowichan Bay's Official Community Plan (OCP) estimated a 2279-person service population and projected a service population increase of 502 by year 2041 (AE, 2022). The per capita water demand is estimated at 350 L/day, with a maximum day demand (MDD) of 13.9 L/s and 20-year MDD of 22.6 L/s (AE, 2022). The predominant sources to meet water system demands are Valleyview Wells 1 and 2. The Pavenham Well, located at the CBWD office, is currently inoperative and the Kidd Well, situated northwest of the main service area, is maintained as a backup well.

Major components of the water system from source to tap include the following:

- Two wells currently in use (Valleyview Wells 1 and 2)
- Two backup wells (Pavenham Well and Kidd Well)
- 20 km of watermains
- 80 hydrants and 1100 connections
- Three reservoirs (Pavenham Road Reservoir, Telegraph Road Reservoir, and Ordano Road Reservoir)
- Two treatment stations (Valleyview and Pavenham)
- One booster pump (Ordano Road)
- Two pressure zones (above and below the 45 m elevation line)
- Water treated with minor amounts of sodium hypochlorite

In 2021, the disinfection system for the Valleyview Wells was updated to permit individual dosing of each supply well. The CBWD intends to maintain a free chlorine residual of 0.2 mg/L within the distribution system.

3.1 Production Well Construction and Operating Details

As previously noted, the primary wells used by the CBWD are Valleyview Wells 1 and 2. These wells are registered with the Province with respective Well Plate Identification Number's (WPID's) 38473 and 13088. The Valleyview Wells are located near the Valleyview Centre at 1440 Cowichan Bay Road, approximately 30 m north-south from one another. The Kidd Well (WPID 13060) is located near the mouth of the Koksilah and Cowichan Rivers at 2284 Cowichan Bay Road, and the Pavenham Well (WPID 13062) is situated at the CBWD's office site at 1760 Pavenham Road. Well reports from the Province indicate that all four wells are completed in unconsolidated sediments between 43.0 m (141 ft) and 66.1 m (217 ft) depth below ground surface (bgs). The locations of each well are shown in Figure 2.2 and construction details are summarized in Table 3.1 below. Well logs are provided in Appendix A.

Table 3.1. Cowichan Bay Waterworks District Well Details

Well ID	Valleyview Well 2 (WPID 13088)	Valleyview Well 1 (WPID 38473)	Kidd Well (WPID 13060)	Pavenham Well (WPID 13062)
Date Drilled	August 1996	August 2013	February 1985	August 1957
Driller	Fyfe's Well Drilling Ltd.	Drillwell Enterprises Ltd.	Drillwell Enterprises Ltd.	Pacific Water Wells Ltd.
Drilling Method	N/R	Dual Rotary	Air Rotary	N/R
Nominal Diameter	200 mm (8")	250 mm (10")	200 mm (8")	150 mm (6")
Total Depth (bgs)	62.2 m (204 ft)	60.4 m (198 ft)	43.0 m (141 ft)	66.1 m (217 ft)
Screen Details	150 slot screen, 59.4 m to 60.1 m (195 to 200 ft)	150 slot screen, from 57.3 m to 60.4 m (188 to 198 ft)	120 slot screen, from 39.6 m to 43.0 m (130 to 141 ft)	No. 50 screen, from 64.6 m to 66.1 m (212 to 217 ft)
Driller's Estimated Yield	18 L/s (290 USgpm)	38 L/s (600 USgpm)	16 L/s (250 USgpm)	4.0 L/s (65 USgpm)
Current Pumping Capacity	6 L/s (95 USgpm)	12 L/s (190 USgpm)	0 L/s	6.3 L/s (100 USgpm)
Static Water Level (btoc)	11.6 m (38 ft)	12.2 m (40 ft)	Artesian	41.1 m (135 ft)
Lat. Decimal Degrees N	48.711794	48.711489	48.75325	48.73677
Lat. Decimal Degrees W	-123.609012	-123.608899	-123.65561	-123.62172
Legal Description of Land	Lot 2 Plan VIP18824 Sec 8 Rng 5 Shawnigan District	Lot 2 Plan VIP18824 Sec 8 Rng 5 Shawnigan District	Lot A Plan VIP1725 Sec 10 Rng 2 Cowichan District	Lot 1 Plan 15581 Sec 5 Rng 4 Cowichan District
PID and/or Civic Address	1400 Cowichan Bay Rd PID 003-778-304	1400 Cowichan Bay Rd PID 003-778-304	North of 2284 Cowichan Bay Rd PID 002-032-759	1760 Pavenham Rd PID 004-534-611

Note: Information reported in Table 2.1. is based off available well driller's logs for WPID 13088, 38473, 13060 and 13062 retrieved from the Water Resources Atlas (ENV, 2022a). N/R = Not reported

3.1.1 Pavenham Well

The Pavenham Well was drilled in August 1957 by Pacific Water Wells Ltd. It was completed to a total depth of 66.1 m (217') with 150 mm (6")-diameter casing. A 20 horsepower pump, capable of flows up to 6.3 L/s (100 USgpm), is currently installed in the well. The greensand filtration system in place to remove elevated concentrations of total iron and total manganese from the Pavenham Well water is not currently in working order. The CBWD is therefore not using the Pavenham Well for water supply at this time, however, it is being maintained as a backup well.

3.1.2 Kidd Well

In February 1985, Drillwell Enterprises Ltd. (Drillwell) constructed the Kidd Well to a total depth of 43.0 m (141 ft). The well was drilled with a 200 mm (8")-diameter casing and had an original driller-estimated yield of 16 L/s (250 USgpm). At the time of drilling, flowing artesian conditions were reported (static water surface above ground level). Aeration and chlorination were installed to treat water sourced from the Kidd Well for sulphur dioxide issues and for disinfection purposes. Based on the Kidd Well's elevation near sea level and proximity to the Cowichan Estuary, seawater intrusion is a potential risk to groundwater quality. Due to aesthetic water quality complaints from the well, it has not operated for many years, but

is maintained by the CBWD as a backup well. Through conversation with Calvin Slade, a Director on the CBWD's Board of Trustees, we understand that the pump currently installed in the well has a capacity of approximately 19 L/s (300 US gpm), however, the electrical equipment at the Kidd Well requires updating before the well can be operated.

3.1.3 Valleyview Well 2

Valleyview Well 2 was drilled in October 1996 by Fyfe's Well Drilling Ltd., with a 200 mm (8")-diameter casing to a total depth of 62.2 m (204 ft). At the time of drilling, the yield was estimated by the driller to be 18 L/s (290 USgpm) and was later rated at 31 L/s (490 USgpm) (Lowen, 2008). Prior to 2009, the well was operated by the owners of the Valleyview Centre, who transferred operation of the well to the CBWD for it to be connected to the existing distribution system. The well is currently unable to operate at its rated pumping capacity due to sand pumping issues, likely from over-excavation during well construction causing finer sediments to settle around the upper well screen (Thurber, 2013). The Provincial well log notes an alteration was completed in March 2012 by Drillwell in an attempt to fix the sand pumping. Between 2013 and 2014, the pump intake depth was raised to approximately 24.3 m below top of casing (80 ft), although the exact date that this work occurred is uncertain. The current pumping capacity of Valleyview Well 2 is 6 L/s, which is substantially below its rated capacity.

3.1.4 Valleyview Well 1

In 2013, Thurber Engineering Ltd. (Thurber) provided hydrogeological services including design, drilling, test pumping, management and evaluation of groundwater quality and yield for an additional production well located near the Valleyview Center. Valleyview Well 1 was constructed by Drillwell to a total depth of 60.4 m (198 ft) with a 250 mm (10")-diameter casing. In 2013, BC Aquifer Services Ltd. (BC Aquifer) test pumped the well under the supervision of Thurber. The test pumping program included a 5-hour long step test and 48-hour long constant rate test. Thurber estimated a long-term yield of 38 L/s (600 USgpm) for Valleyview Well 1 but, due to well pump sizing, its current operating capacity is on the order of 12 L/s (190 USgpm).

3.2 Water System Monitoring

The CBWD operator collects routine bacteriological samples from the following water supply sources and points of distribution located throughout the CBWD's water system:

- Valleyview Wells 1 and 2 (weekly);
- Telegraph Road Reservoir (weekly);
- Pavenham Road Reservoir (bi-weekly);
- Ordano Road Reservoir (bi-weekly);
- Valleyview Centre Bakery (weekly);
- Bench School (weekly);

- Hecate Park (bi-weekly); and,
- Kidd Site (bi-weekly).

The civic addresses of the sampling sites are provided in Table 3.2.

Table 3.2. Water System Sample Sites

Sample Site	Civic Address
Valleyview Wells 1 and 2	1400 Cowichan Bay Rd
Pavenham Road Reservoir	1760 Pavenham Rd
Telegraph Road Reservoir	4367 Telegraph Rd
Ordano Road Reservoir	West of 1765 Ordano Rd
Valleyview Centre Bakery	1400 Cowichan Bay Road
Kidd Site	North of 2284 Cowichan Bay Rd
Hecate Park	1865 Cowichan Bay Rd
Bench School	1501 Cowichan Bay Rd

Note: Civic addresses report from Island Health (2022) Facility Sampling History.

The Island Health Authority (IH) requires raw water from the operational supply wells to be sampled monthly for bacterial parameters. The CBWD exceeds the minimum requirement through weekly sampling of the Valleyview Wells and Telegraph Road Reservoir, and bi-weekly sampling the Ordano Road Reservoir and Pavenham Road Reservoir. Based on the size of the water system, monthly bacterial samples are required from four water distribution sites. The water distribution sites are the Valleyview Centre Bakery, Bench School, Kidd Site and Hecate Park. The Valleyview Centre and Bench school are sampled weekly and the Kidd site and Hecate Park are sampled on alternating weeks. The current sampling schedule results in three distribution sites sampled per week, for up to 12 monthly samples. Through conversation with the CBWD's current operator, Melodie McKnight, new distribution sites may be added to the routine sampling schedule. A full spectrum analysis of the water produced from the supply wells is collected every two years.

3.3 Water Usage

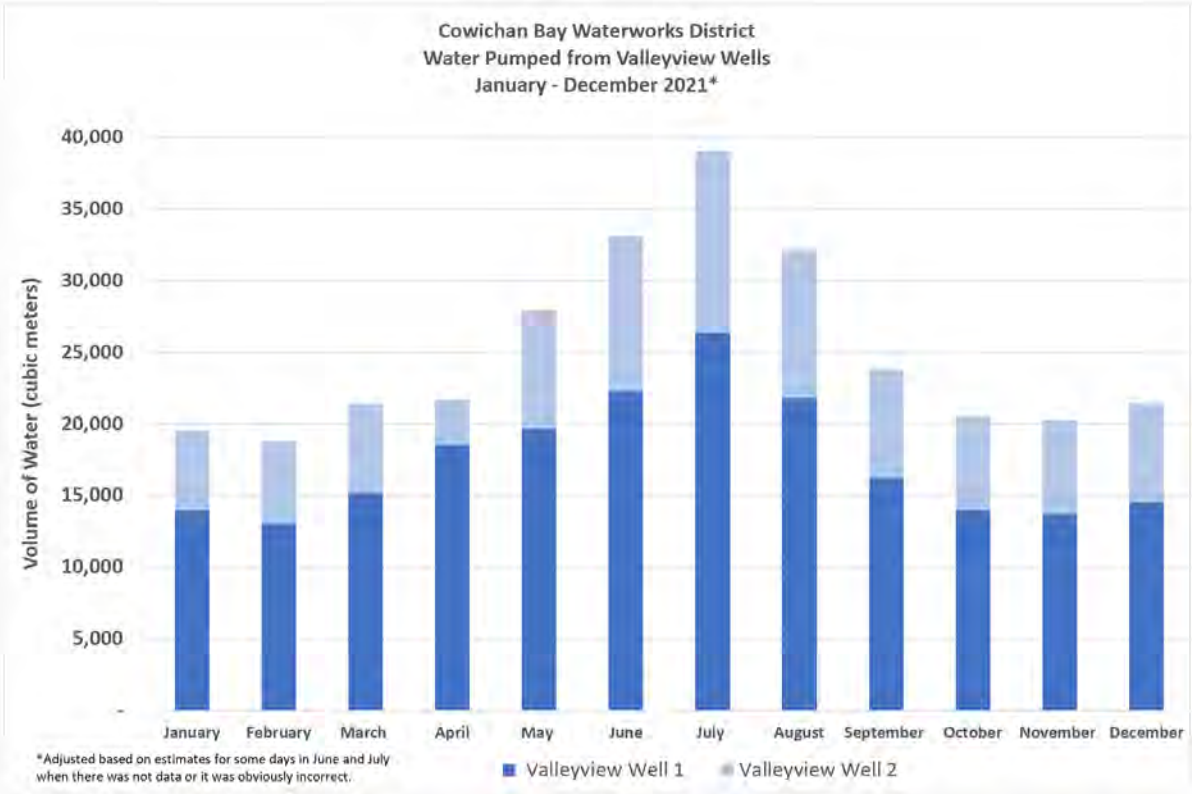
The Valleyview Wells are continually operated to meet water system demands, which vary throughout the season. Monthly groundwater extraction totals are collected by the water system's operator. According to the water usage data provided to WWAL by CBWD, the annual water usage in 2021 amounted to 299,600 m^3/year, with a peak demand occurring in July. The 2021 monthly extraction volumes are summarized in Table 3.3. and illustrated in Figure 3.1, on the following page.

Table 3.3. Valleyview Wells 2021 usage data

Month	Valleyview Well 1 m^3	Valleyview Well 2 m^3	Total m^3
Jan-21	13,938	5,581	19,519
Feb-21	12,991	5,807	18,799
Mar-21	15,208	6,160	21,368
Apr-21	18,535	3,149	21,684
May-21	19,631	8,289	27,920
Jun-21	22,292	10,859	33,151
Jul-21	26,334	12,653	38,987
Aug-21	21,813	10,352	32,164
Sep-21	16,181	7,650	23,831
Oct-21	13,951	6,571	20,522
Nov-21	13,667	6,639	20,306
Dec-21	14,493	6,916	21,409
Total	**209,034**	**90,626**	**299,660**
% of Total	70%	%30	100%
Average demands (L/s)	6.6	2.9	9.5

Note: Extraction data provided to WWAL by the District's Administer, Cheryl Wirsz.

Figure 3.1. Valleyview Wells 2021 Extraction Data



Note: Extraction data provided to WWAL by CBWD.

4. MODULE #1: GROUNDWATER SOURCE DELINEATION AND CHARACTERIZATION

Module #1 from the S2TAG provides the framework for the source protection assessment by delineating well capture zones and source protection areas on which the subsequent steps in the process are focused. The following sections outline our delineation of the source protection areas, review well construction related hazards and describe the raw groundwater quality.

Capture zones are defined as the land area around a well that contributes water to (or recharges) the well. A variety of methods are available to delineate capture zones which vary in terms of their complexity and information requirements. Information typically incorporated into the calculation of capture zones includes well construction information, aquifer thickness and properties, well pumping rates, travel times, and direction and gradient of groundwater flow. In cases where little information is available or when small water systems are being assessed, simple capture zone delineation methods are employed such as arbitrary or calculated fixed radii around a well. In cases where more data exist, more complicated delineation methods such as analytical equations or hydrogeologic modelling may be employed.

In reality, due to the simplifying assumptions, there is always uncertainty associated with calculated capture zones. To address this and to provide a measure of conservatism, larger source protection areas are often defined based on the capture zones, which become the focus for subsequent hazard identification, risk assessment and risk management efforts.

4.1 Well Capture Zone Delineation

Guidance on selecting the methodology for capture zone delineation is provided in the S2TAG and is based on the number of connections in the water system and the information available. For the primarily used Valleyview Wells, both the Calculated Fixed Radius (CFR) and Analytical Equations methodology were used. For the backup Pavenham Well and Kidd Well, only the CFR method was applied.

The following information summarizes hydrogeological data used in our calculations and assumptions made for values where data were not available:

- **Pumping rate (Q)**: The CBWD production wells are currently operating at rates substantially lower than their nominally rated capacities. The CBWD Master Plan, developed by Associated Engineering (AE) in 2022, recommended a future increase in well pumping rates, therefore, for the purpose of delineating a source protection area and as a conservative approach, we assumed that the Valleyview Wells and the Pavenham Well are pumped at their rated capacities (AE, 2022). Due to concerns of saltwater intrusion at the Kidd Well, a reduced pumping rate (approximately half the capacity of the pump currently installed in the well) was assumed.

- **Aquifer thickness (b):** Aquifer thickness was determined based on drilling information provided in well logs retrieved from the WRA (ENV, 2022a).

- **Aquifer porosity (n):** A value of 0.3 was applied to the four wells, a reasonable estimate for sand and gravel aquifers (Fetter, 2001).

- **Aquifer transmissivity (T):** The aquifer transmissivity for the analytical capture zone analysis of the Valleyview Wells was obtained from Thurber (2013) which was based on analysis of constant rate pumping test data of Valleyview Well 1.

- **Aquifer hydraulic gradient (i):** The horizontal hydraulic gradient for the analytical capture zone analysis of the Valleyview Wells was derived by extrapolating water levels in the aquifer near Fisher Road, approximately 2 km south of the Valleyview Wells (WWAL, 2018), to the Valleyview area. Based on this, the gradient was assumed to be 0.005 toward the north-northwesterly (Cowichan Bay).

The values for parameters used in defining the capture zone are summarized in Table 4.1 and Appendix B provides the calculations for determination of the capture zone areas.

Table 4.1. Parameters used in CFR capture zone delineation

Parameter	Value			
	Valleyview Well 1	Valleyview Well 2	Pavenham Well	Kidd Well
Aquifer thickness (b)	50 m	47 m	25 m	11 m
Porosity (n)	0.3	0.3	0.3	0.3
Pumping rates (Q)	38 L/s	6 L/s	10 L/s	8 L/s
Transmissivity (T)	7776 m^2/day	7776 m^2/day	N/A	N/A
Hydraulic gradient (i)	0.005	0.005	N/A	N/A

Note: N/A = Not applicable (transmissivity and hydraulic gradient not used in CFR methodology)

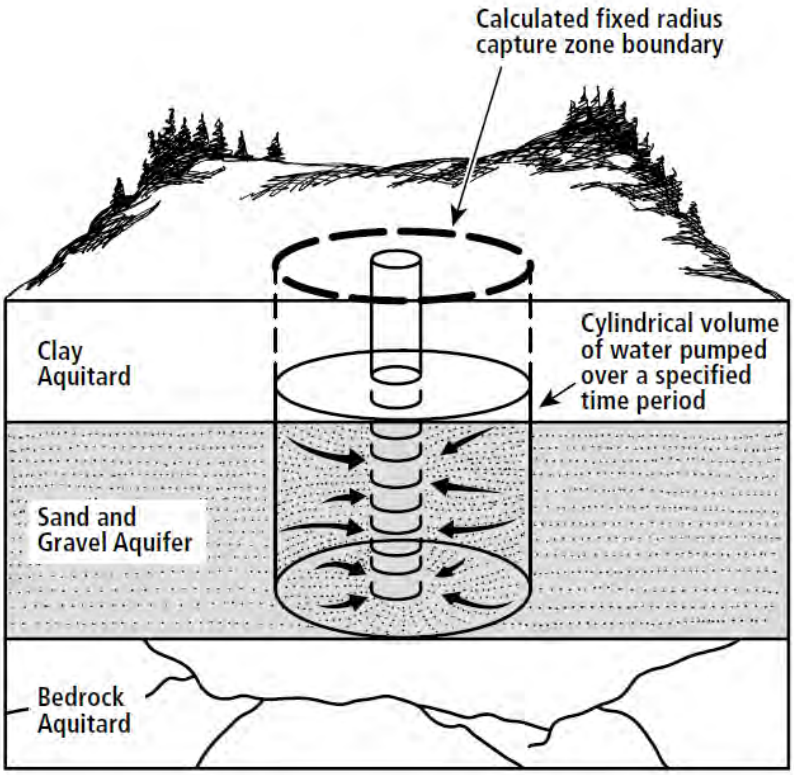
4.1.1 Calculated Fixed Radius Method

CFR capture zones were delineated for 50-day, 1 year and 5-year time frames and results are presented in Table 4.2, on the following page. Figure 4.1 (from BC Ministry of Environment, 2006) shows a general depiction of a capture zone derived utilizing the CFR method, which results in a circular area radiating out from the well concentrically. Our CFR capture zones provide a conservative estimate (larger capture zones), as the aquifers are likely thicker than the values inferred from the well logs which would result in smaller capture zones.

Table 4.2. CFR capture zones for the CBWD supply wells

Timeframe	Valleyview Well 1	Valleyview Well 2	Pavenham Well	Kidd Well
50 day capture zone (m)	112.8	45.3	81.8	110.3
1 year capture zone (m)	159.5	64.0	115.7	156.0
5 year capture zone (m)	356.6	143.1	258.7	348.8

Figure 4.1. Depiction of capture zone derived from CFR method



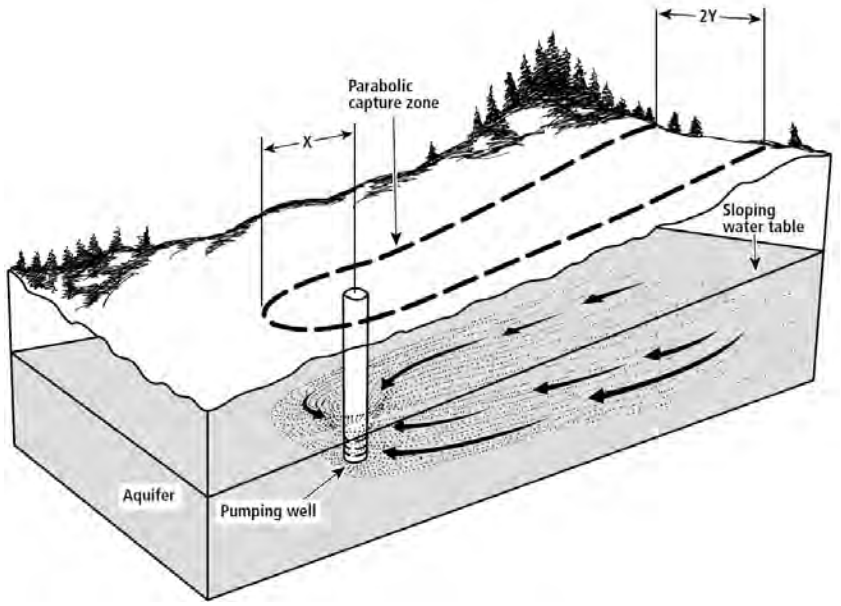
4.1.2 Analytical Equation Method

The Analytical Equations methodology for capture zone delineation incorporates the aquifer hydraulic gradient resulting in a parabolic capture zone. Table 4.3, below, presents the results of the Analytical Equation capture zone delineation for the Valleyview wells, and Figure 4.2 (from BC Ministry of Environment, 2006) illustrates what the various parameters represent.

Table 4.3. Parameters used to delineate analytical capture zones

Parameter	Valleyview Well 1	Valleyview Well 2
Y (m)	42	7
2Y (m)	84	13
X (m)	13	2
1 year capture zone (m)	946	965
5 year capture zone (m)	4730	4827
10 year capture zone (m)	9461	9654

Figure 4.2. Depiction of capture zone derived from Analytical Equation method



4.2 Development of Well Source Protection Area

The proposed well source protection area for the Valleyview Wells is shown in Figure 4.3. This area was conservatively determined by a combination of the 5-year CFR method and 1-year Analytical Equation method for Valleyview Well 1. The capture zones delineated for this well were used to establish the well protection area as they were the largest in aerial extent and Valleyview Well 1 is the primary well used in CBWD's water system.

Based on the available data and information reviewed, the proposed well source protection area for the Pavenham Well and the Kidd Well is defined to be the 5-year CFR method illustrated on Figure 4.4 and Figure 4.5, respectively.

Although the well capture zones are theoretical, any potential harmful activities within the well protection areas should be controlled where practical through planning and regulatory measures.

4.3 Existing Groundwater Quality

Below we summarize the July 2020 and June 2022 water quality results for the CBWD supply wells, retrieved from publicly available data for CBWD water testing (CBWD, 2022) . Samples collected by the operator in 2020 were sent to Bureau Veritas (BV) Laboratory in Victoria, BC and samples collected in 2022 were sent to MB Labs in Sidney, BC for laboratory analysis. Available water quality results for samples collected from the CBWD supply wells are summarized in Table 4.4, on pages 16 and 17, and complete laboratory reports for the data provided by the CBWD are provided in Appendix C.

A review of the water quality data from the Valleyview Wells indicated tested parameters met all health-based Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO) outlined in the Guidelines for Canadian Drinking Water Quality (GCDWQ) (Health Canada, 2022) at the times of sampling and subsequent analyses.

The 2020 and 2022 sampling results from the Pavenham Well demonstrated elevated total iron and manganese concentrations. The AO of 0.3 mg/L for total iron was exceeded, with reported concentrations of 1.89 mg/L and 1.05 mg/L in years 2020 and 2022, respectively. The MAC of 0.12 mg/L for manganese was exceeded in both samples, with reported concentrations of 0.285 mg/L and 0.225 mg/L in years 2020 and 2022, respectively.

The 2022 sampling results from the Kidd Well indicated that the AOs for total dissolved solids (500 mg/L), chloride (250 mg/L), total iron (0.3 mg/L), and sodium (200 mg/L) were exceeded with reported concentrations of 1653 mg/L, 926 mg/L, 1.73 mg/L, and 472 mg/L, respectively. The total manganese MAC (0.12 mg/L) was exceeded with a concentration of 0.294 mg/L.

Sea water intrusion increases the total dissolved solids (TDS) content of an aquifer. A general indication of the TDS content of water can be obtained by measuring the electrical conductivity (EC). Based on work completed by Klassen et al. (2014), 1000 µS/cm is a robust and defensible threshold for EC that can be used to identify wells that are impacted by salinity. The EC reported in the Kidd Well's 2022 sampling was 2850 µS/cm, suggesting that the groundwater produced from this well was likely impacted by seawater intrusion. Sea water intrusion risk mapping completed by WWAL shows that the aquifer vulnerability to sea water intrusion in the vicinity of the Kidd Well is high to very high (WWAL, 2021). The mapping also shows that the aquifer vulnerability to sea water intrusion at the Valleyview and Pavenham Well sites is very low to low (WWAL, 2021).

Iron and manganese exceedances are a common occurrence in BC and are generally attributed to the dissolution of the aquifer matrix. The greensand filtration system in place to remove these constituents

from the Pavenham Well before distribution is currently inoperative and the CBWD is exploring alternative treatment options.

4.4 Well Construction

Well construction is important for wellhead and source water protection. Good well construction practices include: maintaining a casing stickup above the ground surface, ensuring surface drainage is away from the well, installing a secure well cap, and placing a surface seal during drilling. These practices are currently commonplace in addition to being a requirement under the BC *Groundwater Protection Regulation* (*GWPR*) (Province of British Columbia, 2016).

A surface seal is a layer of material with low permeability (often bentonite clay) placed around the upper casing of a well to reduce the downward migration of surface water around the casing anulus. Well logs for Valleyview Well 2, Pavenham Well and the Kidd Well indicate surface seals were not installed as it was not common practice when the wells were drilled.

At the time of the site visit on September 1, 2022, the Valleyview Well 2 was located in a grass covered field. Based on lithology reported in the well log, the aquifer in the vicinity of the well is confined by sandy brown clay and gravel from ground surface to 9 m depth, followed by 1.5 m of compact gravel. Although the aquifer in the vicinity of the well is confined, the nearby sanitary infrastructure (discussed in more detail in Section 5.7), pose an elevated risk to this well in the absence of a surface seal.

The well log for the Kidd Well indicates a ~11 m silt deposit overlies the productive aquifer. Based on the confined nature of the aquifer, and the location of the wellhead being surrounded by a concrete floor of the well house, the lack of surface seal in the Kidd Well likely does not constitute a significant risk for groundwater contamination.

Lithology documented in the Pavenham Well log reports soft sandy silt from ground surface to 2.7 m, underlain by 3.0 m of hardpan clay. Clay deposits act as a confining unit, which provides a barrier for surface contamination to the reach the well intake. Similar to the Kidd Well, the wellhead is completed in a well house with a concrete floor. Based on this and the confined nature of the aquifer, the absence of a surface seal likely does not constitute a notable risk for contamination to this well.

Table 4.4. Summary of 2020 and 2022 water quality data for the CBWD supply wells

		Valleyview Well 1		Valleyview Well 2		Pavenham Well		Kidd Well	
Date Samples Collected (yyyy-mm-dd)		2022-06-21	2020-07-20	2022-06-21	2020-07-05	2022-06-21	2020-07-05	2022-06-21	
Parameters	**Units**								**GCDWQ**
pH	pH units	7.67	7.94	7.86	7.64	7.87	8.11	7.91	AO = 7.0 - 10.5
Conductivity	µs/cm	198	200	187	170	283	290	2850	
UV Transmittance	@254nm	98.5	>97.7	99.4	>97.7	74.7	64.9	90.3	
Turbidity	NTU	0.33	<0.10	0.32	<0.10	2.29	7.2	2.41	Varies
General Parameters and Nutrients									
Total Dissolved Solids	mg/L	115	130	108	98	164	170	1653	AO ≤ 500
Hardness	mg/L	87.4	86.9	83.2	63.7	116	120	408	
Alkalinity (total)	mg/L	95	84	90	69	165	150	150	
Fluoride	mg/L	0.073	0.052	0.071	0.061	0.073	0.17	ND	MAC = 1.5
Nitrate, N	mg/L	0.366	0.336	0.188	0.179	0.013	<0.020	ND	MAC = 10
Nitrite, N	mg/L	ND	<0.0050	ND	<0.0050	0.0103	<0.0050	ND	MAC = 1
Chloride	mg/L	11.5	9.8	8.95	7	11.5	3.2	926	AO ≤ 250
Total Organic Carbon	mg/L	0.75	<0.50	0.51	<0.50	0.197	1.9	2.34	
Sulphate	mg/L	6.31	5.2	7.07	4.9	6.31	<1.0	ND	AO ≤ 500
Selected Total Ions and Metals									
Aluminum	mg/L	0.031	<0.003	0.032	<0.003	0.034	<0.003	0.055	MAC = 2.9
Arsenic	mg/L	0.00139	0.00158	0.00182	0.00185	0.00317	0.0041	0.000592	MAC = 0.010
Barium	mg/L	0.009	0.0036	<0.009	0.0028	0.018	0.02	0.202	MAC = 2.0
Boron	mg/L	0.394	<0.050	0.427	<0.050	0.516	<0.050	0.65	MAC = 5
Chromium	mg/L	0.003	0.0022	0.003	0.0023	<0.003	<0.0010	<0.003	MAC = 0.05
Copper	mg/L	0.008	0.00046	<0.008	0.00023	<0.008	0.00029	0.041	MAC = 2 AO = 1

		Valleyview Well 1		Valleyview Well 2		Pavenham Well		Kidd Well	
Date Samples Collected (yyyy-mm-dd)		2022-06-21	2020-07-20	2022-06-21	2020-07-05	2022-06-21	2020-07-05	2022-06-21	
Parameters	**Units**								**GCDWQ**
Iron	mg/L	0.011	<0.0050	0.01	<0.0050	1.05	1.89	1.73	AO ≤ 0.3
Lead	mg/L	0.0005	<0.00020	<0.0005	0.00041	<0.0005	<0.00020	0.0147	MAC = 0.005
Manganese	mg/L	0.004	<0.0010	0.004	0.0037	**0.225**	**0.285**	**0.294**	MAC = 0.12 AO ≤ 0.02
Mercury	mg/L	0.00001	0.0000019	0.00001	0.000024	<0.000010	<0.0000019	0.00001	MAC = 0.001
Sodium	mg/L	5.63	5.41	7.33	5.8	13.3	13.3	472	AO ≤ 200
Uranium	mg/L	-	0.00021	-	<0.00010	-	<0.00010	-	MAC = 0.02
Zinc	mg/L	0.015	<0.0050	0.016	<0.0050	0.01	0.0065	0.024	AO ≤ 5.0
Bacteriological Parameters									
Total Coliforms	CFU/1000mL	0	0	0	0	0	0	0	MAC = none detectable
E. coli	CFU/1000mL	0	0	0	0	0	0	0	MAC = none detectable
Heterotrophic Plate Count	CFU/1000mL	-	3	-	3	-	66	-	-

Notes:
MAC = Maximum Allowable Concentration (exceedances bold, underlined and orange);
AO = Aesthetic Objective (exceedances underlined and green);
OG = Operational Guideline, for water treatment plants; ND = None Detectable

5. MODULE #2: CONTAMINANT SOURCE INVENTORY

As described within the S2TAG, Module #2 comprises a contaminant source inventory which identifies inherent risks to water quality as well as describing land uses, human activities and other potential contaminant sources that could affect source water quality. The term "contaminant source" is defined within the S2TAG to mean both actual/existing and potential sources of contamination.

5.2 Objectives and Methods

The objective of Module #2 is to inventory existing and known potential contamination sources in and around the proposed source protection area and then to summarize what is known about these sites so that the potential risk to drinking water can be assessed further in Module #7. Also, in Module #7 we assess the existing natural and engineered barriers that are already in place to mitigate risks, as well as the likelihood and consequences of the identified drinking water hazards.

We used the following methods in completing the contamination source survey:

1) A search of iMapBC, which contains information on contaminated sites recorded in the B.C. Site Registry Database;
2) A search of the Federal Contaminated Sites Inventory, which reports suspected, active or closed contaminated sites on federal lands;
3) A review of previous hydrogeological assessment reports;
4) A review of historical aerial photographs for the area;
5) A visual survey of areas in and around the source protection areas conducted during a site visit on September 1, 2020;
6) A review of records on existing wells in the area; and,
7) Discussions with TAC members on historical, current and future land uses (to be completed after review of this draft SWPP).

5.3 Site Registry Database Searches

A search of the iMapBC Environmental Remediation Sites layer, which includes all contaminated sites recorded in the BC Site Registry Database, was completed on July 14, 2022 (Province of British Columbia, 2022) for a 1 km^2 area around each well and for the proposed source protection areas for the wells. No provincially registered sites were identified within these areas for the Valleyview Wells or the Kidd Well, however four Registered Sites were found within 500 m of the Pavenham Well. Table 5.1 summarizes these Registered Sites and their locations are shown on Figure 5.1. Two of the Registered Sites (Site ID# 13116 and 12503) are located inside the established source protection area for the Pavenham Well. All of the Registered Sites are located either cross-gradient or downgradient of the well with respect to inferred groundwater flow direction (based on the topographic gradient).

Table 5.1. Summary of Registered Site search for the area around the Pavenham Well

Site ID Number	Civic Address	Location Relative to Site	Site Details
13116	1720 Pavenham Road, Cowichan Bay	275 m East; Cross-gradient	N/R
12503	1716 Glen Road, Cowichan Bay	290 East; Cross-gradient	N/R
12908	Botwood Lane, Cowichan Bay	500 m Northeast; Downgradient	N/R
8771	1751 Cowichan Bay Road, Cowichan Bay	440 North: Downgradient	Former Shell Canada Products Tank Farm

Note: N/R = Not Reported

In addition to searching the provincial site registry, WWAL completed a search of the Federal Contaminated Sites Inventory on July 14, 2022, to identify any federally registered sites within the proposed source protection areas or within 500 m from the CBWD production wells. No contaminated sites were mapped as being present in the federal inventory.

5.4 Review of Historical Air Photos

WWAL obtained historical air photos to review changing land use in and around the four supply wells over the past 76 years. Table 5.2 to Table 5.4 summarize information gleaned from the photo review.

Table 5.2. Summary of air photos reviewed for Valleyview Wells 1 and 2

Air Photo Number/ Image Source	Year	Comments
BC243:4	1946	Trans Canada Highway present. Well sites cleared of bush, surrounding area largely forested. No other significant signs of development.
BC 1053:60	1950	Area northeast of well sites, on Cowichan Bay Road, cleared of bush. No other significant changes.
BC 2087:9	1957	A few residential houses built southeast of well sites. No significant changes.
BC5057:53	1962	No significant changes.
BC7079:244	1968	No significant changes.
BC7403:274	1972	Roads/paths cleared near well sites.
BCC204:67	1979	Increased development of Cowichan Bay area, sporadic residential neighbourhoods.
BC84027:266	1984	No significant changes.
BCB93095	1993	Increase in residential housing, building development northwest of Dougan Lake. Valleyview Centre built in 1985.
BCC98036	1998	Development apparent around well site, buildings and asphalt appear to be present. Valleyview Well 2 constructed in 1996. Partial clearing of Est-Patrolas IR No. 4, north of site.

ME07460C:238	2007	Increased clearing of Est Patrolas IR No. 4., north of site. No significant changes.
Google Earth Pro	2022	No significant changes.

Table 5.3. Summary of air photos reviewed for Pavenham Well

Air Photo Number/ Image Source	Year	Comments
BC247:107	1946	Cowichan Bay Road present. Well site undeveloped, forested land. Minimal development along shoreline, a few boats docked north of well site. Former lumber/shipment operation present northwest of well site in the Cowichan Estuary.
BC1053:61	1950	No significant changes.
BC2087:8	1957	Increased development of lumber/shipment operation northwest of well site. Well site cleared and constructed in 1957.
BC7076:195	1968	Increased clearing and development of residential subdivision surrounding well site.
BC7399:97	1972	Strip of land cleared east of site, no other significant changes.
BCC204:74	1979	Further residential subdivision development surrounding well site.
BC84029:50	1984	No significant changes.
BCB93096:10	1993	Lot south of the subdivision surrounding well site is cleared. Lumber no longer stored in Cowichan Estuary north of well site.
BCC98036:70	1998	No significant changes.
ME07460C:236	2007	Land west of subdivision surrounding well site is cleared.
Google Earth Pro	2022	No significant changes.

Table 5.4. Summary of air photos reviewed for Kidd Well

Air Photo Number/ Image Source	Year	Comments
BC247:100	1946	Cowichan Bay Road Present. Well site undeveloped, appears grass covered with sporadic trees. Area east of well site is cleared.
BC1053:61	1950	Lumber/shipment operation present east of well site in Cowichan Estuary. No significant changes.
BC2087:8	1957	Increased development of forestry/shipment operation northwest of well site. No other significant changes.
BC5057:51	1962	A few residential houses constructed west of the well site. No other significant changes.
BCC204:75	1979	No significant changes.
BC84027:264	1984	No significant changes.
BCB93095:290	1993	Lumber no longer stored in Cowichan Estuary east of site. Well constructed in 1985, no other significant changes.

BCC98036:69	1998	Expansion of Cowichan Golf & Country Club southwest of site. No significant changes.
ME07460C:236	2007	A few trees cleared at well site. No other significant changes.
Google Earth Pro	2022	No significant changes.

5.5 Visual Survey of Source Protection Area

On September 1, 2022, Chad Petersmeyer, P.Geo., and Natasha Neweduk, GIT, of WWAL conducted a visual survey of the CBWD supply well sites and surrounding areas to identify any observable risks to the supply wells. The District's Administrator, Cheryl Wirsz, met with WWAL to provide access to the sites and provide operational information.

The Valleyview Wells were located in the northwestern portion of the Valleyview Centre, in a grass-covered area surrounded by paved parking. The wellhead sites were not fenced or located in a pump house. At the time of the site visit, the wellheads appeared in good condition. Approximately 15 m west of Valleyview Well 2 and 37 m northwest of Valleyview Well 1, a disinfection building (chlorine analyzer) was located adjacent to a sewerage treatment plant. A community effluent disposal field was located approximately 135 m east and upgradient to the Valleyview Wells. The sewerage treatment plant and disposal field are components of a private sewer system operated by the Valleyview Centre. WWAL was informed during the site visit that the Valleyview Centre has proposed an expansion in the near future. We understand that development may increase the parking area in the vicinity of the Valleyview Wells, reducing the grass-covered area surrounding the wells. The area surrounding the Valleyview Centre consisted of rural residential and agricultural land. Potential contaminant sources to the Valleyview Wells may include hydrocarbons or other substances as runoff from the parking lot. The paved area sloped away from the wells, and catch basins were located throughout the parking area, discharging to a ditch next to the Trans-Canada Highway.

The Pavenham Well was located within a residential subdivision, approximately 35 m south of the CBWD office, and directly west of the Pavenham Road Reservoir. The well was situated in a secure concrete pump house. The driveway adjacent to CBWD office building leading to the Pavenham Reservoir and Well site was an asphalt surface that sloped north.

The Kidd Well site was enclosed by a chain link fence with the pumphouse located within the fenced area. The surrounding area mainly consisted of agricultural land. The well was situated in a lockable shelter adjacent to the pumphouse. At the time of the site visit, a valve in the well house was opened to allow piped water sourced from the Valleyview Wells to discharge to maintain adequate chlorine concentrations in the distribution lines. The Kidd Well itself was not in operation while onsite.

5.6 Private Wells in the Source Protection Area

Old or improperly constructed/maintained wells are potential direct pathways for contaminants to get into an aquifer. It is not uncommon for old wells to have been forgotten or buried as properties change hands, and changes in land use or drainage in an area can result in surface runoff draining into an old well. The *GWPR* requires that unused wells (with no plans for future use) be closed by their owners within 10 years of being no longer used. In our experience, this requirement is not strongly enforced by the Ministry of Forests (MOF) unless there is a complaint, or a specific issue identified.

The Cowichan Bay area is serviced by a combination of the CBWD's water system and private wells. WWAL conducted a search of the BC Ministry of Environment GWELLS database (ENV, 2022c) to identify registered wells within the proposed source protection areas. Within the source protection area for the Valleyview Wells, 14 wells were reported, with well uses varying between irrigation, private domestic, and water supply system. Locations of registered wells surrounding the Valleyview Wells are shown in Figure 4.3 and Table 5.5 summarizes reported well use and construction of reported wells within the search area.

Table 5.5. Summary data for reported wells within the Valleyview Wells source protection areas

WTN	Finished Well Depth (m)	Depth to Water (m)	Well Yield (L/s)	Aquifer Number	Intended Well Use
65065	50.3	22.9	0.6	197	Private Domestic
77081	50.0	3.0	0.6	197	Private Domestic
21297	49.1	13.7	0.2	197	Unknown Well Use
68622	42.1	15.2	1.3	197	Private Domestic
123523	46.3	9.1	0.8	N/R	Private Domestic
30370	41.1	24.4	0.5	197	Unknown Well Use
64015	11.9	6.1	0.4	197	Private Domestic
85453	36.6	6.1	7.6	N/R	Water Supply System
68628	68.6	41.1	1.3	197	Private Domestic
77087	68.58	41.1	1.3	197	Private Domestic
63623	46.0	27.4	2.5	197	Irrigation
68623	39.3	22.6	3.8	197	Irrigation
8985	17.1	14.3	0.0	N/R	Unknown Well Use
8982	24.3	N/R	0.0	N/R	Unknown Well Use

Notes: N/R: Not Reported

WTN 63623, an existing unused well located approximately 200 m east of Valleyview Wells and upgradient to the existing disposal field (see section 5.7), has a well depth of 46 m. Based on the well's depth and location, it may be beneficial to utilize WTN 63623 as a monitoring well since it is located within (or just upgradient from) the Valleyview Centre's disposal field.

Within a 500 m radius of the Pavenham Well and Kidd Well (a search area greater than the source protection areas) seven wells and fourteen wells were reported, respectively. Based on our review, the seven wells in the vicinity of the Pavenham Well were drilled between 1937 and 1972, prior to the area being development and subdivided. Through conversation with the District's Administrator, we understand that the wells were likely abandoned in place and are unlikely to be located.

Well uses near the Kidd Well vary between irrigation, private domestic, and a water supply well correlated to the Cowichan Bay Camping and RV Park located approximately 400 northeast of the Kidd site. Locations of registered wells surrounding the Pavenham Well and Kidd Well are shown in Figures 4.4 and 4.5, respectively. Table 5.6 and Table 5.7 summarize reported well use and construction of reported wells within the search are for the Pavenham Well and Kidd Well, respectively.

Table 5.6. Summary data for reported wells within 500 m of the Pavenham Well

WTN	Finished Well Depth (m)	Depth to Water (m)	Well Yield (L/s)	Aquifer Number	Well Use
21169	57.9	32.3	1.6	197	Unknown
18929	74.1	54.0	3.8	197	Water Supply System (decommissioned)
15183	50.3	41.1	N/R	197	Observation Well
16962	82.0	55.8	0.3	197	Unknown Well Use
16680	18.3	N/R	N/R	197	Unknown Well Use
27422	82.3	65.2	6.3	197	Unknown Well Use
1830	40.5	N/R	0.4	197	Unknown Well Use

Notes: N/R: Not Reported

Table 5.7. Summary data for reported wells within 500 m of the Kidd Well

WTN	Finished Well Depth (m)	Depth to Water (m)	Well Yield (L/s)	Aquifer Number	Well Use
63966	41.8	0.2	6.3	188	Irrigation
62971	42	41.8	6.3	197	Irrigation
48582	41.6	0.6	1.9	188	Irrigation
44178	3.0	N/R	0.0	186	Private Domestic
44176	4.6	N/R	0.0	186	Private Domestic
56954	42.7	N/R	6.6	188	Observation Well
34325	48.8	N/R	25.0	188	Water Supply System
48997	23.3	1.8	0.6	197	Private Domestic
44174	4.3	N/R	0.0	186	N/R
29401	6.1	N/R	0.0	186	Unknown Well Use
64138	152.4	N/R	0.2	198	Unknown Well Use
64139	175.3	N/R	0.4	198	N/R
64140	128.5	N/R	0.4	198	N/R
518	51.1	3.0	0.0	199	N/R

Notes: N/R: Not Reported

5.7 Input from TAC Members

Members of the TAC met on November 29, 2022 to discuss potential risks to the CBWD wells and provide comments on the proposed source protection areas. The CBWD is currently only sourcing water from the Valleyview Wells, therefore, the meeting was primarily focused on the Valleyview source protection area. During the meeting, the manager of the Valleyview Centre, Mr. Adam Knight, explained that the facility has plans to expand. Mike Seymour, P.L.Eng. of MSR Solutions Inc. (MSR) is assisting Mr. Knight with engineering services for the development. Mr. Seymour informed the TAC that the Valleyview Centre wishes to maximize the developable area for expansion in the vicinity of the parking area. The CBWD voiced their desire for wellhead protection and wanted to ensure that the proposed expansion would not pose any detrimental impacts to the Valleyview Wells. It was discussed that land availability and wellhead protection would be priorities when considering setbacks from the wells, which will ultimately require Island Health's approval. With regard to wellhead protection, WWAL requested that the CBWD look into whether a surface seal has been installed on Valleyview Well 2.

During the TAC meeting, there was discussion of separating the treatment building located west of the Valleyview Wells. Due to hazards pertaining to corrosive gases, the TAC believed that it could be beneficial to separate the sewerage treatment, chlorine analyzer, and electrical pump and distribution system from one another.

In the meeting, it was acknowledged that there are two known existing unused wells located at the Valleyview Centre. The TAC discussed the available options for the unused wells, such as decommissioning or converting them into monitoring wells.

Due to increasing water demands, the CBWD informed the TAC that they are looking into drilling an additional well in the Valleyview area, as plans call for the Kidd Well to be eventually decommissioned.

5.8 Stormwater and Sewage Disposal

The Valleyview Wells are located within the vicinity of a private sewer system operated by the Valleyview Centre. The sewerage system includes: a community effluent disposal field located approximately 135 m east and upgradient of the Valleyview Wells, a sewerage treatment plant located approximately 15 m west of Valleyview Well 2 and 37 m northwest of Valleyview Well 1, a sewer gravity main (running north-south) situated approximately 15.5 m west of the Valleyview Wells, and sewer force main (running west-east to the disposal field) located approximately 32 m and 7 m northeast of Valleyview Well 1 and Valleyview Well 2, respectively. Based on its close proximity, if a leak or failure occurred, the Valleyview Centre's sewer system would pose a risk of contamination to the CBWD's Valleyview Wells. Stormwater infrastructure at the Valleyview site consists of catch basins located throughout the parking lot which discharge to a ditch located next to the Trans-Canada Highway. An oil-water separator is located approximately 1 m south of the sewer treatment plant.

The Pavenham Well is located within the CVRD's Cowichan Bay Sanitary Sewer System service area. The sewer system is comprised of pressurized and gravity collection systems that discharge into a pump

station located at Hecate Park. Sewerage is pumped to Duncan for treatment and disposal using Joint Utilities Board (JUB) lagoons (CVRD, 2022a). The CVRD indicates that critical infrastructure is monitored 24-hours a day for failures and, should a failure occur, CVRD staff are notified for immediate action. Stormwater infrastructure near the Pavenham Well is mainly comprised of roadside ditches. The Wilmot Road Drainage system is located approximately 200 m east of the Pavenham Well site.

The Kidd Well does not appear to be located with the CVRD's Cowichan Bay Sanitary System service area, based off the CVRD's interactive web map (CVRD, 2022c). Through conversation with the District's Administrator, we understand that a sewer force main runs along Cowichan Bay Road, east of the Kidd well site. The sanitary infrastructure is part of the Joint Utilities Board Sewerage Treatment Plant, however, its exact location is unknown.

5.9 Connection to and Risks Posed by Surface Water

Considering that the groundwater source for the Valleyview Wells is a confined aquifer, a direct hydraulic connection between the wells and nearby surface water is unlikely. The intake depths for Valleyview Wells 1 and 2 are located approximately 2 m and 1.5 m asl, respectively, which is approximately 50+ m below the top of water elevation of nearby surface waters such as Dougan Lake (~60 m asl) and Patrolas Creek (~51 m asl). Bathymetric data were available for Dougan Lake showing a maximum lake depth of 22 m (38 m asl), indicating that the water body boundary is approximately 36 m above the well intake depths (Province of British Columbia, 1985).

The Pavenham Well is completed in the same confined aquifer as the Valleyview Wells. No freshwater bodies are mapped near the Pavenham Well (ENV, 2022a), therefore, there is likely a low potential for the underlying aquifer nearby to be hydraulic connected to surface water.

As noted above, the Kidd well is also overlain by confining sediments, making a direct connection to nearby surface water unlikely. The 2022 analytical water quality results for the Kidd Well indicate the source water has elevated salinity, however, and is likely being impacted by seawater intrusion at depth.

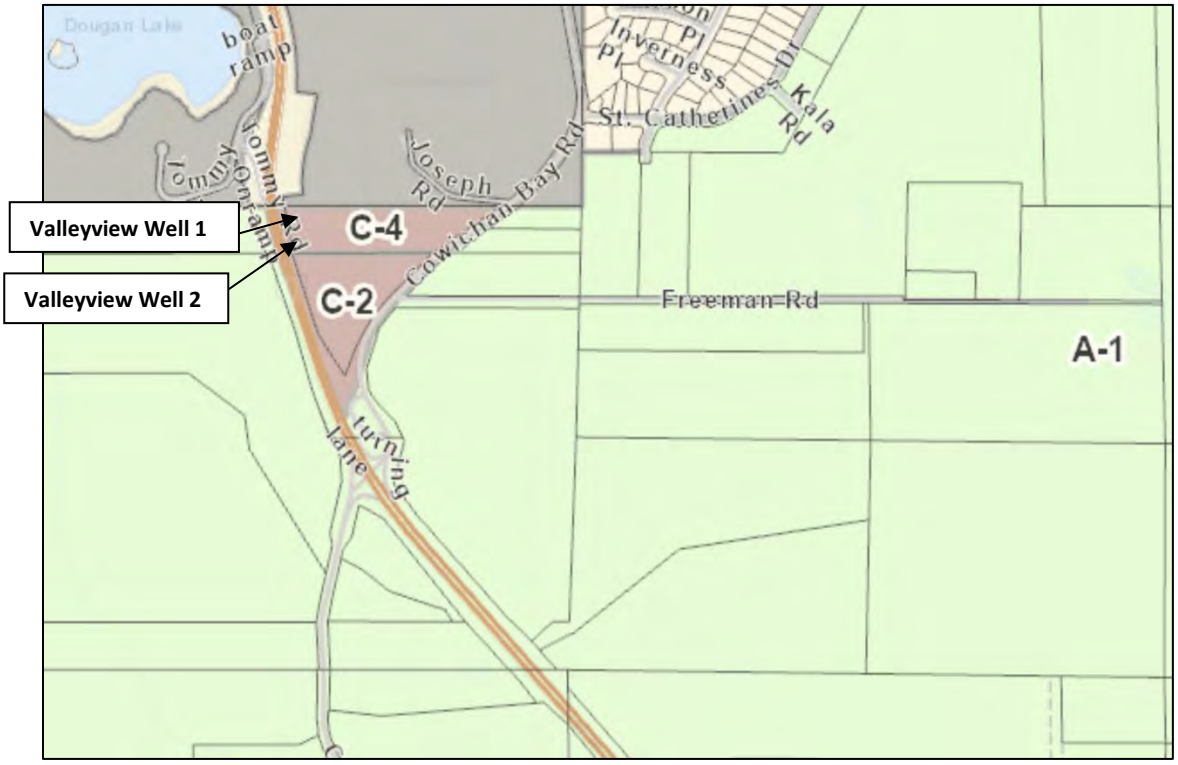
In summary, an impermeable confining layer overlies the productive aquifers at all four supply wells, indicating that there is a low likelihood for the wells to be hydraulically connected to surface water.

5.10 Zoning in the Source Protection Area

The Valleyview Wells are in an area zoned by the CVRD as Rural Tourist Commercial (C-4). Zoning in the well protection area consists of the Est-Patrolas IR No. 4 directly north, Rural Highway Commercial (C-2) immediately south and Agricultural Resource (A-1) to the southeast and southwest. Contamination sources related to Rural Tourist Commercial and Rural Highway Commercial include residential spills of fuels or chemicals, hydrocarbon release from vehicles, road salt associated with deicing and accidental release of hazardous retail substances (e.g., paints, bleach, cleaners). The primary contamination sources

associated with agricultural land use are fertilizers (nitrates), pesticides, bacteria, pharmaceuticals that have been fed to livestock, and the introduction of contaminants though private wells. Figure 5.2 displays the current zoning in the Valleyview Wells source protection areas.

Figure 5.2. Zoning in the Valleyview Wells Source Protection Area

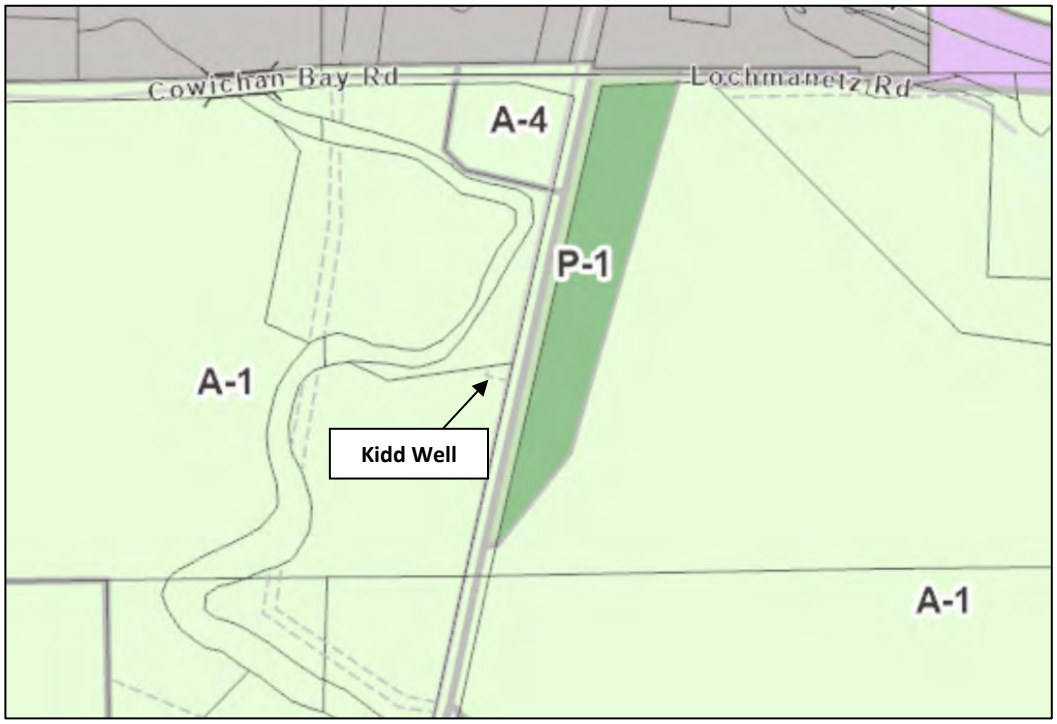


The Pavenham Well is located on a parcel of land zoned as Community Institutional (P-3). The lands surrounding the Pavenham Well, which encompass the source protection area, are primarily zoned as Village Residential (R-3) with sparse Village Cluster Residential (CR-2), Park Recreation (2) and Park Conservation (P-1). Contaminants associated with residential land use includes fuels or household chemicals (e.g., oil for home heating or vehicle maintenance), hazardous household substances (e.g., cleaners, pesticides, polishers, and paints), pharmaceuticals, and the introduction of contaminants through private wells. Figure 5.3 below illustrates the current zoning surrounding the Pavenham Well.

Figure 5.3. Zoning within the Pavenham Well Source Protection Area

The Kidd Well is situated on, and is mainly surrounded by, land zoned as Agricultural Resource (R-3). The Cowichan IR No. 1 is located north of the Kidd Well and a small portion of land east is zoned as Park Conservation (P-1). Contaminants associated with agricultural and recreational (park) land use includes fuels, fertilizers, pesticides, bacteria, nutrients, pharmaceuticals, and the introduction of contaminants though private wells. Figure 5.4, on the following page, displays the current zoning in the Kidd Well source protection area.

Figure 5.4. Zoning within the Kidd Well Source Protection Area



5.11 Climate Change Effects

Climate change is an ongoing process and its effects on the region should be monitored by the CBWD. In general, the expected changes in the Cowichan Valley region include warming throughout all seasons, longer dry spells in the summer months, wetter winters with more precipitation falling as rain at lower elevations, a decrease in snowpack and more intense extreme events (CVRD, 2017). Climate change could also increase the frequency of wildfires (see Section 5.11 below). Both ocean surge and river flooding events could increase in magnitude and frequency, with an increase in the need for flood protection infrastructure. There is also a predicted overall hydrologic transition from snowmelt-dominant watersheds to rainfall-dominant, increasing the need for water conservation and storage (PCIC, 2013).

Sea level is likely to rise by a significant amount by 2100. In 2011, municipalities were advised to plan for 1 m of sea level rise by 2100, and 2 m by 2200 (CVRD, 2022b). Sea level rise is caused by:

- Thermal expansion of water due to climate induced warming of oceanics;
- Melting of major stores of ice;
- Changes in ocean circulation; and,
- Land subsidence.

Sea level rise is expected to decrease the hydraulic gradient for Aquifer 188 in the vicinity of the Kidd Well, resulting in a landward migration of seawater/freshwater interface due to the reduced head differential, and increased salinity in the groundwater produced from the well.

5.12 Wildfire

As the CBWD wells are in a region that is mainly agricultural and rural land, wildfires can pose a risk to the water system. Due to anticipated longer, drier summers, the CVRD (2017) stated that an increased risk in wildfires is expected. Fire can be human-caused or naturally occurring (e.g., lightning strike). The potential for wildfires is influenced by many factors including activities in the watershed, biomass, weather and topography. Wildfires present a risk to the drinking water supply by potential contamination of fire retardant, ash, and sediment/particulate or by threatening the water supply infrastructure. Loss of trees and plants also increase run-off and sediment transport. Methods to reduce the likelihood of wildfires include public education and enforcement of fire bans as well as forest management to mitigate effects of wildfire on infrastructure. It is important that, in the event of a wildfire, the treatment process is managed to mitigate adverse effects to the potable water supply. Fire season and the threat of wildfires can also place additional demands on municipal water systems, as property owners use water to reduce the risk of fire affecting structures.

5.13 Summary of Groundwater Contamination Source Inventory

The results of the contamination source inventory are presented in Table 5.8 and the location of potential contamination sources discussed are shown in Figures 5.5, 5.6 and 5.7.

Table 5.8. Potential groundwater contamination source/hazard ID inventory

Hazard Reference No.	Contaminant Source type and Description	Location	Approx. Distance to Source	Possible Contaminants of Concern	Contaminant Transport Method	Associated Barriers
1	Transportation corridors and potential releases	Residential roads through source protection areas, Trans-Canada Highway	Valleyview Wells: 60 + m Pavenham Well: 50 + m Kidd Well: 10 + m	Hydrocarbon release from vehicle leaks and accidents, larger scale releases associated with tanker trucks, road salts.	Infiltration through unsaturated soil, or runoff then groundwater transport through shallow aquifer.	Attenuation and retardation of transport through unsaturated soils. Confining unit overlying aquifers.
2	Contaminants introduced into existing private used or unused wells, or well casings acting as preferential contamination pathways	Throughout the source protection areas	Various distances and directions around the CBWD wells	Fecal coliforms, viruses, nutrients (e.g. nitrate-nitrogen), Chloride (as an indicator).	Short-circuiting from surface to aquifer into or along well casing, then groundwater flow.	Surface seal present at primarily used Valleyview Well 1, concrete wellhouse present at Pavenham Well and Kidd Well. Confining unit overlying aquifers.
3	Nearby sanitary infrastructure	Private sewer system at Valleyview Centre Cowichan Bay Sewer System	Valleyview Wells: 7 m – 100+ m Pavenham Well: 30+ m Kidd Well: 10+ m	Fecal coliforms, viruses, nutrients (e.g., nitrate-nitrogen), chloride (as an indicator) .	Infiltration through unsaturated soil, runoff then groundwater transport through shallow aquifer.	Attenuation and retardation of transport through unsaturated soils. Confining unit overlying aquifers.
4	Agricultural land use	Throughout the Valleyview Wells and Kidd Well source protection areas	Valleyview Wells: 80+ m Kidd Well: 0 m	Fertilizers (nitrates), pesticides, fecal coliforms, pharmaceuticals that have been fed to livestock.	Infiltration through unsaturated soil, runoff then groundwater transport through shallow aquifer.	Attenuation and retardation of transport through unsaturated soils. Confining unit overlying aquifers.
5	Rural Tourist Commercial land use	Valleyview Centre	Valleyview Wells: 0 m	Hydrocarbon release from vehicle leaks, hazardous retail substances including paints, bleach and cleaners.	Infiltration through unsaturated soil, runoff then groundwater transport through shallow aquifer.	Attenuation and retardation of transport through unsaturated soils. Confining unit overlying aquifers. Surface seal at Valleyview Well 1.

Hazard Reference No.	Contaminant Source type and Description	Location	Approx. Distance to Source	Possible Contaminants of Concern	Contaminant Transport Method	Associated Barriers
6	Wildfires	Throughout the source protection area, only indirectly threatens wells	N/A	Sediment, nutrients, chemicals (e.g. fire retardants)	Directly or transported by run-off and surface flow	Public awareness, agency notifications, natural attenuation
7	Climate Change / Saltwater Intrusion	Throughout the Kidd Well source protection area	N/A	Not a contaminant but a hazard with respect to water supply	N/A	Source protection, water monitoring.

6. MODULE #7: CHARACTERIZE RISKS FROM SOURCE TO TAP

Module #7 of the S2TAG is a key step in the source-to-tap assessment process. The purpose of the module is to integrate all of the water system vulnerabilities into a comprehensive assessment of the major water supply elements and the system as a whole.

Module #7 focuses on quantifying the level of risk for each hazard by defining the likelihood that a hazard will occur and the severity of the outcome in light of the existing source water protection measures and treatment barriers. For example, an event with a low likelihood but a catastrophic outcome can be qualified as a high risk, while at the same time an event with a high likelihood but minor consequences can also be qualified as a high risk. The risk analysis generally focuses on the hazards and vulnerabilities developed in Modules #1 and #2. Where relevant, vulnerabilities have been added in Module #7 relating to water system supply, operation and management.

6.2 Objective and Methodology

Module #7 assigns a level of risk to the hazards and vulnerabilities of the water system. As prescribed in the S2TAG, each hazard is given a likelihood and a consequence ranking to allow for development of a level of risk.

Likelihood is defined as the probability that a hazardous event will occur. A risk may be unlikely in the short term and very likely in the long term, therefore it is useful to provide a timeline on which to assess the likelihood. For this analysis we will use a timeline of 10 years. Table 6.1 (from the S2TAG) presents the likelihood rankings from 'A' to 'E'.

Table 6.1. Levels of Likelihood description

Level	Descriptor	Description	Probability of Occurrence in Next 10 Years
A	Almost certain	Is expected to occur in most circumstances	> 90%
B	Likely	Will probably occur in most circumstances	71-90%
C	Possible	Will probably occur at some time	31-70%
D	Unlikely	Could occur at some time	10-30%
E	Rare	May only occur in exceptional circumstances	< 10%

Consequence is defined as the severity of the outcome of a hazardous event. The severity can be based on the size of the population affected, the impact to the population affected, or the impact to water

system equipment and operation. Table 6.2 (from the S2TAG) presents levels of consequence from 1 to 5.

Table 6.2. Relative levels of Consequence description

Level	Descriptor	Description
1	Insignificant	Insignificant impact, no illness, little disruption to normal operation, little or no increase in normal operating costs.
2	Minor	Minor impact for small population, mild illness moderately likely, some manageable operation disruption, small increase in operating costs
3	Moderate	Minor impact for large population, mild to moderate illness probable, significant moderation to normal operation but manageable, operating costs increase, increased monitoring
4	Major	Major impact for small population, severe illness probable, systems significantly compromised and abnormal operation if at all, high level monitoring required
5	Catastrophic	Major impact for large population, sever illness probable, complete failure of systems

The risk of a hazard is developed from the likelihood of its occurrence and the severity of the consequence. Table 6.3 (from the S2TAG) is the risk matrix used to determine risk based on likelihood and consequence rankings.

Table 6.3. Qualitative risk analysis matrix

Likelihood	Consequences				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A (almost certain)	Moderate	High	Very High	Very High	Very High
B (likely)	Moderate	High	High	Very High	Very High
C (possible)	Low	Moderate	High	Very High	Very High
D (unlikely)	Low	Low	Moderate	High	Very High
E (rare)	Low	Low	Moderate	High	High

6.3 Protection Barriers

A key to defining risks to the water system is understanding the existing barriers in place that protect the water system and water users from each hazard. Barriers are categorized as 'existing' (i.e., should be

maintained), 'review existing' (the barrier should be updated or revisited, see Module #8) or 'ongoing' (the barrier requires continued administrative involvement from the CBWD). The barriers present for the CBWD water system are as outlined in Table 6.4.

Table 6.4. Existing water system protection barriers

Treatment
▪ **Natural Attenuation:** (existing) the natural removal/dilution of contaminants prior to reaching the source extraction point. This generally occurs when deleterious constituents are stripped from runoff as it travels overland or through the ground. It may also include other factors such as settlement of heavy particulate in waterbodies or pathogens dying prior to reaching the extraction point. Natural attenuation is considered a barrier to all hazards presented in Table 5.8.
Monitoring/Management/Training
▪ **Water Quality Monitoring:** (ongoing) allows for reaction to changing conditions in raw water quality, adjustment to treatment processes and changing source waters if needed. ▪ **Water System Maintenance:** (ongoing) preventative maintenance and proactive asset management will reduce the likelihood of failure for water system components and reduce long term water system operation and renewal costs. ▪ **Operator Training:** (ongoing) operator certification and training is a regulatory requirement and will help prevent errors in water system operation.
Policy/Regulation (Source Protection)
• **Emergency Response Plan (ERP):** (existing/ongoing) an effective emergency response may mitigate or eliminate a hazard before the water system is put at risk. An emergency response plan is required to address all potential hazards. The CBWD has an ERP in place for the drinking water system. • **Law Enforcement:** (ongoing) protection against prohibited activities in the watershed that could include dumping, deforestation, or vandalism. • **Land Use Zoning and Permitting:** (ongoing) these are barriers to hazardous activities in the assessment area. The CBWD should be involved in future decisions that could impact the water source.
Public Awareness
• **Public Education:** education informs the public and stakeholders of responsible watershed use and good practices.

6.4 Risk Characterization of Groundwater Sources

Table 6.5 presents the Risk Characterization Summary for the potential drinking water hazards identified for the proposed groundwater source protection areas. The level of risk for each identified hazard ranges from low to moderate.

Table 6.5. Risk characterization summary for the CBWD Water System groundwater sources

Hazard Reference No.	Drinking Water Hazard	Likelihood Level (from Table 6.1)	Consequence Level (from Table 6.2)	Risk Level (from Table 6.3)	Comments
1	Transportation corridors and potential releases	C	1	Low	Low likelihood further mitigated by presence of overlying confining layer protecting aquifer.
2	Contaminants introduced into existing private used or unused wells, or well casings acting as preferential contamination pathways	C	2	Moderate	There are private wells mapped within the source protection areas. The majority of the area wells are likely not constructed with surface seals. Moderate likelihood further mitigated by presence of overlying confining layer protecting aquifer.
3	Nearby sanitary infrastructure	C	3	Moderate to High	There is a disposal field upgradient to the Valleyview Wells, and sewer mains are located in the source protection area of the Valleyview Wells and the Kidd Well. Moderate likelihood further mitigated by presence of overlying confining layer protecting aquifer.
4	Agricultural land use	C	1	Low	Agricultural lands located in the source protection areas of the Valleyview Wells and the Kidd Well. Low likelihood further mitigated by presence of overlying confining layer protecting aquifer.
5	Rural Tourist Commercial Land Use	C	3	Moderate	The Valleyview Wells are located in a grass covered area (not fenced) within the Valleyview shopping Centre. Moderate likelihood further mitigated by presence of overlying confining layer protecting aquifer, and

Hazard Reference No.	Drinking Water Hazard	Likelihood Level (from Table 6.1)	Consequence Level (from Table 6.2)	Risk Level (from Table 6.3)	Comments
					surface seal at Valleyview Well 1.
6	Wildfires	E	2	Low	It is possible that a wildfire could occur in the source protection areas. The risk to the groundwater wells, however, is considered low.
7	Climate Change / Saltwater Intrusion	B	2	High	Sea level rise will decrease the hydraulic gradient for Aquifer 188 and could result in the landward migration of the seawater/freshwater interface (inducing saltwater intrusion). The Kidd well already appears to be impacted by sea water intrusion. Climate change is expected to lead to increased demand for water in the peak season (quantity effect), quality can be affected as well by related events (e.g., increased floods/high intensity storms, seal level rise and wildfire).

7. MODULE #8 RECOMMENDED ACTIONS TO PROMOTE SOURCE WATER PROTECTION

Table 7.1 below provides a comprehensive listing and summary of recommendations for the water system. This table suggests timelines and is also organized with priorities and coordination tasks highlighted.

Recommended actions and strategies moving forward to promote protection of the groundwater source include:

1. Continue the current sampling program for the water system consisting of weekly, bi-weekly and monthly bacteriological water quality monitoring and sampling for comprehensive water quality every two years as per IH conditions on the operating permit. Develop a response procedure should unexpected results be found (e.g., an increase in a drinking water parameter previously not found or previously found below guidelines).

2. Regrade the area around the Valleyview Well heads and consider installing perimeter fencing or protective infrastructure.

3. Add signage around the well heads, clearly informing the public that there are drinking water wells present.

4. Consider adding a surface seal around the upper portion of the production casing for Valleyview Well 2 (if one is confirmed to be absent). The addition of a surface seal would be required under the *GWPR* if future well alterations are made and one could be added in conjunction with future well alterations.

5. If new connections are added to the CBWD water system or the service area is expanded, information should be collected on the property's previous water supply, if any. If a well was previously utilized and will no longer be so, consider proper well abandonment as a condition to connection to the CBWD water system.
    a. If wells are found to be present, the risk they pose should be assessed. If possible, the old unused wells should be properly closed. The method of well closure will depend on the well completion and its condition. The lowest cost method for well closure in the majority of cases would be to remove any existing pump equipment, fill the well casing with bentonite chips or a grout mixture, cutoff the casing below ground and install a bentonite plug at the surface. This method of well closure would be least intrusive to residents and require only light duty equipment. Only in cases where an assessment indicates that the outside of the casing is acting as preferential pathway for drainage would more complicated methods for closure be required (e.g., complete removal of casing).
    b. There will be costs associated with the closure and abandonment of old wells, and a plan for covering costs should be developed. Investigate the possibility of grant funding to cover some of or all of the costs. Model Well Regulation Bylaws were developed by the Ministry of Community, Sport and Cultural Development (British Columbia Ministry of Community, Sport and Cultural Development, 2012) to provide information and documentation to local governments addressing this very issue.

6. Investigate the potential to utilize WTN 63623, an existing unused well located east of the Valleyview wells, as a monitoring well. Other wells located at the Valleyview Centre should be decommissioned unless their location and depth appears optimal for monitoring purposes.

7. Continue to track water extraction volumes from the Valleyview Wells. Water usage data would be necessary to detect leakage in the distribution system and support any water conservation efforts undertaken. Should the Pavenham Well be operated more frequently in the future, water usage should be recorded.

8. Collect continuous water level data from the operational supply wells through the installation of datalogging transducers or equipment connected to the SCADA system (if present).

9. Given that the water quality for the Kidd Well already appears to be impacted by sea water intrusion, the CBWD may want to consider drilling a new supply well in an area where there is less sea water intrusion risk to replace it. Should the Kidd Well become operational again, consider changing the manner in which it is operated (e.g., lower rates and/or limiting drawdown) and implement continuous EC measurement, which enables detection of any potential trends of escalating TDS and encroaching seawater.

10. If additional and/or backup supply sources are desired, assess potential lands where an additional groundwater production well can be drilled. The Valleyview area is likely the most suitable location based on the yields and water quality of existing wells in the area.

11. Develop an educational handout that can be mailed out to residents, informing them of the nature of their water supplies and steps they can take to help protect groundwater quality, including proper operation and maintenance of private septic systems.

12. Review and update the CBWD's Emergency Response Plan to include sewerage leaks and/or failures.

13. Do not store chemicals, petroleum products, fertilizers, pesticides, herbicides, paints, salt, or any other deleterious substance that could contamination the water supply within 15 m of the well heads.

Table 7.1. Overall recommendations for the CBWD Water System

No.	Recommendation	Description	Risks Addressed	Barriers Enhanced	Priority/ Timeline
Treatment / Supply					
1	Treatment	• Water from the Valleyview Wells is treated with chlorine at the disinfection building (chlorine analyzer). • Pavenham Well water is pumped through a manganese greensand filter before distribution, and prior to filtration, potassium permanganate is utilized for oxidation and sodium hypochlorite for disinfection.	2 & 4	Treatment	Ongoing
Monitoring/Management					
2	Water Quality Monitoring	Water quality monitoring allows the water system to react to changes in raw and treated water quality. **Actions:** • Continue water quality monitoring as per the existing Operating Permit. • Monitor the groundwater source every two years for chemical and physical drinking water parameters. • Adjust treatment process as required by raw water quality changes.	All	Treatment	Medium / Ongoing (periodically review existing)
3	Operator Training	Certified operators are a regulatory requirement for water system operation. **Actions:** • Maintain operator training as required by the Operating Permit.		Operator Training	Low / Maintain training
4	Preventative Maintenance and Asset Management	Preventative maintenance is the performance of regular and scheduled maintenance on the water system to prevent failure of infrastructure and includes replacing infrastructure at the end of its life. Asset management is a broad term for tracking, operating, maintaining, upgrading, renewing and disposing of assets effectively. AWWA Manual M5 (American Water Works Association (AWWA), 2017) is a useful resource. **Actions:** • Provide regularly scheduled maintenance for infrastructure. • Renew infrastructure at the end of life. • Perform inspection of equipment and infrastructure to effectively deploy resources. • Periodically review water rates. • Review system capacities as population and water demands increase (treatment capacity, piping capacity, storage capacity, etc.).		Water System Maintenance	Low / Maintain existing

No.	Recommendation	Description	Risks Addressed	Barriers Enhanced	Priority/ Timeline
		• Effective management of other utilities will help safeguard the water system. • Determine the specific capacity (water level drawdown/pumping rate) on an annual basis and review with a qualified professional to predict the need for well maintenance. Well performance has not been assessed since 2002.			
Policy/Regulation					
5	Coordinate with Other Entities in the Assessment Area	The CBWD is not the only governmental body with land use in the proposed protection area. **Action:** • Coordinate with RCMP and Ministry of Transportation and Infrastructure (MOTI) regarding transportation corridors. The CBWD should request notification of any risks or events. • Coordinate with the CVRD on climate mitigation projects. • Coordinate with the MFLNRORD to: 1) acquire Material Safety Data Sheets for fire retardant and any other chemicals used when combating wildfires; and 2) request notification when hazards or events are identified in the protection area.	1, 2, 5, 6 & 7	N/A	High / < 1 year
6	Emergency Response Plan	The Emergency Response Plan is a regulatory requirement. **Actions:** • Update the emergency Response Plan as needed to include protection of water system during an emergency. • Coordinate with MOTI and MFLNRORD. The CBWD should be notified of any hazardous events or spills.	All	Emergency Response Plan	High / < 2 years
7	Law/Bylaw Enforcement	Law/bylaw enforcement can help prevent hazardous activities in the protection area including illegal dumping, or other prohibited activities. **Actions:** • Coordinate with RCMP and bylaw enforcement: 1) ensure laws/bylaws are enforced; 2) agencies to notify the CBWD of hazardous events so appropriate measures can be taken.	2 & 5	Law Enforcement	Low / Ongoing
8	Governmental Involvement	The CBWD should be involved in policy, bylaw and permit development to safeguard the water system and water source. **Actions:** • Prevent or limit industrial/commercial operations within the assessment area.		Land Use; Permitting	Low / Ongoing

No.	Recommendation	Description	Risks Addressed	Barriers Enhanced	Priority/ Timeline
9	Reporting to Vancouver Island Health Authority	Vancouver Island Health Authority required reporting. **Actions:** • Provide reports to the Vancouver Island Health Authority as required by the Operating Permit.	All	N/A	Low / Ongoing
Public Awareness					
10	Public Education	Public education will promote responsible actions in the protection area. **Actions:** • Provide public education on the CBWD's website regarding water supply protection topics such as household and yard chemicals, proper waste disposal, action in the event of a spill, etc. • Provide open houses to inform the public and stakeholders. • This is an opportunity to add public education information regarding efficient water use in the home and the yard.	2, 4 & 5	Public Education	Medium / < 2 years
11	Signage	It is common practice to install warning signs in protection areas as well as general awareness-raising signs in a variety of environmental protection zones. This serves to notify public of the well location to prevent accidental damage and promote responsible activity in the area. **Actions:** • Install "entering groundwater protection zone" signage on main roads leading through protection areas	2, 4 & 5	Public Education	Medium / < 2 years

8. REFERENCES

Associated Engineering (AE). (2022). Cowichan Bay Waterworks District 2021 Water System Master Plan Update.

Blythe, H.E., Rutter, N.W., Sankereli, L.M. (1993). Surficial Geology of the Shawnigan Lake Area (92B/12). 1:50,000. British Columbia Geological Field Survey. Open File 1993-26.

British Columbia Ministry of Community, Sport and Cultural Development. (2012). Model Well Regulation Bylaw.

British Columbia Ministry of Environment. (2006). Well Protection Toolkit.

British Columbia Ministry of Healthy Living and Sport. (2010). Comprehensive Drinking Water Source-to-Tap Assessment Guideline (Version 1.0).

Cowichan Valley Regional District (CVRD). (2022a). Cowichan Bay Sanitary Sewer System. https://www.cvrd.ca/2682/Cowichan-Bay-Sanitary-Sewer-System

Cowichan Valley Regional District (CVRD). (2022b). Sea Level Rise. https://www.cvrd.ca/2953/Sea-Level-Rise

Cowichan Valley Regional District (CVRD). (2022c). *The CVRD Web Map.* https://www.cvrd.ca/2025/Maps-GIS

Cowichan Valley Regional District (CVRD). (2017). Climate Projections for the Cowichan Vallley Regional District 46 pgs.

Environment Canada. (2022). Canadian Climate Normals. https://climate.weather.gc.ca/climate_normals/station_select_1981_2010_e.html?searchType=stnName&txtStationName=squamish&searchMethod=contains

Fetter, C.W. (2001). Applied Hydrogeology–4th ed.

Health Canada. (2022). Guidelines for Canadian Drinking Water Quality. https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html

Island Health. (2022). Cowichan Bay Waterworks District – Facility Sampling History. https://inspections.myhealthdepartment.com/island-health/water-sample-history/?permitID=238A2529-2885-4EE5-B84C-F1A0470ADD7B

Klassen, J., Allen, D.M., Kirste, D. (2014). Chemical Indicators of Saltwater Intrusion for the Gulf Islands, British Columbia. Simon Fraser University. Report to BC Ministry of Forests, Lands and Natural Resource Operations and BC Ministry of Environment.

Lowen Hydrogeology Consulting Ltd. (2008). Certification of Groundwater Quantity and Quality for Production Well No.2 Valleyview Centre, Cobble Hill, BC.

Massey, N.W.D. (1994). Vancouver Island (NTS 92B, C, E, F, G, L; 102I) BCGS Open File 1994-6.

Ministry of Environment and Climate Change Strategy (ENV). (2022a). Water Resources Atlas (WRA)

Ministry of Environment and Climate Change Strategy (ENV). (2022b). Aquifer 197 Factsheet. https://s3.ca-central-1.amazonaws.com/aquifer-docs/00100/AQ_00197_Aquifer_Factsheet.pdf

Ministry of Environment and Climate Change Strategy (ENV). (2022c). Provincial GWELLS database.

Ministry of Environment and Change Strategy (ENV). (2020a). Aquifer 186 Mapping Report. https://s3.ca-central- 1.amazonaws.com/aquifer- docs/00100/AQ_00186_AQ_00186_Aquifer_Mapping_Report_2020.pdf

Ministry of Environment and Change Strategy (ENV). (2020b). Aquifer 188 Mapping Report. https://s3.ca-central- 1.amazonaws.com/aquifer- docs/00100/AQ_00188_AQ_00188_Aquifer_Mapping_Report_2020.pdf

Ministry of Environment and Change Strategy (ENV). (2019a). Aquifer 197 Mapping Report. https://s3.ca-central-1.amazonaws.com/aquifer-docs/00100/AQ_00197_197_Aquifer_Mapping_Report_2019.pdf

Ministry of Environment and Change Strategy (ENV). (2019b). Aquifer 198 Mapping Report. https://s3.ca-central-1.amazonaws.com/aquifer-docs/00100/AQ_00198_198_Aquifer_Mapping_Report_2019.pdf

Pacific Climate Impacts Consortium (PCIC). (2013). Climate Summary for West Coast Region, https://www.pacificclimate.org/sites/default/files/publications/Climate_Summary-West_Coast.pdf

Province of British Columbia. (2016). Groundwater Protection Regulation (GWPR). Victoria, B.C., Canada.

Province of British Columbia. (2022). iMapBC. https://www2.gov.bc.ca/gov/content/data/geographic-data-services/web-based-mapping/imapbc

Province of British Columbia. (1985). Dougan Lake. Fisheries Branch Inventory Operations.

Thurber Engineering Ltd. (Thurber) (2013). Cowichan Bay Waterworks District Well 38473 Hydrogeological Assessment.

Western Water Associates Ltd. (WWAL). (2021). GIS Modelling of Sea Water Intrusion Risk along British Columbia's Coast. Water Science Series WSS2021-06. Province of British Columbia, Victoria, B.C.

Western Water Associates Ltd. (WWAL). (2018). Fisher Road Groundwater Investigation Data Review Report.

WESTERN WATER ASSOCIATES LTD.

STANDARD REPORT LIMITATIONS

1. This Document has been prepared for the particular purpose outlined in the work scope that has been mutually agreed to with the Client.
2. The scope and the period of service provided by Western Water Associates Ltd are subject to restrictions and limitations outlined in subsequent numbered limitations.
3. A complete assessment of all possible conditions or circumstances that may exist at the Site or within the Study Area referenced, has not been undertaken. Therefore, if a service is not expressly indicated, it has not been provided and if a matter is not addressed, no determination has been made by Western Water Associates Ltd. in regards to it.
4. Conditions may exist which were undetectable given the limited nature of the enquiry that Western Water Associates Ltd. was retained to undertake with respect to the assignment. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the Site, or Study Area, which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.
5. In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Western Water Associates Ltd's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Western Water Associates Ltd to form no more than an opinion of the actual conditions of the Site, or Study Area, at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the Site, or Study Area, nor the surroundings, or any laws or regulations.
6. Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either expressed or implied, that the actual conditions will conform exactly to the assessments contained in this Document.
7. Where data supplied by the Client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated.
8. No responsibility is accepted by Western Water Associates Ltd for incomplete or inaccurate data supplied by others.
9. The Client acknowledges that Western Water Associates Ltd may have retained sub-consultants affiliated to provide Services. Western Water Associates Ltd will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Western Water Associates Ltd.
10. This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Western Water Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

Groundwater Supply Development and Management

Source Water Assessment and Protection

Well Monitoring & Maintenance

Environmental & Water Quality Monitoring

Storm & Wastewater Disposal to Ground

Groundwater Modeling

Aquifer Test Design and Analysis

Geothermal / Geoexchange Systems

Policy and Guideline Development

Applied Research

Rural Subdivision Services

Environmental Assessment & Permitting

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Figures

Cowichan Bay Waterworks District
Source Water Protection Plan
WWAL Ref: 22-092-01VC

CBWD Source Water Protection Plan	**Figure 2.1:** General Location of Project Site		
western water ASSOCIATES LTD Consultants in Hydrogeology and Water Resources Management	Drawn by: NN	Date: August 2022	WWAL Project : 22-092-01VR
	Reviewed by: TJS	Image Source: BC Water Resources Atlas	Client: Cowichan Bay Waterworks District

CBWD Source Water Protection Plan	**Figure 2.2 - Site Overview**		
western water ASSOCIATES LTD Consultants in Hydrogeology and Water Resources Management	Drawn by: NN	Date: August 2022	WWAL Project : 22-092-01VR
	Reviewed by: TJS	Image Source: BC Water Resources Atlas	Client: Cowichan Bay Waterworks District

Overview Map

Inset Map

Cowichan Bay

Dougan Lake

Est Patrolas IR No. 4

Valleyview Well 2

Valleyview Well 1

Proposed Source Protection Area

Tommy Rd

Joseph Rd

Cowichan Bay Rd

Ellison Pl

Judge Dr

St. Catherines Dr

Kaja Rd

Freeman Rd

Cobble Hill Rd

Trans-Canada Hwy

rest area

0 2 km

0 250 500 m

Legend

- Provincally Registered Wells

Area Aquifers

- 197
- 198

CBWD Source Water Protection Plan

western water ASSOCIATES LTD

TITLE **Figure 4.3:** Valleyview Wells Source Protection Area

DRAWN	DATE	CLIENT
Morgan Jackson, GIT	November 25, 2022	Cowichan Bay Waterworks District
REVIEWED	**PROJECT NO.**	**REVISION NO.**
Tim Sivak, P. Geo.	22-092-01VC	B

Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number

Overview Map

Inset Map

Cowichan Bay

0 2 km

Proposed Source Protection Area

Pavenham Well

Pritchard Rd

Fenwick Rd

Cowichan Bay Rd

Botwood Lane

Vee Rd

Mallard Way

Caspian Pl

Davenport Rd

Pavenham Rd

Kennedy Lane

Wilmot Rd

Austin Pl

Glen Rd

McGill Rd

Alder Glen Rd

George Rd

Maple Glen Pl

Willow Glen Pl

Simon Pl

Rondeault Rd

Raptor Pl

Falcon Cres

0 250 500 m

Legend

- Provincally Registered Wells

Area Aquifers

- 197
- 198

CBWD Source Water Protection Plan	TITLE **Figure 4.4:** Pavenham Well Source Protection Area		
western water ASSOCIATES LTD	DRAWN Morgan Jackson, GIT	DATE October 4, 2022	CLIENT Cowichan Bay Waterworks District
	REVIEWED Tim Sivak, P. Geo.	PROJECT NO. 22-092-01VC	REVISION NO. A

Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number

Overview Map

Inset Map

Cowichan Bay

Kidd Well

Proposed Source Protection Area

Cowichan Bay Rd

Lochmanetz Rd

Westcan Terminal Rd

T'zouhalem Rd

Bench Rd

176 198 188 197 186 199

0 2 km

0 250 500 m

Legend

- Provincally Registered Wells

Area Aquifers

- 186
- 188
- 197
- 198

CBWD Source Water Protection Plan

western water ASSOCIATES LTD

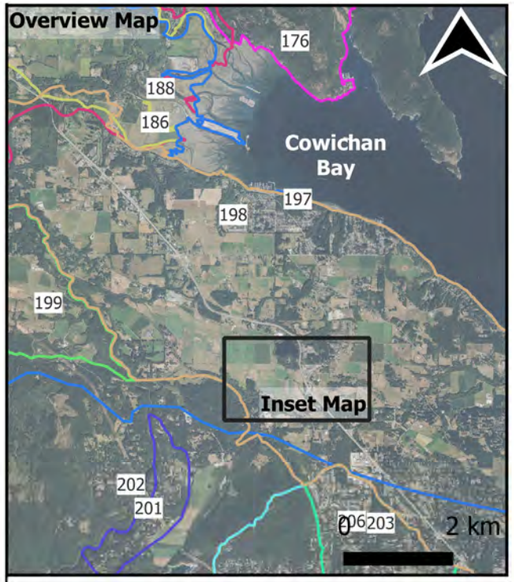
TITLE **Figure 4.5:** Kidd Well Source Protection Area

DRAWN	DATE	CLIENT
Morgan Jackson, GIT	October 4, 2022	Cowichan Bay Waterworks District
REVIEWED	PROJECT NO.	REVISION NO.
Tim Sivak, P. Geo.	22-092-01VC	A

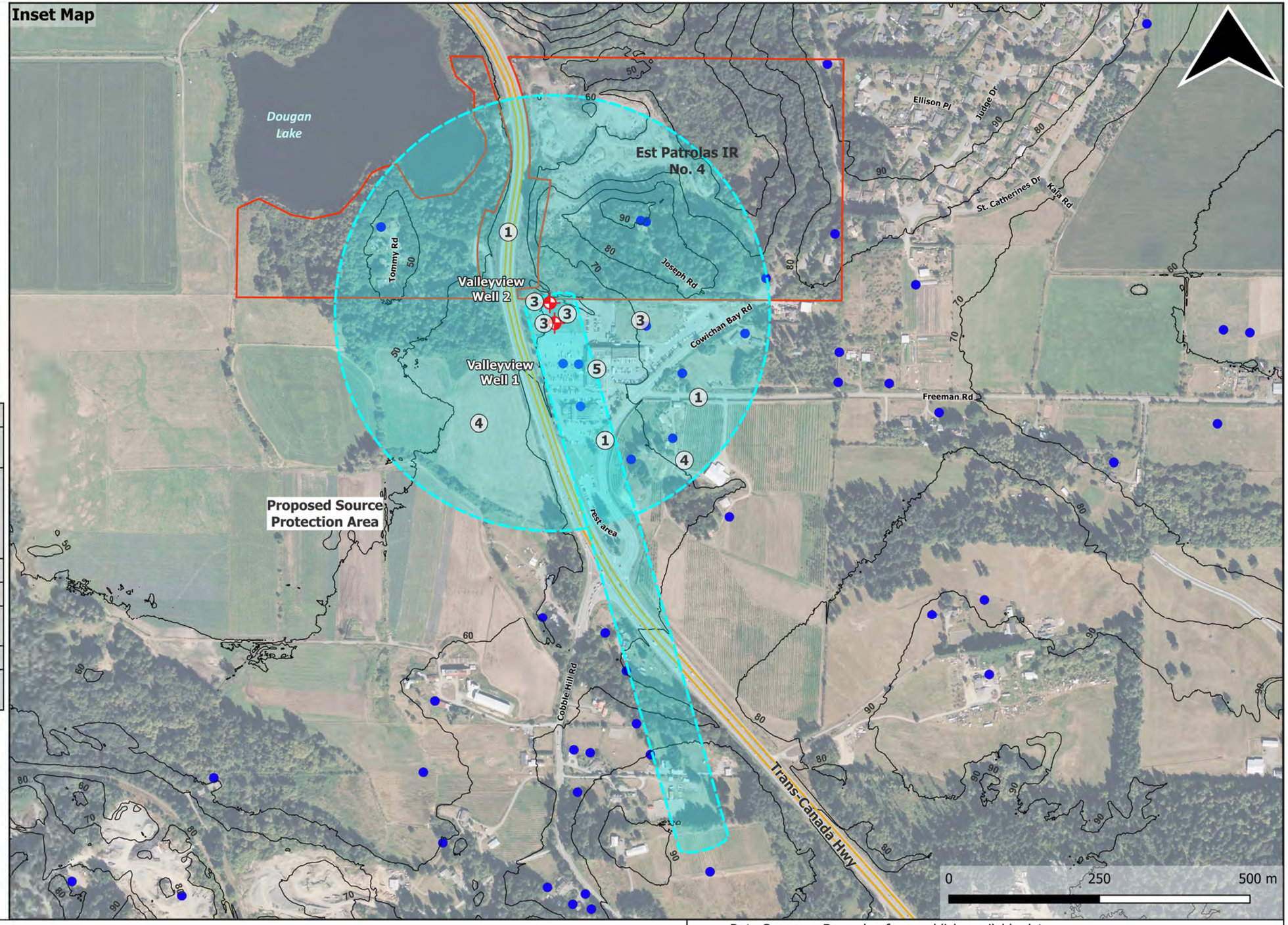
Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number

CBWD Source Water Protection Plan	**Figure 5.1:** Registered Contaminated Sites		
western water ASSOCIATES LTD Consultants in Hydrogeology and Water Resources Management	Drawn by: NN	Date: August 2022	WWAL Project : 22-092-01VR
	Reviewed by: TJS	Image Source: iMapBC	Client: Cowichan Bay Waterworks District



Hazard Number	Description
1	Transportation corridors and potential releases
2	contaminatnts introduced into existing private used or unused wells, or well casings acting as preferential contamination pathways
3	Nearby Sanitary infrastructure
4	Agricultural land use
5	rural tourist commercial landuse
6	Wildfires
7	Climate change / Saltwater intrusion



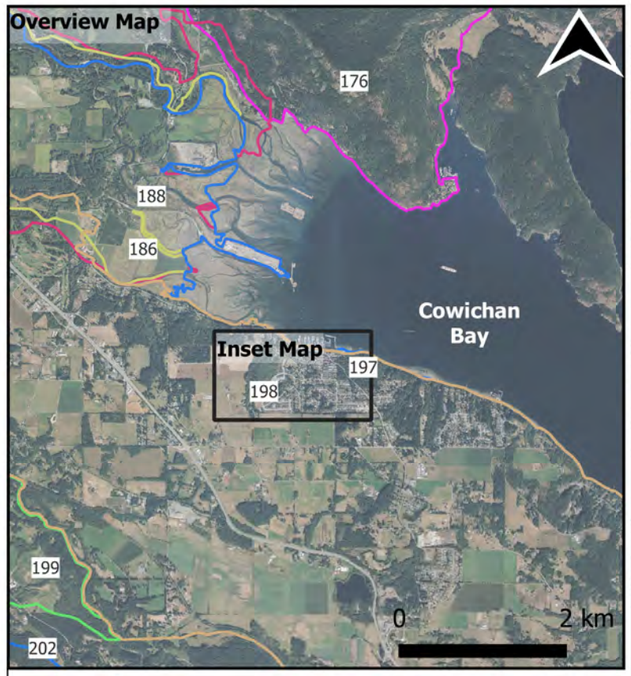
- Provincally Registered Wells

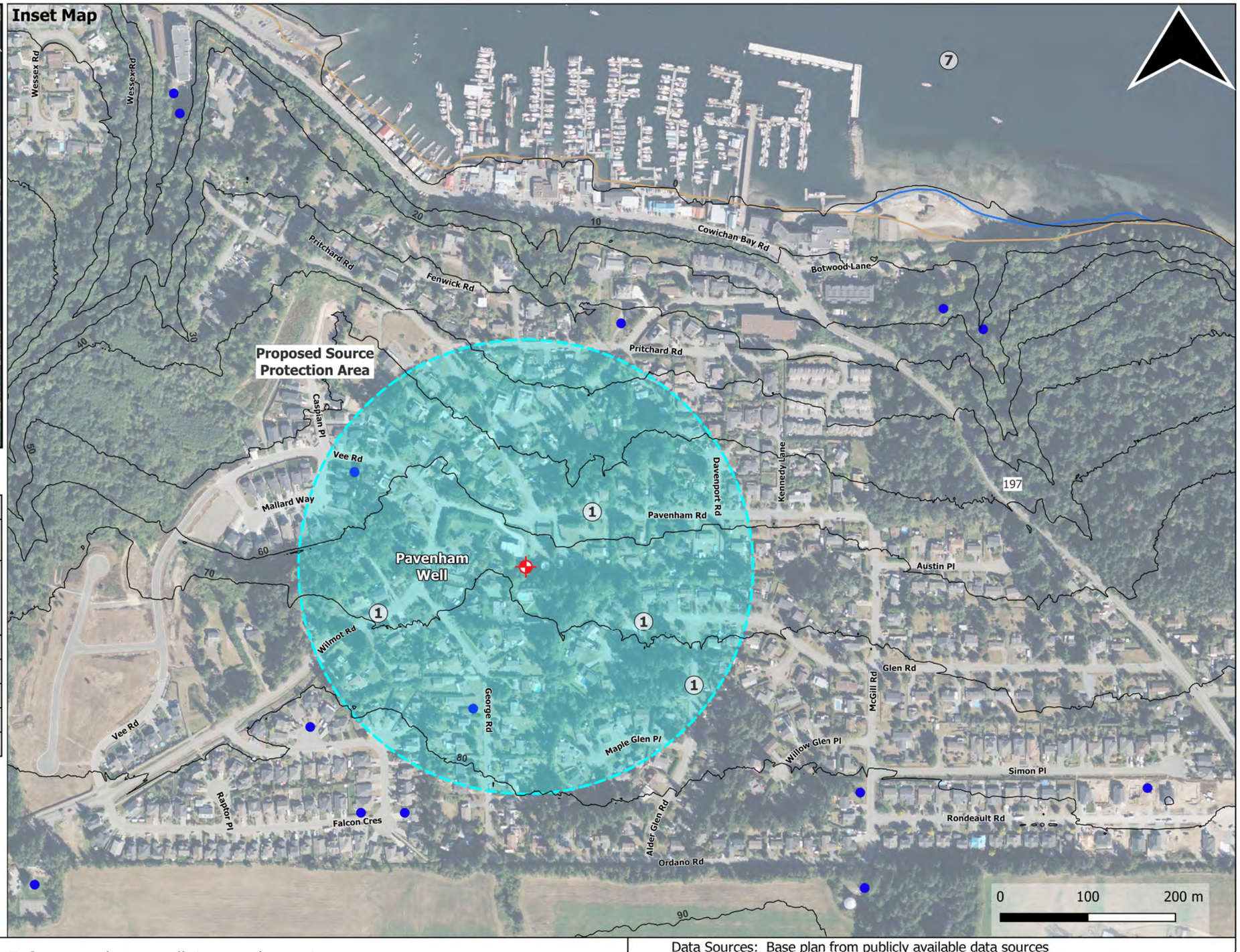
Area Aquifers
- 197
- 198

CBWD Source Water Protection Plan	TITLE **Figure 5.5:** Valleyview Wells Contaminant Source Inventory		
western water ASSOCIATES LTD	DRAWN Morgan Jackson, GIT	DATE December 7, 2022	CLIENT Cowichan Bay Waterworks District
	REVIEWED Tim Sivak, P. Geo.	PROJECT NO. 22-092-01VC	REVISION NO. B

Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number





Contamiant Numbers	Description
1	Transportation corridors and potential releases
2	Contaminants introduced into existing private used or unused wells, or well casings acting as preferential contamination pathways
3	Nearby sanitary infrastructure
4	Agricultural land use
5	Rural tourist commercial land use
6	Wildfires
7	Climate change / Saltwater Intrusion

- Provincally Registered Wells

Area Aquifers
- 197
- 198

CBWD Source Water Protection Plan

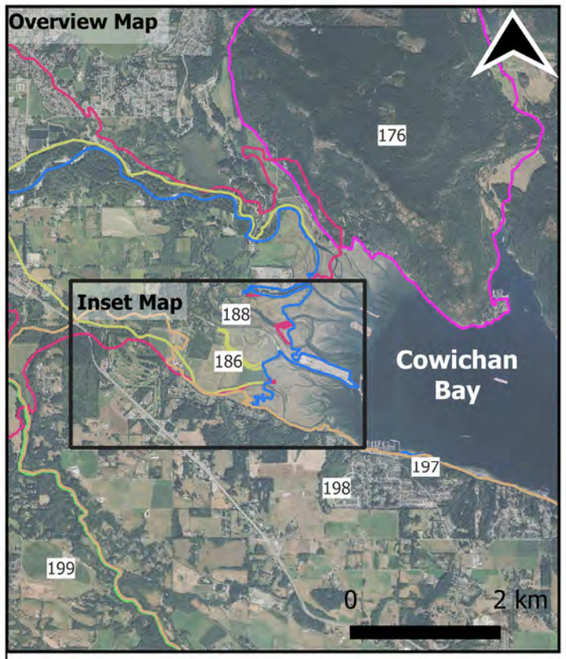
western water ASSOCIATES LTD

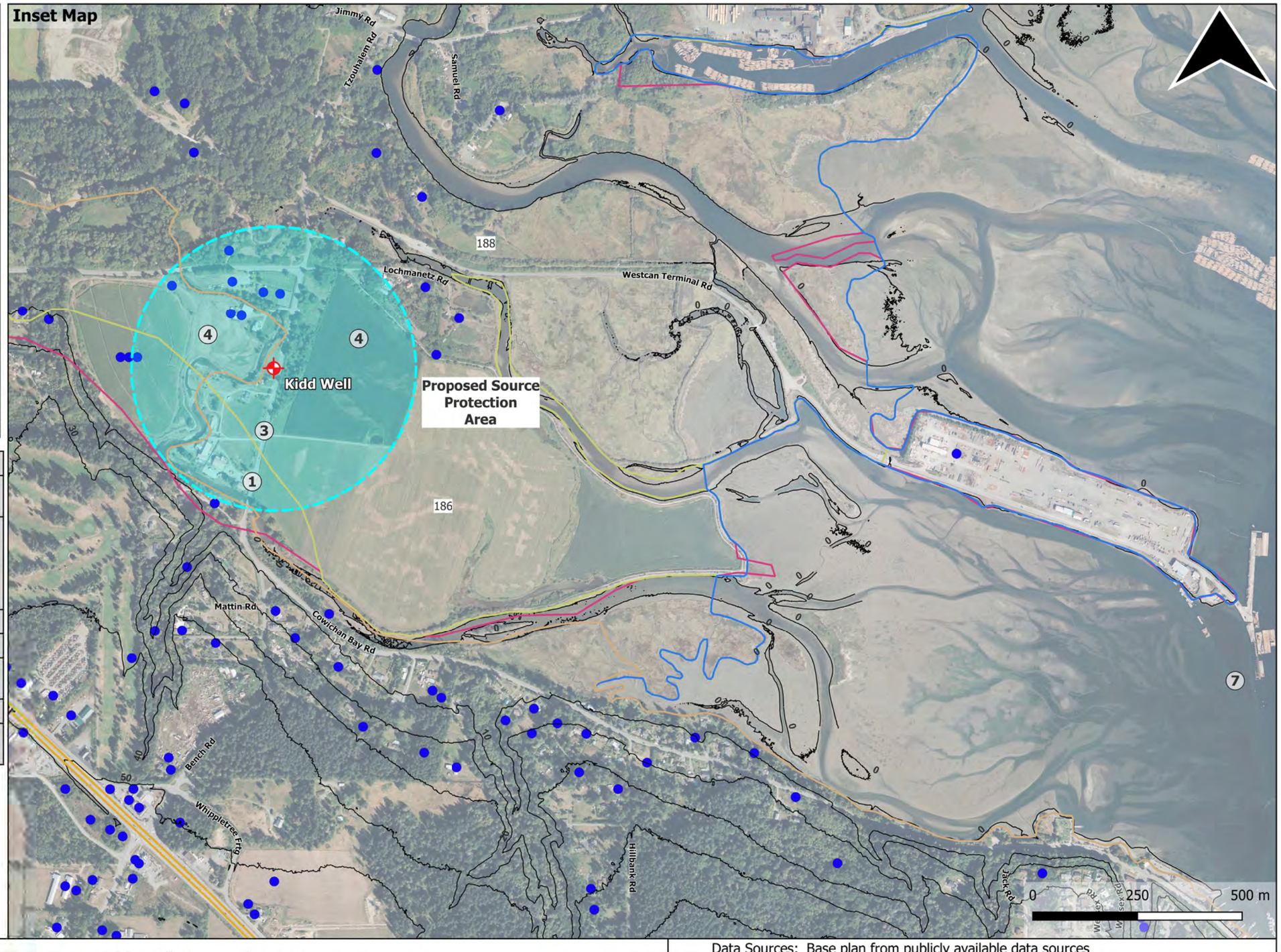
TITLE **Figure 5.6:** Pavenham Well Contaminant Source Inventory

DRAWN	DATE	CLIENT
Morgan Jackson, GIT	October 6, 2022	Cowichan Bay Waterworks District
REVIEWED	PROJECT NO.	REVISION NO.
Tim Sivak, P. Geo.	22-092-01VC	A

Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number





Contaminant Number	Description
1	Transportation corridors and potential releases
2	Contaminants introduced into existing private used or unused wells, or well casings acting as preferential contamination pathways
3	Nearby sanitary infrastructure
4	Agricultural land use
5	Rural tourist commercial land use
6	Wildfires
7	Climate change / Saltwater Intrusion

- Provincially Registered Wells

Area Aquifers
- 186
- 188
- 197
- 198

CBWD Source Water Protection Plan

western water ASSOCIATES LTD

TITLE **Figure 5.7:** Kidd Well Contaminant Source Inventory

DRAWN	DATE	CLIENT
Morgan Jackson, GIT	December 7, 2022	Cowichan Bay Waterworks District
REVIEWED	PROJECT NO.	REVISION NO.
Tim Sivak, P. Geo.	22-092-01VC	B

Data Sources: Base plan from publicly available data sources

Contour interval: 10 m
Map Projection: NAD83 UTM Zone 10N
Other notes: Aquifers identified by aquifer number

Appendix A

Well Logs/Well Completion Reports

Cowichan Bay Waterworks District
Source Water Protection Pan
WWAL Ref: 22-092-01VC

Well Log - Valleyview Well 1

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 108356
Well Identification Plate Number: 38473
Owner Name: Cowichan Bay Water Works District
Intended Water Use: Water Supply System
Artesian Condition: No

Well Status: New
Well Class: Water Supply
Well Subclass: Not Applicable
Aquifer Number: 197

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

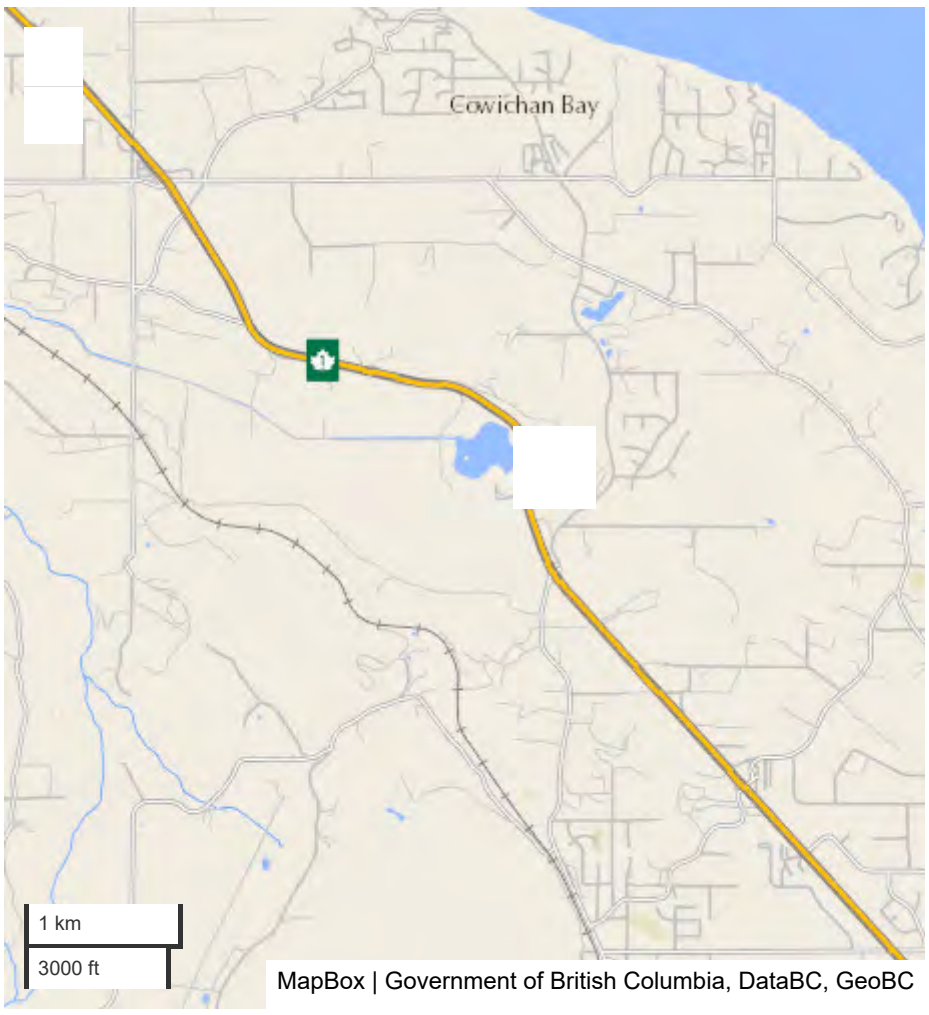
Location Information

Street Address: 1400 Cowichan Bay Road
Town/City: Cobble Hill

Legal Description:

Lot	1
Plan	8038
District Lot	
Block	
Section	18
Township	
Range	5
Land District	16
Property Identification Description (PID)	003778304

Description of Well Location: West Lower Parking lot. Valley View plaza.



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 48.711489 **Longitude:** -123.608899
UTM Easting: 455207 **UTM Northing:** 5395563
Zone: 10 **Coordinate Acquisition Code:** (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	2013-07-02	2013-07-31	Drillwell Enterprises	January 24th 2014 at 7:43 AM

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2013-07-02	2013-07-31				

Well Completion Data

Total Depth Drilled: 201 ft bgl
Finished Well Depth: 198 ft bgl
Final Casing Stick Up: 24 inches
Depth to Bedrock:
Ground elevation: 190 feet

Estimated Well Yield: 600 USgpm
Well Cap: welded
Well Disinfected Status: Disinfected
Drilling Method: Dual Rotary
Method of determining elevation: Unknown

Static Water Level (BTOC): 40 feet btoc
Artesian Flow:
Artesian Pressure (head):
Artesian Pressure (PSI):
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0	9	clay/till			brown	Medium		
9	50	medium sand some pebbles			brown	Soft		
50	80	medium sand, wet			grey	Soft	wb	
80	150	fine sand some silt			grey	Soft	wb, wood bits	
150	177	fine sand, clean with pebbles.			grey	Medium	wb	
177	183	coarse gravel with fine sand			grey	Medium	wb	
183	199	coarse gravel with coarse sand			grey	Medium	wb	
199	201	till - water shut off			grey	Hard	water shut off	
201		coarse sand and gravel			grey	Medium	wb, END HOLE; last 40 ft drilled by bailer & dual rotary	

Casing Details

From (ft bgl)	To (ft bgl)	Casing Type	Casing Material	Diameter (in)	Wall Thickness (in)	Drive Shoe
0	18	Steel Removed		12		Not Installed
0	187		Steel	10	0.365	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 2 inches
Surface Seal Depth: 20 feet

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From (ft bgl)	To (ft bgl)
There are no records to show	

Screen Details

Intake Method: Screen
Type:
Material: Stainless Steel
Opening: Continuous Slot
Bottom: Plate

Installed Screens

From (ft bgl)	To (ft bgl)	Diameter (in)	Assembly Type	Slot Size
185.00	188.00	8.50	K_RISER	
188.00	198.00	8.50	SCREEN	150.00

Well Development

Developed by: Air lifting

Development Total Duration: 50 hours

Well Yield

Estimation Method: Pumping
Estimation Rate: 600 USgpm
Estimation Duration: 24 hours
Static Water Level Before Test: 40 ft (btoc)
Drawdown: 52 ft (btoc)
Hydrofracturing Performed: No
Increase in Yield Due to Hydrofracturing:

Well Decommission Information

Reason for Decommission:
Method of Decommission:
Sealant Material:
Backfill Material:
Decommission Details:

Comments

Last 40 ft casing advanced by dual rotary and bailer. WELL RECORD SUBMITTED THROUGH EWELLS.

Alternative Specs Submitted: Yes

Documents

No additional documentation available for this well.

Disclaimer

Well Log - Valleyview Well 2

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 85452
Well Identification Plate Number: 13088
Owner Name: COWICHAN BAY WATERWORKS DISTRICT
Intended Water Use: Water Supply System
Artesian Condition: No

Well Status: Alteration
Well Class: Water Supply
Well Subclass: Not Applicable

Aquifer Number: 197

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:

Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

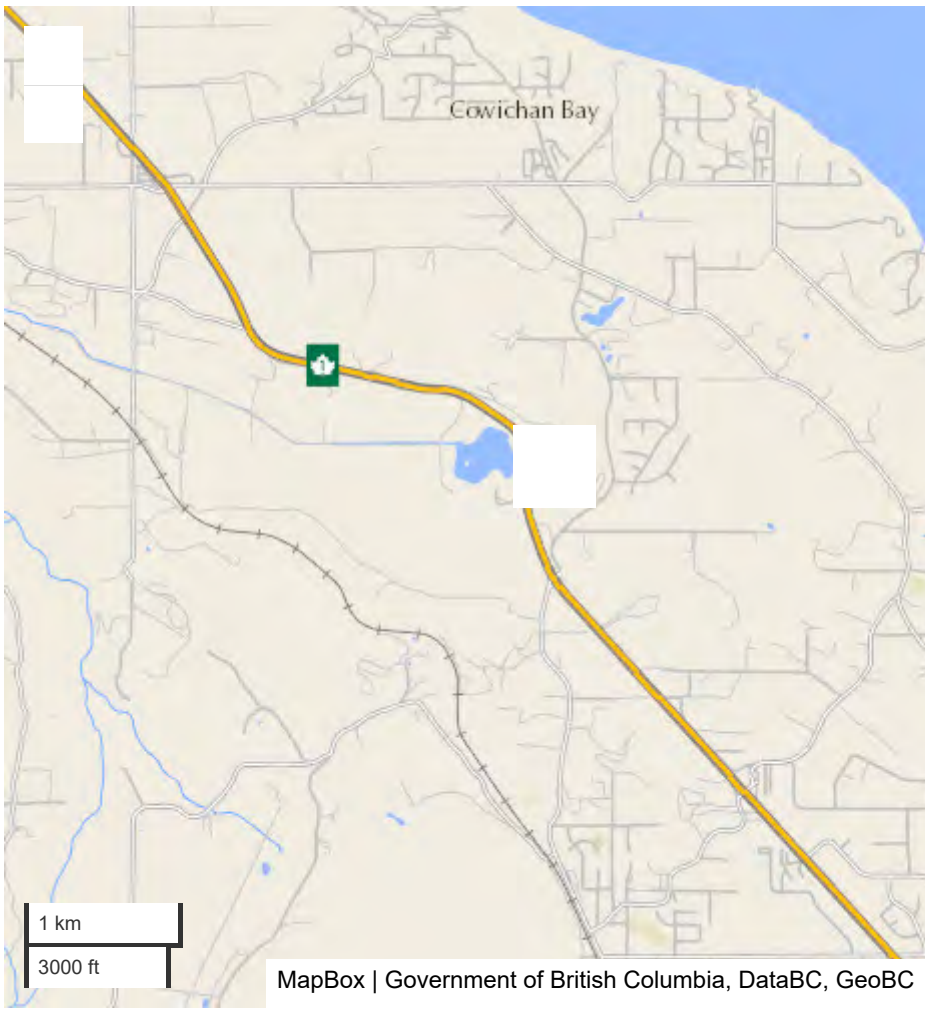
Location Information

Street Address: 1400 COWICHAN BAY RD
Town/City: COBBLE HILL

Legal Description:

Lot	1
Plan	8038
District Lot	
Block	
Section	18
Township	
Range	5
Land District	53
Property Identification Description (PID)	

Description of Well Location: VALLEYVIEW CENTRE



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 48.711794 **Longitude:** -123.609012
UTM Easting: 455199 **UTM Northing:** 5395597
Zone: 10 **Coordinate Acquisition Code:** (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	1996-10-18	1996-10-25	Fyfe's Well Drilling	May 31st 2006 at 7:06 AM

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
1996-10-18	1996-10-25	2012-03-15	2012-03-15		

Well Completion Data

Total Depth Drilled: 204 ft bgl
Finished Well Depth: 200 ft bgl
Final Casing Stick Up: 36 inches
Depth to Bedrock:
Ground elevation: 210 feet

Estimated Well Yield: 300 USgpm
Well Cap: PITLESS
Well Disinfected Status: Not Disinfected
Drilling Method: Other
Method of determining elevation: Unknown

Static Water Level (BTOC): 38 feet btoc
Artesian Flow:
Artesian Pressure (head):
Artesian Pressure (PSI):
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0	30	SANDY BROWN CLAY AND GRAVEL						
30	35	COMPACT GRAVEL						
35	40	CLEAN COARSE BLUE SAND						
40	51	DAMP COARSE BLUE SAND AND GRAVEL						
51	55	WATER BEARING BLUE SAND AND GRAVEL. 5 GPM						
55	164	WATER BEARING BLUE SANDS						
164	204	WATER BEATHING COARSE SANDS AND GRAVEL S. 150+ GPM						

Casing Details

From (ft bgl)	To (ft bgl)	Casing Type	Casing Material	Diameter (in)	Wall Thickness (in)	Drive Shoe
0	192		Steel	6	0.25	Installed

Surface Seal and Backfill Details

Surface Seal Material:
Surface Seal Installation Method:
Surface Seal Thickness:
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From (ft bgl)	To (ft bgl)
There are no records to show	

Screen Details

Intake Method:
Type: Telescope
Material: Stainless Steel
Opening: Continuous Slot
Bottom: Plate

Installed Screens

From (ft bgl)	To (ft bgl)	Diameter (in)	Assembly Type	Slot Size
186.00	195.00	5.00	SCRN_BLANK	
187.00	200.00	7.00	K_RISER	150.00
195.00	200.00	7.00	SCREEN	150.00

Well Development

Developed by: Air lifting

Development Total Duration:

Well Yield

Estimation Method: Pumping
Static Water Level Before Test:
Hydrofracturing Performed: No

Estimation Rate: 290 USgpm
Drawdown:
Increase in Yield Due to Hydrofracturing:

Estimation Duration: 4 hours

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:

Method of Decommission:
Backfill Material:

Comments

LOCATED IN A VAULT. WELL ALTERATION COMPLETED 2012-03-15 BY DOUG WATT OF DRILLWELL. WORKING ON WELL IN ATTEMPT TO STOP SAND PUMPING. VIDEO CAMERA SHOWED SAND POURING IN TOP SCREEN. INSTALLED PACKER ASSEMBLY TO SEAL OFF TOP SCREEN. METHOD OF DRILLING = DRILLED

Alternative Specs Submitted: Yes

Documents

Unable to retrieve file list.

Disclaimer

Well Log - Pavenham Well

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

92B·072·2·4·2 WTN 15184

COWICHAN BAY WATERWORKS #1 — WATER INVESTIGATIONS BRANCH, DEPT. OF LANDS, FORESTS, AND WATER RESOURCES, VICTORIA, B.C.

LEGAL LOCATION SEC 5 RGE NORTH EAST CORNER OF LOT 1 ON PRAUENHAM RD. — WELL LOCATION MAP COORDINATES X4 Y5 #4
LAND DISTRICT COWICHAN
LICENCE NO. — DATE LICENCE — AMOUNT — N.T.S. GRID SHEET

OWNER'S NAME G HIGHMOOR — ADDRESS R.R.1. COWICHAN STATION
DRILLER'S NAME PACIFIC W. WELLS — ADDRESS NANAIMO — DATE OF COMPLETION AUG 30/57
DEPTH 217 — ELEVATION OF 108 — ☐ ESTIMATED ☐ SURVEYED — CASING DIAM. 6" — LENGTH 217' — TYPE S. P.
METHOD OF CONSTRUCTION DRILLED — SCREEN ☒ — SIZE #50 — LENGTH 5' — TYPE JOHN ARMCO
LOCATION OF SCREEN 212-217 — DEVELOPED ☐ — DESCRIBE
PERFORATED CASING ☐ LENGTH — LOCATION OF PERFORATIONS
GRAVEL PACK ☐ LENGTH — DIAM. — SIZE GRAVEL, ETC.
DISTANCE TO WATER FROM TOP OF CASING 135' — ☐ ESTIMATED ☐ MEASURED — WATER LEVEL ELEVATION — ARTESIAN PRESSURE — P.S.I. DATE
WATER USE

PRODUCTION TEST SUMMARY

DATE
TEST BY
BAIL TEST ☐ DURATION OF TEST
PUMP TEST ☒ RATE 150 G.P.M.
WATER LEVEL AT COMPLETION OF TEST
DRAWDOWN — AVAILABLE DRAWDOWN
SPECIFIC CAPACITY — gpm/ft. dd
PERMEABILITY — USgpd/ft² STORAGE COEFF.
TRANSMISSIVITY < DRAWDOWN — USgpd/ft. RECOVERY — USgpd/ft.
REMARKS

CHEMISTRY

TEST BY — DATE
TOTAL DISSOLVED SOLIDS — mg/l — TEMPERATURE — °C — pH — CONDUCTANCE — μmhos/cm AT 25°C
IRON (Fe) — mg/l — SILICA (SiO_2) — mg/l — TOTAL HARDNESS ($CaCO_3$) — mg/l
TOTAL ALKALINITY ($CaCO_3$) — mg/l — PHEN. ALKALINITY ($CaCO_3$) — mg/l — MANGANESE (Mn) — mg/l

ANIONS	mg/l	epm	% epm	CATIONS	mg/l	epm	% epm
CARBONATE (CO_3)				CALCIUM (Ca)			
BICARBONATE (AS CO_3)				MAGNESIUM (Mg)			
SULPHATE (SO_4)				SODIUM (Na)			
CHLORIDE (Cl)				POTASSIUM (K)			
NITRATE (NO_2 + NO_3)							
* TKN (NO_3)							
PHOSPHORUS (P)							
TOTAL				TOTAL			

* TKN : TOTAL KJELDAHL NITROGEN

CHEMISTRY FIELD TESTS

TEST BY — DATE — EQUIPMENT USED

CONTENTS OF FOLDER

☒ DRILL LOG ☐ PUMP TEST DATA ☒ CHEMICAL ANALYSIS
☐ SIEVE ANALYSIS ☐ GEOPHYSICAL LOGS ☐ REPORT

OTHER SITE I.D. "1401188"

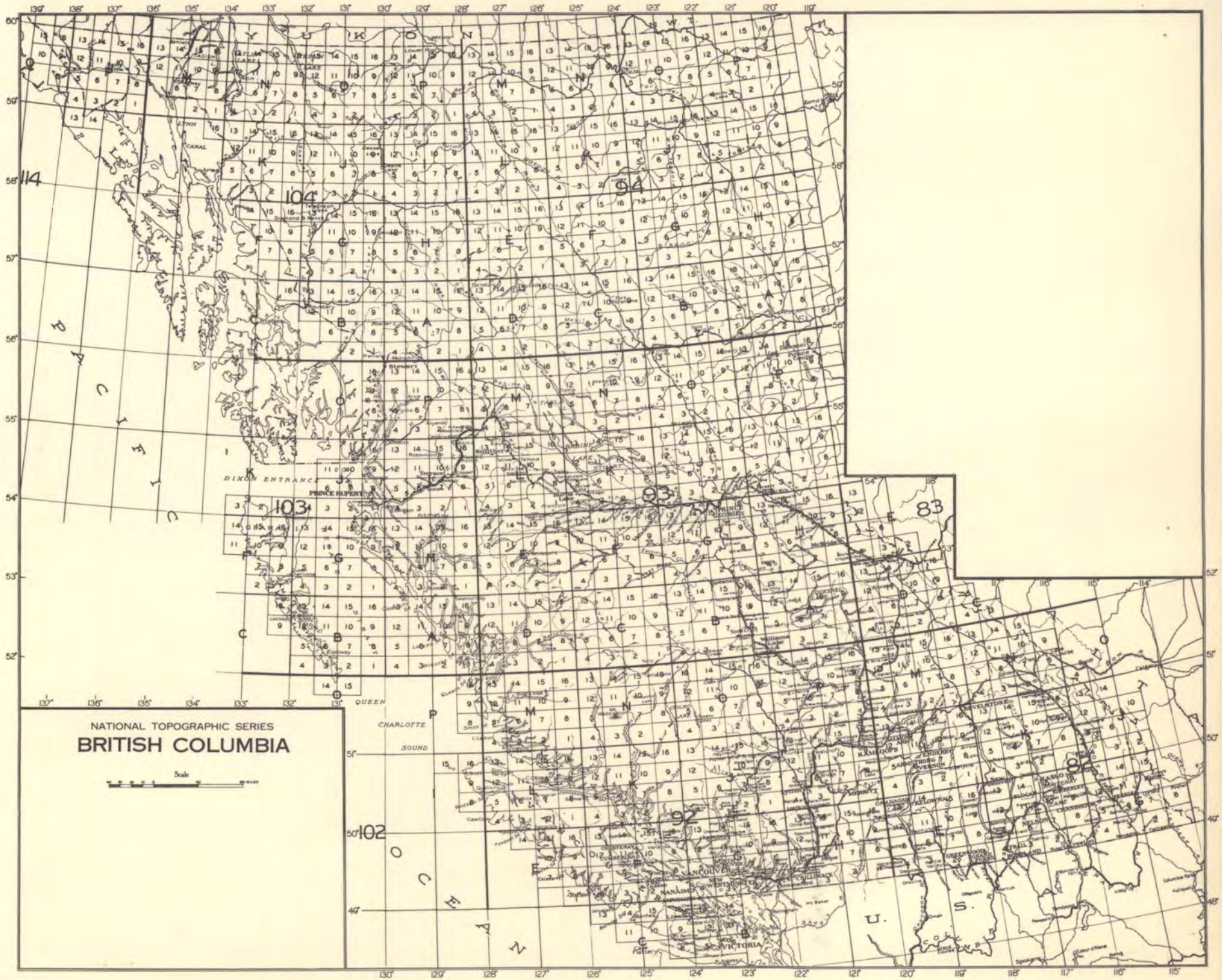
SOURCES OF INFORMATION See Underwood Report June 21, 1972 Water System Study for Cowichan Bay W.W.

LITHOLOGY

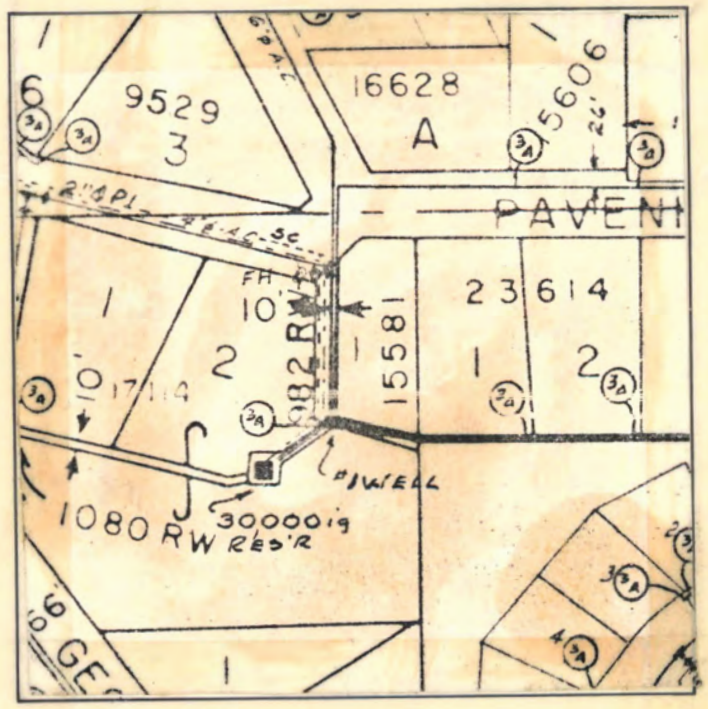
FROM	TO	DESCRIPTION
0	9	SOFT SANDY SILT
9	19	VERY TIGHT HARDPAN
19	45	BROWN SILTY SAND TAKES WATER
45	82	GREY BLUE SILTY SAND AND CLAY
82	116	GREY BLUE SILTY SAND
116	124	FINE BLUE SILTY SAND
124	143	DIRTY BROWN SAND AND GRAVEL - WATER
143	186	LAYERS OF FINE BLUE SILTY SAND & CLAY WITH SOME DIRTY GRAVEL.
186	199	FINE SILT & CLAY LAYERS
199	217	CLEAN COARSE GRAVEL

WellID 13062

REMARKS Pump capacity Well pump 65 gpm.


NATIONAL TOPOGRAPHIC SERIES
BRITISH COLUMBIA
Scale
PACIFIC OCEAN
DIXON ENTRANCE
QUEEN CHARLOTTE SOUND
PRINCE RUPERT
VANCOUVER
VICTORIA
U. S.
114
104
94
103
93
83
102
92
82

NORTH



WEST

EAST

SOUTH

CARD BY GH DATE June 24/76

ADDITIONAL DATA ADDED BY _____

REMARKS

Well Log - Kidd Well

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Province of British Columbia Ministry of Environment Water Investigations Branch

SHT. 1

92B/13 0E

COWICHAN L.DIST

WATER WELL RECORD

Date 85 2 13 (YR MO DY)

Legal Description & Address

Descriptive Location LT. 1, SEC. 10, Rge 2, PL. 19615

Owners Name & Address COWICHAN BAY WATER DIST.

NTS MAP | ELEV | WELL No.

UTM Z | E | N | UTM Date 19__

1. TYPE OF WORK 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse 5 ☐ Other

3. WATER WELL USE 1 ☐ Domestic 2 ☑ Municipal 3 ☐ Irrigation 4 ☐ Commercial & Industrial 5 ☐ Other

4. DRILLING ADDITIVES

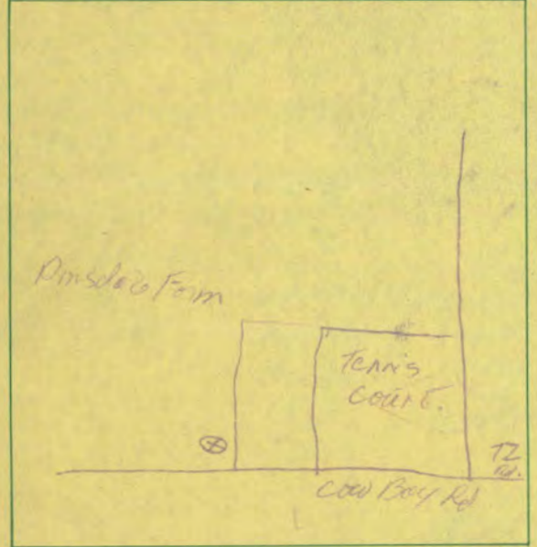
5. MEASUREMENTS from 1 ☑ ground level 2 ☐ top of casing

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	5'	SANDY BROWN TOP-SOIL	
5'	29'	WATER BEARING GRAVEL	
29'	57'	SILTY SAND + GRAVEL	
57'	71'	WATER BEARING SILTY GRAVEL	
71'	79'	VERY SILTY SAND	
79'	105'	SILT	
105'	115'	WATER BEARING GRAVEL	
115'	118'	SILTY GRAVEL	
118'	130'	SAND + GRAVEL (WATER BEARING)	
130'	141'	COURSE GRAVEL	
141'		SILTY GRAVEL	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH



9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete 6 ☐ Other

							units
Hole Diameter							ins
Diameter	8"						ins
from	0						ft
to	141'						ft
Thickness	.280						ins
Weight							lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded 4 ☐ New 5 ☐ Used

Perforations:

Shoe(s): 1 - 8"

Open hole, from ____ to ____ ft Diameter ____ ins

Grout:

10. SCREEN: 1 ☑ Nominal 2 ☐ Pipe Size

Type 1 ☑ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre 4 ☐ Other

Material 1 ☑ Stainless Steel 2 ☐ Plastic 3 ☐ Other

Set from 141 to 130 ft below ground level

SCREEN & BLANKS							units
Length	11'2"						ft
Diam. I D	7½"						ins
Slot Size	120						ins
from	141'						ft
to	130'						ft

Fittings, top K-PACKER bottom BAIL

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping 6 ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail Date (YR MO DY)

Rate ____ USgpm Temp ____ °C SWL before test ____ ft

____ ft after test of ____ hrs ____ mins

TIME in mins & DRAWDOWN in ft				TIME in mins & RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING ft	RECOMMENDED PUMPING RATE USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☐ no

15. WATER ANALYSIS: 1 ☐ Hardness ____ mg/ℓ

2 ☐ Iron ____ mg/ℓ 3 ☐ Chloride ____ mg/ℓ

4 ☐ pH ____ Field Date ____

SITE I D No ____ Lab Date (YR MO DY)

16. FINAL WELL COMPLETION DATA

Well Depth 141 ft Water Flowing + 250 USgpm

Static Water Level GROUND ft Pressure Head ____ ft

Back filled

Well Head Completion WELDED LID

17. DRILLER PLEASE PRINT SURNAME WATT FIRST NAME DOUG

Signature Doug Watt

18. CONTRACTOR, Address DRILLWELL ENTERPRISES LTD. KEN SLADE R.R. 1, COWICHAN BAY, B.C. V0R 1N0

Member, B C W W D A ☐ yes ☐ no ;

Appendix B

Capture Zone Radius Calculations

Cowichan Bay Waterworks District
Source Water Protection Plan
WWAL Ref: 22-092-01VC

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Capture Zone Delineation Worksheet: Calculated Fixed Radius Method

Project Name: Cowichan Bay Water District Source Water Proetection Plan
WWAL Project Number: 22-092-01VC
Well Name: Valleyview Well 1 (WPID 38473)
Calculations by: NN
Checked by: CP
Date: 06-Sep-22

CFR Formula: r = sqrt((10038*Q*t) / (n*b))

where:	Fill in Shaded Cells		
	0.5 year	1 year	5 year
r = radius in meters			
Q = average pumping rate in L/s	38.00	38.00	38.00
t = travel time in years	0.5	1	5
n = aquifer porosity	0.3	0.3	0.3
b = aquifer thickness in metres	50.0	50.0	50.0

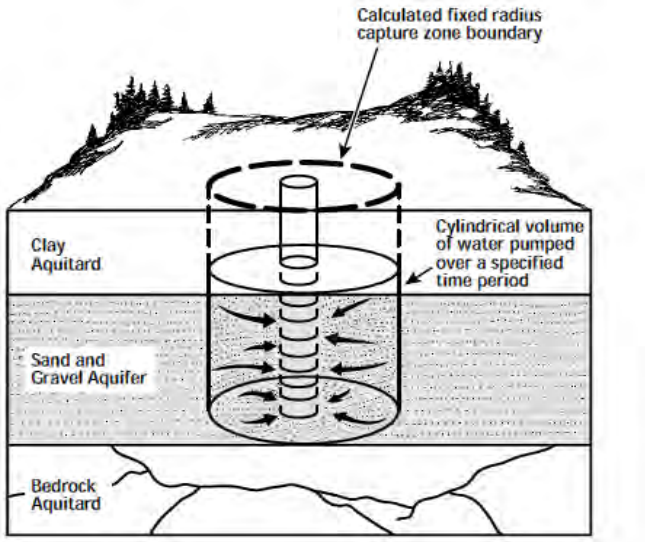


Image Source: BC Well Protection Toolkit. ENV 2006.

Assumptions
1) Aquifer assumed to 50 m in thickness based on well log for WPID 38473.
2) Assume well to be pumped at rated capacity of 38 L/s.

Result Radius (m):	CFR (0.5 year)	CFR (1 year)	CFR (5 year)
	112.8	159.5	356.6

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

Appendix B: Capture Zone Worksheets

Capture Zone Delineation Worksheet: Analytical Equations Method

Project Name: CBWD Source Water Protection Plan
WWAL Project Number: 22-092-01VC
Well Name: Valleyview Well 1 (WPID 38473)
Calculations by: NN
Checked by: CP
Date: 06-Sep-22

AE Formulas: **Y = Q / (2000 * T * i)** **X = Y / π** **dTOT = (t * K * i) / n**

where:
Y = half width of the capture zone in metres
Q = average pumping rate in L/s
T = transmissivity (m2/s)
i = ambient hydraulic gradient

X = downgradient reach of capture zone

where:
dTOT = upgradient extent of capture zone for specified time in metres
k = hydraulic conductivity in m/y (transmissivity / aquifer thickness)
i = ambient hydraulic gradient
n = aquifer porosity
b = aquifer thickness in m

Data input cells

Q	38
T (m2/day)	7776
T (m2/s)	0.09
i	0.005
b	50
k (m/y)	56764.8
d 1year	1
d 5 yr	5
d 10 yr	10
n	0.3

Results (metres)

Y	**42**
2Y	**84**
X	**13**
d 1 year	**946**
d 5y ear	**4730**
d 10 year	**9461**

Assumptions
1) Hydraulic gradient estimated from measured water levels in the aquifer near Fisher Road (WWAL, 2018)
2) Transmissivity estimated from analysis of constant rate pumping test of Valleyview Well 1 in previous hydrological study (Thuber, 2013).

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

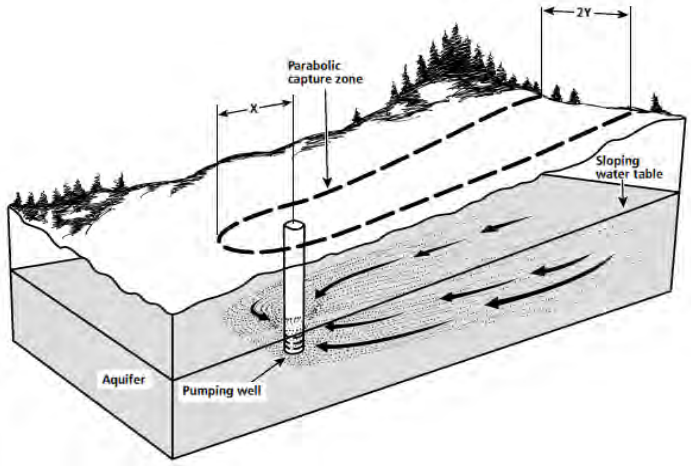
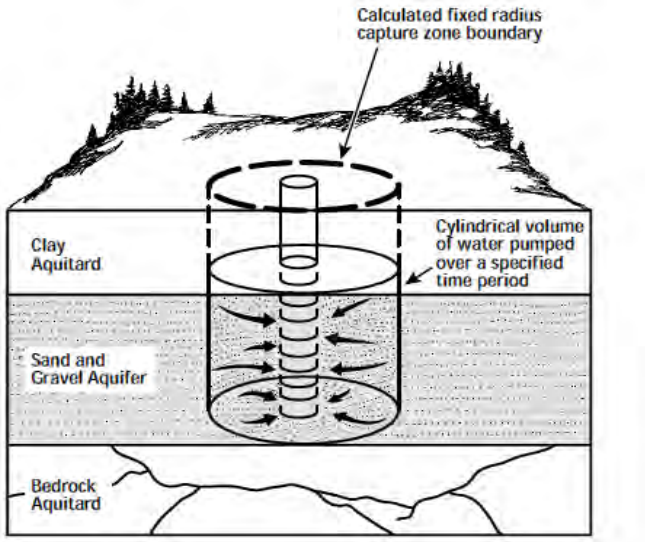


Image Source: BC Well Protection Toolkit. ENV 2006.

Capture Zone Delineation Worksheet: Calculated Fixed Radius Method

Project Name: Cowichan Bay Water District Source Water Proetection Plan
WWAL Project Number: 22-092-01VC
Well Name: Valleyview Well 2 (WPID 13088)
Calculations by: NN
Checked by: CP
Date: 06-Sep-22



CFR Formula: r = sqrt((10038*Q*t) / (n*b))

where:	Fill in Shaded Cells		
	0.5 year	1 year	5 year
r = radius in meters			
Q = average pumping rate in L/s	6.00	6.00	6.00
t = travel time in years	0.5	1	5
n = aquifer porosity	0.3	0.3	0.3
b = aquifer thickness in metres	49.0	49.0	49.0

Assumptions
1) Aquifer assumed to be 49 m in thickness based on well log for WPID 13088.
2) Assume well to be pumped at rated capacity of 6 L/s.

Image Source: BC Well Protection Toolkit. ENV 2006.

Result Radius (m):	CFR (0.5 year)	CFR (1 year)	CFR (5 year)
	45.3	64.0	143.1

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

Appendix B: Capture Zone Worksheets

Capture Zone Delineation Worksheet: Analytical Equations Method

Project Name: CBWD Source Water Protection Plan
WWAL Project Number: 22-092-01VC
Well Name: Valleyview Well 2 (WPID 13088)
Calculations by: NN
Checked by: CP
Date: 06-Sep-22

AE Formulas: **Y = Q / (2000 * T * i)**

where:
Y = half width of the capture zone in metres
Q = average pumping rate in L/s
T = transmissivity (m2/s)
i = ambient hydraulic gradient

X = Y / π

X = downgradient reach of capture zone

dTOT = (t * K * i) / n

where:
dTOT = upgradient extent of capture zone for specified time in metres
k = hydraulic conductivity in m/y (transmissivity / aquifer thickness)
i = ambient hydraulic gradient
n = aquifer porosity
b = aquifer thickness in m

Data input cells

Q	6
T (m2/day)	7776
T (m2/s)	0.09
i	0.005
b	49
k (m/y)	57923.27
d 1year	1
d 5 yr	5
d 10 yr	10
n	0.3

Results (metres)

Y	**7**
2Y	**13**
X	**2**
d 1 year	**965**
d 5y ear	**4827**
d 10 year	**9654**

Assumptions
1) Hydraulic gradient estimated from measured water levels in the aquifer near Fisher Road (WWAL, 2018)
2) Transmissivity estimated from analysis of constant rate pumping test of Valleyview Well 1 in previous hydrological study (Thuber, 2013).

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

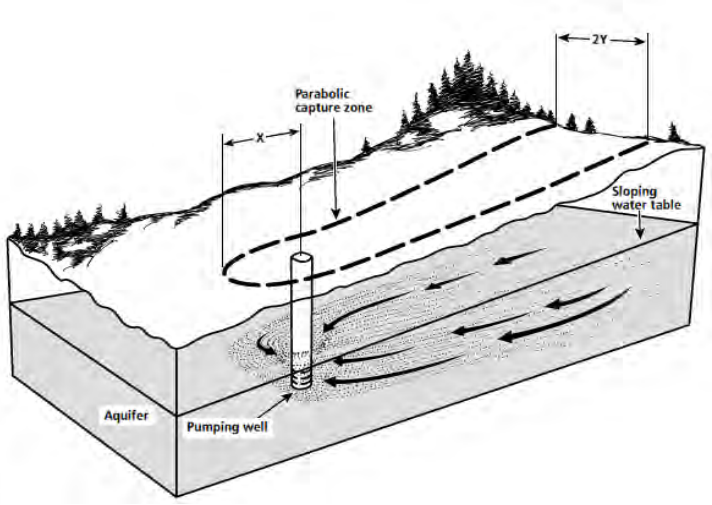


Image Source: BC Well Protection Toolkit. ENV 2006.

Capture Zone Delineation Worksheet: Calculated Fixed Radius Method

Project Name: Cowichan Bay Water District Source Water Proetection Plan
WWAL Project Number: 22-092-01VC
Well Name: Pavenham Well (WPID 13062)
Calculations by: NN
Checked by: CP
Date: 06-Sep-22

CFR Formula: r = sqrt((10038*Q*t) / (n*b))

where:
r = radius in meters
Q = average pumping rate in L/s
t = travel time in years
n = aquifer porosity
b = aquifer thickness in metres

Fill in Shaded Cells		
0.5 year	1 year	5 year
10.00	10.00	10.00
0.5	1	5
0.3	0.3	0.3
25.0	25.0	25.0

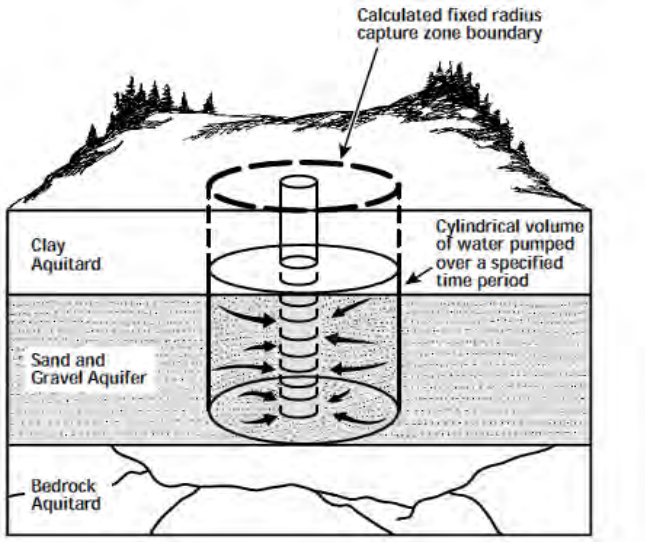


Image Source: BC Well Protection Toolkit. ENV 2006.

Assumptions
1) Aquifer assumed to be 25 m in thickness based on well log for WPID 13062.
2) Assume well to be pumped at rated capacity of 10 L/s.

Result Radius (m):	CFR (0.5 year)	CFR (1 year)	CFR (5 year)
	81.8	115.7	258.7

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

Capture Zone Delineation Worksheet: Calculated Fixed Radius Method (TBD)

Project Name: Cowichan Bay Water District Source Water Proetection Plan
WWAL Project Number: 22-092-01VC
Well Name: Kidd Well (WPID 13060)
Calculations by: NN
Checked by:
Date: 06-Sep-22

CFR Formula: r = sqrt((10038*Q*t) / (n*b))

where:	Fill in Shaded Cells		
	0.5 year	1 year	5 year
r = radius in meters			
Q = average pumping rate in L/s	8.00	8.00	8.00
t = travel time in years	0.5	1	5
n = aquifer porosity	0.3	0.3	0.3
b = aquifer thickness in metres	11.0	11.0	11.0

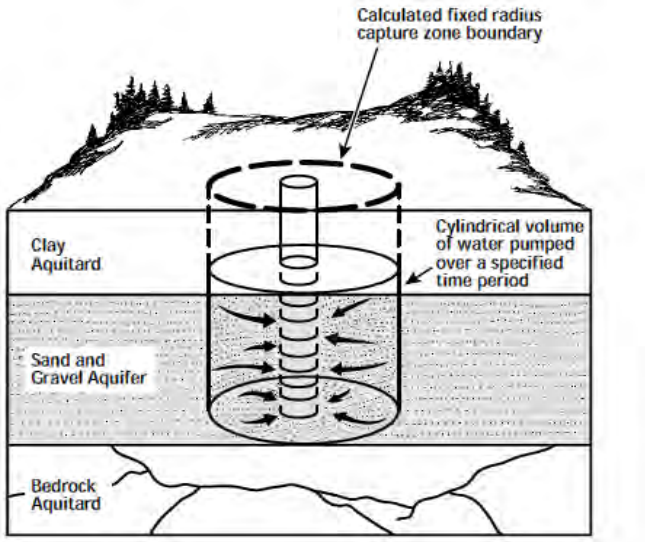


Image Source: BC Well Protection Toolkit. ENV 2006.

Assumptions
1) Aquifer assumed to be 11 m thickness based on well log for WPID 13060.
2) Assume well to be pumped at rated capacity of 38 L/s.

Result Radius (m):	CFR (0.5 year)	CFR (1 year)	CFR (5 year)
	110.3	156.0	348.8

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

Appendix C

Laboratory Reports

Cowichan Bay Waterworks District
Source Water Protection Plan
WWAL Ref: 22-092-01VC

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Laboratory Reports - Valleyview Well 1

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Your C.O.C. #: wi023232, WI023232

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908446
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050475
Received: 2020/07/20, 14:05

Sample Matrix: Drinking Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH (1)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2320 B m
Chloride/Sulphate by Auto Colourimetry (1)	1	N/A	2020/07/21	BBY6SOP-00011 / BBY6SOP-00017	SM23-4500-Cl/SO4-E m
Colour (True) by Kone Lab (1)	1	N/A	2020/07/21	BBY6SOP-00057	SM 23 2120 C m
Conductivity @25C (1)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2510 B m
Fluoride (1)	1	N/A	2020/07/24	BBY6SOP-00048	SM 23 4500-F C m
Sulphide (as H2S)	1	N/A	2020/07/24		Auto Calc
Hardness Total (calculated as CaCO3) (1, 2)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Mercury (Total) by CV (1)	1	2020/07/22	2020/07/22	AB SOP-00084	BCMOE BCLM Oct2013 m
Heterotropic Plate Count (MF) in Water (1)	1	N/A	2020/07/21	BBY4SOP-00003	SM 23 9215
Na, K, Ca, Mg, S by CRC ICPMS (total) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total) (1)	1	N/A	2020/07/22	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
Nitrogen (Total) (1)	1	N/A	2020/07/24	BBY6SOP-00016	SM 23 4500-N C m
Ammonia-N (Total)	1	N/A	2020/07/24	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate + Nitrite (N) (1)	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA (1)	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrogen - Nitrate (as N) (1)	1	N/A	2020/07/22	BBY WI-00033	Auto Calc
Nitrogen (Tot. Organic) Calculation (1)	1	N/A	2020/07/24	BBY WI-00033	Auto Calc
pH @25°C (1, 3)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 4500-H+ B m
Sat. pH and Langelier Index (@ 4.4C) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Sat. pH and Langelier Index (@ 60C) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Total Sulphide	1	N/A	2020/07/24	AB SOP-00080	SM 23 4500 S2-A D Fm
Total Dissolved Solids (Filt. Residue) (1)	1	2020/07/23	2020/07/24	BBY6SOP-00033	SM 23 2540 C m
Total Coliform & E.Coli by MF-Chromocult (1)	1	N/A	2020/07/21	BBY4SOP-00143	Merck KGaA Version 1
Carbon (Total Organic) (4)	1	N/A	2020/07/26	AB SOP-00087	MMCW 119 1996 m
Turbidity (1)	1	N/A	2020/07/21	BBY6SOP-00027	SM 23 2130 B m
UV absorbance @254nm-Unfiltered	1	N/A	2020/07/23	CAL SOP-00274	SM 23 5910B m
UV transmittance @254nm-Unfiltered	1	N/A	2020/07/23		Auto-Calc

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your C.O.C. #: wi023232, WI023232

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908446
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050475
Received: 2020/07/20, 14:05

by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BV Labs Vancouver
(2) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(4) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bvlabs.com
Phone# (403) 291-3077

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C050475
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6986		
Sampling Date					2020/07/20 09:15		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #1 RAW	RDL	QC Batch
ANIONS							
Nitrite (N)	mg/L	1	-	-	<0.0050	0.0050	9931654
Calculated Parameters							
Total Hardness (CaCO3)	mg/L	-	-	-	86.9	0.50	9928639
Nitrate (N)	mg/L	10	-	-	0.336	0.020	9929144
Total Organic Nitrogen (N)	mg/L	-	-	-	<0.020	0.020	9929439
Sulphide (as H2S)	mg/L	-	0.05	-	<0.0020	0.0020	9929450
Transmittance at 254nm	%T/cm	-	-	-	>97.7	N/A	9929454
Misc. Inorganics							
Conductivity	uS/cm	-	-	-	200	2.0	9931293
pH	pH	-	-	7.0:10.5	7.94	N/A	9931291
Total Organic Carbon (C)	mg/L	-	-	-	<0.50	0.50	9935700
Total Dissolved Solids	mg/L	-	-	-	130	10	9932375
Anions							
Alkalinity (PP as CaCO3)	mg/L	-	-	-	<1.0	1.0	9931292
Alkalinity (Total as CaCO3)	mg/L	-	-	-	84	1.0	9931292
Bicarbonate (HCO3)	mg/L	-	-	-	100	1.0	9931292
Carbonate (CO3)	mg/L	-	-	-	<1.0	1.0	9931292
Dissolved Fluoride (F)	mg/L	1.5	-	-	0.052	0.050	9934007
Hydroxide (OH)	mg/L	-	-	-	<1.0	1.0	9931292
Total Sulphide	mg/L	-	0.05	-	<0.0018	0.0018	9934727
Dissolved Chloride (Cl)	mg/L	-	250	-	9.8	1.0	9929739
Dissolved Sulphate (SO4)	mg/L	-	500	-	5.2	1.0	9929739
MISCELLANEOUS							
True Colour	Col. Unit	-	15	-	<5.0	5.0	9929954
UV absorbance (254nm)	AU/cm	-	-	-	<0.010	0.010	9932284
Nutrients							
Total Ammonia (N)	mg/L	-	-	-	<0.015	0.015	9933378
Nitrate plus Nitrite (N)	mg/L	-	-	-	0.336	0.020	9931653
Total Nitrogen (N)	mg/L	-	-	-	0.341	0.020	9933761
Physical Properties							
Turbidity	NTU	see remark	see remark	see remark	<0.10	0.10	9930120

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

BV Labs - Partial/Rush Results

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C050475
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6986		
Sampling Date					2020/07/20 09:15		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #1 RAW	RDL	QC Batch
Elements							
Total Mercury (Hg)	ug/L	1	-	-	<0.0019	0.0019	9930940
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	-	-	100	<3.0	3.0	9930844
Total Antimony (Sb)	ug/L	6	-	-	<0.50	0.50	9930844
Total Arsenic (As)	ug/L	10	-	-	1.58	0.10	9930844
Total Barium (Ba)	ug/L	1000	-	-	3.6	1.0	9930844
Total Beryllium (Be)	ug/L	-	-	-	<0.10	0.10	9930844
Total Bismuth (Bi)	ug/L	-	-	-	<1.0	1.0	9930844
Total Boron (B)	ug/L	5000	-	-	<50	50	9930844
Total Cadmium (Cd)	ug/L	5	-	-	<0.010	0.010	9930844
Total Chromium (Cr)	ug/L	50	-	-	2.2	1.0	9930844
Total Cobalt (Co)	ug/L	-	-	-	<0.20	0.20	9930844
Total Copper (Cu)	ug/L	2000	1000	-	0.46	0.20	9930844
Total Iron (Fe)	ug/L	-	300	-	<5.0	5.0	9930844
Total Lead (Pb)	ug/L	5	-	-	<0.20	0.20	9930844
Total Manganese (Mn)	ug/L	120	20	-	<1.0	1.0	9930844
Total Molybdenum (Mo)	ug/L	-	-	-	<1.0	1.0	9930844
Total Nickel (Ni)	ug/L	-	-	-	<1.0	1.0	9930844
Total Selenium (Se)	ug/L	50	-	-	0.19	0.10	9930844
Total Silicon (Si)	ug/L	-	-	-	10500	100	9930844
Total Silver (Ag)	ug/L	-	-	-	<0.020	0.020	9930844
Total Strontium (Sr)	ug/L	7000	-	-	63.0	1.0	9930844
Total Thallium (Tl)	ug/L	-	-	-	<0.010	0.010	9930844
Total Tin (Sn)	ug/L	-	-	-	<5.0	5.0	9930844
Total Titanium (Ti)	ug/L	-	-	-	<5.0	5.0	9930844
Total Uranium (U)	ug/L	20	-	-	0.21	0.10	9930844
Total Vanadium (V)	ug/L	-	-	-	6.4	5.0	9930844
Total Zinc (Zn)	ug/L	-	5000	-	<5.0	5.0	9930844
Total Zirconium (Zr)	ug/L	-	-	-	<0.10	0.10	9930844
Total Calcium (Ca)	mg/L	-	-	-	19.3	0.050	9929143
Total Magnesium (Mg)	mg/L	-	-	-	9.41	0.050	9929143
Total Potassium (K)	mg/L	-	-	-	0.714	0.050	9929143

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C050475
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6986		
Sampling Date					2020/07/20 09:15		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #1 RAW	RDL	QC Batch
Total Sodium (Na)	mg/L	-	200	-	5.41	0.050	9929143
Total Sulphur (S)	mg/L	-	-	-	<3.0	3.0	9929143
Microbiological Param.							
Heterotrophic Plate Count	CFU/mL	-	-	-	3	1	9929692
Total Coliforms	CFU/100mL	0	-	-	0	N/A	9929691
E. coli	CFU/100mL	0	-	-	0	N/A	9929691
Calculated Parameters							
Langelier Index (@ 4.4C)	N/A	-	-	-	-0.761	N/A	9929444
Langelier Index (@ 60C)	N/A	-	-	-	0.279	N/A	9929448
Saturation pH (@ 4.4C)	N/A	-	-	-	8.70	N/A	9929444
Saturation pH (@ 60C)	N/A	-	-	-	7.66	N/A	9929448

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.7°C

Sample YC6986 [VALLEYVIEW WELL #1 RAW] : Sample was analyzed past recommended hold time for Heterotropic Plate Count (MF) in Water. Sample was analyzed past recommended hold time for Iron Related Bacteria. Sample was analyzed past recommended hold time for Sulphate Reducing Bacteria.
MAC,AO,OG: The guidelines that have been included in this report have been taken from the Canadian Drinking Water Quality Summary Table,June 2019.

Criteria A = Maximum Acceptable Concentration (MAC) / Criteria B = Aesthetic Objectives (AO) / Criteria C = Operational Guidance Values (OG)
It is recommended to consult these guidelines when interpreting your data since there are non-numerical guidelines that are not included on this report.

Turbidity Guidelines:
1. Chemically assisted filtration: less than or equal to 0.3 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 1.0 NTU at any time.
2. Slow sand / diatomaceous earth filtration: less than or equal to 1.0 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 3.0 NTU at any time.
3. Membrane filtration: less than or equal to 0.1 NTU in 99% of the measurements made or at least 99% of the time each calendar month. Shall not exceed 0.3 NTU at any time.
4. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less.
Measurement of Uncertainty has not been accounted for when stating conformity to the selected criteria, where applicable.

Results relate only to the items tested.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C050475
Report Date: 2020/07/28

QUALITY ASSURANCE REPORT

Cowichan Bay Waterworks
Sampler Initials: JW

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9929739	Dissolved Chloride (Cl)	2020/07/21	104	80 - 120	103	80 - 120	<1.0	mg/L	1.3	20
9929739	Dissolved Sulphate (SO4)	2020/07/21	NC	80 - 120	94	80 - 120	<1.0	mg/L	1.4	20
9929954	True Colour	2020/07/21			97	80 - 120	<5.0	Col. Unit	NC	20
9930120	Turbidity	2020/07/21			101	80 - 120	<0.10	NTU	2.7	20
9930844	Total Aluminum (Al)	2020/07/22	98	80 - 120	101	80 - 120	<3.0	ug/L	2.4	20
9930844	Total Antimony (Sb)	2020/07/22	104	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
9930844	Total Arsenic (As)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Barium (Ba)	2020/07/22	102	80 - 120	102	80 - 120	<1.0	ug/L	1.0	20
9930844	Total Beryllium (Be)	2020/07/22	98	80 - 120	100	80 - 120	<0.10	ug/L		
9930844	Total Bismuth (Bi)	2020/07/22	87	80 - 120	92	80 - 120	<1.0	ug/L		
9930844	Total Boron (B)	2020/07/22	97	80 - 120	99	80 - 120	<50	ug/L	NC	20
9930844	Total Cadmium (Cd)	2020/07/22	102	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
9930844	Total Chromium (Cr)	2020/07/22	99	80 - 120	101	80 - 120	<1.0	ug/L	NC	20
9930844	Total Cobalt (Co)	2020/07/22	99	80 - 120	101	80 - 120	<0.20	ug/L	NC	20
9930844	Total Copper (Cu)	2020/07/22	96	80 - 120	100	80 - 120	<0.20	ug/L	0.35	20
9930844	Total Iron (Fe)	2020/07/22	101	80 - 120	104	80 - 120	<5.0	ug/L	2.2	20
9930844	Total Lead (Pb)	2020/07/22	100	80 - 120	101	80 - 120	<0.20	ug/L		
9930844	Total Manganese (Mn)	2020/07/22	99	80 - 120	102	80 - 120	<1.0	ug/L	8.0	20
9930844	Total Molybdenum (Mo)	2020/07/22	103	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
9930844	Total Nickel (Ni)	2020/07/22	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
9930844	Total Selenium (Se)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Silicon (Si)	2020/07/22	109	80 - 120	111	80 - 120	<100	ug/L	0.51	20
9930844	Total Silver (Ag)	2020/07/22	98	80 - 120	99	80 - 120	<0.020	ug/L	NC	20
9930844	Total Strontium (Sr)	2020/07/22	105	80 - 120	105	80 - 120	<1.0	ug/L	0.78	20
9930844	Total Thallium (Tl)	2020/07/22	101	80 - 120	102	80 - 120	<0.010	ug/L		
9930844	Total Tin (Sn)	2020/07/22	101	80 - 120	102	80 - 120	<5.0	ug/L		
9930844	Total Titanium (Ti)	2020/07/22	101	80 - 120	105	80 - 120	<5.0	ug/L		
9930844	Total Uranium (U)	2020/07/22	103	80 - 120	103	80 - 120	<0.10	ug/L	NC	20
9930844	Total Vanadium (V)	2020/07/22	100	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zinc (Zn)	2020/07/22	99	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zirconium (Zr)	2020/07/22	103	80 - 120	104	80 - 120	<0.10	ug/L		
9930940	Total Mercury (Hg)	2020/07/22	93	80 - 120	99	80 - 120	<0.0019	ug/L	NC	20
9931291	pH	2020/07/22			102	97 - 103				

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9931292	Alkalinity (PP as CaCO3)	2020/07/22					<1.0	mg/L	NC	20
9931292	Alkalinity (Total as CaCO3)	2020/07/22	NC	80 - 120	99	80 - 120	<1.0	mg/L	0.58	20
9931292	Bicarbonate (HCO3)	2020/07/22					<1.0	mg/L	0.58	20
9931292	Carbonate (CO3)	2020/07/22					<1.0	mg/L	NC	20
9931292	Hydroxide (OH)	2020/07/22					<1.0	mg/L	NC	20
9931293	Conductivity	2020/07/22			99	80 - 120	<2.0	uS/cm	0.23	10
9931653	Nitrate plus Nitrite (N)	2020/07/22	105	80 - 120	109	80 - 120	<0.020	mg/L	NC	25
9931654	Nitrite (N)	2020/07/22	101	80 - 120	102	80 - 120	<0.0050	mg/L	NC	20
9932284	UV absorbance (254nm)	2020/07/23			96	N/A	<0.010	AU/cm	NC	20
9932375	Total Dissolved Solids	2020/07/24	103	80 - 120	92	80 - 120	<10	mg/L	3.7	20
9933378	Total Ammonia (N)	2020/07/24	NC	80 - 120	108	80 - 120	<0.015	mg/L	0.010 (1)	20
9933761	Total Nitrogen (N)	2020/07/24	102	80 - 120	97	80 - 120	<0.020	mg/L	1.7	20
9934007	Dissolved Fluoride (F)	2020/07/24	100	80 - 120	102	80 - 120	<0.050	mg/L	0	20
9934727	Total Sulphide	2020/07/24	103	80 - 120	106	80 - 120	<0.0018	mg/L	6.9	20
9935700	Total Organic Carbon (C)	2020/07/26	106	80 - 120	100	80 - 120	<0.50	mg/L	NC	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

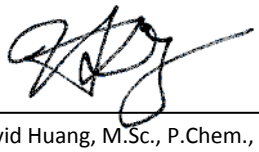
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

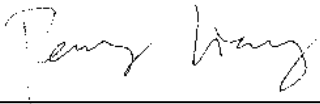
Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



David Huang, M.Sc., P.Chem., QP, Scientific Services Manager



Harry (Peng) Liang, Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs - Partial/Rush Results

WI023232

BV Job #: C050475_COC

BUREAU VERITAS

Victoria: Unit 1, 851 Viewfield Rd, Victoria, BC V9A 4V2 Ph: (250) 386-6112 Toll Free: (833) 282-5227
Courtenay: 2755 B Moray Ave, Courtenay, BC V9N 8M9 Ph: (250) 338-7788 Toll Free: (833) 282-5227

Company (Invoicing): COWICHAN BAY WATER DIST.
Company (Reporting): IFC WATER SOLUTIONS LTD.
Contact Name: JOE WOOLLS
Mailing Address:

Phone #:
E-mail: joe@ifcwater.ca

After Hours Contact #:

☑ Regular Turnaround Time (TAT) (5 days for most tests)
☐ **RUSH** Please contact the lab **Surcharges will be applied**

Project Name: Date Required:

SPECIAL INSTRUCTIONS:
Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

VANCOUVER ISLAND HEALTH AUTHORITY
Medical Health Officer: 1.800.204.6166
Drinking Water Officer: 250.755.6215

Payment Received: Yes ☐ **No** ☐

	Sample Identification (Sample Location &/or Description)	Sample Location (eg. Tap, Wellhead)	Date/Time Sampled (24hr)	PLEASE CIRCLE: Samples from a Drinking Water Source? Y/N	Does source supply multiple households? Y/N	Are individuals drinking this water? Y/N	Are you on a boil water advisory? Y/N	ANALYSIS REQUESTED PLEASE SELECT BELOW: Drinking Water Scan	Home Safety Scan	Total Metals Scan including Hardness & Hg	Total Coliform and E. Coli	VIHA ICP	Report Current Drinking Water Criteria
1	VALLEYVIEW WELL #1 RAW	PUMP STN.	JULY 20/20	(Y) N	(Y) N	(Y) N	Y (N)					X	X
2			9:15AM	Y N	Y N	Y N	Y N						X
3	VALLEYVIEW WELL #2 RAW	PUMP STN	9:45AM	(Y) N	(Y) N	(Y) N	Y (N)					X	X
4				Y N	Y N	Y N	Y N						X
5				Y N	Y N	Y N	Y N						X

All information on this form must be completed before testing

If your drinking water source services two or more homes, we strongly recommend that you contact local health authorities to find out how the Drinking Water Protection Act applies to this system. Please be aware that, in this situation, we are legally obligated to report results directly to local health authorities.

Sample Collection

For determining drinking water quality, samples should be representative of the water that will be consumed; therefore, we suggest sampling at the kitchen tap. However, other sampling locations may be used to determine pre-treatment water quality or for troubleshooting purposes.

1. Remove aerator/screen from faucet.
2. Let the water run for 5 minutes.
3. Label the bottle with your name, date and time you are taking the sample.
4. Fill all bottle(s) provided. Take care not to touch the inside of the bottle or underside of cap.
5. Cap the sample and place it in fridge or small cooler with icepack.

Remember: It is important that you do not contaminate the sample as you handle the container. Wash your hands before you start and be careful not to touch the rim of the bottle or the inside of the cap.

Bureau Veritas
RECEIVED IN VICTORIA
D. Nordbrugt
JUL 20 2020 @ 1405
By:
Temps: 14 | 15 | 15 on ice

DON'T:

Don't rinse or boil any bottle you receive from the lab.

Don't let the sample sit out overnight, please refrigerate.

Don't freeze the sample.

Sample Transportation & Delivery

1. Samples should arrive at the laboratories (Courtenay or Victoria) within 24 hrs of sampling. Ship samples between Monday and Thursday to avoid lab scheduling conflicts.
2. The sample should be kept cool during transit (<8°C - refrigerated or packed on ice).
3. Fill out the Chain of Custody (COC) form beside these instructions and submit with the sample. Incomplete or missing COC's will result in delays impacting turnaround time and the lab's ability to proceed with time sensitive tests.
4. Delivery Options:
   Personally deliver samples to Courtenay or Victoria (Samples will be forwarded to Burnaby on your behalf unless analysis is completed locally in Courtenay. Please consider sample hold times.)
   Overnight shipping to Burnaby: If you ship a sample on the same day that it was collected you can use an overnight courier.
   Same day shipping: Available in some areas. Please contact the lab for details.

Print name and sign: *Relinquished By:	Date (yy/mm/dd):	Time (24 hr):	Print name and sign: Received by:	Date (yy/mm/dd):	Time (24hr):	Time Sensitive	Laboratory Use Only: Temperature on Receipt (°C): A) B) C) Just sampled & rec'd on ice:	Custody Seal: Present? Intact?	Yes	No	N/A
J. WOOLLS	JULY 20/20	2:00 PM	[illegible]	2020/07/21	09:04	☐					

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS AND SAMPLES ANALYZED OUTSIDE REGULATORY HOLD TIMES.

COC-1035

SEE ACIR

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:16p No. W168775
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 10.7C
Samplers: Trisha Oud

Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
Valley View #1 38473	21Jun22	10:30a	0	2	0	0	0

WATER DISTRICT SCREEN

Sample	Date	Time	Lactose Fermentors	Coliforms Total	Fecal	E.coli	Total Aeromonas	Sulfur Reducing/ Iron Bacteria	Yeast/Fungi	TPC*
Valley View #1 38473	21Jun22	10:30a	0.02	ND	ND	ND	ND	ND / ND	ND / ND	6.0

* all counts are colony forming units per milli-litre

TC = total coliform bacteria FC = fecal coliform bacteria (aka Thermotolerant Coliforms)
NC = non-coliform bacteria ND = none detected
TPC = total plate count- spread plate method - 35C/48hr TGEA FDA/BAM 9th ed, Oct 2020
CFU = colony forming units

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 9th ed, Oct 2020
Bergy's Manual of Systematic Bacteriology vol 1, AOAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

Comments:
For Interpretation of Results:
Total, Fecal Coliforms or E.coli present greater than 0 CFU/100mL (0 CFU/mL):
IF Coliform numbers exceed safe limits for drinking water- water is not suitable for drinking without treatment.

Total Non-coliform bacteria (=Lactose Fermentors) equal to or greater than 200 CFU/100mL (2.0 CFU/mL):
IF the number organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

If Total Plate Count bacteria are -
A) greater than 100 CFU/mL:
high numbers of microbial organisms indicate that this water supply should be monitored on a seasonal basis.
B) greater than 500 CFU/mL:
the number of organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

- see following page for chemistry results -

W. Riggs
Sr. Microbiologist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL.: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:16p No. W168775 pg2
Source Well
Type of Sample water
No. of Samples 1
Comments Arrival temp.: 10.7C
Sampler: Trisha Oud

Sample: Valley View #1 38473 21Jun22 10:30a

ELEMENTS		SAMPLE	UNITS	Maximum Limits Permissible In Drinking Water*
1) Aluminium	Al	0.031	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	1.39	ug/L	10.0 ug/L
4) Barium	Ba	<0.009	mg/L	2.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	0.394	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.010	ug/L	7.00 ug/L
8) Calcium	Ca	20.6	mg/L	200 mg/L
9) Chromium	Cr	0.003	mg/L	0.050 mg/L
10) Cobalt	Co	<0.005	mg/L	no limit listed
11) Copper	Cu	<0.008	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	0.011	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	<0.500	ug/L	5.00 ug/L
16) Magnesium	Mg	8.74	mg/L	50.0 mg/L
17) Manganese	Mn	<0.004	mg/L	0.120 MAC 0.020 AO
18) Mercury	Hg	<0.010	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.005	mg/L	no limit listed
20) Nickel	Ni	<0.004	mg/L	no limit listed
21) Phosphorus	P	0.021	mg/L	no limit listed
22) Potassium	K	0.620	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	5.91	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	no limit listed
27) Sodium	Na	5.63	mg/L	200 mg/L
28) Strontium	Sr	0.060	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	0.015	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		87.4	mg/L	75-150 mg/L = mod.hard
pH		7.67	units	7.0 to 10.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of the Canadian Council of Resource and Environment Ministers - Guidelines for Canadian Drinking Water Quality, 2020.

Comments:
All constituents tested meet Canadian and B.C. drinking water standards.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:16p No. W168775 pg3
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 10.7C
Sampler: Trisha Oud

SAMPLE	DATE	TIME	Alkalinity (mg/L)	NH_3-N (ug/L)	Cl^- (mg/L)	Colour (TCU)	E.C. (uS/cm)
Valley View #1 38473	21Jun22	10:30a	95.0	5.90	11.5	ND	198
Lab Blank			ND	ND	ND	ND	ND
S_o			0.100	0.254	0.015	0.300	0.300
REF. VALUE			100	10.0	10.0	5.00	147
STD ± 2SD			110 ± 7.54	9.94 ± 0.799	10.8 ± 1.01	4.92 ± 0.411	142 ± 12.0

SAMPLE	DATE	TIME	CORROSIVITY (Is @20C)	F^- (mg/L)	S^{2-} (ug/L)	TKN (mg/L)	NO_3-N (ug/L)
Valley View #1 38473	21Jun22	10:30a	-0.426	0.073	ND	0.022	366
Lab Blank				ND	ND	ND	ND
S_o				0.007	0.007	0.012	0.160
REF. VALUE				1.00	50.0	1.00	10.0
STD ± 2SD				1.08 ± 0.089	48.2 ± 0.442	0.980 ± 0.091	9.88 ± 0.782

SAMPLE	DATE	TIME	NO_2-N (ug/L)	SO_4^{2-} (mg/L)	T.O.C. (mg/L)	T&L (mg/L)	TDS (mg/L)
Valley View #1 38473	21Jun22	10:30a	ND	6.31	0.750	ND	115
Lab Blank			ND	ND	ND	ND	ND
S_o			0.300	0.075	0.300	0.070	0.010
REF. VALUE			10.0	10.0	5.00	1.00	200
STD ± 2SD			10.6 ± 0.812	10.9 ± 0.833	4.88 ± 0.492	0.929 ± 0.079	203 ± 17.4

SAMPLE	DATE	TIME	Turbidity (NTU)	UVT (%)
Valley View #1 38473	21Jun22	10:30a	0.330	98.5
Lab Blank			ND	ND
S_o			0.015	0.003
REF. VALUE			40.0	90.0
STD ± 2SD			39.0 ± 4.07	90.3 ± 0.020

SD = standard deviation; REF VALUE = primary or secondary reference material
STD = secondary standard calibrated to primary standard reference material
S_o = standard deviation at zero analyte concentration; method detection limit is generally considered to be 3x S_o value
ND = none detected n/a = not applicable

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Laboratory Reports - Valleyview Well 2

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Your C.O.C. #: wi023232, WI023232

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908448
Version: 3 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050475
Received: 2020/07/20, 14:05

Sample Matrix: Drinking Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH (1)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2320 B m
Chloride/Sulphate by Auto Colourimetry (1)	1	N/A	2020/07/21	BBY6SOP-00011 / BBY6SOP-00017	SM23-4500-Cl/SO4-E m
Colour (True) by Kone Lab (1)	1	N/A	2020/07/21	BBY6SOP-00057	SM 23 2120 C m
Conductivity @25C (1)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2510 B m
Fluoride (1)	1	N/A	2020/07/24	BBY6SOP-00048	SM 23 4500-F C m
Sulphide (as H2S)	1	N/A	2020/07/24		Auto Calc
Hardness Total (calculated as CaCO3) (1, 2)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Mercury (Total) by CV (1)	1	2020/07/22	2020/07/22	AB SOP-00084	BCMOE BCLM Oct2013 m
Heterotropic Plate Count (MF) in Water (1)	1	N/A	2020/07/21	BBY4SOP-00003	SM 23 9215
Na, K, Ca, Mg, S by CRC ICPMS (total) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total) (1)	1	N/A	2020/07/22	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
Nitrogen (Total) (1)	1	N/A	2020/07/24	BBY6SOP-00016	SM 23 4500-N C m
Ammonia-N (Total)	1	N/A	2020/07/24	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate + Nitrite (N) (1)	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA (1)	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrogen - Nitrate (as N) (1)	1	N/A	2020/07/22	BBY WI-00033	Auto Calc
Nitrogen (Tot. Organic) Calculation (1)	1	N/A	2020/07/24	BBY WI-00033	Auto Calc
pH @25°C (1, 3)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 4500-H+ B m
Sat. pH and Langelier Index (@ 4.4C) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Sat. pH and Langelier Index (@ 60C) (1)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Total Sulphide	1	N/A	2020/07/24	AB SOP-00080	SM 23 4500 S2-A D Fm
Total Dissolved Solids (Filt. Residue) (1)	1	2020/07/23	2020/07/24	BBY6SOP-00033	SM 23 2540 C m
Total Coliform & E.Coli by MF-Chromocult (1)	1	N/A	2020/07/21	BBY4SOP-00143	Merck KGaA Version 1
Carbon (Total Organic) (4)	1	N/A	2020/07/25	AB SOP-00087	MMCW 119 1996 m
Turbidity (1)	1	N/A	2020/07/21	BBY6SOP-00027	SM 23 2130 B m
UV absorbance @254nm-Unfiltered	1	N/A	2020/07/23	CAL SOP-00274	SM 23 5910B m
UV transmittance @254nm-Unfiltered	1	N/A	2020/07/23		Auto-Calc

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your C.O.C. #: wi023232, WI023232

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908448
Version: 3 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050475
Received: 2020/07/20, 14:05

by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BV Labs Vancouver
(2) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(4) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bvlabs.com
Phone# (403) 291-3077
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C050475
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6987		
Sampling Date					2020/07/20 09:45		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #2 RAW	RDL	QC Batch
ANIONS							
Nitrite (N)	mg/L	1	-	-	<0.0050	0.0050	9931651
Calculated Parameters							
Total Hardness (CaCO3)	mg/L	-	-	-	63.7	0.50	9928639
Nitrate (N)	mg/L	10	-	-	0.179	0.020	9929144
Total Organic Nitrogen (N)	mg/L	-	-	-	0.038	0.020	9929439
Sulphide (as H2S)	mg/L	-	0.05	-	<0.0020	0.0020	9929450
Transmittance at 254nm	%T/cm	-	-	-	>97.7	N/A	9929454
Misc. Inorganics							
Conductivity	uS/cm	-	-	-	170	2.0	9931277
pH	pH	-	-	7.0:10.5	7.64	N/A	9931276
Total Organic Carbon (C)	mg/L	-	-	-	<0.50	0.50	9935380
Total Dissolved Solids	mg/L	-	-	-	98	10	9932375
Anions							
Alkalinity (PP as CaCO3)	mg/L	-	-	-	<1.0	1.0	9931275
Alkalinity (Total as CaCO3)	mg/L	-	-	-	69	1.0	9931275
Bicarbonate (HCO3)	mg/L	-	-	-	84	1.0	9931275
Carbonate (CO3)	mg/L	-	-	-	<1.0	1.0	9931275
Dissolved Fluoride (F)	mg/L	1.5	-	-	0.061	0.050	9934007
Hydroxide (OH)	mg/L	-	-	-	<1.0	1.0	9931275
Total Sulphide	mg/L	-	0.05	-	<0.0018	0.0018	9934727
Dissolved Chloride (Cl)	mg/L	-	250	-	7.0	1.0	9929739
Dissolved Sulphate (SO4)	mg/L	-	500	-	4.9	1.0	9929739
MISCELLANEOUS							
True Colour	Col. Unit	-	15	-	<5.0	5.0	9929954
UV absorbance (254nm)	AU/cm	-	-	-	<0.010	0.010	9932284
Nutrients							
Total Ammonia (N)	mg/L	-	-	-	0.068	0.015	9933378
Nitrate plus Nitrite (N)	mg/L	-	-	-	0.179	0.020	9931650
Total Nitrogen (N)	mg/L	-	-	-	0.284	0.020	9933761
Physical Properties							
Turbidity	NTU	see remark	see remark	see remark	<0.10	0.10	9930120

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

BV Labs - Partial/Rush Results

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6987		
Sampling Date					2020/07/20 09:45		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #2 RAW	RDL	QC Batch
Elements							
Total Mercury (Hg)	ug/L	1	-	-	0.0240	0.0019	9930940
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	-	-	100	<3.0	3.0	9930844
Total Antimony (Sb)	ug/L	6	-	-	<0.50	0.50	9930844
Total Arsenic (As)	ug/L	10	-	-	1.85	0.10	9930844
Total Barium (Ba)	ug/L	1000	-	-	2.8	1.0	9930844
Total Beryllium (Be)	ug/L	-	-	-	<0.10	0.10	9930844
Total Bismuth (Bi)	ug/L	-	-	-	<1.0	1.0	9930844
Total Boron (B)	ug/L	5000	-	-	<50	50	9930844
Total Cadmium (Cd)	ug/L	5	-	-	<0.010	0.010	9930844
Total Chromium (Cr)	ug/L	50	-	-	2.3	1.0	9930844
Total Cobalt (Co)	ug/L	-	-	-	<0.20	0.20	9930844
Total Copper (Cu)	ug/L	2000	1000	-	0.23	0.20	9930844
Total Iron (Fe)	ug/L	-	300	-	<5.0	5.0	9930844
Total Lead (Pb)	ug/L	5	-	-	0.41	0.20	9930844
Total Manganese (Mn)	ug/L	120	20	-	3.7	1.0	9930844
Total Molybdenum (Mo)	ug/L	-	-	-	<1.0	1.0	9930844
Total Nickel (Ni)	ug/L	-	-	-	<1.0	1.0	9930844
Total Selenium (Se)	ug/L	50	-	-	0.35	0.10	9930844
Total Silicon (Si)	ug/L	-	-	-	9480	100	9930844
Total Silver (Ag)	ug/L	-	-	-	<0.020	0.020	9930844
Total Strontium (Sr)	ug/L	7000	-	-	49.6	1.0	9930844
Total Thallium (Tl)	ug/L	-	-	-	<0.010	0.010	9930844
Total Tin (Sn)	ug/L	-	-	-	<5.0	5.0	9930844
Total Titanium (Ti)	ug/L	-	-	-	<5.0	5.0	9930844
Total Uranium (U)	ug/L	20	-	-	<0.10	0.10	9930844
Total Vanadium (V)	ug/L	-	-	-	7.0	5.0	9930844
Total Zinc (Zn)	ug/L	-	5000	-	<5.0	5.0	9930844
Total Zirconium (Zr)	ug/L	-	-	-	<0.10	0.10	9930844
Total Calcium (Ca)	mg/L	-	-	-	14.7	0.050	9929143
Total Magnesium (Mg)	mg/L	-	-	-	6.57	0.050	9929143
Total Potassium (K)	mg/L	-	-	-	0.637	0.050	9929143

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C050475
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6987		
Sampling Date					2020/07/20 09:45		
COC Number					WI023232		
	UNITS	MAC	AO	OG	VALLEYVIEW WELL #2 RAW	RDL	QC Batch
Total Sodium (Na)	mg/L	-	200	-	5.80	0.050	9929143
Total Sulphur (S)	mg/L	-	-	-	<3.0	3.0	9929143
Microbiological Param.							
Heterotrophic Plate Count	CFU/mL	-	-	-	3	1	9929692
Total Coliforms	CFU/100mL	0	-	-	0	N/A	9929691
E. coli	CFU/100mL	0	-	-	0	N/A	9929691
Calculated Parameters							
Langelier Index (@ 4.4C)	N/A	-	-	-	-1.26	N/A	9929444
Langelier Index (@ 60C)	N/A	-	-	-	-0.214	N/A	9929448
Saturation pH (@ 4.4C)	N/A	-	-	-	8.90	N/A	9929444
Saturation pH (@ 60C)	N/A	-	-	-	7.85	N/A	9929448

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.7°C

Sample YC6987 [VALLEYVIEW WELL #2 RAW] : Sample was analyzed past recommended hold time for Heterotropic Plate Count (MF) in Water. Sample was analyzed past recommended hold time for Iron Related Bacteria. Sample was analyzed past recommended hold time for Sulphate Reducing Bacteria.
MAC,AO,OG: The guidelines that have been included in this report have been taken from the Canadian Drinking Water Quality Summary Table,June 2019.

Criteria A = Maximum Acceptable Concentration (MAC) / Criteria B = Aesthetic Objectives (AO) / Criteria C = Operational Guidance Values (OG)
It is recommended to consult these guidelines when interpreting your data since there are non-numerical guidelines that are not included on this report.

Turbidity Guidelines:
1. Chemically assisted filtration: less than or equal to 0.3 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 1.0 NTU at any time.
2. Slow sand / diatomaceous earth filtration: less than or equal to 1.0 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 3.0 NTU at any time.
3. Membrane filtration: less than or equal to 0.1 NTU in 99% of the measurements made or at least 99% of the time each calendar month. Shall not exceed 0.3 NTU at any time.
4. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less.
Measurement of Uncertainty has not been accounted for when stating conformity to the selected criteria, where applicable.

Results relate only to the items tested.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9929739	Dissolved Chloride (Cl)	2020/07/21	104	80 - 120	103	80 - 120	<1.0	mg/L	1.3	20
9929739	Dissolved Sulphate (SO4)	2020/07/21	NC	80 - 120	94	80 - 120	<1.0	mg/L	1.4	20
9929954	True Colour	2020/07/21			97	80 - 120	<5.0	Col. Unit	NC	20
9930120	Turbidity	2020/07/21			101	80 - 120	<0.10	NTU	2.7	20
9930844	Total Aluminum (Al)	2020/07/22	98	80 - 120	101	80 - 120	<3.0	ug/L	2.4	20
9930844	Total Antimony (Sb)	2020/07/22	104	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
9930844	Total Arsenic (As)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Barium (Ba)	2020/07/22	102	80 - 120	102	80 - 120	<1.0	ug/L	1.0	20
9930844	Total Beryllium (Be)	2020/07/22	98	80 - 120	100	80 - 120	<0.10	ug/L		
9930844	Total Bismuth (Bi)	2020/07/22	87	80 - 120	92	80 - 120	<1.0	ug/L		
9930844	Total Boron (B)	2020/07/22	97	80 - 120	99	80 - 120	<50	ug/L	NC	20
9930844	Total Cadmium (Cd)	2020/07/22	102	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
9930844	Total Chromium (Cr)	2020/07/22	99	80 - 120	101	80 - 120	<1.0	ug/L	NC	20
9930844	Total Cobalt (Co)	2020/07/22	99	80 - 120	101	80 - 120	<0.20	ug/L	NC	20
9930844	Total Copper (Cu)	2020/07/22	96	80 - 120	100	80 - 120	<0.20	ug/L	0.35	20
9930844	Total Iron (Fe)	2020/07/22	101	80 - 120	104	80 - 120	<5.0	ug/L	2.2	20
9930844	Total Lead (Pb)	2020/07/22	100	80 - 120	101	80 - 120	<0.20	ug/L		
9930844	Total Manganese (Mn)	2020/07/22	99	80 - 120	102	80 - 120	<1.0	ug/L	8.0	20
9930844	Total Molybdenum (Mo)	2020/07/22	103	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
9930844	Total Nickel (Ni)	2020/07/22	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
9930844	Total Selenium (Se)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Silicon (Si)	2020/07/22	109	80 - 120	111	80 - 120	<100	ug/L	0.51	20
9930844	Total Silver (Ag)	2020/07/22	98	80 - 120	99	80 - 120	<0.020	ug/L	NC	20
9930844	Total Strontium (Sr)	2020/07/22	105	80 - 120	105	80 - 120	<1.0	ug/L	0.78	20
9930844	Total Thallium (Tl)	2020/07/22	101	80 - 120	102	80 - 120	<0.010	ug/L		
9930844	Total Tin (Sn)	2020/07/22	101	80 - 120	102	80 - 120	<5.0	ug/L		
9930844	Total Titanium (Ti)	2020/07/22	101	80 - 120	105	80 - 120	<5.0	ug/L		
9930844	Total Uranium (U)	2020/07/22	103	80 - 120	103	80 - 120	<0.10	ug/L	NC	20
9930844	Total Vanadium (V)	2020/07/22	100	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zinc (Zn)	2020/07/22	99	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zirconium (Zr)	2020/07/22	103	80 - 120	104	80 - 120	<0.10	ug/L		
9930940	Total Mercury (Hg)	2020/07/22	93	80 - 120	99	80 - 120	<0.0019	ug/L	NC	20
9931275	Alkalinity (PP as CaCO3)	2020/07/22					<1.0	mg/L	NC	20

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9931275	Alkalinity (Total as CaCO3)	2020/07/22	NC	80 - 120	98	80 - 120	<1.0	mg/L	0.30	20
9931275	Bicarbonate (HCO3)	2020/07/22					<1.0	mg/L	0.30	20
9931275	Carbonate (CO3)	2020/07/22					<1.0	mg/L	NC	20
9931275	Hydroxide (OH)	2020/07/22					<1.0	mg/L	NC	20
9931276	pH	2020/07/22			101	97 - 103			0.38	N/A
9931277	Conductivity	2020/07/22			100	80 - 120	<2.0	uS/cm	0.21	10
9931650	Nitrate plus Nitrite (N)	2020/07/22	107	80 - 120	110	80 - 120	<0.020	mg/L	2.9	25
9931651	Nitrite (N)	2020/07/22	97	80 - 120	102	80 - 120	<0.0050	mg/L	NC	20
9932284	UV absorbance (254nm)	2020/07/23			96	N/A	<0.010	AU/cm	NC	20
9932375	Total Dissolved Solids	2020/07/24	103	80 - 120	92	80 - 120	<10	mg/L	3.7	20
9933378	Total Ammonia (N)	2020/07/24	NC	80 - 120	108	80 - 120	<0.015	mg/L	0.010 (1)	20
9933761	Total Nitrogen (N)	2020/07/24	102	80 - 120	97	80 - 120	<0.020	mg/L	1.7	20
9934007	Dissolved Fluoride (F)	2020/07/24	100	80 - 120	102	80 - 120	<0.050	mg/L	0	20
9934727	Total Sulphide	2020/07/24	103	80 - 120	106	80 - 120	<0.0018	mg/L	6.9	20
9935380	Total Organic Carbon (C)	2020/07/25	104	80 - 120	100	80 - 120	<0.50	mg/L	1.2	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

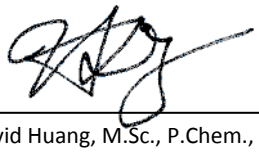
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

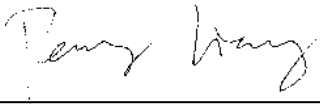
Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



David Huang, M.Sc., P.Chem., QP, Scientific Services Manager



Harry (Peng) Liang, Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs - Partial/Rush Results

WI023232

BV Job #: C050475_COC

BUREAU VERITAS

Victoria: Unit 1, 851 Viewfield Rd, Victoria, BC V9A 4V2 Ph: (250) 386-6112 Toll Free: (833) 282-5227
Courtenay: 2755 B Moray Ave, Courtenay, BC V9N 8M9 Ph: (250) 338-7788 Toll Free: (833) 282-5227

Company (Invoicing): COWICHAN BAY WATER DIST.
Company (Reporting): IFC WATER SOLUTIONS LTD.
Contact Name: JOE WOOLLS
Mailing Address:

Phone #:
E-mail: joe@ifcwater.ca

After Hours Contact #:

☑ Regular Turnaround Time (TAT) (5 days for most tests)
☐ **RUSH** Please contact the lab **Surcharges will be applied**

Project Name: Date Required:

SPECIAL INSTRUCTIONS:
Return Cooler ☐ **Ship Sample Bottles (please specify)** ☐

VANCOUVER ISLAND HEALTH AUTHORITY
Medical Health Officer: 1.800.204.6166
Drinking Water Officer: 250.755.6215

Payment Received: Yes ☐ **No** ☐

	Sample Identification (Sample Location &/or Description)	Sample Location (eg. Tap, Wellhead)	Date/Time Sampled (24hr)	PLEASE CIRCLE: Samples from a Drinking Water Source? Y/N	Does source supply multiple households? Y/N	Are individuals drinking this water? Y/N	Are you on a boil water advisory? Y/N	ANALYSIS REQUESTED PLEASE SELECT BELOW: Drinking Water Scan	Home Safety Scan	Total Metals Scan including Hardness & Hg	Total Coliform and E. Coli	VIHA ICP	Report Current Drinking Water Criteria
1	VALLEYVIEW WELL #1 RAW	PUMP STN.	JULY 20/20	(Y) N	(Y) N	(Y) N	Y (N)					X	X
2			9:15AM	Y N	Y N	Y N	Y N						X
3	VALLEYVIEW WELL #2 RAW	PUMP STN	9:45AM	(Y) N	(Y) N	(Y) N	Y (N)					X	X
4				Y N	Y N	Y N	Y N						X
5				Y N	Y N	Y N	Y N						X

All information on this form must be completed before testing

If your drinking water source services two or more homes, we strongly recommend that you contact local health authorities to find out how the Drinking Water Protection Act applies to this system. Please be aware that, in this situation, we are legally obligated to report results directly to local health authorities.

Sample Collection

For determining drinking water quality, samples should be representative of the water that will be consumed; therefore, we suggest sampling at the kitchen tap. However, other sampling locations may be used to determine pre-treatment water quality or for troubleshooting purposes.

1. Remove aerator/screen from faucet.
2. Let the water run for 5 minutes.
3. Label the bottle with your name, date and time you are taking the sample.
4. Fill all bottle(s) provided. Take care not to touch the inside of the bottle or underside of cap.
5. Cap the sample and place it in fridge or small cooler with icepack.

Remember: It is important that you do not contaminate the sample as you handle the container. Wash your hands before you start and be careful not to touch the rim of the bottle or the inside of the cap.

Bureau Veritas
RECEIVED IN VICTORIA
D. Nordbrugt
JUL 20 2020 @ 1405
By:
Temps: 14 | 15 | 15 on ice

DON'T:

Don't rinse or boil any bottle you receive from the lab.

Don't let the sample sit out overnight, please refrigerate.

Don't freeze the sample.

Sample Transportation & Delivery

1. Samples should arrive at the laboratories (Courtenay or Victoria) within 24 hrs of sampling. Ship samples between Monday and Thursday to avoid lab scheduling conflicts.
2. The sample should be kept cool during transit (<8°C - refrigerated or packed on ice).
3. Fill out the Chain of Custody (COC) form beside these instructions and submit with the sample. Incomplete or missing COC's will result in delays impacting turnaround time and the lab's ability to proceed with time sensitive tests.
4. Delivery Options:
   Personally deliver samples to Courtenay or Victoria (Samples will be forwarded to Burnaby on your behalf unless analysis is completed locally in Courtenay. Please consider sample hold times.)
   Overnight shipping to Burnaby: If you ship a sample on the same day that it was collected you can use an overnight courier.
   Same day shipping: Available in some areas. Please contact the lab for details.

Print name and sign: *Relinquished By:	Date (yy/mm/dd):	Time (24 hr):	Print name and sign: Received by:	Date (yy/mm/dd):	Time (24hr):	Time Sensitive	Laboratory Use Only: Temperature on Receipt (°C): A) B) C) Just sampled & rec'd on ice:	Custody Seal: Present? Intact?	Yes	No	N/A
J. WOOLLS	JULY 20/20	2:00 PM	[illegible]	2020/07/21	09:04	☐					

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS AND SAMPLES ANALYZED OUTSIDE REGULATORY HOLD TIMES.

COC-1035

SEE ACIR

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:13p No. W168774
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 10.7C
Sampler: Trisha Oud

Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
Valley View #2 13088	21Jun22	10:45a	0	0	0	0	0

WATER DISTRICT SCREEN

Sample	Date	Time	Lactose Fermentors	Coliforms Total	Fecal	E.coli	Total Aeromonas	Sulfur Reducing/ Iron Bacteria	Yeast/Fungi	TPC*
Valley View #2 13088	21Jun22	10:45a	ND	ND	ND	ND	ND	ND / ND	ND / ND	0.04

* all counts are colony forming units per milli-litre

TC = total coliform bacteria FC = fecal coliform bacteria (aka Thermotolerant Coliforms)
NC = non-coliform bacteria ND = none detected
TPC = total plate count- spread plate method - 35C/48hr TGEA FDA/BAM 9th ed, Oct 2020
CFU = colony forming units

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 9th ed, Oct 2020
Bergy's Manual of Systematic Bacteriology vol 1, AOAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

Comments:
For Interpretation of Results:
Total, Fecal Coliforms or E.coli present greater than 0 CFU/100mL (0 CFU/mL):
IF Coliform numbers exceed safe limits for drinking water- water is not suitable for drinking without treatment.

Total Non-coliform bacteria (=Lactose Fermentors) equal to or greater than 200 CFU/100mL (2.0 CFU/mL):
IF the number organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

If Total Plate Count bacteria are -
A) greater than 100 CFU/mL:
high numbers of microbial organisms indicate that this water supply should be monitored on a seasonal basis.
B) greater than 500 CFU/mL:
the number of organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

- see following page for chemistry results -

W. Riggs
Sr. Microbiologist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

Date 21Jun22 2:13p No. W168774 pg2
Source Well
Type of Sample water
No. of Samples 1

TEL: (250) 743-3075
admin@independentpump.ca

Comments Arrival temp.: 10.7C
Sampler: Trisha Oud

Sample: Valley View #2 13088 21Jun22 10:45a

ELEMENTS		SAMPLE	UNITS	Maximum Limits Permissible In Drinking Water*
1) Aluminium	Al	0.032	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	1.82	ug/L	10.0 ug/L
4) Barium	Ba	<0.009	mg/L	2.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	0.427	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.010	ug/L	7.00 ug/L
8) Calcium	Ca	20.8	mg/L	200 mg/L
9) Chromium	Cr	0.003	mg/L	0.050 mg/L
10) Cobalt	Co	<0.005	mg/L	no limit listed
11) Copper	Cu	<0.008	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	0.010	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	<0.500	ug/L	5.00 ug/L
16) Magnesium	Mg	7.60	mg/L	50.0 mg/L
17) Manganese	Mn	0.004	mg/L	0.120 MAC 0.020 AO
18) Mercury	Hg	<0.010	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.005	mg/L	no limit listed
20) Nickel	Ni	<0.004	mg/L	no limit listed
21) Phosphorus	P	0.028	mg/L	no limit listed
22) Potassium	K	0.640	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	5.89	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	no limit listed
27) Sodium	Na	7.33	mg/L	200 mg/L
28) Strontium	Sr	0.060	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	0.016	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		83.2	mg/L	75-150 mg/L = mod.hard
pH		7.86	units	7.0 to 10.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of the Canadian Council of Resource and Environment Ministers - Guidelines for Canadian Drinking Water Quality, 2020.

Comments:
All constituents tested meet Canadian and B.C. drinking water standards.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:13p No. W168774 pg3
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 10.7C
Sampler: Trisha Oud

SAMPLE	DATE	TIME	Alkalinity (mg/L)	NH_3-N (ug/L)	Cl^- (mg/L)	Colour (TCU)	E.C. (uS/cm)
Valley View #2 13088	21Jun22	10:45a	90.0	3.10	8.95	0.300	187
Lab Blank			ND	ND	ND	ND	ND
S_o			0.100	0.254	0.015	0.300	0.300
REF. VALUE			100	10.0	10.0	5.00	147
STD ± 2SD			110 ± 7.54	9.94 ± 0.799	10.8 ± 1.01	4.92 ± 0.411	142 ± 12.0

SAMPLE	DATE	TIME	CORROSIVITY (Is @20C)	F^- (mg/L)	S^{2-} (ug/L)	TKN (mg/L)	NO_3-N (ug/L)
Valley View #2 13088	21Jun22	10:45a	-0.255	0.071	ND	0.004	188
Lab Blank				ND	ND	ND	ND
S_o				0.007	0.007	0.012	0.160
REF. VALUE				1.00	50.0	1.00	10.0
STD ± 2SD				1.08 ± 0.089	48.2 ± 0.442	0.980 ± 0.091	9.88 ± 0.782

SAMPLE	DATE	TIME	NO_2-N (ug/L)	SO_4^{2-} (mg/L)	T.O.C. (mg/L)	T&L (mg/L)	TDS (mg/L)
Valley View #2 13088	21Jun22	10:45a	ND	7.07	0.510	ND	108
Lab Blank			ND	ND	ND	ND	ND
S_o			0.300	0.075	0.300	0.070	0.010
REF. VALUE			10.0	10.0	5.00	1.00	200
STD ± 2SD			10.6 ± 0.812	10.9 ± 0.833	4.88 ± 0.492	0.929 ± 0.079	203 ± 17.4

SAMPLE	DATE	TIME	Turbidity (NTU)	UVT (%)
Valley View #2 13088	21Jun22	10:45a	0.320	99.4
Lab Blank			ND	ND
S_o			0.015	0.003
REF. VALUE			40.0	90.0
STD ± 2SD			39.0 ± 4.07	90.3 ± 0.020

SD = standard deviation; REF VALUE = primary or secondary reference material
STD = secondary standard calibrated to primary standard reference material
S_o = standard deviation at zero analyte concentration; method detection limit is generally considered to be 3x S_o value
ND = none detected n/a = not applicable

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Laboratory Reports - Pavenham Well

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Your C.O.C. #: WI023231

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908444
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050473
Received: 2020/07/20, 14:05

Sample Matrix: Drinking Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2320 B m
Chloride/Sulphate by Auto Colourimetry	1	N/A	2020/07/21	BBY6SOP-00011 / BBY6SOP-00017	SM23-4500-Cl/SO4-E m
Colour (True) by Kone Lab	1	N/A	2020/07/21	BBY6SOP-00057	SM 23 2120 C m
Conductivity @25C	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 2510 B m
Fluoride	1	N/A	2020/07/24	BBY6SOP-00048	SM 23 4500-F C m
Sulphide (as H2S) (1)	1	N/A	2020/07/24		Auto Calc
Hardness Total (calculated as CaCO3) (2)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Mercury (Total) by CV	1	2020/07/22	2020/07/22	AB SOP-00084	BCMOE BCLM Oct2013 m
Heterotropic Plate Count (MF) in Water	1	N/A	2020/07/21	BBY4SOP-00003	SM 23 9215
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total)	1	N/A	2020/07/22	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
Nitrogen (Total)	1	N/A	2020/07/24	BBY6SOP-00016	SM 23 4500-N C m
Ammonia-N (Total) (1)	1	N/A	2020/07/24	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate + Nitrite (N)	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA	1	N/A	2020/07/22	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrogen - Nitrate (as N)	1	N/A	2020/07/22	BBY WI-00033	Auto Calc
Nitrogen (Tot. Organic) Calculation	1	N/A	2020/07/24	BBY WI-00033	Auto Calc
pH @25°C (3)	1	N/A	2020/07/22	BBY6SOP-00026	SM 23 4500-H+ B m
Sat. pH and Langelier Index (@ 4.4C)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Sat. pH and Langelier Index (@ 60C)	1	N/A	2020/07/23	BBY WI-00033	Auto Calc
Total Sulphide (1)	1	N/A	2020/07/24	AB SOP-00080	SM 23 4500 S2-A D Fm
Total Dissolved Solids (Filt. Residue)	1	2020/07/23	2020/07/24	BBY6SOP-00033	SM 23 2540 C m
Total Coliform & E.Coli by MF-Chromocult	1	N/A	2020/07/21	BBY4SOP-00143	Merck KGaA Version 1
Carbon (Total Organic) (1, 4)	1	N/A	2020/07/26	AB SOP-00087	MMCW 119 1996 m
Turbidity	1	N/A	2020/07/21	BBY6SOP-00027	SM 23 2130 B m
UV absorbance @254nm-Unfiltered (1)	1	N/A	2020/07/23	CAL SOP-00274	SM 23 5910B m
UV transmittance @254nm-Unfiltered (1)	1	N/A	2020/07/23		Auto-Calc

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used

Your C.O.C. #: WI023231

Attention: CB WATERWORKS

Cowichan Bay Waterworks
1760 Pavenham Rd
Cowichan Bay, BC
Canada V0R 1N1

Report Date: 2020/07/28
Report #: R2908444
Version: 2 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

BV LABS JOB #: C050473
Received: 2020/07/20, 14:05

by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BV Labs Calgary Environmental
(2) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(4) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bvlabs.com
Phone# (604) 734 7276

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C050473
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6980		
Sampling Date					2020/07/20 12:50		
COC Number					WI023231		
	UNITS	MAC	AO	OG	OFFICE WELL RAW	RDL	QC Batch
ANIONS							
Nitrite (N)	mg/L	1	-	-	<0.0050	0.0050	9931654
Calculated Parameters							
Total Hardness (CaCO3)	mg/L	-	-	-	120	0.50	9928639
Nitrate (N)	mg/L	10	-	-	<0.020	0.020	9929144
Total Organic Nitrogen (N)	mg/L	-	-	-	<0.020	0.020	9929439
Sulphide (as H2S)	mg/L	-	0.05	-	0.0067	0.0020	9929450
Transmittance at 254nm	%T/cm	-	-	-	64.9	N/A	9929454
Misc. Inorganics							
Conductivity	uS/cm	-	-	-	290	2.0	9931277
pH	pH	-	-	7.0:10.5	8.11	N/A	9931291
Total Organic Carbon (C)	mg/L	-	-	-	1.9	0.50	9935700
Total Dissolved Solids	mg/L	-	-	-	170	10	9932375
Anions							
Alkalinity (PP as CaCO3)	mg/L	-	-	-	<1.0	1.0	9931275
Alkalinity (Total as CaCO3)	mg/L	-	-	-	150	1.0	9931275
Bicarbonate (HCO3)	mg/L	-	-	-	190	1.0	9931275
Carbonate (CO3)	mg/L	-	-	-	<1.0	1.0	9931275
Dissolved Fluoride (F)	mg/L	1.5	-	-	0.17	0.050	9934007
Hydroxide (OH)	mg/L	-	-	-	<1.0	1.0	9931275
Total Sulphide	mg/L	-	0.05	-	0.0063	0.0018	9933839
Dissolved Chloride (Cl)	mg/L	-	250	-	3.2	1.0	9929739
Dissolved Sulphate (SO4)	mg/L	-	500	-	<1.0	1.0	9929739
MISCELLANEOUS							
True Colour	Col. Unit	-	15	-	6.3	5.0	9929954
UV absorbance (254nm)	AU/cm	-	-	-	0.188	0.010	9932284
Nutrients							
Total Ammonia (N)	mg/L	-	-	-	1.3	0.015	9933378
Nitrate plus Nitrite (N)	mg/L	-	-	-	<0.020	0.020	9931653
Total Nitrogen (N)	mg/L	-	-	-	1.00	0.020	9933761
Physical Properties							
Turbidity	NTU	see remark	see remark	see remark	7.2	0.10	9930120

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

BV Labs - Partial/Rush Results

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs Job #: C050473
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6980		
Sampling Date					2020/07/20 12:50		
COC Number					WI023231		
	UNITS	MAC	AO	OG	OFFICE WELL RAW	RDL	QC Batch
Elements							
Total Mercury (Hg)	ug/L	1	-	-	<0.0019	0.0019	9930940
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	-	-	100	<3.0	3.0	9930844
Total Antimony (Sb)	ug/L	6	-	-	<0.50	0.50	9930844
Total Arsenic (As)	ug/L	10	-	-	4.10	0.10	9930844
Total Barium (Ba)	ug/L	1000	-	-	20.0	1.0	9930844
Total Beryllium (Be)	ug/L	-	-	-	<0.10	0.10	9930844
Total Bismuth (Bi)	ug/L	-	-	-	<1.0	1.0	9930844
Total Boron (B)	ug/L	5000	-	-	<50	50	9930844
Total Cadmium (Cd)	ug/L	5	-	-	<0.010	0.010	9930844
Total Chromium (Cr)	ug/L	50	-	-	<1.0	1.0	9930844
Total Cobalt (Co)	ug/L	-	-	-	<0.20	0.20	9930844
Total Copper (Cu)	ug/L	2000	1000	-	0.29	0.20	9930844
Total Iron (Fe)	ug/L	-	300	-	**1890**	5.0	9930844
Total Lead (Pb)	ug/L	5	-	-	<0.20	0.20	9930844
Total Manganese (Mn)	ug/L	120	20	-	**285**	1.0	9930844
Total Molybdenum (Mo)	ug/L	-	-	-	<1.0	1.0	9930844
Total Nickel (Ni)	ug/L	-	-	-	<1.0	1.0	9930844
Total Selenium (Se)	ug/L	50	-	-	<0.10	0.10	9930844
Total Silicon (Si)	ug/L	-	-	-	12900	100	9930844
Total Silver (Ag)	ug/L	-	-	-	<0.020	0.020	9930844
Total Strontium (Sr)	ug/L	7000	-	-	136	1.0	9930844
Total Thallium (Tl)	ug/L	-	-	-	<0.010	0.010	9930844
Total Tin (Sn)	ug/L	-	-	-	<5.0	5.0	9930844
Total Titanium (Ti)	ug/L	-	-	-	<5.0	5.0	9930844
Total Uranium (U)	ug/L	20	-	-	<0.10	0.10	9930844
Total Vanadium (V)	ug/L	-	-	-	<5.0	5.0	9930844
Total Zinc (Zn)	ug/L	-	5000	-	6.5	5.0	9930844
Total Zirconium (Zr)	ug/L	-	-	-	<0.10	0.10	9930844
Total Calcium (Ca)	mg/L	-	-	-	30.7	0.050	9929143
Total Magnesium (Mg)	mg/L	-	-	-	10.5	0.050	9929143
Total Potassium (K)	mg/L	-	-	-	1.04	0.050	9929143

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

BV Labs - Partial/Rush Results

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs Job #: C050473
Report Date: 2020/07/28

Cowichan Bay Waterworks
Sampler Initials: JW

VIHA PKG, WELLS/SPRINGS - BURNABY (DRINKING WATER)

BV Labs ID					YC6980		
Sampling Date					2020/07/20 12:50		
COC Number					WI023231		
	UNITS	MAC	AO	OG	OFFICE WELL RAW	RDL	QC Batch
Total Sodium (Na)	mg/L	-	200	-	13.3	0.050	9929143
Total Sulphur (S)	mg/L	-	-	-	<3.0	3.0	9929143
Microbiological Param.							
Heterotrophic Plate Count	CFU/mL	-	-	-	66	1	9929692
Total Coliforms	CFU/100mL	0	-	-	0	N/A	9929691
E. coli	CFU/100mL	0	-	-	0	N/A	9929691
Calculated Parameters							
Langelier Index (@ 4.4C)	N/A	-	-	-	-0.141	N/A	9929444
Langelier Index (@ 60C)	N/A	-	-	-	0.900	N/A	9929448
Saturation pH (@ 4.4C)	N/A	-	-	-	8.25	N/A	9929444
Saturation pH (@ 60C)	N/A	-	-	-	7.21	N/A	9929448

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.7°C

Version #2: Report reissued with updated company name as per client request. 20200728
MAC,AO,OG: The guidelines that have been included in this report have been taken from the Canadian Drinking Water Quality Summary Table,June 2019.

Criteria A = Maximum Acceptable Concentration (MAC) / Criteria B = Aesthetic Objectives (AO) / Criteria C = Operational Guidance Values (OG)
It is recommended to consult these guidelines when interpreting your data since there are non-numerical guidelines that are not included on this report.

Turbidity Guidelines:
1. Chemically assisted filtration: less than or equal to 0.3 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 1.0 NTU at any time.
2. Slow sand / diatomaceous earth filtration: less than or equal to 1.0 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 3.0 NTU at any time.
3. Membrane filtration: less than or equal to 0.1 NTU in 99% of the measurements made or at least 99% of the time each calendar month. Shall not exceed 0.3 NTU at any time.
4. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less.
Measurement of Uncertainty has not been accounted for when stating conformity to the selected criteria, where applicable.

Results relate only to the items tested.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9929739	Dissolved Chloride (Cl)	2020/07/21	104	80 - 120	103	80 - 120	<1.0	mg/L	1.3	20
9929739	Dissolved Sulphate (SO4)	2020/07/21	NC	80 - 120	94	80 - 120	<1.0	mg/L	1.4	20
9929954	True Colour	2020/07/21			97	80 - 120	<5.0	Col. Unit	NC	20
9930120	Turbidity	2020/07/21			101	80 - 120	<0.10	NTU	2.7	20
9930844	Total Aluminum (Al)	2020/07/22	98	80 - 120	101	80 - 120	<3.0	ug/L	2.4	20
9930844	Total Antimony (Sb)	2020/07/22	104	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
9930844	Total Arsenic (As)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Barium (Ba)	2020/07/22	102	80 - 120	102	80 - 120	<1.0	ug/L	1.0	20
9930844	Total Beryllium (Be)	2020/07/22	98	80 - 120	100	80 - 120	<0.10	ug/L		
9930844	Total Bismuth (Bi)	2020/07/22	87	80 - 120	92	80 - 120	<1.0	ug/L		
9930844	Total Boron (B)	2020/07/22	97	80 - 120	99	80 - 120	<50	ug/L	NC	20
9930844	Total Cadmium (Cd)	2020/07/22	102	80 - 120	100	80 - 120	<0.010	ug/L	NC	20
9930844	Total Chromium (Cr)	2020/07/22	99	80 - 120	101	80 - 120	<1.0	ug/L	NC	20
9930844	Total Cobalt (Co)	2020/07/22	99	80 - 120	101	80 - 120	<0.20	ug/L	NC	20
9930844	Total Copper (Cu)	2020/07/22	96	80 - 120	100	80 - 120	<0.20	ug/L	0.35	20
9930844	Total Iron (Fe)	2020/07/22	101	80 - 120	104	80 - 120	<5.0	ug/L	2.2	20
9930844	Total Lead (Pb)	2020/07/22	100	80 - 120	101	80 - 120	<0.20	ug/L		
9930844	Total Manganese (Mn)	2020/07/22	99	80 - 120	102	80 - 120	<1.0	ug/L	8.0	20
9930844	Total Molybdenum (Mo)	2020/07/22	103	80 - 120	104	80 - 120	<1.0	ug/L	NC	20
9930844	Total Nickel (Ni)	2020/07/22	99	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
9930844	Total Selenium (Se)	2020/07/22	103	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
9930844	Total Silicon (Si)	2020/07/22	109	80 - 120	111	80 - 120	<100	ug/L	0.51	20
9930844	Total Silver (Ag)	2020/07/22	98	80 - 120	99	80 - 120	<0.020	ug/L	NC	20
9930844	Total Strontium (Sr)	2020/07/22	105	80 - 120	105	80 - 120	<1.0	ug/L	0.78	20
9930844	Total Thallium (Tl)	2020/07/22	101	80 - 120	102	80 - 120	<0.010	ug/L		
9930844	Total Tin (Sn)	2020/07/22	101	80 - 120	102	80 - 120	<5.0	ug/L		
9930844	Total Titanium (Ti)	2020/07/22	101	80 - 120	105	80 - 120	<5.0	ug/L		
9930844	Total Uranium (U)	2020/07/22	103	80 - 120	103	80 - 120	<0.10	ug/L	NC	20
9930844	Total Vanadium (V)	2020/07/22	100	80 - 120	102	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zinc (Zn)	2020/07/22	99	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
9930844	Total Zirconium (Zr)	2020/07/22	103	80 - 120	104	80 - 120	<0.10	ug/L		
9930940	Total Mercury (Hg)	2020/07/22	93	80 - 120	99	80 - 120	<0.0019	ug/L	NC	20
9931275	Alkalinity (PP as CaCO3)	2020/07/22					<1.0	mg/L	NC	20

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9931275	Alkalinity (Total as CaCO3)	2020/07/22	NC	80 - 120	98	80 - 120	<1.0	mg/L	0.30	20
9931275	Bicarbonate (HCO3)	2020/07/22					<1.0	mg/L	0.30	20
9931275	Carbonate (CO3)	2020/07/22					<1.0	mg/L	NC	20
9931275	Hydroxide (OH)	2020/07/22					<1.0	mg/L	NC	20
9931277	Conductivity	2020/07/22			100	80 - 120	<2.0	uS/cm	0.21	10
9931291	pH	2020/07/22			102	97 - 103				
9931653	Nitrate plus Nitrite (N)	2020/07/22	105	80 - 120	109	80 - 120	<0.020	mg/L	NC	25
9931654	Nitrite (N)	2020/07/22	101	80 - 120	102	80 - 120	<0.0050	mg/L	NC	20
9932284	UV absorbance (254nm)	2020/07/23			96	N/A	<0.010	AU/cm	NC	20
9932375	Total Dissolved Solids	2020/07/24	103	80 - 120	92	80 - 120	<10	mg/L	3.7	20
9933378	Total Ammonia (N)	2020/07/24	NC	80 - 120	108	80 - 120	<0.015	mg/L	0.010 (1)	20
9933761	Total Nitrogen (N)	2020/07/24	102	80 - 120	97	80 - 120	<0.020	mg/L	1.7	20
9933839	Total Sulphide	2020/07/24	81	80 - 120	105	80 - 120	<0.0018	mg/L	NC	20
9934007	Dissolved Fluoride (F)	2020/07/24	100	80 - 120	102	80 - 120	<0.050	mg/L	0	20
9935700	Total Organic Carbon (C)	2020/07/26	106	80 - 120	100	80 - 120	<0.50	mg/L	NC	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

David Huang, M.Sc., P.Chem., QP, Scientific Services Manager

Harry (Peng) Liang, Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs - Partial/Rush Results

BUREAU VERITAS

WI 023231

DRINKING WATER SUBMISSION CHAIN OF CUSTODY RECORD

Victoria: Unit 1, 851 Viewfield Rd, Victoria, BC V9A 4V2 Ph: (250) 386-5112 Toll Free: (833) 282-5227
Courtenay: 2755 B Moray Ave, Courtenay, BC V9N 8M9 Ph: (250) 338-7788 Toll Free: (833) 282-5227

BV Job #:

Company (Invoicing): COWICHAN BAY WATER DEST
Company (Reporting): IFC WATER.
Contact Name: JOE WOOLLS
Mailing Address:
Phone #:
E-mail: joe@ifcWATER.CA
After Hours Contact #:

VANCOUVER ISLAND HEALTH AUTHORITY
Medical Health Officer: 1.800.204.6166
Drinking Water Officer: 250.755.6215

Payment Received: Yes ☐ No ☐

☑ Regular Turnaround Time (TAT) (5 days for most tests)
☐ **RUSH** Please contact the lab **Surcharges will be applied**

Project Name: Date Required:

SPECIAL INSTRUCTIONS:
Return Cooler ☐ Ship Sample Bottles (please specify) ☐

All information on this form must be completed before testing can commence.

If your drinking water source services two or more homes, we strongly recommend that you contact local health authorities to find out how the Drinking Water Protection Act applies to this system. Please be aware that, in this situation, we are legally obligated to report results directly to local health authorities.

Sample Collection
For determining drinking water quality, samples should be representative of the water that will be consumed; therefore, we suggest sampling at the kitchen tap. However, other sampling locations may be used to determine pre-treatment water quality or for troubleshooting purposes.

1. Remove aerator/screen from faucet.
2. Let the water run for 5 minutes.
3. Label the bottle with your name, date and time you are taking the sample.
4. Fill all bottle(s) provided. Take care not to touch the inside of the bottle or underside of cap.
5. Cap the sample and place it in fridge or small cooler with icepack.

Remember: It is important that you do not contaminate the sample as you handle the container. Wash your hands before you start and be careful not to touch the rim of the bottle or the inside of the cap.

DON'T:
Don't rinse or boil any bottle you receive from the lab.
Don't let the sample sit out overnight, please refrigerate.
Don't freeze the sample.

Bureau Veritas
RECEIVED IN VICTORIA
JUL 20 2020 @ 1405
By: RMO DrVadbright
Temps: 14 | 15 | 15 on ice

Sample Transportation & Delivery
1. Samples should arrive at the laboratories (Courtenay or Victoria) within 24 hrs of sampling. Ship samples between Monday and Thursday to avoid lab scheduling conflicts.
2. The sample should be kept cool during transit (<8°C - refrigerated or packed on ice).
3. Fill out the Chain of Custody (COC) form besi missing COC's will result in delays impacting tests.
4. Delivery Options:
   Personally deliver samples to Courtenay or V unless analysis is completed locally in Courte
   Overnight shipping to Burnaby: If you ship a overnight courier.
   Same day shipping: Available in some areas

C050473_COC

	Sample Identification (Sample Location &/or Description)	Sample Location (eg. Tap, Wellhead)	Date/Time Sampled (24hr)	Samples from a Drinking Water Source? Y/N	Does source supply multiple households? Y/N	Are individuals drinking this water? Y/N	Are you on a boil water advisory? Y/N	Drinking Water Scan	Home Safety Scan	Total Metals Scan including Hardness & Hg	Total Coliform and E. Coli	VIHA Kit	Report Current Drinking Water Criteria
1	OFFICE WELL RAW	PUMP STN	JULY 20/20	(Y)	(Y)	(Y)	Y						
2			12:50 PM	N	N	N	(N)					X	X
3				Y	Y	Y	Y						
4				N	N	N	N						X
5				Y	Y	Y	Y						
				N	N	N	N						X
				Y	Y	Y	Y						
				N	N	N	N						X
				Y	Y	Y	Y						
				N	N	N	N						X

Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Bureau Veritas Laboratories' standard Terms and Conditions. Signing of this Chain of Custody document is acknowledgment and acceptance of our terms available at http://www.bvlabs.com/terms-and-conditions

Print name and sign	Date (yy/mm/dd):	Time (24 hr):	Print name and sign	Date (yy/mm/dd):	Time (24hr):	Time Sensitive
*Relinquished By: J. WOOLLS	20/07/20	2:00 PM	Received by: [illegible] PETRO TACL	2020/07/21	09:04	☐

*IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS AND SAMPLES ANALYZED OUTSIDE REGULATORY HOLD TIMES.

Laboratory Use Only
Temperature on Receipt (°C): A) B) C)
Just sampled & rec'd on ice: ☐
Custody Seal: Present? N/A Intact?

	Yes	No	N/A
	☐	☐	☐
	☐	☐	☐

COC-1035

SEE ACR

BBY FCD-00077/14

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:10p No. W168773
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 11.5C
Sampler: Trisha Oud

Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
Office Well Plate #13062	21Jun22	09:30a	0	0	0	0	0

WATER DISTRICT SCREEN

Sample	Date	Time	Lactose Fermentors	Coliforms Total	Fecal	E.coli	Total Aeromonas	Sulfur Reducing/ Iron Bacteria	Yeast/Fungi	TPC*
Office Well Plate #13062	21Jun22	09:30a	ND	ND	ND	ND	ND	ND / ND	ND / ND	0.46

* all counts are colony forming units per milli-litre

TC = total coliform bacteria FC = fecal coliform bacteria (aka Thermotolerant Coliforms)
NC = non-coliform bacteria ND = none detected
TPC = total plate count- spread plate method - 35C/48hr TGEA FDA/BAM 9th ed, Oct 2020
CFU = colony forming units

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 9th ed, Oct 2020
Bergy's Manual of Systematic Bacteriology vol 1, ADAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

Comments:
For Interpretation of Results:
Total, Fecal Coliforms or E.coli present greater than 0 CFU/100mL (0 CFU/mL):
IF Coliform numbers exceed safe limits for drinking water- water is not suitable for drinking without treatment.

Total Non-coliform bacteria (=Lactose Fermentors) equal to or greater than 200 CFU/100mL (2.0 CFU/mL):
IF the number organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

If Total Plate Count bacteria are -
A) greater than 100 CFU/mL:
high numbers of microbial organisms indicate that this water supply should be monitored on a seasonal basis.
B) greater than 500 CFU/mL:
the number of organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

- see following page for chemistry results -

W. Riggs
Sr. Microbiologist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:10p No. W168773 pg2
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 11.5C
Sampler: Trisha Oud

Sample: Office Well Plate #13062 21Jun22 09:30a

ELEMENTS		SAMPLE	UNITS	Maximum Limits Permissible In Drinking Water*
1) Aluminium	Al	0.034	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	3.17	ug/L	10.0 ug/L
4) Barium	Ba	0.018	mg/L	2.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	0.516	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.010	ug/L	7.00 ug/L
8) Calcium	Ca	30.8	mg/L	200 mg/L
9) Chromium	Cr	<0.003	mg/L	0.050 mg/L
10) Cobalt	Co	<0.005	mg/L	no limit listed
11) Copper	Cu	<0.008	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	1.05	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	<0.500	ug/L	5.00 ug/L
16) Magnesium	Mg	9.45	mg/L	50.0 mg/L
17) Manganese	Mn	0.225	mg/L	0.120 MAC 0.020 AO
18) Mercury	Hg	<0.010	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.005	mg/L	no limit listed
20) Nickel	Ni	<0.004	mg/L	no limit listed
21) Phosphorus	P	0.945	mg/L	no limit listed
22) Potassium	K	0.900	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	6.89	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	no limit listed
27) Sodium	Na	13.3	mg/L	200 mg/L
28) Strontium	Sr	0.110	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	0.010	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		116	mg/L	75-150 mg/L = mod.hard
pH		7.87	units	7.0 to 10.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of the Canadian Council of Resource and Environment Ministers - Guidelines for Canadian Drinking Water Quality, 2020.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:10p No. W168773.pg3
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 11.5C
Sampler: Trisha Oud

Sample: Office Well Plate #13062 21Jun22 09:30a

Comments:

Iron: high amounts of Iron can cause staining of laundry, porcelain and plumbing fixtures; can produce an undesirable taste. Essential for health.

Manganese: not considered to be toxic; high amounts of Manganese can cause staining of laundry, porcelain and plumbing fixtures; may produce an undesirable taste.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
XA
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL.: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:10p No. W168773 pg4
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 11.5C
Sampler: Trisha Oud

SAMPLE	DATE	TIME	Alkalinity (mg/L)	NH_3-N (mg/L)	Cl^- (mg/L)	Colour (TCU)	E.C. (uS/cm)
Office Well	21Jun22	09:30a	165	1.26	11.5	9.53	283
Plate #13062							
Lab Blank			ND	ND	ND	ND	ND
S_o			0.100	0.254 ug/L	0.015	0.300	0.300
REF. VALUE			100	10.0	10.0	5.00	147
STD ± 2SD			110 ± 7.54	9.94 ± 0.799	10.8 ± 1.01	4.92 ± 0.411	142 ± 12.0

SAMPLE	DATE	TIME	CORROSIVITY (Is @20C)	F^- (mg/L)	S^{2-} (ug/L)	TKN (mg/L)	NO_3-N (ug/L)
Office Well	21Jun22	09:30a	0.189	0.073	ND	1.26	13.0
Plate #13062							
Lab Blank				ND	ND	ND	ND
S_o				0.007	0.007	0.012	0.160
REF. VALUE				1.00	50.0	1.00	10.0
STD ± 2SD				1.08 ± 0.089	48.2 ± 0.442	0.980 ± 0.091	9.88 ± 0.782

SAMPLE	DATE	TIME	NO_2-N (ug/L)	SO_4^{2-} (mg/L)	T.O.C. (mg/L)	T&L (mg/L)	TDS (mg/L)
Office Well	21Jun22	09:30a	10.3	6.31	0.197	0.534	164
Plate #13062							
Lab Blank			ND	ND	ND	ND	ND
S_o			0.300	0.075	0.300	0.070	0.010
REF. VALUE			10.0	10.0	5.00	1.00	200
STD ± 2SD			10.6 ± 0.812	10.9 ± 0.833	4.88 ± 0.492	0.929 ± 0.079	203 ± 17.4

...contin\

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:10p No. W168773 pg5
Source Well
Type of Sample water
No. of Samples 1
Comments Arrival temp.: 11.5C
Sampler: Trisha Oud

SAMPLE	DATE	TIME	Turbidity (NTU)	UVT (%)
Office Well	21Jun22	09:30a	2.29	74.7
Plate #13062				
Lab Blank			ND	ND
S_o			0.015	0.003
REF. VALUE			5.00	90.0
STD ± 2SD			4.89 ± 0.422	90.3 ± 0.020

SD = standard deviation; REF VALUE = primary or secondary reference material
STD = secondary standard calibrated to primary standard reference material
S_o = standard deviation at zero analyte concentration; method detection limit is generally considered to be 3x S_o value
ND = none detected n/a = not applicable

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Laboratory Reports - Kidd Well

| #301 - 1095 McKenzie Ave, Victoria, B.C. V8P 2L5 | P:1.250.704.4428 | Vernon | Prince George | www.westernwater.ca |

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:30p No. W168776
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 12.1C
Sampler: Trisha Oud

Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
Kidd Well #13060	21Jun22	10:00a	0	4	0	0	0

WATER DISTRICT SCREEN

Sample	Date	Time	Lactose Fermentors	Coliforms Total	Fecal	E.coli	Total Aeromonas	Sulfur Reducing/ Iron Bacteria	Yeast/Fungi	TPC*
Kidd Well #13060	21Jun22	10:00a	0.04	ND	ND	ND	ND	ND / ND	ND / ND	1.22

* all counts are colony forming units per milli-litre

TC = total coliform bacteria FC = fecal coliform bacteria (aka Thermotolerant Coliforms)
NC = non-coliform bacteria ND = none detected
TPC = total plate count- spread plate method - 35C/48hr TGEA FDA/BAM 9th ed, Oct 2020
CFU = colony forming units

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 9th ed, Oct 2020
Bergy's Manual of Systematic Bacteriology vol 1, AOAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

Comments:
For Interpretation of Results:
Total, Fecal Coliforms or E.coli present greater than 0 CFU/100mL (0 CFU/mL):
IF Coliform numbers exceed safe limits for drinking water- water is not suitable for drinking without treatment.

Total Non-coliform bacteria (=Lactose Fermentors) equal to or greater than 200 CFU/100mL (2.0 CFU/mL):
IF the number organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

If Total Plate Count bacteria are -
A) greater than 100 CFU/mL:
high numbers of microbial organisms indicate that this water supply should be monitored on a seasonal basis.
B) greater than 500 CFU/mL:
the number of organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

- see following page for chemistry results -

W. Riggs
Sr. Microbiologist

MB LABS LTD.
ANALYTICAL & TESTING SERVICES P.O. BOX 2103, SIDNEY, B.C. V8L 1Y0 TEL: (250) 656-1334 EMAIL: info@mblabs.com
MB LABORATORIES LTD.

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:30p No. W168776 pg2
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 12.1C
Sampler: Trisha Oud

Sample: Kidd Well #13060 21Jun22 10:00a

ELEMENTS		SAMPLE	UNITS	Maximum Limits Permissible In Drinking Water*
1) Aluminium	Al	0.055	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	0.592	ug/L	10.0 ug/L
4) Barium	Ba	0.202	mg/L	2.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	0.650	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.010	ug/L	7.00 ug/L
8) Calcium	Ca	93.8	mg/L	200 mg/L
9) Chromium	Cr	<0.003	mg/L	0.050 mg/L
10) Cobalt	Co	<0.005	mg/L	no limit listed
11) Copper	Cu	0.041	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	1.73	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	14.7	ug/L	5.00 ug/L
16) Magnesium	Mg	42.2	mg/L	50.0 mg/L
17) Manganese	Mn	0.294	mg/L	0.120 MAC 0.020 AO
18) Mercury	Hg	<0.010	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.005	mg/L	no limit listed
20) Nickel	Ni	<0.004	mg/L	no limit listed
21) Phosphorus	P	0.305	mg/L	no limit listed
22) Potassium	K	23.6	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	5.17	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	no limit listed
27) Sodium	Na	472	mg/L	200 mg/L
28) Strontium	Sr	2.87	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	0.024	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		408	mg/L	>300 mg/L = very hard
pH		7.91	units	7.0 to 10.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of the Canadian Council of Resource and Environment Ministers - Guidelines for Canadian Drinking Water Quality, 2020.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:30p No. W168776 pg3
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 12.1C
Sampler: Trisha Oud

Sample: Kidd Well #13060 21Jun22 10:00a

Comments:

Iron: high amounts of Iron can cause staining of laundry, porcelain and plumbing fixtures; can produce an undesirable taste. Essential for health.

Lead: toxic and accumulates in body tissues; Lead may come from old lead pipes, solders, or industrial discharges. Even small amounts can contribute to learning disability in children.

Manganese: not considered to be toxic; high amounts of Manganese can cause staining of laundry, porcelain and plumbing fixtures; may produce an undesirable taste.

Sodium: essential for health; usually from salt-water intrusion, water softeners & some mineral deposits.

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

Client/Code

Independent Pump & Mechanical -E
*A
PO Box 390
Shawnigan Lake, BC
V0R 2W0

TEL: (250) 743-3075
admin@independentpump.ca

Date 21Jun22 2:30p No. W168776 pg4
Source Well
Type of Sample water
No. of Samples 1

Comments Arrival temp.: 12.1C
Sampler: Trisha Oud

SAMPLE	DATE	TIME	Alkalinity (mg/L)	NH_3-N (mg/L)	Cl^- (mg/L)	Colour (TCU)	E.C. (uS/cm)
Kidd Well #13060	21Jun22	10:00a	150	1.85	926	4.68	2850
Lab Blank			ND	ND	ND	ND	ND
S_o			0.100	0.254 ug/L	0.015	0.300	0.300
REF. VALUE			100	10.0	10.0	5.00	147
STD ± 2SD			110 ± 7.54	9.94 ± 0.799	10.8 ± 1.01	4.92 ± 0.411	142 ± 12.0

SAMPLE	DATE	TIME	CORROSIVITY (Is @20C)	F^- (mg/L)	S^{2-} (ug/L)	TKN (mg/L)	NO_3-N (ug/L)
Kidd Well #13060	21Jun22	10:00a	0.671	ND	ND	2.04	ND
Lab Blank				ND	ND	ND	ND
S_o				0.007	0.007	0.012	0.160
REF. VALUE				1.00	50.0	1.00	10.0
STD ± 2SD				1.08 ± 0.089	48.2 ± 0.442	0.980 ± 0.091	9.88 ± 0.782

SAMPLE	DATE	TIME	NO2-N (ug/L)	SO_4^{2-} (mg/L)	T.O.C. (mg/L)	T&L (mg/L)	TDS (mg/L)
Kidd Well #13060	21Jun22	10:00a	ND	ND	2.34	0.293	1653
Lab Blank			ND	ND	ND	ND	ND
S_o			0.300	0.075	0.300	0.070	0.010
REF. VALUE			10.0	10.0	5.00	1.00	200
STD ± 2SD			10.6 ± 0.812	10.9 ± 0.833	4.88 ± 0.492	0.929 ± 0.079	203 ± 17.4

SAMPLE	DATE	TIME	Turbidity (NTU)	UVT (%)
Kidd Well #13060	21Jun22	10:00a	2.41	90.3
Lab Blank			ND	ND
S_o			0.015	0.003
REF. VALUE			40.0	90.0
STD ± 2SD			39.0 ± 4.07	90.3 ± 0.020

SD = standard deviation; REF VALUE = primary or secondary reference material
STD = secondary standard calibrated to primary standard reference material
S_o = standard deviation at zero analyte concentration; method detection limit is generally considered to be 3x S_o value
ND = none detected n/a = not applicable

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist