Ministry of Municipal Affairs and Housing

University Endowment Lands

2021 Drinking Water Quality Monitoring Report

Prepared July 2022

EXECUTIVE SUMMARY

The University Endowment Lands (UEL) implemented a Drinking Water Quality Monitoring Program in 2002. The UEL adopted the Water Quality Monitoring and Reporting Plan developed by the Greater Vancouver Regional District (GVRD), its member municipalities and the region's Medical Health Officers. With this approved monitoring program in place, the UEL has collected and analyzed water quality data since 2002. This report provides an outline of the program and its water quality testing results for the year 2021.

The implementation of the Drinking Water Quality Monitoring program was a significant commitment made by the UEL to monitor the delivery of safe and high-quality water. It generates valuable data for gaining an understanding of the UEL's water distribution system and for evaluating the historic performance of the system in a reliable and systematic way. Most importantly, it allows for potential health hazards to be identified and consumers' water concerns to be addressed.

The sampling analysis demonstrates that during 2021, all 179 samples taken met the bacteriological standards set out in the *Drinking Water Protection Act* through the *Drinking Water Protection Regulation.* Additionally, all samples met the health standards specified in the *Guidelines for Canadian Drinking Water Quality*.

The UEL is committed to delivering water of the highest quality and will continue to make the necessary effort to ensure its continued success.

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1.0 INTRODUCTION

In 2002, the University Endowment Lands (UEL) implemented a Drinking Water Quality Monitoring Program to monitor the delivery of safe and high-quality water. This annual Water Quality Monitoring Report is required under the program and as a requirement of the *British Columbia Drinking Water Protection Act* (BCDWPA).

During 2021, the provision of drinking water was governed by the *British Columbia Drinking Water Protection Regulation* (BCDWPR), pursuant to the BCDWPA. This regulation requires drinking water suppliers in BC to:

- Develop a protocol to notify the Drinking Water Officer (DWO) of situations or conditions that render or could render the water unsuitable to drink.
- Implement a plan for collecting, shipping, and analyzing water samples in compliance with the standards set by the DWO.
- Implement a plan for reporting monitoring results to the DWO and to water users, including the preparation of an annual report.

The UEL monitors the water quality in the UEL distribution system on a weekly basis in accordance with their Drinking Water Quality Monitoring Program. There was a total of nine sampling stations in operation throughout 2021. Seven (7) of the stations were sampled in two (2) groups alternating weekly. The remaining two (2) stations are sampled biannually. Appendix A shows the locations of the sampling stations. Appendix B includes a tabular and graphic summary of the weekly test results for 2021.

This document includes a brief introduction to the UEL's water distribution system and its drinking water monitoring and testing program. The remaining parts of this document summarize the results and analyses of water samples collected in 2021 and evaluate the distribution system's performance in delivering safe drinking water.

2.0 WATER DISTRIBUTION SYSTEM

The UEL is responsible for the installation, operation, and maintenance of its water distribution system which includes: 24 km of watermains, 568 service connections, 523 water meters, 97 hydrants, 287 line valves, and two pressure reducing valve stations. The UEL receives water from Metro Vancouver through two (2) supply points; one (1) located at Blanca Street and West 16th Avenue and the other at Drummond Drive and West 6th Avenue. Water is then supplied to the UEL's customers through its distribution system. The UEL also supplies water to the University of British Columbia (UBC) through two (2) connection points; one (1) located at Wesbrook Mall and University Boulevard, and the other, located at West 16th Avenue between Blanca Street and Wesbrook Mall. The UEL has adopted a comprehensive watermain replacement program and an operations and maintenance (O&M) program for the water distribution system to ensure the highest quality water is delivered in ample quantity and pressure to its customers.

The watermain replacement program systematically replaces aging infrastructure in the water distribution system to ensure the system continues to meet the needs of the UEL. In 2021, the UEL replaced 220 m of aging asbestos cement (AC) watermain with polyvinyl chloride (PVC) watermain and abandoned approximately 230 m of redundant steel watermain. The O&M program includes an annual watermain unidirectional flushing (UDF) program, a hydrant inspection and maintenance program, a comprehensive cross connection control program, and the Drinking Water Quality Monitoring Program.

The watermain UDF program is conducted annually and was conducted between April and May in 2021. The UEL intends to continue the watermain UDF program on an annual basis going forward.

There are 418 total cross connection control backflow devices registered in the UEL with 316 from single family dwellings and 102 from multi-family or commercial land uses (note that several commercial users have multiple registered units within their building). Test reports are required to be submitted annually proving the devices have been tested and meet the required standards. In 2021, there was a total compliance rate of 80% as shown in Table 1. Compared to 2020, there was a 7% increase in overall compliance.

The UEL relies on voluntary compliance with their cross-connection control bylaw with letters of non-compliance being issued to addresses delinquent in submitting inspection reports. In addition, the UEL followed-up with several non-compliant properties in an effort to enforce the bylaw.

Table 1. Cross Connection Control Backflow Devices

AREA	INSTALLED	TESTED	OUTSTANDING	COMPLIANCE (%)
Single Family	316	257	59	81
Multi-Family/ Commercial	102	79	23	77
Total	**418**	**336**	**82**	**80**

3.0 TESTING AND MONITORING PROGRAM

Drinking water quality is a function of source water quality, water treatment, and water quality changes after treatment. As a result, monitoring of drinking water quality consists of three (3) components: source water monitoring, monitoring after treatment, and monitoring in the distribution system. While Metro Vancouver carries out testing of water at the source and after treatment, the UEL's Drinking Water Quality Monitoring Program is focused on monitoring the water quality within its own water distribution system.

The monitoring and testing program consists of routine monitoring (for obtaining an accurate overview of water quality within the distribution system), and non-routine monitoring (for handling complaint and emergency situations). Monitoring involves three (3) components: the collection of samples, the laboratory analyses of those samples, and the review and analysis of the results by the UEL, Metro Vancouver, and Vancouver Coastal Health (VCH).

3.1 Routine Monitoring

The collection of water samples was completed as part of an annual contract with Caro Analytical Services. Samples were collected from sampling stations within the UEL on a regular basis and then forwarded to laboratories for various analyses. The collection, transportation, and analysis of the samples were performed in accordance with the *Standard Methods for the Examination of Water and Wastewater 23rd Edition*, 2017, published by the American Public Health Association, the American Water Works Association, and the Water Environment Federation. All analyses were conducted by laboratories that are accredited by the Canadian Association of Environmental Analytical Laboratories or an equivalent certification program for the other tests performed, as approved by the Provincial Health Officer.

All testing parameters except vinyl chloride were analyzed by the laboratories of Metro Vancouver. Analysis of vinyl chloride, a volatile organic compound, was tested by the laboratory of Caro Analytical Services.

3.1.1 Sampling Parameters

The parameters that were analyzed are summarized in Table 2.

Table 2. Sampling Parameters

	PARAMETERS
Microbiological	Total Coliforms, Escherichia Coli, Heterotrophic Plate Count (HPC)
Chemical and Physical	Turbidity, Temperature, Free Chlorine Residual, pH, Aluminum, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Zinc, Haloacetic Acids (HAAs), Trihalomethanes (THMs), Vinyl Chloride

The most relevant parameters are briefly discussed below. Further details regarding the parameters listed in the above table can be found by accessing the supporting documents of the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) through the following web site:
https://www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html
or by contacting Health Canada at **(613) 957-2991**.

Total Coliforms

One of the primary concerns in water quality is the growth of coliform bacteria. The presence of coliforms indicates a possibility of regrowth of the bacteria in biofilms or the intrusion of untreated water.

Escherichia Coli (E. coli)

E. coli is used as an indicator of microbiological safety of drinking water; if detected, enteric pathogens may also be present. E. coli monitoring is used, in conjunction with other indicators, as part of a multi-barrier approach to producing drinking water at an acceptable quality.

Heterotrophic Plate Counts

Heterotrophic Plate Counts (HPC) are a useful operational tool for monitoring general bacteriological water quality through the treatment process and in the distribution system. HPC results are not an indicator of water safety and should not be used as an indicator of potential adverse human health effects. Increases in HPC concentrations above baseline levels are considered undesirable.

Free Chlorine Residual

Free chlorine residual provides a good indication of water quality within the distribution system. Low chlorine residual may indicate deteriorating water quality as a result of bacterial regrowth or stagnant water. The operational target is 0.5 mg/L in Metro Vancouver's transmission system which allows municipalities to meet a target of 0.2 mg/L at the end points of their distribution system.

Turbidity

Turbidity in distribution systems is caused by naturally occurring particles consisting of inorganic and organic matter. Controlling turbidity is important for both health and aesthetic reasons. Bacteria, viruses, and protozoa can adhere to suspended particles in turbid water and interfere with disinfection. Excessive turbidity detracts from the appearance of treated water and has often been associated with unacceptable tastes and odours.

Disinfection By-products

Haloacetic acids (HAAs) and Trihalomethanes (THMs) are disinfection by-products (DBPs) and are formed in drinking water when chlorine reacts with organic matter that is naturally present in raw water supplies. Research suggests that HAAs have an adverse impact on human health and may possibly be carcinogenic. The most common THM is chloroform which is classified as being possibly carcinogenic. DBPs are maintained as low as possible without compromising the effectiveness of disinfection.

pH

pH is used as a measure of the acidity and basicity of water. pH is monitored in a distribution system because at low values water becomes corrosive while at high levels chlorine disinfection is less effective and efficient. Health Canada guidelines state an optimal pH between 7.0 and 10.5.

Copper

Copper is used extensively in plumbing for domestic water systems. Although copper is frequently found in surface water, distributed water contains considerably more copper than the original water supply because of the dissolution of copper from copper piping. Copper can stain laundry and plumbing fixtures and cause an undesirable bitter taste in water. Copper intake at extremely high doses can result in adverse health effects.

Iron

Iron is naturally present in food and drinking water. However, there is no evidence to indicate that concentrations of iron commonly found in food or water constitute any hazard to human health. Iron can stain laundry and plumbing fixtures and cause undesirable tastes in beverages. The precipitation of excessive iron imparts an objectionable reddish-brown color to the water. Iron may also promote the growth of certain microorganisms, which can lead to the deposition of a slimy coat in piping.

Lead

Lead was used in drinking water plumbing and as solder in distribution systems. Older distribution systems may also be made from lead pipe or appurtenances. Lead is present in tap water as a result of dissolution from natural sources or from household plumbing systems. Lead is a cumulative general poison and has been classified as being potentially carcinogenic to humans. Fetuses, infants, young children, and pregnant women are most susceptible to adverse health effects caused by lead. In order to minimize exposure to lead introduced into drinking water from plumbing systems, it is recommended that only cold water be used, after an appropriate period of flushing to rid the system of standing water, for sampling, drinking, beverage preparation, and cooking.

Vinyl Chloride

The presence of vinyl chloride in potable water is associated mainly with the use of polyvinyl chloride (PVC) water pipes manufactured with incompletely polymerized vinyl chloride monomer. Acute exposure or chronic inhalation results in a variety of adverse effects in humans. Sufficient evidence has accumulated to implicate vinyl chloride as a human and animal carcinogen.

Zinc

Although zinc is present in surface waters at low concentrations, levels in domestic water systems can be considerably higher because of the use of zinc in plumbing materials. Water containing zinc in excessive concentrations has an undesirable astringent taste and may develop a greasy film upon boiling. Long-term ingestion of zinc in excess of the daily requirement has not shown to result in adverse effects.

3.1.2 Sampling Locations

Sampling locations are distributed in different areas within the UEL to obtain an accurate overview of water quality in the distribution system. The nine (9) locations were strategically selected based on land use and system configuration.

The locations include:

- residential area supply;
- high-density residential area supply;
- institutional area supply; and,
- water source supply.

These locations are illustrated in Appendix A.

Table 3. Drinking Water Sampling Stations

STATION	LOCATION	FLOW CATEGORY	SUPPLY TYPE
S-A	Drummond Dr. & W. 6th Ave.	Source	Water Source / Residential
S-B	Wycliffe Rd. & Tasmania Cres.	Low Flow	Residential
S-C[1,2]	Norma Rose Elementary	Service Connection	Institutional
S-D	Acadia Rd. & Toronto Rd.	Source	Water Source / High-Density Residential
S-E	Western Pkwy. South of Chancellor Blvd.	Medium Flow	Residential
S-F	NW Marine Dr. at the UEL boundary	Low Flow	Residential
S-G[3]	Chancellor Blvd. East of Acadia	Medium Flow	Institutional
S-H[1]	University Hill Elementary	Service Connection	Institutional
S-J	East Side of NW Marine Dr.	Low Flow	Residential

[1] Stations are taps located within schools. These stations are not used for weekly sampling.
[2] Norma Rose Elementary School is serviced through the UBC water distribution system.
[3] Station S-G was transferred to an adjacent watermain on December 10th and the first sample at the new location was collected on December 14th.

3.1.3 Sampling Frequency

The UEL, as a purveyor of drinking water to a population of less than 5000, is required to test at least four (4) samples per month as outlined in *Schedule B* of the BCDWPR During 2021, the UEL tested nearly four (4) times the minimum required number of samples.

Parameters that have greater effects on health were sampled and analyzed more often than those that only affect the aesthetic quality. The sampling frequency of different parameters from different sampling locations is summarized in Table 4.

Table 4. Sampling Frequency

Frequency:	FOUR SAMPLES PER WEEK	FOUR SAMPLES PER YEAR	TWO SAMPLES PER YEAR
Parameters:	Total coliforms E. Coli HPC Free chlorine residual Turbidity Temperature	Haloacetic Acids pH Trihalomethanes	Aluminum Antimony Arsenic Barium Boron Cadmium Calcium Chromium Cobalt Copper Iron Lead Magnesium Manganese Mercury Molybdenum Nickel Potassium Selenium Silver Sodium Zinc Vinyl Chloride
Station Names:	S-A, S-B, S-D, S-E, S-F, S-G, S-J	S-B, S-E	S-A, S-C, S-H
Station Category:	Residential Areas	Residential Areas	Residential Areas & Taps in Building

Notes: Weekly sampling stations are sampled on a biweekly rotating schedule with four stations sampled in week one and the other three stations sampled in week two.
S-A and S-C were sampled for vinyl chlorides while S-C and S-H were sampled for metals.

3.2 Non-routine Monitoring

A laboratory was on-call for monitoring for complaint and emergency situations. Consumer complaints were recorded so that water quality concerns could be tracked and responded to efficiently. In any emergency, the procedures outlined in the UEL Emergency Response Plan would be followed.

4.0 SAMPLE ANALYSIS RESULTS

A total of 179 samples were taken from the UEL water distribution system during 2021. The sample analysis results are summarized in Table 5 below and some of the parameters worth noting are discussed in this section. Refer to Appendix B for detailed sample analysis results. It should be noted that the limits contained within the GCDWQ are recommendations only and representative of best practices. These can become requirements if the DWO places a condition on the Operating Permit for the UEL. At present, there are no such DWO conditions placed on the UEL.

Table 5. Summary of Analysis Results

Sample Station	No. of Samples	HPC (CFU/mL)			Free Chlorine Residual (mg/L)			Turbidity (NTU)			Positive Coliform Tests	Positive E. coli Tests
		Low	Avg	High	Low	Avg	High	Low	Avg	High		
S-A	26	<2	2	4	0.34	0.47	0.60	0.11	0.19	0.60	none	none
S-B	26	<2	3	12	0.33	0.49	0.60	0.10	0.17	0.68	none	none
S-D	26	<2	2	6	0.43	0.55	0.70	0.10	0.17	0.43	none	none
S-E	26	<2	2	2	0.30	0.50	0.67	0.09	0.14	0.21	none	none
S-F	25	<2	7	20	0.13	0.33	0.53	0.11	0.17	0.70	none	none
S-G	25	<2	3	14	0.06	0.29	0.50	0.11	0.18	0.30	none	none
S-J	25	<2	2	2	0.25	0.44	0.54	0.11	0.17	0.30	none	none
Total	179		3			0.44			0.17		none	none

[1]Metro Vancouver: HPC tests were not completed on samples taken on December 21 and 29, 2020.
[2]Average values calculated using all samples collected in 2020 from all stations.

Total Coliforms

For total coliforms, the BCDWPR requires that 1) when there is one (1) sample in a 30-day period, the sample contains no total coliform bacteria per 100 mL and that 2) when there is more than one (1) sample in a 30-day period, at least 90% of samples have no detectable total coliform bacteria per 100 mL and no sample has more than 10 total coliform bacteria per 100 ml. None of the 179 samples tested positive for total coliforms.

E. coli

For E. coli, the BCDWPR requires that the samples contain no detectable colonies per 100 mL. No E. coli colonies were detected in the 179 samples analysed for microbiological criteria in 2021.

Heterotrophic Plate Count, HPC

The GCDWQ does not indicate a maximum acceptable concentration of HPC and instead states that unexpected increase outside the baseline range could indicate a change in the treatment process, a disruption or contamination in the distribution system, or a change in the general bacteriological quality of the water. However, the United States Environmental Protection Agency note that concentration in drinking water should be maintained below 500 CFU/mL to aid in the better maintenance of the treatment and distribution systems. All 179 samples tested for HPC indicated levels below 500 CFU/mL.

Turbidity

The GCDWQ recommends that turbidity levels of no more than 1.0 Nephelometric Turbidity Units (NTU) be present for water entering the distribution system. Maintaining an NTU below 1.0 minimizes the potential for interference with disinfection and allows for adequate operation of the distribution system. Of the 179 samples tested, no sample measured greater than 1.0 NTU. In the event of a high turbidity reading, the procedure is to flush the applicable water main and re-sample as appropriate.

Free Chlorine Residual

Two (2) sampling stations (S-F and S-G) within the UEL had readings below the free chlorine residual target of 0.2 mg/L. These stations are located at the furthest ends of the water distribution system, which has low flows due to a low number of connections. These conditions increase the likelihood of stagnant water and the deterioration of chlorine residual.

Table 6 displays the percentage of samples for each station with a free chlorine residual less than 0.2 mg/L while Appendix B shows individual results in tabular and graphical form. From 2020 to 2021, samples containing less than 0.2 mg/L of chlorine were reduced from 24% to 16% at station S-F and increased from 15% to 20% at station S-G. As shown in the detailed information for station S-F, free chlorine levels were generally maintained above the 0.2 mg/L threshold but dropped below 0.2 mg/L during the fall months. when water usage begins to drop. Low chlorine residuals at station S-G are thought to be reflective of the periodic water usage at the UEL Works Yard.

Table 6. Summary of Free Chlorine Residual Results

Sample Station	Free Chlorine Residual
	% of Samples <0.2 mg/L
S-A	0%
S-B	0%
S-D	0%
S-E	0%
S-F	16%
S-G	20%
S-J	0%

In 2017, a strategy was implemented to improve chlorine residual and HPC results at station S-F. Circulation of water at station S-F was increased by releasing water through a discharge line at a controlled rate of 2 L/min. The intent was to decrease the water age in the area by removing 'old' water from the system and promoting the flow of 'fresh' water to the area. In 2018, the water discharge line continued to operate and samples from station S-F were closely monitored as additional strategies were implemented to improve free chlorine residuals in the area. In 2019, two (2) new temporary sampling stations (S-I and S-J) were installed to monitor chlorine residuals in other locations of Area

B. The results indicated that chronic low chlorine residuals were a localized issue at station S-F. Station S-I was subsequently removed and station S-J currently remains in service for continued monitoring.

On Oct 23, 2019, the UEL removed deteriorating and redundant infrastructure in the vicinity of station S-F in an effort to minimize the volume of water that needed to be introduced as 'fresh' water. As a result, station S-F was moved 150 m to the west and the discharge line was temporarily decommissioned until it was reinstated in 2020. In addition, the UEL completed the replacement of aging cast iron water main on Acadia Road from Chancellor Boulevard to NW Marine Drive in 2020. With those two interventions, chlorine residual and HPC sampling results had seen significant improvements in 2020.

In 2021, the improvements at site S-F continued with all samples returning a detectable chlorine residual. The UEL will continue to monitor chlorine residuals at S-F and adjust the bleed rate as necessary to maintain chlorine residuals but no further interventions are planned.

Disinfection By-products and pH

Two (2) sample stations, S-B and S-E, were tested for disinfection by-products and pH. Table 7 displays the analysis results.

Table 7. Disinfection By-products and pH Analysis Results

		THM (ppb)						HAA (ppb)							
Sample Location	Sample Date	Bromodichloromethane	Bromoform	Chlorodibromomethane	Chloroform	Total Trihalomethanes	Total THM Quarterly Running Annual Average	Dibromoacetic Acid	Dichloroacetic Acid	Monobromoacetic Acid	Monochloroacetic Acid	Trichloroacetic Acid	Total Haloacetic Acid	Total HAA Quarterly Running Annual Average	pH
S-B	23-Feb-21	<1	<1	<1	26	26	27	<0.5	11	<1	<2	11	25	24	7.5
S-B	1-Jun-21	<1	<1	<1	23	24	26	<0.5	12	<1	<2	13	28	25	7.6
S-B	24-Aug-21	<1	<1	<1	25	27	26	<0.5	6	<1	<2	3	9	21	8.1
S-B	23-Nov-21	<1	<1	<1	33	34	28	<0.5	9	<1	<2	11	20	20	8.0
S-E	23-Feb-21	<1	<1	<1	29	30	30	<0.5	10	<1	<2	10	22	25	7.5
S-E	1-Jun-21	<1	<1	<1	21	22	28	<0.5	10	<1	<2	8	20	25	7.5
S-E	24-Aug-21	<1	<1	<1	27	28	28	<0.5	7	<1	<2	3	11	20	7.9
S-E	23-Nov-21	<1	<1	<1	32	33	28	<0.5	10	<1	<2	9	20	18	7.8

Both stations S-B and S-E meet the GCDWQ requirement for the running annual average of quarterly samples for THM of 100 ppb (0.1 mg/L) and for HAA of 80 ppb (0.080 mg/L). The maximum THM concentration sampled was 34.0 ppb (0.0340 mg/L) and 33.0 ppb (0.0330 mg/L) for stations S-B and S-E, respectively. The maximum HAA concentration sampled was 28 ppb (0.028 mg/L) for station S-B and 22 ppb (0.022 mg/L) for station S-E.

The pH concentrations for both stations S-B and S-E were within the GCDWQ recommended range of 7.0 to 10.5 for water treatment related objectives. An increase in pH can be noted in the August and November sampling results. This was a result of an effort by Metro Vancouver to protect copper pipes and hot water tanks in buildings. Starting in June 2021 Metro Vancouver worked to increase the pH of the drinking water in their transmission system aiming for a target range in their system of 8.3 to 8.5.

Vinyl Chloride

Vinyl chloride concentration was tested twice in 2021 with the samples taken from stations S-A and S-C on April 20th and November 9th. During sample testing, the vinyl chloride concentration was below 1 ppb (0.001 mg/L), which meets the requirement from GCDWQ of less than 2 ppb (0.002 mg/L).

Metals

Two (2) sample locations, stations S-C and S-H, were tested for total concentration of various metals in 2021. Analysis results are presented below in Table 8, measured in µg/L (ppb or 0.001 mg/L). All metal levels fall below the recommended limits outlined in the GCDWQ.

Table 8. Metals Analysis Results

Sample Station		S-C		S-H		GCDWQ	
Sampled date		20/04/2021	9/11/2021	20/04/2021	9/11/2021	Health Guideline	Aesthetic Objective
Total Concentration (µg/L)	Aluminum	28	48	43	75	n/a	200
	Antimony	<0.5	<0.5	<0.5	<0.5	6	n/a
	Arsenic	<0.5	<0.5	<0.5	<0.5	10	n/a
	Barium	2.7	2.6	1.6	1.4	2000	n/a
	Boron	<10	<10	<10	<10	5000	n/a
	Cadmium	<0.2	<0.2	<0.2	<0.2	7	n/a
	Calcium	4020	7820	5770	10300	n/a	n/a
	Chromium	<0.05	<0.05	0.13	0.14	50	n/a
	Cobalt	<0.5	<0.5	<0.5	<0.5	n/a	n/a
	Copper	52.0	14.9	0.6	2.3	≤2000	≤1000
	Iron	21	13	21	20	n/a	≤300
	Lead	<0.5	<0.5	<0.5	<0.5	5	n/a
	Magnesium	171	188	113	103	n/a	n/a
	Manganese	4.2	3.5	1.3	0.9	≤120	≤50
	Mercury	<0.05	<0.05	<0.05	<0.05	1	n/a
	Molybdenum	<0.5	<0.5	<0.5	<0.5	n/a	n/a
	Nickel	<0.5	<0.5	<0.5	<0.5	n/a	n/a
	Potassium	168	149	181	183	n/a	n/a
	Selenium	<0.5	<0.5	<0.5	<0.5	50	n/a
	Silver	<0.5	<0.5	<0.5	<0.5	n/a	n/a
	Sodium	2070	1550	1890	1690	n/a	≤200,000
	Zinc	<3.0	<3.0	<3.0	<3.0	n/a	≤5000

5.0 EMERGENCY WATER SUPPLY

In 2019, the UEL started working through the commissioning and permitting process of an emergency water supply well located at the UEL's Works Yard. This work was based on recommendations from the Metro Vancouver Regional Engineers Advisory Committee Temporary Provision of Drinking Water Guideline and the UEL's commitment to emergency preparedness and planning.

The purpose of the well is to supply water to residents in the event that distribution system is inoperable. As part of the UEL's Water Provision Emergency Plan, the UEL plans to supply a minimum of 4 L of potable water per person per day in the immediate aftermath of a disaster, increasing to 10 L per day in the weeks following a disaster until the regular water supply is restored. The water would be supplied to residents through filling of individual containers at the UEL Work's Yard or if needed through community distribution points.

The well was initially constructed in March/April 2019 with regulatory compliance testing completed in November 2021. The well is part of the UEL's Water Utility Emergency Plan and Water Provision Emergency Plan which have been approved by the DWO. An application has also been made to register the well under the Water Sustainability Act.

The UEL is testing monthly for bacteriological contamination in the same manner as the piped distribution system. No samples returned with positive bacteriological contamination result in 2021. Results of the testing are presented in Appendix C.

6.0 SUMMARY

The UEL implemented a Drinking Water Quality Monitoring Program in 2002 based on the standard program adopted by Metro Vancouver member municipalities, the Guidelines for Canadian Drinking Water Quality (GCDWQ), and input from Vancouver Coastal Health (VCH). With this approved monitoring program in place, the UEL has collected and analyzed water quality data since 2002.

The implementation of the Drinking Water Quality Monitoring program is a significant commitment made by the UEL to deliver safe water to its consumers. It generates valuable data for gaining an understanding of the UEL's water distribution system and for evaluating the past performance of the system in a reliable and systematic way. Most importantly, it allows for potential health hazards to be identified and consumers' water concerns to be addressed.

The watermain replacement program systematically replaces aging infrastructure in the water distribution system to ensure the system continues to meet the needs of UEL residents. In 2021, the UEL replaced 220 m of aging AC watermain with polyvinyl chloride (PVC) watermain and abandoned approximately 230 m of redundant steel watermain.

A unidirectional flushing (UDF) program is conducted annually. This helps reduce the risk of sediment and corrosion by-products that build up in the watermains producing turbidity. Unidirectional flushing can help reduce the habitats where bacteria grow but does not address the underlying reasons for the bacterial growth or loss of disinfectant residual. In 2015, VCH recommended that a long-term strategy be developed to address these issues. Working with VCH, a strategy was developed to improve the loss of chlorine residual at station S-F. The strategy limits the stagnation of water near station S-F which is caused by limited water usage. In 2021, a sampling results from station S-F showed a detectable chorine residual in every sample.

The UEL cross connection control program relies on voluntary compliance. In 2021, 80% of all the registered devices were tested and proven to be functioning as intended to protect the public water system from contamination. The UEL relies on voluntary compliance with their cross-connection control bylaw and letters of non-compliance are issued to properties that do not submit inspection reports. UEL increases their enforcement efforts through proactive issuance of notices and warning letters where appropriate.

The sampling analysis demonstrates that during 2021, all 179 samples met the bacteriological standards set out in the *Drinking Water Protection Act* through the *Drinking Water Protection Regulation*. Additionally, all samples met the health standards set out in the *Guidelines for Canadian Drinking Water Quality*. The UEL is committed to delivering water of the highest quality and will continue to make the necessary effort to ensure its continued success.

As part of the UEL's Water Utility Emergency Plan and Water Provision Emergency Plan the UEL has constructed an emergency potable water supply well to be used following a

disaster that renders the piped water distribution system inoperable. The well is maintained and kept active throughout the year through different uses at the UEL Public Works Yards. Water quality samples are taken monthly.

REFERENCES

British Columbia Drinking Water Protection Regulation. *Drinking Water Protection Act* Reg. 200/2003, 2003

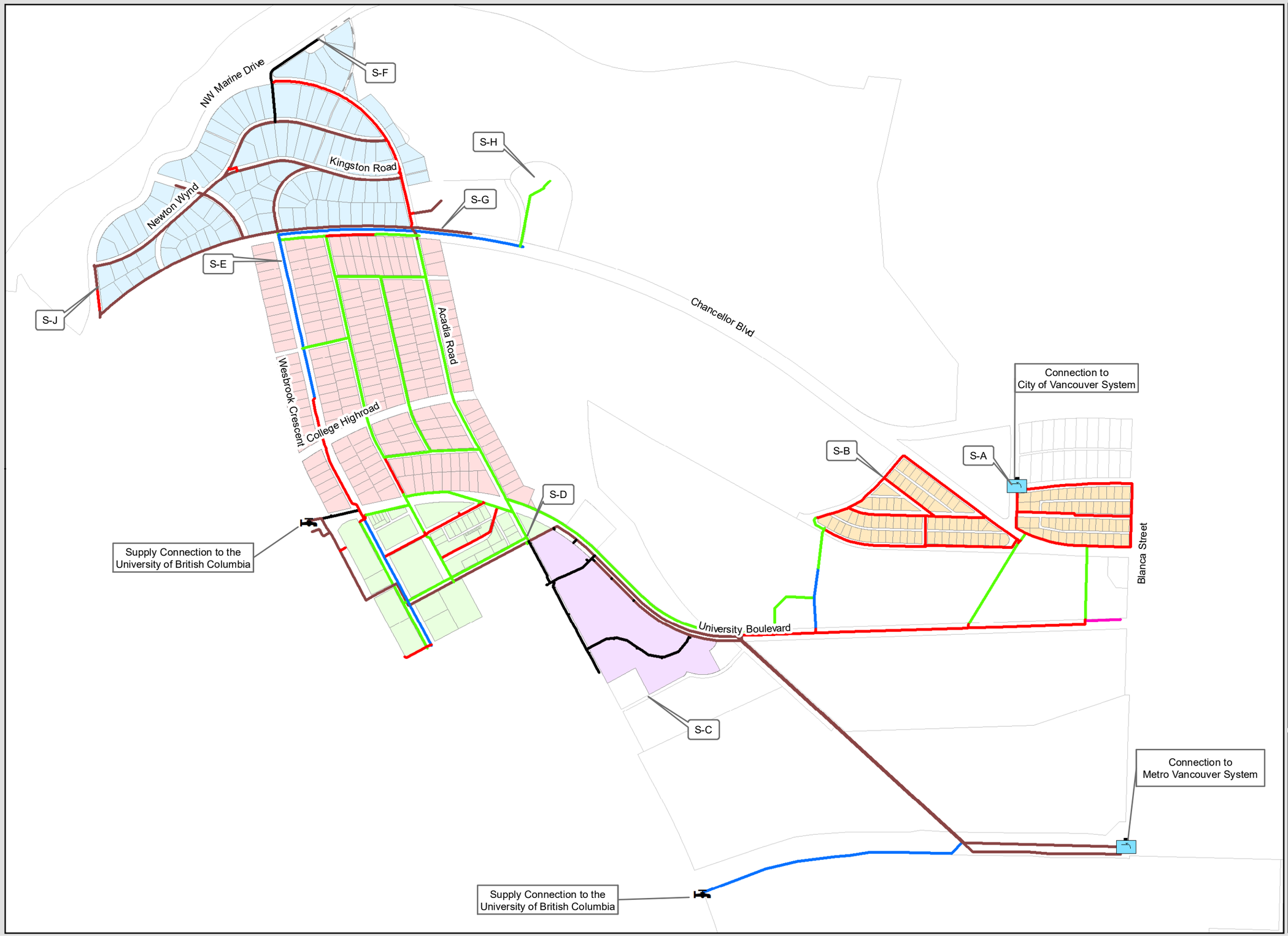
Guidelines for Canadian Drinking Water Quality – Health Canada, February 2017 <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html>

Standard Methods for the Examination of Water and Wastewater, 23rd Edition. APHA, AWWA, WEF, 2017

Water Quality Monitoring and Reporting Plan for the GVRD and Member Municipalities. Regional Engineers Advisory Committee (REAC), May 2000

APPENDIX A

Water Sampling Stations Map



Legend

- UEL Water Supply
- Connection to UBC

Material

- Asbestos Cement
- Cast Iron
- Ductile Iron
- Polyvinyl Chloride
- Steel
- High Density Polyethylene

UEL Areas

- Area A
- Area B
- Area C
- Area D
- Ieləm'

Overview Map

N
W E
S

0 230 460

Metres

1:10,000

NAD 1983 UTM Zone 10N

2020 Water Quality Report
Location: University Endowment Lands

BRITISH COLUMBIA

Existing UEL Water System Sample Locations

March 2022
Project: 60639142 - 303

AECOM

Appendix A

APPENDIX B

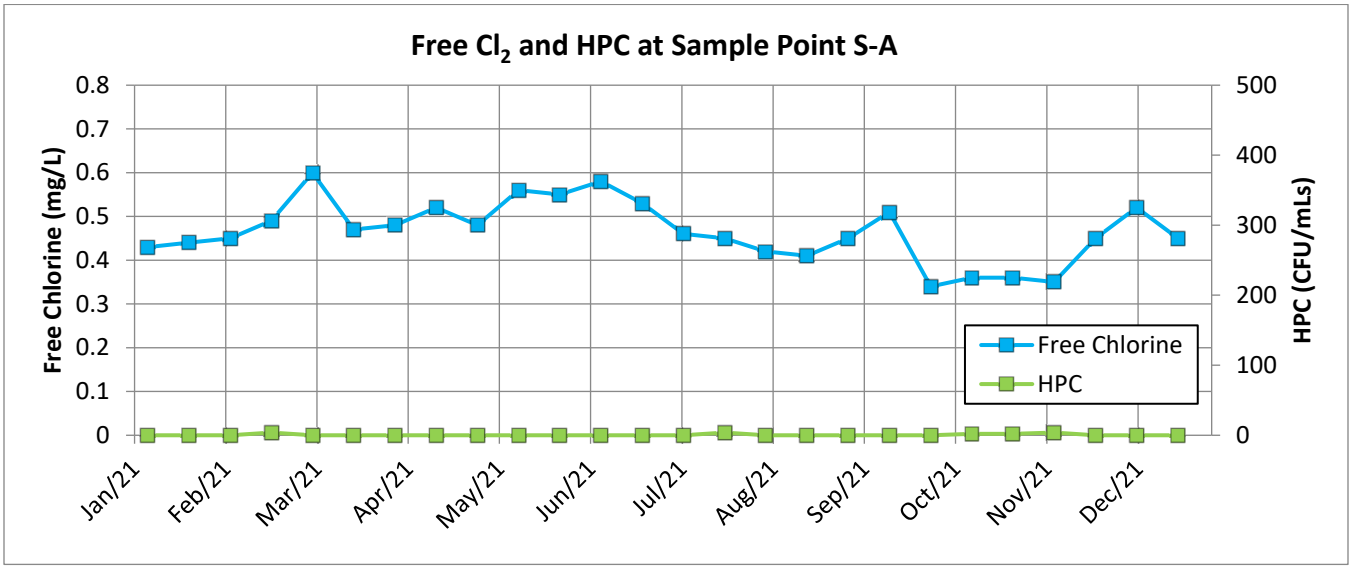
Sample Analysis Results

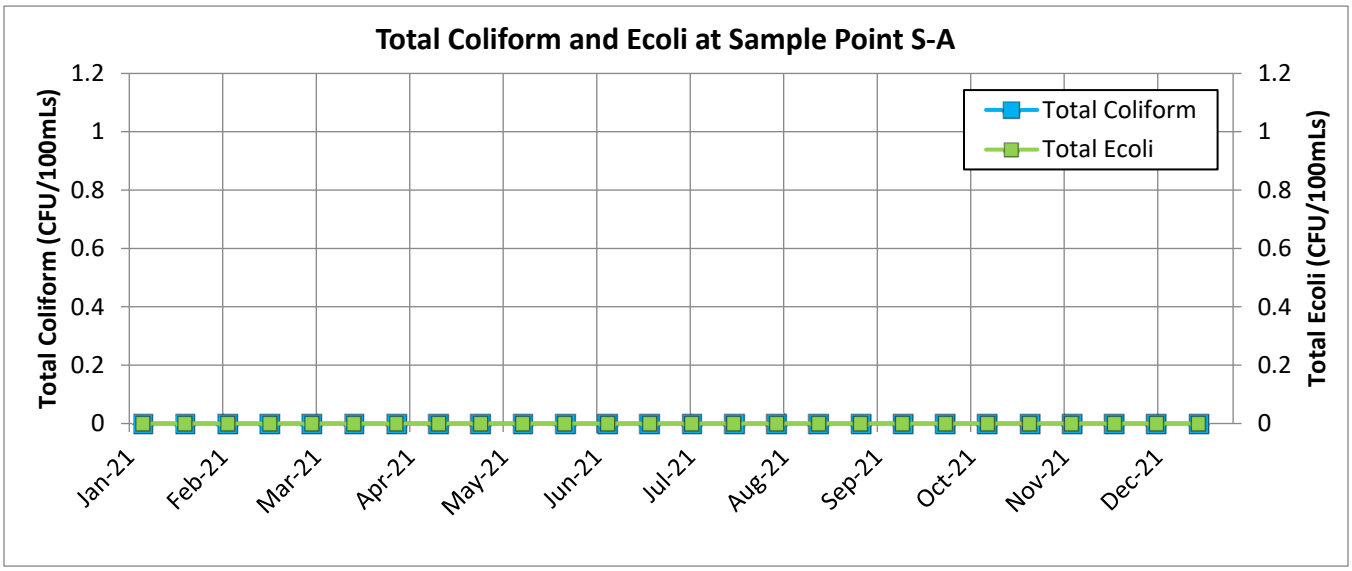
Sample Point S-A
Location: Drummond Dr. & W. 6th Ave.

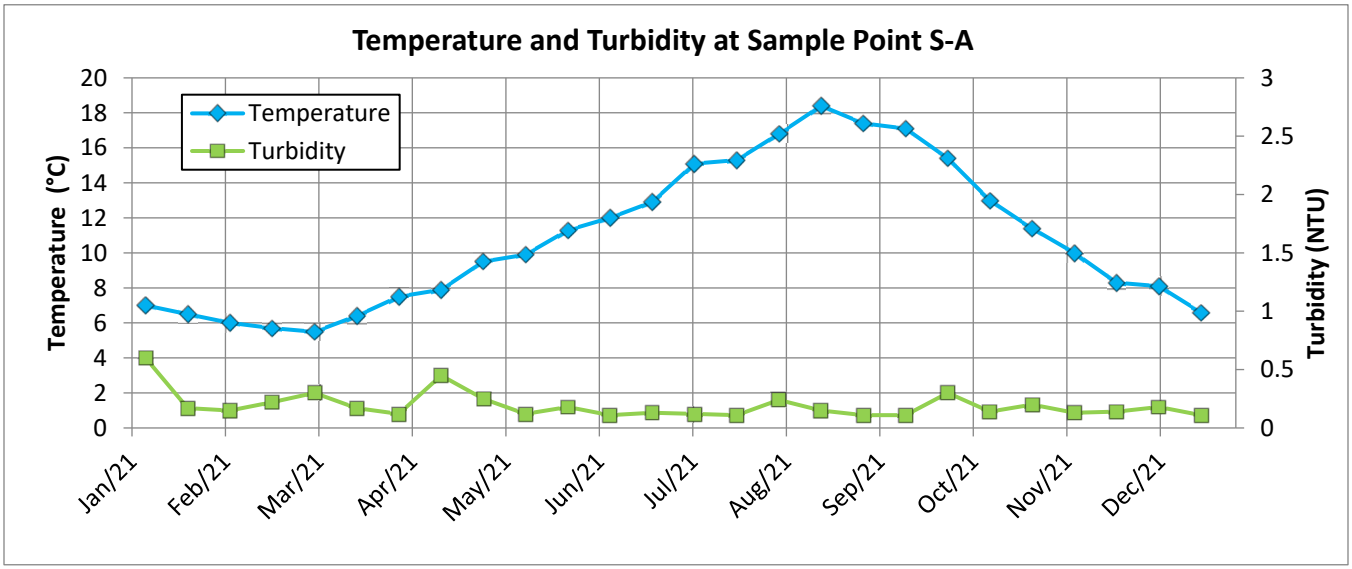
Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
5-Jan-21	0.43	<1	<2	7	<1	0.6
19-Jan-21	0.44	<1	<2	6.5	<1	0.17
2-Feb-21	0.45	<1	<2	6	<1	0.15
16-Feb-21	0.49	<1	4	5.7	<1	0.22
2-Mar-21	0.6	<1	<2	5.5	<1	0.3
16-Mar-21	0.47	<1	<2	6.4	<1	0.17
30-Mar-21	0.48	<1	<2	7.5	<1	0.12
13-Apr-21	0.52	<1	<2	7.9	<1	0.45
27-Apr-21	0.48	<1	<2	9.5	<1	0.25
11-May-21	0.56	<1	<2	9.9	<1	0.12
25-May-21	0.55	<1	<2	11.3	<1	0.18
8-Jun-21	0.58	<1	<2	12	<1	0.11
22-Jun-21	0.53	<1	<2	12.9	<1	0.13
6-Jul-21	0.46	<1	<2	15.1	<1	0.12
20-Jul-21	0.45	<1	4	15.3	<1	0.11
3-Aug-21	0.42	<1	<2	16.8	<1	0.24
17-Aug-21	0.41	<1	<2	18.4	<1	0.15
31-Aug-21	0.45	<1	<2	17.4	<1	0.11
14-Sep-21	0.51	<1	<2	17.1	<1	0.11
28-Sep-21	0.34	<1	<2	15.4	<1	0.3
12-Oct-21	0.36	<1	2	13	<1	0.14
26-Oct-21	0.36	<1	2	11.4	<1	0.2
9-Nov-21	0.35	<1	4	10	<1	0.13
23-Nov-21	0.45	<1	<2	8.3	<1	0.14
7-Dec-21	0.52	<1	<2	8.1	<1	0.18
21-Dec-21	0.45	<1	NA[1]	6.6	<1	0.11

Min	0.34	<1	<2	5.5	<1	0.11
Average	0.47	<1	2	10.8	<1	0.19
Max	0.60	<1	4	18.4	<1	0.60
Count	26	26	25	26	26	26

[1] Results not provided by Metro Vancouver lab.


Free Cl2 and HPC at Sample Point S-A
Free Chlorine (mg/L)
HPC (CFU/mLs)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Free Chlorine
HPC
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21


Total Coliform and Ecoli at Sample Point S-A
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
1.2
1
0.8
0.6
0.4
0.2
0
Total Coliform
Total Ecoli
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

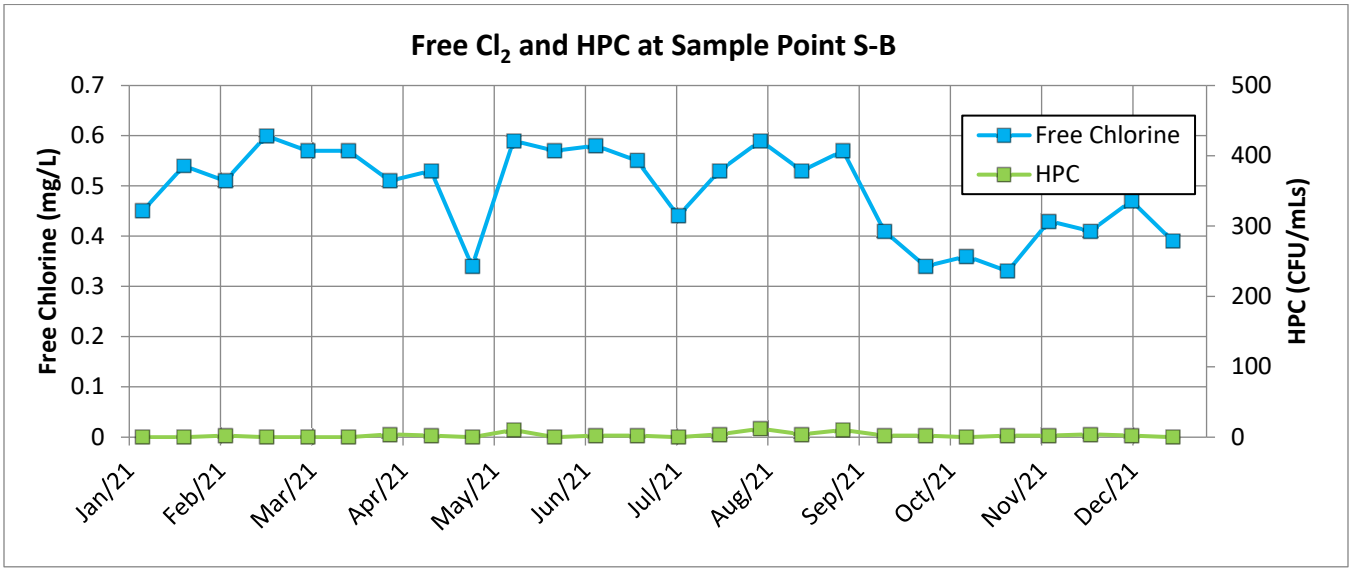

Temperature and Turbidity at Sample Point S-A
Temperature (°C)
Turbidity (NTU)
20
18
16
14
12
10
8
6
4
2
0
3
2.5
2
1.5
1
0.5
0
Temperature
Turbidity
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

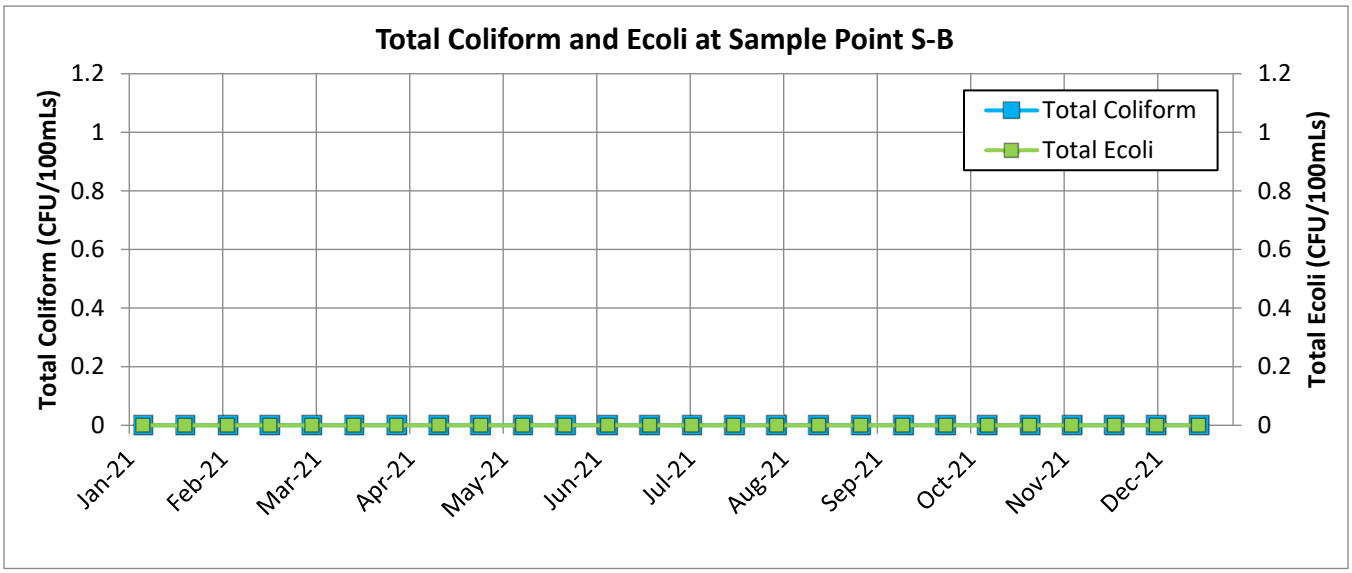
Sample Point S-B
Location Wycliff Road & Tasmania Crescent

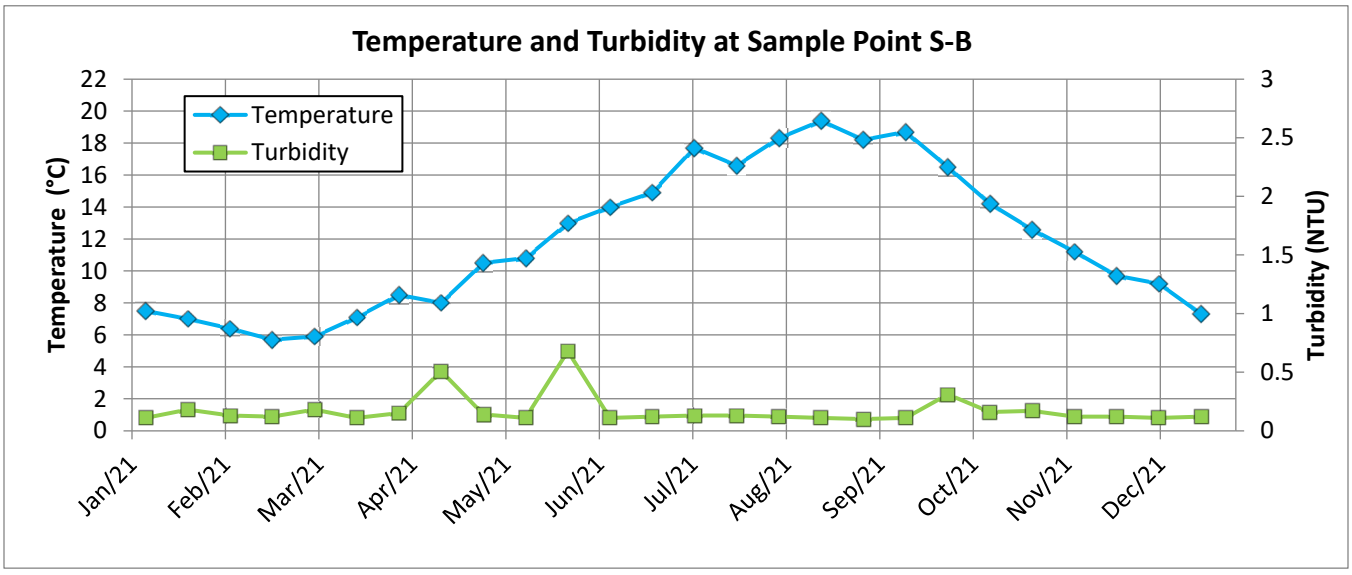
Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
5-Jan-21	0.45	<1	<2	7.5	<1	0.11
19-Jan-21	0.54	<1	<2	7	<1	0.18
2-Feb-21	0.51	<1	2	6.4	<1	0.13
16-Feb-21	0.6	<1	<2	5.7	<1	0.12
2-Mar-21	0.57	<1	<2	5.9	<1	0.18
16-Mar-21	0.57	<1	<2	7.1	<1	0.11
30-Mar-21	0.51	<1	4	8.5	<1	0.15
13-Apr-21	0.53	<1	2	8	<1	0.51
27-Apr-21	0.34	<1	<2	10.5	<1	0.14
11-May-21	0.59	<1	10	10.8	<1	0.11
25-May-21	0.57	<1	<2	13	<1	0.68
8-Jun-21	0.58	<1	2	14	<1	0.11
22-Jun-21	0.55	<1	2	14.9	<1	0.12
6-Jul-21	0.44	<1	<2	17.7	<1	0.13
20-Jul-21	0.53	<1	4	16.6	<1	0.13
3-Aug-21	0.59	<1	12	18.3	<1	0.12
17-Aug-21	0.53	<1	4	19.4	<1	0.11
31-Aug-21	0.57	<1	10	18.2	<1	0.1
14-Sep-21	0.41	<1	2	18.7	<1	0.11
28-Sep-21	0.34	<1	2	16.5	<1	0.31
12-Oct-21	0.36	<1	<2	14.2	<1	0.16
26-Oct-21	0.33	<1	2	12.6	<1	0.17
9-Nov-21	0.43	<1	2	11.2	<1	0.12
23-Nov-21	0.41	<1	4	9.7	<1	0.12
7-Dec-21	0.47	<1	2	9.2	<1	0.11
21-Dec-21	0.39	<1	NA[1]	7.3	<1	0.12

Min	0.33	<1	<2	5.7	<1	0.10
Average	0.49	<1	3	11.9	<1	0.17
Max	0.60	<1	12	19.4	<1	0.68
Count	26	26	25	26	26	26

[1] Results not provided by Metro Vancouver lab.


Free Cl2 and HPC at Sample Point S-B
Free Chlorine (mg/L)
HPC (CFU/mLs)
Free Chlorine
HPC
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21


Total Coliform and Ecoli at Sample Point S-B
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
Total Coliform
Total Ecoli
1.2
1
0.8
0.6
0.4
0.2
0
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

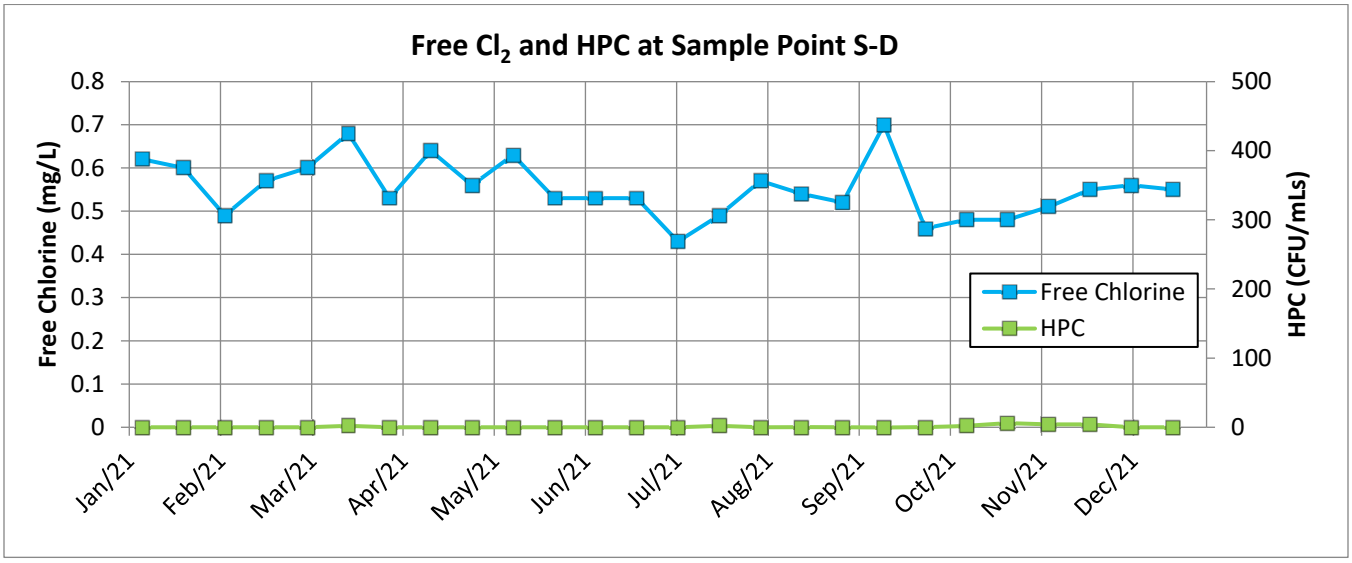

Temperature and Turbidity at Sample Point S-B
Temperature (°C)
Turbidity (NTU)
Temperature
Turbidity
22
20
18
16
14
12
10
8
6
4
2
0
3
2.5
2
1.5
1
0.5
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

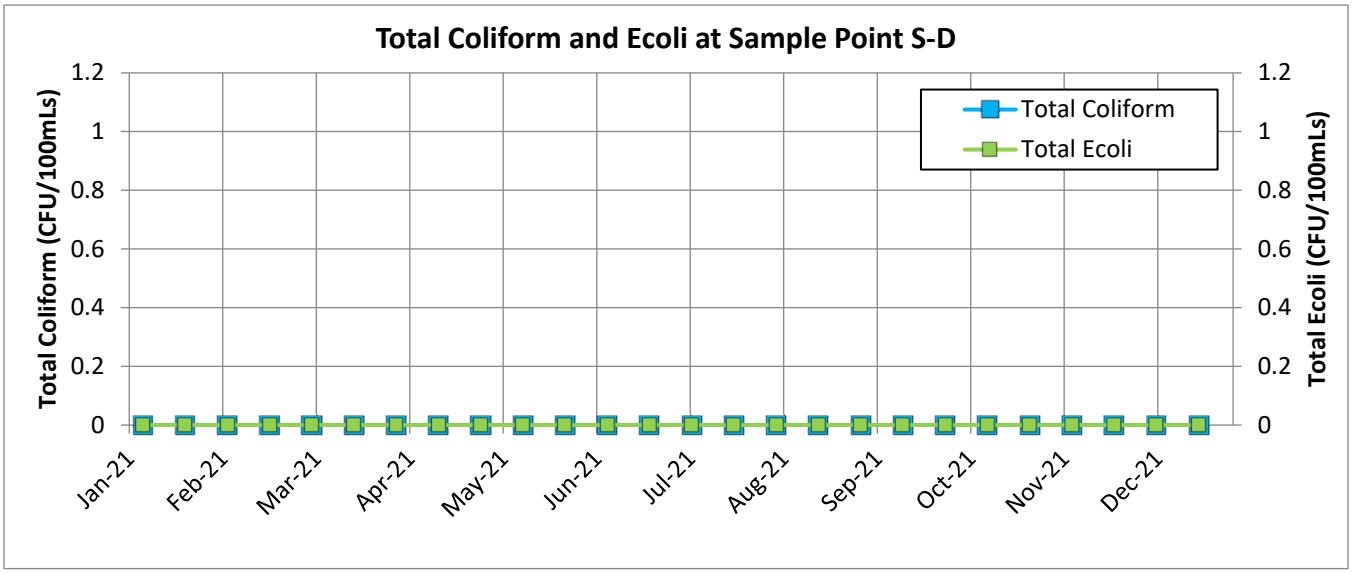
Sample Point S-D
Location: Acadia Rd. & Toronto Rd.

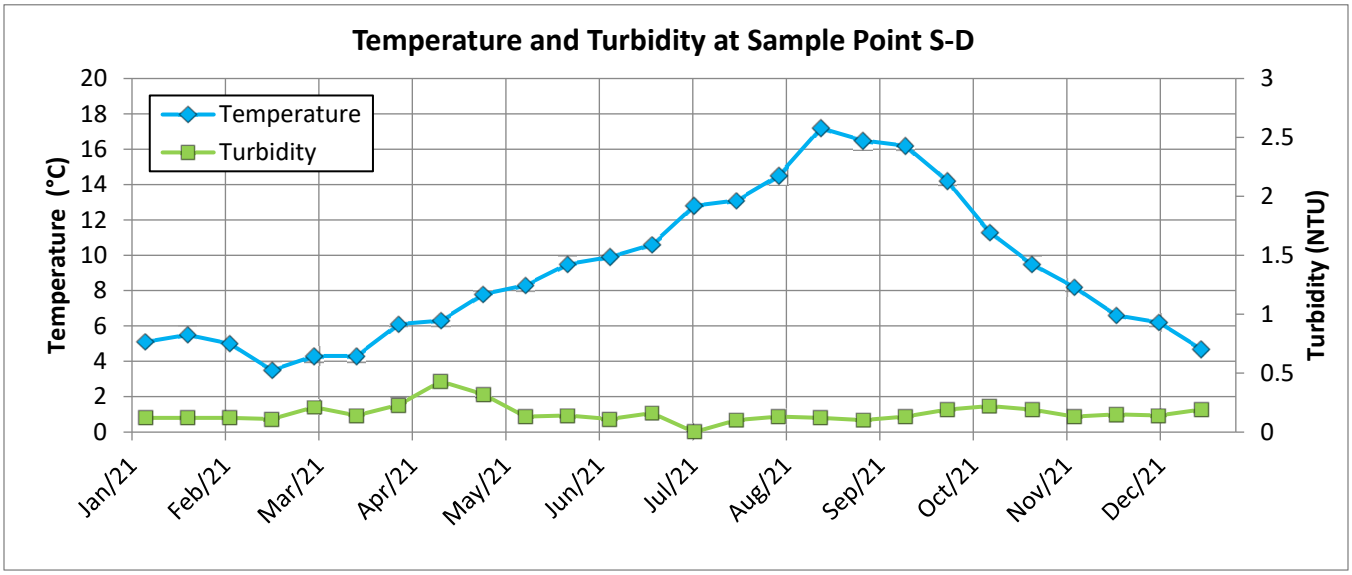
Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
5-Jan-21	0.62	<1	NA[1]	5.1	<1	0.12
19-Jan-21	0.6	<1	<2	5.5	<1	0.12
2-Feb-21	0.49	<1	<2	5	<1	0.12
16-Feb-21	0.57	<1	<2	3.5	<1	0.11
2-Mar-21	0.6	<1	<2	4.3	<1	0.21
16-Mar-21	0.68	<1	2	4.3	<1	0.14
30-Mar-21	0.53	<1	<2	6.1	<1	0.23
13-Apr-21	0.64	<1	<2	6.3	<1	0.43
27-Apr-21	0.56	<1	<2	7.8	<1	0.32
11-May-21	0.63	<1	<2	8.3	<1	0.13
25-May-21	0.53	<1	<2	9.5	<1	0.14
8-Jun-21	0.53	<1	<2	9.9	<1	0.11
22-Jun-21	0.53	<1	<2	10.6	<1	0.16
6-Jul-21	0.43	<1	<2	12.8	<1	NA[2]
20-Jul-21	0.49	<1	2	13.1	<1	0.1
3-Aug-21	0.57	<1	<2	14.5	<1	0.13
17-Aug-21	0.54	<1	<2	17.2	<1	0.12
31-Aug-21	0.52	<1	<2	16.5	<1	0.1
14-Sep-21	0.7	<1	<2	16.2	<1	0.13
28-Sep-21	0.46	<1	<2	14.2	<1	0.19
12-Oct-21	0.48	<1	2	11.3	<1	0.22
26-Oct-21	0.48	<1	6	9.5	<1	0.19
9-Nov-21	0.51	<1	4	8.2	<1	0.13
23-Nov-21	0.55	<1	4	6.6	<1	0.15
7-Dec-21	0.56	<1	<2	6.2	<1	0.14
21-Dec-21	0.55	<1	NA[3]	4.7	<1	0.19

Min	0.43	<1	<2	3.5	<1	0.10
Average	0.55	<1	2	9.1	<1	0.17
Max	0.70	<1	6	17.2	<1	0.43
Count	26	26	24	26	26	26

[1] LA (Contamination).
[2] Results not provided by metro Vancouver lab.
[3] LA (Sample bottle disposed before reading).


Free Cl2 and HPC at Sample Point S-D
Free Chlorine (mg/L)
HPC (CFU/mLs)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Free Chlorine
HPC
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21


Total Coliform and Ecoli at Sample Point S-D
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
1.2
1
0.8
0.6
0.4
0.2
0
Total Coliform
Total Ecoli
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

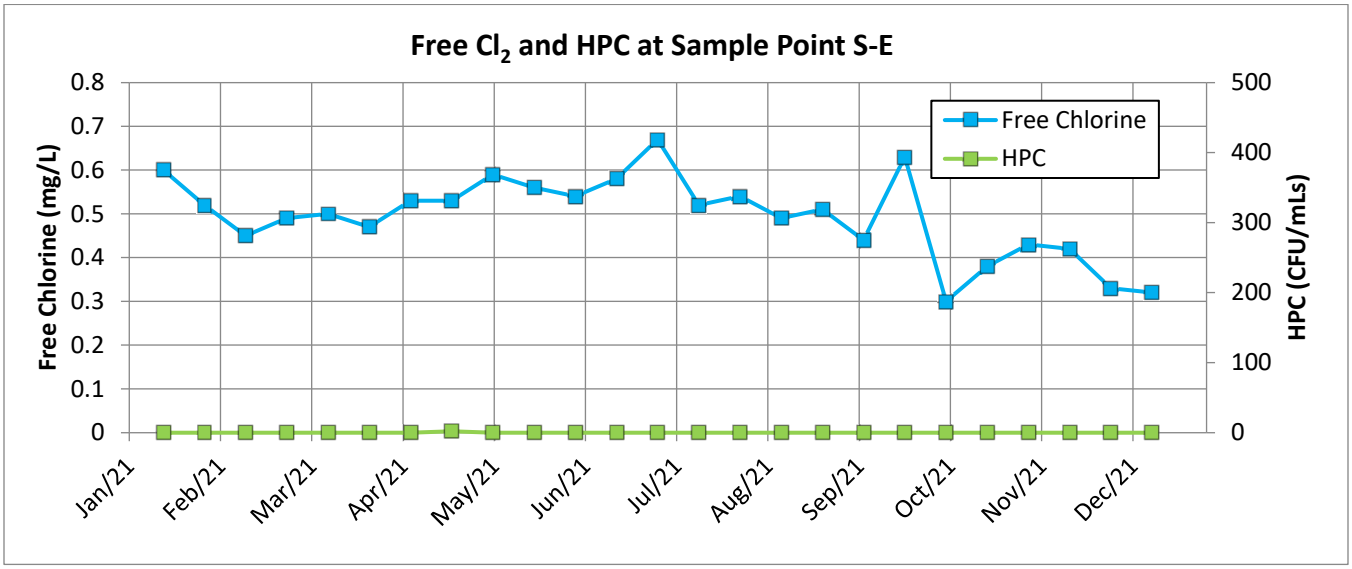

Temperature and Turbidity at Sample Point S-D
Temperature (°C)
Turbidity (NTU)
20
18
16
14
12
10
8
6
4
2
0
3
2.5
2
1.5
1
0.5
0
Temperature
Turbidity
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

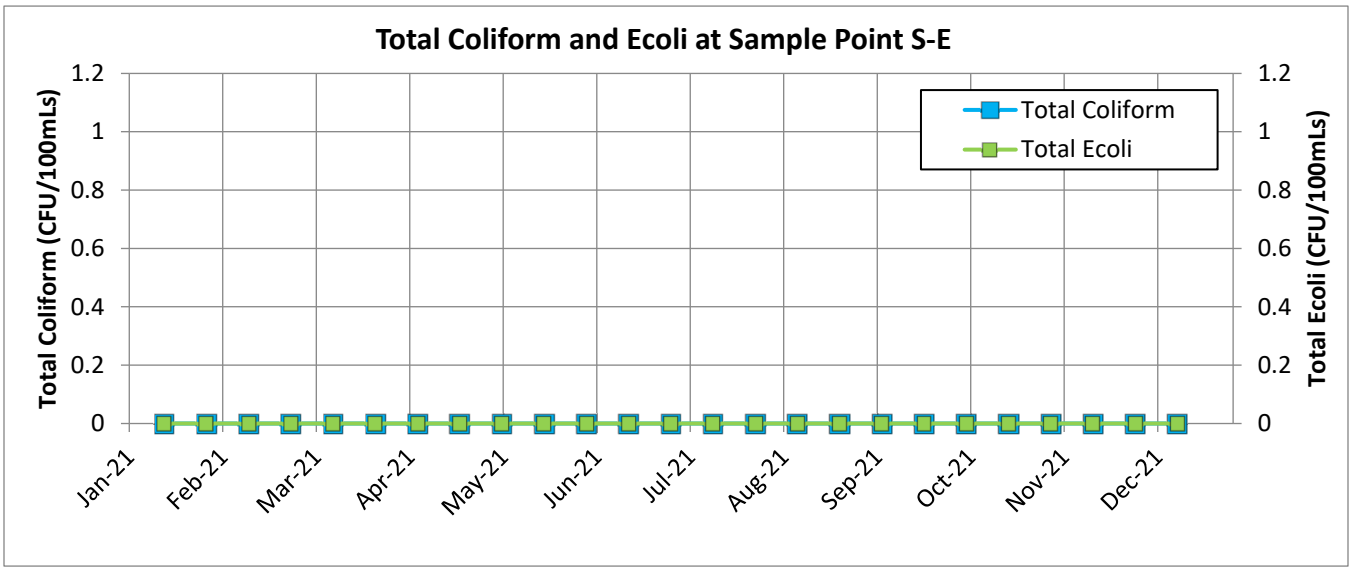
Sample Point S-E
Location: Western Pkwy. S. of Chancellor Blvd.

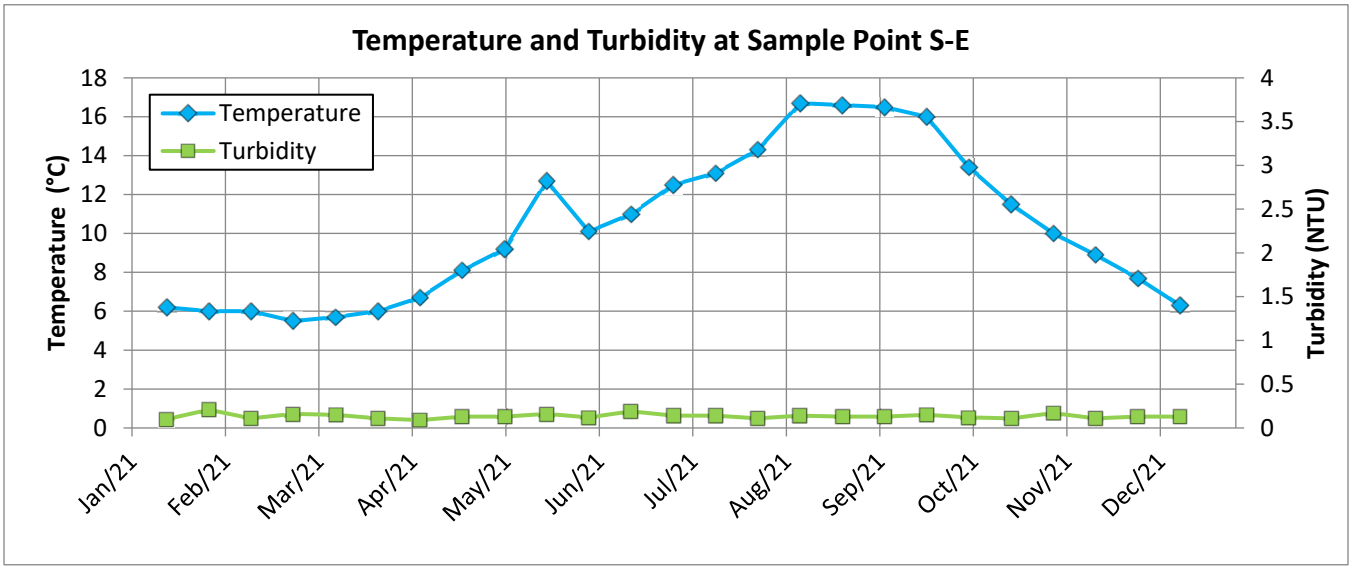
Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
12-Jan-21	0.6	<1	<2	6.2	<1	0.1
26-Jan-21	0.52	<1	<2	6	<1	0.21
9-Feb-21	0.45	<1	<2	6	<1	0.11
23-Feb-21	0.49	<1	<2	5.5	<1	0.16
9-Mar-21	0.5	<1	<2	5.7	<1	0.15
23-Mar-21	0.47	<1	<2	6	<1	0.11
6-Apr-21	0.53	<1	<2	6.7	<1	0.09
20-Apr-21	0.53	<1	2	8.1	<1	0.13
4-May-21	0.59	<1	<2	9.2	<1	0.13
18-May-21	0.56	<1	<2	12.7	<1	0.16
1-Jun-21	0.54	<1	<2	10.1	<1	0.12
15-Jun-21	0.58	<1	<2	11	<1	0.19
29-Jun-21	0.67	<1	<2	12.5	<1	0.14
13-Jul-21	0.52	<1	<2	13.1	<1	0.14
27-Jul-21	0.54	<1	<2	14.3	<1	0.11
10-Aug-21	0.49	<1	<2	16.7	<1	0.14
24-Aug-21	0.51	<1	<2	16.6	<1	0.13
7-Sep-21	0.44	<1	<2	16.5	<1	0.13
21-Sep-21	0.63	<1	<2	16	<1	0.15
5-Oct-21	0.3	<1	<2	13.4	<1	0.12
19-Oct-21	0.38	<1	<2	11.5	<1	0.11
2-Nov-21	0.43	<1	<2	10	<1	0.17
16-Nov-21	0.42	<1	<2	8.9	<1	0.11
30-Nov-21	0.33	<1	<2	7.7	<1	0.13
14-Dec-21	0.32	<1	<2	6.3	<1	0.13
29-Dec-21	0.54	<1	NA[1]	4.7	<1	0.18

Min	0.30	<1	<2	4.7	<1	0.09
Average	0.50	<1	2	10.1	<1	0.14
Max	0.67	<1	2	16.7	<1	0.21
Count	26	26	25	26	26	26

[1] Results not provided by Metro Vancouver lab.


Free Cl2 and HPC at Sample Point S-E
Free Chlorine (mg/L)
HPC (CFU/mLs)
Free Chlorine
HPC
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21


Total Coliform and Ecoli at Sample Point S-E
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
Total Coliform
Total Ecoli
1.2
1
0.8
0.6
0.4
0.2
0
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

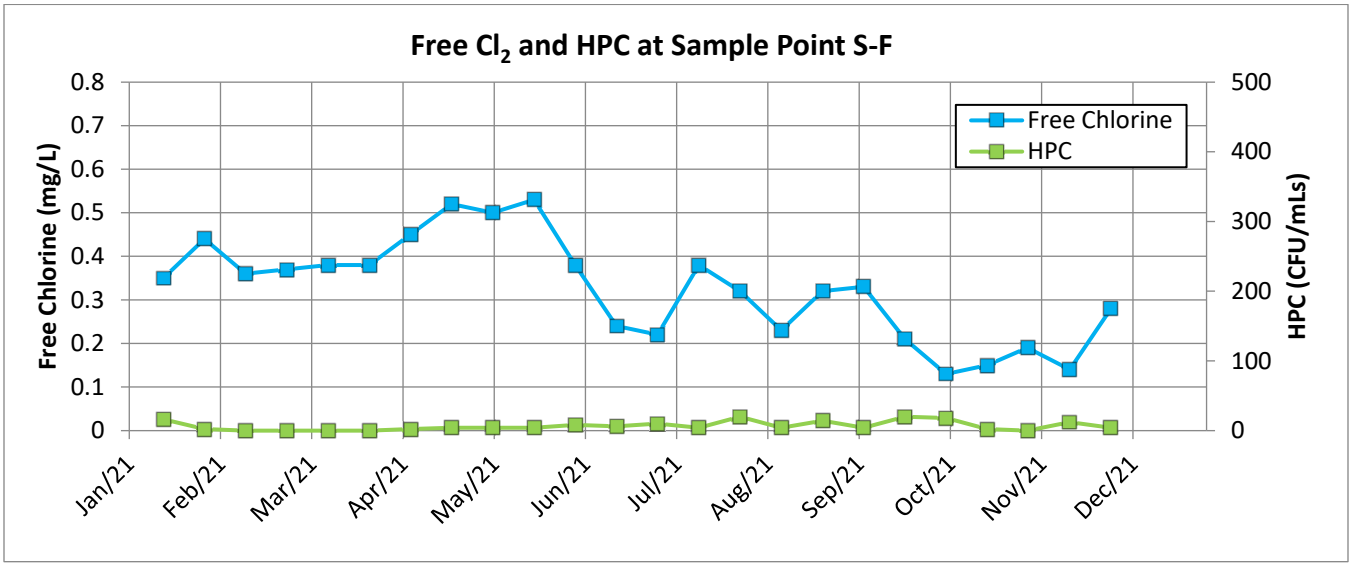

Temperature and Turbidity at Sample Point S-E
Temperature (°C)
Turbidity (NTU)
Temperature
Turbidity
18
16
14
12
10
8
6
4
2
0
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

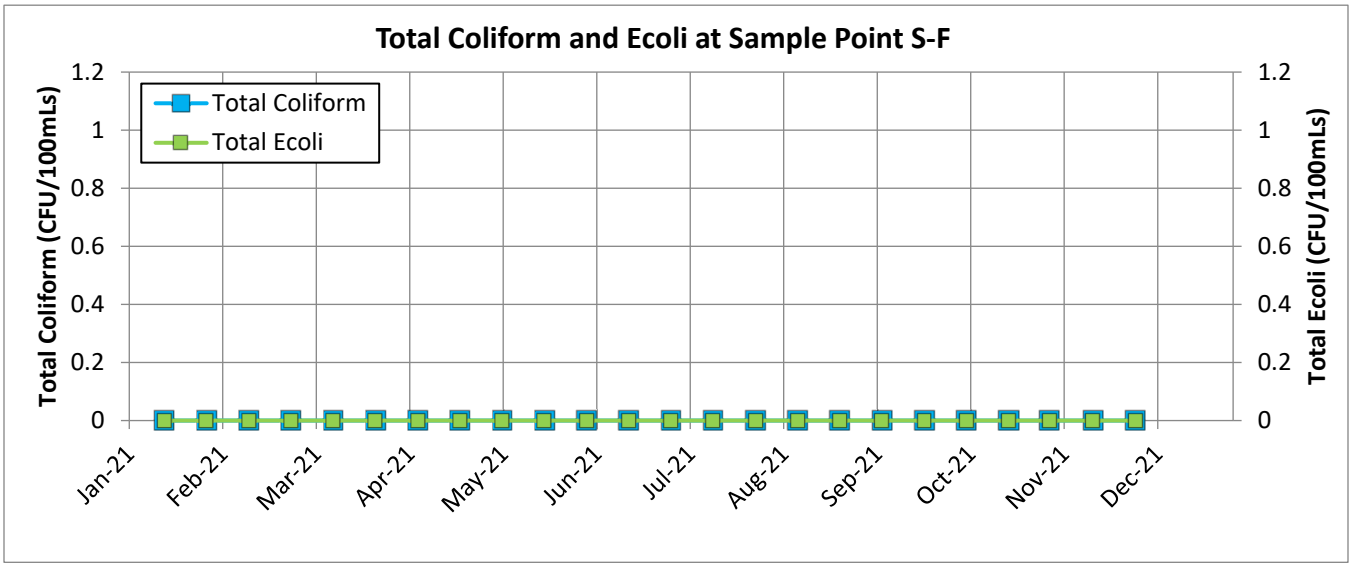
Sample Point S-F
Location: Marine Drive at UEL Boundary

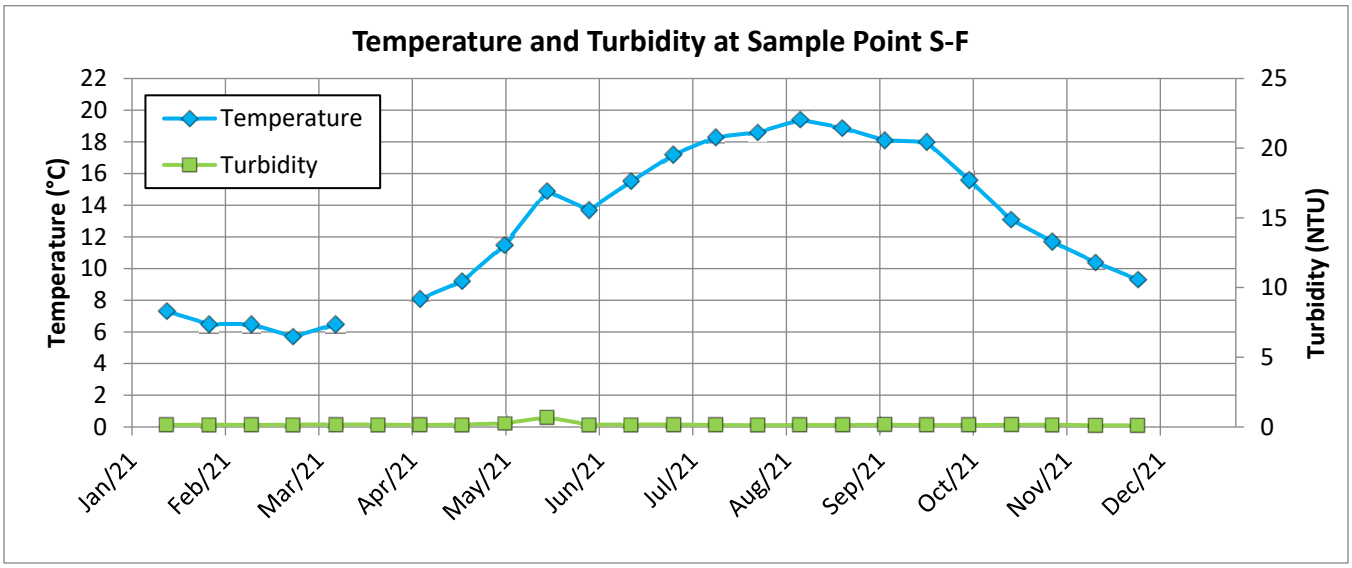
Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
12-Jan-21	0.35	<1	16	7.3	<1	0.13
26-Jan-21	0.44	<1	2	6.5	<1	0.17
9-Feb-21	0.36	<1	<2	6.5	<1	0.13
23-Feb-21	0.37	<1	<2	5.7	<1	0.16
9-Mar-21	0.38	<1	<2	6.5	<1	0.18
23-Mar-21	0.38	<1	<2	NA[1]	<1	0.16
6-Apr-21	0.45	<1	2	8.1	<1	0.13
20-Apr-21	0.52	<1	4	9.2	<1	0.16
4-May-21	0.5	<1	4	11.5	<1	0.26
18-May-21	0.53	<1	4	14.9	<1	0.7
1-Jun-21	0.38	<1	8	13.7	<1	0.16
15-Jun-21	0.24	<1	6	15.5	<1	0.16
29-Jun-21	0.22	<1	10	17.2	<1	0.18
13-Jul-21	0.38	<1	4	18.3	<1	0.13
27-Jul-21	0.32	<1	20	18.6	<1	0.12
10-Aug-21	0.23	<1	4	19.4	<1	0.13
24-Aug-21	0.32	<1	14	18.9	<1	0.13
7-Sep-21	0.33	<1	4	18.1	<1	0.15
21-Sep-21	0.21	<1	20	18	<1	0.13
5-Oct-21	0.13	<1	18	15.6	<1	0.13
19-Oct-21	0.15	<1	2	13.1	<1	0.14
2-Nov-21	0.19	<1	<2	11.7	<1	0.16
16-Nov-21	0.14	<1	12	10.4	<1	0.11
30-Nov-21	0.28	<1	4	9.3	<1	0.11
14-Dec-21	0.35	<1	6	7.9	<1	0.18

Min	0.13	<1	<2	5.7	<1	0.11
Average	0.33	<1	7	12.6	<1	0.17
Max	0.53	<1	20	19.4	<1	0.70
Count	25	25	25	25	25	25

[1] Temperature recording unseasonably low.


Free Cl2 and HPC at Sample Point S-F
Free Chlorine (mg/L)
HPC (CFU/mLs)
Free Chlorine
HPC
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

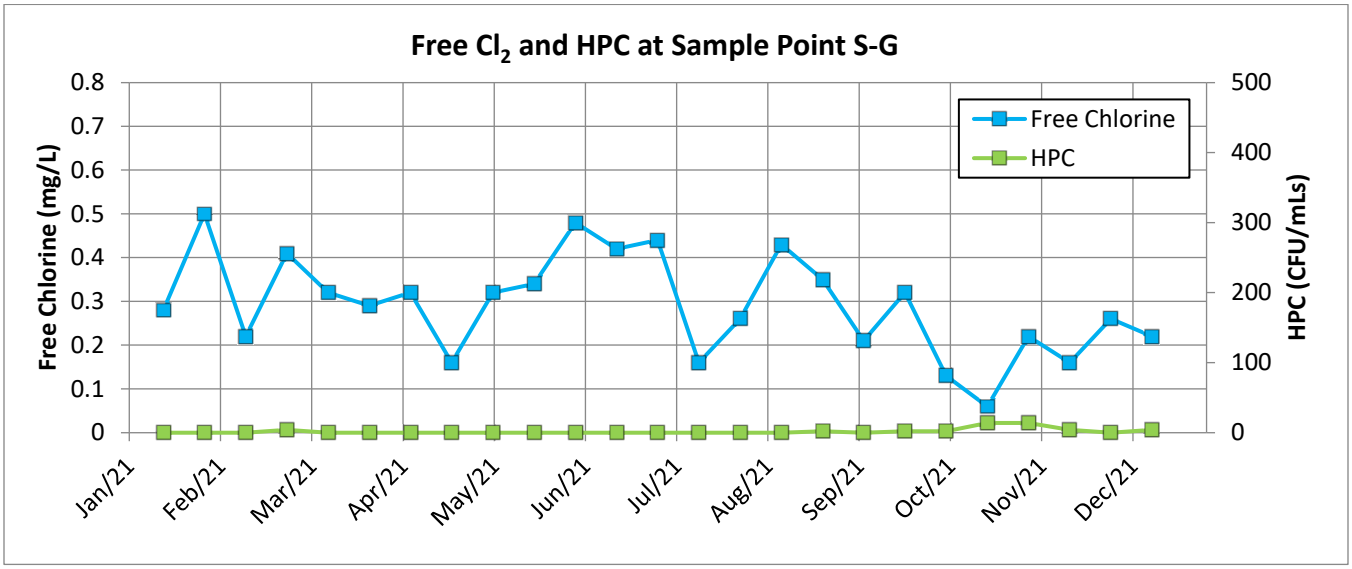

Total Coliform and Ecoli at Sample Point S-F
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
Total Coliform
Total Ecoli
1.2
1
0.8
0.6
0.4
0.2
0
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

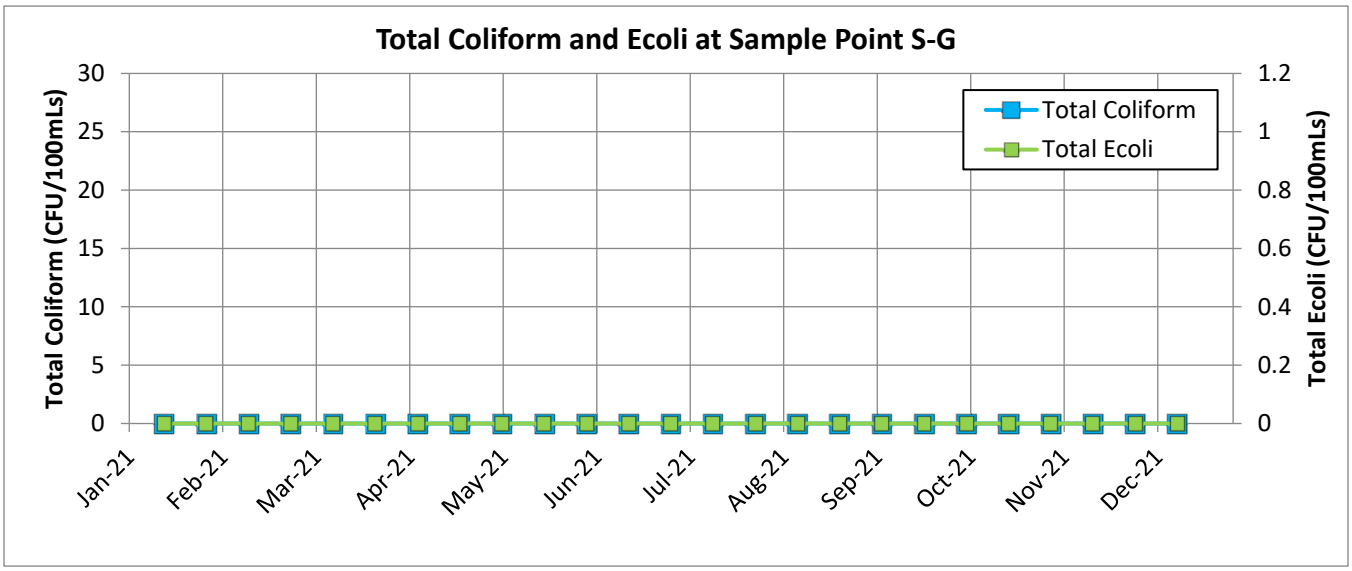

Temperature and Turbidity at Sample Point S-F
Temperature (°C)
Turbidity (NTU)
Temperature
Turbidity
22
20
18
16
14
12
10
8
6
4
2
0
25
20
15
10
5
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

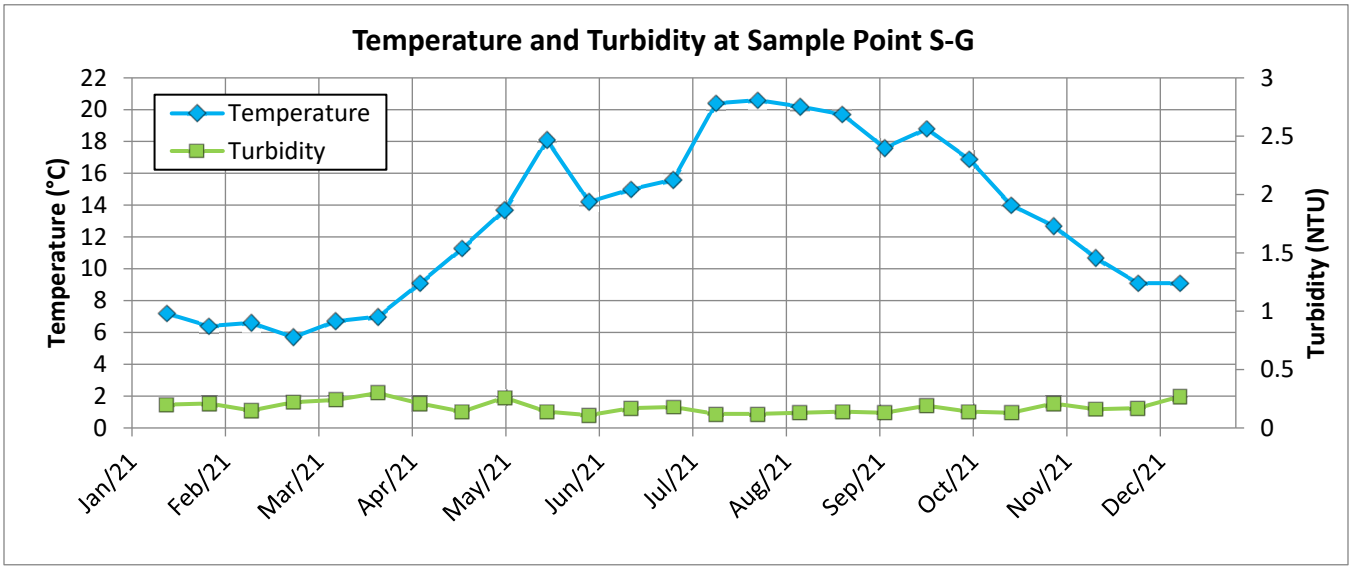
Sample Point S-G
Location: Chancellor Blvd. East of Acadia

Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
12-Jan-21	0.28	<1	<2	7.2	<1	0.2
26-Jan-21	0.5	<1	<2	6.4	<1	0.21
9-Feb-21	0.22	<1	<2	6.6	<1	0.15
23-Feb-21	0.41	<1	4	5.7	<1	0.22
9-Mar-21	0.32	<1	<2	6.7	<1	0.24
23-Mar-21	0.29	<1	<2	7	<1	0.3
6-Apr-21	0.32	<1	<2	9.1	<1	0.21
20-Apr-21	0.16	<1	<2	11.3	<1	0.14
4-May-21	0.32	<1	<2	13.7	<1	0.26
18-May-21	0.34	<1	<2	18.1	<1	0.14
1-Jun-21	0.48	<1	<2	14.2	<1	0.11
15-Jun-21	0.42	<1	<2	15	<1	0.17
29-Jun-21	0.44	<1	<2	15.6	<1	0.18
13-Jul-21	0.16	<1	<2	20.4	<1	0.12
27-Jul-21	0.26	<1	<2	20.6	<1	0.12
10-Aug-21	0.43	<1	<2	20.2	<1	0.13
24-Aug-21	0.35	<1	2	19.7	<1	0.14
7-Sep-21	0.21	<1	<2	17.6	<1	0.13
21-Sep-21	0.32	<1	2	18.8	<1	0.19
5-Oct-21	0.13	<1	2	16.9	<1	0.14
19-Oct-21	0.06	<1	14	14	<1	0.13
2-Nov-21	0.22	<1	14	12.7	<1	0.21
16-Nov-21	0.16	<1	4	10.7	<1	0.16
30-Nov-21	0.26	<1	<2	9.1	<1	0.17
14-Dec-21	0.22	<1	4	9.1	<1	0.27

Min	0.06	<1	<2	5.7	<1	0.11
Average	0.29	<1	3	13.1	<1	0.18
Max	0.50	<1	14	20.6	<1	0.30
Count	25	25	25	25	25	25


Free Cl_2 and HPC at Sample Point S-G
Free Chlorine (mg/L)
HPC (CFU/mLs)
Free Chlorine
HPC
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
400
300
200
100
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

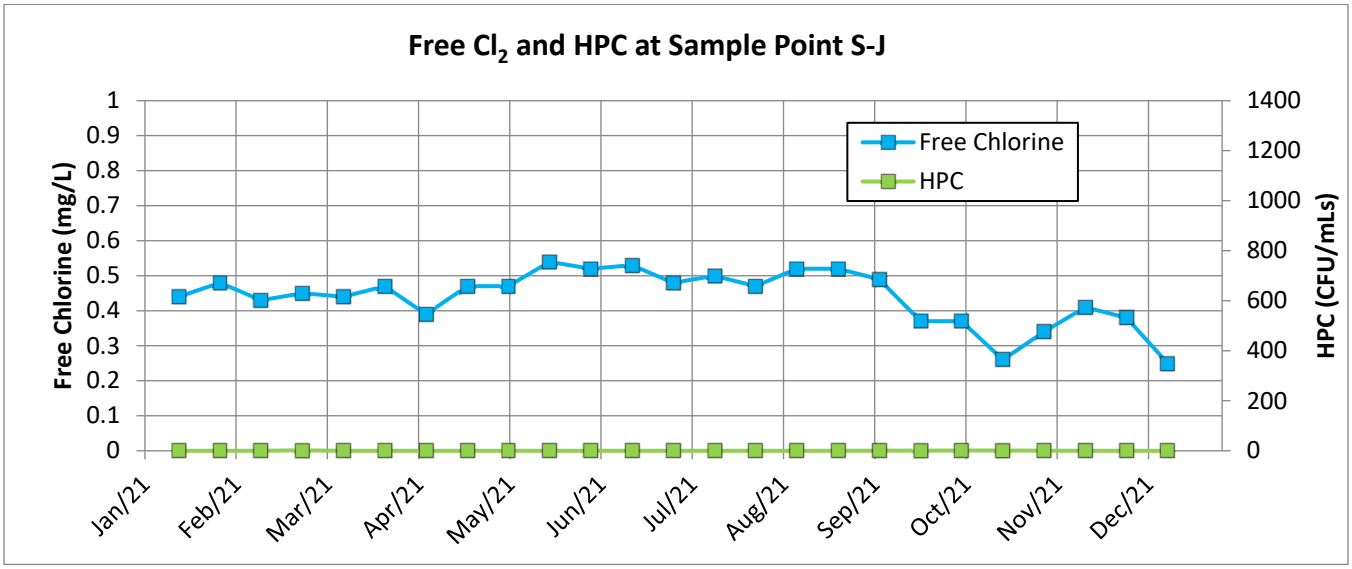

Total Coliform and Ecoli at Sample Point S-G
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
Total Coliform
Total Ecoli
30
25
20
15
10
5
0
1.2
1
0.8
0.6
0.4
0.2
0
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21

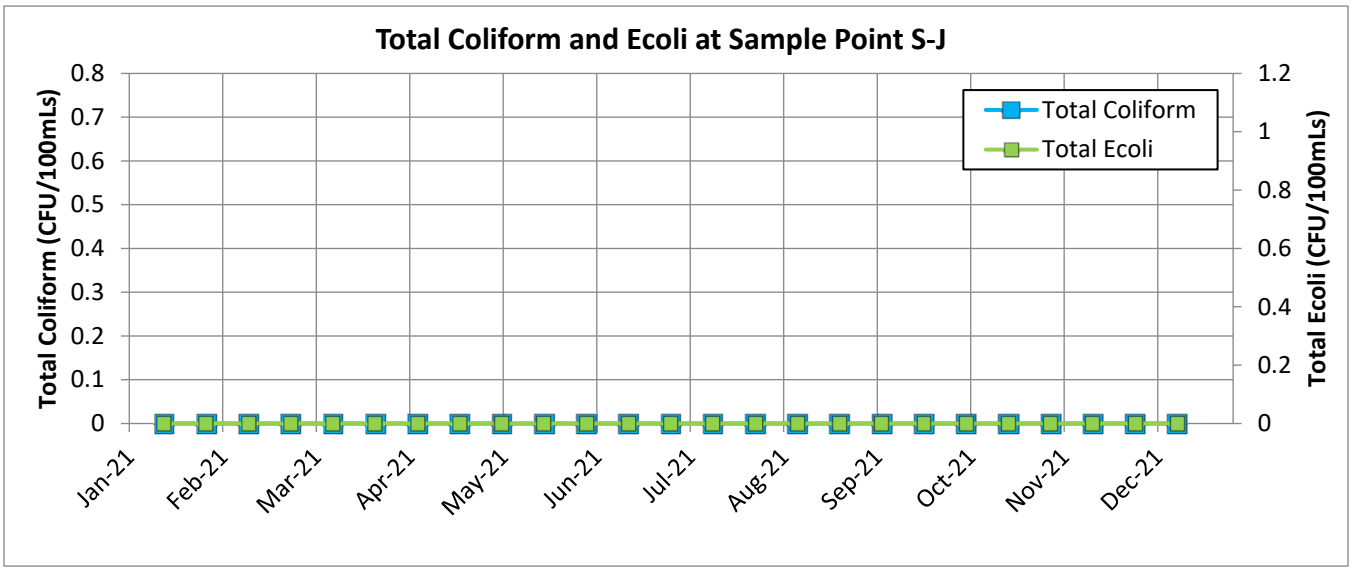

Temperature and Turbidity at Sample Point S-G
Temperature (°C)
Turbidity (NTU)
Temperature
Turbidity
22
20
18
16
14
12
10
8
6
4
2
0
3
2.5
2
1.5
1
0.5
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

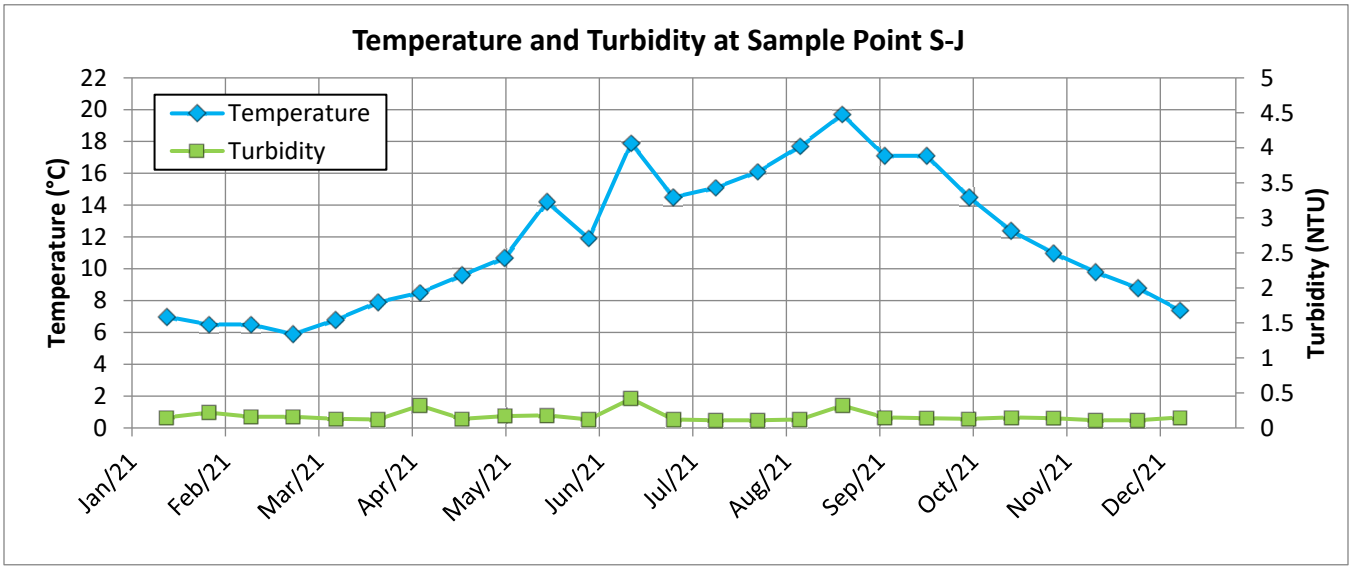
Sample Point S-J
Location: East side of NW Marine Dr

Sampled Date	Chlorine Free (mg/L)	E. Coli (CFU/100mLs)	HPC (CFU/mLs)	Temperature (°C)	Total Coliform (CFU/100mLs)	Turbidity (NTU)
12-Jan-21	0.44	<1	<2	7	<1	0.15
26-Jan-21	0.48	<1	<2	6.5	<1	0.22
9-Feb-21	0.43	<1	<2	6.5	<1	0.16
23-Feb-21	0.45	<1	2	5.9	<1	0.16
9-Mar-21	0.44	<1	<2	6.8	<1	0.13
23-Mar-21	0.47	<1	<2	7.9	<1	0.12
6-Apr-21	0.39	<1	<2	8.5	<1	0.32
20-Apr-21	0.47	<1	<2	9.6	<1	0.13
4-May-21	0.47	<1	<2	10.7	<1	0.17
18-May-21	0.54	<1	<2	14.2	<1	0.18
1-Jun-21	0.52	<1	<2	11.9	<1	0.12
15-Jun-21	0.53	<1	<2	17.9	<1	0.42
29-Jun-21	0.48	<1	<2	14.5	<1	0.12
13-Jul-21	0.5	<1	<2	15.1	<1	0.11
27-Jul-21	0.47	<1	<2	16.1	<1	0.11
10-Aug-21	0.52	<1	<2	17.7	<1	0.12
24-Aug-21	0.52	<1	<2	19.7	<1	0.32
7-Sep-21	0.49	<1	<2	17.1	<1	0.15
21-Sep-21	0.37	<1	2	17.1	<1	0.14
5-Oct-21	0.37	<1	<2	14.5	<1	0.13
19-Oct-21	0.26	<1	2	12.4	<1	0.15
2-Nov-21	0.34	<1	<2	11	<1	0.14
16-Nov-21	0.41	<1	<2	9.8	<1	0.11
30-Nov-21	0.38	<1	<2	8.8	<1	0.11
14-Dec-21	0.25	<1	<2	7.4	<1	0.15

Min	0.25	<1	<2	5.9	<1	0.11
Average	0.44	<1	2	11.8	<1	0.17
Max	0.54	<1	2	19.7	<1	0.42
Count	25	25	25	25	25	25


Free Cl2 and HPC at Sample Point S-J
Free Chlorine (mg/L)
HPC (CFU/mLs)
Free Chlorine
HPC
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1400
1200
1000
800
600
400
200
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21


Total Coliform and Ecoli at Sample Point S-J
Total Coliform (CFU/100mLs)
Total Ecoli (CFU/100mLs)
Total Coliform
Total Ecoli
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.2
1
0.8
0.6
0.4
0.2
0
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21


Temperature and Turbidity at Sample Point S-J
Temperature (°C)
Turbidity (NTU)
Temperature
Turbidity
22
20
18
16
14
12
10
8
6
4
2
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan/21
Feb/21
Mar/21
Apr/21
May/21
Jun/21
Jul/21
Aug/21
Sep/21
Oct/21
Nov/21
Dec/21

APPENDIX C

Well Water Quality Results

Emergency Water Supply Well Water Quality Results
Location: UEL Public Works Yard

Date Sampled	Field Parameters				General Parameters	Microbiological Parameters	
	Free Chlorine (mg/L)	Conductivity (µS/cm)	pH (pH units)	Field Temp. (°C)	Turbidity (NTU)	Total Coliforms (MPN/100 mL)	E. coli (MPN/100 mL)
2021-01-05	<0.02	165	7.8	9	7.31	<1	<1
2021-02-02	<0.02	147	6.9	10	3.54	<1	<1
2021-03-02	<0.02	160	8.1	9.5	4.43	<1	<1
2021-04-06	<0.02	145	8.2	9.4	N/A[1]	<1	<1
2021-05-04	<0.02	155	7.7	10.4	13.0	<1	<1
2021-06-01	<0.02	169	7.2	10.0	7.24	<1	<1
2021-07-06	<0.02	149	7.0	10.9	2.44	<1	<1
2021-08-03	<0.02	150	7.0	10.3	3.90	<1	<1
2021-09-07	<0.02	173	7.1	11.1	4.96	<1	<1
2021-10-05	<0.02	172	7.6	10.8	12.3	<1	<1
2021-11-02	<0.02	164	8.1	10.1	22.6	<1	<1
2021-12-07	<0.02	164	7.8	10.3	N/A[1]	<1	<1

[1]Results not provided by testing contractor.