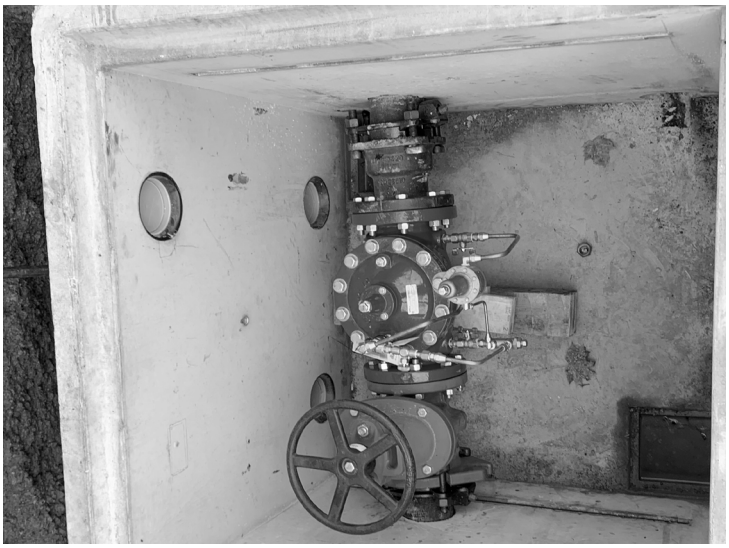
Drinking Water Quality – 2023 Annual Report

MAY 2024 | ENGINEERING, PARKS AND ENVIRONMENT

PREPARED BY WES MASON SECTON MANAGER, UTILITIES



Executive Summary

The City of North Vancouver's Water Utility Branch is tasked with delivering safe and clean drinking water efficiently and sustainably to the Residents and Businesses of The City. This report outlines information about the City's distribution network, maintenance and operation in support of the City's application the water distribution system annual Operating Permit.

The City utilities water supply originating from both Capilano and Seymour Watersheds which are both treated by Metro Vancouver at the Seymour Falls Filtration plant prior to reaching the City's network.

The City conducts water quality testing for a range of health-based and non-health-based parameters. This includes E. Coli, Coliform, HAAs and THMs, Turbidity, chlorine residuals and water temperature. On a whole the City testing program showed that the City's water supply is excellent. There were no instances of microbiological or chemical parameters exceeding relevant guidelines. The physical turbidity measurement only exceeded the relevant guideline level of 1.0 NTU three times out of a total of 518 samples (0.77%).

Chlorine residuals met or exceeded the required of at least 0.2 mg/L in all but 0.08 % of samples. This positive results helps to minimize risks to the quality of water in the network. Water temperature exceeded the maximum recommended value of 15 degrees Celsius on a number of occasions during last summer. Unfortunately this is not a parameter The City can easily control, however it is only of aesthetic importance to the overall quality of Water in the network.

The City is continuing to maintain, upgrade and expand the water distribution network. Last year 450m of new pipe was laid with more pipe replacement planned for 2024. The City maintains a staff complement of 9 employees with relevant direct qualification and experience in the operation of water distributions systems. These staff are regularly trained and recertified in a number of relevant courses and qualifications.

The overall quality of the water distributed, the maintenance of the physical network and high level of operator qualification required for safe operation of the water utility in The City is good. This has resulted in excellent water quality in 2023 and will continue to ensure the delivery of safe and clean drinking water to all users in the City of North Vancouver well into the future.

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1. Introduction

The City of North Vancouver's Drinking Water Quality Annual Report provides annual operating information about our drinking water and supports the City's application for the water distribution system annual Operating Permit. The Medical Health Officer issues the permit as required by the Drinking Water Protection Act.

In conjunction with the Greater Vancouver Water District (Metro Vancouver), the City continues to deliver safe, high-quality water to its residents and other users. The City's capital plan for the water utility continues to prioritize ongoing replacement of aging or problematic water infrastructure and to provide funding for the maintenance programs related to water quality.

The Regional Drinking Water Management Plan (DWMP), prepared by Metro Vancouver in 2011, provides direction for a sustainable water supply and includes commitments at both the municipal and regional level. The 2011 DWMP is an update of the 2007 plan and reflects fundamental improvements in water quality treatment at the Seymour Filtration Plant and a larger focus on sustainability of the drinking water resource.

The primary goals of the Plan remain unchanged and are as follows:

- Goal 1: Provide Clean, Safe Drinking Water
- Goal 2: Ensure the Sustainable Use of Water Resources
- Goal 3: Ensure the Efficient Supply of Water

2. Source Water

Metro Vancouver has three watersheds that provide our drinking water: Capilano and Seymour Watersheds on the North Shore and Coquitlam Watershed in Coquitlam. Drinking water is supplied to more than 2.8 million residents from these sources. Both the Capilano and Seymour water sources are filtered and disinfected at the Seymour Falls Water Filtration Plant prior to distribution and are both sources for the City of North Vancouver.

The watersheds are protected from urban development, closed to public access, and managed as natural assets of the highest importance to the region we live in. Protecting the source of our drinking water protects other natural assets.

Metro Vancouver is responsible for monitoring and testing water for bacteriological, chemical, and physical quality. Metro Vancouver maintains a laboratory for the drinking water program, testing all source water as well as samples collected by member municipalities from their distribution systems. Metro Vancouver prepares a comprehensive annual water quality control report providing information for the entire Metro Vancouver service area. Extensive information on water in general is provided on the Metro Vancouver web site (www.metrovancouver.org).

The City of North Vancouver is located between the Capilano and Seymour source water reservoirs, and since all water from both reservoirs is treated at Seymour Falls, there is no variation in the quality of source water across the City under normal operating conditions. Source water delivered to Pressure Zone 2 (south of Tempe Heights and north of Keith Road) is delivered by the from the Lynn Valley Road feed and partly stored in the Metro Vancouver Greenwood Reservoir in Greenwood Park. The area south of Keith Road (CNV Pressure Zone 3) is primarily fed by the Metro Vancouver Capilano Main No. 7. Isolated portions of the City in the Tempe Heights and Queensbury School area (CNV Pressure Zone 1) are serviced from water from the District of North Vancouver water mains to provide efficient distribution of water without additional pumping infrastructure. Conversely, isolated portions of the District are serviced by the City of North Vancouver water utility for the same reason.

3. Distribution System

3.1. General

The City of North Vancouver's water distribution system serves an estimated population of about 63,000 which accounts for about 73% of water consumption. The remaining 27% of usage falls to institutional, commercial, and industrial base uses.

The distribution network comprises roughly 170 kilometres of pipe divided into five pressure zones, with thirteen pressure reducing stations, and over 6,700 service connections. Approximately 46.88% of the water main system is cast iron, 42.48% is ductile iron and 8.96% is PVC, with the remainder being composed of a mix of materials. The oldest pipes in the system were installed circa 1911. Appendix A contains a map showing locations of sampling station and pressure reducing stations which correlate with the GVWD water sources to the City, and the various pressure zones.

3.2. Testing

The City's water quality sampling program is based on accepted protocols developed in consultation with the Medical Health Officer (MHO). The program provides bacteriological, chemical, and physical testing to evaluate water quality. There are 20 sampling stations located throughout the City to give a broad cross-section of the water quality in the distribution system. Samples are taken from half the stations each week, such that each station is tested on a bi-weekly basis. The City monitors pressure and temperature data for source water supplied by Metro Vancouver at all of the pressure reducing valve stations.

The *Guidelines for Canadian Drinking Water Quality* classifies water quality parameters into the following groups:

- microbiological
- chemical and physical
- radiological

Parameters that have been included in the guidelines, include: Health-Based concerns, Aesthetic Objectives, or Operational Guidelines. For the health-based parameters, a maximum acceptable concentration is provided under the guidelines. Aesthetic objectives and operational guidelines also have suggested limits or ranges. In some cases, a parameter may have a health-based maximum limit, and a more stringent aesthetic objective.

Maximum acceptable concentration limits have been established for certain substances known or suspected to cause adverse effects on health. The Health Canada standards have been developed to safeguard health based on lifelong consumption and the use of the water for all usual domestic purposes, including personal hygiene.

The bi-weekly samples from all 20 stations are tested for the following health-based parameters:

- microbiological evidence (E.coli, HPC, coliform)

- turbidity

Three sampling stations are tested for the health-based parameters Haloacetic Acids (HAA) and Trihalomethanes (THMs) that are the by-products of chlorine disinfection, on a less frequent basis:

- No. 807 – 1900 Hamilton
- No. 808 – 980 West 1st Street
- No. 812 – 539 East 20th Street

Metals analysis is also provided at three additional stations and are tested at a lower frequency:

- No. 801 – 568 West 28th Street
- No. 803 – 200 Blk East 8th Street
- No. 804 – 848 East 6th Street

Most metals are health-based parameters, but not all. A list of aesthetic-based parameters is provided in the following section.

The bi-weekly samples from all 20 stations are tested for the following aesthetic parameters:

- temperature
- chlorine residual

Additional chemical and physical based water quality parameters that are not health-based include:

- ammonia
- calcium
- chlorine
- colour
- copper
- hardness
- iron
- magnesium
- odour
- pH
- silver
- sodium
- sulphate
- sulphide
- taste
- temperature
- total dissolved solids
- zinc

3.3. Water Quality Sampling Results

3.3.1. DISCUSSION ON HEALTH-BASED PARAMETERS

In 2023 none of the health-based parameters tested exceeded the maximum acceptable limits under the Guidelines.

3.3.1.1. Micro-Biological Parameters

Microbiological results for the 2023 testing year were that all E.coli and coliform tested below the guidelines, with no instances of positive coliform or positive E.coli samples. This is indicative of positive system-wide disinfection.

Data regarding E.coli and Coliform testing is provided in the following two tables.

E. coli Sample Summary Since 2014

Year	Average E. coli (MF/100mL)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	0	520	0	0.0%
2015	0	520	0	0.0%
2016	0	520	0	0.0%
2017	0	520	0	0.0%
2018	0	520	0	0.0%
2019	0	530	0	0.0%
2020	0	510	0	0.0%
2021	0	519	0	0.0%
2022	0	518	0	0.0%
2023	0	520	0	0.00%
Note: No occurrence of E.coli is the guideline limit				

The City has not had any positive tests for E. coli in the past ten years of water quality testing as can be seen in the table above. Total coliforms were not detected in any of the sampling in 2018, 2019, 2021, 2022 and 2023. Detectable levels of total coliforms were observed between 2014 and 2017 and in 2020. None of the individual samples exceeded the guideline of 10MF/100ml, nor did the percentage of samples containing coliforms exceed the guideline of 10%.

Coliform Sample Summary Since 2014

Year	Sample Count	# Samples Total Coliform >10 MF/100ml	# Samples Containing Total Coliforms	% Samples Containing Total Coliforms
2014	520	0	1	0.19%
2015	520	0	3	0.58%
2016	520	0	1	0.19%
2017	520	0	3	0.58%
2018	520	0	0	0.00%
2019	530	0	0	0.00%
2020	510	0	1	0.19%
2021	519	0	0	0.00%
2022	518	0	0	0.00%
2023	520	0	0	0.00%

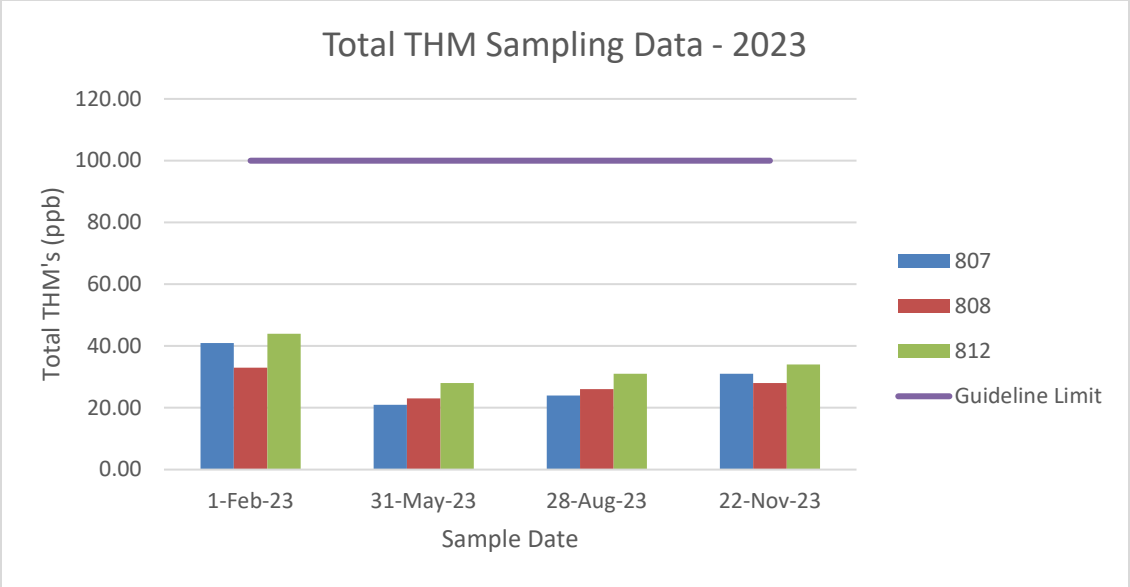
3.3.1.2. Chemical and Physical Parameters

The concentration of total HAAs and THMs in the samples collected quarterly remained consistently low, at about one-fourth of the maximum acceptable limit.

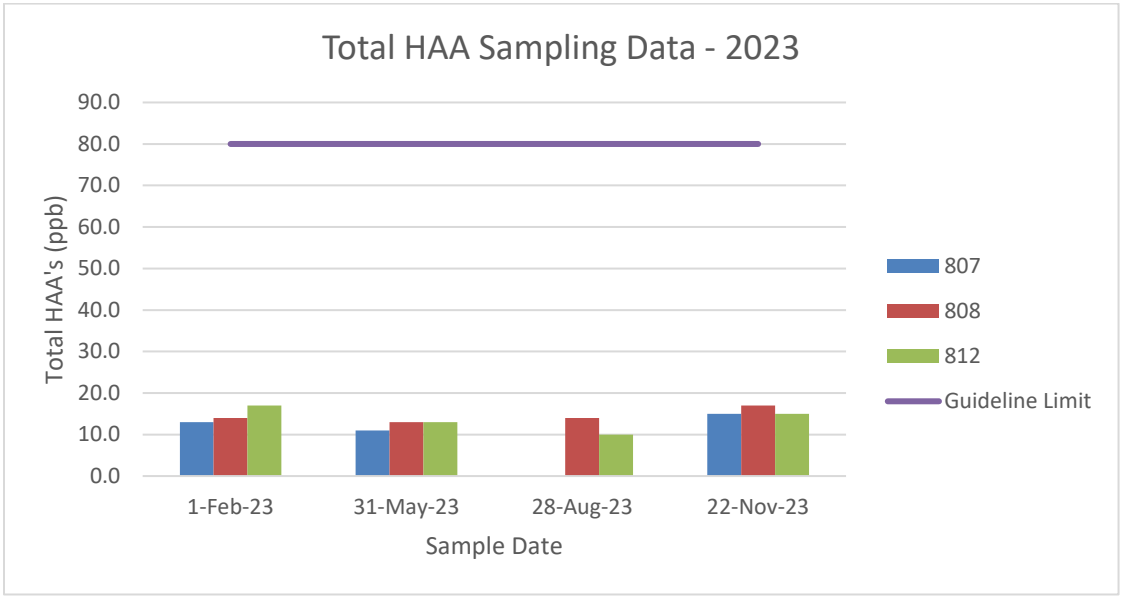
Vinyl chloride testing is conducted at one station in Tempe Heights, where the water system is constructed entirely from PVC pipe. Measurable concentrations were detected in 2022, but they were below the public health guideline allowable concentrations. Metro Vancouver provides the testing and data summary services and alerts the City to any water quality problems. The table and figures below summarize the HAA, THM and vinyl chloride data collected in 2023.

Station ID	Station Name	Period 2023	Total THMs µg/L (100 µg/L max acceptable)	Total HAAs Acids µg/L (80 µg /L max acceptable)	Chloride Vinyl µg/L (2 µg/L max acceptable)
807	1900 Block Hamilton	1st Qtr	31	11	-
		2nd Qtr	28	12	-
		3rd Qtr	30	12	-
		4th Qtr	31	12	-
808	980 West 1st	1st Qtr	26	14	-
		2nd Qtr	25	13	-
		3rd Qtr	26	13	-
		4th Qtr	28	14	-
812	2000 Block Queensbury	1st Qtr	34	15	-
		2nd Qtr	33	14	-
		3rd Qtr	34	14	-
		4th Qtr	36	15	-
814	2640 Tempe Knoll	2nd Qtr	-	-	<1
		4th Qtr	-	-	<1

The following two figures summarize the total THM and HAA concentrations graphically by station and sampling period. Spatially the results for total THMs for all sites were very comparable, with little difference between the three sites. The only consistent observation is that THM concentrations at Station 807 & 812 were slightly higher then Station 808. All the total THM concentrations are substantially lower than the allowable guideline value.



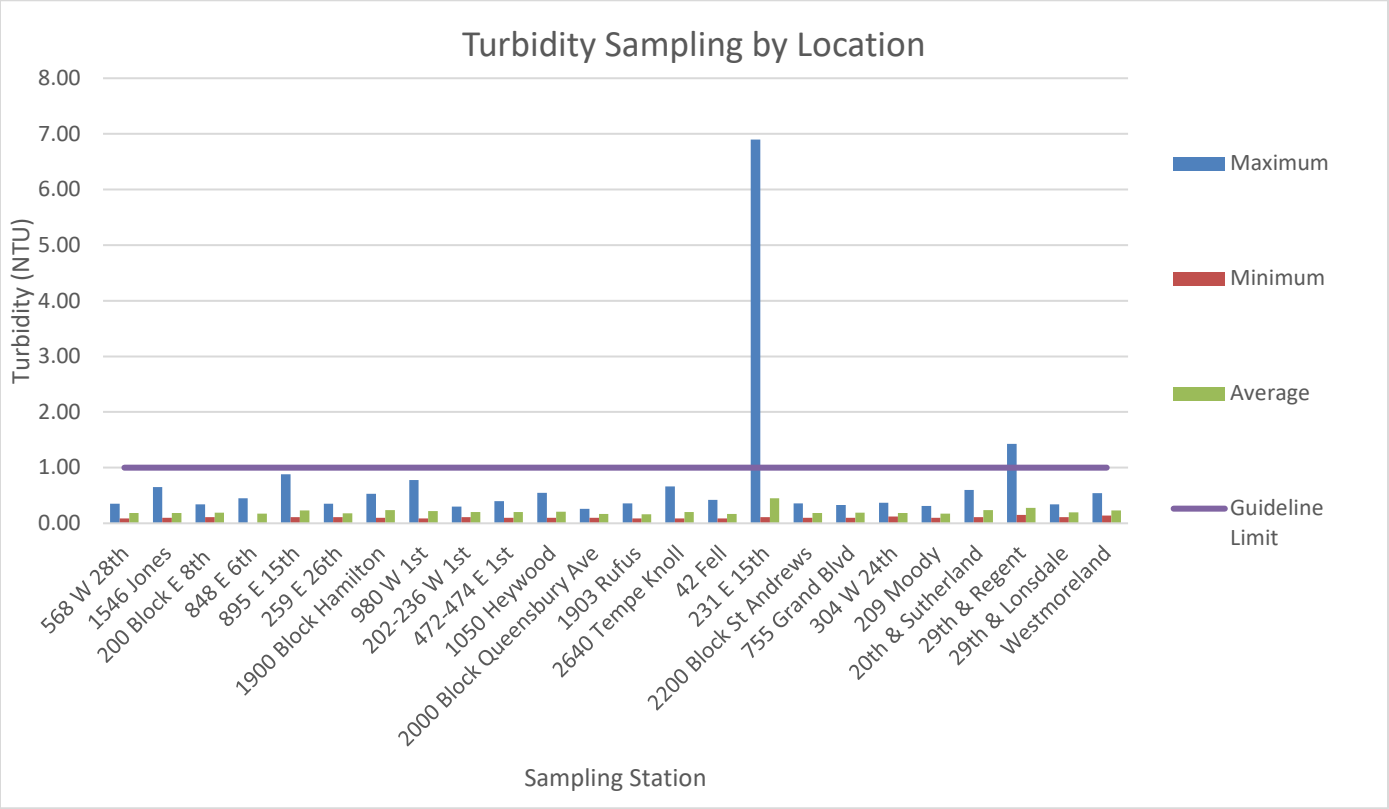
The following figure plots total HAA by period and sampling station, where total HAA was typically slightly higher at sampling station 812 (539 East 20th). There is otherwise very little variation in the results and total HAA concentrations are substantially lower than the allowable guideline value.



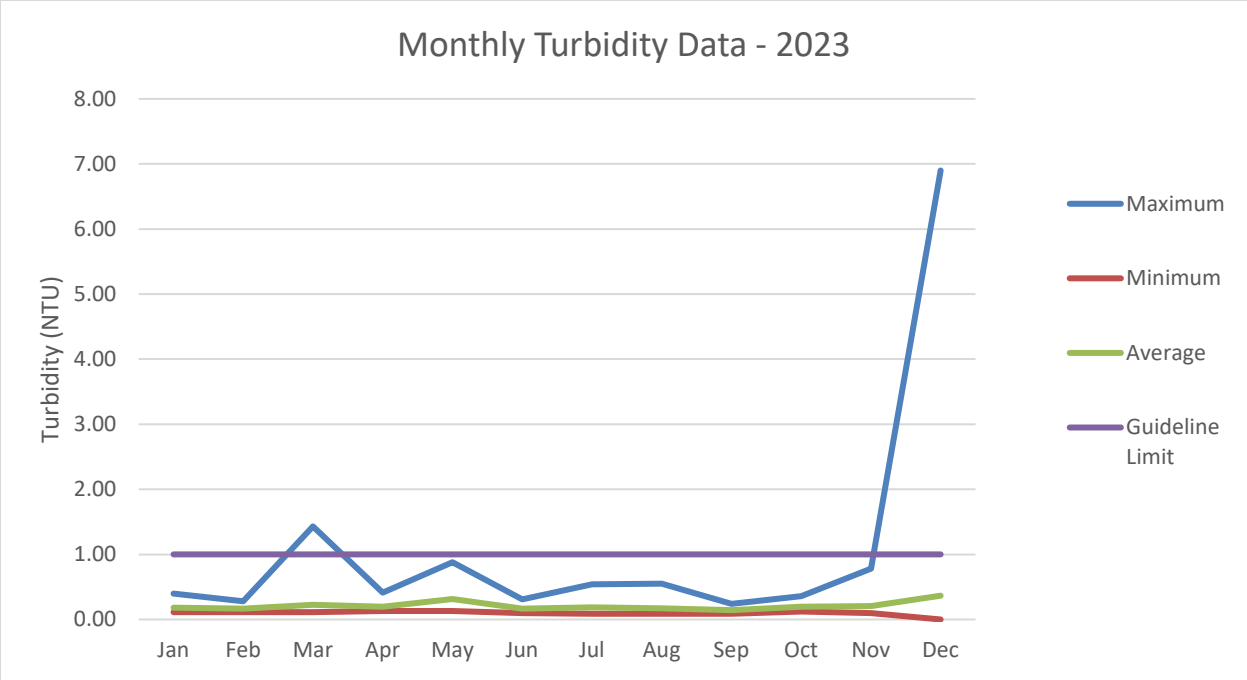
Turbidity caused by rainfall events affecting the watersheds is beyond the control of the City and is less common now due to universal filtration of both North Shore sources (since April 2015). Water main cleaning, water main breaks, and high velocity flows due to firefighting are the other primary sources of turbidity in the City and they are primarily managed annually through water main flushing programs, as well as being addressed on a longer-term basis through water main replacement.

The City includes turbidity testing for each sample in the field as part of the sampling program. This ensures an immediate response to turbidity problems if necessary, rather than a delay caused by waiting for GVWD lab results.

In the next ten years significant water main replacement is planned and is expected to continue to improve water quality and reduce instances of higher turbidity.



The event at 231 East 15th Street was due to a contractor flushing his new 200mm service line fully at 250 East 15th Street. It was dealt with promptly and cleared up quickly.
When high turbidity measurements are found in the field, waterworks operations staff reviews current activities in the water utility and surrounding construction activity to try to determine the cause of the higher turbidity. The City tracks all reports of high turbidity as part of the comprehensive asset management processes for the water utility.



The figures above summarize the turbidity data by station and by month. The 1 high spike in turbidity was from the event at 231 East 15th Street. Appendix B provides a description of the sampling parameters, the allowable limits, and a detailed summary of the 2023 test results.

3.3.2. DISCUSSION ON NON-HEALTH-BASED PARAMETERS

3.3.2.1. Chlorine Residual

Chlorine residual, while not a health-based parameter, is a requirement for all distribution systems as chlorine is the barrier for micro-biological regrowth following initial filtration and disinfection. It is a requirement to maintain a chlorine residual of at least 0.2 mg/L for distribution systems.

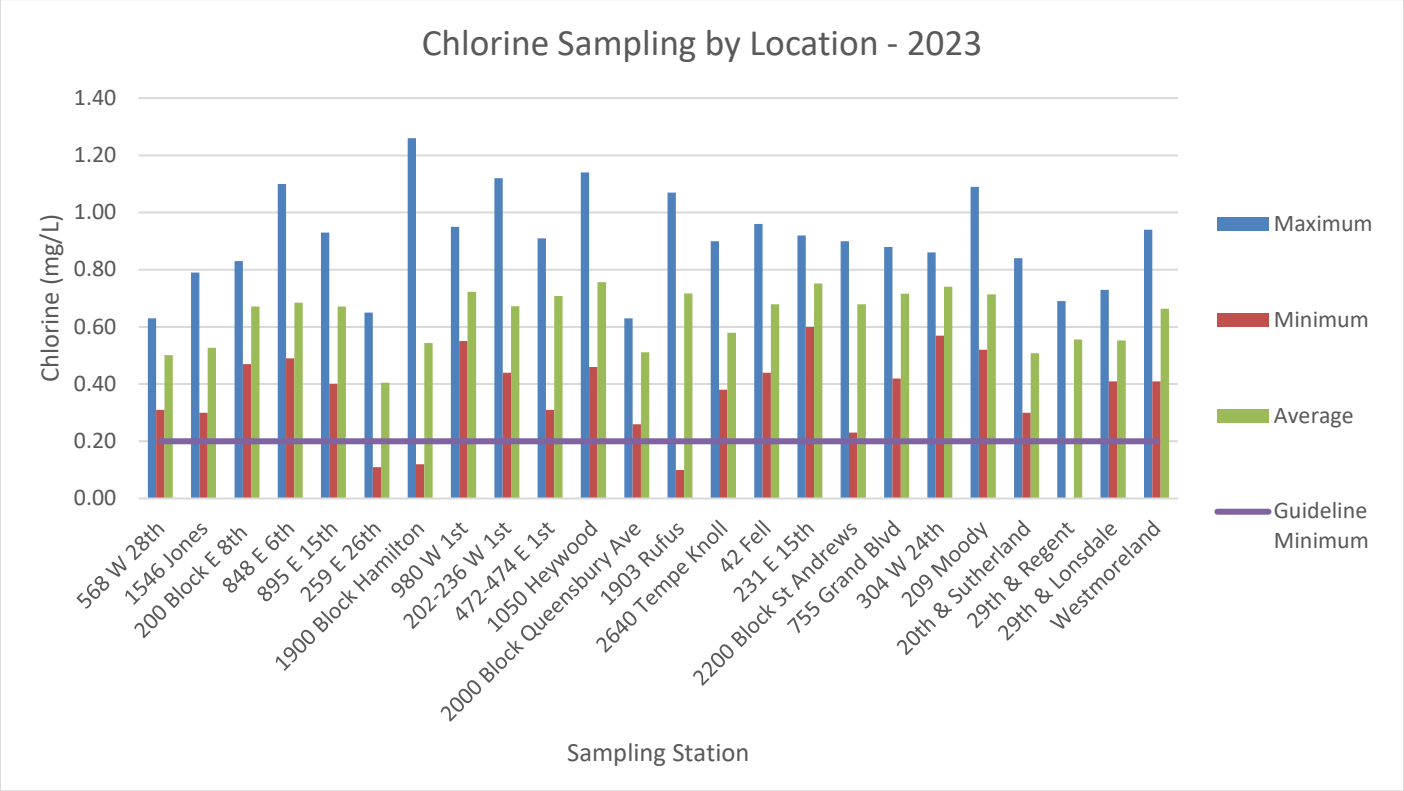
Chlorine residual sampling results showed a system average at 0.65 mg/l, which is well above the 0.2 mg/l minimum standard. During 2023, there were three recorded instances from a total of 519 samples were monitoring stations exhibited chlorine concentrations below the 0.2 mg/l criteria.

Stations that had low chlorine concentration include:

- Station No. 806 – 259 East 26th Street: 1 low concentration samples
- Station No. 807 – 1900 Hamilton: 1 low concentration sample

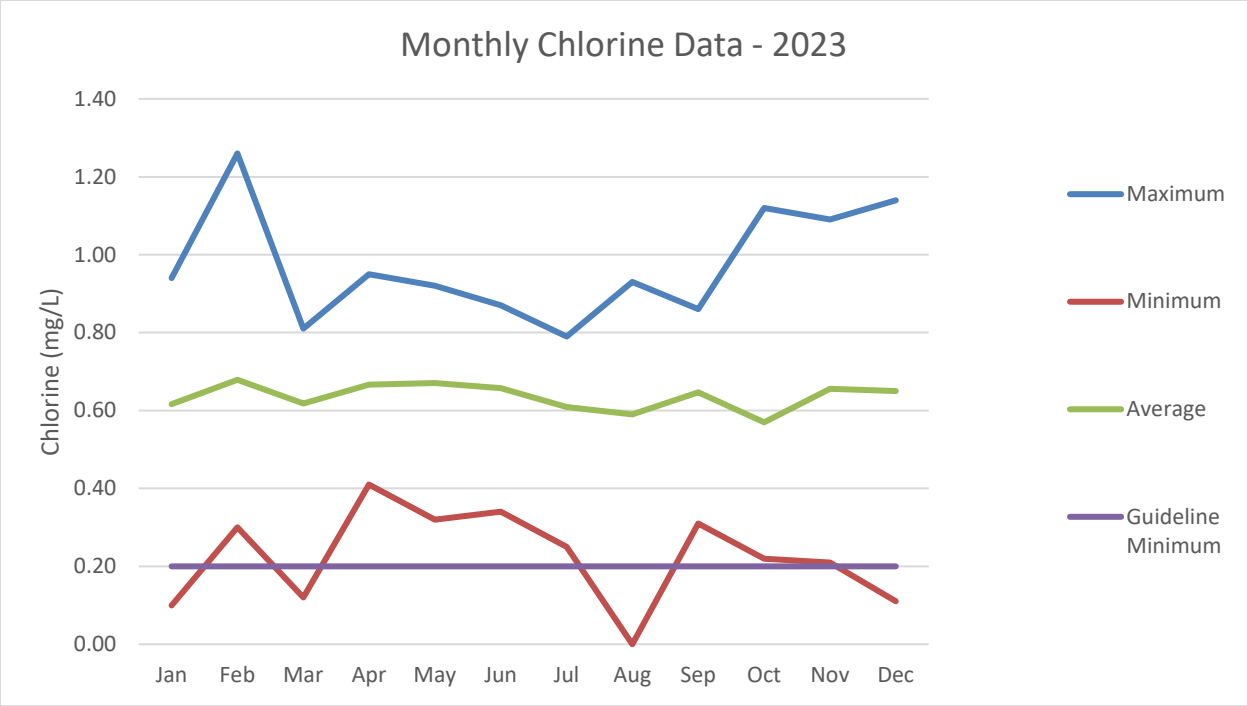
The City monitors four additional locations at feed locations from Metro Vancouver (20th/Sutherland, Westmoreland), and the District of North Vancouver (29th Regent, 29th/Lonsdale). These sites are not part of the standard reporting requirements, but rather reflect the concentration of chlorine of water entering the distribution system.

In 2023, the instances of low chlorine residuals were rare and appeared to be isolated events with no trends. The figures below summarize the chlorine sampling data for 2023.



The following figure shows an aggregate of all 20 monitoring sites, which highlights a fairly consistent result throughout the year, albeit with some fluctuation on the minimum and maximum measurements. Local factors such as water demands and pipe materials further reduce chlorine concentration measured as these key locations.

One low chlorine concentration sample was identified at 1900 Hamilton Avenue. In this quiet residential area north of Marine Drive and west of Fell Avenue, water in this area is drawn from the nearby Westmoreland Metro Vancouver source, but due to older cast iron water mains and lower residential demands, it is likely that the chlorine concentrations were reduced more quickly than water was being consumed. To aid concentrations, a water flushing station was installed at this location and the flow is controlled with a solenoid to help move more water through this area.



3.3.2.2. Water Temperature & Other Aesthetic Properties

Water temperature during the summer months at times exceeds the recommended value of 15 degrees Celsius in the City distribution system. While higher temperatures are not aesthetically pleasing and may influence bacterial regrowth our chlorine levels stayed within guidelines and had no issues with coliforms or E coli, City Water Utility Operations cannot influence water temperature to a large degree.

In 2023, water temperature exceeded the recommended value a total of 47 times out of 518 samples, or a total of 9% of the time. Higher water temperatures were observed in all of the sampling stations, and temperatures stayed below 17ºC.

The primary non-health-based metals that are often detected in drinking water include: iron, copper, and zinc. In the City's water system all concentrations measured are below the aesthetic objectives, with iron being the most prevalent metal detected in the three sample sets.

Appendix B provides a description of the sampling parameters, the allowable limits, and a detailed summary of the 2023 test results.

3.4. Risks

Risks to distribution water quality include the following issues related to disinfection and maintenance-related activities. The City's Water Utility procedures were developed to minimize and mitigate these foreseen risks.

Increased chlorine residuals can increase the levels of Haloacetic Acid (HAA) and Trihalomethanes (THMs). Longer-than-average exposure to THMs is an indicator of by-product-related cancer risk.

Chlorine residuals below 0.2 mg/l can potentially allow pathogenic organisms to multiply.

Insufficient levels of maintenance and care can put the water system at risk. Water main cleaning is an essential component of the care that is required to maintain high-quality drinking water. Planned replacement of aging pipes reduces the risk of water main breaks and the associated risk of contamination.

3.5. Issues

In 2023 source water for the entire year was treated at the Seymour Falls filtration plant, which has led to the delivery of relatively consistent chlorine residuals at the City feeds from Metro Vancouver. Temperature continues to be a challenge, as average water temperatures in August, September, and October tend to exceed the guideline threshold.

In 2023 the City has seen improvements in maintaining consistent chlorine residuals in the distribution system and continues to see complete compliance with respect to health-related micro-biological parameters, chlorine by-products and vinyl chloride concentrations. On-going replacement of unlined cast-iron water mains continues to be an annual priority for the City to continue to achieve the water quality goals around residual chlorine concentrations and turbidity.

3.6. Water System Operation and Maintenance

The goal for water system flushing is to clean all mains on a 5 year cycle and the following table depicts the generalized water system cleaning schedule. Areas for cleaning are prioritized based on observations and operational decisions. The zones are mapped in Appendix A.

City of North Vancouver Water Main Cleaning Plan	
Water Pressure Zones	**Frequency Goal**
Zone 1/5	Semi Annually or as needed
Zone 2	Every 5 years
Zone 3	Every 5 years
Zone 4	Every 5 years
Turbid Water Reports	As required

Combining the cleaning program with the valve actuation program has the added benefit of ensuring all valves in the system are open and maintaining flows in the designed fashion.

In 2023, a total of 3 water projects were constructed with a total length of 320 m of new water main.

2023 Water Main Construction	2024 Water Main Construction
A. Kennard R-O-W – Heywood to Shavington (R)	A. 2500 and 2600 Jones Avenue (R)
B. Lane between 1100 Block of Shavington and 1200 Block of Heywood (N)	B. 200 and 300 Block West 27th Street (R)
C. ½ Block 100 E 4th Street (R)	C.200 Block East 24th Street (R)
	D. 600 Block West 17th Street (R)
	E. 1700 Block Wolfe St (R)
	F. 600 Block Fir Street (R)

	I. 100 Block East 13th Street (R)

R – Replacement water main construction
N – New water main construction

All the new and replacement water main construction improves flow capability and pipe quality, both of which have a positive influence on water quality and overall system resiliency.

The City has a number of objectives associated with asset replacement and new main construction. These include:

- Replacement of aging unlined cast iron water mains for improved water quality and reliability (i.e. unplanned water main breaks).
- Increase in water main size of replacement mains to meet current and future needs.
- Addition of new looped water mains to increase distribution and circulation and to add redundancy.
- To provide more resilient water mains that are restrained at each connection in the event of earthquakes.

In replacing water mains, the City also replaces water services that are part of the public utility for increased reliability and to decrease foreseeable service leaks and breaks.

The City has a goal of replacing between about 1% and 1.3% of aging cast iron water mains every year, in order to progressively renew the water utility for improved reliability and water quality.

4. Significant Incidents

2023 was a typical year for planned and reactive maintenance (e.g. repairing breaks) however there were no incidents in the City's water distribution system that significantly compromised water quality. The City of North Vancouver's Engineering Department's Emergency Plan includes identification of critical elements in the water system infrastructure as well as key water quality topics.

A comprehensive water communication protocol for source water turbidity events was established through a task force of Metro Vancouver member municipalities and the Vancouver Coastal and Fraser Health Authorities and endorsed in March 2008. The protocol is now included in the Appendix D Response Plan.

5. Operator Qualifications

The table below highlights the qualifications and experience of City of North Vancouver staff directly involved in the operation of the water system ordered by years of work experience.

Employee	Position	Courses	Qualifications	Work Experience
W. Mason	Section Manager, Utilities	Tradesman Plumber Cross Connection Control	EOCP Water Distribution III	23 years
T. Van Nes	Supervisor	Cross Connection Control	EOCP Water Distribution II	11 years
C. Smith	Utility Trades worker	Cross Connection Control	EOCP Water Distribution II	8 years
S. Barber	Utility Trades worker		EOCP Water Distribution II	4 years
L. Kelsch	P.M. Public Works	Cross Connection Control	EOCP Water Distribution II Sewer Waste Water III	8 Years
B. Pollock	Plumbing and Gas Inspector	Cross Connection Control Tradesman Plumber Hydronic Technician		17years
L. Beaupre	Irrigation System Worker	Cross Connection Control	Irrigation Industry Assoc. of B.C. Level 1 + 2	12 years
T. Stefas	Pipefitter		EOCP Water Distribution I	17 years

The City recognizes the value that operator education and training provides and maintains a number of positions where EOCP certification is a requirement. Staff members participate annually in a variety of workshops, product orientations, and technical courses. The City's water system is a Class II distribution system, which includes staff with Level III certification. The City staff complement is knowledgeable, experienced, and appropriately qualified to operate the City's water distribution system.

6. Security Measures

Security measures for water systems typically concentrate on the protection of water sources and reservoirs. The City's system relies upon the GVWD for water supply and storage and therefore has not employed any extraordinary measures. Supply points (GVWD meter stations and PRVs) could be the most vulnerable components of our system but are no more vulnerable than fire hydrants and individual service connections. City staff will continue to keep apprised of security issues and will implement operational changes as required.

7. Notification and Emergency Response Plan

The City's Notification and Emergency Response Plan is included in Appendix D. The City of North Vancouver's Engineering, Parks and Environment Emergency Response Plan is up to date and tested annually to ensure new staff are aware of expectations in the event of an emergency.

8. Conclusion

In 2023 The City of North Vancouver's drinking water broadly met the goals Metro Vancouver's RDWP. That is The City provided clean, safe drinking water, it ensured the sustainable use of water resources and ensured the efficient supply of water to all residents and businesses.

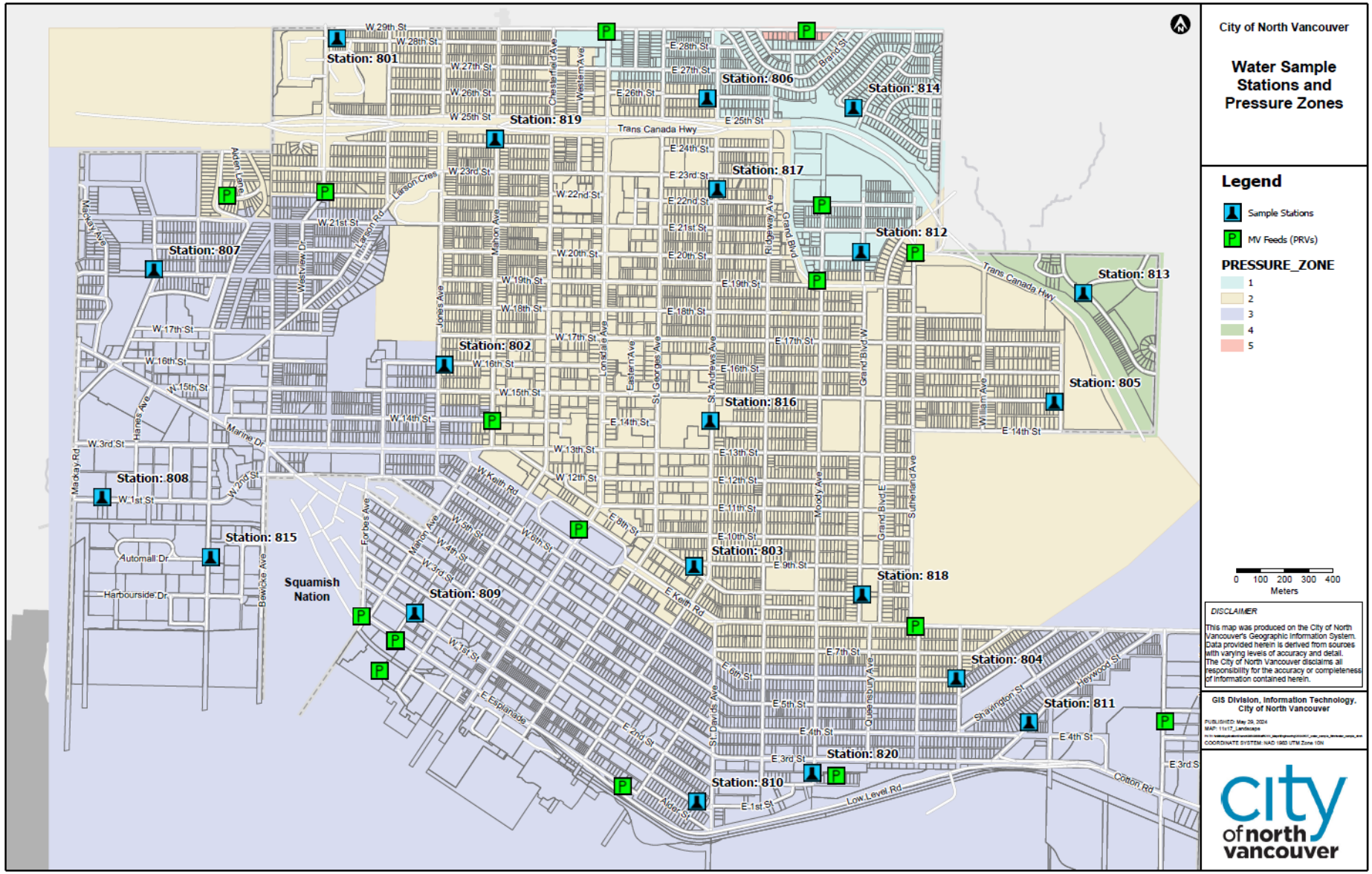
Last year, the vast majority of samples met all health and aesthetic qualities that are tracked. There were no microbiological and chemical parameters tested for that exceeded the acceptable limits and a small number of samples that exceeded physical turbidity parameters. Chlorine residuals were maintained on average throughout the year and across the City's network with only 0.19% of results not meeting the required concentrations. Water temperature remains somewhat problematic during summer, and correlates well with average summer temperatures.

Broadly speaking there are minimal issues with the City's supply, low risk factors and good security measures which continue to protect the water supply from contamination. The water system network continues to be upgraded across the network and the City continues to maintain a range of appropriately qualified staff in the operations water utility branch.

These measures will continue to ensure the ongoing supply of safe drinking water to residents and businesses into the future.

9. Appendices

Appendix A: CNV Water Zones and Sampling Station Locations


City of North Vancouver
Water Sample Stations and Pressure Zones
Legend
Sample Stations
MV Feeds (PRVs)
PRESSURE_ZONE
1
2
3
4
5
Station: 801
Station: 802
Station: 803
Station: 804
Station: 805
Station: 806
Station: 807
Station: 808
Station: 809
Station: 810
Station: 811
Station: 812
Station: 813
Station: 814
Station: 815
Station: 816
Station: 817
Station: 818
Station: 819
Station: 820
Squamish Nation
Trans Canada Hwy
Marine Dr
Low Level Rd
E Keith Rd
W Keith Rd
E Esplanade
Automall Dr
Harbourside Dr
Cotton Rd
0 100 200 300 400
Meters
DISCLAIMER
This map was produced on the City of North Vancouver's Geographic Information System. Data provided herein is derived from sources with varying levels of accuracy and detail. The City of North Vancouver disclaims all responsibility for the accuracy or completeness of information contained herein.
GIS Division, Information Technology, City of North Vancouver
city of north vancouver

The following chart shows the sampling station locations with a designation for the type of flow being evaluated.

Table A-1: Water Sampling Locations

Station	Zone	Location	Flow Type
801	2	568 West 28th	B
802	2	1546 Jones	A
803	2	200 Block East 8th	B
804	2	848 East 6th	C
805	2	895 East 15th	B
806	2	203 East 26th	B
807	3	1900 Block Hamilton	B
808	3	980 West 1st	B
809	3	202-236 West 1st	A
810	3	472-474 East 1st	B
811	3	1050 Heywood	B
812	1	2000 Block Queensbury Ave	C
813	4	1903 Rufus	B
814	1	Tempe Glen at Tempe Knoll	C
815	3	42 Fell	B
816	2	231 East 15th	A
817	2	2200 Block St Andrew's	A
818	2	8th & West Grand BLVD	A
819	2	304 West 24th	B
820	3	Moodyville Park	B
Source A	2	20th & Sutherland	S
Source B	3	29th & Regent	S
Source C	1	29th & Lonsdale	S
Source D	1	Westmoreland	S

Flow Type Descriptions for Sampling Locations
S = Source water (14% of samples) A = High to medium flow - transmission mains (24% of samples) B = Medium to low flow - distribution mains (48% of samples) C = Very little flow - dead ends, unlooped lines, poor circulation (14% of samples)

The system comprises of 127,000 metres of water main in a basic grid format. Sampling is done on Wednesdays. Each station is sampled on a bi-weekly bases and the GVRD provides the testing and data summary.

Appendix B: Water Sampling Parameters and 2023 Sampling Results

The following provides a simple description of the sampling parameters:

Chlorine (mg/L) – Free Chlorine in milligrams per litre: Minimum 0.2

The chlorine residual within the water distribution system is the indicator for the effectiveness of the disinfection process. The source water at Capilano and Seymour is treated to 1.5 mg/L and the goal is to maintain 0.2 to 0.4 mg/L at the extremities of the distribution system.

E. coli (MF/100 mL) – E. coli (Membrane Filtered per 100 millilitres): Maximum 0

The microbiological quality of water is measured by sampling the number of coliform organisms. E.coli coliforms are considered key indicators and could indicate sewage contamination. None of the coliform organisms detected should be E.coli coliforms.

In rare circumstances, the E.coli coliform test and the total coliform test will read MPN/100mLs. This indicates the sample was too turbid for the normal Membrane Filtration test and required an alternative method. MPN is an abbreviation of “Most Probable Number”.

HPC (CFU/mL) – Heterotrophic Plate Count (Colony Forming Units per millilitre): Maximum 500

Measuring the heterotrophic plate count (HPC) is an analytic method that is a useful operational tool for monitoring general bacteriological water quality throughout the treatment process and in the distribution system. HPC results are not an indicator of water safety and, as such, should not be used as an indicator of potential adverse human health effects. Each drinking water system will have a baseline range of HPC bacteria levels depending on the site-specific characteristics. Unexpected increases in the HPC 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.

Increases in HPC bacteria concentrations can be sudden or can gradually increase over time. Although some variation in HPC levels is normal and can occur seasonally, these increases can indicate a change in raw water quality, problems with drinking water treatment, or problems in the distribution system or plumbing and should be investigated.

Consistently low levels of HPC bacteria in the finished drinking water are an indicator that the treatment system is functioning properly. In the distribution system, HPC results outside of the normal range can provide some indication of stagnation, tuberculation, low or no residual disinfectant, and availability of nutrients for bacterial regrowth.

Coliforms (MF/100mL) – Total Coliforms (Membrane Filtered per 100 millilitres): Maximum 10

The microbiological quality of water is measured by sampling the number of coliform organisms. No sample should contain more than 10 total coliforms per 100 millilitres, and 90% or more of

the samples taken in a 30-day period must have zero coliform organisms. As well, no consecutive samples from the same site should show the presence of coliform organisms.

Temp (ºC) – Temperature (Degrees Celsius): Maximum 15

Temperature is measured in degrees Celsius at the time a sample is taken. Higher temperatures in the distribution system may contribute to bacterial regrowth.

Turbidity (NTU) – Turbidity (Nephelometric Turbidity Unit): Maximum 1

Turbidity describes the amount of disturbed sediment in water. The presence of turbidity can have significant effects on both the microbiological quality of water and on the detection of bacteria and viruses. More important, however, is that the sediment interferes with the disinfection process. Turbidity's interference with chlorination can range from negligible to severe.

Water Sampling Results

The following tables summarize the chlorine residual, E.coli, HPC, coliform, temperature and turbidity samples for the source water and sampling stations in 2023. In terms of the source water stations, the 29th & Lonsdale and 29th & Regent Sites are from the District of North Vancouver distribution system and not direct from GVWD mains. Sutherland and Westmoreland are direct from GVWD mains.

Table B-1: Chlorine Sampling Results - 2023

Station	Location	Minimum Chlorine (mg/L)	Average Chlorine (mg/L)	Maximum Chlorine (mg/L)	Sample Count	Samples Below 0.2 mg/L
801	568 West 28th	0.31	0.5	0.63	26	0
802	1546 Jones	0.3	0.53	0.79	26	0
803	200 Blk East 8th	0.47	0.67	0.83	26	0
804	848 East 6th	0.49	0.68	1.10	26	0
805	895 East 15th	0.40	0.67	0.93	26	0
806	259 East 26th	0.11	0.40	0.65	26	1
807	1900 Blk Hamilton	0.12	0.54	1.26	26	1
808	980 West 1st	0.55	0.72	0.95	26	0
809	202-236 West 1st	0.44	0.67	1.12	26	0
810	472-474 East 1st	0.31	0.71	0.91	26	0
811	1050 Heywood	0.46	0.76	1.14	26	0
812	2000 Blk Queensbury Ave	0.26	0.51	0.63	26	0
813	1903 Rufus	0.10	0.72	1.07	26	1
814	2640 Tempe Knoll	0.38	0.58	0.90	26	0
815	42 Fell (Pump Station)	0.44	0.68	0.96	26	0
816	231 East 15th-LGH	0.60	0.75	0.92	26	0
817	2200 Blk St. Andrew's	0.23	0.68	0.90	26	0
818	755 Grand Blvd	0.42	0.72	0.88	26	0
819	304 West 24th	0.57	0.74	0.86	26	0
820	209 Moody	0.52	0.71	1.09	26	0
Source A	20th & Sutherland	0.30	0.51	0.84	25	0
Source B	29th & Regent	0.00	0.56	0.69	25	1
Source C	29th & Lonsdale	0.41	0.55	0.73	25	0
Source D	Westmoreland	0.41	0.66	0.94	25	0
-	**All Locations**	**0.36**	**0.63**	**0.91**	**620**	**4**

Table B-2: E. coli Sampling Results - 2023

Station	Location	Minimum E. coli (MF/100mL)	Average E. coli (MF/100mL)	Maximum E. coli (MF/100mL)	Sample Count	Samples Exceeding 0 MF/100mL
801	568 West 28th	0.00	0.00	0.00	26	0
802	1546 Jones	0.00	0.00	0.00	26	0
803	200 Blk East 8th	0.00	0.00	0.00	26	0
804	848 East 6th	0.00	0.00	0.00	26	0
805	895 East 15th	0.00	0.00	0.00	26	0
806	259 East 26th	0.00	0.00	0.00	26	0
807	1900 Blk Hamilton	0.00	0.00	0.00	26	0
808	980 West 1st	0.00	0.00	0.00	26	0
809	202-236 West 1st	0.00	0.00	0.00	26	0
810	472-474 East 1st	0.00	0.00	0.00	26	0
811	1050 Heywood	0.00	0.00	0.00	26	0
812	2000 Blk Queensbury Ave	0.00	0.00	0.00	26	0
813	1903 Rufus	0.00	0.00	0.00	26	0
814	2640 Tempe Knoll	0.00	0.00	0.00	26	0
815	42 Fell (Pump Station)	0.00	0.00	0.00	26	0
816	231 East 15th-LGH	0.00	0.00	0.00	26	0
817	2200 Blk St. Andrew's	0.00	0.00	0.00	26	0
818	755 Grand Blvd	0.00	0.00	0.00	26	0
819	304 West 24th	0.00	0.00	0.00	26	0
820	209 Moody	0.00	0.00	0.00	26	0
-	**All Locations**	**0.00**	**0.00**	**0.00**	**520**	**0**

Table B-3: HPC Sampling Results - 2023

Station	Location	Minimum HPC (CFU/mL)	Average HPC (CFU/mL)	Maximum HPC (CFU/mL)	Sample Count	Samples Exceeding 500 CFU/mL
801	568 West 28th	0.00	2.15	10.00	26	0
802	1546 Jones	0.00	0.00	0.00	26	0
803	200 Blk East 8th	0.00	1.54	6.00	26	0
804	848 East 6th	0.00	0.00	0.00	26	0
805	895 East 15th	0.00	1.00	8.00	26	0
806	259 East 26th	0.00	3.77	22.00	26	0
807	1900 Blk Hamilton	0.00	4.08	36.00	26	0
808	980 West 1st	0.00	0.54	4.00	26	0
809	202-236 West 1st	0.00	0.38	6.00	26	0
810	472-474 East 1st	0.00	3.85	30.00	26	0
811	1050 Heywood	0.00	1.00	4.00	26	0
812	2000 Blk Queensbury Ave	0.00	7.85	40.00	26	0
813	1903 Rufus	0.00	4.92	68.00	26	0
814	2640 Tempe Knoll	0.00	24.15	390.00	26	0
815	42 Fell (Pump Station)	0.00	1.00	8.00	26	0
816	231 East 15th-LGH	0.00	2.92	28.00	26	0
817	2200 Blk St. Andrew's	0.00	3.08	58.00	26	0
818	755 Grand Blvd	0.00	3.00	54.00	26	0
819	304 West 24th	0.00	1.23	10.00	26	0
820	209 Moody	0.00	24.31	370.00	26	0
-	**All Locations**	**0.00**	**5.23**	**65.80**	**520**	**0**

Table B-4: Coliform Sampling Results – 2023

Station	Location	Minimum Coliform (MF/100mL)	Average Coliform (MF/100mL)	Maximum Coliform (MF/100mL)	Sample Count	Samples Exceeding 10 MF/100mL
801	568 West 28th	0.00	0.00	0.00	26	00.00
802	1546 Jones	0.00	0.00	0.00	26	0.00
803	200 Blk East 8th	0.00	0.00	0.00	26	0.00
804	848 East 6th	0.00	0.00	0.00	26	0.00
805	895 East 15th	0.00	0.00	0.00	26	0.00
806	259 East 26th	0.00	0.00	0.00	26	0.00
807	1900 Blk Hamilton	0.00	0.00	0.00	26	0.00
808	980 West 1st	0.00	0.00	0.00	26	0.00
809	202-236 West 1st	0.00	0.00	0.00	26	0.00
810	472-474 East 1st	0.00	0.00	0.00	26	0.00
811	1050 Heywood	0.00	0.00	0.00	26	0.00
812	2000 Blk Queensbury Ave	0.00	0.00	0.00	26	0.00
813	1903 Rufus	0.00	0.00	0.00	26	0.00
814	2640 Tempe Knoll	0.00	0.00	0.00	26	0.00
815	42 Fell (Pump Station)	0.00	0.00	0.00	26	0.00
816	231 East 15th-LGH	0.00	0.00	0.00	26	0
817	2200 Blk St. Andrew's	0.00	0.00	0.00	26	0
818	755 Grand Blvd	0.00	0.00	0.00	26	0
819	304 West 24th	0.00	0.00	0.00	26	0
820	209 Moody	0.00	0.00	0.00	26	0
-	**All Locations**	**0**	**0**	**0**	**520**	**0**

Table B-5: Temperature Sampling Results - 2023

Station	Location	Sample Count	Maximum Temperature (ºC)	Minimum Temperature (ºC)	Average Temperature (ºC)	Samples Exceeding 15 ºC
801	568 West 28th	26	17.00	6.00	10.92	4
802	1546 Jones	26	16.00	5.00	10.77	2
803	200 Blk East 8th	26	17.00	6.00	10.62	3
804	848 East 6th	26	17.00	6.00	11.04	5
805	895 East 15th	26	16.0	5.0	10.58	1
806	259 East 26th	26	16.0	6.0	10.81	3
807	1900 Blk Hamilton	26	17.0	4.5	10.56	1
808	980 West 1st	26	17.0	4.5	10.37	4
809	202-236 West 1st	26	16.00	5.0	10.38	3
810	472-474 East 1st	26	16.0	4.50	10.33	4
811	1050 Heywood	26	16.0	5.0	10.04	1
812	2000 Blk Queensbury Ave	26	16.00	5.00	10.85	3
813	1903 Rufus	26	15.00	4.00	9.96	0
814	2640 Tempe Knoll	26	17.00	5.00	10.88	5
815	42 Fell (Pump Station)	26	16.00	5.00	10.31	2
816	231 East 15th-LGH	26	15.00	5.00	9.69	0
817	2200 Blk St. Andrew's	26	16.00	4.00	9.77	1
818	755 Grand Blvd	26	16.0	5.0	10.00	1
819	304 West 24th	26	15.00	5.0	9.81	
820	209 Moody	26	17.00	5.00	11.04	3
Total	**All Locations**	**520**	**16.20**	**5.03**	**10.44**	**46**

Table B-6: Turbidity Sampling Results - 2023

Station	Location	Sample Count	Maximum Turbidity (NTU)	Minimum Turbidity (NTU)	Average Turbidity (NTU)	Samples Exceeding 1 NTU
801	568 West 28th	26	0.35	0.09	0.19	0
802	1546 Jones	26	0.65	0.10	0.19	0
803	200 Blk East 8th	26	0.34	0.11	0.19	0
804	848 East 6th	26	0.45	0.00	0.18	0
805	895 East 15th	26	0.88	0.11	0.23	0
806	259 East 26th	26	0.35	0.11	0.18	0
807	1900 Blk Hamilton	26	0.53	0.10	0.24	0
808	980 West 1st	26	0.78	0.09	0.22	0
809	202-236 West 1st	26	0.30	0.11	0.20	0
810	472-474 East 1st	26	0.40	0.10	0.20	0
811	1050 Heywood	26	0.55	0.10	0.21	0
812	2000 Blk Queensbury Ave	26	0.26	0.10	0.17	0
813	1903 Rufus	26	0.36	0.09	0.16	0
814	2640 Tempe Knoll	26	0.66	0.09	0.20	0
815	42 Fell (Pump Station)	26	0.42	0.09	0.17	0
816	231 East 15th-LGH	26	6.90	0.11	0.45	1
817	2200 Blk St. Andrew's	26	0.36	0.10	0.19	0
818	755 Grand Blvd	26	0.33	0.10	0.19	0
819	304 West 24th	26	0.37	0.12	0.18	0
820	209 Moody	26	0.31	0.10	0.18	0
Source A	20th & Sutherland	26	0.60	0.11	0.24	0
Source B	29th & Regent	26	1.43	0.15	0.28	1
Source C	29th & Lonsdale	26	0.34	0.11	0.20	0
Source D	Westmoreland	26	0.54	0.14	0.23	0
Total	**All Locations**	**620**	**0.77**	**0.10**	**0.21**	**2**

The following analytical results are from the City's distribution system and include: disinfection by-products (DBPs) (Haloacetic Acids and Trihalomethanes), vinyl chloride, and metals. DBP is a term used to describe a group of organic and inorganic compounds formed during water disinfection. This monitoring is required under the Water Quality Monitoring and Reporting Plan for the GVRD and Member Municipalities.

The table below shows the current guidelines.

Table B-7: Drinking Water Quality Guidelines

Parameter	Guidelines for Canadian Drinking Water Quality
Total Trihalomethanes	**100 µg/L (ppb) or 0.1 mg/L (ppm)**
Total Haloacetic Acids	**80 µg/L (ppb) or 0.080 mg/L (ppm)**
Vinyl Chloride	**2 µg/L (ppb) or 0.002 mg/L (MAC)**
Aluminium	**200 µg/L (ppb) or 0.2 mg/L (AO)**
Antimony	**6 µg/L (ppb) or 0.006 mg/L (MAC)**
Arsenic	**10 µg/L (ppb) or 0.01 mg/L (MAC)**
Barium	**1000 µg/L (ppb) or 1.0 mg/L (MAC)**
Boron	**5000 µg/L (ppb) or 5.0 mg/L (MAC)**
Cadmium	**5 µg/L (ppb) or 0.005 mg/L (MAC)**
Chromium	**50 µg/L (ppb) or 0.05 mg/L (MAC)**
Copper	**≤1000 µg/L (ppb) or ≤1.0 mg/L (AO)**
Iron	**≤ 300 µg/L (ppb) or 0.3 mg/L (AO)**
Lead	**5 µg/L (ppb) or 0.005 mg/L (MAC)**
Manganese	**≤ 12 µg/L (ppb) (MAC) and ≤ 20 µg/L (AO)**
Mercury	**1.0 µg/L (ppb) or 0.001 mg/L (MAC)**
Selenium	**50 µg/L (ppb) or 0.05 mg/L (MAC)**
Sodium	**≤ 200,000 µg/L (ppb) or 200 mg/L (AO)**
Zinc	**≤ 5000 µg/L (ppb) or 5 mg/L (AO)**

(MAC) Maximum Acceptable Concentration (AO) Aesthetic Objective

The table on the next page contains the data from the analysis carried out each quarter for the individual compounds in each group of disinfection by-products. The standard for these compounds is based on the total amount of the group detected; therefore, the total for each group has been calculated for each site. The table also contains the quarterly running average results for total Trihalomethanes and total Haloacetic Acids for individual sites. Both results are within Canadian guideline limits.

Semi-annual vinyl chloride analysis is done where PVC pipe is used in the distribution system. Analysis was provided in the 2nd and 4th quarters for Station 814 in the Tempe Heights area. Both samples were within Canadian guideline limits.

Table B-8: Quarterly Disinfection By-Products Results – 2023

Station ID	Station Name	Period 2019	Total THMs µg/L (100 µg/L max acceptable)	Quarterly Average THMs (µg/L)	Total HAAs Acids µg/L (80 µg /L max acceptable)	Quarterly Average HAAs (µg/L)	Chloride Vinyl µg/L (2µg/L max acceptable)
807	1900 Block Hamilton	1st Qtr	41	31	13	11	-
		2nd Qtr	21	28	11	12	-
		3rd Qtr	24	30	9.9	12	-
		4th Qtr	31	31	15	12	-
808	980 West 1st	1st Qtr	33	26	14	14	-
		2nd Qtr	23	25	13	13	-
		3rd Qtr	26	26	14	13	-
		4th Qtr	28	28	17	14	-
812	2000 Block Queensbury	1st Qtr	44	34	17	15	-
		2nd Qtr	28	33	13	14	-
		3rd Qtr	31	34	10	14	-
		4th Qtr	34	36	15	15	-
814	2640 Tempe Knoll	2nd Qtr	-	-	-	-	<1
		4th Qtr	-	-	-	-	<1

The maximum acceptable concentration (MAC) in the Canadian guidelines for total THMs is a location yearly running average of 100 ug/L based on quarterly samples.

Metals analysis is done semi-annually. Copper, iron, lead, and zinc are the parameters required under the Water Quality Monitoring and Reporting Plan, but since the method of analysis produces other metals results as well, they were also included. All the results were within the guidelines except for Iron concentrations at Station 801 in the second testing of 2020. This only occurred once and does not appear to be a chronic issue. The guideline for iron is for aesthetic purposes so was not a health risk.

Table B-9: Metals Sampling Results – 2023

	Station 801 568 West 28th Street		Station 803 200 Block East 8th Street		Station 804 848 East 6th Street	
Date Collected	February 14th	September 11th	February 14th	September 11th	February 14th	September 11th
Aluminum Total (µg/L)	36	28	39	26	39	28
Antimony Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Barium Total (µg/L)	2.6	3.3	2.6	3.0	2.6	3.3
Boron Total (µg/L)	<10	<10	<10	<10	<10	<10
Cadmium Total (µg/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium Total (µg/L)	88180	8550	8470	8080	8350	8820
Chromium Total (µg/L)	0.07	<0.05	<0.05	<0.05	<0.05	<0.05
Cobalt Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper Total (µg/L)	1	1.4	1.2	1.3	.6	2.
Iron Total (µg/L)	12	9	14	9	7	6
Lead Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium Total (µg/L)	210	224	217	218	211	228
Manganese Total (µg/L)	3.3	7.4	4.5	9.4	4.4	7..9
Mercury Total (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Potassium Total (µg/L)	178	212	178	212	177	207
Selenium Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver Total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium Total (µg/L)	1560	1770	1580	1710	1620	1690
Zinc Total (µg/L)	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

Vancouver Coastal Health
800 – 601 West Broadway
Vancouver, BC V5Z 4C2

May 12th, 2022

Water System Operators

Re: Metals in Drinking Water – "Flush" Message in Annual Reports

Vancouver Coastal Health (VCH) is requiring all water systems to include the following health message with your next annual reports to your users:

> ***Contamination of drinking water with Lead can have health impacts over time, and in BC the source is most likely to be plumbing fixtures within a building. Anytime the water in a particular faucet has not been used for six hours or longer, "flush" your cold-water pipes by running the water until you notice a change in temperature. This could take as little as five to thirty seconds if there has been recent heavy water use such as showering or toilet flushing. Otherwise, it could take two minutes or longer. The more time water has been sitting in your home's pipes, the more Lead it may contain.***
>
> ***Use only water from the cold-tap for drinking cooking, and especially making baby formula. Hot water is likely to contain higher levels of Lead.***
>
> ***The two actions recommended above are very important to the health of your family. They will probably be effective in reducing Lead levels because most of the Lead in household water usually comes from the plumbing in your house, not from the local water supply.***
>
> ***Conserving water is still important. Rather than just running the water down the drain you could use the water for things such as watering your plants.***

If you have any questions, please contact you closest Drinking Water Officer noted below.

Sincerely,

Dr. Michael Schwandt
Medical Health Officer
Vancouver Coastal Health

- (604) 983-6793 Central Coast
- (604) 983-6793 North Shore
- (604) 485-3310 Powell River
- (604) 233-3147 Richmond
- (604) 885-5164 Sechelt
- (604) 892-2293 Squamish
- (604) 675-3800 Vancouver
- (604) 932-3202 Whistler

Appendix C: Water Sample Trends

Appendix C was added to the Water Quality Report in 2003 and provides a 5 year comparison of sampling results to help understand trends with regard to water quality. The appendix provides information for the seven most recent years.

The table and chart statistics are based on the results from the six weekly sampling parameters taken for the water distribution system as a whole and do not separate the five different pressure zones within the City's system.

The tables present a summary of the weekly sampling station results, not including the high and low categories, for each of the last six years.

The six charts compare each year by sampling parameter with respect to the number of samples outside the target standards described in Appendix B.

Table C-1: Yearly Chlorine Sample Summary

Year	Average Chlorine (mg/L)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	0.496	624	63	10.10%
2015	0.603	622	25	4.02%
2016	0.633	625	7	1.12%
2017	0.586	624	5	0.80%
2018	0.616	625	3	0.48%
2019	0.60	530	7	1.32%
2020	0.58	510	13	2.5%
2021	0.58	519	7	1.35%
2022	0.62	518	2	0.39%
2023	0.65	620	4	0.65%

Table C-2: Yearly E. coli Sample Summary

Year	Average E. coli (MF/100mL)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	0	520	0	0.0%
2015	0	520	0	0.0%
2016	0	520	0	0.0%
2017	0	520	0	0.0%
2018	0	520	0	0.0%
2019	0	530	0	0.0%
2020	0	510	0	0.0%
2021	0	519	0	0.0%
2022	0	518	0	0.0%
2023	0	520	0	0.0%

Table C-3: Yearly HPC Sample Summary

Year	Average HPC (CFU/mL)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	4.27	500	2	0.40%
2015	1.01	499	0	0.00%
2016	0.73	499	0	0.00%
2017	0.37	490	0	0.00%
2018	4.16	501	1	0.20%
2019	2.53	530	0	0.00%
2020	3.95	510	0	0.0%
2021	1.96	518	0	1.96%
2022	0.00	518	0	0.00%
2023	5.23	520	0	0.00%

Table C-4: Yearly Coliform Sample Summary

Year	Average Coliform (MF/100mL)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	0.00192	520	0	0.0%
2015	0.00577	520	0	0.0%
2016	0.00385	520	0	0.0%
2017	0.00962	520	0	0.0%
2018	0.0	520	0	0.0%
2019	0.0	530	0	0.0%
2020	0.00196	510	0	0.0%
2021	0	519	0	0.0%
2022	0	518	0	0.0%
2023	0	520	0	0.0%

Table C-5: Yearly Temperature Sample Summary

Year	Average Temperature (ºC)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	10.79	520	111	21.35%
2015	11.98	520	130	25.00%
2016	11.46	520	93	17.88%
2017	9.75	520	47	9.04%
2018	10.04	521	51	9.79%
2019	10.28	530	84	15.8%
2020	10.74	510	70	13.7%
2021	11.00	519	127	24.47%
2022	9.76	518	40	7.72%
2023	10.43	520	46	8.85%

Table C-6: Yearly Turbidity Sample Summary

Year	Average Turbidity (NTU)	Sample Count	# Outside Guidelines	% Outside Guidelines
2014	0.33	623	13	2.09%
2015	0.21	622	5	0.80%
2016	0.25	624	8	1.28%
2017	0.35	616	13	2.11%
2018	0.25	625	8	1.28%
2019	0.23	637	9	1.41%
2020	0.25	611	13	2.13%
2021	0.20	519	4	0.77%
2022	0.27	517	4	0.77%
2023	0.21	620	2	0.32%

Note: It should be recognized the sampling parameter averages are sometimes skewed by high values for a low number of samples outside of the guidelines.

Appendix D: Notification and Emergency Response Plan

1. Notification Requirements: for situations that may affect water portability.

Situation	Notifying Agency	Agency Notified	Time Frame For Notification
E. coli Positive Sample	GVWD	CNV and VCH	Immediate
Total Coliforms over 10/100mLs and no chlorine residual	GVWD	CNV	Immediate
Chemical Contamination	GVWD	CNV and VCH	Immediate
Chemical Contamination - Municipality	CNV	VCH GVWD and DNV	Immediate
Turbidity > 5 NTU	CNV/GVWD	CNV and VCH	Immediate
GVWD Disinfection Failure	GVWD	CNV and VCH	Immediate in any situation where water quality regulations may not be met.
Loss of Pressure Due to High Demand	CNV	GVWD Operations and VCH	Immediate
Main Break With Suspected Contamination	CNV	VCH	Immediate
Main Break With Potential Environmental Damage	CNV	MOE	Immediate

2. Response Plans:

[a] E.coli Positive Samples

If any interim samples have been taken from the site they will be examined by the lab. Interim samples are samples that may have been taken from the site in the period between when the E.coli positive sample was taken and when it was determined to be positive.

The chlorine residual noted on the sampler's field sheet will be reviewed by the lab and compared to previous readings to determine if there was a localized loss of disinfectant residual.

The Section Manager – Utilities (or designate) and the VCH will be notified immediately by the GVWD laboratory.

Arrangements will be made for the immediate collection of a repeat sample and, where possible, the collection of samples from upstream and downstream of the E.coli-positive sample location.

VCH will be contacted and the need for a "boil water" notice will be evaluated.

If a boil water notice is warranted, the public notification process as outlined in the Water Quality Monitoring and Reporting Plan for the GVWD and Member Municipalities will be followed. The boil water notice will be under the direction of Vancouver Coastal Health.

The lab will initiate the procedures necessary for the identification of E.coli with standard biochemical tests.

The lab will contact the CNV with consecutive negative sample results and the results of the species identification tests. The CNV will contact VCH to evaluate these results and to determine whether the advisory can be lifted.

[b] Chemical Contamination

In the event of chemical contamination in the water distribution system, VCH will be immediately notified. Immediate steps will be taken to isolate the contaminated area and the level of contamination will be determined through water sampling and testing. The chemical will be identified and any public health risk factors associated with the chemical presence will be determined. A public advisory will be carried out under the guidance of VCH.

[c] Turbidity Events

Turbidity in the water distribution system is monitored on a regular basis through the water sampling program. Water sampling results yielding readings > 1 NTU are scrutinized, along with corresponding free chlorine. Any sections of the water system generating high turbidity results will be field checked and flushed if necessary.

For turbidity sample results > 5 NTU, VCH will be immediately notified and an evaluation will be made for any necessary actions. The Source Water Turbidity Event procedures are noted below.

[d] GVWD Disinfection Failure

Upon notification by GVWD that an interruption in disinfection has occurred, the City will immediately commence more frequent monitoring of free chlorine residual levels at strategic locations. The monitoring frequency will be at the advice of the GVWD and VCH, and will continue until disinfection is resumed.

[e] Loss of Pressure

In the event of extreme pressure loss, the City will isolate the section or facility from the distribution system and supplement pressure to the affected area. The City will immediately consult with GVWD and VCH regarding further actions. All water quality complaints from the public will be immediately and thoroughly investigated for potential contamination.

[f] Water Main Break

For water main breaks where chemical or microbiological contamination of the system is suspected, the City will isolate the contaminated section from the rest of the distribution system. The City will immediately consult with VCH regarding further actions. All water quality complaints from the public will be immediately and thoroughly investigated for potential contamination.

Water samples will be taken from the vicinity of all water main breaks and tested for bacteria if contamination is suspected. The procedures outlined above in [b] will be implemented if necessary.

Emergency Management British Columbia will also be notified if a water main break results in potential harm to fish habitat (chlorine or siltation).

3. Follow Up

Following a return to normal after any of the above situations, an assessment will be made for the need to notify the affected public.

4. Response Protocol addition for part [c] Turbidity Events

The procedures below are from the Source Water Turbidity Communications Task Force and were endorsed by the REAC Water Subcommittee at its meeting on March 12th, 2008 and by the Medical Health Officers from the Vancouver Coastal and Fraser Health Authorities at a meeting on April 7th, 2008.

Metro Vancouver Communications Responsibilities

Requirement	Status	Comments
Notify Vancouver Coastal Health (VCH) as required under the Drinking Water Protection Act and provide timely updates to VCH and Fraser Health (FH) as required.	No change from current practice.	Vancouver Coastal Health is the Regulator of the Greater Vancouver District under the Drinking Water Protection Act.
Notify member municipalities and provide timely updates. Concurrent or advance notification is required when public messages are involved. Notify municipal Water Quality Contacts (or alternate as required) by phone (24/7) for extraordinary turbidity events.	There is an established practice to notify both operations and water quality contacts of municipalities.	The intent is to use telephone, email, pager or other means of communication as required until it is confirmed that the notification of an extraordinary event has been received by each municipality.
Maintain up-to-date phone and e-mail contact lists.	Updated on regular basis.	
For water quality issues related to the regional (GVWD) water system, take the lead in the development of public messages in advance by working with the Vancouver Coastal Health Authority (GVWD Regulator) and the Fraser Health Authority.		General guidelines for public messages for source water turbidity events are shown on page 4.
For water quality issues related to the regional (GWVD) water system, notify the general public by using appropriate means.	No change from current practice.	Metro Vancouver is responsible for broad public communications. Communications to specific groups is the responsibility of the municipalities and Health Authorities.
For extraordinary turbidity events, organize conference calls and invite municipalities to participate along with health authorities.	As required.	Highly effective way of coordinating response.
For extraordinary turbidity events, notify the BC Nurse Line.	New	Improved communication.
Answer calls from the public and refer calls to health authorities and specific municipalities as required.	No change from current practice.	
At the end of the event, provide information to the Health Authorities and affected municipalities that the situation has improved to the point where normal operations can be resumed.	New.	

Communications Responsibilities of Health Authorities

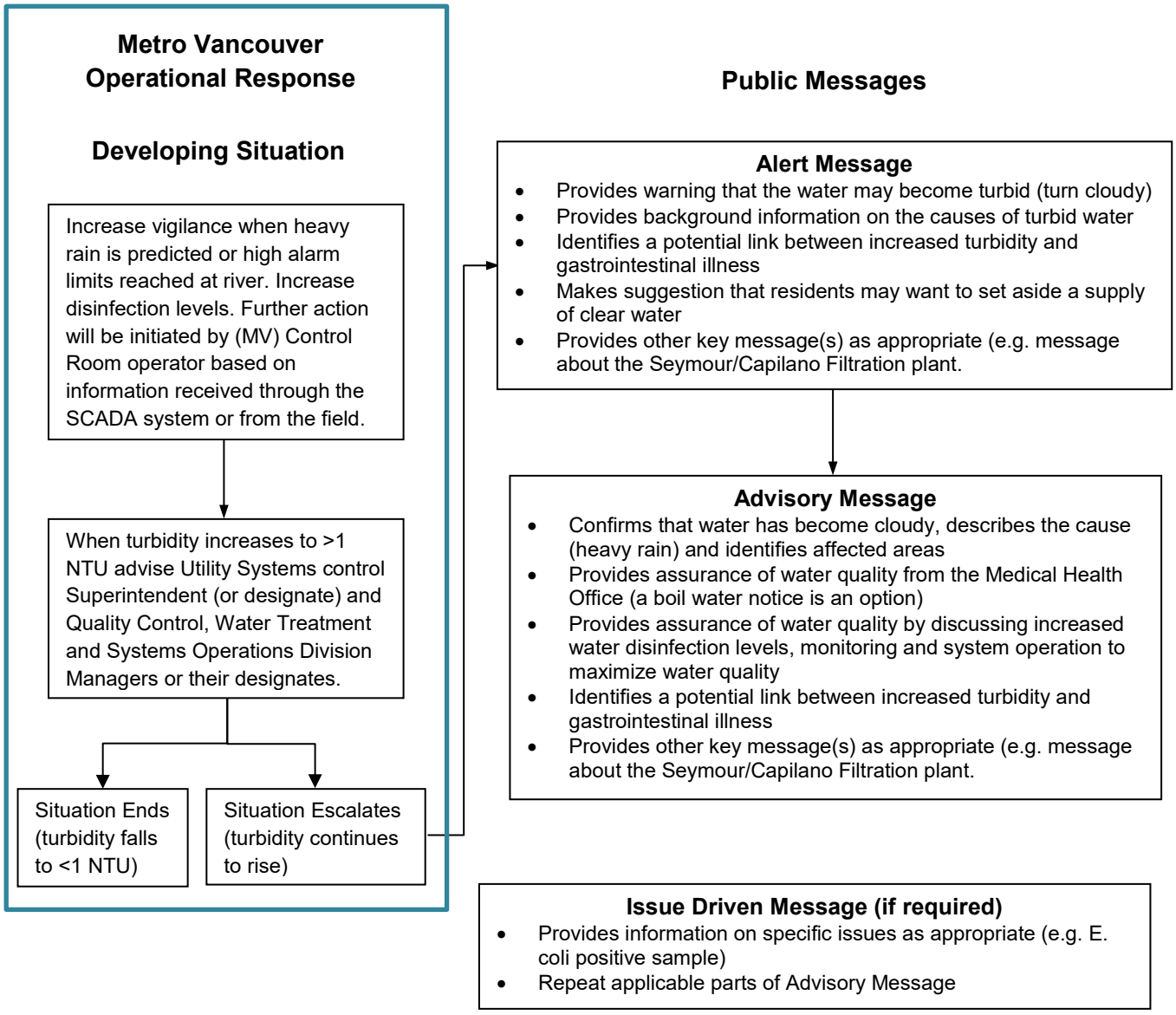
Requirement	Status	Comments
Regulatory issues.	Underway.	Working to ensure clarity and consistency of terminology.
Assist water suppliers with drafting answers to health-related questions from the public and with identifying communications responsibilities for specific groups.	New.	Will facilitate consistent and appropriate communication and messaging.
Refer regional water system operational questions to Metro Vancouver.	No change.	
Refer local water system questions to the appropriate municipality.	No change.	
Improve communication protocols between Vancouver Coastal and Fraser Health Authorities.	Underway.	For example, VCH and FH will harmonize their Question and Answer sheets for Turbidity.
As required, answer calls from the public and refer calls to Metro Vancouver and specific municipalities.	No change.	
Maintain up-to-date phone and email lists.	Updated on a regular basis.	
For extraordinary events, the VCH MHO will direct Metro Vancouver to organize and implement regular conference call. VCH and FH (if applicable) and all member municipalities should be invited to participate.	New.	Highly effective way of coordinating response.
Confirm to all participants that normal operations can be resumed and special communications efforts (e.g. web site messages etc.) can be ended.	New.	

Communications Responsibilities of Municipalities

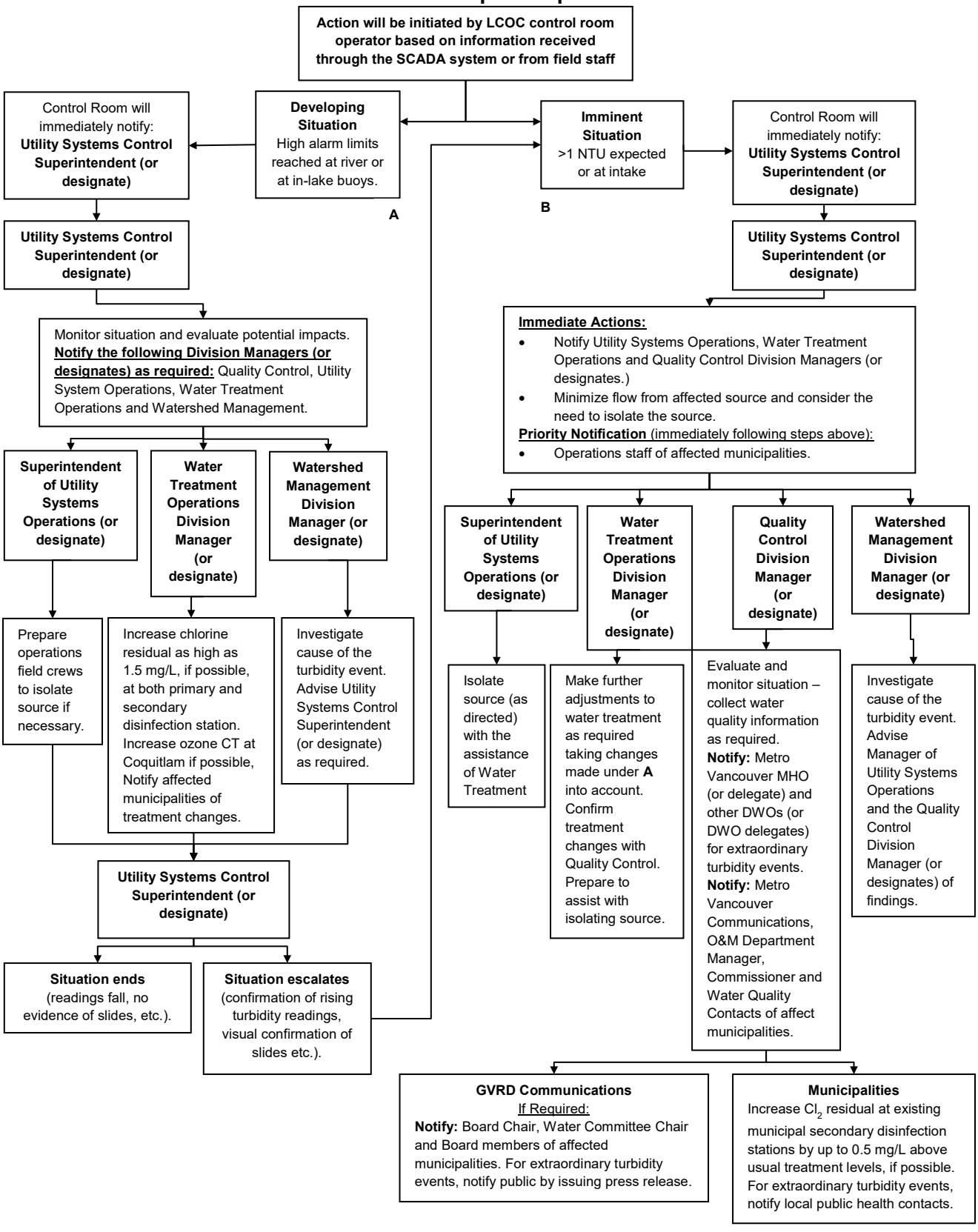
Requirement	Status	Comments
Municipalities must notify the appropriate health authority drinking water program staff of an extraordinary turbidity event (unless both parties participate in a conference call - the conference call will constitute notification).	No change.	Meets regulatory requirement.

Requirement	Status	Comments
Include customer notification as part of the municipal water supply plan. Consult with the healthy authority about notification responsibilities for specific groups.	Some municipalities have begun this work.	Will clarify customer notification processes.
Answer local calls and enquiries and refer calls to Metro Vancouver and health authorities as required.	No change.	
Maintain up-to-date phone and e-mail contact lists.	Updated on a regular basis.	
Respond to local issues.	No change form current practices.	
Develop answers to anticipated questions from consumers. For matters related to health, consult the health authority before finalizing messages which involve health issues. In consultation with the health authority, develop processes for referring callers with questions about clinical symptoms to health professionals.	Municipalities in various stages of the process.	Will improve ability of municipalities to respond to questions from the public.
Ensure that local messages are consistent with Metro Vancouver messages and refer regional water system operational issue to Metro Vancouver.	Municipalities in various stages of the process.	Will improve ability of municipalities to respond to questions from the public.
Based on information received from Metro Vancouver regarding the resumption of normal operations, inform the applicable health authority that normal operations can be resumed.	New.	

Guidelines for Source Water Turbidity Events



SOURCE WATER TURBIDITY EVENTS
Metro Vancouver and Municipal Response Procedures



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