

Technical Memorandum

DATE: November 9, 2022

TO: Dave Jarvis, Manager of Utilities Operations
Township of Langley

FROM: Shona Robinson, PhD, P.Eng.

RE: FORT LANGLEY WATER SYSTEM SAMPLING AND ANALYSIS
2022 Sampling Program Outcomes
Our File 0647.166-300

1. Introduction

1.1 Langley Water Supply

The Township of Langley (ToL) is served by a blend of Metro Vancouver drinking water, from the Coquitlam reservoir, and local wells which supply groundwater. Depending on the location within ToL, residences may receive a greater portion of Metro Vancouver water or local groundwater, resulting in water quality and characteristics varying by neighbourhood.

ToL has received complaints from residents regarding the quality of drinking water received in three particular areas: Fort Langley, Forest Knolls, and a subdivision east of 216 Street. Concerns reported included corroded fittings, leaks and resultant damage, build-up of corrosion by-products, and worry about acidic water. These three areas draw much of their water from Fort Langley Well #2 (88 Avenue Well), which is reported to have a pH below the minimum value recommended in the Guidelines for Canadian Drinking Water Quality (GCDWQ).

The Township of Langley reports that, through regular water sampling and testing pursuant to the guidelines set by the British Columbia Drinking Water Protection Regulations, the pH of water from Fort Langley Well #2 averages between 6.5 and 7.0. In 2015, Health Canada published a technical document through the GCDWQ involving a review and adjustment of the recommended pH levels for finished drinking water from 6.5-8.5 to the current 7.0-10.5.¹

In 2021, Metro Vancouver began implementing treatment to their water supply to increase their water system pH levels to a target level of 8.3 - 8.5 for the region.² Information relating to this adjustment is appended to this memorandum (Appendix B). Subsequently, the Township of Langley also began investigating treatment options to increase the pH of the Fort Langley Well #2 water to match the targets set by Metro Vancouver and the GCDWQ.

The well is currently being upgraded with a pH control system, which is designed to bring the water into the recommended GCDWQ range (7.0 to 10.5) and align with target set by Metro Vancouver in June 2021 (8.3 to 8.5). The Fort Langley Well #2 pH adjustment facility is scheduled to be in operation before the end of 2022.

¹ <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-ph-eng.pdf>

² http://www.metrovancouver.org/services/water/WaterPublications/Fact_Sheet-Corrosion_Control_Program-Copper_Pipes_Protection.pdf



1.2 Corrosion In Drinking Water

Corrosion Indices

Corrosion is the deterioration of the material, usually a metal, via oxidation. In the case of drinking water systems, the affected material often includes metal pipes, fittings, and valves. Corrosion in drinking water systems is a function of:

- the type and quality of metals and materials used in contact with the water;
- electrochemical interactions;
- duration of exposure to corrosive water; and
- the quality of drinking water in the system (i.e., water corrosivity).

There is no single characteristic of drinking water that dictates its corrosivity; pH is a particularly influential parameter, along with alkalinity, temperature, total dissolved solids, hardness, and others. Several indices exist to estimate the corrosivity of drinking water, which consider combinations of measured water parameters. These indices are not precise indicators by absolute measurement, they are indicators of the tendency of water to be either corrosive or scale forming. Common indices include the Langelier Saturation Index (LSI) and the Calcium Carbonate Precipitation Potential (CCPP).

- The LSI is based on the theoretical tendency of water to deposit or dissolve calcium carbonate. A positive LSI indicates a tendency to form a protective scale, whereas a negative LSI suggests corrosive water. It should be noted that the LSI is not accurate outside of a pH range of 6.5 - 9.5 (the present study falls at the low end of this range).
- The CCPP is a measure of the theoretical quantity of CaCO_3 that can be precipitated from oversaturated water or dissolved by undersaturated water. The CaCO_3 dissolution potential serves as a proxy for general corrosivity. A negative CCPP indicates that water could dissolve CaCO_3 , with a CCPP of -5 to -10 indicating “mildly corrosive” water and below -10 (i.e., more negative than -10) indicating “corrosive” water. A positive CCPP indicates that water could be scale forming and precipitate CaCO_3 .

The Rothberg, Tamburini, and Winsor (RTW) Model for Corrosion Control and Process Chemistry is a spreadsheet-based tool which was developed to estimate LSI and CCPP. The model has been updated over time and the current version is called the Tetra Tech (RTW) Model for Water Process and Corrosion Chemistry. This model was used to assess the corrosivity of each water sample by calculating CCPP and LSI.

pH and Corrosion

Although, as stated above, water corrosivity depends on a combination of characteristics, pH is influential, with low pH causing water to be more corrosive. Based on the Health Canada technical document for pH, “there is no evidence of an association between the pH of the diet and direct adverse health effects”.³ Extreme pH can cause health effects, but these extremes are not approached by drinking water, even outside of the GCDWQ compliant range. As illustrated in Figure 2, the reported pH of Fort Langley Well #2 is lower than the GCDWQ (i.e., Health Canada) compliant range, but not extreme. Thus, Langley’s low pH may be a contributor to corrosion, but direct health effects are not of concern.

³ <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-ph-eng.pdf>

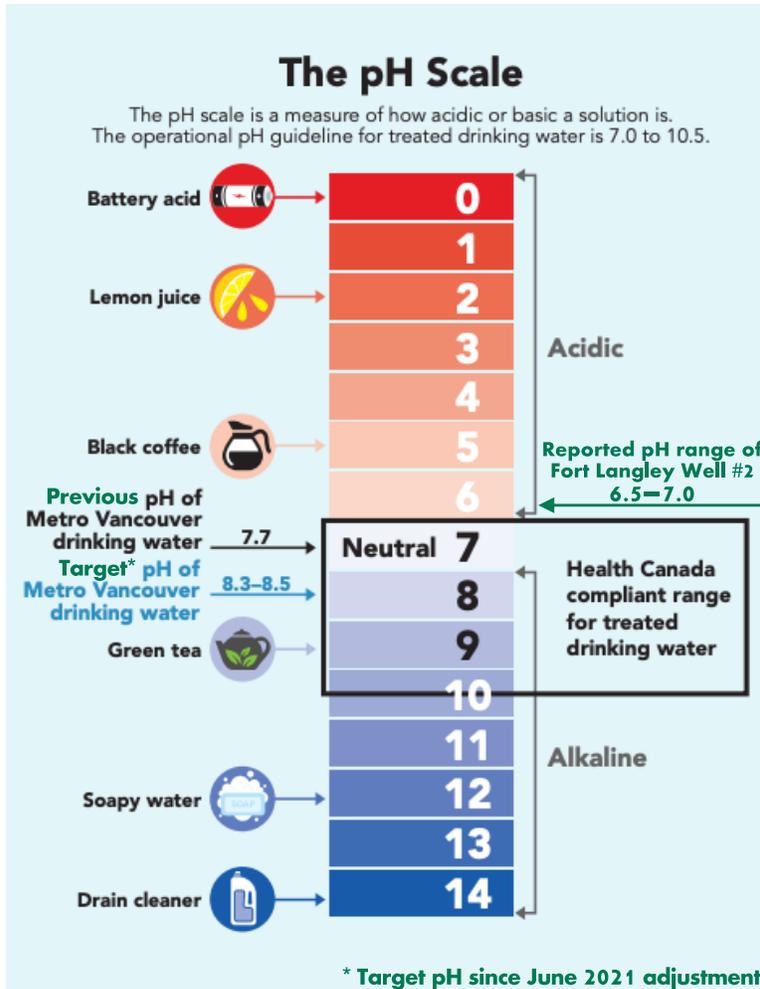


Figure 1. pH Scale, Adapted (Changes in Green) from Metro Vancouver, 2021 ⁴

Corrosion and Metals

Corrosivity influences the amount of lead and copper in drinking water samples, as corrosive water is prone to dissolving metal in some metallic pipes, fixtures, and valves. The presence of lead and copper in drinking water can pose a health risk to users, and their mitigation is a complex issue. Groundwater, such as that supplied by Fort Langley Well #2, does not typically contain significant levels of lead or copper. Though the water may be free of lead and copper at the source, post-treatment, and through the distribution system, these metals can then be leached from domestic plumbing components and observed at the tap. Even some relatively modern (pre-2013) brass components may contain up to 8% lead; such plumbing fixtures may be more prone to lead leaching in the presence of corrosive water.

Lead and copper limits are outlined in the Health Canada GCDWQ. In 2019, these Guidelines were revised reducing the maximum allowable concentration (MAC) for lead from 0.01 mg/L to 0.005 mg/L; ideally, lead levels should be as low as reasonably achievable (ALARA) below this limit. A MAC of 2

⁴ http://www.metrovancouver.org/services/water/WaterPublications/Fact_Sheet-Corrosion_Control_Program-Copper_Pipes_Protection.pdf



mg/L was established for copper, in addition to the existing aesthetic objective (AO) for copper of 1 mg/L. Levels of these metals can be reduced via several approaches:

- Treat water prior to building plumbing so it is less corrosive to domestic plumbing components.
- Reduce lead and copper in building plumbing.
- Reduce contact time of drinking water with building plumbing (e.g., flushing).
- Treat water at the point of consumption to remove lead and copper.

1.3 Present Study

The present study was designed to understand residential water quality in the three focus areas served by Fort Langley Well #2. This included an investigation of water corrosivity in residences, as well as typical lead and copper concentrations, which may be elevated due to corrosive water.

In the present work, a set of water characteristics which may relate to corrosion were measured, and the LSI and CCPP were calculated for all water samples. In addition, lead and copper were measured.

To obtain samples from residences in the areas of interest, ToL contacted residents who had recently noted concerns regarding their drinking water quality. Resident volunteers from this group allowed ToL and KWL staff to sample in their homes. Further sampling was conducted at the well source and several public-side sampling locations to differentiate the impact of private-side fixtures compared with the source water. Sampling results are detailed in this technical memorandum.

2. Methodology

2.1 Sample Types

The following protocols were revised from the original KWL proposal, based on discussion with ToL staff. The scope was revised to include Random Daytime (RDT) samples, 30-minute Stagnation (30MS) samples, and flushed samples from public-side sampling stations.

Random Daytime Samples

Random daytime samples provide a representative estimate of metals exposure and water characteristics throughout the day. RDT samples were collected from all homes in the study. To conduct RDT sampling, a 1 L sample was collected randomly during the day at the cold water tap where water is used for drinking and food preparation, without stagnation and without prior flushing. This first 1 L sample was analyzed for metals, and the next 1 L sample was analyzed for all other parameters.

To give a statistically robust sense of area-wide water quality, RDT samples require a relatively large number of sites. This is due to the variation in water quality introduced by time-of-day and variable tap use prior to collection. Despite this drawback, RDT sampling is simple and fast to execute; it is therefore practical to conduct when sampling residences. On a community scale, RDT samples give an estimate of the average water characteristics to which the residents are exposed.

30-Minute Stagnation Samples

30MS samples are also intended to provide a representative estimate of metals exposure and water characteristics. However, 30MS samples are collected using a more rigorous protocol, thus are more reproducible than RDT sampling. Because these samples are more reproducible, 30MS sampling was conducted for several residents in each area who agreed to have the procedure repeated in potential future monitoring, acting as 'sentinel sites'.



To conduct 30MS sampling, the cold tap was flushed for 5 minutes, and then allowed to stand for 30 minutes. During this time no water was to be drawn from any outlet within the residence, including the flushing of toilets. After the 30-minute stagnation period, two 1 L samples were collected without any flushing prior to collection. The first two 1 L samples were analyzed for metals and the results were averaged; the next 1 L sample was analyzed for all other parameters.

Public-Side Samples

Three dedicated water sampling stations (one near each area), as well as Fort Langley Well #2, were flushed thoroughly and sampled. The first 1 L sample immediately following a 5-minute flush was analyzed for metals, and the next 1 L sample was analyzed for all other parameters. This procedure was designed to assess water quality in the municipal distribution system. As Fort Langley residential samples were collected on a different day from the other two areas, the corresponding sampling stations were sampled on the same days as those areas. The well was sampled on both days for a total of five public-side samples.

2.2 Sample Areas

Figure 2 illustrates the three sampling areas within ToL. These areas were selected as they were identified as receiving a high number of customer complaints regarding corrosion and concerns of acidic water; these areas also draw a large volume of water from Fort Langley Well #2. There were also four sampling locations testing the public side of the drinking water system. Flushed public-side samples were taken from Fort Langley Well #2, as well as 3 other sampling stations, each corresponding to a nearby sampling area. One of these sampling stations was near the Fort Langley Area, one near 216 Street, and one near Forest Knolls. These locations are illustrated on Figure 2 by red circles.

Based on the response rate from residents who were sent letters, KWL and ToL staff were not able to collect the proposed 80 RDT samples. 65 properties were sent letters and 35 responses were received. Only 32 of 35 properties were sampled due to 3 residents not being home at the time of sampling. In all, 14 RDT samples were collected from the 216 Street East area, 14 RDT samples from the Fort Langley area, and 4 RDT samples from the Forest Knolls area, for a total of 32 RDT samples.

KWL and ToL staff were able to conduct an additional 3 30MS samples in the Fort Langley Area, increasing the number of sentinel sites in this area from 3 to 6. Both Forest Knolls and 216 Street East included 3 30MS samples.

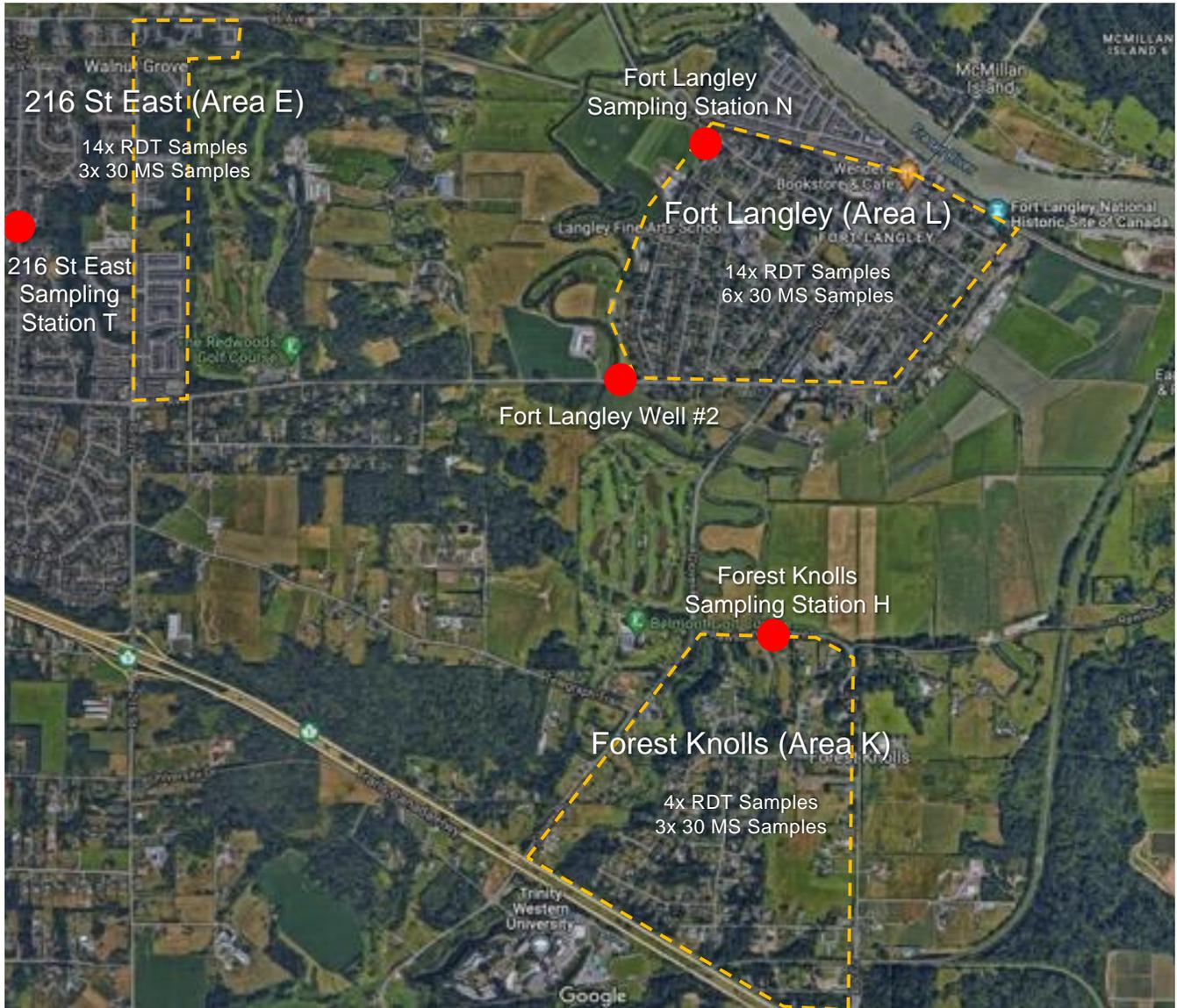


Figure 2: Township of Langley Sampling Areas



3. Sampling Results

The average results of the Fort Langley Water System Sampling and Analysis are summarized in Table 1 (RDT results and public side well/sampling station results) and Table 2 (30MS results) below. A complete table of results table is included in Appendix A.

The present study sampling results of Fort Langley Well #2 and the three public side sampling stations revealed an average pH value of 6.5 across 4 sampling points. Fort Langley Well #2 was sampled twice with sampling events occurring roughly one week apart. Each sampling event yielded a pH value of 6.4.

Table 1: RDT Sampling and Public Side Sampling Average Results by Area

Analyte ¹	Units	Private Side Overall (32 Samples)	Fort Langley (14 Samples) ²	Forest Knolls (4 Samples) ³	216 th St. E (14 Samples) ⁴	Public Side (5 Samples)
Chloride	mg/L	44	39	53	47	41
Sulfate	mg/L	14	13	17	16	13
Total Hardness (as CaCO ₃)	mg/L	68	67	89	62	69
Temperature	°C	19	19	19	19	12
pH	pH Units	6.5	6.5	6.3	6.5	6.5
Oxidation-Reduction Potential	mV	717	712	725	719	506
Total Alkalinity	mg/L	61	68	57	54	60
Bicarbonate Alkalinity	mg/L	61	68	57	54	60
Total Dissolved Solids	mg/L	186	165	250	189	166
Conductivity	µS/cm	288	277	345	282	267
Total Copper	mg/L	0.26	0.37	0.21	0.15	0.01
Total Lead	mg/L	0.0048	0.0064	0.0083	0.0022	0.0006
Calcium Carbonate Precipitation Potential	mg/L	-78	-83	-93	-69	-75
Langelier Saturation Index	-	-2.0	-1.9	-2.0	-2.1	-2.0

1. Where a concentration was below the detection limit, the detection limit value was assumed in calculating averages.
 2. 3 instances of lead exceeding 0.005 mg/L MAC; 1 instance of copper above AO but below MAC
 3. 1 instance of lead exceeding 0.005 mg/L MAC
 4. 1 instance of lead exceeding 0.005 mg/L MAC



Table 2: 30MS Sampling Average Results by Area

Analyte ¹	Units	30MS Overall (12 Samples)	Fort Langley (6 Samples) ²	Forest Knolls (3 Samples)	216 th St. E (3 Samples)
Chloride	mg/L	47	47	57	37
Sulfate	mg/L	16	15	18	17
Total Hardness (as CaCO ₃)	mg/L	75	78	97	47
Temperature	°C	19	18	19	20
pH	pH Units	6.4	6.4	6.3	6.6
Oxidation-Reduction Potential	mV	750	744	742	771
Total Alkalinity	mg/L	66	76	72	39
Bicarbonate Alkalinity	mg/L	66	76	72	39
Total Dissolved Solids	mg/L	204	193	231	198
Conductivity	µS/cm	306	320	348	235
Total Copper	mg/L	0.22	0.34	0.10	0.08
Total Lead	mg/L	0.0030	0.0037	0.0024	0.0024
Calcium Carbonate Precipitation Potential	mg/L	-94	-100	-112	-65
Langelier Saturation Index	-	-2.0	-1.8	-1.9	-2.4

1. Where a concentration was below the detection limit, the detection limit value was assumed in calculating averages.
2. 1 instance of lead exceeding 0.005 mg/L MAC

4. Conclusions and Recommendations

Conclusions from the sampling program observations are as follows:

- Based on the two calculated corrosion indices, water in all three observed areas, as well as the public-side sampling stations is considered corrosive. See section 1.2 for more information on corrosion indices.
- Corrosive water, in conjunction with plumbing fixture materials, may be contributing to lead exceeding GCDWQ levels in drinking water within some residences.
- As the observed public-side lead concentrations were roughly an order of magnitude lower than residential lead concentrations, private-side fixtures and solder are possible contributors.

Recommendations for next steps are as follows:

- Notify residents whose water exceeded the GCDWQ MAC for lead. Residents can take precautions such as flushing taps (until cold) prior to drinking or installing point-of-use treatment systems to address this issue.
- Continue with construction and commissioning of the water conditioning facility for Fort Langley Well #2.
- Once the conditioning facility is online, repeat the 30MS sampling at the same 12 sites.



KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

Reviewed by:

Shona Robinson, Ph.D., P.Eng.
Project Engineer


Irfan Gehlen, P.Eng.
Water Supply & Treatment Sector Leader

SJR/aah

- Encl.: Appendix A: Individual Sample Results Table
- Appendix B: Corrosion Control Program – Copper Pipes Protection Fact Sheet (Metro Vancouver)

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Revision History

Revision #	Date	Status	Revision Description	Author
0	November 9, 2022	Final		SJR



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consulting engineers

Appendix A

Individual Sample Results Tables



Appendix A: Sampling Analysis Results

Table A-1: Fort Langley RDT Sample Results (Area "L")

Date Sampled					2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24
Sample ID					L-001-RDT	L-002-RDT	L-003-RDT	L-004-RDT	L-005-RDT	L-006-RDT	L-007-RDT	L-008-RDT	L-009-RDT	L-010-RDT	L-011-RDT	L-012-RDT	L-013-RDT	L-014-RDT
Analyte	RL ¹	Units	MAC ²	AO ³														
Field Tests (Matrix: Water)																		
pH	0.1	pH units		7-10.5	6.3	6.4	6.4	6.5	6.4	6.5	6.4	6.5	6.5	6.4	6.4	6.4	6.6	6.9
Temperature		°C		15	19.2	16.4	20.6	17.7	15.4	17.9	19	17	21.4	19.5	19.3	20.5	23.8	18.2
Oxidation-Reduction Potential	2	mV			650	717	601	729	761	735	757	767	656	725	742	746	640	745
Anions (Matrix: Water)																		
Chloride	0.1	mg/L		250	51	50.9	51.1	23.8	51.6	50.5	40.8	51.4	16.1	35.9	37.2	49.4	25.8	14.3
Sulfate	1	mg/L		500	16.8	16.9	16.8	6.7	16.9	17	13.5	16.9	4.6	11.5	12	16.1	7.6	4.2
Calculated Parameters (Matrix: Water)																		
Total Hardness (as CaCO ₃)	0.5	mg/L			91.9	78.9	85.8	54.9	83	90.5	66.7	79.6	29	60.2	65	87.9	48	23.1
General Parameters (Matrix: Water)																		
Total Alkalinity (as CaCO ₃)	1	mg/L			76	84.5	91.4	46.5	84.9	83.1	70.5	86.3	38.1	63.8	65.9	79.3	51.2	35.5
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			76	84.5	91.4	46.5	84.9	83.1	70.5	86.3	38.1	63.8	65.9	79.3	51.2	35.5
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	217	203	214	110	204	214	175	208	81	154	161	203	100	68
Conductivity	2	uS/cm			354	354	357	169	348	347	286	357	132	259	266	337	190	122
Total Metals (Matrix: Water)																		
Total Copper	0.0004	mg/L	2	1	0.928	0.125	0.871	0.125	0.184	0.354	0.074	1	0.0701	0.0713	0.179	0.39	0.814	0.0313
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.00545	0.00188	0.0159	0.0454	0.0013	0.00099	0.00144	0.00239	0.00209	0.00245	0.00474	0.00284	0.00183	0.00084
KWL (Matrix: Water)																		
CCPP		mg/L			-109	-106	-59	-111	-86	-94	-90	-48	-88	-89	-97	-47	-21	-47
Langelier Saturation Index					-1.8	-1.7	-2.1	-1.8	-1.7	-1.9	-1.7	-2.4	-2.0	-2.0	-1.7	-1.9	-2.1	-2.3

- Notes:
1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.
 2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.
 3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.
 4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.



Table A-2: Forest Knolls RDT Sample Results (Area "K")

Date Sampled					2022-10-02	2022-10-02	2022-10-02	2022-10-02
Sample ID					K-001-RDT	K-002-RDT	K-003-RDT	K-004-RDT
Analyte	RL ¹	Units	MAC ²	AO ³				
Field Tests (Matrix: Water)								
pH	0.1	pH units		7-10.5	6.4	6.3	6.4	6.2
Temperature		°C		15	22.7	20	17.4	14.9
Oxidation-Reduction Potential	2	mV			701	722	750	728
Anions (Matrix: Water)								
Chloride	0.1	mg/L		250	52.4	52.4	53.4	54.7
Sulfate	1	mg/L		500	17	17.3	17.1	17.1
Calculated Parameters (Matrix: Water)								
Total Hardness (as CaCO ₃)	0.5	mg/L			88.5	88.3	87.2	92
General Parameters (Matrix: Water)								
Total Alkalinity (as CaCO ₃)	1	mg/L			59.6	53.1	59.9	54.4
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			59.6	53.1	59.9	54.4
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	247	229	254	268
Conductivity	2	uS/cm			341	346	346	346
Total Metals (Matrix: Water)								
Total Copper	0.0004	mg/L	2	1	0.129	0.531	0.0758	0.119
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.00282	0.0263	0.00304	0.00095
KWL (Matrix: Water)								
CCPP		mg/L			-77	-90	-84	-120
Langelier Saturation Index					-1.8	-2.0	-1.9	-2.2

Notes:

1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.
2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.
3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.
4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.



Table A-3: East of 216 Subdivision RDT Sample Results (Area "E")

Date Sampled					2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02	2022-10-02
Sample ID					E-001-RDT	E-002-RDT	E-003-RDT	E-004-RDT	E-005-RDT	E-006-RDT	E-007-RDT	E-008-RDT	E-009-RDT	E-010-RDT	E-011-RDT	E-012-RDT	E-013-RDT	E-014-RDT
Analyte	RL ¹	Units	MAC ²	AO ³														
Field Tests (Matrix: Water)																		
pH	0.1	pH units		7-10.5	6.4	6.8	6.4	6.1	6.3	6.4	6.4	6.4	6.6	6.4	6.5	6.8	6.7	7.4
Temperature		°C		15	18.9	25	21.2	18.9	17.8	20.1	22.4	18.4	14.8	16.7	16.4	20.9	18.6	20.9
Oxidation-Reduction Potential	2	mV			782	288	742	787	792	779	728	784	590	792	795	760	740	707
Anions (Matrix: Water)																		
Chloride	0.1	mg/L		250	58.1	17	57.5	58.6	58	69.8	57.7	56.3	57.9	55.6	55.4	14.9	32.3	3.8
Sulfate	1	mg/L		500	18.1	4.5	18.1	18.4	18.1	20.6	18.1	18.1	18.1	18.2	18	4.1	9.1	<1.0
Calculated Parameters (Matrix: Water)																		
Total Hardness (as CaCO ₃)	0.5	mg/L			89.1	26.9	87.5	32.1	89.1	90.5	94.6	93.2	0.836	95.5	93.3	21	47.6	5.07
General Parameters (Matrix: Water)																		
Total Alkalinity (as CaCO ₃)	1	mg/L			64.1	35	61.2	37.7	62.4	53.9	69.4	70.2	61.3	74.6	72.5	30.9	42.9	21.9
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			64.1	35	61.2	37.7	62.4	53.9	69.4	70.2	61.3	74.6	72.5	30.9	42.9	21.9
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	252	104	231	225	227	197	213	199	194	203	235	121	161	88
Conductivity	2	uS/cm			351	130	353	317	355	353	335	339	346	345	345	118	209	55.7
Total Metals (Matrix: Water)																		
Total Copper	0.0004	mg/L	2	1	0.0765	0.132	0.126	0.2	0.133	0.0785	0.089	0.0539	0.0409	0.09	0.0775	0.0439	0.815	0.203
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.00068	0.00223	0.00268	0.00711	0.00392	0.00219	0.00329	0.00095	0.00174	0.00079	0.00175	0.00121	0.00228	0.0004
KWL (Matrix: Water)																		
CCPP		mg/L			-86	-23	-80	-109	-104	-74	-85	-92	-65	-99	-80	-22	-35	-9
Langelier Saturation Index					-1.8	-2.2	-1.8	-3.0	-2.0	-1.9	-1.7	-1.8	-3.7	-1.8	-1.7	-2.3	-2.0	-2.4

- Notes:
1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.
 2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.
 3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.
 4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.



Table A-4: Sampling Stations and Well Sample Results

Date Sampled					2022-09-24	2022-09-24	2022-10-02	2022-10-02	2022-10-02
Sample ID					L-0SS-N	W-0SS-W	K-0SS-H	E-0SS-T	W-0SS-W-2
Analyte	RL ¹	Units	MAC ²	AO ³	Fort Langley Sampling Station	Fort Langley Well #2	Forest Knolls Sampling Station	Near 216 th Subdivision Sampling Station	Fort Langley Well #2 (Sampling Event 2)
Field Tests (Matrix: Water)									
pH	0.1	pH units		7-10.5	6.6	6.4	6.9	6.4	6.4
Temperature		°C			14.9	11.9	12.3	10.7	12.4
Oxidation-Reduction Potential	2	mV			630	322	698	625	254
Anions (Matrix: Water)									
Chloride	0.1	mg/L		250	19.4	49.8	56.5	22.1	56.4
Sulfate	1	mg/L		500	5.5	17	18.3	6.2	18.1
Calculated Parameters (Matrix: Water)									
Total Hardness (as CaCO ₃)	0.5	mg/L			31.9	91.9	97	35.8	88.3
General Parameters (Matrix: Water)									
Total Alkalinity (as CaCO ₃)	1	mg/L			41.6	84.2	68	36.6	71.9
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			41.6	84.2	68	36.6	71.9
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	87	204	223	99	217
Conductivity	2	uS/cm			149	344	348	153	342
Total Metals (Matrix: Water)									
Total Copper	0.0004	mg/L	2	1	0.0391	0.0022	0.00739	0.0142	0.00162
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.00065	0.0002	0.00067	0.00129	0.0002
KWL (Matrix: Water)									
CCPP		mg/L			-47	-118	-35	-69	-105
Langelier Saturation Index					-2.3	-1.8	-1.4	-2.6	-1.9

Notes:

1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.
2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.
3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.
4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.



Table A-5: Fort Langley 30MS Sample Results (Area "L")

Date Sampled					2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24	2022-09-24
Sample ID					L-00A-30MS	L-00B-30MS	L-00C-30MS	L-00D-30MS	L-00E-30MS	L-00F-30MS
Analyte	RL ¹	Units	MAC ²	AO ³						
Field Tests (Matrix: Water)										
pH	0.1	pH units		7-10.5	6.4	6.4	6.4	6.3	6.5	6.4
Temperature		°C		15	17.7	17.1	19.3	17.9	17.6	18.6
Oxidation-Reduction Potential	2	mV			703	742	722	761	766	767
Anions (Matrix: Water)										
Chloride	0.1	mg/L		250	51.6	51.6	51	51.3	36.8	39.2
Sulfate	1	mg/L		500	17	17	17	16.9	10.8	12.9
Calculated Parameters (Matrix: Water)										
Total Hardness (as CaCO ₃)	0.5	mg/L			89.5	84.8	85.7	82.5	56.9	69.55
General Parameters (Matrix: Water)										
Total Alkalinity (as CaCO ₃)	1	mg/L			83.9	82	83.8	80.6	60.2	66.3
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			83.9	82	83.8	80.6	60.2	66.3
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	206	210	210	217	144	168
Conductivity	2	uS/cm			348	348	349	348	243	281
Total Metals (Matrix: Water)										
Total Copper	0.0004	mg/L	2	1	0.79	0.171	0.432	0.4755	0.04265	0.1425
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.003575	0.003675	0.00841	0.00063	0.001465	0.004415
KWL (Matrix: Water)										
CCPP		mg/L			-105	-106	-102	-123	-71	-90
Langelier Saturation Index					-1.7	-1.8	-1.7	-1.9	-2.0	-1.9

Notes:

1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.
2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.
3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.
4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.



Table A-6: Forest Knolls 30MS Sample Results (Area "K")

Date Sampled					2022-10-02	2022-10-02	2022-10-02
Sample ID					K-00A-30MS	K-00B-30MS	K-00C-30MS
Analyte	RL ¹	Units	MAC ²	AO ³			
Field Tests (Matrix: Water)							
pH	0.1	pH units		7-10.5	6.4	6.3	6.2
Temperature		°C		15	21.6	18.4	17.2
Oxidation-Reduction Potential	2	mV			722	763	740
Anions (Matrix: Water)							
Chloride	0.1	mg/L		250	56.9	56.7	57.1
Sulfate	1	mg/L		500	18	18.2	18.2
Calculated Parameters (Matrix: Water)							
Total Hardness (as CaCO ₃)	0.5	mg/L			93.35	98.05	99.45
General Parameters (Matrix: Water)							
Total Alkalinity (as CaCO ₃)	1	mg/L			75.6	69.9	69.9
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			75.6	69.9	69.9
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	236	222	236
Conductivity	2	uS/cm			349	349	347
Total Metals (Matrix: Water)							
Total Copper	0.0004	mg/L	2	1	0.08445	0.1111	0.11495
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.001745	0.00469	0.000705
KWL (Matrix: Water)							
CCPP		mg/L			-91	-111	-135
Langelier Saturation Index					-1.7	-1.9	-2.0
Notes:							
1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.							
2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.							
3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.							
4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.							



Table A-7: Subdivision East of 216th Street 30 MS Sample Results (Area “E”)

Date Sampled					2022-10-02	2022-10-02	2022-10-02
Sample ID					E-00B-30MS	E-00C-30MS	E-00D-30MS
Analyte	RL ¹	Units	MAC ²	AO ³			
Field Tests (Matrix: Water)							
pH	0.1	pH units		7-10.5	7.4	6.4	6.1
Temperature		°C		15	20	21.3	18.7
Oxidation-Reduction Potential	2	mV			725	787	800
Anions (Matrix: Water)							
Chloride	0.1	mg/L		250	3.12	53.7	53.6
Sulfate	1	mg/L		500	<1.0	17.3	17.4
Calculated Parameters (Matrix: Water)							
Total Hardness (as CaCO ₃)	0.5	mg/L			3.11	79.05	57.65
General Parameters (Matrix: Water)							
Total Alkalinity (as CaCO ₃)	1	mg/L			21.2	60	36.5
Phenolphthalein Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Bicarbonate Alkalinity (as CaCO ₃)	1	mg/L			21.2	60	36.5
Carbonate Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Hydroxide Alkalinity (as CaCO ₃)	1	mg/L			<1.0	<1.0	<1.0
Total Dissolved Solids	15	mg/L		500	93	262	238
Conductivity	2	uS/cm			51.2	345	310
Total Metals (Matrix: Water)							
Total Copper	0.0004	mg/L	2	1	0.04545	0.1021	0.08565
Total Lead	0.0002	mg/L	0.005 ALARA ⁴		0.001485	0.001805	0.003765
KWL (Matrix: Water)							
CCPP		mg/L			-9	-79	-105
Langelier Saturation Index					-2.6	-1.9	-2.8
Notes:							
1. Reporting Limit (default). The actual RL may be higher than the default RL due to various factors.							
2. Maximum Allowable Concentration as per the Guidelines for Canadian Drinking Water Quality.							
3. Aesthetic Objective as per the Guidelines for Canadian Drinking Water Quality.							
4. As Low as Reasonably Achievable as per the Guidelines for Canadian Drinking Water Quality.							



KERR WOOD LEIDAL
consulting engineers

Appendix B

Corrosion Control Program Copper Pipes Protection Fact Sheet (Metro Vancouver)

Corrosion Control Program: Copper Pipes Protection



APRIL 2021

Improving our drinking water quality and protecting against corrosion of copper pipes

Project Overview

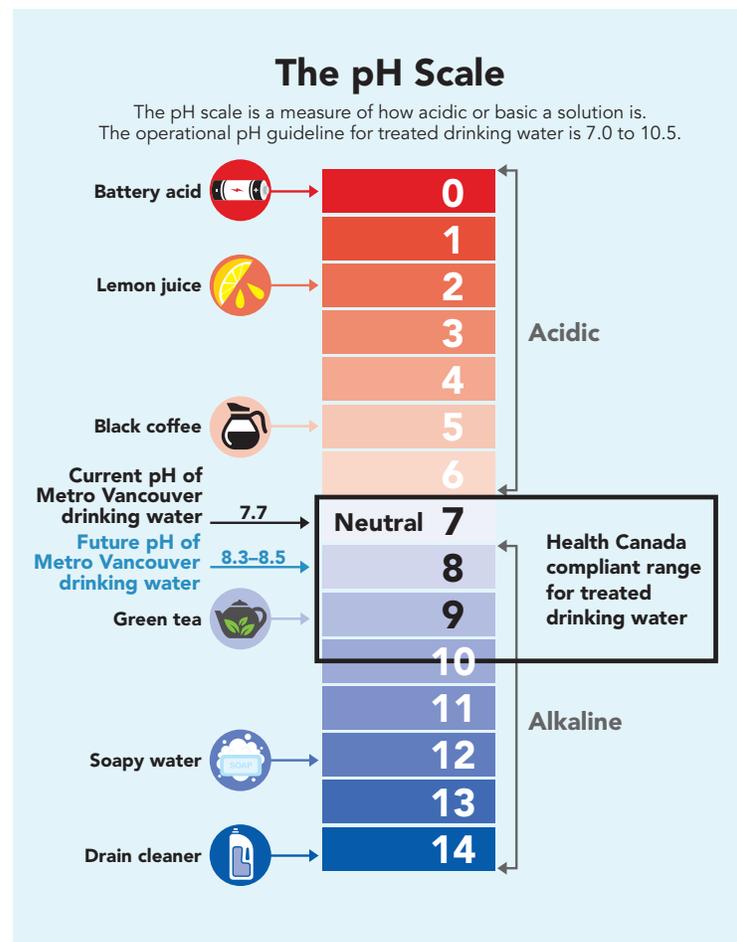
To protect copper pipes and hot water tanks in buildings, Metro Vancouver is planning to increase the pH of the region's drinking water through the use of natural minerals. This increase will:

- Reduce the release of copper from pipes in buildings caused by low pH in the region's water;
- Reduce leaks in pipes caused by copper corrosion;
- Help preserve the lifespan of pipes and hot water tanks; and
- Reduce green stains on tubs, sinks, and grout.

Metro Vancouver currently delivers water with a pH of 7.7, which is compliant with Health Canada's Guidelines for Canadian Drinking Water Quality, which range from 7 to 10.5. Adjusting the pH is an existing key component of Metro Vancouver's water treatment process because our untreated source water is naturally slightly acidic.

Increasing the pH to a target range of 8.3 to 8.5 will make the water less corrosive. To help improve the stability of the target pH level in the water transmission and distribution pipes, the alkalinity will be doubled to about 20 mg/L (expressed as calcium carbonate) using natural minerals. Alkalinity is a measure of the buffering capacity of the water to neutralize acids and bases to help maintain a stable pH level. These changes might prompt some water users such as health care facilities and breweries to adjust and calibrate their operations to the change in pH and alkalinity.

Metro Vancouver will continue to deliver high quality drinking water throughout the region that tastes and smells the same.

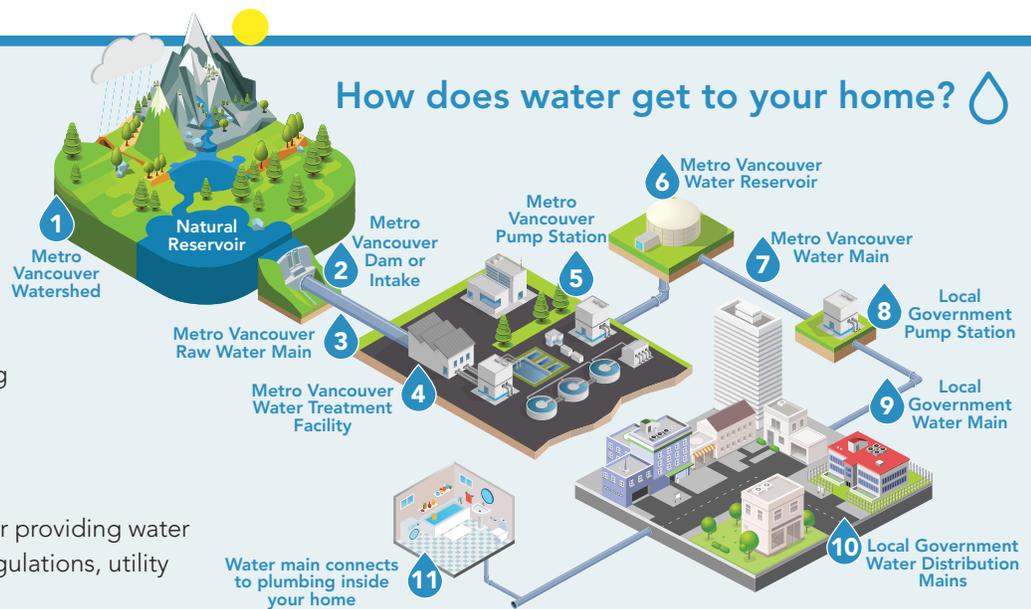


Metro Vancouver and its local governments work together to supply clean, safe drinking water to the region.

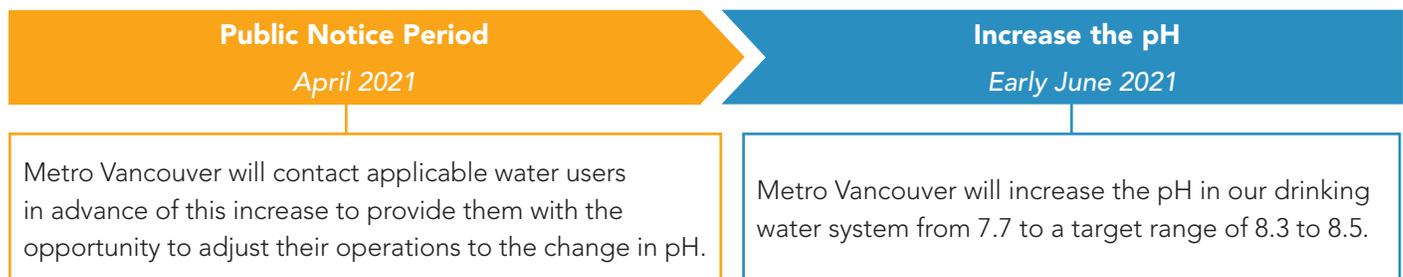
Metro Vancouver is responsible for protecting and providing the region's water supply, including: protecting our watersheds; storing, treating and ensuring the quality of our water; supplying water directly to our local governments; and planning for future supply and demand.

Our local governments are responsible for providing water to residents and businesses, enforcing regulations, utility billing, and, where used, water metering.

How does water get to your home?



Project Timeline



Metro Vancouver is committed to the continuous improvement of drinking water quality. The Corrosion Control Program began in the 1990s and involves several steps to reduce pipe corrosion. This upcoming change in pH is an important step in this long-term program to improve water quality and reduce pipe corrosion through the addition of natural minerals to our drinking water.

COVID-19 and Delivery of Essential Services

Metro Vancouver continues to closely monitor developments regarding COVID-19 and our paramount commitment is to maintain essential services to the region while protecting the health and safety of our employees, contractors, residents and businesses. Metro Vancouver's construction projects are key components in ensuring the ongoing delivery of essential services as defined by the Province of BC. Metro Vancouver follows the guidance of the Provincial Health Officer and is taking all necessary measures to ensure our work sites remain safe and healthy.

Contacting Metro Vancouver

Metro Vancouver Information Centre:
604-432-6200 (Monday to Friday from 8 AM to 4:30 PM)
icentre@metrovancouver.org (Please include 'Corrosion Control Program' in the subject line)

metrovancouver
 Together we make our region strong