City of Kamloops
Drinking Water Annual Report
2021

Canada's Tournament Capital

Kamloops Centre for Water Quality
1315 River Street, Kamloops, BC

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1.0 INTRODUCTION

This report was prepared in compliance with the requirements under the British Columbia *Drinking Water Protection Act* (DWPA) and the City of Kamloops' (the City's) Operating Permit. This document includes an overview of the treatment and distribution system within the city, a summary of the total water consumption and water quality analysis within the system, and a recap of projects and related operations. This report has been provided to Interior Health and posted on the City's website for public reading.

2.0 KAMLOOPS WATER SYSTEM

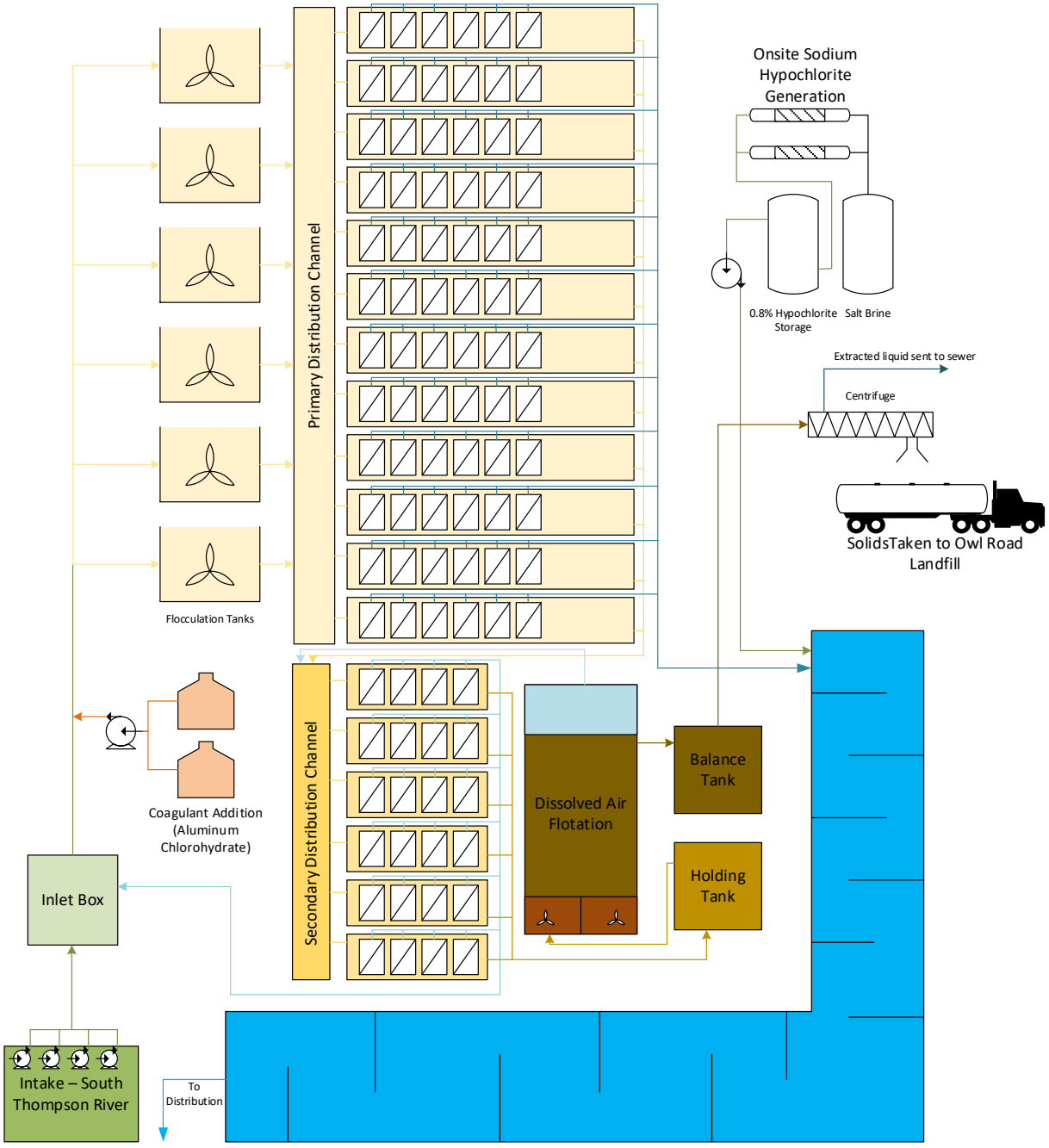
The City's drinking water system consists of a single treatment plant, which feeds an extensive distribution system that supplies water throughout the community. The only large community that is not fed from the central system is the Rayleigh Waterworks District, which has its own system supplied from the North Thompson River. The City's treatment plant, the Kamloops Centre for Water Quality (KCWQ), is an ultra-filtration membrane treatment facility that chlorinates the finished water to ensure the water's safety throughout the distribution system. The water treatment and distribution/storage systems are assessed and classified as Level IV systems through the Environmental Operators Certification Program (EOCP) and require highly qualified and certified operational staff.

2.1 Kamloops Centre for Water Quality

The KCWQ treats water from the South Thompson River and supplies most of the city's population. KCWQ is a Suez ZeeWeed 500D ultra-filtration membrane water treatment facility that can produce 160,000 m^3 per day (or 160 million litres per day, MLD). Leaders in Environmental and Energy Design (LEED) certify the building as a gold-standard green, which is reflected by the KCWQ's processes. Of the water taken into the facility, 99.99 % is processed and delivered as drinking water. The solids recovered through the filtering process are taken the City's Owl Road Resource Recovery Centre, where they are used as clean cover.

A layout of the KCWQ and the accompanying process can be seen in Figure 1.

Figure 1: The Kamloops Centre for Water Quality Plant Processes



2.1.1 *KCWQ Production Totals*

Overall water use in Kamloops has varied from 17,105,703 m^3 to 20,517,881 m^3 over the past decade. The 2021 single-day peak production (June 30) was the largest single-day use observed the past decade and was related to directly to the extreme daily maximum temperatures (44–47°C) observed in Kamloops June/July 2021. Figures 2 and 3 show the monthly total water consumption over the past 10 years. Total consumption for 2021 was close to the upper end of the 10-year average likely due to the extremely high daily temperatures seen in Kamloops in the summer of 2021.

Figure 2: Monthly Total Production for the Past 10 Years

Month	Total Production (m^3)										Year to Year Comparison		
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average	Minimum	Maximum
January	1,004,683	997,845	998,516	998,859	999,352	936,100	916,086	899,134	950,250	926,492	962,732	899,134	1,004,683
February	912,473	870,821	903,897	875,057	876,222	823,798	809,346	853,167	894,331	837,180	865,629	809,346	912,473
March	1,000,423	1,013,585	1,001,555	1,001,061	991,862	893,219	912,847	955,490	931,501	942,894	964,444	893,219	1,013,585
April	1,338,717	1,256,169	1,155,441	1,377,097	1,519,266	982,158	1,029,452	1,062,333	950,250	1,332,908	1,200,379	950,250	1,519,266
May	2,338,361	2,228,929	1,736,305	2,405,924	2,089,764	1,576,441	2,226,009	2,069,861	1,854,085	2,153,131	2,067,881	1,576,441	2,405,924
June	2,008,220	2,128,609	2,435,774	2,633,979	2,317,143	2,596,685	2,318,204	2,510,126	1,664,238	2,833,400	2,344,638	1,664,238	2,833,400
July	2,895,880	3,424,556	3,187,312	2,922,031	2,421,451	3,322,818	2,675,200	2,445,471	2,216,536	3,421,547	2,893,280	2,216,536	3,424,556
August	3,257,773	3,133,474	2,746,427	2,659,919	2,740,741	2,869,866	2,445,042	2,629,652	2,623,550	2,654,901	2,776,134	2,445,042	3,257,773
September	2,366,983	2,036,171	1,836,736	1,737,829	1,618,868	2,046,575	1,470,836	1,636,242	2,046,294	1,745,439	1,854,197	1,470,836	2,366,983
October	1,383,194	1,254,593	1,237,151	1,147,270	1,096,279	1,128,010	1,026,683	1,082,077	1,121,312	1,173,299	1,164,987	1,026,683	1,383,194
November	999,703	1,114,296	996,238	976,284	958,048	899,987	905,669	953,635	917,608	985,269	970,674	899,987	1,114,296
December	1,011,471	1,005,151	1,006,889	989,458	978,535	919,666	920,749	971,695	935,748	998,380	973,774	919,666	1,011,471
Total	*20,517,881*	*20,464,199*	*19,242,241*	*19,724,769*	*18,607,531*	*18,993,324*	*17,656,123*	*18,068,883*	*17,105,703*	*20,004,839*	*19,038,549*	*17,105,703*	*20,517,881*
Daily Peak	117,905	124,608	121,608	106,999	99,564	117,078	106,218	102,470	102,470	138,446	113,736	99,564	138,446
Peak Date	08-Aug	25-Jul	16-Jul	28-Jun	19-Aug	03-Jul	18-Jul	08-Aug	08-Aug	30-Jun			
Daily Low	29,794	29,094	28,771	28,603	29,330	15,394	29,330	27,073	27,073	24,490	26,895	15,394	29,794
Daily Average	*56,060*	*56,066*	*52,718*	*54,040*	*50,840*	*52,037*	*48,373*	*49,504*	*46,865*	*54,808*	*52,131*	*46,865*	*56,066*

Figure 3: Graphical Representation of the KCWQ 10-Year Monthly Water Consumption

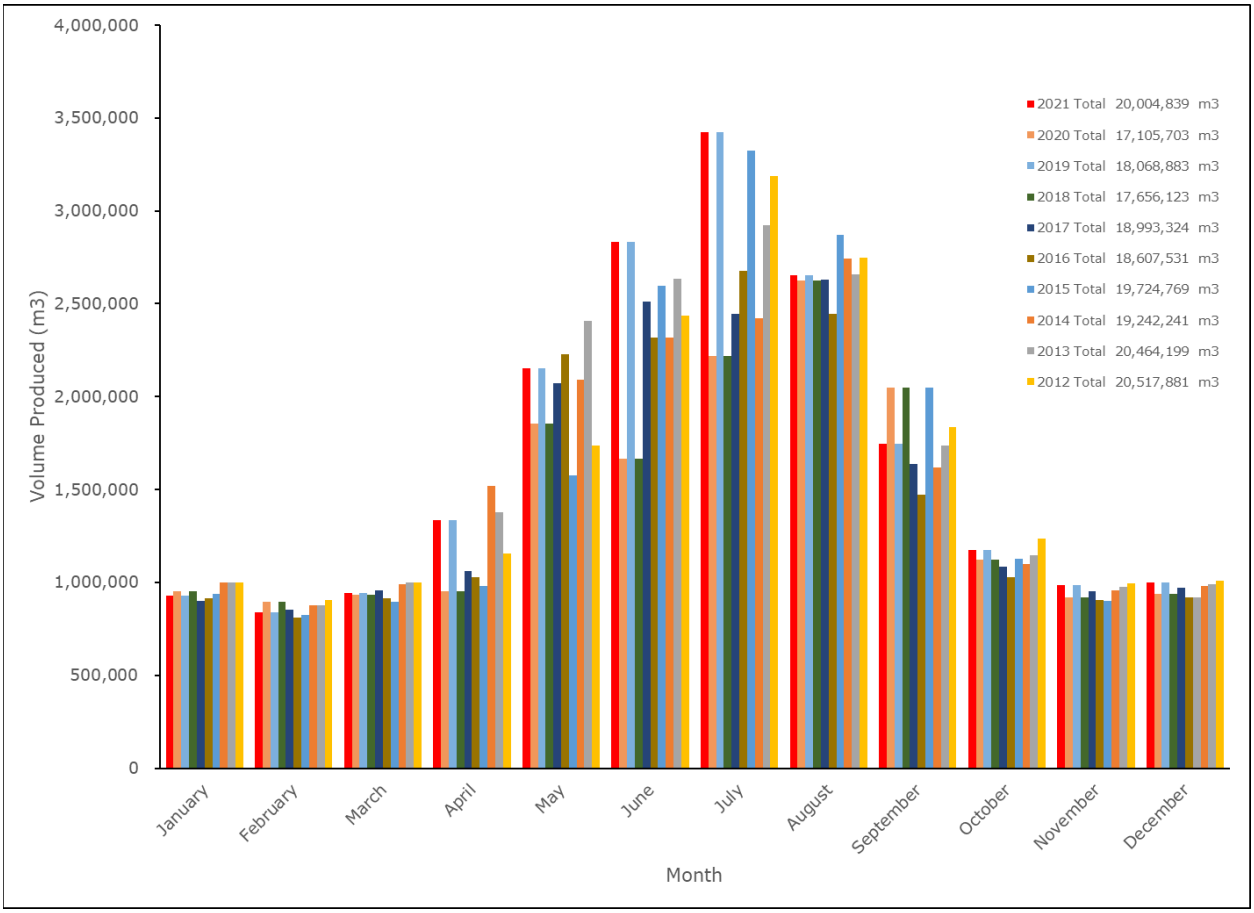
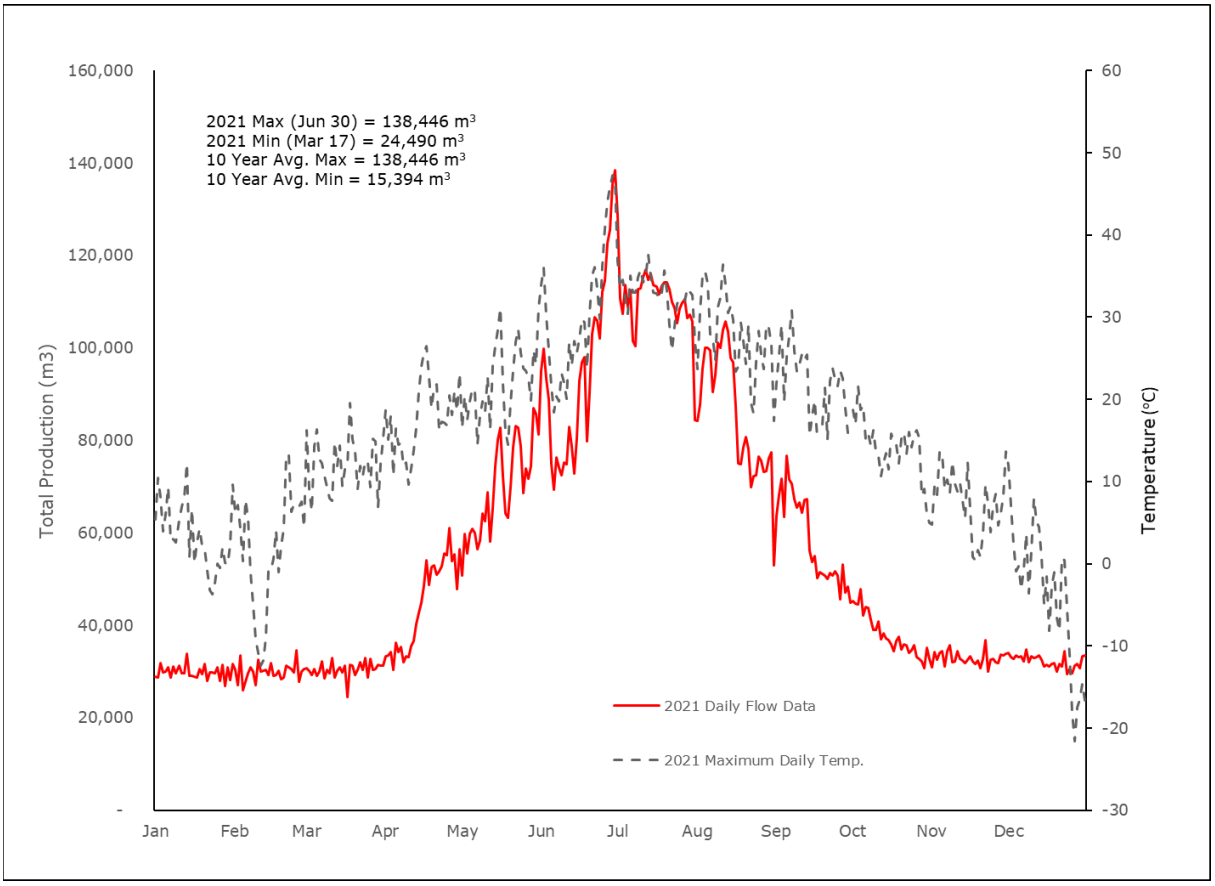


Figure 4 shows the daily water consumption for 2021 with an overlay of the maximum daily temperature. The daily peak for 2021 was 138,446 m^3 on June 30. This large production volume matches directly with the elevated temperatures seen during the same period. The highest single-day production at KCWQ happened on August 28, 2006, when the KCWQ treated 149,140 m^3.

Figure 4: KCWQ Daily Water Flows for 2020 With Daily Average Temperature Overlay



2.2 Water Conservation

The total usage in 2021 was typical when compared to the 10-year average. Irrigation demands continue to be the largest factor in water demand, so methods to address this challenge are be considered as the next phase of water conservation.

2.3 Distribution System Overview

The distribution system is the most complex water distribution systems in Canada due to the area's unique topography. The distribution system consists of over 632.6 km of water mains, 45 booster stations, 45 reservoirs, 2,391 fire hydrants, and a total of 25,358 connections. The City also maintains a trucked-in water system, which supplies potable water to the Tournament Capital Ranch (TCR), a sports recreation area.

The material of the water mains in the distribution system is quite varied (Figure 5). The maintenance of this distribution system consists of actively replacing lines that

have reached the end of their functional life, need upgrading due to inadequate sizing for development, or are in poor condition and cause issues.

Figure 5: Water Main Material Summary

Material	Length (km)	% of Total Pipe	% Change from Last Year
AC - Asbestos Cement	175.416	27.73%	-0.58%
CI - Cast Iron	36.294	5.74%	-0.02%
CU - Copper	0.854	0.13%	0.00%
DI - Ductile Iron	102.46	16.20%	-0.75%
GI - Galvanized Iron	0.276	0.04%	0.00%
HYP - High Pressure Concrete	17.323	2.74%	0.01%
PLY - Polyethylene	2.143	0.34%	7.23%
PVC - Polyvinyl Chloride	287.15	45.39%	0.64%
STL - Steel	10.726	1.70%	0.00%
Total	***632.6***		

The City of Kamloops uses asset management practices to identify and strategically plan the replacement of water infrastructure. Water mains are replaced based on their life expectancy, condition and risk. Typically, new mains are constructed of PVC. Any increases in water main material besides PVC (Figure 5) are due to updates in the GIS system on previously unidentified or improperly identified mains; these increases may not reflect the addition of newly installed lines of that type.

In 2021, the City continued work to improve asset management for the water system. Staff are working to identify future needs based on criticality, life expectancy, condition, and capacity.

2.4 Cross-Connection Program

The City is developing an enhanced Cross-Connection Control Program, in compliance with Interior Health's permit to operate a water system (*Drinking Water Protection Act*). The purpose of this program is to protect public health by ensuring that the safe, clean drinking water the City provides is not contaminated due to backflow. At present, the City is working on revisions for a newly created, stand-alone Cross-Connection Control Bylaw developing a bylaw and accompanying program to protect our drinking water.

The Cross-Connection Control Program will use the premise isolation method and will address cross-connection threats by establishing policies and procedures as well as backflow preventer selection, installation, testing, and maintenance practices and procedures. The program will track all premise isolation backflow preventers directly connected to the City's water distribution system to ensure that they remain in proper working order. The program currently monitors an inventory of roughly 1,300 testable devices (premise isolation and internal protection) and maintains a list of certified backflow preventer testers to help ensure qualified persons are testing the backflow preventers.

The City will maintain and assess its program in an ongoing manner, and in conjunction with Interior Health periodically to review its effectiveness to ensuring that clean safe water is delivered to the people of the City.

2.5 EOCP Certified Operators

The City has a full complement of staff to assure the safe treatment and distribution of potable water throughout the City of Kamloops. Staffing levels for EOCP-certified water treatment and distribution operators are shown in Figure 6.

Figure 6: Operator Certification Levels

Certification	Level	Number of Certified Operators
Water Treatment	I	0
	II	0
	III	4
	IV	2
Water Distribution	I	13
	II	18
	III	2
	IV	3
Total		***42***

3.0 2021 WATER SYSTEM HIGHLIGHTS, FUTURE PROJECTS, AND SERVICE REQUEST SUMMARIES

The following sections will highlight some of the major projects and challenges that arose throughout the 2021 operating year as well as summarize the requests for service received for the water distribution system.

3.1 2021 KCWQ Summary

The following is a list of some of the projects started at KCWQ in 2021:

- Planning upgrades for river intake tide gates. Works to be completed in 2022.
- Plant-wide ethernet communications project. Works to be completed in 2022.

One of the greatest challenges faced at KCWQ continued to be adapting to the COVID-19 pandemic. The City took extreme measures to protect its operators and limit access to one of the City's most critical buildings. Access to the facility was restricted to essential workers only as a means of protecting staff and the water supply.

3.2 2021 Distribution System Summary

3.2.1 *Booster Stations and Reservoirs*

- Valleyview East Reservoir - online now and providing increased water storage for the Valleyview area.
- Completed cleaning of SW #2 Reservoir

3.2.2 *Distribution System*

- Distribution pipe from Summit to Columbia along Notre Dame Drive improved equalization between 1935 East and West reservoirs.

3.2.3 *Requests for Service*

In 2021, there were a total of 3,167 requests for service filed with the Civic Operations Department related to water distribution and treatment. Figure 7 is a breakdown of the categories to which each of the requests is related.

Figure 7: Service Requests in Water Treatment and Distribution

Request Categories Related to Utilities/ Water	Number of Requests	
	2020	2021
Booster Stations	8	5
Cross Connection Control	17	56
Frozen Services	4	11
General	89	74
Hydrants	44	80
Irrigation On/Off	15	17
No Water	63	88
Reservoirs	9	10
Service Boxes	76	84
Service Location	102	91
Turn Service On/Off	533	607
Water Filling Station	20	14
Water Leak	175	205
Water Meters	1469	1686
Water Pressure	65	68
Water Quality	61	53
Water Restrictions	15	18
Totals	***2,765***	***3,167***

In 2021, there were 34 Service leaks and 14 Main Breaks recorded in the City of Kamloops.

4.0 WATER QUALITY SAMPLING AND ANALYSIS

The City's Water Quality Monitoring Program (WQMP) incorporates principles from the Guidelines for Canadian Drinking Water Quality (GCDWQ) and BC's DWPA and *Drinking Water Projection Regulation* (DWPR). The program is designed to monitor weekly, monthly, quarterly, and annual water quality for immediate and long-term water quality trends. The WQMP uses the multi-barrier approach. The City has one primary surface water source—the South Thompson River—for all domestic purposes. A second surface water source—the North Thompson River—is an emergency backup.

The City's treatment, distribution, and storage system water quality monitoring program is performed by EOCP-certified staff who take samples at designated sites.

4.1 Quality Assurance and Quality Control Program

The City's Utility Services Division staff are committed to ensuring accurate information is gathered from the WQMP. As directed in the DWPA and DWPR, a water supplier is required to have its bacteriological analysis completed by a certified laboratory that is approved by the Provincial Health Officer. The City utilizes a certified third-party laboratory to analyze weekly bacteriological samples and the more comprehensive annual full spectrum analysis.

Staff taking samples are trained on the proper sampling methods to ensure accuracy of our results and to protect the quality of our water. Field instruments for chlorine residual, turbidity, and pH are scheduled for monthly cleaning and calibration.

The WQMP program also includes quality control inspections and calibrations of sampling and analyzing equipment. Online chlorine analyzers are checked nightly at the KCWQ and weekly within the distribution system.

All samples are collected and shipped in accordance with the 2005 21st Edition Standard Methods for the Examination of Water and Wastewater. A sample confirmation or requisition and chain of custody form accompany all samples sent to the certified lab. City staff have developed procedures for sampling and shipping.

4.2 KCWQ Water Quality Testing

A variety of water quality parameters are measured at the KCWQ to monitor the treatment process. Figures 8, 9, and 10 summarize the results of the nightly analysis for the KCWQ. These analyses are performed in-house by the certified operators at the KCWQ.

4.2.1 *True and Apparent Colour*

Colour in water can be imparted in two ways: through dissolved material or suspended material. The suspended material could be clays, silts, algae, or any other material that can be remain undissolved in water. The dissolved materials are typically organics such as tannins that are leached from plants, trees, or roots and

impart a yellowish/brown colour. They may also be from dissolved metals like iron. Suspended material in water is much easier to treat through filtration, while dissolved material may be more difficult to treat. Apparent colour is a measure of all colour in water, including suspended material, and true colour measures only the dissolved colour. Colour is not a health issue, but it is unwanted as aesthetically it does not make for appealing drinking water.

4.2.2 *pH*

pH is a measure of the activity of the hydrogen ion in water. It represents the acidity or basicity of water. The pH scale goes from 0 to 14, with anything smaller than 7 being acidic, anything greater than 7 being basic, and 7 being neutral. Drinking water is regulated to fall between a pH of 6.5 and 8.5 under the GCDWQ. The KCWQ targets to be slightly on the higher side of that range to protect distribution pipes against corrosion.

4.2.3 *Hardness*

Hardness is primarily made up of dissolved calcium and magnesium in water. These compounds are not harmful to health; people require them in their diet. However, high levels of calcium and magnesium may cause "soap scum" when reacting with soaps. This "soap-scum" will require more soap or detergent when cleaning and can clog pipes and hot water tanks. Hardness is broken down into the following general categories: 0 to 60 mg/L as CaCO3 is considered soft, 61 to 120 mg/L is considered moderate, 121 to 180 mg/L is considered hard, and anything over 180 mg/L is considered very hard.

4.2.4 *Alkalinity*

Alkalinity is a measure of the buffering capacity of water. Alkalinity will keep the pH stable if something acidic or basic is introduced to the water. The higher the alkalinity, the more stable your pH will remain. In general, this parameter has no health implications and is strictly used as a guideline in treatment processes.

4.2.5 *Conductivity and Total Dissolved Solids (TDS)*

Conductivity and total dissolved solids (TDS) are linked as the probe that measures conductivity in water will provide an estimate of the TDS. Conductivity is a measure of how well a water sample conducts electricity. As water is an insulator, its ability to conduct electricity is directly related to the concentration of dissolved solids within the water. In water treatment, this measurement is used to monitor any changes in water quality.

4.2.6 *Total Suspended Solids*

Total suspended solids (TSS) is a measure of all the colloidal material in water. TSS in the source water gives an indication of the amount of solids that will be removed in the treatment process. The higher the TSS, the "dirtier" the water is. There is no guideline limit on TSS under the GCDWQ.

4.2.7 *Turbidity*

Turbidity is a measure of the clarity of the water. It is also directly related to the colloidal material in the water. Turbidity is measured by passing a beam of light through the sample and measuring the amount of water that is refracted at a 90° angle. The units applied are called nephelometric turbidity units (NTU). The GCDWQ state that drinking water should have a turbidity of less than 1 NTU. The KCWQ membrane water treatment plant should not have a turbidity of greater than 0.1 NTU leaving the plant.

4.2.8 *Aluminum*

An aluminum-based coagulant is used in the treatment process. Aluminum is monitored in source and treated water to ensure that coagulant is not being overdosed and is not entering our drinking water at elevated levels. The GCDWQ sets the operational guideline for water treatment plants at 0.1 mg/L.

4.2.9 *Free and Total Chlorine (Cl_2)*

Chlorine levels are important in water treatment to ensure that water is safe throughout the distribution system. The primary form of chlorine used in our treatment system is sodium hypochlorite. Free chlorine measures the amount of hypochlorite in our water, while total chlorine measures the free chlorine plus any combined chlorine disinfectants such as chloramines. KCWQ targets a residual free chlorine level of > 0.2 mg/L at the end of the distribution system. There is no guideline limit on free and total chlorine under the GCDWQ.

Figure 8: KCWQ Average Monthly Raw Water Analysis

Month	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	TSS (mg/L)	Turbidity (NTU)	Aluminium (mg/L)	Temperarture (°C)
January	3	14	7.78	43	42	43.3	82.5	2.7	2.0	ND	4.4
February	3	12	7.78	44	43	43.0	81.7	2.3	2.2	ND	3.1
March	3	15	7.80	46	44	45.5	86.3	3.3	2.5	ND	5.9
April	4	18	7.89	48	46	47.6	90.3	3.6	2.8	0.011	9.5
May	5	21	7.85	44	43	44.0	82.7	3.3	3.0	0.008	12.1
June	4	19	7.74	39	38	40.1	76.2	6.7	3.2	0.024	16.0
July	4	17	7.89	38	36	39.5	75.2	6.2	4.0	0.015	19.9
August	4	14	7.93	38	37	40.3	76.6	4.5	2.3	0.016	20.8
September	2	12	7.90	38	37	41.1	78.2	2.3	1.4	0.019	18.5
October	3	13	7.80	39	37	40.0	76.0	1.8	1.6	0.014	13.4
November	3	14	7.77	40	38	38.7	73.7	2.2	1.6	0.014	9.1
December	3	13	7.70	40	38	38.3	72.9	3.7	1.9	0.016	5.1
Minimum	***ND***	***ND***	***7.61***	***34***	***34***	***36.9***	***50.9***	***0.2***	***0.3***	***ND***	***2.1***
Maximum	***11***	***64***	***8.06***	***49***	***48***	***53.7***	***101.8***	***26.9***	***10.6***	***0.050***	***22.1***
Average	***4***	***15***	***7.82***	***41***	***40***	***41.8***	***79.3***	***3.6***	***2.4***	***0.017***	***11.5***

*ND refers to Non-Detectable Limit

Figure 9: KCWQ Average Monthly Treated Water Analysis

Month	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Aluminium (mg/L)	Temperarture (°C)	Free Chlorine (mg/L)	Total Chlorine (mg/L)
January	0	0	7.91	43	42	52.3	99.1	0.016	ND	4.9	1.35	1.45
February	0	0	7.86	44	43	53.1	100.6	0.017	ND	3.6	1.35	1.49
March	0	0	7.91	46	44	55.8	105.6	0.020	ND	6.1	1.35	1.43
April	0	0	7.98	48	45	56.3	106.5	0.023	0.007	9.6	1.41	1.50
May	0	0	7.97	43	43	50.4	95.6	0.021	0.018	12.1	1.37	1.49
June	0	0	7.87	39	39	46.3	88.0	0.015	0.021	16.1	1.39	1.49
July	0	0	8.05	38	38	46.2	87.7	0.014	0.018	19.9	1.36	1.45
August	0	0	8.04	37	38	45.6	86.6	0.015	0.018	21.0	1.35	1.50
September	0	0	8.03	38	38	46.3	87.8	0.014	0.019	18.5	1.38	1.49
October	0	0	7.92	39	39	47.7	90.6	0.015	0.015	13.9	1.34	1.44
November	0	0	7.88	39	39	47.2	89.5	0.015	0.011	10.8	1.40	1.45
December	0	0	7.80	39	39	45.1	85.5	0.015	0.012	6.6	1.39	1.46
Minimum	***ND***	***ND***	***7.62***	***35***	***35***	***43.3***	***82.2***	***0.010***	***ND***	***2.3***	***1.19***	***1.28***
Maximum	***2***	***2***	***8.45***	***49***	***48***	***58.0***	***109.7***	***0.033***	***0.052***	***22.5***	***1.69***	***1.91***
Average	***1***	***1***	***7.94***	***41***	***40***	***49.3***	***93.5***	***0.017***	***0.016***	***12.0***	***1.37***	***1.47***
Guidelines for Canadian Drinking Water Quality Objectives	Aesthetic Objective: ≤ 15 mg/L	Aesthetic Objective: ≤ 15 mg/L	6.5 - 8.5	No guideline for drinking water	No guideline for drinking water	Aesthetic Objective : ≤500 mg/L	No guideline for drinking water	Operational Guideline: <0.1 NTU	Operational guidleine: < 0.1 mg/L	Aesthetic Objective: ≤ 15 °C	No guideline for drinking water	No guideline for drinking water

*ND refers to Non-Detectable Limit

Figure 10: KCWQ Average Monthly Distribution Water Analysis

Distribution System Water Analysis												
	Reservoir	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Field Temp (°C)	Free Cl_2 (mg/L)	Total Cl_2 (mg/L)
January	Booster #4 SW	ND	ND	8.03	43	42	55.6	105.2	0.118	5.6	0.95	1.05
	Knutsford	ND	ND	7.95	44	42	54.7	103.6	0.132	7.0	0.95	1.05
	Cinnamon Ridge	ND	ND	7.84	43	42	53.5	101.4	0.231	8.2	0.20	0.27
	Juniper #3	ND	ND	7.84	44	42	52.9	100.2	0.179	9.1	0.83	0.91
	418 Booster	ND	ND	7.98	44	42	54.6	103.3	0.216	5.1	1.06	1.16
	Noble Creek	ND	ND	8.32	44	42	54.2	102.7	0.101	9.9	1.00	1.10
	Memorial	ND	ND	7.88	44	43	52.8	100.1	0.104	3.8	1.16	1.25
February	Booster #4 SW	ND	ND	7.93	44	43	55.2	104.4	0.136	3.3	1.00	1.08
	Knutsford	ND	ND	7.92	45	43	55.8	105.7	0.175	6.3	0.87	1.03
	Cinnamon Ridge	ND	ND	7.80	45	43	55.2	104.6	0.261	5.1	0.32	0.40
	Juniper #3	ND	ND	7.92	44	43	54.3	102.9	0.089	7.6	0.88	0.98
	418 Booster	ND	ND	7.97	44	43	55.3	104.8	0.112	3.8	1.15	1.25
	Noble Creek	ND	ND	8.19	45	43	57.6	109.0	0.115	9.5	0.87	0.96
	Memorial	ND	ND	7.85	45	43	54.6	103.4	0.207	2.1	1.24	1.34
March	Booster #4 SW	ND	ND	7.94	46	45	56.8	107.6	0.142	7.2	0.87	0.96
	Knutsford	ND	ND	7.94	46	44	56.7	107.3	0.293	6.4	1.02	1.12
	Cinnamon Ridge	ND	ND	7.77	45	44	55.3	104.6	0.122	5.2	0.38	0.46
	Juniper #3	ND	ND	7.87	46	44	56.3	106.5	0.186	8.5	0.77	0.85
	418 Booster	ND	ND	7.89	46	44	57.5	108.8	0.188	5.1	0.98	1.06
	Noble Creek	ND	ND	8.10	46	45	58.3	110.2	0.103	8.5	0.87	0.96
	Memorial	ND	ND	8.07	46	45	56.7	107.3	0.294	6.0	1.07	1.20
April	Booster #4 SW	1.5	2.5	7.95	48	46	57.2	108.3	0.428	9.9	0.79	0.88
	Knutsford	1	4	7.96	48	47	57.3	108.5	0.268	7.9	0.86	0.94
	Cinnamon Ridge	ND	ND	7.91	48	45	55.7	105.4	0.121	7.6	0.57	0.68
	Juniper #3	ND	ND	7.93	48	46	56.8	107.4	0.307	10.5	0.81	0.92
	418 Booster	ND	ND	7.94	48	46	58.2	110.1	0.099	7.8	1.01	1.12
	Noble Creek	ND	ND	8.02	48	46	58.7	111.1	0.190	10.3	0.79	0.85
	Memorial	ND	3	8.02	47	47	56.7	107.2	0.212	5.8	1.04	1.14
May	Booster #4 SW	0	0	7.99	43	42	50.6	96.0	0.122	11.8	0.97	1.06
	Knutsford	0	0	7.92	45	45	54.5	103.1	0.223	9.5	0.68	0.76
	Cinnamon Ridge	ND	ND	7.86	45	43	52.1	98.8	0.174	10.2	0.47	0.55
	Juniper #3	ND	ND	7.85	44	42	51.2	97.0	0.132	12.9	0.84	0.92
	418 Booster	ND	ND	7.91	45	43	52.2	98.8	0.196	11.7	1.13	1.21
	Noble Creek	ND	ND	8.02	46	44	55.0	104.0	0.121	12.8	0.77	0.86
	Memorial	ND	ND	7.86	43	43	51.6	97.7	0.224	12.0	1.10	1.22
June	Booster #4 SW	ND	ND	7.83	40	39	46.0	87.0	0.218	15.5	0.98	1.07
	Knutsford	ND	ND	7.82	40	39	46.9	89.0	0.202	12.0	0.97	1.07
	Cinnamon Ridge	ND	ND	7.79	39	38	47.1	89.3	0.123	13.7	0.47	0.56
	Juniper #3	0	0	7.88	38	38	45.2	85.7	0.145	15.0	0.86	0.95
	418 Booster	0	0	7.83	38	39	46.1	89.5	0.128	14.8	1.24	1.34
	Noble Creek	0	0	7.88	40	39	47.5	90.0	0.127	16.3	0.92	0.98
	Memorial	ND	ND	7.84	39	39	45.6	86.5	0.164	15.4	1.07	1.18
July	Booster #4 SW	0	0	7.93	37	37	46.0	87.3	0.165	19.4	0.98	1.09
	Knutsford	ND	ND	8.01	38	37	45.2	85.8	0.228	15.1	0.88	0.96
	Cinnamon Ridge	ND	ND	7.80	38	37	44.6	84.6	0.091	18.4	0.22	0.30
	Juniper #3	2	2	7.89	38	38	45.8	87.0	0.106	19.1	1.05	1.14
	418 Booster	ND	1	8.00	38	38	45.7	86.8	0.115	18.6	1.26	1.35
	Noble Creek	ND	ND	8.01	38	37	47.2	89.4	0.096	20.3	0.78	0.87
	Memorial	ND	ND	7.97	38	38	44.7	84.8	0.196	19.4	1.06	1.17
August	Booster #4 SW	ND	ND	7.94	38	37	44.3	84.2	0.120	21.1	0.84	0.93
	Knutsford	ND	ND	8.03	39	38	44.7	84.8	0.096	17.0	0.80	0.90
	Cinnamon Ridge	3	3	7.80	37	37	45.3	86.0	0.234	18.3	0.24	0.29
	Juniper #3	ND	ND	7.93	38	37	44.8	85.2	0.097	20.6	0.82	0.91
	418 Booster	ND	ND	7.93	38	38	44.9	85.6	0.118	19.8	1.06	1.15
	Noble Creek	ND	ND	8.07	38	38	45.9	87.1	0.094	21.2	0.54	0.62
	Memorial	ND	2	7.99	38	37	43.8	83.2	0.116	20.4	0.98	1.08
September	Booster #4 SW	ND	ND	8.01	38	38	44.9	85.2	0.145	18.5	0.86	0.94
	Knutsford	0	1	8.08	39	38	45.7	86.7	0.172	16.1	0.60	0.69
	Cinnamon Ridge	0	0	7.81	38	37	43.3	82.2	0.111	17.1	0.26	0.33
	Juniper #3	0	0	7.93	39	38	45.6	86.5	0.197	18.1	0.66	0.75
	418 Booster	0	0	7.99	39	39	44.9	85.3	0.109	18.0	1.15	1.25
	Noble Creek	0	0	8.13	40	39	46.4	88.1	0.085	19.0	0.71	0.84
	Memorial	0	0	7.89	38	38	44.7	84.8	0.185	18.2	1.02	1.10
October	Booster #4 SW	ND	ND	7.94	40	38	46.0	87.4	0.257	14.9	0.88	0.98
	Knutsford	ND	ND	8.03	40	38	47.8	90.7	0.107	14.7	0.43	0.52
	Cinnamon Ridge	2	2	7.83	40	38	48.6	92.1	0.126	15.5	0.16	0.23
	Juniper #3	ND	ND	7.89	40	39	47.8	90.7	0.095	14.3	0.76	0.84
	418 Booster	ND	ND	7.91	40	40	48.2	91.4	0.113	14.4	1.23	1.32
	Noble Creek	ND	3	8.24	40	38	50.5	95.6	0.168	19.8	0.60	0.70
	Memorial	ND	ND	7.88	40	39	46.8	88.7	0.187	13.8	1.01	1.12
November	Booster #4 SW	ND	ND	7.87	40	39	47.5	90.0	0.161	10.3	1.04	1.13
	Knutsford	ND	ND	7.96	39	38	48.7	92.3	0.181	13.3	0.66	0.72
	Cinnamon Ridge	ND	ND	7.77	40	38	47.1	89.5	0.097	12.6	0.16	0.25
	Juniper #3	0	0	7.85	40	39	47.8	90.7	0.107	13.6	0.82	0.90
	418 Booster	ND	ND	7.89	40	39	48.4	91.8	0.089	11.3	1.03	1.12
	Noble Creek	ND	ND	8.15	41	40	48.6	96.7	0.109	16.2	0.74	0.85
	Memorial	ND	ND	7.84	40	38	47.6	90.4	0.227	10.1	1.10	1.19
December	Booster #4 SW	0	0	7.78	40	39	46.0	87.3	0.073	8.0	1.04	1.11
	Knutsford	ND	ND	7.99	40	38	55.5	91.0	0.114	10.6	0.50	0.58
	Cinnamon Ridge	ND	ND	7.74	40	39	47.4	89.8	0.078	11.4	0.38	0.50
	Juniper #3	0	0	7.75	40	39	46.8	88.8	0.089	9.4	0.75	0.82
	418 Booster	0	0	7.79	39	39	47.5	90.1	0.120	7.3	1.15	1.24
	Noble Creek	0	0	8.04	40	39	49.2	93.2	0.098	12.6	1.09	1.18
	Memorial	0	0	7.75	40	38	45.3	85.9	0.170	5.6	1.19	1.27
Minimum		***ND***	***ND***	***7.64***	***31***	***35***	***40.8***	***77.5***	***0.010***	***1.3***	***0.02***	***0.05***
Maximum		***3***	***4***	***8.55***	***50***	***52***	***78.5***	***116.5***	***0.943***	***24.4***	***1.53***	***1.60***
Average		***0***	***1***	***7.93***	***42***	***40***	***50.1***	***94.9***	***0.155***	***12.3***	***0.84***	***0.93***

*ND refers to Non-Detectable Limit

4.3 Distribution Sampling

The City is committed to providing safe drinking water to its customers. The distribution system is sampled at a minimum of 23 different locations weekly. These samples are analyzed for background bacterial counts, total coliforms and *E. coli*.

4.3.1 *Background Bacterial Monitoring*

Background bacteria monitoring is done through a heterotrophic plate count (HPC). Heterotrophic bacteria are a group of bacteria that use carbon as a food source and can be found in a variety of water sources. Most bacteria found in water are heterotrophic. In general, these bacteria are not pathogenic and the HPC test will not tell you whether the water is safe to drink. Because of this, there is no maximum acceptable concentration (MAC), as stated in the GCDWQ. This test tells us if there are conditions within the system that bacteria can regrow or thrive in.

Background bacteria are monitored to show the overall "health" of the distribution system. If a sample is positive for background bacteria greater than 200 counts, the system is flushed and resampled. Any positive counts of any size for background bacteria are also resampled, which is above and beyond any legislative requirements.

4.3.2 *Coliform Bacterial Monitoring*

Coliform bacteria are a group of bacteria that provide a more of a narrow focus compared to the background bacteria test. These bacteria represent a large group of bacteria found in water, in soil, on vegetation, and in the feces of mammals. Most of these bacteria are not harmful to humans, the ease of testing of these bacteria makes for a good indicator of contamination.

In water treatment systems, there is a zero-threshold allowance for coliforms within water samples. If a sample shows up positive for coliforms, the site is immediately resampled. If coliforms are found again, a boil water advisory is put in place. The distribution area is then pulled offline and cleaned before being put back into action and resampled.

4.3.3 *E. Coli Bacterial Monitoring*

E. coli bacteria are a subsection of coliform bacteria. While generally not harmful to human health, specific strains can cause serious health issues and even death in some instances. These bacteria are also found almost exclusively in the feces of mammals; therefore, they are a definite sign of contamination. Any positive counts for *E. coli* result in an immediate resampling and may result in cleaning of the affected area and boil water advisories. The results for the 2020 distribution system are shown in Figure 11.

Figure 11: 2021 Distribution System Biological Sampling

Week	Number of Samples Taken	Samples Positive for Background Bacteria	Samples Positive for Coliforms	Samples Positive for *E. Coli*	Notes/ Measures Taken
January 04	23	<1	<1	<1	
January 11	23	<1	<1	<1	
January 18	23	<1	<1	<1	
January 25	23	<1	<1	<1	
February 01	23	1	<1	<1	Background Count of 1
February 08	23	3	<1	<1	Background Count of 3
February 15	23	1	<1	<1	Background Count of 1
February 22	23	1	<1	<1	Background Count of 1
March 01	23	<1	<1	<1	
March 08	23	9	<1	<1	Background Count of 9
March 15	23	1	<1	<1	Background Count of 1
March 22	23	<1	<1	<1	
March 29	23	<1	<1	<1	
April 05	23	14	<1	<1	Backgroun Count of 14
April 12	24	<1	<1	<1	Tournament Capital Ranch now included in weekly samples
April 19	24	<1	<1	<1	
April 26	24	1	<1	<1	Background Count of 1
May 03	24	<1	<1	<1	
May 10	24	<1	<1	<1	
May 17	25	<1	<1	<1	Rose Hill sample included as requested by Interior Health
May 24	24	<1	<1	<1	
May 31	24	1	<1	<1	Background Count of 1
June 07	24	1	<1	<1	Background Count of 1
June 14	24	<1	<1	<1	
June 21	24	<1	<1	<1	
June 28	24	<1	<1	<1	
July 05	24	<1	<1	<1	
July 12	24	<1	<1	<1	
July 19	24	<1	<1	<1	
July 26	24	<1	<1	<1	
August 02	24	2	<1	<1	Background Count of 2
August 09	24	<1	<1	<1	
August 16	24	<1	<1	<1	
August 23	24	<1	1	<1	Total Coliform Count of 1 at Orchard Booster
August 30	24	<1	<1	<1	
September 06	24	<1	<1	<1	
September 13	25	<1	<1	<1	Mission Flats Scale included in sample set
September 20	24	1	<1	<1	Background Count of 1
September 27	25	1	<1	<1	Background Count of 1
October 04	24	1	<1	<1	Background Count of 1
October 11	24	<1	<1	<1	
October 18	24	<1	<1	<1	
October 25	24	1	<1	<1	Background Count of 1
November 01	23	<1	<1	<1	Tournament Captial Ranch finished for season
November 08	23	<1	<1	<1	
November 15	23	19	<1	<1	Background Count of 19
November 22	23	<1	<1	<1	
November 29	23	4	<1	<1	Background Count of 4
December 06	23	<1	<1	<1	
December 13	23	1	<1	<1	Background Count of 1
December 20	23	<1	<1	<1	
December 27	23	<1	<1	<1	
Totals	***1228***	***63***	***1***	***0***	

There was a total of 63 positive results for background bacteria and one positive result for total coliforms. After resampling, all results came back negative.

4.4 Yearly Raw and Distribution Sampling

The following extensive water quality analysis results were completed by a provincially accredited lab from the source water and within the distribution system on two dates (May 20 and December 20) in 2021. The sampling events were completed in compliance with the KCWQ operational certificate. The samples were taken by City staff and sent to CARO Analytical Services (CARO) in Kelowna, BC. The results of these analyses can be seen in Figures 12 through 20. As seen in the Figures, all treated water quality parameters are within the GCDWQ.

Figure 12: CARO Anions Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Campbell Creek Booster	
				20-May-21	20-Dec-21	20-May-21	20-Dec-21
Bromide	mg/L	0.1	N/A	<0.10	<0.10	<0.10	<0.10
Chloride	mg/L	0.1	AO<=250	0.63	0.48	5.11	4.12
Fluoride	mg/L	0.1	MAC=1.5	<0.10	<0.10	<0.10	<0.10
Nitrate (as N)	mg/L	0.01	MAC=10	0.044	0.034	0.053	0.037
Nitrite (as N)	mg/L	0.01	MAC=1	<0.010	<0.010	<0.010	<0.010
Phosphate (as P)	mg/L	0.005	N/A	<0.0050	<0.0050	<0.0050	<0.0050
Sulfate	mg/L	1	AO<=500	6	5.4	6.1	5.4
MAC = Maximum Acceptable Concentration AO = Aesthetic objective							

Figure 13: CARO General Parameters Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Campbell Creek Booster	
				20-May-21	20-Dec-21	20-May-21	20-Dec-21
Hardness, Total (as CaCO3)	mg/L	0.5	None Required	45	38.2	44.2	36.2
Nitrate+Nitrite (as N)	mg/L	0.02	N/A	0.0438	0.0345	0.0532	0.0367
Colour, True	CU	5	AO<=15	5.2	5.8	<5.0	<5.0
Alkalinity, Total (as CaCO3)	mg/L	1	N/A	43.5	37	44.3	38.1
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	1	N/A	43.5	37	44.3	38.1
Alkalinity, Carbonate (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.05	None Required	<0.050	<0.050	<0.050	<0.050
BOD, 5-day	mg/L	4.1	N/A	9	<4.1	4	10.5
Carbon, Total Organic	mg/L	0.5	N/A	1.92	1.59	1.53	1.66
Carbon, Dissolved Organic	mg/L	0.5	N/A				1.54
Cyanide, Total	mg/L	0.002	MAC=0.2			<0.0020	<0.0020
Nitrogen, Total Kjeldahl	mg/L	0.05	N/A	0.213	<0.100	0.156	<0.050
Oil & Grease, Total	mg/L	2	N/A			<2.0	<2.0
Solids, Total Dissolved	mg/L	15	AO<=500	29	50	50	53
Sulfide, Total	mg/L	0.02	AO<=0.05			<0.020	<0.020
Turbidity	NTU	0.1	OG<1	1.3	1.36	<0.10	<0.10
Conductivity (EC)	uS/cm	2	N/A	91.8	84.3	108	98.5
MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value							

Figure 14: CARO Total Recoverable Metals Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Campbell Creek Booster	
				20-May-21	20-Dec-21	20-May-21	20-Dec-21
Aluminum, total	mg/L	0.005	OG<0.1	0.059	0.0758	0.0107	0.0075
Antimony, total	mg/L	0.0002	MAC=0.006	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, total	mg/L	0.0005	MAC=0.01	<0.00050	<0.00050	<0.00050	<0.00050
Barium, total	mg/L	0.005	MAC=2	0.0118	0.0103	0.0109	0.0093
Beryllium, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Boron, total	mg/L	0.05	MAC=5	<0.0500	<0.0500	<0.0500	<0.0500
Cadmium, total	mg/L	0.00001	MAC=0.005	<0.000010	<0.000010	<0.000010	<0.000010
Calcium, total	mg/L	0.2	None Required	13.5	11.8	13.4	11.2
Chromium, total	mg/L	0.0005	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Copper, total	mg/L	0.0004	MAC=2	0.00451	0.0042	0.00201	0.00307
Iron, total	mg/L	0.01	AO<=0.3	0.08	0.114	<0.010	<0.010
Lead, total	mg/L	0.0002	MAC=0.005	<0.00020	<0.00020	<0.00020	<0.00020
Lithium, total	mg/L	0.0001	N/A	0.00073	0.00072	0.00065	0.0007
Magnesium, total	mg/L	0.01	None Required	2.7	2.13	2.59	2
Manganese, total	mg/L	0.0002	MAC=0.12	0.00371	0.00516	0.00088	0.0009
Mercury, total	mg/L	0.00001	MAC=0.001	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum, total	mg/L	0.0001	N/A	0.00088	0.00067	0.00062	0.00056
Nickel, total	mg/L	0.0004	N/A	0.00045	0.00075	0.00059	0.00056
Phosphorus, total	mg/L	0.05	N/A	<0.050	0.073	<0.050	<0.050
Potassium, total	mg/L	0.1	N/A	1.07	0.83	0.99	0.8
Selenium, total	mg/L	0.0005	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, total	mg/L	1	N/A	4	3.4	3.4	3.1
Silver, total	mg/L	0.00005	None Required	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, total	mg/L	0.1	AO<=200	1.98	1.63	5.35	4.31
Strontium, total	mg/L	0.001	7	0.0877	0.0723	0.0865	0.0701
Sulfur, total	mg/L	3	N/A	<3.0	<3.0	<3.0	<3.0
Tellurium, total	mg/L	0.0005	N/A	<0.00050	<0.00050	<0.00050	<0.00050
Thallium, total	mg/L	0.00002	N/A	<0.000020	<0.000020	<0.000020	<0.000020
Thorium, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Tin, total	mg/L	0.0002	N/A	<0.00020	<0.00020	<0.00020	<0.00020
Titanium, total	mg/L	0.005	N/A	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten, total	mg/L	0.001	N/A	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, total	mg/L	0.00002	MAC=0.02	0.000332	0.000314	0.000086	0.000049
Vanadium, total	mg/L	0.001	N/A	<0.0010	<0.0010	<0.0010	<0.0010
Zinc, total	mg/L	0.004	AO<=5	<0.0040	0.0158	0.0049	<0.0040
Zirconium, total	mg/L	0.0001	N/A	<0.00010	0.00013	<0.00010	<0.00010

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

Figure 15: CARO Pesticides, Herbicides, and Fungicides Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Campbell Creek Booster	
				20-May-21	20-Dec-21
Glyphosate	mg/L	0.05	MAC=0.28	<0.050	<0.050
Phenolics, Total	mg/L	0.002	N/A	<0.00200	<0.00200
Alachlor	ug/L	0.1	N/A	<0.100	<0.100
Aldrin	ug/L	0.006	N/A	<0.006	<0.006
Atrazine	ug/L	0.1	N/A	<0.100	<0.100
Azinphos-methyl	ug/L	0.2	MAC=20	<0.200	<0.200
alpha-BHC	ug/L	0.01	N/A	<0.010	<0.010
beta-BHC	ug/L	0.05	N/A	<0.050	<0.050
delta-BHC	ug/L	0.05	N/A	<0.050	<0.050
gamma-BHC (Lindane)	ug/L	0.05	N/A	<0.050	<0.050
Bromacil	ug/L	0.1	N/A	<0.100	<0.100
Captan	ug/L	0.1	N/A	<0.100	<0.100
alpha-Chlordane	ug/L	0.05	N/A	<0.050	<0.050
gamma-Chlordane	ug/L	0.05	N/A	<0.050	<0.050
Chlordane (cis + trans)	ug/L	0.05	N/A	<0.050	<0.050
Chlorothalonil	ug/L	0.05	N/A	<0.050	<0.050
Chlorpyrifos	ug/L	0.01	MAC=90	<0.010	<0.010
Cyanazine	ug/L	0.1	N/A	<0.100	<0.100
p,p-DDD	ug/L	0.01	N/A	<0.010	<0.010
p,p'-DDE	ug/L	0.01	N/A	<0.010	<0.010
p,p'-DDT	ug/L	0.01	N/A	<0.010	<0.010
Diazinon	ug/L	0.02	MAC=20	<0.020	<0.020
Dichlorvos	ug/L	0.1	N/A	<0.100	<0.100
Dieldrin	ug/L	0.01	N/A	<0.010	<0.010
Dimethoate	ug/L	0.2	MAC=20	<0.200	<0.200
Disulfoton	ug/L	0.1	N/A	<0.100	<0.100
Endosulfan I	ug/L	0.01	N/A	<0.010	<0.010
Endosulfan II	ug/L	0.01	N/A	<0.010	<0.010
Endosulfan sulfate	ug/L	0.05	N/A	<0.050	<0.050
Endrin	ug/L	0.02	N/A	<0.020	<0.020
Endrin aldehyde	ug/L	0.02	N/A	<0.020	<0.020
Endrin ketone	ug/L	0.02	N/A	<0.020	<0.020
Fenchlorphos (Ronnel)	ug/L	0.1	N/A	<0.100	<0.100
Heptachlor	ug/L	0.01	N/A	<0.010	<0.010
Heptachlor epoxide	ug/L	0.01	N/A	<0.010	<0.010
Malathion	ug/L	0.1	MAC=190	<0.100	<0.100
Methyl parathion	ug/L	0.1	N/A	<0.100	<0.100
Metolachlor	ug/L	0.1	MAC=50	<0.100	<0.100
Metribuzin	ug/L	0.2	MAC=80	<0.200	<0.200
Parathion	ug/L	0.1	N/A	<0.100	<0.100
Pentachloronitrobenzene	ug/L	0.1	N/A	<0.100	<0.100
cis-Permethrin	ug/L	0.02	N/A	<0.020	<0.010
trans-Permethrin	ug/L	0.01	N/A	<0.010	<0.010
Phorate	ug/L	0.1	MAC=2	<0.100	<0.100
Simazine	ug/L	0.2	MAC=10	<0.200	<0.200
Sulfotep	ug/L	0.1	N/A	<0.100	<0.100
Terbufos	ug/L	0.1	MAC=1	<0.100	<0.100
Triallate	ug/L	0.1	N/A	<0.100	<0.100
Trifluralin	ug/L	0.2	MAC=45	<0.200	<0.200

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

Figure 16: CARO Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Campbell Creek Booster	
				20-May-21	20-Dec-21
Acenaphthene	ug/L	0.05	N/A	<0.050	<0.050
Acenaphthylene	ug/L	0.2	N/A	<0.200	<0.200
Acridine	ug/L	0.05	N/A	<0.050	<0.050
Anthracene	ug/L	0.01	N/A	<0.010	<0.010
Benz(a)anthracene	ug/L	0.01	N/A	<0.010	<0.010
Benzo(a)pyrene	ug/L	0.01	MAC=0.04	<0.010	<0.010
Benzo(b+j)fluoranthene	ug/L	0.05	N/A	<0.050	<0.050
Benzo(g,h,i)perylene	ug/L	0.05	N/A	<0.050	<0.050
Benzo(k)fluoranthene	ug/L	0.05	N/A	<0.050	<0.050
2-Chloronaphthalene	ug/L	0.1	N/A	<0.100	<0.100
Chrysene	ug/L	0.05	N/A	<0.050	<0.050
Dibenz(a,h)anthracene	ug/L	0.01	N/A	<0.010	<0.010
Fluoranthene	ug/L	0.03	N/A	<0.030	<0.030
Fluorene	ug/L	0.05	N/A	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	ug/L	0.05	N/A	<0.050	<0.050
1-Methylnaphthalene	ug/L	0.1	N/A	<0.100	<0.100
2-Methylnaphthalene	ug/L	0.1	N/A	<0.100	<0.100
Naphthalene	ug/L	0.2	N/A	<0.200	<0.200
Phenanthrene	ug/L	0.1	N/A	<0.100	<0.100
Pyrene	ug/L	0.02	N/A	<0.020	<0.020
Quinoline	ug/L	0.05	N/A	<0.050	<0.050
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective	OG = Operational Guidance Value	

Figure 17: CARO Volatile Organic Compounds (VOC) Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Campbell Creek Booster	
				20-May-21	20-Dec-21
Bromodichloromethane	mg/L	0.001	N/A	0.0013	<0.0010
Bromoform	mg/L	0.001	N/A	<0.0010	<0.0010
Chloroform	mg/L	0.001	N/A	0.0477	0.0289
Dibromochloromethane	mg/L	0.001	N/A	<0.0010	<0.0010
Benzene	ug/L	0.5	MAC=5	<0.5	<0.5
Bromodichloromethane	ug/L	1	N/A	1.3	<1.0
Bromoform	ug/L	1	N/A	<1.0	<1.0
Carbon tetrachloride	ug/L	0.5	MAC=2	<0.5	<0.5
Chlorobenzene	ug/L	1	AO<=30	<1.0	<1.0
Chloroethane	ug/L	2	N/A	<2.0	<2.0
Chloroform	ug/L	1	N/A	47.7	28.9
Dibromochloromethane	ug/L	1	N/A	<1.0	<1.0
1,2-Dibromoethane	ug/L	0.3	N/A	<0.3	<0.3
Dibromomethane	ug/L	1	N/A	<1.0	<1.0
1,2-Dichlorobenzene	ug/L	0.5	AO<=3	<0.5	<0.5
1,3-Dichlorobenzene	ug/L	1	N/A	<1.0	<1.0
1,4-Dichlorobenzene	ug/L	1	AO<=1	<1.0	<1.0
1,1-Dichloroethane	ug/L	1	N/A	<1.0	<1.0
1,2-Dichloroethane	ug/L	1	MAC=5	<1.0	<1.0
1,1-Dichloroethylene	ug/L	1	MAC=14	<1.0	<1.0
cis-1,2-Dichloroethylene	ug/L	1	N/A	<1.0	<1.0
trans-1,2-Dichloroethylene	ug/L	1	N/A	<1.0	<1.0
Dichloromethane	ug/L	3	MAC=50	<3.0	<3.0
1,2-Dichloropropane	ug/L	1	N/A	<1.0	<1.0
1,3-Dichloropropene (cis + trans)	ug/L	1	N/A	<1.0	<1.0
Ethylbenzene	ug/L	1	AO<=1.6	<1.0	<1.0
Methyl tert-butyl ether	ug/L	1	AO<=15	<1.0	<1.0
Styrene	ug/L	1	N/A	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/L	0.5	N/A	<0.5	<0.5
Tetrachloroethylene	ug/L	1	MAC=10	<1.0	<1.0
Toluene	ug/L	1	AO<=24	<1.0	<1.0
1,1,1-Trichloroethane	ug/L	1	N/A	<1.0	<1.0
1,1,2-Trichloroethane	ug/L	1	N/A	<1.0	<1.0
Trichloroethylene	ug/L	1	MAC=5	<1.0	<1.0
Trichlorofluoromethane	ug/L	1	N/A	<1.0	<1.0
Vinyl chloride	ug/L	1	MAC=2	<1.0	<1.0
Xylenes (total)	ug/L	2	AO<=20	<2.0	<2.0

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

5.0 SMALL WATER SYSTEMS

The City owns and operates two small water systems in areas that the distribution system does not reach. One of those systems is at the Tournament Capital Ranch in Rayleigh and the other is a reverse osmosis system for the Kamloops Sewage Treatment Centre (KSTC) administration building.

5.1 Tournament Capital Ranch Water System

The City trucks treated and chlorinated drinking water to the Tournament Capital Ranch potable water system and the water is stored in a 38 m^3 cistern. The cistern supplies the washroom/concession building and the outdoor fountains/taps with potable water. Operation and monitoring of this site occurs only in the summer months when the site is open to the public. Chlorine residual and microbial water sampling occur weekly and the 2021 microbial results are shown in Figure 18.

Figure 18: Microbial Water Sampling Results at Tournament Capital Ranch

Week	Samples Positive for Background Bacteria	Samples Positive for Coliforms	Samples Positive for *E. Coli*
April 12	<1	<1	<1
April 19	<1	<1	<1
April 26	<1	<1	<1
May 03	<1	<1	<1
May 10	<1	<1	<1
May 17	<1	<1	<1
May 24	<1	<1	<1
May 31	1	<1	<1
June 07	<1	<1	<1
June 14	<1	<1	<1
June 21	<1	<1	<1
June 28	<1	<1	<1
July 05	<1	<1	<1
July 12	<1	<1	<1
July 19	<1	<1	<1
July 26	<1	<1	<1
August 02	<1	<1	<1
August 09	<1	<1	<1
August 16	<1	<1	<1
August 23	<1	<1	<1
August 30	<1	<1	<1
September 06	<1	<1	<1
September 13	<1	<1	<1
September 20	<1	<1	<1
September 27	<1	<1	<1
October 04	<1	<1	<1
October 11	<1	<1	<1
October 18	<1	<1	<1
October 25	<1	<1	<1
Totals	***1***	***0***	***0***

There was one positive result for background bacteria. After resampling, all results came back negative.

5.2 Kamloops Sewage Treatment Center Water System

As the City municipal water system does not extend to KSTC, a local water supply and treatment system was installed to provide potable water to the KSTC administration building only.

A 250 mm diameter bedrock well was constructed to a depth of 168 m and completed with a 150 mm diameter Sched 80 PVC liner slotted over the interval 87 – 147 m. The well is located north of the KSTC access road and immediately to the east of the administration building parking lot. The water treatment system is installed in the administration building mechanical room.

Water is pumped from the well through pre-treatment and softening stages before it flows through an Ultraviolet Disinfection and Reverse Osmosis (RO) system. After the treatment, it is stored in a 1,590 L storage tank.

5.2.1 *In-House Testing*

Water use in 2021 was measured at 240 m^3 from January to December. This works out to a usage rate of 0.660 m^3 per day, which is lower than the design level of 1.35 m^3 per day.

The results of the 2021 in-house testing are shown in Figure 19.

Figure 19: 2021 In-House Testing of Treated Water at KSTC

	No. of Samples	Temperature (°C)	pH	Conductivity (µS/cm)
RO Treated Water	38	21.5	9.3	239

The 2021 in-house testing indicated that the RO system is functioning well.

5.2.2 *External Testing*

In 2021, samples of treated water were taken twice and sent to a commercial laboratory for a full analysis. The results are shown in Figure 20.

Figure 20: 2021 Average RO Treated Water Chemical and Physical Parameters at KSTC

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	April 21	September 22	
General Parameters			
pH	8.03	8.35	7.0–10.5
TSS (mg/L)	<2.0	<2.0	No guideline for drinking water
TDS (mg/L)	80	42	Aesthetic Objective: ≤ 500 mg/L
Conductivity (µS/cm)	114	91.4	No drinking water quality guideline
Total Hardness	9.06	11.6	No drinking water quality guideline
Turbidity	0.37	0.37	Operational Guideline: < 0.1 NTU
True Colour	<5.0	<5.0	Aesthetic Objective: ≤ 15 mg/L
Chloride	7.01	5.63	Aesthetic Objective: ≤ 250 mg/L
Fluoride	<0.10	<0.10	1.5 mg/L (max)
Sulphate	4.5	2.6	Aesthetic Objective: ≤ 500 mg/L
Sulphide	<0.020	<0.020	Aesthetic Objective: ≤ 0.05 mg/L
Nutrients (ppm)			
Total Ammonia-N	<0.050	<0.050	No drinking water quality guideline
Nitrate-N	<0.010	<0.010	10 mg/L (max)
Nitrite-N	<0.010	<0.010	1 mg/L (max)

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	April 21	September 22	
Total Phosphorus-P	0.0242	0.076	No drinking water quality guideline
Bacteriological Parameters (CFU/100 mL)			
Faecal Coliforms	<1	<1	0 CFU
Total Coliforms	<1	<1	0 CFU
E. coli	<1	<1	0 CFU
Total Metals (ppm)			
Aluminum	<0.0050	0.0065	Operational Guideline: < 0.1 mg/L
Antimony	<0.00020	<0.00020	0.006 mg/L (max)
Arsenic	0.00182	0.00112	0.01 mg/L (max)
Barium	<0.0050	<0.0050	1.0 mg/L (max)
Beryllium	<0.00010	<0.00010	No drinking water quality guideline
Bismuth	<0.00010	<0.00010	No drinking water quality guideline
Boron	0.941	0.803	5 mg/L (max)
Cadmium	<0.000010	<0.000010	0.005 mg/L (max)
Calcium	3.85	4.49	No drinking water quality guideline
Chromium	<0.00050	<0.00050	0.05 mg/L (max)
Cobalt	<0.00010	<0.00010	No drinking water quality guideline
Copper	0.0257	0.00668	Aesthetic Objective: ≤ 1 mg/L
Iron	<0.010	<0.010	Aesthetic Objective: ≤ 0.3 mg/L
Lead	0.00098	<0.00020	0.01 mg/L (max)
Lithium	0.00098	0.00062	No drinking water quality guideline

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	April 21	September 22	
Magnesium	0.095	0.125	No drinking water quality guideline
Manganese	0.00084	0.00097	Aesthetic Objective: ≤ 0.02 mg/L
Mercury	<0.000010	<0.000010	0.001 mg/L(max)
Molybdenum	0.00712	0.00342	No drinking water quality guideline
Nickel	0.0009	0.0009	No drinking water quality guideline
Potassium	<0.10	<0.10	No drinking water quality guideline
Selenium	<0.00050	<0.00050	0.05 mg/L (max)
Silicon	3.2	3.1	No drinking water quality guideline
Silver	<0.000050	<0.000050	No drinking water quality guideline
Sodium	20	16.4	Aesthetic Objective: ≤ 200 mg/L
Strontium	0.0116	0.0128	No drinking water quality guideline
Sulphur	<3.0	<3.0	No drinking water quality guideline
Tellurium	<0.00050	<0.00050	No drinking water quality guideline
Thallium	<0.000020	<0.000020	No drinking water quality guideline
Thorium	<0.00010	<0.00010	No drinking water quality guideline
Tin	0.00048	<0.00020	No drinking water quality guideline
Titanium	<0.0050	<0.0050	No drinking water quality guideline
Uranium	<0.000020	<0.000020	0.02 mg/L (max)
Vanadium	<0.0010	0.0011	No drinking water quality guideline

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	April 21	September 22	
Zinc	0.0134	<0.0040	Aesthetic Objective: ≤ 5 mg/L
Zirconium	<0.00010	<0.00010	No drinking water quality guideline

The RO treated water at KSTC met all drinking water quality guidelines for nitrogen, phosphorus and total metals.