# Greater Vernon Water 2023 Annual Report

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## LIST OF ACRONYMS

| | |
|---|---|
| AO | Aesthetic Objectives |
| AWWA | American Water Works Association |
| BMP | Best Management Practice |
| BoD | Board of Directors |
| CCC | Cross Connection Control |
| CoV | City of Vernon |
| CR | Coldstream Ranch |
| CT | Contact Time |
| DAF | Dissolved Air Flotation |
| DBP | Disinfection By-Product |
| DCWAPR | Duteau Creek Watershed Assessment Response Plan |
| DCWTP | Duteau Creek Water Treatment Plant |
| DMP | Drought Management Plan |
| DoC | District of Coldstream |
| DOC | Dissolved Organic Carbon |
| DWPA / DWPR | *BC Drinking Water Protection Act and Regulation* |
| EOCP | Environmental Operators Certification Program |
| ERT | Encoder-Receiver-Transmitter |
| FLOC | Flocculent |
| GCDWQ | Guidelines for Canadian Drinking Water Quality |
| GIS | Geographic Information Systems |
| GVW | Greater Vernon Water |
| HAA | Haloacetic Acid |
| IH | Interior Health |
| MAC | Maximum Acceptable Concentrations |
| MDD | Maximum Day Demand |
| MHWTP | Mission Hill Water Treatment Plant |
| MWP | Master Water Plan |
| MoE | Ministry of Environment |
| NTU | Nephelometric Turbidity Units |
| OBWB | Okanagan Basin Water Board |
| PAC | Poly Aluminum Chloride |
| PRV | Pressure-Reducing Valve |
| PS | Pump Station |
| RDNO | Regional District of North Okanagan |
| SCADA | Supervisory Control and Data Acquisition software |
| TAC | Technical Advisory Committee |
| TWG | Technical Working Group |
| TCU | True Colour Units |
| THM | Trihalomethane |
| TOC | Total Organic Carbon |
| UVT | Ultra Violet Transmissivity |
| WQI | Water Quality Indicators |

# INTRODUCTION

As required by the *British Columbia Drinking Water Protection Act*, the Regional District of North Okanagan (RDNO), Greater Vernon Water (GVW) provides the following annual report in accordance with our conditions on permit.

This report summarizes data from the GVW system from the source water to the municipal distribution system. The report outlines where water comes from, how it is treated to ensure safe drinking water and how that water is distributed and used. Drinking water can be complex and much of the information provided in this report is technical in nature. Please contact GVW (phone: 250-550-3700 or email: utilities@rdno.ca) should you have any questions.

In British Columbia, a community water system must hold a "Permit to Operate" as directed in the *Drinking Water Protection Act (DWPA)* and *Drinking Water Protection Regulations* (*DWPR*) passed May 16, 2003 by the Province of BC. Community water systems must also follow Health Canada Guidelines for Canadian Drinking Water Quality (GCDWQ) and the technical documents.

Interior Health (IH), through the Drinking Water Officers (DWOs) who have the delegated legislative authority, regulate GVW from source to tap under the DWPA.

This report outlines the programs and projects GVW has developed and implemented to meet legislation.

# WATER SYSTEM OVERVIEW

GVW is a regional water system that supplies and delivers water to customers in the City of Vernon (CoV), the District of Coldstream (DoC), and portions of Electoral Areas "B", "C" and "D", and the Township of Spallumcheen. Based on the 2021 census, growth, and service connections, the population served is approximately 65,000.

The RDNO owns and manages the GVW water system in addition to operating the supply and treatment facilities, while the CoV and DoC are contracted for the operations and maintenance of the distribution system.

GVW holds 40 water licences and supplies water to customers via six (6) water intakes from the following surface water sources:

1. Duteau Creek (Duteau Creek intake, Goose Lake intake)
2. Kalamalka Lake
3. Okanagan Lake (Outback and Delcliffe intakes)
4. King Edward Lake (Deer Creek intake).

Duteau Creek supplies the largest water volume to the GVW service area, with both non-potable (untreated) and potable (treated) water. Kalamalka Lake is the second largest water supply and provides only potable water. There are two (2) intakes on Okanagan Lake which service two (2) small potable water systems, the Outback and Delcliffe (these two (2) water systems have stand alone annual reports provided on the RDNO website).

Goose Lake functions as an open reservoir, receiving water from the Duteau Creek Water Treatment Plant (DCWTP), to provide non-potable water to agricultural customers on the western side of Swan Lake and in the Bella Vista Area. Deer Creek (King Edward Lake) provides non-potable water to a limited number of Coldstream agricultural customers combined with some groundwater.

GVW also manages four (4) groundwater wells:

- Coldstream Ranch (CR) Wells 3 and 2 – both are in service all year round to supply agricultural non-potable water. Well 3 is approved as emergency supply in the potable / domestic supply if required.
- Antwerp Springs (Antwerp) Deep and Shallow Wells – are currently not in service. The Antwerp Deep is approved as emergency supply in the potable / domestic supply if required. The Antwerp Shallow Well is currently not operational and will only be used for irrigation once a non-potable water main is installed close enough to connect the well.

GVW has approximately 21,000 service connections. There are approximately 800 active farm or agriculture status connections, 1,500 commercial, institutional / park, or industrial connections (ICI) and approximately 20,000 residential connections. All active service connections are metered.

### Staffing

The overall management of GVW lies with the RDNO (Table 1, Appendix). The RDNO operations team is responsible for treatment and supply (Table 2, Appendix). Distribution system operations are contracted under agreement with the CoV and DoC under the direction of RDNO staff (Tables 3 and 4, Appendix). Section 12 of the DWPR outlines the qualification standards for water supply system operators. Operators must be certified by the Environmental Operators Certification Program (EOCP) for their specific system class.

## Drinking Water Sources and Treatment

### Duteau Creek

Water from Duteau Creek supplies domestic (potable) and agricultural (non-potable) water for GVW. Duteau Creek originates on the Aberdeen Plateau and the watershed is controlled with seven (7) earthen dams forming three (3) reservoirs: Grizzly, Aberdeen, and Haddo Lakes. The Duteau Creek watershed covers an area of approximately 21,275 hectare (ha) (213 $km^2$) between Grizzly Hills summit (elevation of 1,800 metres (m)) on the Aberdeen Plateau and the Duteau Creek Intake (point of diversion) at an elevation of 660 m.

Duteau Creek flows out of Haddo Lake and continues downstream for approximately 13 km before entering Harvey Lake, a small reservoir created by Headgates Dam which also contains the Duteau Creek intake. Water is diverted into the GVW system at this point through a transmission main pipe to the DCWTP with a bypass for the non-potable system located before the DCWTP. Water is also released through the Headgates Dam low level outlet into Duteau Creek for Environmental Flow Needs as per an agreement between the RDNO and the Province.

### Duteau Creek – non-potable

Just before entering the DCWTP, water can either be diverted into the DCWTP for treatment or diverted to the non-potable system bypassing treatment and supplying irrigation water to farms in the Von Keyserlingk and Springfield areas.

- Maximum day demand (MDD) in 2023 was 11.78 Megalitres per day (ML/d) on July 3.

### Duteau Creek – potable

Water diverted to the DCWTP for treatment is first clarified by Dissolved Air Flotation (DAF), then injected with chlorine before entering the 10 ML covered reservoir and finally disinfected by UV before entering the distribution system.

Organic carbon removal in the DAF is typically in the order of 60% which includes the removal of the yellow colour from the water. The water is chlorinated before the reservoir to provide sufficient contact time for viruses. Ultraviolet (UV) disinfection after the reservoir adds another layer of treatment and assists GVW in meeting the *4-3-2-1-0 Drinking Water Treatment Objectives* (BC MOH, 2024). The UV inactivates Cryptosporidium and Giardia.

The design capacity of the plant is 160 ML/d,

- MDD in 2023 was 91.3 ML/d on both July 22 and July 23.

### Kalamalka Lake

Water from Kalamalka Lake supplies domestic (potable) water for GVW. The Kalamalka Lake Pump Station (PS) is located on West Kal Road in Coldstream, BC with the intake located 327 m from the shoreline in 20 m of water and 3 m off the lake bottom to improve water quality. Water is pumped from Kalamalka Lake to the Mission Hill Water Treatment Plant (MHWTP) for disinfection treatment using a UV reactor and chlorine. The plant has a design capacity of 60 ML/d.

- MDD in 2023 was 35.86 ML/d on August 4.

## Separated Non-Potable Water Sources

### Goose Lake

Goose Lake is located west of Swan Lake. Following the completion of the West Swan Lake Separation project in 2013, water stored in Goose Lake is used solely for agricultural (non-potable) purposes. Goose Lake reservoir is filled with treated water from the DCWTP, but once it enters the open reservoir it is no longer potable. There is a backflow prevention device installed to ensure there is no cross connection with the potable water system.

- MDD in 2023 was 24.33 ML/d on August 2.

### King Edward Lake

The Deer Creek intake is supplied by releases from the King Edward Lake reservoir. It is used for agricultural demands in the “King Edward Lake Service Area” (Coldstream Creek and Grey Road area). The King Edward Lake Service Area uses this source primarily to supply peak summer flows to augment the CR wells.

- MDD in 2023 was 11.28 ML/d on August 19 for King Edward.

### Coldstream Ranch (CR) Groundwater Wells

CR Wells 3 and 2 are both located on the CR lands near the intersection of Highway 6 and Kalamalka Road. These well sources are used to meet agricultural irrigation demands in King Edward Lake Service Area in addition to King Edward Lake. They are the primary supply for this area in the off season.

CR Well 3 is 50 m deep screened in a confined aquifer with an annular seal and is designated as an emergency backup supply for the potable water system authorized by Interior Health. The well is on a variable speed frequency drive and produces between 57 and 63 L/sec which controls pressure in the service area. Chlorination, a turbidity meter, and a backflow prevention device have been installed at this well in case it is needed for potable water in an emergency.

CR Well 2 is 24 m deep, screened in an unconfined aquifer with no annual seal and has a pumping capacity of 50 L/sec. This well is only used as a non-potable source.

- MDD in 2023 was 4.18 ML/d on June 28 for CR Well 3.
- MDD in 2023 was 2.56 ML/d on July 20 for CR Well 2.

## Drinking Water Distribution System

The GVW distribution system has a service area of 244 $km^2$ with close to 700 km of pipeline, 39 pump stations, 91 pressure reducing stations, 22 concrete balancing reservoirs, and 88 pressure zones.

### New Water Mains

Disinfection of new water mains is completed in accordance with AWWA C651 - 14 - Continuous Feed Method. If water samples taken following initial disinfection are not acceptable and do not meet water quality standards, the process is repeated.

### Pressure Reducing Valve (PRV) Station

The maximum design water pressure for piping within most of the water distribution system is 1,040 kPa (150 psi). 91 Pressure Reducing Valves (PRV) within the GVW system control the pressure in the water system by creating head losses that prevent pressures from exceeding the design maximum.

The operators currently service the PRV stations as required to extend their service life. The BC Building Code requires all buildings to have an on-site PRV to protect internal plumbing systems from high or fluctuating pressures. Most internal plumbing and fixtures are rated at a maximum of about 50 psi.

### System Control - Supervisory Control and Data Acquisition Software

Operators and management use the Supervisory Control and Data Acquisition Software (SCADA) system for monitoring reservoir water levels, operating pumps, monitoring water quality control equipment, and maintaining a historical data file of the water system's operations. All monitoring is done through wireless connections. When a problem is detected within the system, the SCADA system sends out alarms and, depending on the location of the problem, either the RDNO, CoV, or DoC operators respond.

### Water System Value and Asset Management

GVW has an Asset Management Investment Plan (AMIP). The primary goal of an AMIP is to replace infrastructure to obtain full lifecycle and to extend the life of an asset where possible. Criteria has been developed to guide this process that reviews actual conditions as opposed to only using the estimated lifespan listed for an asset. This has allowed GVW to extend the life of certain assets, delay replacement of others and focus on assets that are truly at the end of their life to more efficiently use replacement dollars.

The approximate total value of the GVW water system, is estimated to be $1,269.7 million (GVW Interim Asset Management Investment Plan Values, 2023, Figure 1).

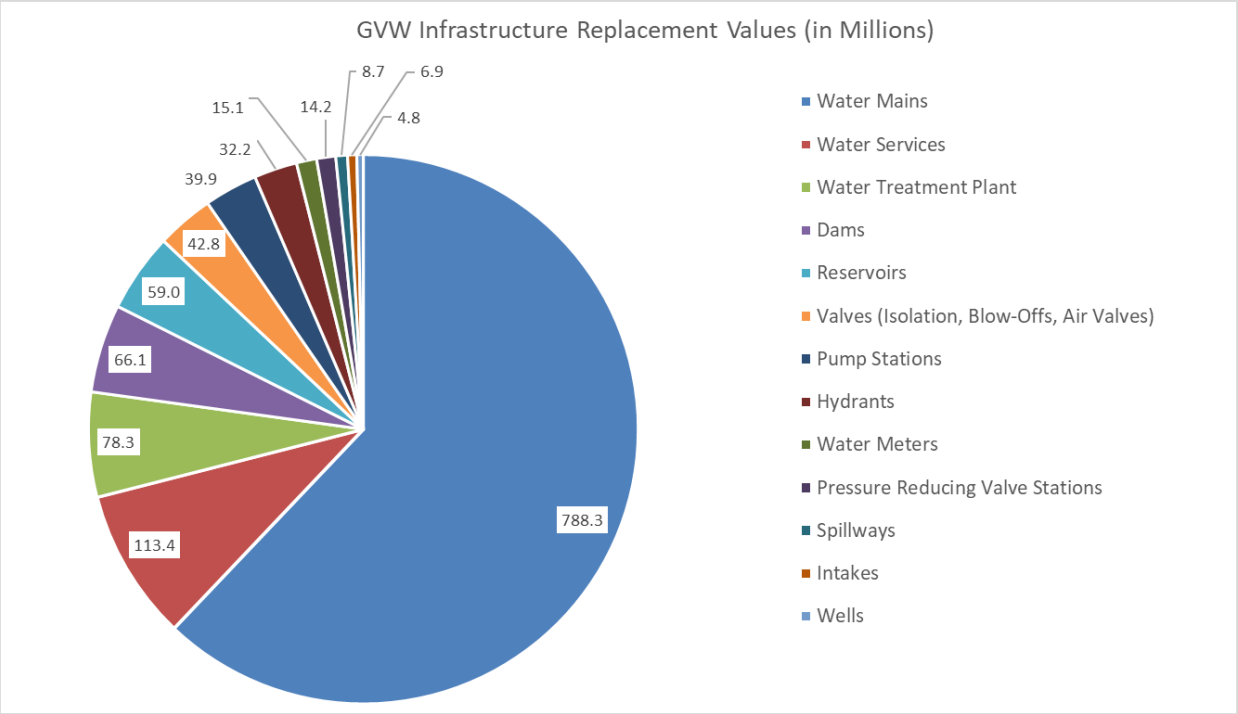



Figure 1: GVW Infrastructure Replacement Values

All GVW assets are entered into the Geographic Information Systems (GIS). Attributes for each asset include year of install, material, size, number of breaks for pipes and other features depending on the asset.

GVW uses a modeling tool developed in partnership with UBC Okanagan to analyze risk of failure in GVW's water mains which is used to rank their replacement based on soil corrosivity, water aggressiveness, pressure, age of pipe, number of breaks and consequence of failure. High ranked projects are reviewed with operations and the highest ranked pipes are incorporated into a 5-year rolling capital plan focusing on the water mains with the highest breaks. GVW also collaborates with the CoV and DoC to schedule projects with their works, such as road and sewer renewal projects, to save costs and reduce the public impact related to infrastructure projects.

GVW employs a summer student to locate, survey, enter curb stops and services into GIS and report necessary repair of service valves to operations staff. This aids in asset management and helps operations staff to easily locate curb stops and ensure valves are operational during emergencies.

## Capital Works Projects

Capital works projects completed in 2023 are shown in Table 5.

Table 5: Capital Projects Completed in 2023.

| Project Number | Project (Partner Jurisdiction) | 2023 Capital Budget | Project Notes |
|---|---|---|---|
| 372-15-11 | Domestic and ICI Meter Replacement | $ 171,684 | Replacement of large ICI/strata meters. Goal of 10 per year. All large meter replacements completed in 2023. Replacement of Residential meters added as renewal budget in operations. |
| 372-18-02 | Purchase SROWs | $ 226,981 | Changing project structure to an annual capital budget line (i.e. 372-24-03) and reducing budget as these take substantial time to complete. |
| 372-19-02 | McMechan Transmission Main Phase 1 - 25 Ave. through Lakeview Park | $ 1,639,644 | Complete Transmission main connection from MHWTP to McMechan Reservoir to remove capacity bottleneck - required for growth. 3 Phase project. PH1 completed. Ph2 and Ph3 between 2025 or 2028, should be completed by filtration plant commissioning. |
| 372-19-17 | Duteau Creek Alignment | $ 548,142 | Part of Headgates Dam Improvement Project to stabilize Duteau Creek. Construction completed in spring of 2023. |
| 372-20-04 | Longacre Dry: Apollo Rd to Longacre Pl: Pipe Replacement | $ 658,791 | Construction completed in 2023. |
| 372-20-05 | Headgates Intake: Confined Space Valve Replacement | $ 336,115 | Part of Headgates Dam Improvement Project - to correct a confined space of the Duteau supply at Headgates Intake. Construction completed in spring of 2023. |
| 372-21-11 | 28 Ave: Rail crossing casing (COV) | $ 65,000 | Substantial completion Nov. 2023 - Asbuilts outstanding - will be coded to ops Capital Clean up budget (376-580, WAT221, GVW382) |
| 372-22-12 | Coldstream Creek Road: Tassie to Kalamalka Lake Pipe Replacement | $ 1,697,000 | Part of DOC's paving program - substantial for water completed in fall. Outstanding costs to be coded to operations capital clean up budget. |
| 372-22-13 | Replacement of DCWTP Hypochlorite Tanks - Phase 2 - Replace Remaining 2 of 4 Tanks | $ 226,695 | Completed. Replacement existing aged/leaking hypo tanks at DCWTP. 2 tanks replaced in 2022 with remaining tanks replaced in 2023. |
| 372-22-14 | 32 Ave: Phase 1 - PV Rd to 20 St Pipe Replacement (COV) | $ 491,535 | Partnership project with COV to be completed over 3 phases from PV Rd to 15 St. Phase 2 - 18 St to 20 St: budgeted as 2024 project (372-24-10) |
| 372-23-08 | MHWTP - replace dosing pumps | $ 100,000 | Completed. VFDs obsolete, replacing to internal drives - more functionality for lower dose anticipated with filtration (use current pump heads). |
| 372-23-09 | Replace Valves and Air Valves on Duteau transmission main (Phase 1 Reid Road to Park Lane) | $ 200,000 | Replacing valves and air valves on Duteau transmission main to reduce emergency pipe shut downs. Large coordinated operations project. Phase 1 completed fall of 2023, Phase 2 Murphy to PRV1: budgeted as 2024 project (372-24-11) |
| 372-23-14 | Vehicle 021 (Van) Replacement - VEH024 | $ 65,000 | Completed. Replacement of VEH021 as was transferred to dog control. |

# WATER EFFICIENCY PROGRAM

GVW has a Water Efficiency Program (WEP) that focuses on water demand management, accounting for lost water and managing the Water Shortage Plan. The WEP is essential to GVW for using water efficiently, reducing lost water from the system, conserving water resources, reducing operational costs, and protecting the environment. It enables the utility to adapt to climate variability and maintain a reliable water supply while also raising public awareness and promoting sustainable water use.

## Drought Management

GVW follows the Water Shortage Management Plan (WSMP) when assessing drought conditions and water system demands. Staff use available data and forecasted conditions to assess the potential stage restrictions and the level of conservation messaging.

Figure 2 shows the Duteau Creek storage level trend for 2023. The trend shows the early spring levels were average and the reservoirs stopped filling by mid-May, when GVW began using stored water to meet customer demands. This highlights the importance of snow melt and June precipitation in determining water availability for the rest of the year.

GVW remained in “Normal” restrictions through the summer, but issued “Stage 1” restrictions in the fall due to lack of precipitation. Stage 1 restrictions after September affect GVW operations and Environmental Flow Needs (EFN). To conserve water from Duteau Creek, GVW makes operational and source changes to conserve water and minimize use.

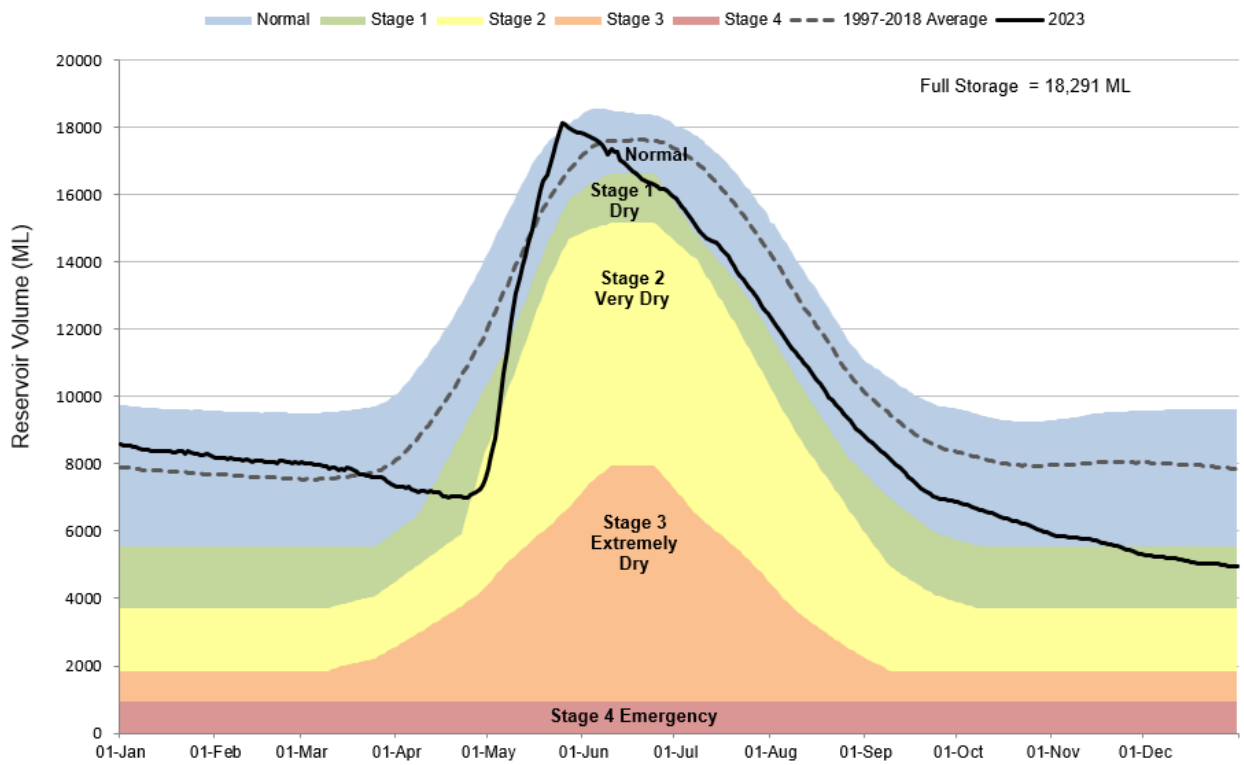



Figure 2: 2023 Duteau Creek Water Storage Graph

Based on concerns for infrastructure due to lack of precipitation in the fall of 2023, staff reviewed the WSMP in early 2024 and updated the Duteau Creek Water Storage Graph to better protect infrastructure and downstream EFNs. The updated WSMP is available at www.rdno.ca/gvw.

In 2023, the Okanagan and Bessette Creek Water Basins experienced drought conditions.

## Water Consumption

Figure 3 shows the GVW water consumption trend for 2015 to 2022 with the 2023 actual consumption pattern. The trend shows increased water usage early in the spring and continued peak use through to mid-August for both potable and non-potable sources. The trend also shows the highest water use in early June during this time frame (2015 – 2023), which corresponds to unseasonably high temperatures with no precipitation.

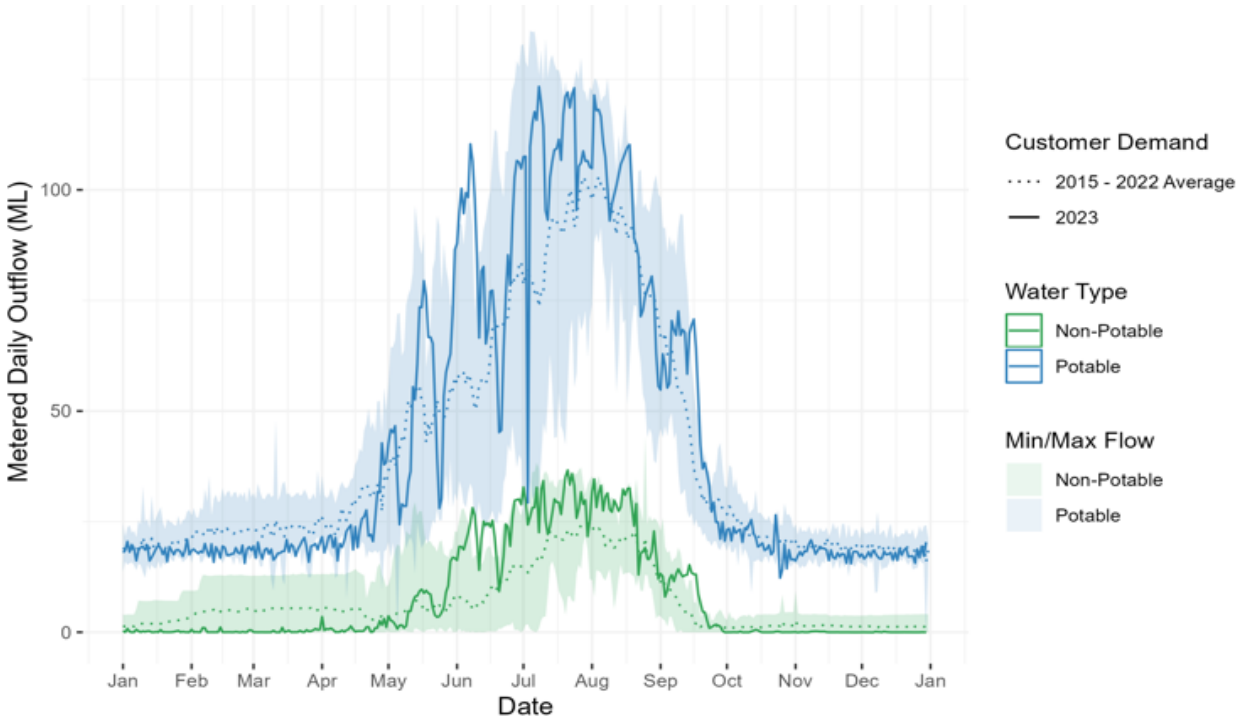



Figure 3: 2023 GVW Total Water Demand

## Conservation-Oriented Water Rates

GVW uses tiered water rates to encourage conservation by charging higher rates as customer water use increases. This system provides a financial incentive for customers to reduce consumption. Tiered rates paired with education programs help customers understand their water bills, adopt conservation practices, and make informed decisions about water use. For more information, visit www.rdno.ca/conservation.

## Water Consumption

GVW monitors water flows at multiple entry points. These sources are Duteau Creek, Kalamalka Lake, Deer Creek / King Edward Lake, and the groundwater wells. In 2023, approximately 18,643,577 ML of water flowed into the GVW distribution system from these sources. Figure 4 shows the breakdown of sources. Total inflow volumes differ from the metered water consumption due to several factors, including unmetered water use activities, such as firefighting, water main flushing, fire hydrant usage, consumption at water quality monitoring stations, or unauthorized consumption, such as leaks or theft. Table 6 summarizes metered and estimated unmetered water consumption in comparison to source inflows. The estimated water loss percentage in 2023 was 18%. GVW continues to work to reduce water losses in the system with leak detection programs, water audits, system metering, bypass enforcement and infrastructure improvements.

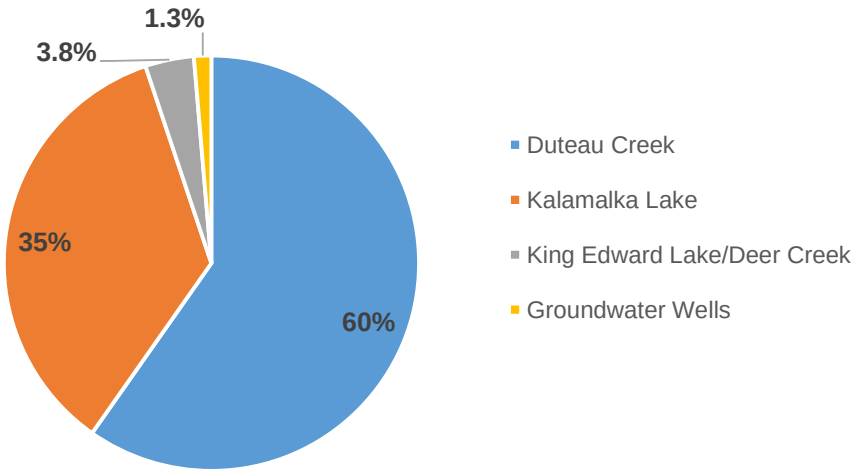



Figure 4: Percentage of GVW Water Use by Source in 2023

Table 6: Comparison of Source Inflows to Estimated Metered and Unmetered Consumption

| Water Supplied | Annual Volume (ML) | Annual Total Volume (ML) |
|---|---|---|
| **Total Volume from all Sources** | | **18,642** |
| Duteau Creek Water Treatment Plant (Potable) | 10,217 | |
| Misson Hill Water Treatment Plant | 6,541 | |
| Duteau Creek (Non-Potable) | 923 | |
| Deer Creek / King Edward Lake | 709 | |
| Groundwater | 252 | |
| **Authorized Consumption** | | **15,233** |
| Residential | 5,114 | |
| Commercial | 1,808 | |
| Parks | 132 | |
| Agriculture | 7,949 | |
| Authorized Metered & Unmetered | 245 | |
| **Water Losses** | | **3,409** |
| Apparent Losses (from data & metering, estimate) | 344 | |
| Unknown Losses (estimate) | 3,065 | |
| **Percent Lost Water** | | **18%** |

# WATERSHED MANAGEMENT PROGRAM

The first step to providing safe, clean, reliable drinking water is to ensure source water quality and quantity is maintained to a high standard. With ever-increasing activity on both public and private land, it is critical to ensure good and abundant source water even before it is treated.

An integral part of watershed management is partnerships with those who have jurisdiction and impact on the landscape. The RDNO has benefited from good relationships, coordinated efforts, and regular meetings.

## Duteau Creek Source Assessments and Source Protection Plans

The Duteau Creek community watershed is primarily public land. While the RDNO has no legislative authority over land use and practices on public land, it is required under the GVW operating permit to complete and implement a comprehensive source assessment and response plan. The Duteau Creek Watershed Assessment and Recommendations for Source Protection Report (Watershed Assessment) was received by the RDNO Board of Directors (BoD) in December 2008.

The Duteau Creek Watershed Protection Plan Technical Advisory Committee (TAC) was formed in 2009 and includes representation from provincial agencies, Indigenous Peoples, forest licencees and range tenure holders.

In 2014, the Duteau Creek Watershed Assessment Response Plan (DCWARP) was endorsed by the RDNO BoD and accepted by IH. The DCWARP aims to action the recommendations in the Watershed Assessment and is reviewed annually by the TAC through the development of annual work plans.

In 2023, the TAC was renamed the Duteau Creek Watershed Technical Working Group (TWG). The TWG re-evaluated and refocused the goals and recommendations of the 2014 DCWARP through a facilitated workshop. This resulted in an updated 2024 DCWARP and a 5-year action plan based on the actions identified in the workshop. The plan will be reviewed annually at the TWG spring meeting and updated again in 2029.

## Kalamalka Lake Source Assessments and Source Protection Plans

In 2011, the RDNO BoD endorsed the Source Assessment of the Regional District of North Okanagan – Greater Vernon Water Utility North Kalamalka Lake Intake Report (Assessment).

The North Kalamalka Intake Response Plan was completed in 2017 and aims to respond to recommendations from the Assessment and provide actions to reduce risks to water quality and identify responsible parties. Work continues to forward the goals of the source response plans.

## Watershed Monitoring Program

From a water quantity perspective, the RDNO monitors the source water availability through a series of RDNO-owned hydrometric stations, remote lake level readings, snow courses, and flow measurements within the Duteau Creek watershed. Within the Kalamalka Lake watershed, the RDNO monitors the Water Survey Canada stations and the lake levels to understand water availability.

From a water quality perspective, the RDNO monitors the water quality in the Duteau Creek watershed to assess if best management practices (BMPs) by public land users are protecting water quality. The major tributary to Kalamalka Lake, Coldstream Creek is monitored in

partnership with the Ministry of Environment (MoE) to observe water quality changes. Additionally, Kalamalka Lake is monitored in partnership with the District of Lake Country, to track long-term changes and determine protection goals. Further analysis of Kalamalka Lake and Coldstream Creek is conducted by Larratt Aquatic Consulting (LAC). Monitoring source water can often signal when changes are occurring and trigger actions to prevent long-term contamination, ultimately reducing operating costs for water treatment and distribution. Further water quality information for the Duteau Creek and Kalamalka Lake watersheds will be discussed in the following section, Water Quality Monitoring Program.

# WATER QUALITY MONITORING PROGRAM

The Water Quality Monitoring Program (WQMP) has been designed so that water is monitored weekly, monthly, quarterly and annually to understand variations in water quality and provide sufficient data to statistically analyze trends from the source to the tap. The following legislation, regulation and guidelines are used to develop a reporting and monitoring program:

1. Guidelines for Canadian Drinking Water Quality (GCDWQ)
2. *Drinking Water Protection Act and Regulation* (DWPA and DWPR)
3. Source Drinking Water Quality Guidelines (SDWQG)
4. Drinking Water Treatment Objectives for Surface Water Supplies in BC
5. Decision Tree for Responding to Turbidity Event in Unfiltered Drinking Water.

Drinking water quality is influenced by source water quality, water treatment, and distribution system characteristics. As a result, the monitoring of drinking water quality consists of four (4) components in the Source to Tap Approach:

1. Source (raw) water monitoring
2. Monitoring after treatment (at outflow of treatment plant)
3. Monitoring in the distribution system (including cross connection control)
4. Monitoring and addressing customer concerns.

The WQMP outlines the sample locations, parameters analyzed and their frequency throughout the year. The program is updated annually and submitted to IH. The 2023 WQMP has been included in this report as Attachment A. The following sections describe the results of the 2023 program.

## Source Monitoring Program

Source water quality monitoring is an important component of the multi-barrier approach to drinking water management. The source monitoring program focuses on the point where raw, untreated water first enters the water system. This location also serves as the final monitoring point for the watershed monitoring program. Results are compared to both health and aesthetic guidelines, criteria and regulations. Water quality trends are monitored to evaluate the impacts of watershed activities and to indicate potential effects on treatment and chlorine demand. Chemical, physical and biological parameters are tested weekly, monthly, seasonally and annually at each source, as scheduled in the WQMP (Attachment A).

Turbidity is one of the most important physical parameters monitored by the RDNO. Turbidity is caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, plankton, and other microscopic organisms. Excessively high

turbidity can have a negative effect on disinfection techniques. IH's 4-3-2-1-0 Drinking Water Objective states that raw water turbidity must be less than 1.0 Nephelometric Turbidity Units (NTU) in a 24-hour average, unless there is an agreement otherwise. If the 1.0 NTU objective is not met, the water purveyor must advise the public.

At this time, GVW does not have filtration on any of its sources, making it challenging to remove source water turbidity. With good operational oversight, the DCWTP DAF treatment system removes turbidity from normal freshet and events, but significant events such as landslides or debris flows overwhelm the treatment system. Turbidity is continuously measured at Kalamalka Lake and Duteau Creek intakes through online turbidity meters and SCADA, as well as regular comparisons with hand-held turbidity meters.

Raw water (untreated) monitoring for 2023 was completed on the following sources:

- Duteau Creek watershed
- Duteau Creek intake
- Kalamalka Lake watershed (Coldstream Creek)
- Kalamalka Lake intake
- Deer Creek intake
- Goose Lake surface and intake

## Duteau Creek Source Monitoring Program Summary

### Duteau Creek Watershed

Depending on water availability and water quality within the reservoirs, four (4) to five (5) sites are sampled biweekly during the snow-free season, approximately May to November. The sites are chosen and adjusted based on activities in the watershed such as range cattle, recreation, and forestry. The water flowing over the weir at Haddo Lake is sampled the most frequently, as it is the point where the water enters the main stem of the creek. The sampling parameters and frequency are detailed in the WQMP (Attachment A).

Data from the monitoring sites in 2023 did not reveal any significant or immediate impacts on water quality; however, there were no significant rain fall events that tend to cause extremely high turbidity events. Over the years, it has been observed that water quality is influenced by land activities within the watershed which can increase erosion during freshet and weather events. The cumulative effects of these activities continue to be monitored.

## Duteau Creek Intake

The Duteau Creek intake is sampled at a line located in the intake building. Water quality is monitored online and by taking samples on a weekly, monthly, and annual schedule as detailed in the WQMP (Attachment A).

### Physical-Chemical Monitoring

#### Turbidity

Monthly water quality reports and the GVW Water Quality Deviation Response Plan provide further details regarding turbidity events and/or trigger levels for response and notification (Attachment B).

Figure 5 shows the daily average turbidity for both the raw water at the Duteau Creek intake and the treated water leaving the DCWTP in 2023. This graph demonstrates the effectiveness of the water treatment process, showing that treated turbidity, even without filtration, remains well below the MAC of <1 NTU. Turning off the DCWTP is rare and has only been done in 2013 and 2017 during extreme rainfall events. 2023 did not have any events that caused water quality concerns that required the DCWTP to be turned off.

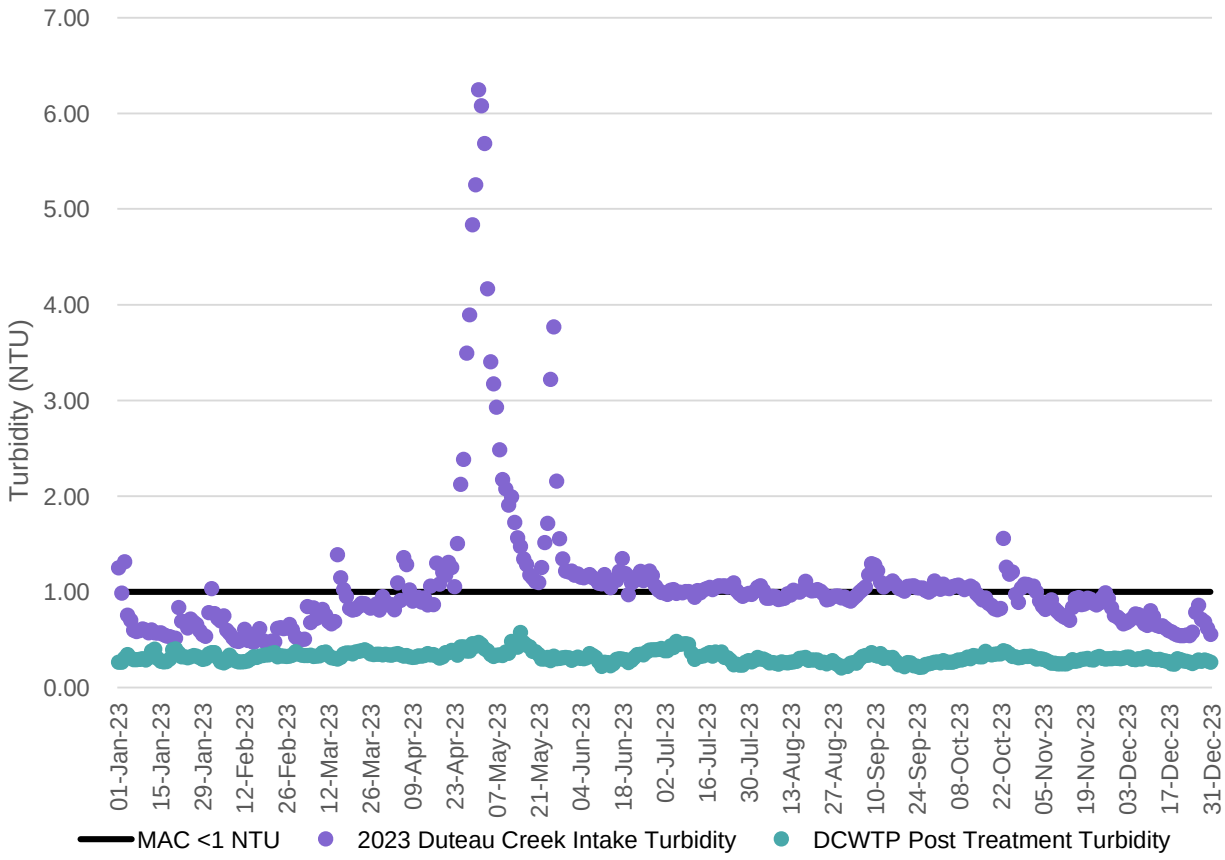



Figure 5: SCADA Daily Average Turbidity at Duteau Creek Intake and DCWTP Post Treatment in 2023.

### Temperature

Analyzing water temperature trends over time can indicate long-term changes and fluctuations. Incoming temperature is important for the effectiveness of the treatment process. Dramatic fluctuations in temperature can make treatment more difficult. In 2023, Duteau Creek raw water temperature increased slightly earlier in spring compared to previous years (Figure 6); however, there were no significant temperature fluctuations in 2023. It is expected that climate change will have an impact on source and distribution water temperatures, potentially affecting drinking water quality.

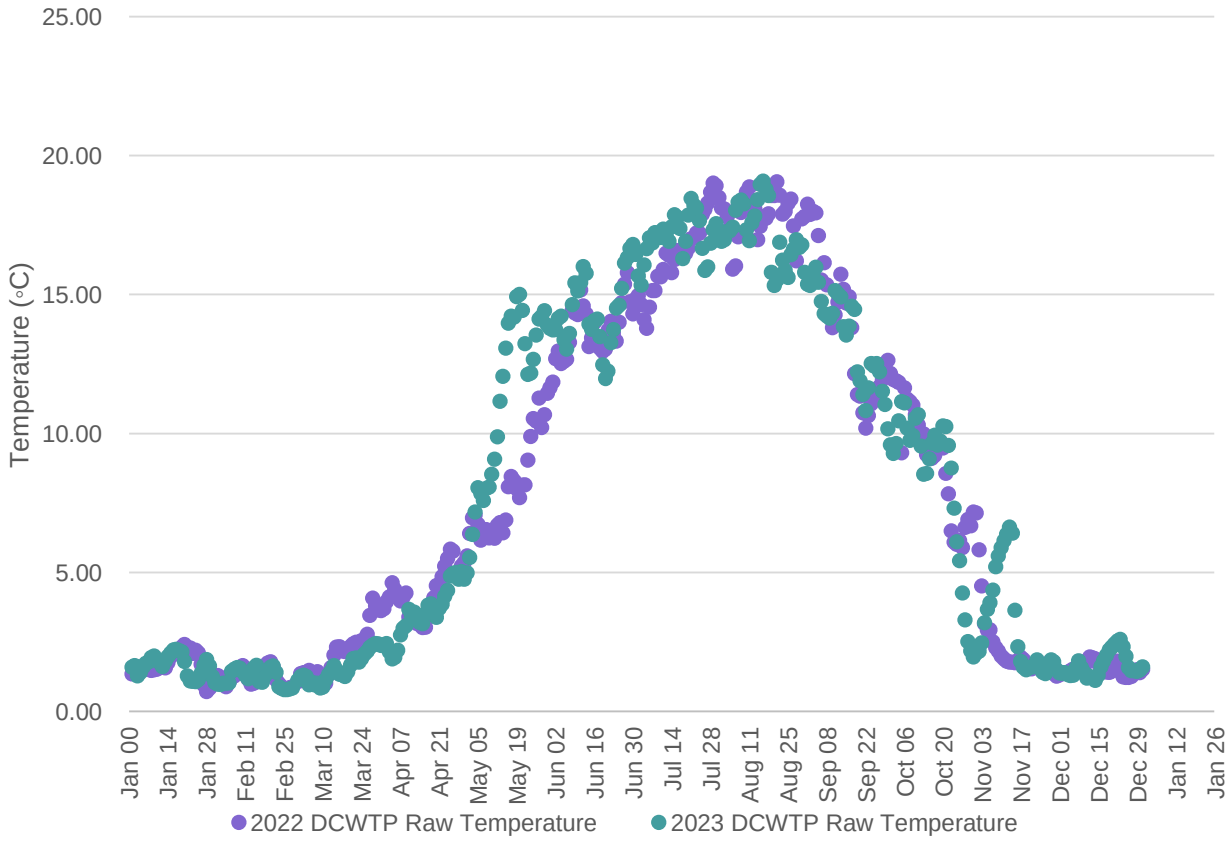



Figure 6: SCADA Daily Average Temperature of the Raw Water Entering DCWTP in 2022 and 2023.

## pH

pH is a key factor to consider as it impacts the treatment process and the distribution system. Figure 7 shows a fluctuating long-term trend with lows observed during 2008-2010 and peaks from 2015-2017. Since 2020, the trend appears to be moving toward lower pH levels which may correspond to lower amounts of rainfall during this time. This will be investigated further in the coming years. Low pH is an indication of corrosive water, which leads to concerns in the distribution system.

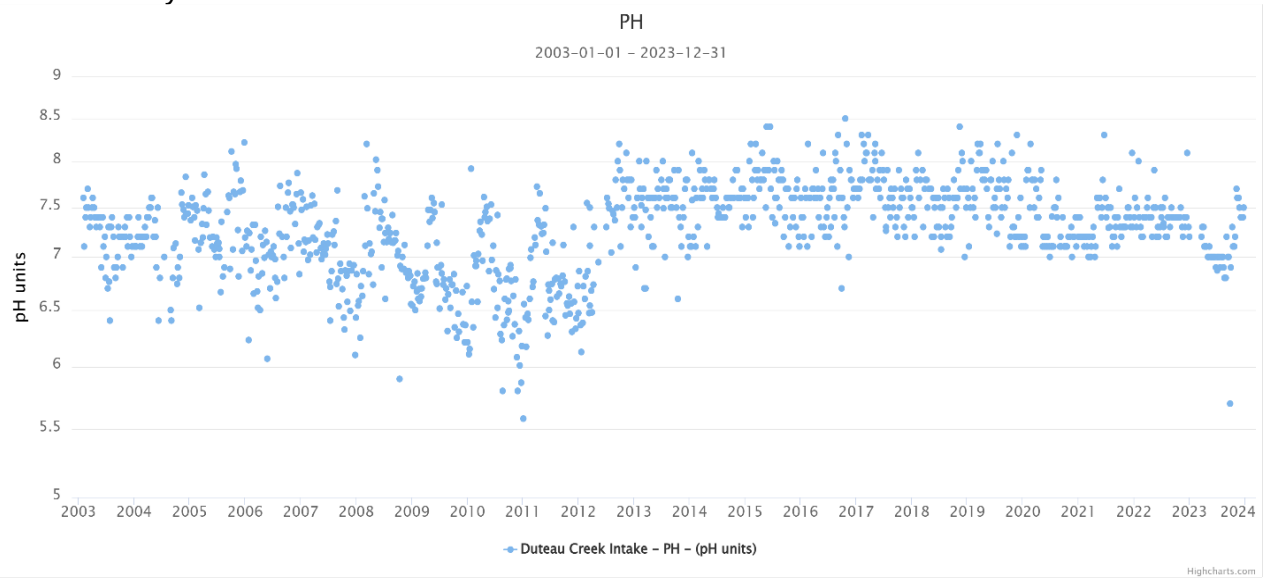



Figure 7: Weekly pH Grab Samples at Duteau Creek Intake from 2003 to 2023.

## Chlorophyll a

Chlorophyll a, a measure of the concentration of the green pigment found in plants, is generally used as an indicator of phytoplankton (algae) in the water sampled. Monthly measurements of chlorophyll taken from May to November in 2023 were within the normal range seen historically (Figure 8). Notably, the June, July and August samples showed 0 µg/L chlorophyll a, although a second sample taken in July contained 1.14 µg/L. These zero readings are somewhat unusual compared to previous years.

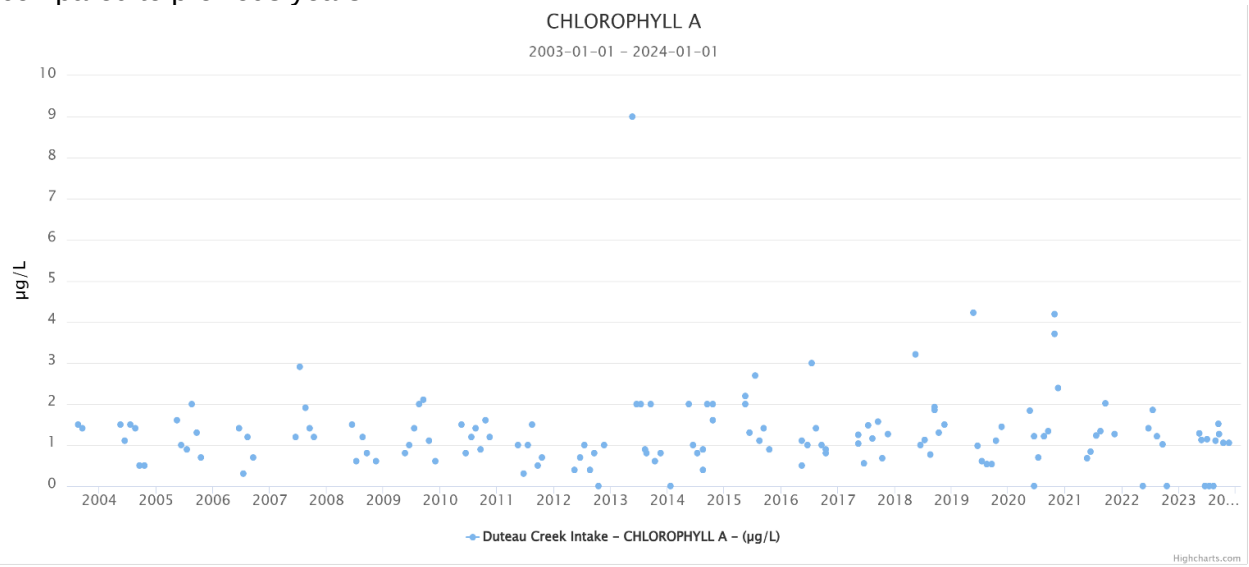



Figure 8: Chlorophyll a Concentration from Grab Samples Taken at Duteau Creek Intake from 2003 to 2023.

## Organic Carbon

Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) are measures of suspended and dissolved carbon bound in organic molecules and organisms. TOC and DOC are important to monitor in the Duteau Creek source as they are precursors for disinfection by-products (DBPs), which will be discussed further in the Distribution section of this report. DOC is particularly relevant at the DCWTP as elevated levels can reduce the effectiveness of the UV disinfection. The Source Drinking Water Quality Guideline MAC for TOC is 4.0 mg/L.

In 2023, the Duteau Creek Intake sample showed an average TOC of 9.5 mg/L and an average DOC of 9.0 mg/L, which dropped to 4.5 mg/L for TOC and 4.4 mg/L for DOC following treatment. This demonstrates that the DAF at the DCWTP is effective in reducing the organic carbon significantly, as shown in Figure 9 and in Figure 27 in the Treatment Monitoring Program section.

TOC and DOC levels in Duteau Creek water are strongly correlated (Figure 10) which shows that the TOC is mostly made up of DOC. The organic carbon component is composed of humic and fulvic acids, typical of the water quality found on the Aberdeen Plateau (e.g. Oyama Lake, Beaver Lake, and King Edward Lake).

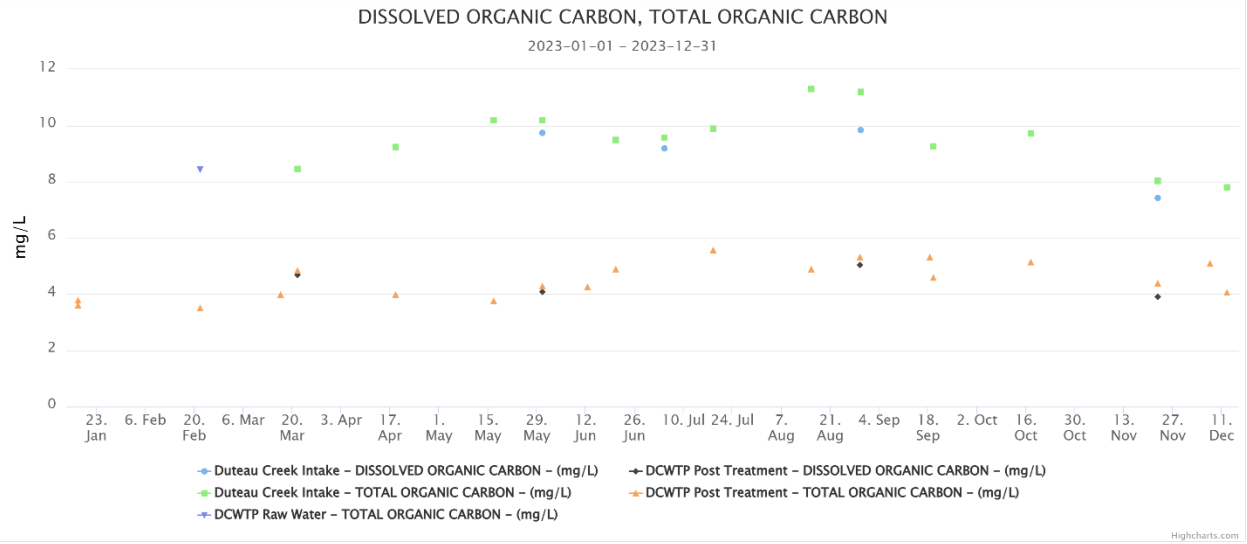



Figure 9: Organic Carbon Concentrations from Grab Samples Taken at Duteau Creek Intake and Post-Treatment in 2023.

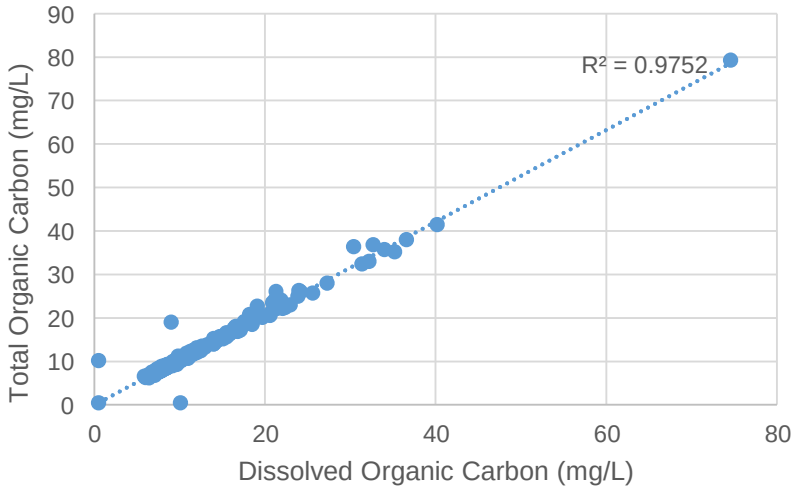



Figure 10: TOC and DOC Correlation at Duteau Creek Intake from 2003 to 2023.

## Biological Monitoring

### Bacteria

Monitoring for Total Coliform bacteria (TC) and *Escherichia Coli* (*E.coli)* is an important part of understanding source water quality and detecting potential changes. Table 7 summarizes the TC and *E.coli* bacteria sample results from Duteau Creek Intake in 2023.

Table 7: Duteau Creek Intake Bacteria Sample Summary

| Total Coliform MPN/100 mL | Accredited Lab | RDNO Lab |
|---|---|---|
| # of Samples | 52 | 92 |
| Min | 14 | 16 |
| Max | >2,420 | >2,420 |
| Mean | 561 | 572 |
| # of Samples > 100 MPN/100 mL | 34 | 62 |
| # of Samples < 1 MPN/100 mL | 0 | 0 |
| *E.coli* MPN/100 mL | Accredited Lab | RDNO Lab |
| # of Samples | 52 | 92 |
| Min | <1 | <1 |
| Max | 19 | 28 |
| Mean | 5 | 6 |
| # of Samples > 20 MPN/100 mL | 0 | 1 |
| # of Samples < 1 MPN/100 mL | 11 | 22 |

### Total Coliforms

In 2023, TC began increasing in May and peaked in August and September, as shown in Figure 11. This trend is consistent with previous years of monitoring at the Duteau Creek Intake. The observed increase in total coliforms could be attributed to warmer temperatures promoting bacterial growth, along with increased recreational and animal activity in the watershed. Additionally, reduced streamflow during the summer and fall may result in less dilution.

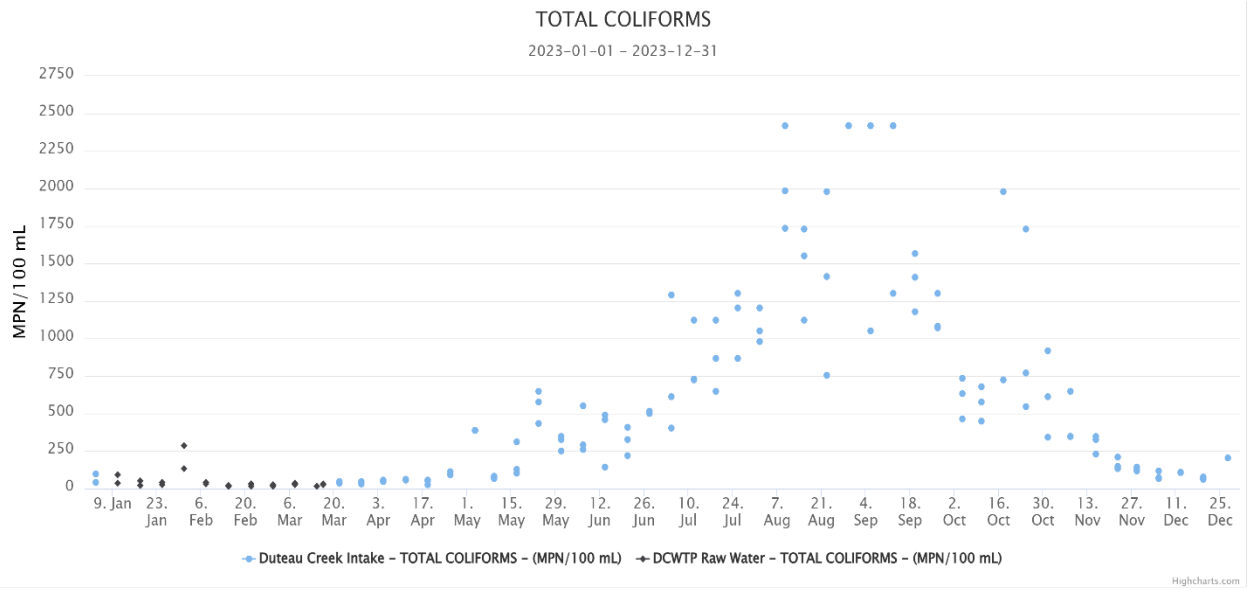



Figure 11: Total Coliforms Counts from Grab Samples Taken at Duteau Creek Intake in 2023.

### *E.Coli*

*E.coli* levels at the Duteau Creek Intake were lower in 2023 compared to previous years, with counts exceeding 20 MPN/100 mL only once (Figure 12).

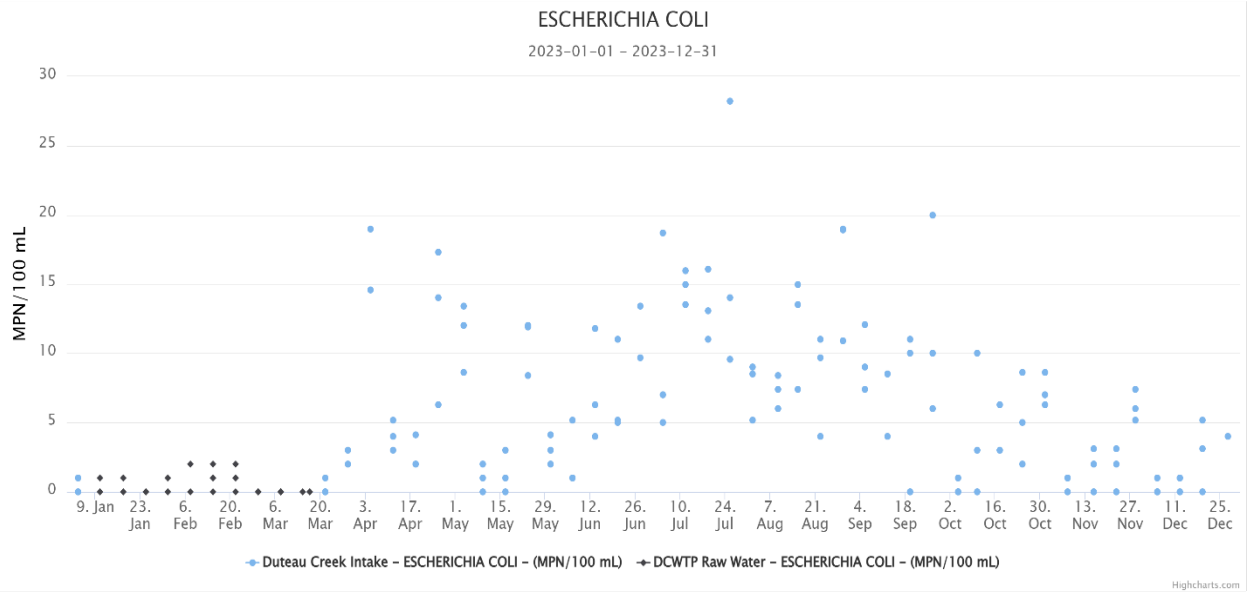



Figure 12: *E.Coli* Counts from Grab Samples Taken at Duteau Creek Intake in 2023.

### Algae

Algae are monitored as they contribute to the organic loading in the system and contribute to taste and odour. Algae was not a concern in 2023 at the Duteau Creek intake and the treatment at the DCWTP is able to address any algae present.

## Kalamalka Lake Source Monitoring Program Summary

### Kalamalka Lake Watershed

Since 2017, four (4) sites on Coldstream Creek have been regularly monitored. The sites were chosen in collaboration with the MoE. At all sample sites, we typically observe an increase in turbidity during freshet from late April to mid-June, along with a decrease in conductivity as overland water dilutes the base flow of the system.

### Chloride

Chloride concentrations are measured to monitor for human impacts, and based on the trends seen in Coldstream Creek, is primarily linked to road salt used for winter road maintenance. The trend over the years is that it generally increases gradually through the spring and summer before peaking in winter. It is assumed that the rapid decrease in spring aligns to just after the "first flush", or when the first hard rain washes most of the road salt into the streams. Chloride from winter road salt applications can remain stored in soils and snowpacks, slowly leaching into the creek as temperatures rise. Additionally, as the weather warms, increased irrigation from surrounding agriculture can mobilize chloride from soils or fertilizers and the chloride is more concentrated in the reduced stream volume. In 2023, the School Road sample site showed slightly higher chloride concentrations than in previous years, with the highest concentrations occurring in January and February (Figure 13).

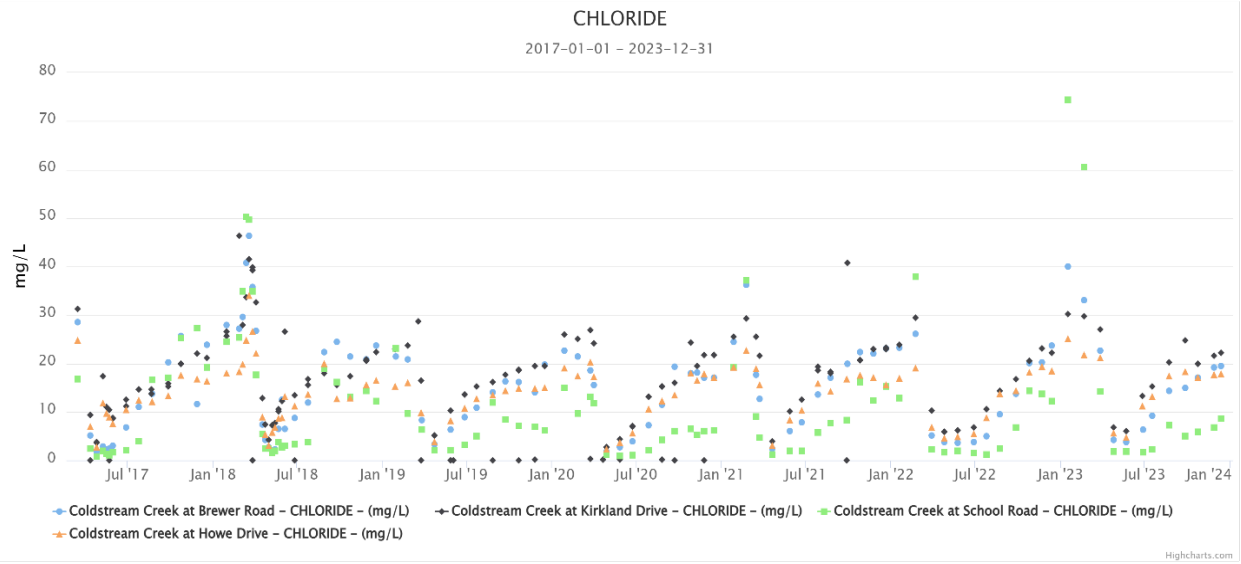



Figure 13: Chloride Concentrations from Grab Samples Taken at Coldstream Creek Sample Sites from 2017 to 2023.

### Nitrogen

Nitrogen is monitored in Coldstream Creek to assess human impacts and is especially harmful to fish and provides nutrients for algae blooms. Nitrogen sources in this area are likely primarily from fertilizers and septic fields. The nitrogen trending shows that at School Road, the most upstream sample location, nitrogen is already being detected but the concentrations are the lowest. The Brewer Road site shows a large variable input source that is reduced between Brewer Road and Howe Drive, likely from dilution of other drainages. Between Howe Drive and Kirkland Drive, the nitrogen remains consistent showing no dilution and no apparent significant inputs (Figure 14).

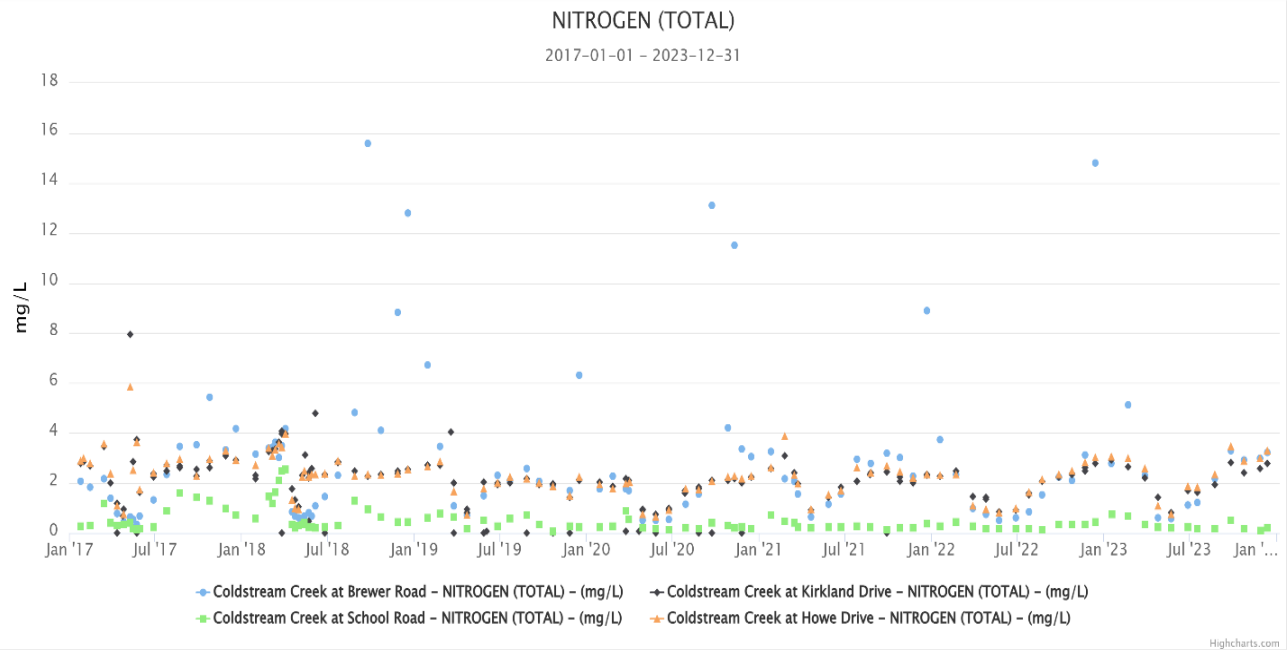



Figure 14: Nitrogen Concentrations from Grab Samples Taken at Coldstream Creek Sample Sites from 2017 to 2023.

There are both large tracks of agricultural land and a significant number of septic fields between School Road and Howe Drive as well as significant inflows (Brewer and Deer Creek). To better assess potential input sources, additional sampling sites will be added to the monitoring program in 2024. Larratt Aquatic Consulting (LAC) conducts further analysis of Coldstream Creek which can be found in the LAC 2023 Kalamalka Lake Water Quality Study.

### Kalamalka Lake Intake

The Kalamalka Lake Intake is sampled from the Kalamalka Lake PS. Water quality is monitored through SCADA and by taking samples on a weekly, monthly, and annual schedule as outlined in the WQMP (Attachment A).

## Physical-Chemical Monitoring

### Turbidity

Turbidity in Kalamalka Lake is a challenging factor for water quality as it can affect the MHWTP UV disinfection process. The MHWTP has dual disinfection (UV and chlorine) but no pre-treatment (i.e. clarification) or filtration; therefore, RDNO operators have developed procedures to direct operations during increasing turbidity events. Historically, Kalamalka Lake water turbidity stays below 1 NTU except during freshet and the natural marl process.

Marl occurs due to the lake's naturally high calcium and sulphate concentrations, which precipitate seasonally due to an increase in water temperature and changes in water chemistry. These

precipitates increase the turbidity in the lake. Marl creates the colour in Kalamalka Lake, as the precipitates diffract the sunlight. The timing and the intensity of the colour varies from year to year due to fluctuations in water chemistry, water temperature and algae growth. Turbidity increases due to marl with no increase in total coliforms at the intake. Additionally, marl is inorganic and the resulting turbidity does not negatively impact disinfection as organic carbon does.

In 2023, turbidity at Kalamalka Lake Intake and MHWTP Post Treatment followed a typical trend, increasing in late April and into May during freshet and again in late July during marl (Figure 15). The elevated data points in late October were due to a two-day shutdown of the Kalamalka Lake source for maintenance and are not relevant to drinking water quality in the distribution system.

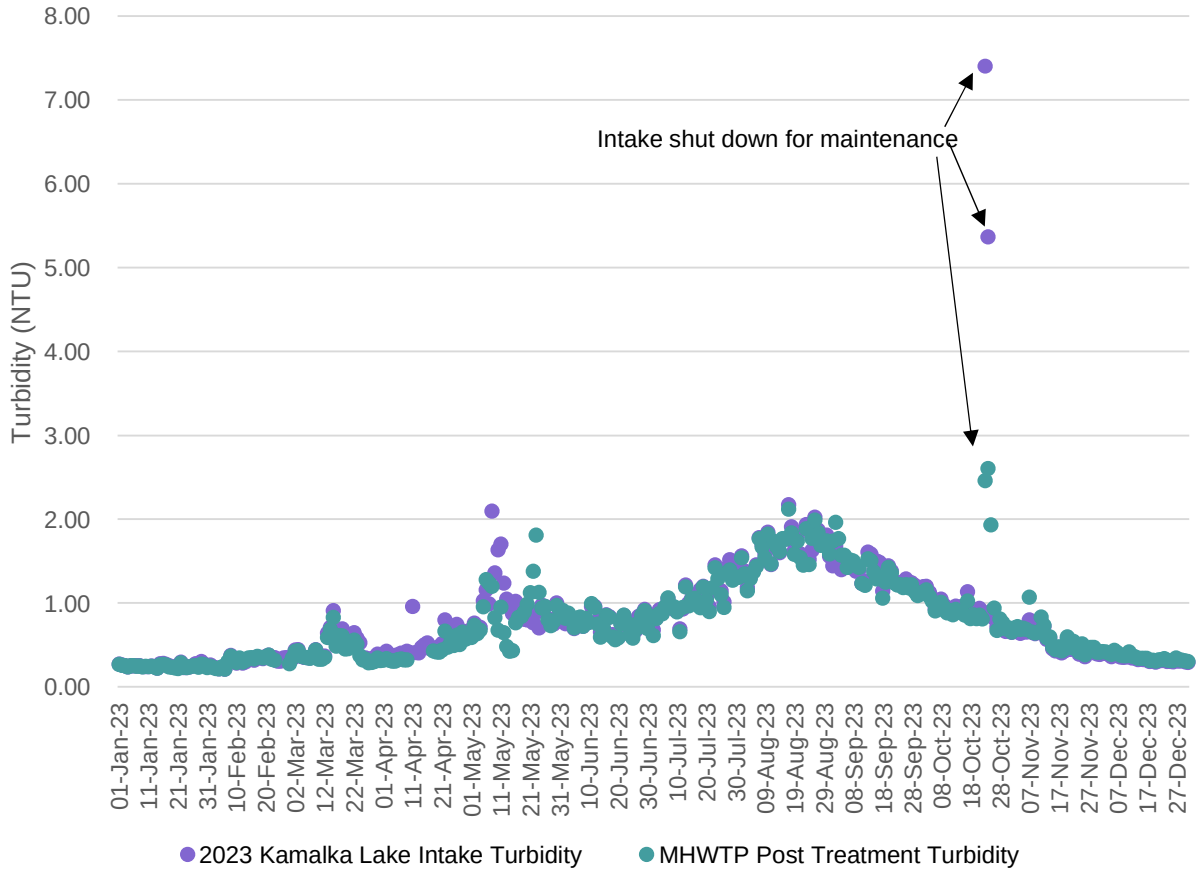



Figure 15: SCADA Daily Average Turbidity at Kalamalka Lake Intake and MHWTP Post Treatment in 2023.

## Temperature

Temperature in Kalamalka Lake is influenced by incoming surface water from freshet flows, wind-driven whole lake seiches, and lake turnover. Temperature often correlates with turbidity, as marl precipitation occurs when temperature increases, in combination with other factors (Figure 16).

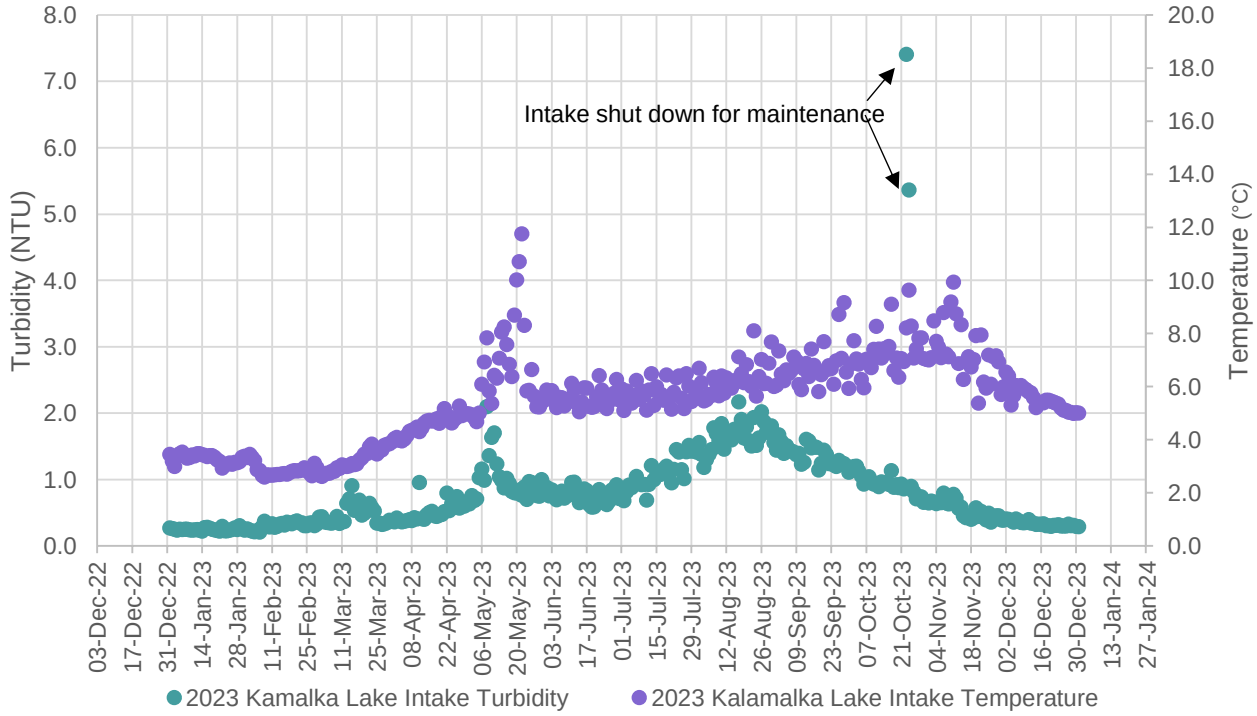



Figure 16: SCADA Daily Averages of Temperature and Turbidity at Kalamalka Lake Intake in 2023.

In 2023, grab sample temperature readings ranged between 3.8ºC and 13.0ºC. The annual average temperature was slightly higher than the historical average, following a cooler year in 2022. The turbidity spikes seen around May correspond to freshet.

Figure 17 provides the average annual temperature at the Kalamalka Lake Intake from 2003 to 2023. The trend indicates a gradual increase in temperature at the Kalamalka Lake Intake, which will be further explored.

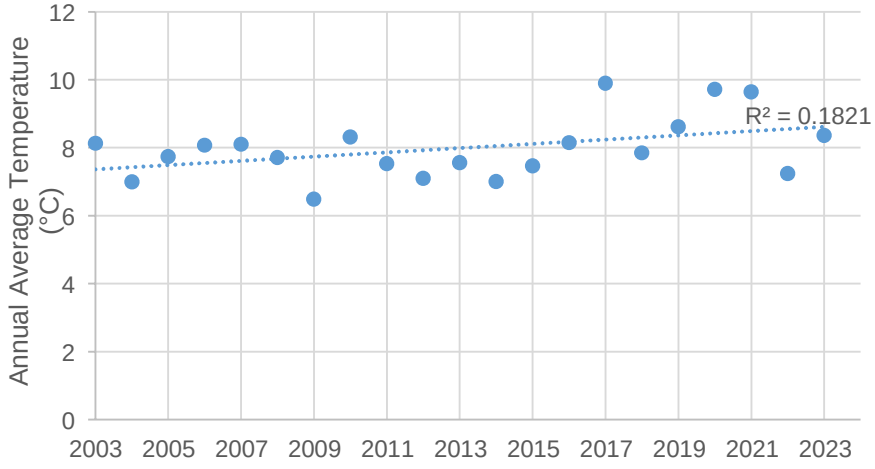



Figure 17: Annual Average Temperature from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

### pH

The pH at the Kalamalka Lake Intake has historically ranged between 6.7 and 8.7. In 2023, the annual average pH was 7.5, which is the lowest average recorded at this site. The pH appears to be decreasing over time at this sample location (Figure 18) and will be further investigated.

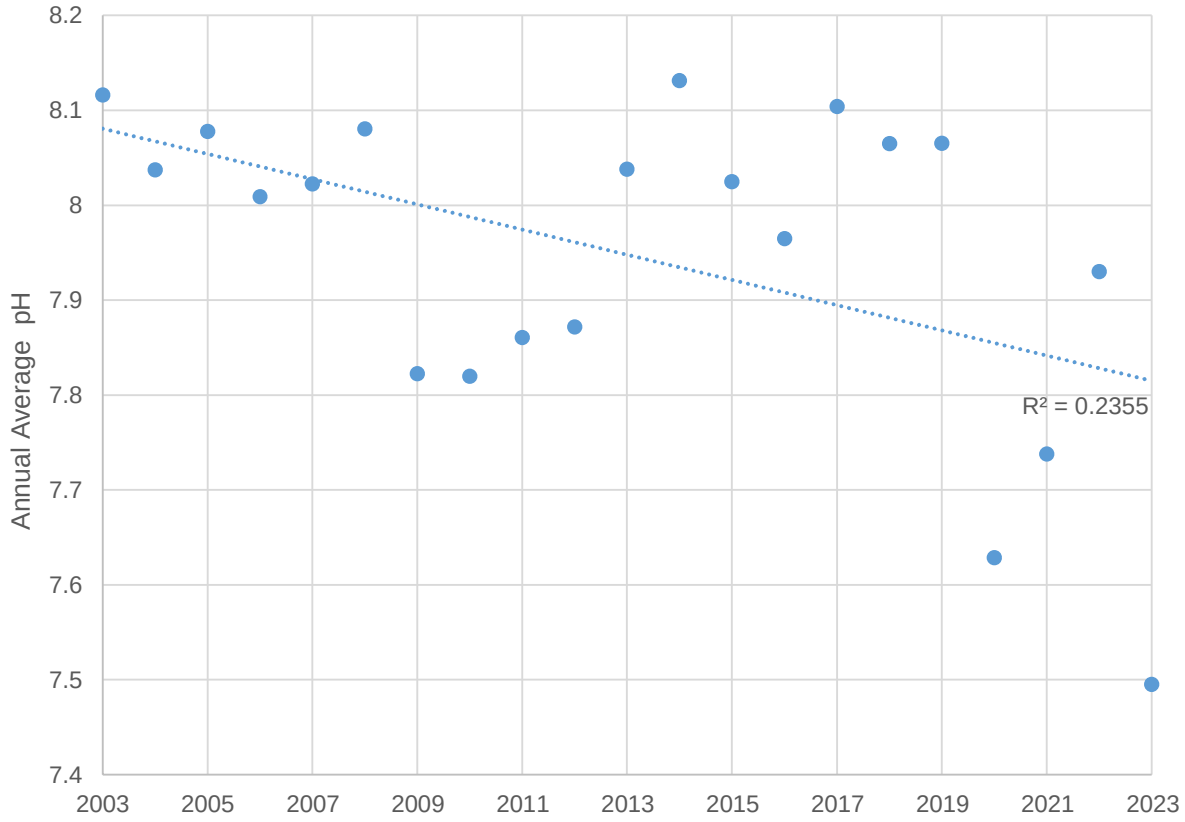



Figure 18: Annual Average pH from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

### Alkalinity / Hardness

Alkalinity is a measure of the water's ability to buffer pH changes. In Kalamalka Lake, alkalinity has fluctuated over the years of record, ranging from 107 to 176 mg/L $CaCO_3$. This is considered to be high alkalinity, which means the lake is more resistant to influences that would cause pH change.

Hardness results have ranged between 158 to 187 mg/L as $CaCO_3$, except for three (3) outlying samples around 130 mg/L. According to Health Canada, water with a hardness between 120 and 180 mg/L is considered hard. The high alkalinity and hardness of Kalamalka Lake water makes it less corrosive to water pipes but can cause scale.

## Chlorophyll a

The data suggests that annual average chlorophyll a concentrations in Kalamalka Lake follow a cyclical pattern, with peaks observed in 2004, 2009, 2015, and 2020, approximately every five (5) years (Figure 19). In 2020, chlorophyll a levels were notably elevated, which coincided with a significant algae bloom in the lake. In 2023, the annual average chlorophyll a concentration was lower than 2020 but appears elevated compared to historical averages; however, most results throughout the year were comparable to previous years. One (1) sample from Kalamalka Lake in September 2023 recorded a historical high of 16.3 ug/L, during a time of high algae densities in the lake (Figure 20). Overall, chlorophyll a concentrations appear to be increasing over time, likely in relation to the increasing algae densities observed.

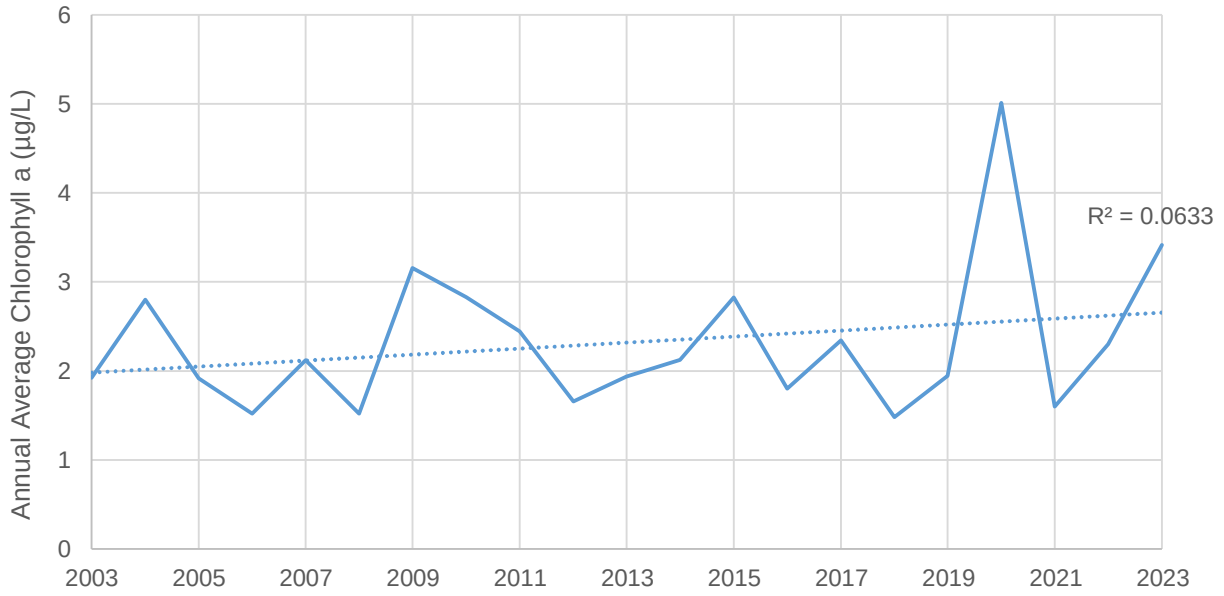



Figure 19: Annual Average Chlorophyll a from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

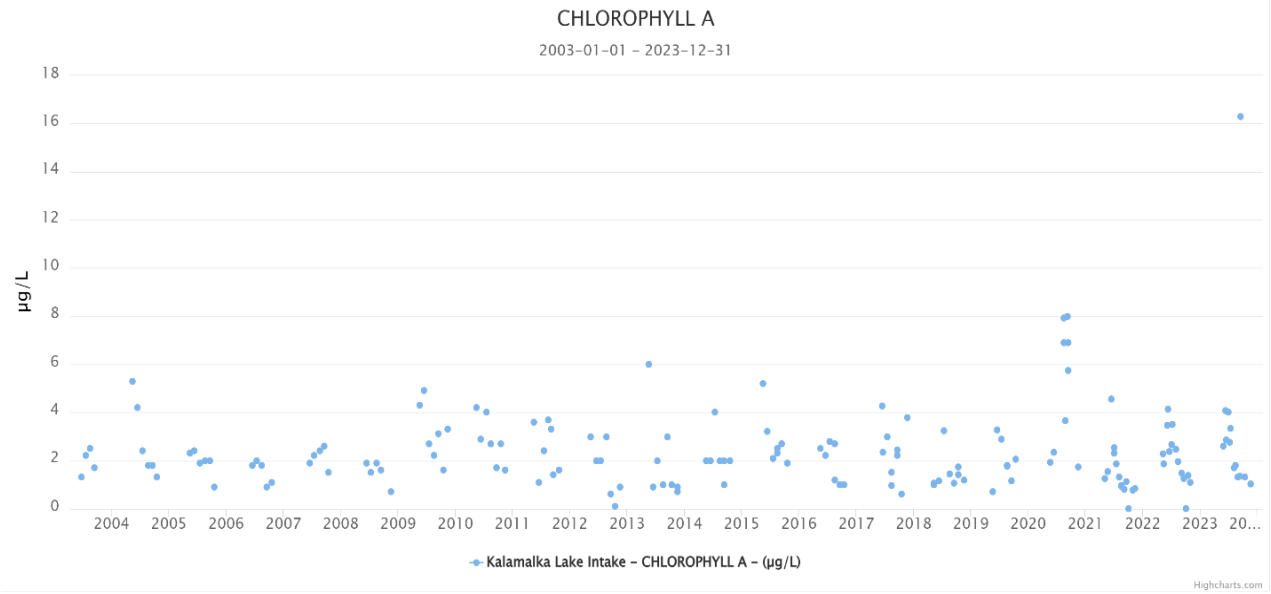



Figure 20: Chlorophyll a Concentrations from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

## Organic Carbon

A significant peak in TOC and DOC occurred around 2010 in Kalamalka Lake, with TOC reaching nearly 15 mg/L, suggesting an organic input event—potentially linked to watershed disturbance or runoff. Following this spike, concentrations stabilized, generally ranging between 3 and 7 mg/L for both parameters (Figure 21). Like Duteau Creek, TOC and DOC are strongly related in Kalamalka Lake when incorporating all data from 2003 to 2023 (Figure 22). This long-term relationship suggests that most organic carbon in the lake is typically present in dissolved form. However, in 2023, the relationship is not as strong ($R^2 = 0.68$), indicating that the organic carbon may have been present in particulate or non-dissolved forms during the year. These organic compounds are important to monitor as they are precursors to disinfection by-products (DBPs) in the system, which will be discussed further in the Distribution section of this report.

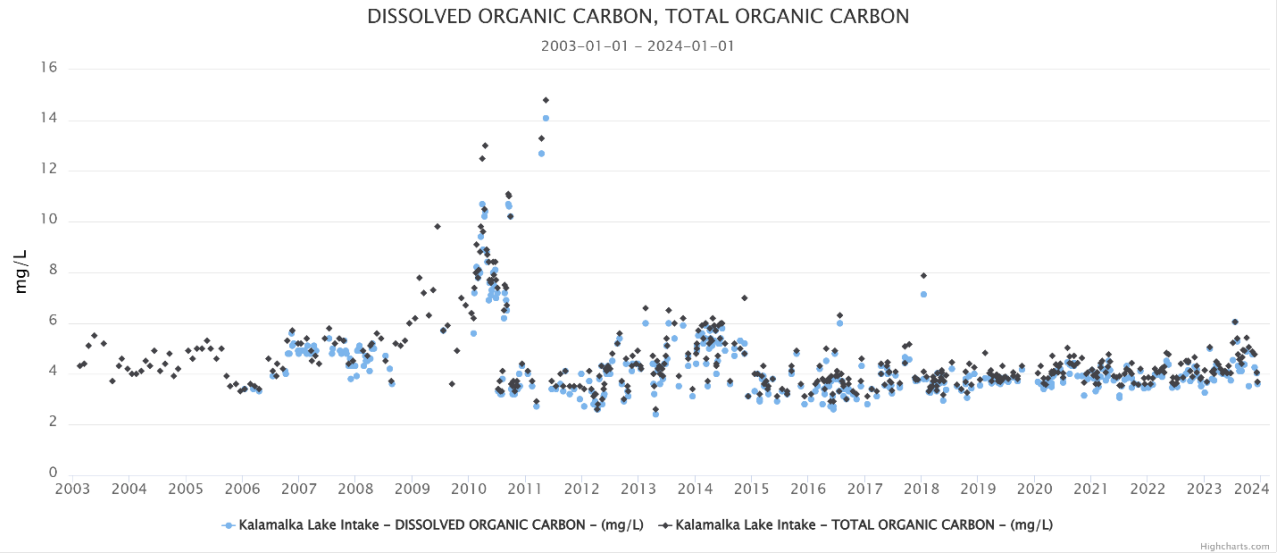



Figure 21: TOC and DOC Concentrations from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

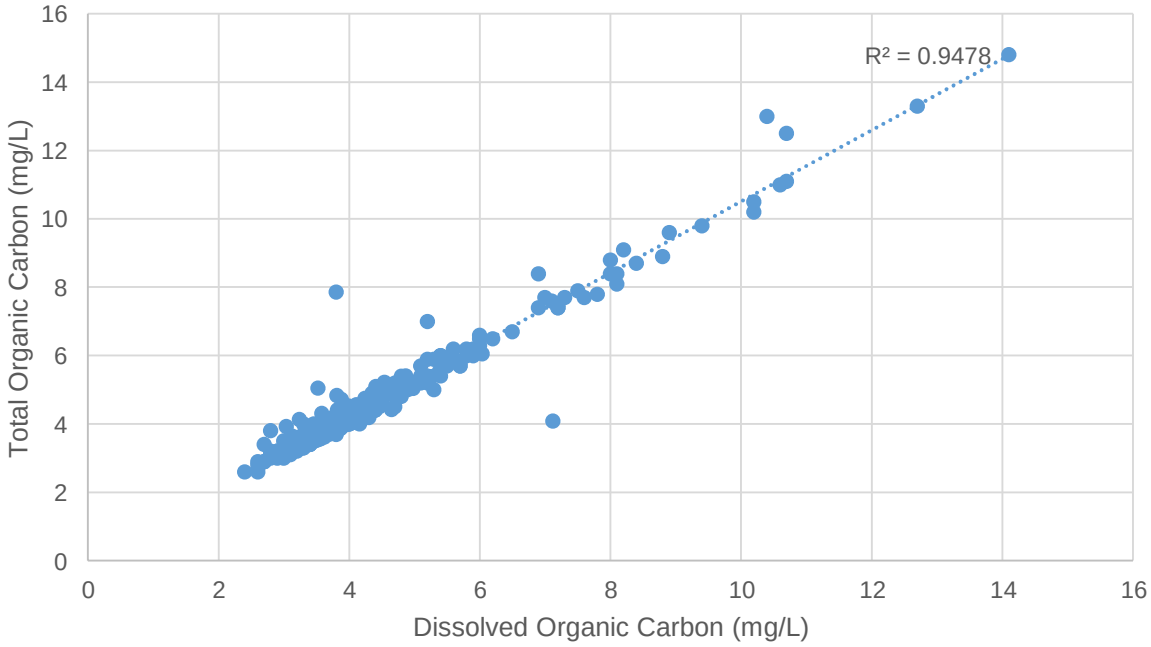



Figure 22: TOC and DOC Correlation at Kalamalka Lake Intake from 2003 to 2023.

### Volatile Organic Compounds

Volatile Organic Compounds (VOC's) are monitored to assess human impact and are an indication of petrochemical contamination (i.e. gasoline, solvents). VOC's have been sampled annually at the Kalamalka Lake Intake since 2004 due to the higher risk related to boating activities. All parameters and results have been non-detect during this time.

### Light Extractable Petroleum Hydrocarbons (LEPH) / Heavy Extractable Petroleum Hydrocarbons (HEPH)

Fuel, LEPH, and HEPH are monitored to assess human impact and are another test for petrochemical contamination but from a broader source (i.e. gasoline, solvents, creosote). These tests have been analyzed approximately every two (2) years at the Kalamalka Lake Intake since 2011. They are completed in August or early September to monitor if any of these chemicals could be entering the lake due to human activities. No compounds were detected in 2023.

### Pesticides and Herbicides

Pesticides and herbicides are monitored to assess human impact in the watershed and determine if they travel from surrounding lands to the lake. A scan of the most common compounds in use is analyzed approximately every two (2) years at the Kalamalka Lake Intake since 2013. No compounds tested for were detected in 2023.

## Biological Monitoring

### Bacteria

Monitoring for Total Coliform bacteria (TC) and *Escherichia Coli* (*E.coli)* is an important part of understanding source water quality and detecting potential changes. Table 8 summarizes the TC and *E.Coli* bacteria sample results from Kalamalka Lake Intake for 2023.

Table 8: Kalamalka Lake Intake Bacteria Sample Summary

| Total Coliform MPN/100 mL | Accredited Lab | RDNO Lab |
|---|---|---|
| # of Samples | 51 | 63 |
| Min | <1 | <1 |
| Max | 132 | 179 |
| Mean | 13 | 11 |
| Counts > 100 MPN/100 mL | 1 | 1 |
| Counts < 1 MPN/100 mL | 1 | 2 |
| **E. coli MPN/ 100 mL** | **Accredited Lab** | **RDNO Lab** |
| # of Samples | 51 | 63 |
| Min | <1 | <1 |
| Max | 30 | 32 |
| Mean | 3 | 3 |
| Counts > 20 MPN/100 mL | 1 | 1 |
| Counts < 1 MPN/100 mL | 17 | 21 |

### Total Coliforms

In October 2023, two (2) grab samples of the 114 samples analysed from Kalamalka Lake Intake showed slightly elevated (>50 MPN/100 ml) TC counts (Figure 23). Despite these samples, overall TC counts were lower in 2023 compared to previous years.

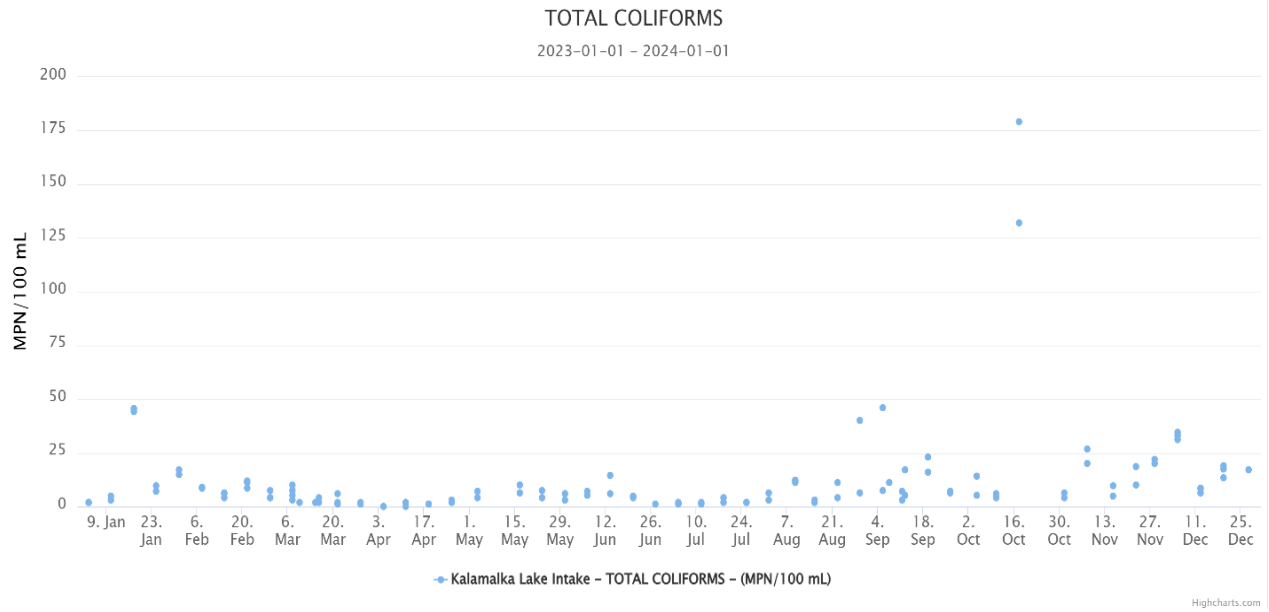



Figure 23: Total Coliforms Counts from Grab Samples Taken at Kalamalka Lake Intake in 2023.

### *E.Coli*

*E.coli* grab samples from the Kalamalka Lake Intake in 2023 followed a similar seasonal pattern to previous years, with slightly elevated counts in the fall and winter months. Overall, *E.coli* counts in 2023 were lower compared to previous years (Figure 24).

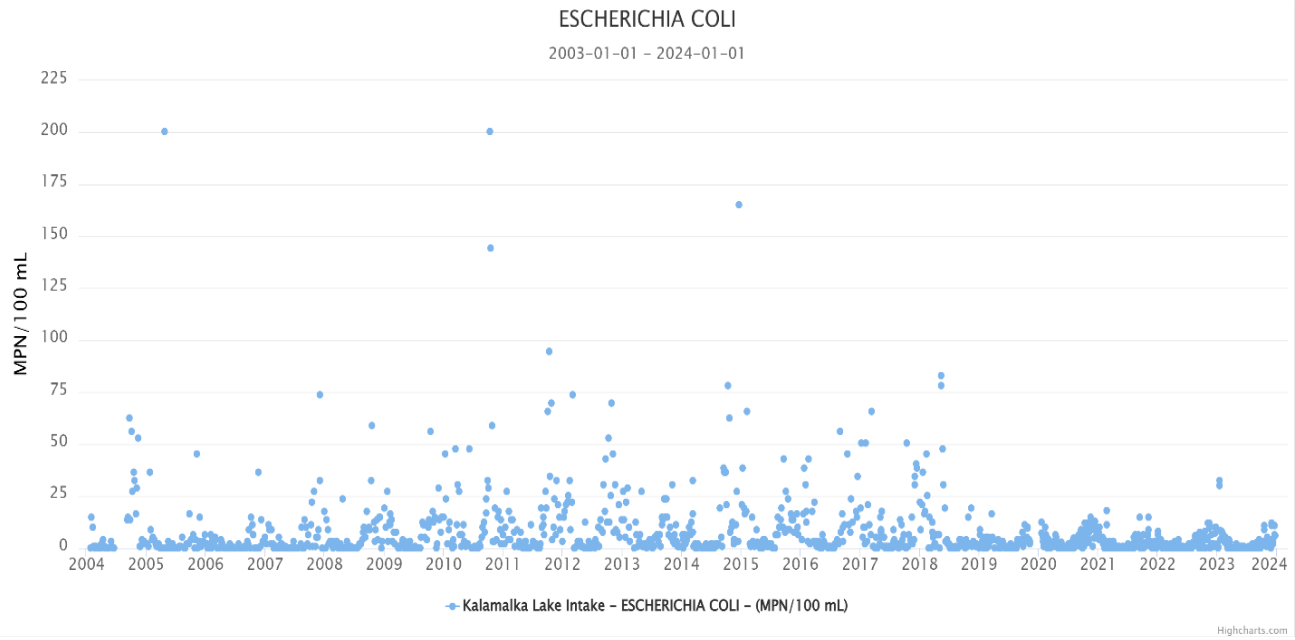



Figure 24: E. coli Counts from Grab Samples Taken at Kalamalka Lake Intake from 2003 to 2023.

## Algae

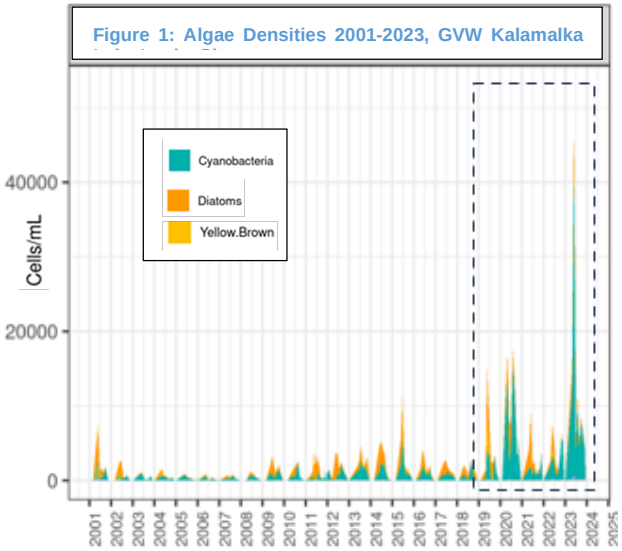
Algae is an ongoing concern in Kalamalka Lake, affecting taste and odour, adding to the biomass in the distribution system fueling regrowth and has the potential to be toxic if Cyanobacteria is present. The RDNO conducts year-round sampling to identify, speciate, and count the algae present at the Kalamalka Lake Intake. The RDNO also conducts sampling for nutrients that contribute to algal growth, which are often indicators of human impacts to the source water quality. Further study and observation on Kalamalka Lake miroflora (water chemistry and thermal profiles), is conducted by Larratt Aquatic Consulting Ltd.

To understand nutrient loading and the potential for algae blooms, an outline is provided in the BC Decision Protocol for Cyanobacterial Toxins (MOH, 2018). Within the protocol, further investigation into toxin formation is recommended if any of the following conditions are met:

1. nitrogen greater than 658 ug/L
2. phosphorous greater than 26 ug/L
3. N:P ratio less than 23
4. algae blooms observed.

In 2023, the highest nitrogen (total) observed at the Kalamalka Lake Intake was 498 ug/L and the highest phosphorus (total) was 17 ug/L, both below the protocol thresholds for the first two (2) points; however, there were two (2) instances where the N:P ratio was less than 23 in July and August. The RDNO monitors cyanobacteria counts and conducts microcystin testing when these counts exceed a threshold level.

Figure 1: Algae Densities 2001-2023, GVW Kalamalka




Since 2020, algae densities have increased dramatically in Kalamalka Lake as shown in figure to the right from the Larratt Aquatic Consulting (LAC)'s 2023 Kalamalka Lake Water Quality Study. In 2023, algae densities, predominantly Cyanobacteria, were very high in the north end of the lake where the intake is located but intake samples did match the lake and were below the level requiring notification or the threshold for microcystin testing.

For a detailed summary of the lake's water quality and algae data, see the Larratt Aquatic Consulting (LAC)'s 2023 Kalamalka Lake Water Quality Study.

# Treatment Monitoring Program

## Duteau Creek Water Treatment Plant

Water quality at the DCWTP is monitored online through SCADA, as well as through sampling and analysis of certain parameters throughout the treatment process by RDNO operators. The sampling analysis and frequency is outlined in the WQMP (Attachment A). Water quality staff take samples weekly at the reservoir outlet, and complete additional sampling on a monthly and annual schedule as detailed in WQMP (Attachment A). The chlorine Contact Time (CT) for 4 log inactivation of viruses is applied just when the water enters the DCWTP reservoir and the dosage can be adjusted when required. Table 9 summarizes the DCWTP monthly averages for post-treatment free chlorine, pH, and pre-treatment UV in 2023.

Table 9: Duteau Creek Water Treatment Plant 2023 Monthly SCADA Averages

| DCWTP Monthly SCADA Averages | | | |
|---|---|---|---|
| Parameter | Post Treatment Free Chlorine (mg/L) | Post Treatment pH | Pre Treatment UVT (%) |
| January | 1.91 | 7.29 | 89.16 |
| February | 1.90 | 7.24 | 88.59 |
| March | 1.91 | 7.21 | 87.87 |
| April | 1.91 | 7.26 | 86.19 |
| May | 1.91 | 7.04 | 86.06 |
| June | 1.91 | 7.16 | 86.63 |
| July | 1.90 | 7.10 | 84.15 |
| August | 1.91 | 7.04 | 84.84 |
| September | 1.92 | 7.12 | 87.13 |
| October | 1.91 | 7.29 | 88.98 |
| November | 2.22 | 7.22 | 91.51 |
| December | 1.92 | 7.30 | 89.59 |

## Treatment Targets for Turbidity

Online turbidity analyzers continuously record raw and treated water turbidity to ensure that the treatment process is functioning correctly and that water entering the distribution system meets provincial standards. Online turbidity analyzers are monitored through SCADA and trigger alarms when turbidity exceeds predefined thresholds. Operators and staff respond as outlined in the GVW Water Quality Deviation Response Plan (Attachment B).

The DCWTP is effective at reducing raw water turbidity levels to ensure the levels entering the distribution system are less than 1 NTU. No water with a daily average turbidity greater than 1 NTU entered the distribution system in 2023.

## Ultraviolet Transmittance

UV Transmittance (UVT) is monitored at 254 nm to evaluate the effectiveness of UV disinfection at the DCWTP which has a minimum validation threshold of 76 %. UVT (unfiltered) is continuously recorded online when the plant is running, with daily grab samples collected for verification to ensure the UVT does not drop below 76%. As shown in Figure 25, UVT values ranged from 82.1% and 96.5% before UV treatment, indicating optimal conditions for effective UV disinfection.

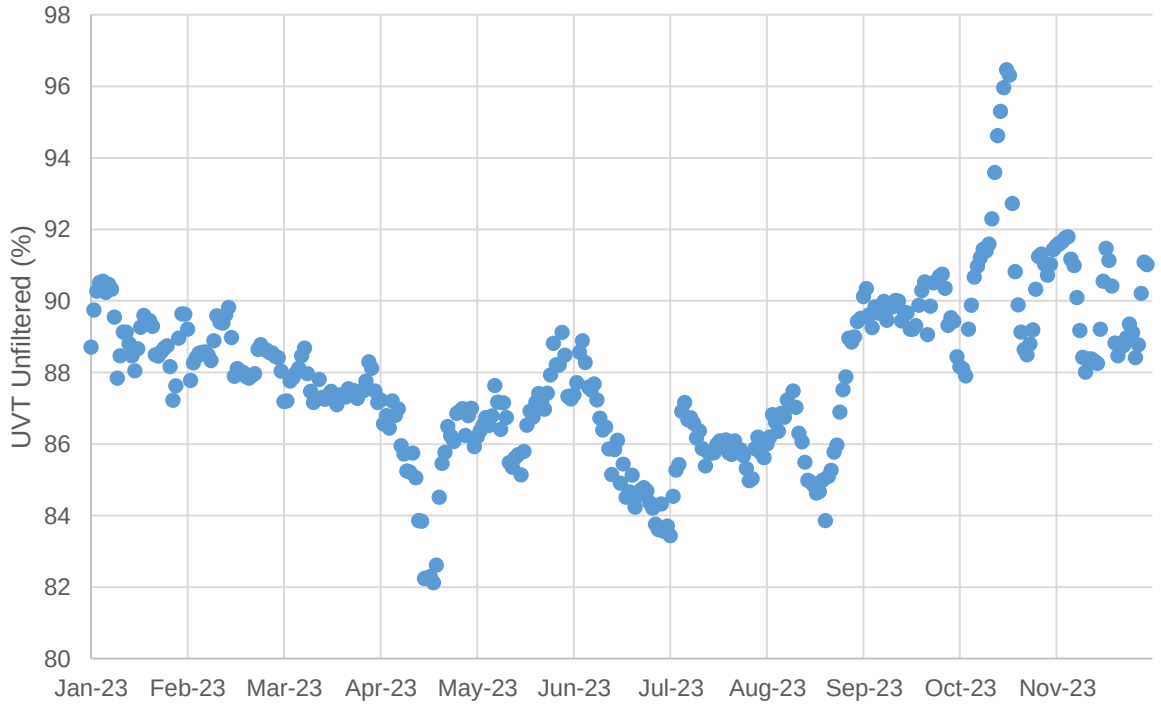



Figure 25: SCADA Daily Average UVT (Unfiltered) at the DCWTP (Pre-UV Treatment) in 2023.

## Aluminum

Aluminum in drinking water is subject to operational guidance values, which are specifically applicable to treatment plants using aluminum-based coagulants. For conventional treatment facilities, the operational guidance value is 0.1 mg/L, while for other types of treatment systems, it is 0.2 mg/L. These values are reported as a 12-month running average.

At the DCWTP, both total and dissolved aluminum concentrations are monitored monthly at the reservoir intake and within the distribution system. These measurements reflect residual aluminum carryover from the DAF process. Elevated levels of dissolved aluminum may indicate either high aluminum content in the raw water or overdosing of Poly Aluminum Chloride (PAC), the plant's primary coagulant. Such carryover is a concern not only for immediate water quality but also for potential aluminum accumulation in the distribution system, which can degrade long-term water quality.

Figure 26 shows the annual average total aluminum concentrations from 2011 to 2023, including data from the Duteau Creek Intake, DCWTP Post Treatment, and within the distribution system at PRV 1 and PRV 2. As shown in the figure, the source water contains measurable levels of naturally occurring total aluminium. It also highlights the improved control of coagulant dosing over time since the treatment plant began operating in late 2010. Total aluminum is one (1) of the parameters monitored as part of the Water Quality Indicators (WQI) for plant operations. In the distribution system, total aluminum was historically measured at PRV 1, with monitoring shifting

to PRV 2 in 2019 to better represent the broader system. Overall, the data shows that current total aluminum levels do not pose a health concern. The GCDWQ MAC for total aluminum is 2.9 mg/L.

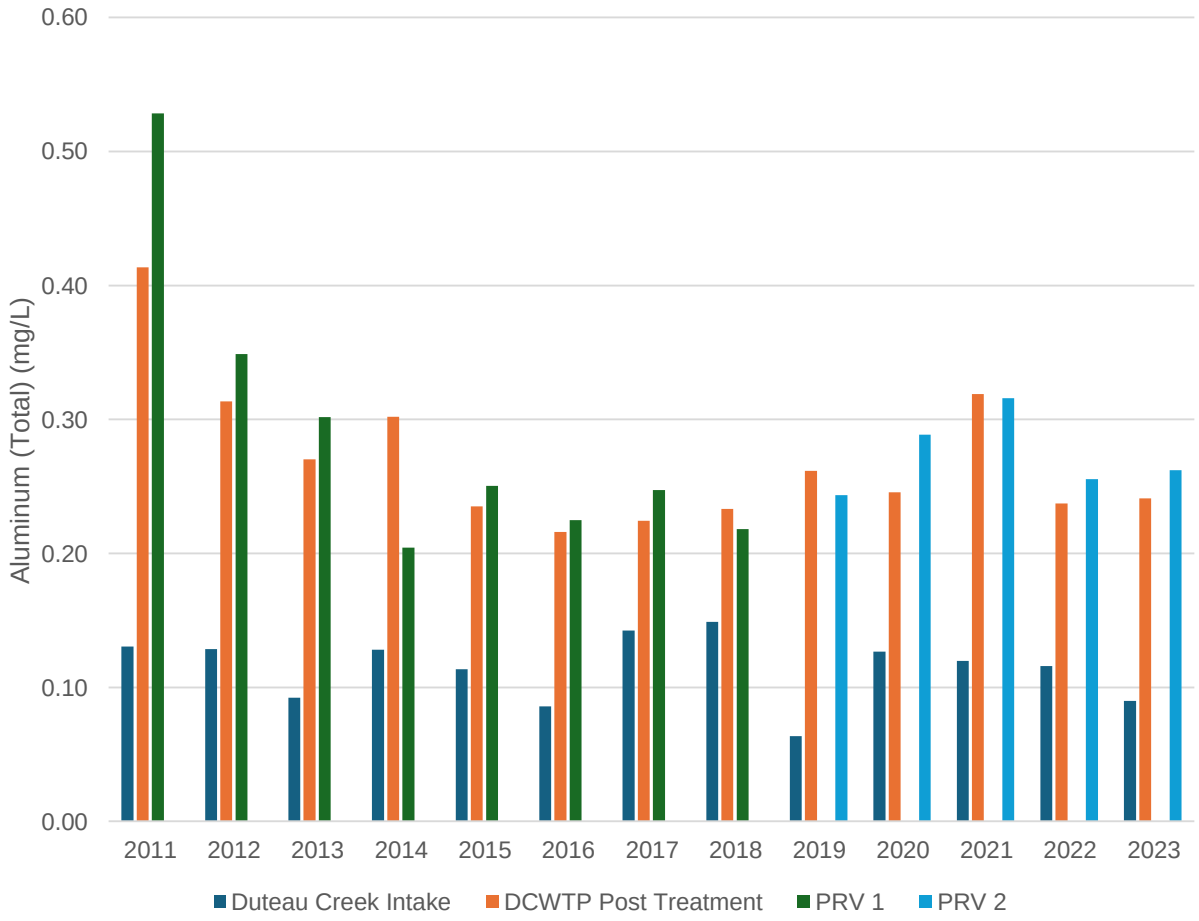



Figure 26: Annual Average Total Aluminum from Grab Samples in the Duteau Creek System from 2011 to 2023.

## Total and Dissolved Organic Carbon

Figure 27 displays monthly grab sample results for total organic carbon (TOC) from the raw water (Haddo Weir and Duteau Creek Intake) and post-treatment at the DCWTP. These measurements allow for the calculation of percent removal, providing insight into treatment efficiency.

TOC and DOC are important parameters due to their effect on the formation of disinfection by-products (DBPs), which will be discussed further in the Distribution section of this report. TOC and DOC also affect the UV disinfection process as organic carbon absorbs UV light, potentially reducing disinfection effectiveness.

Measurements taken since 2003 show an apparent peak in 2011, followed by a gradual decline and have remained stable since. TOC levels at Haddo Weir are consistent with those at the intake, any significant deviations would indicate changes in watershed conditions between the reservoirs and the intake.

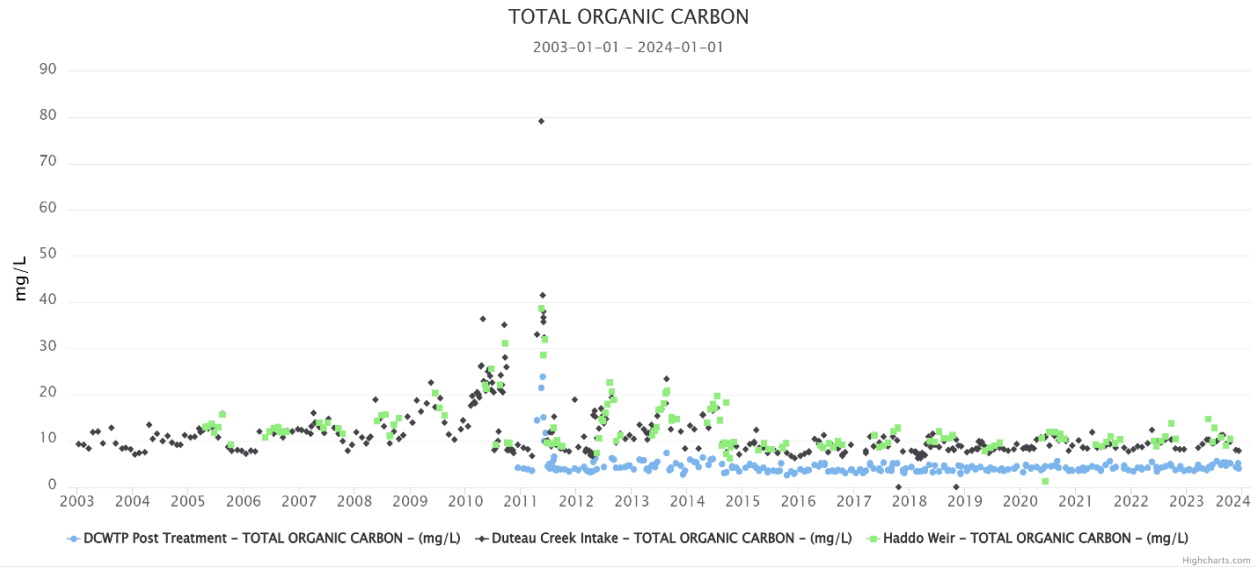



Figure 27: Total Organic Carbon from Grab Samples in the Duteau Creek System from 2003 to 2023.

## Mission Hill Water Treatment Plant

Water quality at the MHWTP is monitored online through SCADA, and through sampling and analysis of certain parameters throughout the treatment process by RDNO operators. The sampling analysis and frequency is outlined in the WQMP (Attachment A). Water quality staff take samples weekly at the wetwell outlet, and complete additional sampling on a monthly and annual schedule as detailed in the WQMP (Attachment A). The chlorine Contact Time (CT) for 4 log inactivation of viruses is applied at the MHWTP reservoir and the dosage can be adjusted if required. Table 10 summarizes the monthly averages for post-treatment free chlorine and pre-treatment UVT (%) in 2023. The UV at MHWTP has a minimum validation of 86 %. All off-spec water is reported in the monthly water quality reports available on the RDNO website at https://www.rdno.ca/gvw/waterquality.

Table 10: Mission Hill Water Treatment Plant 2023 Monthly SCADA Averages

| MHWTP Monthly SCADA Averages | | |
|---|---|---|
| Parameter | Post Treatment Free Chlorine (mg/L) | Pre Treatment UVT (%) |
| January | 2.00 | 91.47 |
| February | 1.99 | 91.41 |
| March | 2.10 | 91.68 |
| April[1] | 2.00 | 91.78 |
| May[2] | 2.08 | 90.97 |
| June | 2.04 | 90.43 |
| July | 1.99 | 90.39 |
| August | 2.26 | 89.74 |
| September | 2.30 | 91.05 |
| October | 2.22 | 93.81 |
| November | 2.13 | 91.86 |
| December | 2.00 | 91.17 |

[1]8 days of SCADA data could not be recovered due to computer error, but regular monitoring did not note a water quality deviation.

[2]Kalamalka Lake source was turned off on May 4, 2023 due to high turbidity during freshet and turned back on May 24, 2023.

## Treatment Targets for Turbidity

Online turbidity analyzers continuously record raw and treated water turbidity to ensure that water entering the distribution system meets the provincial standards. Turbidity analyzers are monitored through SCADA and trigger alarms when turbidity exceeds predefined thresholds. Unlike the DCWTP, the type of treatment at the MHWTP does not reduce turbidity from the source water. When turbidity levels at the Kalamalka Lake intake are trending greater than the defined values in the GVW Water Quality Deviation Response Plan, and when system demand allows, the source is turned off and switched to the DCWTP. The MHWTP was turned off in May 2023 due to high turbidity for a total of 20 days.

### Ultraviolet Transmittance

UV Transmittance (UVT) is monitored at 254 nm to evaluate the effectiveness of UV disinfection at the MHWTP which has a minimum validation of 86%. UVT (unfiltered) is continuously recorded online when the plant is running and monitored through SCADA. As shown in Figure 28, UVT values ranged from 89.4% and 92.18% before UV treatment, indicating optimal conditions for effective UV disinfection. Some data points are missing from the figure in April, May and October due to the UVT analyzer being repaired, the MHWTP being offline, or SCADA disruptions.

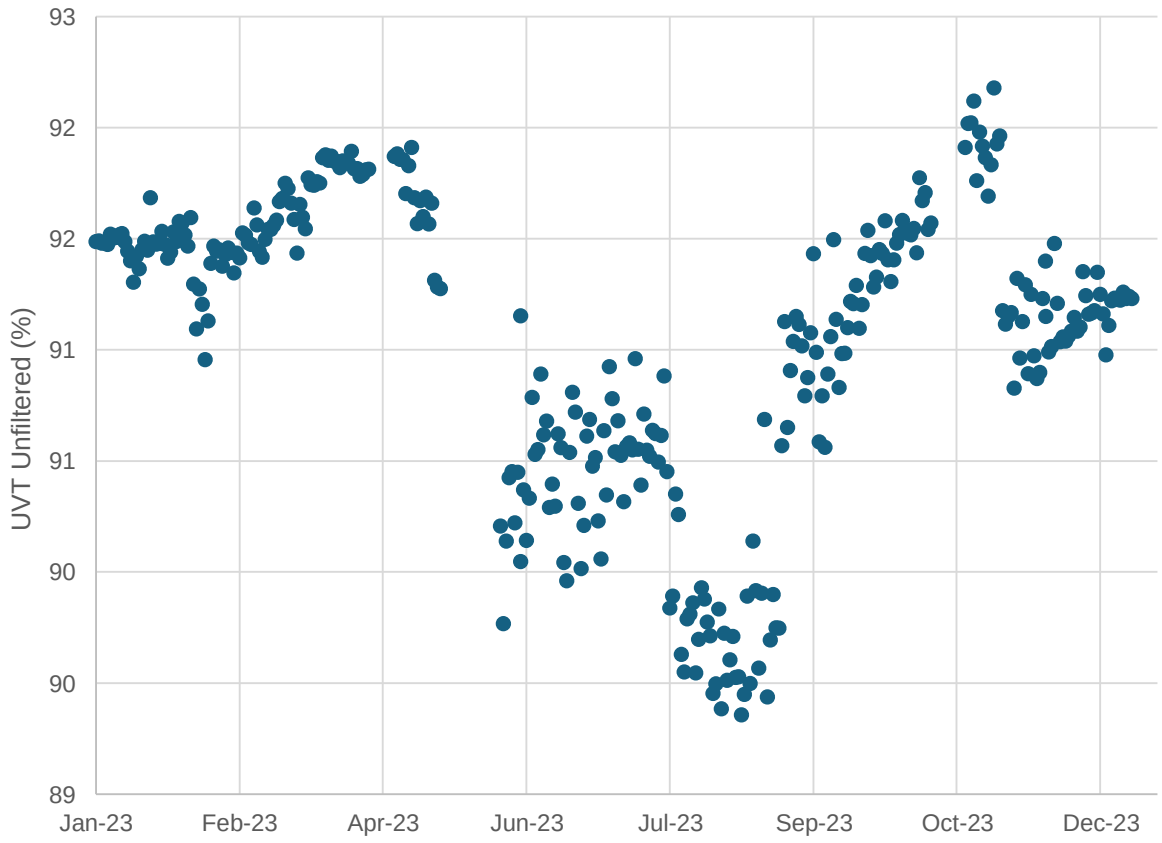



Figure 28: SCADA Daily Average UVT (Unfiltered) at the MHWTP (Pre-UV Treatment) in 2023.

## Distribution Monitoring Program

Following treatment and / or disinfection, the distribution water quality program is designed to meet the community water system regulations prescribed by the *DWPR* Schedules A and B, as well as the *GCDWQ* including Maximum Acceptable Concentrations (MACs) and Aesthetic Objectives (AOs). Additional parameters may be monitored if they are known to create problems within the water distribution system or are required for individual projects.

The water distribution system is monitored weekly by operators and water quality staff. If unacceptable field parameters are observed, further investigation is conducted and flushing may be initiated. Routine field parameters include: pH, turbidity, temperature, conductivity, free and total chlorine, and bacteria.

Distribution sampling site locations and frequency are determined by GVW and / or following provincial requirements. The monitoring program is designed to capture changes in water quality as it flows through the distribution system. GVW submits an annual Water Quality Monitoring Plan (WQMP) to the IH, included as Attachment A.

During normal operations, the distribution system acts as two (2) separate systems, each area supplied by either Duteau Creek or Kalamalka Lake. However, the system is fully integrated and can be supplied by either source or by blending sources which impacts the results at sampling sites. Conductivity measurements are used to identify the source water where Kalamalka Lake water has a conductivity between 400 and 500 µS/cm and treated Duteau Creek water has a conductivity between 100 and 200 µS/cm. Blending of sources will be somewhere in the middle.

GVW is a very large system that has a service area of 35 km from north to south and close to 700 km of pipes. Water quality throughout the service area can be very different depending on proximity to treatment plants or chlorine booster stations, water age and the amount of water used in an area. To obtain representative samples throughout the distribution system, GVW uses both dedicated and continuously running sample analysers for certain parameters located at utility-owned sites (i.e. reservoirs and pump stations) and grab samples from water quality sample stations. GVW has 84 regularly monitored sample stations connected directly to water lines throughout the system to ensure accuracy and accessibility. In certain cases, sampling may be completed at public buildings or residential homes, but is not preferred as the sites can be unreliable due to access issues or may not provide accurate results due to issues with the internal plumbing or stagnant water. Sampling sites are re-evaluated and updated as the GVW program evolves.

GVW is committed to the health and safety of the water system and maintaining public confidence. Close collaboration with IH helps ensure that residents receive safe, high-quality drinking water.

## Bacterial Testing Overview

The *DWPA* and DWPR have established the following water quality standards for potable water systems where more than one (1) sample is taken in a 30-day period, as set out in Schedule A:

- No detectable *E. coli* per 100 mL in any sample of water.
- At least 90% of samples have no detectable TC per 100 mL, and
- No sample has more than 10 TC per 100 mL.

GVW, as the drinking water purveyor serving the Greater Vernon area with a population of approximately 65,000, is required to test a minimum of 67 bacterial samples per month at an accredited lab as outlined in Schedule B of the DWPR. GVW exceeds the number of samples required as additional sites are added to the program due to the complexity and long pipe lengths in the distribution system as well as added sampling in low chlorine areas.

In 2023, there were a total of 1,779 bacterial samples taken at 89 sample sites in the GVW distribution system. Table 11 summarizes the bacterial sampling results with the following summarizing the 2023 sampling program:

- One (1) sample collected from the distribution system could not be definitively confirmed as negative for *E.coli*. This sample was taken on the same morning as a large multi-building fire in downtown Vernon, during which significant and atypical water movement occurred due to firefighting activities. Additionally, the sample exceeded the 30-hour holding time before being processed at the accredited lab, which may have affected results. The sample, analyzed as CFU/100 mL, resulted in overgrowth with background bacteria. While TC was detected, the bacterial overgrowth prevented an accurate count. No visible *E.coli* was observed; however, due to the overgrowth, the presence or absence of *E.coli* could not be definitively confirmed and was therefore reported as > 200 CFU/100 mL. The re-sample taken three (3) days later contained zero *E.coli.*

- 99.2% of samples in the Duteau Creek system and 97.1% of samples in the Kalamalka system had no detectable TC per 100 mL.
- Two (2) samples had more than 10 TC per 100 mL:
    - One (1) sample was from the Kalamalka Lake distribution system, and is the same sample taken on the morning of the downtown fire incident, which is described in the first bullet above.
    - The other sample was from the Duteau Creek distribution system. This sample was taken July 25th at 7900 McClounie Road, in front of Kalamalka Secondary School. This sample station is located at the end of a water line and has little to no flow during the summer when school is not in session. This sample was also analyzed after the 30-hour holding time had been exceeded at the accredited lab and the final result was estimated due to the high bacterial count. The re-sample taken three (3) days later contained zero TC. To address the stagnant water and potential bacterial growth, regular flushing occurs during the summer at this sample site.

Table 11: Distribution Bacterial Sampling Summary

| 2023 Distribution Bacterial Sampling Summary | | |
|---|---|---|
| RDNO Lab Results | Distribution | |
| | Duteau Creek | Kalamalka Lake |
| Number of samples (MPN or P/A) | 384 | 487 |
| Number of samples containing *E.coli* (MPN or P/A) | 0 | 0 |
| Number of samples containing TC (MPN or P/A) | 0 | 2 |
| % of samples with zero TC | 100% | 99.6% |
| Number of occasions with consecutive samples containing TC | 0 | 0 |
| Accredited Lab Results | Distribution | |
| | Duteau Creek | Kalamalka Lake |
| Number of samples (CFU or MPN) | 257 | 651 |
| Number of samples containing *E.coli* (CFU or MPN) | 0 | 1 |
| Number of samples containing TC (CFU or MPN) | 2 | 19 |
| % of samples with zero TC | 99.2% | 97.1% |
| Number of occasions with consecutive samples containing TC | 0 | 2 |
| Both Lab results combined | Distribution | |
| | Duteau Creek | Kalamalka Lake |
| Number of samples | 641 | 1138 |
| Number of samples containing *E.coli* | 0 | 1 |
| Number of samples containing TC | 2 | 21 |
| % of samples with zero TC | 99.7% | 98.2% |
| Number of samples with >10 TCs | 1 | 1 |

## Disinfection By-Products

Trihalomethanes (THMs) are disinfection by-products formed when chlorine reacts with naturally occurring organic compounds in the source water. The concentration of THMs in treated water is influenced by numerous factors, including TOC, temperature, pH, water age, and chlorine dose. 10 distinct THM compounds can form but only four (4) are commonly found at significant levels in treated drinking water:

- Chloroform
- Bromodichloromethane
- Dibromochloromethane
- Bromoform

These four (4) compounds are collectively referred to as Total Trihalomethanes (TTHMs). In this report, TTHMs refer to the average concentration of these four (4) compounds at each sampling site.

The GCDWQ MAC for TTHMs is 0.1 mg/L (100 µg/L) and is based on a locational running annual average, calculated from a minimum of quarterly samples collected at the point in the distribution system where THMs are expected to be highest.

Haloacetic acids (HAAs) are another group of disinfection by-products formed through the reaction of chlorine with organic compounds in source water. Their formation is influenced by several factors such as bromide concentration, temperature, pH, water age, and chlorine dose. While several HAA compounds can form, five (5) are commonly found in treated drinking water:

- Monochloroacetic acid
- Monobromoacetic acid
- Dichloroacetic acid
- Trichloroacetic acid
- Dibromoacetic acid.

These compounds are collectively referred to as Total Haloacetic Acids (THAAs). In this report, THAAs refer to the average concentration of all five (5) compounds at each sampling site.

The GCDWQ MAC for HAAs is 0.08 mg/L (80 µg/L), also based on a locational running annual average of a minimum of quarterly samples taken in the distribution system. HAAs may enter water sources through agricultural runoff, industrial wastewater, or accidental spills.

Health Canada advises that water utilities should make every effort to maintain disinfection by-product concentrations as low as reasonably achievable, without compromising the effectiveness of disinfection.

GVW collects THM and HAA samples quarterly at eight (8) sample sites throughout the distribution. Conductivity measurements are also taken to identify the source water (Tables 12 and 13).

## Duteau Creek Distribution System TTHMs

As noted in the Treatment Monitoring Program section, the DCWTP removes THM precursors such as organic carbons. This also reduces the chlorine demand and the colour of the water. As a result, the TTHMs have been reduced by almost 50% since the commissioning of the DCWTP in 2010; however, in 2023, the combined annual average of TTHMs remains above the GCDWQ MAC of 100 µg/L (Figure 29).

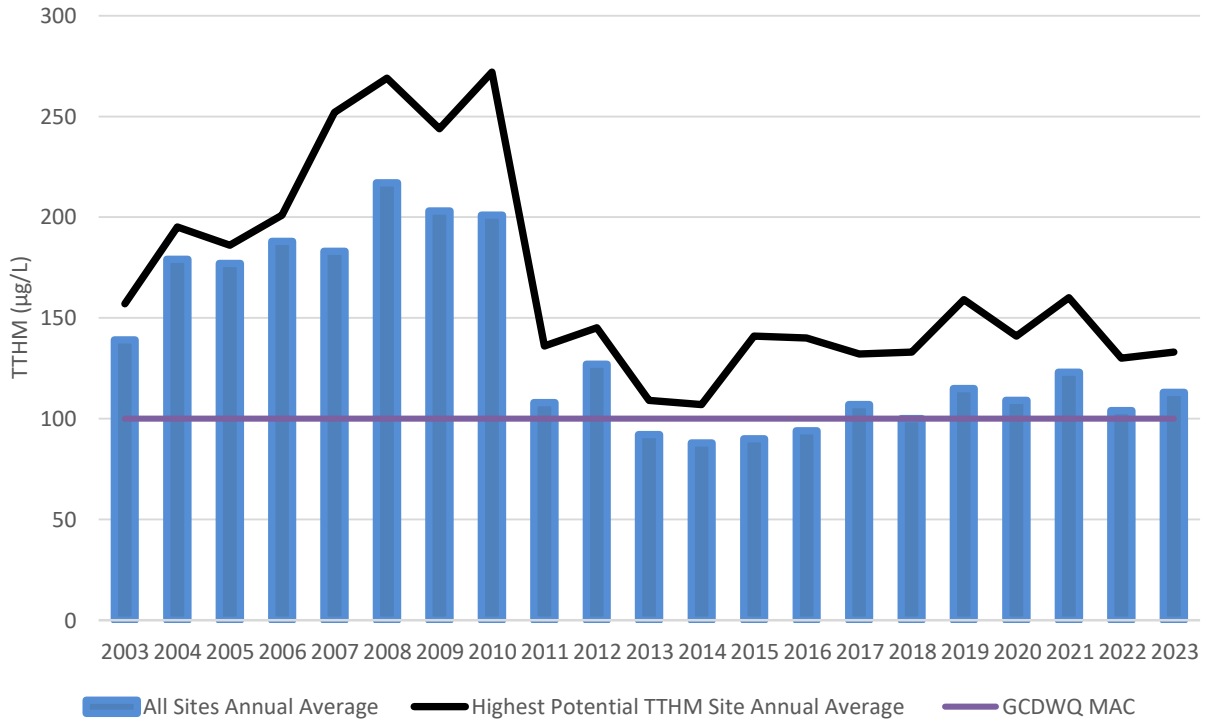



Figure 29: Annual Average TTHMs in the Duteau Creek Distribution System from 2003 to 2023.

Figure 30 shows the 2023 TTHMs for the Duteau Creek distribution system sampling sites. With the exception of the DCWTP site, the annual average TTHM levels at all locations exceeded the GCDWQ MAC. Palfrey Drive SS was not sampled in September due to nearby construction activity. Some of the sample sites were receiving Kalamalka Lake source water or a blend at the time of sampling, which may influence the TTHM concentration (Table 12). To address elevated TTHM levels, further improvements are being studied through chlorine management strategies within both the treatment process and the distribution system (looping, re-chlorination stations, reservoir management, and operational adjustments).

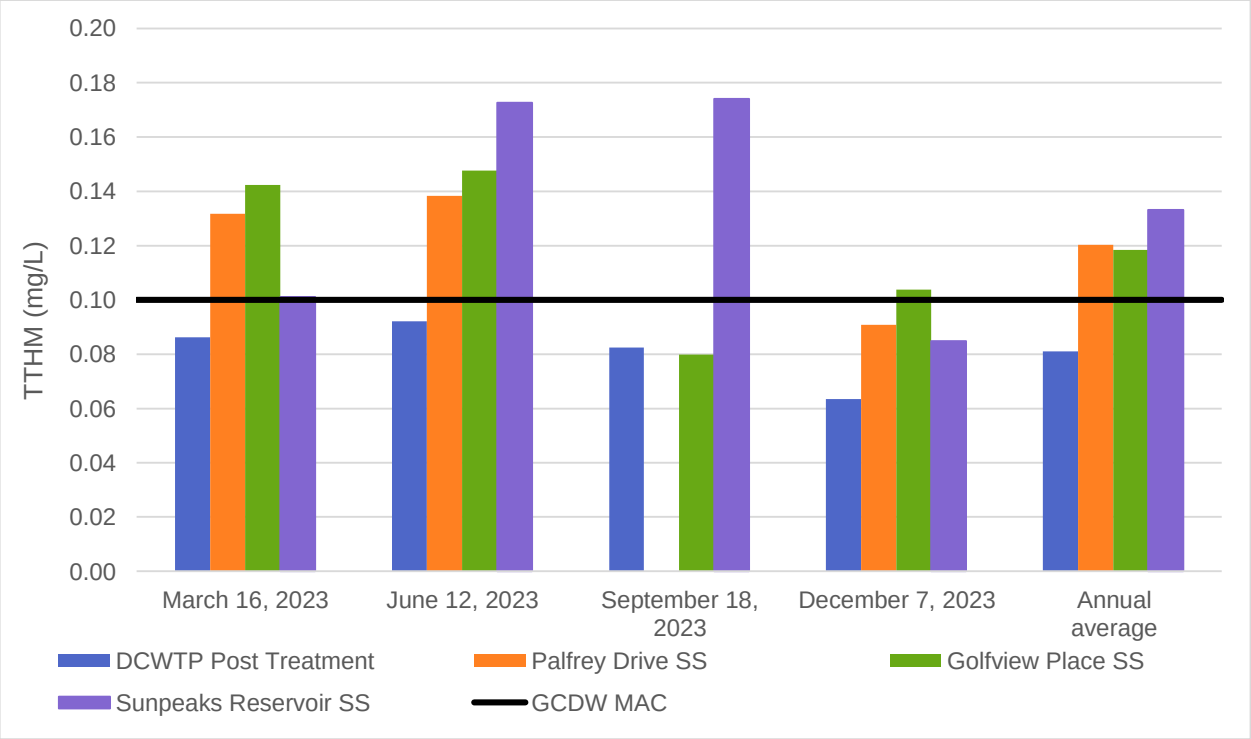



Figure 30: 2023 TTHMs in the Duteau Creek Distribution System.

Table 12: Conductivity at Duteau Creek Distribution TTHM and THAA Sample Sites in 2023

| Date | DCWTP Post Treatment | Palfrey Drive SS | Golfview Place SS | Sunpeaks Reservoir SS |
|---|---|---|---|---|
| March 16 | 110 | 120 | 320 | 430 |
| June 12 | 100 | 100 | 150 | 270 |
| September 18 | 100 | NA | 110 | 110 |
| December 7 | 102 | 96 | 360 | 414 |

## Duteau Creek Distribution System THAAs

HAAs have been monitored since 2011 in the GVW water distribution system at the same locations as THM's. In 2023, the combined annual average of THAAs at the Duteau Creek distribution system sample sites was below the GCDWQ MAC of 80 µg/L (Figure 31).

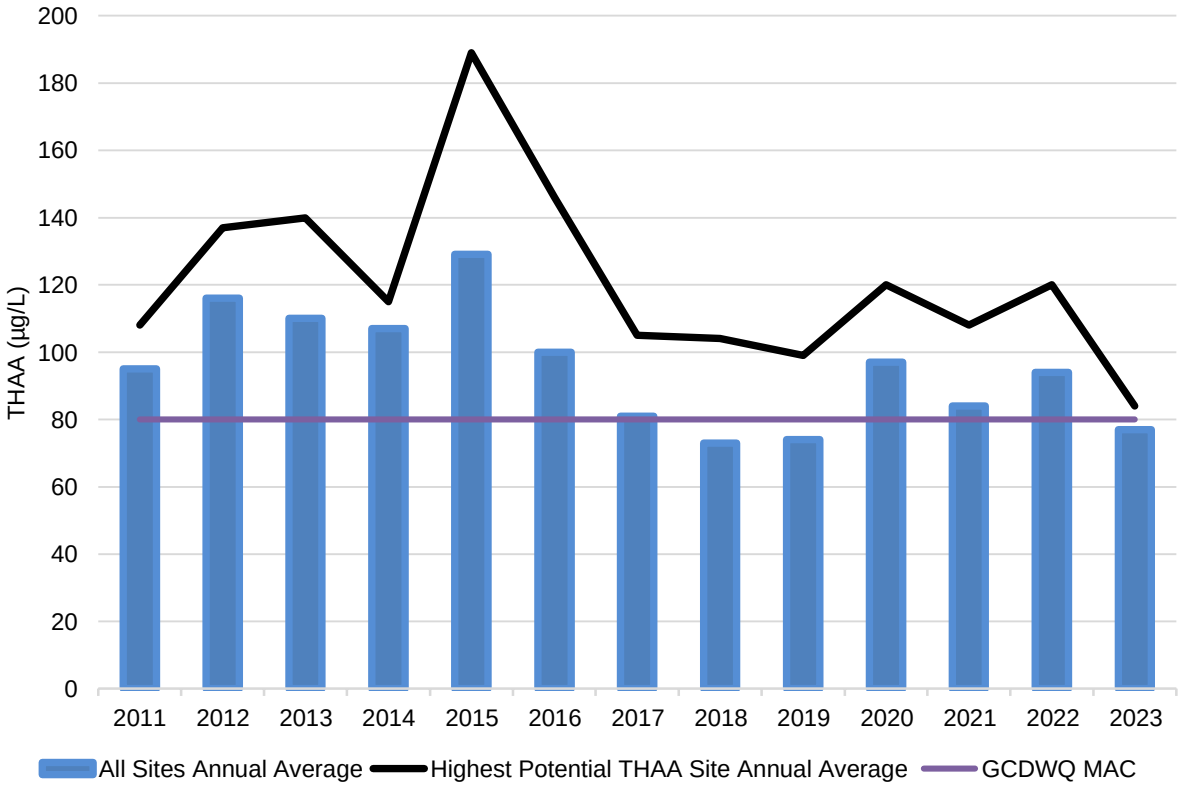



Figure 31: Annual Average THAAs in the Duteau Creek Distribution System from 2011 to 2023.

Figure 32 shows the 2023 THAAs for the Duteau Creek distribution system sample sites. Like TTHMs, the average annual THAAs for all sampling sites exceeded the GCDWQ MAC, except for the DCWTP sample site. Palfrey Drive SS was not sampled in September due to nearby construction activity. Some of the sample sites were receiving Kalamalka Lake source water or a blend at the time of sampling, which may influence the THAA concentration (Table 12).

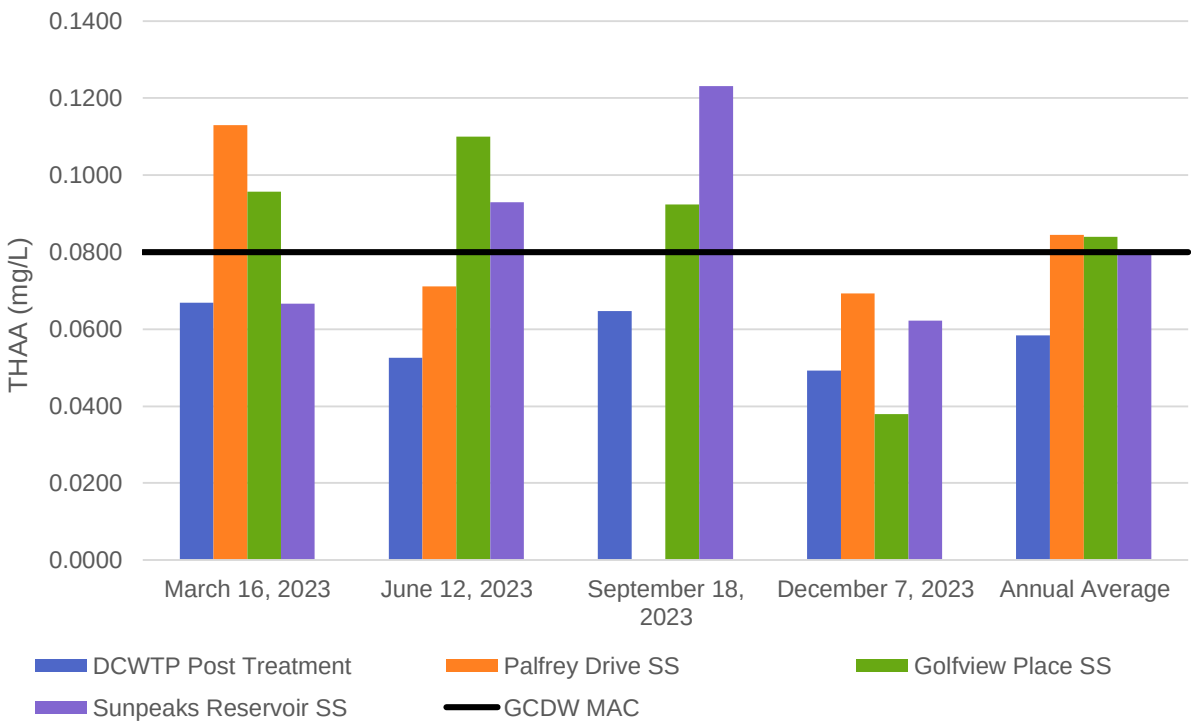



Figure 32: 2023 THAAs in the Duteau Creek Distribution System.

## Kalamalka Distribution System TTHMs

The Kalamalka Lake distribution system has been monitored for THMs since 2003. Unlike Duteau Creek, Kalamalka Lake has lower levels of disinfection by-product precursors, including little to no measurable colour and lower organic carbon levels throughout most of the year. The Kalamalka Lake distribution system has many pressure zones and a grid system with bidirectional flow to and from reservoirs, markedly different from the long, linear Duteau Creek distribution system.

In 2023, the Kalamalka distribution system combined annual average was below the GCDWQ MAC again; however, the average annual TTHMs at the highest potential sites remains above the guideline (Figure 33).

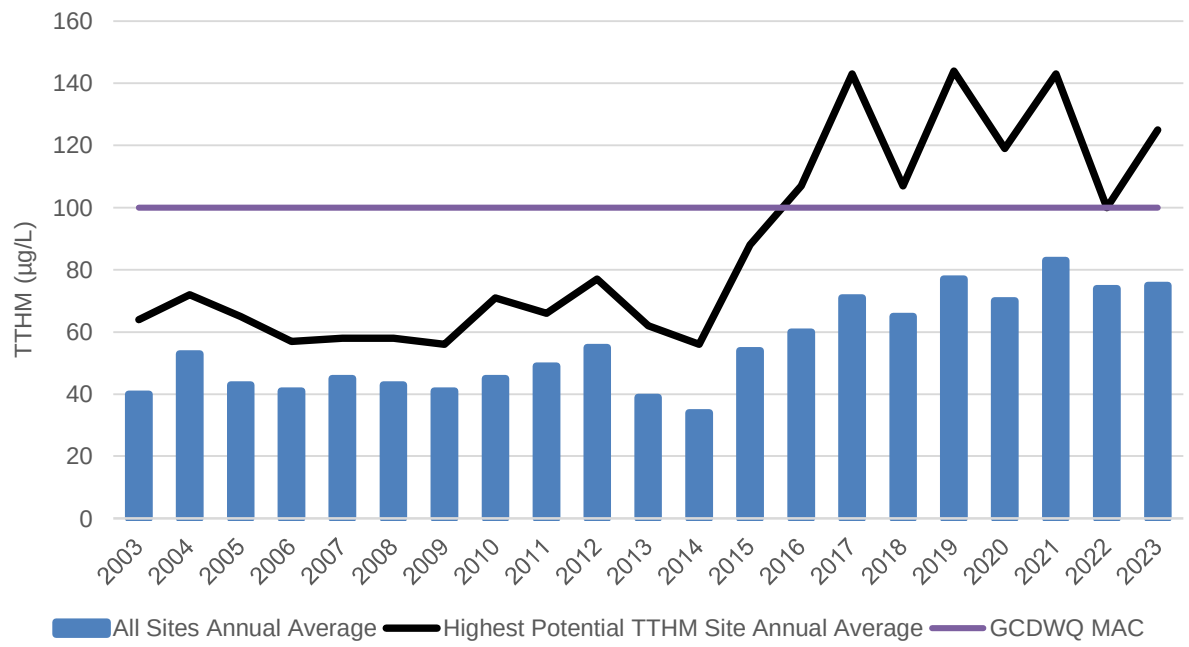



Figure 33: Annual Average TTHMs in the Kalamalka Lake Distribution System from 2003 to 2023.

Tavistock Reservoir and Longspoon Reservoir sample sites have the longest retention time and continue to have the highest THMs in the Kalamalka distribution system in 2023 (Figure 34). These sample sites have been close to or have exceeded the GCDWQ MAC for TTHMs for several years which appear to align to the flood year of 2017 and more recently, could be the elevated algae that has been seen since 2020. Adding the planned filtration at the MHWTP will improve removal of precursors and should reduce the formation potential of all disinfection by-products. All sample sites appear to have been receiving Kalamalka Lake source water at the time of sampling in 2023, based on the conductivity measured (Table 13).

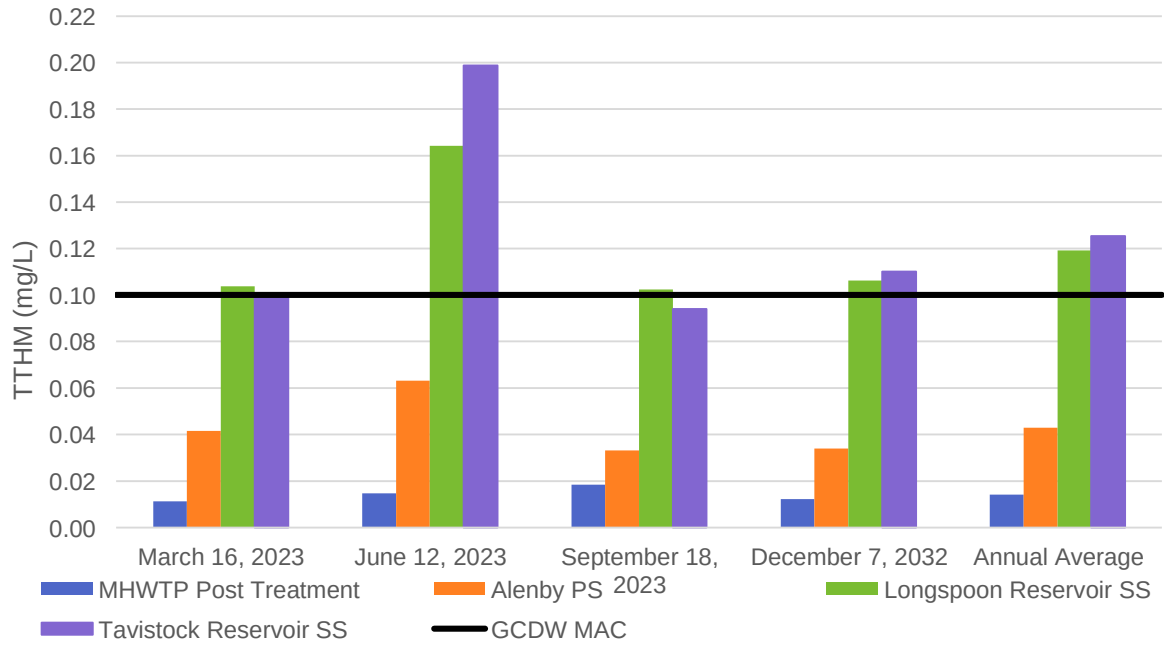



Figure 34: 2023 TTHMs in the Kalamalka Lake Distribution System.

Table 13: Conductivity at Kalamalka Lake Distribution TTHM and THAA Sample Sites in 2023

| Date | MHWTP Post Treatment | Allenby PS | Longspoon Reservoir SS | Tavistock Reservoir SS |
|---|---|---|---|---|
| March 16 | 430 | 420 | 430 | 430 |
| June 12 | 430 | 430 | 410 | 400 |
| September 18 | 450 | 430 | 440 | 450 |
| December 7 | 438 | 438 | 446 | 445 |

## Kalamalka Lake Distribution System THAAs

In 2023, the combined annual average of THAAs at the Kalamalka Lake distribution system sample sites was below the GCDWQ MAC of 80 µg/L (Figure 35). This has been true since the start of THAA monitoring in 2011.

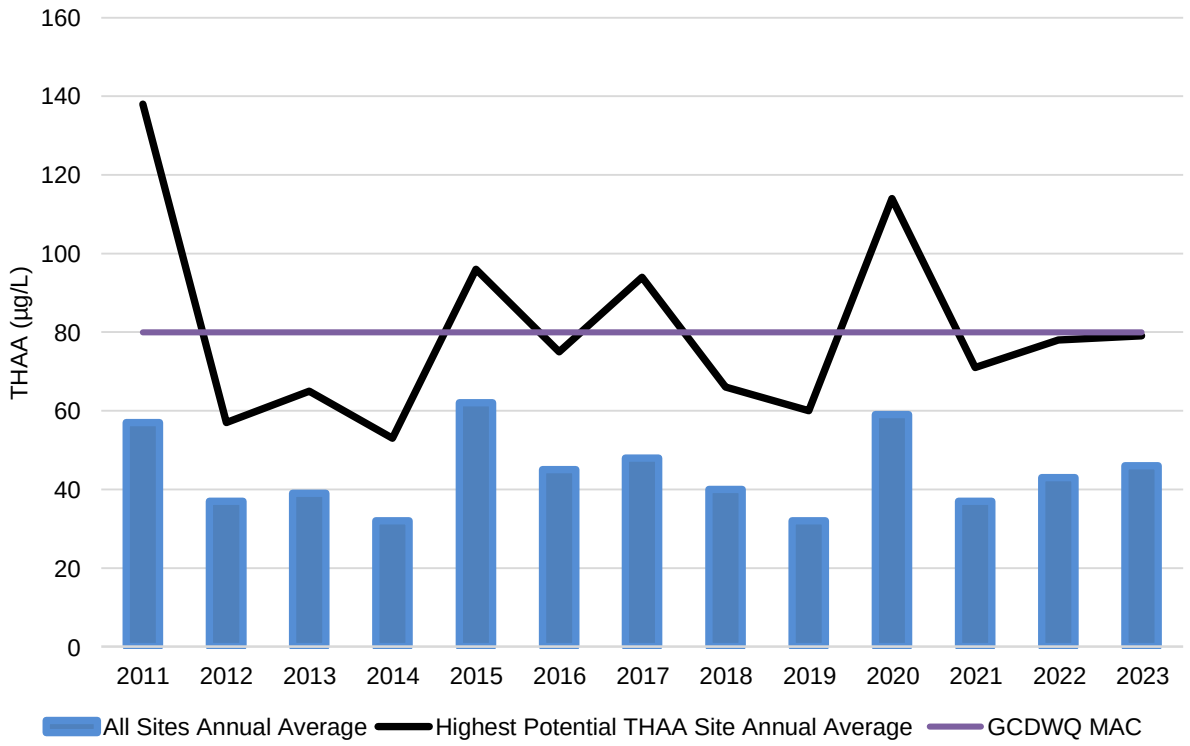



Figure 35: Annual Average THAAs in the Kalamalka Lake Distribution System from 2011 to 2023.

Figure 36 shows the 2023 THAAs for the Kalamalka Lake distribution system sample sites. As with TTHMs, the Tavistock Reservoir and Longspoon Reservoir sample sites consistently have the highest THAA concentrations throughout the year; however, the annual averages at these sites were below the GCDW MAC in 2023.

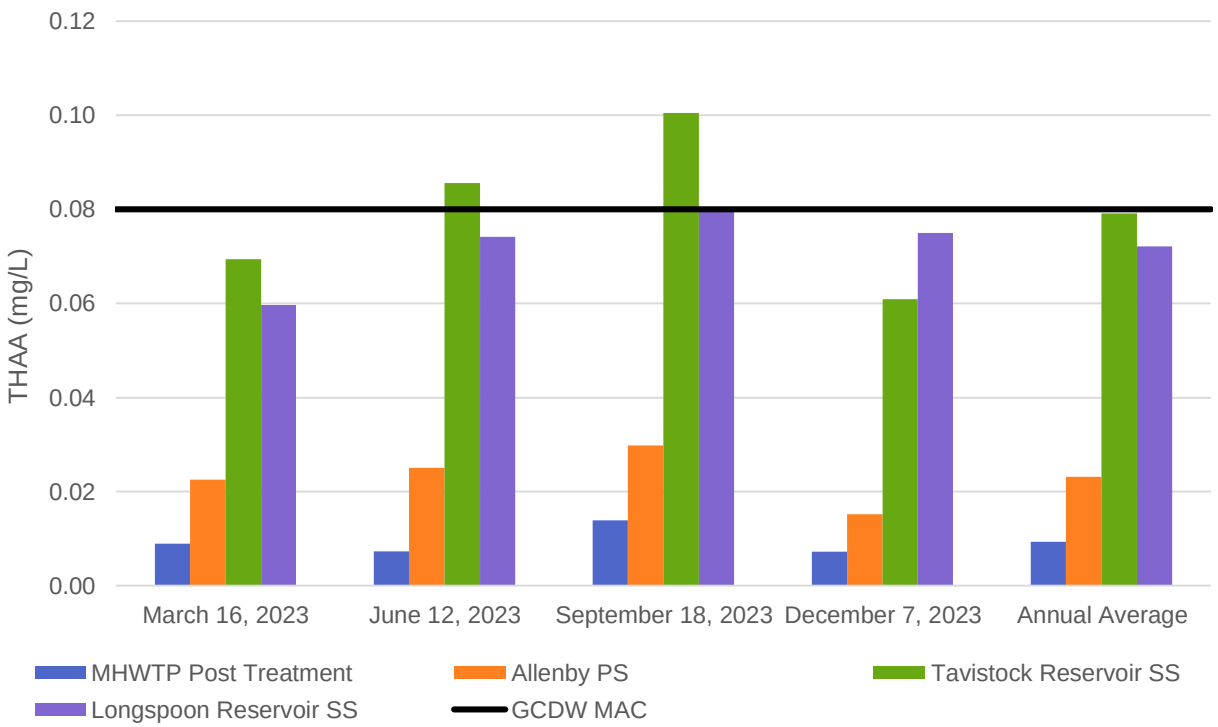



Figure 36: 2023 THAAs in the Kalamalka Lake Distribution System.

## Zinc Orthophosphate and Corrosion Control

Water sourced from Duteau Creek is considered corrosive due to the neutral to low pH, low alkalinity, and low hardness. This causes internal corrosion of metal pipes and creates a water quality issue by imparting a colour to the water which is aesthetic but unpleasant for customers. To mitigate corrosion within the distribution system, zinc orthophosphate (Zn O-PO4) is added to the Duteau Creek treated water as a corrosion inhibitor during low flows (typically from October / November to March / April). Zn O-PO4 minimizes the leaching of metals such as iron, lead, and copper from the distribution pipes and connections into the water. Additionally, the DCWTP can add caustic soda to the water to adjust the pH. In 2023, the target pH for water leaving the DCWTP was 7.0 to 7.2.

## Quality Assurance and Quality Control Program

To assess the quality of the sampling and analytical results, the RDNO carries out a comprehensive quality assurance and quality control program (QA / QC) as defined in the Water Quality Monitoring Program (Attachment A). The program ensures the quality of field samples, RDNO lab results, travel quality of samples, and accredited lab results.

## Customer Calls and Response

In 2023, RDNO water quality staff responded to 64 customer calls, 32 general inquiries and 32 water quality investigations.

Customer inquiries range from clarification regarding the source water they are on to questions about specific parameters within the water system.

Water quality investigations involved 16 reports of coloured or turbid water, five (5) concerns related to illness or skin irritation, five (5) inquiries about clogged filters, five (5) complaints regarding taste and odour, and one (1) report of a pink ring in a toilet (airborne bacteria).

Customers concerned with illness or skin irritation are recommended to consult a medical professional as treated drinking water commonly does not cause these issues.

Water quality investigations start with standard diagnostic questions for the customer to determine if the issue is internal (within the customer's property) or if further analysis is required.

After speaking with the customer, water quality staff communicates with the CoV and / or the DoC to determine if there are any water main breaks, flushing or maintenance work occurring within the area. Staff review maps which show the types of water mains and typical flows in the area, as well as historic water quality information for the area. Staff will proceed with collecting samples if needed. After the water is analysed, the results are reviewed, and further action is determined if necessary.

All water quality calls are tracked in an online database.

## CROSS CONNECTION CONTROL PROGRAM

GVW has a Cross Connection Control (CCC) bylaw and program as required by the conditions on permit issued by IH since 2005. The CCC program is guided by the current bylaw: *Regional District of North Okanagan Cross Connection Control Regulation Bylaw No. 2651, 2014* and CSA Standard B64.10.

The CCC program uses FAST to track identified CCC risks in the system and as of 2023, tracks 3,069 active devices at 2,129 facilities. The number of devices and facilities tracked has continually increased as properties are developed and risks are identified through surveys, as shown below in Figure 37.

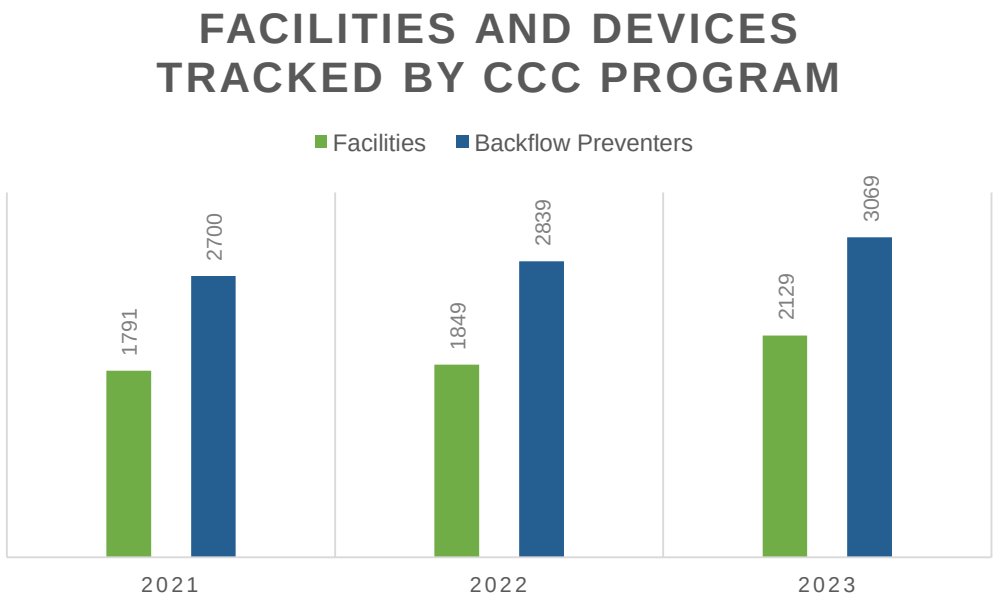



Figure 37: Number of facilities and devices tracked by the CCC Program in 2021, 2022, and 2023.

Agricultural properties are considered high-risk and GVW requires all properties to have backflow prevention in place. Farmers have 45 days after turn-on to have their devices tested and submit a report to GVW, and if they don't, they are shut off. In 2023, 15 agricultural properties were not in compliance with the backflow preventer testing requirement and had their agricultural water service turned off as an enforcement action.

The FAST management system and tester portal was implemented in 2022. As of January 1, 2023, testers are now charged a fee to submit paper copies of tests, but no fee if they submit using the FAST portal. The move to the FAST tester submission portal has reduced follow-up with testers and staff time for data entry.

Beginning in late 2022, a contractor was retained to complete CCC surveys at properties that were identified as requiring assessment for cross connections. 25 CCC surveys were completed in 2023.

# EMERGENCY RESPONSE / INCIDENTS / NOTIFICATION

## Water Quality Notification and Communication

GVW has an Emergency Response Plan (ERP) which includes the GVW Water Quality Deviation Response Plan. These documents contain the contacts, criteria, and procedures necessary to assist operators and staff to make timely, informed decisions in the event of water quality changes or emergencies. GVW requires all CoV and DoC operators to attend an annual training session where these documents are discussed. The GVW ERP is reviewed and updated annually and provided to IH, CoV and DoC operators. GVW must inform customers when there is a change in drinking water quality or service. Most notices are precautionary or related to a change in the water, which may be of interest to some consumers. A WQA is issued when a public health threat from the water supply system is higher than considered normally acceptable, but not serious enough to warrant (or will not be resolved by) a BWN. Notices describe the purpose, provide actions that can be taken to reduce risks, and alert customers of system changes. A BWN is issued when testing reveals a contaminant such as *E.coli* or other coliform organisms in the water supply system, and / or the system fails to meet drinking water treatment objectives, and the associated public health threat can be effectively addressed by boiling the water.

Most water utilities frequently experience minor disruptions. Pipes break, valves seize, hydrants leak, and power outages occur. Although these are not anticipated, the problems experienced can usually be corrected with minimal disruption, and regular service can be restored quickly.

In cases of water main breaks, GVW adheres to the procedures set out in the American Water Works Association (AWWA) Standard C651-14 regarding water main chlorination prior to re-commissioning of the main.

In 2023, GVW issued a total of 28 public notices to customers, which are summarized in Table 14.

Table 14: Summary of Customer Notification in 2023

| Number of Notices | Type of Notice |
|---|---|
| 1 | Boil Water Notices (BWN) + Rescind notices |
| 4 | Water Quality Advisories (WQA) + Rescind notices |
| 2 | Water Restrictions |
| 3 | Service Interruption |
| 4 | Water Source Change (continued into 2024) |
| 9 | Rescind or Update Notice |
| 1 | Informational Media Release |

An advisory or notice is provided to customers as quickly and efficiently as possible. Notification may include media releases, email to subscribers, social media, road signs, radio, and / or newspaper ads. Under specific circumstances, notifications are hand-delivered.

If customers are interested in getting more timely notices, it's advised they subscribe to the RDNO mailing list by going to https://www.rdno.ca/subscribe to receive notifications for their area.

## AVAILABLE DOCUMENTS AND REPORTS

The following supporting documents and reports are available on the RDNO website at https://www.rdno.ca/gvw or available upon request:

- Monthly Water Quality Reports
- Comprehensive Water Quality Analysis Results
- Current Water Supply Reports
- Greater Vernon Water 2017 Master Water Plan
- Greater Vernon Water 2024 Water Shortage Management Plan
- 2014 Duteau Creek Watershed Assessment Response Plan DCWARP 2024 – 2029 Action Plan
- Larratt Aquatic Consulting 2023 Kalamalka Lake Water Quality Study

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# APPENDIX

Table 1: RDNO Utilities Department

| RDNO Utilities | |
|---|---|
| Zee Marcolin, P.Eng | General Manager, Utilities |
| John Lord, P.Eng | Manager, Water Distribution |
| Sandy Edwards, AScT | Manager, Projects |
| Tricia Brett, P.Ag | Manager, Water Quality |
| Amanda Summerfelt | Water Efficiency Coordinator |
| Connie Hewitt, AScT | Water Quality Technologist |
| Jamie Ferris | Water Quality Technician |
| Chris Cannon | Water Quality Technician |
| Alec Busby, EIT | Assistant Utilities Engineer |
| Mike Philips, AScT | Engineering Technologist/Bylaw Officer |
| Skyler Ganz, AScT | Engineering Technologist |
| Kimberley Berndt | Engineering Technician |
| Keiko Parker, AScT | Manager, Small Utilities |
| Nathan Betz | Cross Connection Control Officer |
| Jonathan McLuskie | Utilities Quality Assurance Inspector |

Table 2: RDNO Water Treatment Operators

| RDNO Operators | | | |
|---|---|---|---|
| **Last Name** | **First Name** | **Certification #** | **Certification Held** |
| Heidt | Dustin | 4498 | WDIII, WTIV |
| McGaw | Becky | 9086 | WTIII |
| Tucker | Chris | 6489 | WTIII, WTIV, WDII |
| Lockwood | Ryan | 1000755 | WTII, WDI |
| Cimon | Caroline | 1001075 | WTII, WWTII |
| Beckett | Jemma | 1001610 | WTII |
| Radu | David | 1002040 | WTII |
| Saric | Jozo | | WTI |
| Schwartz | Johnathan | | WTI |
| Hartwig | Corey | 9378 | WTI, Electrical Instrumentation Technician |
| Schepers | Aaron | | Electrical Instrumentation Technician |

Table 3: CoV Water Distribution Operators 2023

| City of Vernon Operators | | | |
|---|---|---|---|
| **Last Name** | **First Name** | **Certification #** | **Certification Held** |
| Austin | Mercedes | 1001060 | WD I, WWC I |
| Bouchard | Marty | 1000696 | WD I, WWC II |
| Becraft | Spencer | 1001538 | WD 1, WWC I |
| Briggs | Geordie | 6495 | WD III, WWC II |
| Browne | Ryan | 8176 | WD III, WWC II |
| Callbeck | Brad | 1001930 | WWC I |
| Cleverley | Curt | 7193 | WD III, WWC I |
| Cruz | Edwin | 1001325 | WD II, WWC I |
| Dobson | Scott | 1000438 | WD II, WWC II |
| Gaythorpe | Glen | 7271 | WD III, WWC II, SCS1 |
| Gibbins | Richard | | |
| Greenan | Craig | 1001795 | WWC I |
| Holloway | Ryan | 8876 | WD II, WWC I |
| Holtz | Collin | 9158 | WD I, WWC II, WWC I |
| Irwin | Sean | 8610 | WD II, WWC II |
| Jacob | MASON | 1000333 | WD I, WWC I |
| Johannson | Iain | 9427 | WD II, WWC I |
| Knight | Jessie | 1000335 | WD II, WWC I |
| Lochhead | Chuck | 1002120 | WD II, WD 1 |
| Martin | Derek | 1001431 | WD I, WWC I |
| Novakowski | Dan | 1001106 | WD II, WWC I |
| Parker | Ryan | 6988 | WD IV, WWC II, CH |
| Pope | Carson | 8840 | WWC I |
| Price | Eric | 9215 | WD II, WWC I |
| Rempel | Chris | 7192 | WD I, WWC I |
| Rennie | DYLAN | 1000532 | WD I, WWC I |
| Roberts | Alex | 1001050 | WD I, WWC I |
| Rowan | Jared | 1001263 | WD II, WWC I |
| Stowards | Blaine | 8247 | WD II, WWC II |
| Vandermeer | Ray | 5742 | WD II, WWC II, WWT OIT |

Table 4: DoC Water Distribution Operators 2023

| District of Coldstream Operators | | | |
|---|---|---|---|
| **Last Name** | **First Name** | **Certification #** | **Certification Held** |
| Comeau | Brent | 5662 | WDII, WWCII |
| Davyduke | Matt | 7160 | WDII, WWCI |
| Lerbeck | Ron | 9379 | WDI |
| Mazereeuw | Jack | 5747 | WDII, WWCII, SWS |
| McKay | Gordon | 3471 | WDI |
| Nicholson | Cory | 7053 | WDI |
| Scherck | James | 7776 | WDII, WWCI |
| Webster | Jason | 1000440 | WDI |

## ATTACHMENTS

Attachment A: GVW 2023 Water Quality Monitoring Program

Attachment B: GVW Water Quality Deviation Response Plan

# 2023

# Greater Vernon Water
# Water Quality Monitoring Program

Prepared for: Interior Health

Regional District of North Okanagan

9848 Aberdeen Road, Coldstream, BC

4/13/2023

**Table of Contents**

**Tables**

# 1. INTRODUCTION

## *1.1 Acronyms and Definitions*

**Aesthetic Objectives (AO)** – Guidelines for Canadian Drinking Water Quality (GCDWQ) applies these objectives to different substances in water that may affect the acceptance by the customer.

**CARO** - a full service environmental laboratory that provides analytical services.

**Certified Lab** – a lab approved in writing by the Provincial Health Officer.

**Colilert™** - a product used to detect total coliforms and *E.coli* in water. It is based on IDEXX's patented Defined Substrate Technology (DST). When total coliforms metabolize Colilert's nutrient-indicator, ONPG, the sample turns yellow. When *E.coli* metabolize Colilert's nutrient-indicator MUG, which fluoresces when exposed to UV light.

**Colisure™** - a product used to detect Total Coliform and *E.coli* in water. Total Coliform metabolizes Colisure's nutrient – indicator chlorophenol red-beta-D-galactopyranoside (CPRG) that turns the sample from a yellow to red magenta. When *E.coli* metabolizes the Colisure nutrient – indicator MUG (4-methyl-umbelliferyl-β-D-galactopyranoside), which fluoresces when exposed to UV light.

**CoV** – City of Vernon.

**DAF** – Dissolved Air Floatation.

**DCWTP** – Duteau Creek Water Treatment Plant.

**DoC** – District of Coldstream.

**DWPA** – *Drinking Water Protection Act*.

**DWPR** – *Drinking Water Protection Regulation*.

**DWTP** - Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies

***E.coli*** – *Escherichia coli* is a gram negative rod of the family Enterobacteriaceae. Most strains of *E.coli* do not produce debilitating toxins but there are a few strains that do, one being the *E.coli* O157:H7 strain.

**ENKI** – internet based data software system with centralized information management.

**ERA** – Environmental Resource Associates – company who provides Certified Reference Materials (CRMs) and Proficiency Testing (PT) products.

**GCDWQ** – Guidelines for Canadian Drinking Water Quality.

**GVW** – Greater Vernon Water.

**HPC** – Heterotrophic Plate Count.

**IMAC** – Interim Maximum Concentrations – GCDWQ has established these concentrations which estimates lifetime risks of cancer associated with the guideline.

**MAC** – Maximum Acceptable Concentrations – GCDWQ has established these concentrations for different substances which may have adverse effects on health.

**MF** – Membrane Filtration – testing method that theoretically detects a single bacterium in a 100/mL sample.

**MHWTP** – Mission Hill Water Treatment Plant.

**MPN** – Most Probable Number – estimate of Coliform density.

**P/A** – Presence/Absence – procedure used to detect the presence of Total Coliform and *E.coli.*

**PHO** – Provincial Health Officer.

**Quanti-Tray® Enumeration Procedure** – used to numerate Colisure™ and Colilert™ procedures by counting the number of positive wells and referring to the MPN table.

**RDNO** – Regional District of North Okanagan.

**RPD** - Relative Percent Difference.

**SCADA** – Supervisory Control and Data Acquisition – is a system for remote monitoring and control that operates with coded signals over communication channels.

**Source Water** – untreated water before treatment or disinfection.

**TC** – Total Coliform group is a gram negative, non-spore forming rod-shaped bacteria. A group of specific bacteria called indicator bacteria which indicate a probable presence of pathogenic bacteria.

**UV** – Ultraviolet.

**Water Distribution System** – RDNO owned and administrated by GVW. The operations and maintenance is contracted to the CoV and DoC.

**WaterTrax®** – internet based data software system with centralized information management. Alerts are generated to operations and regulators.

## 1.2 Background

As guidance for the Greater Vernon Water (GVW) Water Quality (WQ) Program, the Guidelines for Canadian Drinking Water Quality (GCDWQ), the British Columbia *Drinking Water Protection Act and Regulation* (DWPA and DWPR) and the Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies (DWTO); have been drawn on to develop this "Monitoring Plan". The program is designed to monitor weekly and monthly variations in WQ plus long term WQ trends.

GVW WQ uses the multi-barrier approach in the monitoring program. Staff monitor the source water in the watersheds, at the intakes and the wellheads before treatment or disinfection. GVW has two surface water sources used for domestic purposes, two surface water sources and two groundwater wells used for agriculture purposes and one groundwater well as an emergency backup. The source water monitoring program is discussed in section 2.

The treatment facilities are monitored by the Regional District of North Okanagan (RDNO) operators and the WQ staff. This portion of the WQ program is discussed in section 3.

The GVW transmission and distribution system monitoring program incorporates certified operators from the City of Vernon (CoV), District of Coldstream (DoC), and the RDNO to sample at designated sites. WQ staff complete sampling for Trihalomethanes, Haloacetic Acids, distribution projects and more in depth analysis quarterly. During regular operations, there are two distinct potable water systems (Duteau Creek and Kalamalka Lake) where dedicated sample sites are monitored as outlined in section 4. While the distinction is not as clear as in the past and there are more interconnections, the system is still considered distinct. The interconnections within the distribution are used when necessary and the Duteau Creek or the Kalamalka Lake sources can provide water to the whole water system.

There are three distinct irrigation distribution systems Goose Lake, Deer Creek (King Edward) and untreated Duteau Creek water. These systems have limited WQ analysis, outlined in section 2.

## 1.3 Quality Assurance and Quality Control Program

To ensure good data is collected, a sampling program should include a Quality Assurance (QA) plan. QA is a system of activities designed to make sure the data meets defined standards of quality. It pertains to the overall management of the sampling program, and includes; planning, documentation, training, consistency in collecting and handling samples and analysis, validation and reporting. An important part of QA is *Quality Control* (QC). QC refers to the technical activities used to reduce errors throughout the sampling program. These activities measure the performance of a process against defined standards to verify the data meets the expected quality. Errors can occur in the field, laboratory or while handling the data. QC should include both internal and external measures. Internal QC is a set of measures undertaken by the project's own samplers and analysts. External QC involves people and laboratories outside of the project utility (USEPA 1996).

The following steps have been employed by GVW to ensure reliable information from the WQ Monitoring Program:

1. As directed in the *DWPA and DWPR,* a water supplier is required to have their bacteriological analysis completed by a certified laboratory approved by the Provincial Health Officer (PHO). GVW uses CARO Analytical Services (CARO) to analyze bacteriological samples plus a multitude of other parameters.

2. Due to the nature of the water system there are a number of operators taking WQ samples and performing field measurements. Training through GVW for WQ sampling and emergency response is provided annually to operators to ensure collection and responses are correct. This refresher is used to reduce errors in the sampling program.

3. To assess the quality of the sampling and analytical results, field duplicates are analyzed for the program at a rate of approximately 10% of the total number of samples collected. A duplicate sample is defined as a field sample of water collected from the same location, split into two equal parts, and submitted to the analytical laboratory under a separate label so the laboratory has no knowledge of the samples site location. The collection and analysis of the duplicate samples provide information on the combined (field and analytical) precision of the sampling and analytical program. The individual analytical results in each of the samples of the duplicate pair are compared and the Relative Percent Difference (RPD) is calculated for each analyte pair. RPDs are calculated using the following formula, where *"a" a*nd *"b"* are duplicate pair values in identical units.

$$RPD = \left( \frac{(a-b)}{\left( \frac{a+b}{2} \right)} \right) \times 100$$

4. A RPD of 30% or less is generally considered acceptable while a RPD of greater than 30% may indicate a problem in either sampling or analysis (MoE 1998b). This limit may vary somewhat depending on the analysis involved and the concentration of the analyte.

5. The RPD also tends to increase as the result approaches the detection limit. Therefore, use of this threshold is restricted to values five times over their detection limit.

In 2023, GVW WQ staff will take five field blanks, four travel blanks and 37 duplicate samples. Three sites have been selected for field blanks which include, one on Coldstream Creek, one source and one treatment facility. Duplicates will be taken at two sites within the Duteau Creek watershed, one site on Coldstream Creek, two water sources, and two treatment facilities. DoC and CoV operators will each take duplicates at two distribution sites.

Field instruments, including handheld conductivity and pH meters, turbidimeters and colorimeters are brought to the RDNO laboratory for regular maintenance. Handheld conductivity and pH meters are scheduled once a month, turbidimeters are scheduled once every three months and colorimeters are scheduled annually. Operators have been instructed to calibrate pH and conductivity meters before each sampling routine.

In addition to the samples sent to an external lab, the RDNO laboratory uses the Quanti-Tray® Enumeration Procedure to perform Most Probable Number (MPN) and Presence/Absence (P/A) for Total Coliform; and *E.coli.* These analyses are used to supplement the program. There is an associated QC procedure for these tests. The QC procedure is to ensure each package of Colilert™ are providing reliable results.

This is completed by running IDEXX-QC test. The IDEXX-QC meets standards for maintaining accreditation. This is completed by running three sterile vessels with:

- *Escherichia coli*,
- *Klebsiella variicola*, and
- *Pseudomonas aeruginosa*.

All samples are collected and shipped in accordance with the 2005 21st Edition Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, and WEF). A sample confirmation or requisition and chain of custody form accompany all samples sent to the certified laboratory.

GVW WQ staff have developed laboratory procedures that are updated when required.

# 2. SOURCE WATER

## *2.1 Source WQ Program*

The Source WQ Program is designed to compare source water with guidelines, criteria and regulations that have been set for both health and aesthetic reasons. It is also designed to observe seasonal trends that may affect treatment and chlorine demand, and to monitor for potential threats from watershed land use practices.

Source WQ monitoring is an important component of the multi-barrier approach and drinking water management.

It is important for monitoring programs to be as comprehensive as possible. (Source to Tap: Guidance on the Multi-Barrier Approach to Safe Drinking Water; Canadian Council of Ministers of the Environment, 2004).

The program includes parameters easily tested and linked to WQ changes such as turbidity, temperature, pH, conductivity, and bacteria (Total Coliform and *E.coli*). Some of these parameters are also incorporated in the "GVW Water Quality Deviation Response and Notification Program".

Part of the source monitoring program includes the Duteau Creek Watershed and the Kalamalka Lake / Coldstream Creek Watershed. The results are reported as part of the GVW Annual Report, source WQ information and watershed response plans.

GVW is committed to long-term monitoring for all sources.

### *2.1.1 Sampling Locations*

GVW uses two surface water intakes for domestic/potable purposes; Kalamalka Lake and Duteau Creek which are routinely monitored weekly and monthly. Two ground water sources, Coldstream Ranch Well 3 and Antwerp Springs PH 2 are available for emergency purposes, which are monitored before and when in use.

Non-potable water sources; Deer Creek (King Edward), Coldstream Ranch Well #2, Goose Lake, and untreated Duteau Creek are separated from the domestic water system and are used for irrigation water only. The following tables outline the sources, sampling point location and a descriptor of the site. Sampling location maps are located in Appendix A.

These sites are not monitored extensively, with the exception of Goose Lake. Goose Lake is monitored weekly during the irrigation season due to the chemistry of the lake. A comprehensive water analysis is completed every 5 years on Coldstream Ranch Well 2, Coldstream Ranch Well 3, Goose Lake Intake and Deer Creek Intake Pond.

Table 1 Domestic Potable Water Sources – Raw Water (untreated)

| Intake / Source Year Round | Location | Sample Site Comment |
|---|---|---|
| Kalamalka Lake Intake | *13204 West Kal Road, Coldstream* | Sample station is located outside on the south side of the Kalamalka Pump Station (PS) |
| Duteau Creek Intake | *95 Lewis Road, RDNO, Electoral Area "D"* | Sample site inside building at Duteau Creek Intake |

| | | |
|---|---|---|
| Antwerp Springs PH 2 | *6282 Highway 6, Coldstream* | Pre-chlorination (emergency Well only) |

★ An annual sampling program for Kalamalka Lake is completed by Larratt Aquatic Consulting.

Table 2 Duteau Creek Watershed Sample Sites

| Duteau Creek Watershed | Sample Site Comment |
|---|---|
| Haddo Weir | Sample on south side of weir. Outflow of Haddo Lake |
| Duteau Creek Bridge | Downstream of bridge at 12km on Haddo main |
| 16 km Aberdeen Road Tributary | Off Aberdeen main – used to monitor impacts of increasing logging in Flyfish subbasin |
| 18 km Aberdeen Road Tributary | Aberdeen main – downstream of culvert – Flyfish Creek |

Table 3 Kalamalka Lake Watershed Sample Sites

| Kalamalka Lake Watershed★ Coldstream Creek | Sample Site Comment |
|---|---|
| Coldstream Creek at Howe Drive | Downstream of the bridge |
| Coldstream Creek at Kirkland Drive | Upstream of the bridge |
| Coldstream Creek at Brewer Road | Downstream of bridge and the culvert |
| Coldstream Creek at School Road | Downstream of the bridge |

Table 4 Irrigation Water Sources - Watershed and Sample Stations

| Intake / Watershed Irrigation | Sample Site Comment |
|---|---|
| Deer Creek Intake Pond | Intake pond – grab sample in front of screens |
| King Edward Outflow | Dam structure outlet |
| Coldstream Ranch Well 3 | Well located on Coldstream Ranch |
| Coldstream Ranch Well 2 | Well located on Coldstream Ranch |
| Goose Lake Intake | Raw water copper line at intake building |
| Von Keyserlingk PS | Irrigation sample station near Von Keyserlingk PS (not regularly sampled) |

## *2.2 Source Monitoring Schedule*

Samples for source water are collected weekly at dedicated copper lines. The 2023 sampling schedule for chemical and physical parameters is outlined in Appendix B. The analysis is completed in the field, the Regional District of North Okanagan laboratory and at CARO Analytical Services.

### 2.2.1 Bacteriological

Samples of untreated water for domestic/potable purposes are collected weekly at water supply intakes and analyzed for Total Coliform and *E.coli*. Iron related bacteria and Sulfate reducing bacteria are collected monthly at Kalamalka Lake intake and annually at Coldstream Ranch Well 3 or before being brought online and after any operational maintenance work as an indicator of microbial changes in the aquifer.

Bacterial levels at the source are indicators of contamination. Historical data has assisted in developing trends for each source and therefore a deviation from "normal" initiates a response. The response includes a second bacterial sample for confirmation, a site visit to investigate and possibly determine the contamination source. *E.coli* levels that rise above and remain high over an extended period of time will undergo further evaluation.

### 2.2.2 Turbidity

Kalamalka Lake Intake and Duteau Creek Intake, have online turbidimeters and are monitored by SCADA. Operations have a maintenance schedule for all online analyzers.

The turbidity is reported from the Mission Hill Water Treatment Plant (MHWTP) before chlorination and Ultraviolet (UV) disinfection and at the Duteau Creek Water Treatment Plant (DCWTP) after the Dissolved Air Floatation (DAF), chlorination and UV disinfection. The provincial guidance "Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water, April 2013" and the "GVW Water Quality Deviation Response and Notification Plan" which provides details on turbidity events and/or trigger levels used for response and notification.

### 2.2.3 Chemical, Biological and Physical

Comprehensive samples are taken annually for each water source as well as at two distribution sites; Allenby PS for the Kalamalka distribution and PRV 2 for the Duteau Creek distribution. Allenby PS and PRV 2 are completed biannually to identify seasonal changes in flow and quality. The comprehensive list of parameters is outlined below.

Table 5 Comprehensive Water Analysis

| Parameters | | |
|---|---|---|
| Alkalinity (Total) | Cyanide (Total) | Selenium (Total) |
| Aluminum (Dissolved)[1] | Dissolved Solids (Total) | Sodium (Total) |
| Aluminum (Total) | Fluoride | Strontium (Total) |
| Antimony (Total) | Hardness (Total) | Sulfate |
| Arsenic (Total) | Iron (Total) | Turbidity |
| Barium (Total) | Lead (Total) | Temperature |
| Boron (Total) | Magnesium (Total) | Uranium (Total) |
| Cadmium (Total) | Manganese (Total) | Zinc (Total) |
| Calcium (Total) | Mercury (Total) | Dissolved Organic Carbon* |
| Chloride | Molybdenum (Total) | $UV_{254}$* |
| Chromium (Total) | Nickel (Total) | Phosphorus (Total)* |
| Cobalt (Total) | Nitrate | Total Dissolved Phosphorous* |
| Color (True) | Nitrite | Total Kjeldahl Nitrogen* |
| Conductance @ 25 C | pH | Total Organic Carbon* |
| Copper (Total) | Potassium (Total) | Chlorophyll a* |

[1] The Duteau Creek source.
* Sampled at surface water sources only.

Parameters checked routinely at surface sources are in Appendix B with more detail below:

- ***Total Organic and Dissolved Organic Carbon*** relate to Trihalomethane's production and UV disinfection effectiveness. Organic loading is also an indicator of pollutants in the water.

- ***Aluminum*** is monitored at the Duteau Creek source as the natural level is part of the cumulative value after treatment (Poly-Aluminum-Chloride, the flocculants used in the treatment process) in the Duteau Creek system.

- ***Chlorophyll a, Algae density, Total Phosphorous, Total Nitrogen*** is monitored at sources during the "growing" season, algae growth period and during lake turnovers (fall and spring).

- ***Total Phosphorous, Total Nitrogen and Ammonia*** are monitored at the Coldstream Creek locations monthly with increased monitoring during early snow melt, freshet, and flooding. Phosphorous and ammonia loading is an indicator of fertilizers and biological degradation.

- ***Herbicides, pesticides and fuel scans*** are completed every two years for the Kalamalka Lake Intake (scheduled for 2023). E very five years for the groundwater wells: Coldstream Ranch Well 2 and 3, and Antwerp Springs PH 2 (scheduled for 2023).

- **Volatile Organic Compounds (VOC)** are scheduled annually for the Kalamalka Lake Intake.

An emergency sampling kit is available in the RDNO laboratory to be used in the case of a spill, possible cross connection or other emergency testing.

# 3. TREATMENT AND DISINFECTION FACILITIES

## *3.1 DCWTP*

The DCWTP has flocculation, DAF, chlorine (generated on site) and UV treatment. The DCWTP operators complete the following sampling and analysis:

Table 6 DCWTP Samples and Analysis

| Raw | Online – Real Time | Grab Sample Frequency |
|---|---|---|
| Turbidity | Online | Daily |
| Temperature | Online | Daily |
| pH | Online | Daily |
| Conductivity | Online | Daily |
| Alkalinity | N/A | Daily |
| True Color | N/A | Daily |
| Apparent Color | N/A | Daily |
| Dissolved Organic Carbon | Online | N/A |
| Total Aluminum | N/A | Weekly |
| **Mid-Process** | Online – Real Time | Grab Sample Frequency |
| pH - each train | Online | Monday, Wednesday, Friday |
| Streaming Current - each train | Online | N/A |
| Turbidity - each DAF | Online | Daily |
| DAF Effluent | Online – Real Time | Grab Sample Frequency |
| Turbidity | Online | Daily |

| | | |
|---|---|---|
| Alkalinity | N/A | Daily |
| Dissolved Aluminum | N/A | Tuesday, Friday |
| True Colour | N/A | Daily |
| UVT | Online | Daily |
| Pre-UV (Reservoir Outlet) | Online - Real Time | Grab Sample Frequency |
| Free Chlorine residual | Online | Daily |
| UVT (2) | Online | Daily |
| pH | Online | Daily |
| Post-UV | Online - Real Time | Grab Sample Frequency |
| Free Chlorine residual | Online | Daily |
| Alkalinity | N/A | Monday, Wednesday, Friday |
| Reactive phosphate[1] | N/A | Monday, Wednesday, Friday |
| Post-UV | Online - Real Time | Grab Sample Frequency |
| Temperature | N/A | Daily |
| pH | N/A | Daily |
| Turbidity | Online | Daily |

[1]Reactive phosphate is analyzed from September through April.

WQ staff will also sample and analyze bacteria and conductivity at the UV outlet.

The monthly and quarterly sampling schedules are outlined in the Appendices. The Chlorine Contact Time (CT) is applied at the DCWTP reservoir and dosage can be adjusted if required. Bacteria samples are taken after contact time, on Tuesdays: CARO bacterial and an in-house P/A.

## *3.2 MHWTP*

The MHWTP consists of UV disinfection and chlorination generated on site.

Table 7 MHWTP Samples and Analysis

| MHWTP | Online – Real Time | Grab Sample Frequency (excluding holidays) |
|---|---|---|
| Free Chlorine residual (before contact chamber) | Online | Monday to Friday |
| Free Chlorine residual (after contact chamber) | Online | Monday to Friday |
| Turbidity | Online | Monday to Friday |
| UVT | Online | Monday to Friday |
| Conductivity | Online | Monday to Friday |
| Temperature | Online | Monday to Friday |
| pH | Online | Monday to Friday |
| Total Organic Carbon | Online (calculated number using UV254) | N/A |
| MHWTP | Grab Samples | Grab Sample Frequency (excluding holidays) |
| Conductivity | Grab Sample | Monday to Friday |
| Temperature | Grab Sample | Monday to Friday |

A chlorine residual analyzer monitors free chlorine levels after 20 minutes of contact time. The UVT is monitored online before the reactors. Both instruments are alarmed for low levels.

WQ staff will also sample at the point where chlorine contact time should be achieved.

The monthly and quarterly sampling schedules are outlined in the Appendices. Bacteria samples are taken after contact time, on Tuesdays: CARO bacterial and an in-house MPN.

### *3.3 Coldstream Ranch Well 3, Antwerp Springs PH 2*

The Coldstream Ranch Well 3 was drilled and brought online in 2021. This well replaced Coldstream Ranch Well 1, which is no longer operational. Coldstream Ranch Well 3 and Antwerp Springs PH 2 are both equipped with sodium hypochlorite tote/tank systems to be used as an emergency potable source. Both are equipped with chlorine residual analyzers and turbidity meters tracked through SCADA.

## 4. TRANSMISSION / DISTRIBUTION SYSTEM

### *4.1 Distribution WQ Program*

This portion of the WQ program is designed to meet the community water system regulations prescribed by the *DWPA and DWPR,* Schedules A and B. Supporting this design is also in the *Canadian Drinking Water Guidelines* which provide levels set for health reasons, Maximum Acceptable Concentrations (MAC), aesthetic values and Aesthetic Objectives (AO). Other parameters may be monitored if they are known to create problems within water distribution systems.

#### *4.1.1 Sampling Stations – Type, Location and Number*

**Type** - the locations for distribution sampling have been determined by the Manager, WQ, GVW staff operations, and IH. The monitoring regime is designed to capture the changes in WQ as it flows through the pipeline (i.e. flow patterns in the water distribution system). The site locations are broken down into flow ratings of high, medium and low or dead ends. The ideal combination is:

- 10% high flows/ main transmission/ Entry Point (H or EP),
- 40% medium flow (M),
- 40% low flow (L), and
- 10% dead-ends, un-looped lines and stagnant areas (DE).

After the annual review of the sampling sites, the breakdown for each water system is as follows:

Duteau Creek supplied system has a total of 41 sample sites:

- 12 % (5 sites) high flows/ main transmission/ entry point,
- 32% (13 sites) medium flow,
- 34 % (14 sites) low flow, and
- 22 % (9 sites) dead-ends, un-looped lines and stagnant areas.

Kalamalka Lake supplied system has a total of 33 sites:

- 9 % (3 Sites) high flows/ main transmission/ entry point,
- 52 % (17 Sites) medium flow,
- 27 % (9 Sites) low flow, and
- 12 % (4 sites) dead-ends, un-looped lines and stagnant areas.

**Number** - at this time there are **74** sampling sites regularly sampled throughout the GVW distribution system.

**Location** - the preferred location for dedicated sampling sites are sites connected directly to a water main. Public buildings or residential are the least preferred sampling sites as they may not be accessible at all times and results may not always be reliable. If a sample line cannot be run continuously, it should be a suitable size to allow water from the main to reach the tap after a brief flushing. Sampling sites are being re-evaluated as the GVW program evolves.

Every year, the RDNO discusses sample site locations with CoV and DoC operators. Some sample stations are moved to better locations and approximately three new sample stations are installed annually. In 2023, the sample station site locations will be reviewed to determine any changes required.

## *4.2 Distribution Monitoring Schedule for GVW WQ Program*

### *4.2.1 Duteau Creek and Kalamalka Lake Distribution Sampling Sites*

During regular operations, GVW has two main water sources with two treatment plants supplying the distribution systems:

- Duteau Creek Water Treatment Plant (DCWTP) - Duteau Creek Water Distribution system (gravity fed system), and
- Mission Hill Water Treatment Plant (MHWTP) - Kalamalka Lake Water Distribution system (pumped system).

As mentioned above, the two water systems have many interconnections which allow some blending of treated water. The water distribution system can also run on one source (treatment plant) if an emergency arises or a planned shutdown is required. There are some obstacles if this happens during peak demand periods (i.e.: summer flows) but GVW could include seasonal source Coldstream Ranch Well 3 and Antwerp Springs PH 2 to provide extra volume.

The distribution monitoring schedule is prepared by management and WQ staff. Operators and staff from the DoC, CoV and the RDNO have routes covered on a rotating four week schedule.

Appendix A has a map of all the distribution sampling sites. This schedule rotates the sampling sites from week to week to assist in a weekly overview of the entire water system. Examples of operations WQ worksheets are located in Appendix C.

The following Tables 8 and 9 are listed by:

- Sample Site Name, Site Description/Location, and
- –Flow Rating:
  - Entry Point (EP): where the water enters the distribution system (treatment plants);
  - High (H): in the distribution system where disinfectant residual is expected to be higher than typical (after entering the distribution system or after re-chlorination);
  - Medium (M): midpoint in the distribution system where disinfectant residual is expected to be typical;
  - Low (L): where disinfectant residual is the lowest; and
  - Dead ends (DE): where disinfectant residual is the lowest.

Table 8 Duteau Water Distribution Sites

| ENKI Sample Site Name | Site Description / Location | Flow Rating |
|---|---|---|
| 43rd Avenue SS | 2001 43 Street | DE |
| 6015 Highway 6 | 6015 Highway 6 | L |

| ENKI Sample Site Name | Site Description / Location | Flow Rating |
|---|---|---|
| 7900 McClounie Road | 7900 McClounie Road – Kalamalka Secondary School | L |
| Aberdeen Road SS | 9007 Aberdeen Road | DE |
| Boss Creek 1 PS Return | Boss Creek PH 1 (Lower) Return/Inlet | DE |
| Boss Creek 2 PS Return | Boss Creek PH 2 (Upper) Return/Inlet | DE |
| Braeburn Drive SS | 8835 Braeburn Drive (PRV 270) | L |
| Brewer Road SS | 6815 Brewer Road | L |
| Coldstream Creek Road SS | 12408 Coldstream Creek Road | L |
| Cosens Bay Road SS | Cosens Bay Road and Grieves Drive | L |
| Cunliffe Reservoir SS | 6910 Cunliffe Road | M |
| DCWTP Post Treatment | 1014 Whitevale Road | EP |
| East Dedecker Road SS | East Dedecker Road at the park | M |
| Foothills Booster | 6805 Foothills Drive | M |
| Golfview Place SS | 466 Golfview Place | L |
| Goose Lake Road PS | 6604 Goose Lake Road | L |
| Haney Road SS | located near SPCA | DE |
| Highway 6 SS | 7446 Highway 6 | L |
| Husband Road PS | 11701 Husband Road | M |
| Kosmina Road SS | 1701 Kosmina Road | M |
| Marmot Court SS | 364 Marmot Court | DE |
| McMechan Booster | 901 39 Avenue | M |
| Mt Grady Road SS | corner of Mt. Grady Court and Mt. Grady Road | L |
| Noble Canyon Road Hydrant | Noble Canyon | DE |
| North BX 2 PS | 6302 Apple Lane | H |
| Old Kamloops Road SS | Highway 97 and Old Kamloops Road | M |
| Palfrey Drive SS | Cunliffe Road and Palfrey Drive | M |
| Pine Road SS | Pine Road and Coldstream Creek Road SS | M |
| Pleasant Valley Road SS | 6522 PV Road | M |
| Ponderosa Way SS | 13900 Ponderosa Way | L |
| PRV 076 | 8101 Highland Place | DE |
| PRV 1 | 8798 Buchanan Road | H |
| PRV 2 | 4714 Pleasant Valley Road | H |
| Ravine Drive PS | 35 Ravine Drive | M |
| Rugg Road SS | 6926 Rugg Road | DE |
| South BX 1 PS | 3600 East Vernon Road | H |

| ENKI Sample Site Name | Site Description / Location | Flow Rating |
|---|---|---|
| South BX 2 PS | 5121 Dixon Dam | H |
| Springfield Road SS | 5608 Petworth/Springfield | L |
| Sunpeaks Reservoir SS | 7444 Sun Peaks Drive | L |
| Upland Drive SS | 488 Upland Drive | L |
| **Total Duteau Sites** | **EP = 1 / H = 4 / M = 13 / L = 14 / DE = 9** | |

Table 9 Kalamalka Lake Distribution Sites

| ENKI Sample Site Names | Site Description / Location | Type |
|---|---|---|
| 15th Street SS | 2702 15 Street | M |
| 21st Avenue SS | 2101 32 Street | M |
| 25 Street SS | 4404 25 St SS | M |
| 30th Street SS | 3402 - 30 Street | M |
| 35 Street SS | 2806 35 Street | M |
| 43rd Street SS | 2001 43rd Street SS | M |
| 4714 Pleasant Valley SS | City Yard fill station at 4714 Pleasant Valley Road | M |
| Allenby PS | 5715 Bella Vista Road | M |
| Amber Drive SS | 7095 Amber Drive | DE |
| Anderson Way SS | 5100 Anderson Way | M |
| Balsam Reservoir SS | 558 Balsam Court | M |
| Brassy Place SS | 803 Brassy Place | DE |
| College Way SS | Highway 97 and College Way | M |
| Dunsmuir Road SS | 3025 Dunsmuir SS | L |
| Kidston Road SS | 12101 Kidston Road | DE |
| Kirkland Drive SS | 7906 Kirkland Drive | L |
| Kokanee Booster | 9320 Kokanee Road | M |
| Longacre Drive SS | 6532 Longacre Drive | L |
| Longspoon Court SS | 595 Longspoon Court | L |
| McMechan Reservoir SS | 39 Avenue | H |
| MHWTP Post Treatment | 3350 Reservoir Road | EP |
| Mission Road SS | 1400 Mission Road | L |
| Mt Grady Court SS | Mt Grady Court and Mt Grady Road | L |
| Okanagan Landing 1 PS | 7864 Okanagan Landing Road | M |
| Okanagan Landing 2 PS | 8979 Okanagan Landing Road | M |
| Okanagan Landing Road SS | 5871 Okanagan Landing Road | M |

| | | |
|---|---|---|
| Pottery Road SS | 1802 Pottery Road | H |
| Tavistock Reservoir SS | 9033 Tavistock Road | L |
| Tronson Road SS | Beachcomber Bay Road & Tronson Road | M |
| Turtle Mountain PS | 3600 Turtle Mountain Blvd | M |
| Upper Commonage Booster | 461 Commonage Road | L |
| Weeks Road SS | 7540 Weeks Road | L |
| West Kal Road SS | 7603 West Kal Road | DE |
| **Total Kal Sites** | **EP = 1 / H = 2 / M = 17 / L = 9 / DE = 4** | |

## *4.3 Bacteriological*

The frequency and number of samples for microbiological control monitoring is based on recommendations from the *DWPA and DWPR.*

Schedule A - WQ Standards for Potable Water Fecal Coliform bacteria – no detectable fecal Coliform bacteria per 100mLs.

*Escherichia coli* (*E.coli)* – no detectable *E.coli* per 100mLs.

Total Coliform Bacteria:

(a) one sample in a 30 day period - no detectable Total Coliform per 100 mls.

(b) more than one sample in a 30 day period - at least 90% of samples have no detectable total bacteria per 100 mls.

Schedule B – Frequency of Monitoring Samples

Population served by the prescribed water supply system: 5,000 to 90,000.

Number of samples per month: 1 per 1,000 populations.

Other considerations when developing a WQ monitoring program:

- quality of the source water
- number of water sources
- past frequency of unsatisfactory samples
- adequacy of treatment and capacity of the treatment plant
- size and complexity of the distribution system
- practice of disinfection; and
- size of population served.

Tables 10 and 11 summarizes the population sizes and number of sources, which help determine the number of bacterial samples to be completed each month for GVW's WQ program. A minimum of **68** bacteriological samples are sent to CARO for analysis each month for the Kalamalka Lake and Duteau Creek systems. A minimum of **50** bacterial samples are completed at the RDNO laboratory using the Colilert® methods for MPN. A total of **118** bacterial samples are analyzed monthly for the water distribution system. The schedule for the water systems is shown below.

Note: Staff and operators are asked to collect a P/A sample if the free chlorine is lower than 0.20 mg/L and to deliver it to the RDNO laboratory RDNO laboratory for analysis.

Table 10 Distribution Bacteria Sampling Frequency

| System | Population (approx.) | Sources/ Intakes | Sample Sites | Samples per month to Caro | Minimum Bacterial Samples per Month |
|---|---|---|---|---|---|
| Kalamalka Lake | 41,000 | 1 | 33 | 42 | 41 |
| Duteau Creek | 17,000 | 1 | 41 | 26 | 17 |
| **Total 2023** | **58,000** | **2** | **74** | **68** | **58** |

Table 11 GVW Sampling Schedule

| Week | Kal Lake CARO | Kal Lake P/A / MPN | Duteau CARO | Duteau P/A/MPN |
|---|---|---|---|---|
| 1 | 10 | 6 | 7 | 5 |
| 2 | 12 | 4 | 5 | 8 |
| 3 | 10 | 7 | 7 | 4 |
| 4 | 10 | 9 | 7 | 67 |
| **Monthly Total** | **42** | **26** | **26** | **24** |

## *4.4 Chlorine Residual and Chlorine Management*

Chlorine is used as a disinfectant for the GVW system. As required in the DWPA, Section 6(b) and Section 5.2(a) of the DWPR. All sampling sites are monitored for free and total chlorine by operators or GVW WQ staff.

A more in-depth look at chlorine management will continue in 2023. Additional chlorine checks will be added to provide operators and the WQ team with more data for chlorine residual and optimization. The sites are as follows:

Table 12 Additional Chlorine Sample Sites

| Chlorine Sites | Description |
|---|---|
| Galiano Road BO | water pumped from South BX #1 |
| Brookside Road BO | small road off Dixon Dam Road |
| Longspoon Court SS | Predator Ridge - chlorination |
| Golfview Place SS | north west - Swan Lake |
| Tavistock Reservoir SS | Adventure Bay |
| Aberdeen Road SS | Aberdeen Road |

## *4.5 Chemical and Physical Parameters*

The chemical and physical testing within the distribution system includes conductivity, temperature, turbidity, free and total chlorine and pH. Parameters chosen for the weekly analysis help identify WQ issues before they become problematic or where source blending is occurring in some areas of the distribution system.

Further examination of WQ in the distribution system is completed quarterly at two sampling sites, which are:

1. Allenby PS (Kalamalka Lake supply), and
2. PRV 2 (Duteau Creek supply).

These sites help determine if there are WQ issues due to changes in alkalinity, pH, flow (high/low), chlorine levels or the type of water mains. The schedule and parameters for these sites are located in Appendix B.

Further WQ information on the following parameters:

### *4.5.1 Aluminum*

Dissolved and total Aluminum are monitored monthly before and after treatment on the Duteau water source. Total aluminum values can reflect on the flocculation process carried through to the treated water. Elevated dissolved aluminum can be an indicator of over application of Poly Aluminum Chloride (PAC), the plant's primary coagulant. Aluminum is a treatment related parameter; with an Operational Guideline, developed in 1998, (OG) of < 0.2 mg/L (other treatment type, not conventional). The OG applies to treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum. OGs are based on a running annual average of monthly samples. The naturally occurring Aluminum in the Duteau Creek source averages around 0.12 mg/L.

Currently, Health Canada has developed a technical guideline document to solicit comments on the proposed guideline and OG values. The document proposed a MAC of 2.9 mg/L for total aluminum and a OG value of 0.050 mg/L is proposed for total aluminum to optimize water treatment and distribution systems.

### *4.5.2 Orthophosphate Corrosion Inhibitor*

Orthophosphates are used primarily as a corrosion inhibitor with its ability to create passivity film on the surface of distribution pipes. In this project, WQ staff have investigated the effectiveness of the zinc orthophosphate addition to the water distribution system. Zinc orthophosphate is injected into the treated water at the DCWTP in the fall until spring to reduce issues arising from cast and ductile iron waterlines in the distribution system. The Zinc orthophosphate has the ability to create an inert and resilient protective, microscopic layer on metal surfaces. This film acts as a barrier between the oxygenated and corrosive potable water and the metal pipe surface which minimizes the release of iron, lead, copper, and other metals that indicate corrosion is occurring and can produce harmful effects in the system. If properly applied, all the Zinc orthophosphate reacts with the pipe surface and there is no active residual left in the water.

Monthly samples and analysis will continue at sample sites shown in Table 13.

Table 13 Corrosion Inhibitor Monitoring Sites

| Sample Sites | Parameters Apply to All Sample Sites |
|---|---|
| DCWTP Post Treatment | Reactive Phosphate, Iron |
| Aberdeen Road SS | |
| Sunpeaks Reservoir SS | |
| Golfview Place SS | |
| Noble Canyon Road Hydrant | |

In 2023, the effectiveness of the Zinc orthophosphate will be reviewed through the sampling program. The dosage rate will also be examined with operations to ensure it is optimal for the

system. Samples are routinely collected at the sites listed in Table 13, then brought to the RDNO laboratory for analysis. Operators at the DCWTP grab samples from the reservoir three times per week to analyze reactive phosphate levels.

### *4.5.3 THM's and HAA's*

Disinfection Byproducts (DBP) are monitored as per the GCDWQ. The distribution systems are monitored quarterly for THM's and HAA's have been designed to look at the following conditions:

- first customer or point of entry - water treatment plants,
- at points in the distribution system with the longest disinfectant retention time,
- the worst case scenario (longest contact time), and
- the effect of different sources blending in the distribution system.

The maximum acceptable concentration (MAC) for the distribution system is based on a locational running annual average of the quarterly samples taken at the sample sites with the longest disinfectant retention time. The following sample sites will be monitored in March, June, September and November of 2023.

Table 14 THM and HAA Monitoring Sites

| Sample Sites | Location in Distribution | Most Common Source | Parameters |
|---|---|---|---|
| DCWTP Post Treatment | first customer – entry point | Duteau Creek | THM, HAA, P/A,TOC |
| Palfrey Drive SS | mid-point - after re-chlorination at PRV#1 | Duteau Creek | THM, HAA, P/A |
| Sunpeaks Reservoir SS | longest disinfectant retention time | Duteau Creek | THM, HAA, P/A |
| Golfview Place SS | longest disinfectant retention time | Duteau Creek | THM, HAA, P/A |
| MHWTP Post Treatment | first customer - entry point | Kalamalka Lake | THM, HAA, P/A, TOC |
| Tavistock Reservoir SS | longest disinfectant retention time | Kalamalka Lake | THM, HAA, P/A |
| Allenby PS | mid-point | Kalamalka Lake | THM, HAA, P/A |
| Longspoon Reservoir SS | longest disinfectant retention time | Kalamalka Lake | THM, HAA, P/A |

## 5. REPORTING

In 2022, RDNO has switched to a new internet based databased called ENKI. Enki is an internet based data software system with centralized information management. The ENKI database is accessible to all who have been registered as "users" by the administrator (GVW Manager, WQ). Prior to 2022, RDNO used WaterTrax, which is an internet based software program. In 2023, all historical data from WaterTrax was uploaded to ENKI.

At this time, WQ notification and maintenance activities such as flushing can be found on the RDNO website at www.rdno.ca. Customers can subscribe to receive announcements, media releases, and updates by email at https://www.rdno.ca/subscribe.

Weekly reports are generated by GVW WQ staff for Operations Supervisors by Friday of each week. This allows an overview of chlorine residuals, turbidity and bacterial results within the distribution system and some source water information.

Monthly WQ reports are generated by GVW WQ staff for Interior Health each month. All reports are sent to the Drinking Water Officer, Operations Supervisors and the WQ Manager by the 15 day of the following month. Following review, the reports are posted on the RDNO website.

An annual WQ report is due on June 30 for the previous year. The report includes microbiological, inorganic and organic parameters for the sources and the distribution system plus recommendations to improve WQ where standards and aesthetic issues are not met.

## 6. REFERENCES

Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water, Ministry of Health, BC, April 2013.

Drinking Water Protection Act [SBC 2001] Chapter 9, *Assented to April 11, 2001.*

Drinking Water Protection Regulation, B.C. Reg. 200/2003 [includes amendments up to B.C. Reg. 87/2011, May 19, 2011].

Guidelines for Canadian Drinking Water Quality, Health Canada, *February 2017.*

WQG-01 Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy, Water Protection & Sustainability Branch , *2017*.

# APPENDICES

**APPENDIX A - WQ Sample Sites**

## Legend

**Sampling Stations - Water System**

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well
- GVW Boundary
- Watermains
- Parcels

O'Keefe Flushing Station
Golfview SS
Hwy 97 / Old Kamloops Rd SS
Highland Pl PRV 77
Goose Lake
Goose Lake Building
Sun Peaks PS
Rugg Rd SS
Foothills PS
PRV #109
Goose Lake PS
PV Rd SS
Marmot Court SS
6198 Brookside Road B/O
North BX #2 PS
North BX #1 PS
BX Park SS
Anderson Way SS
Haney Road SS
South BX #2
City Yard Fill Station (K)
PRV #2
Kin Race Track SS
4404 25 St SS
McMechan Pump Station
McMechan Reservoir
Boss Creek PS #2
Turtle Mountain PS
Vernon City Hall SS
Allenby Pump Station
Boss Creek PS #1



# GVW Sampling Stations - North

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

RDNO

## Legend

**Sampling Stations - Water System**

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well

- GVW Boundary
- Watermains
- Parcels

Boss Creek PS #2
Boss Creek PS #1
1101 Galiano Road B/O
Upland Dr SS
Ravine Pumphouse
RDNO Lab
PRV #24
PRV #1
Venables / Northcott SS
9007 Aberdeen Rd SS
Grey Rd Station
DOC Public Works Yard
Well 1
Well 2
Pine Dr PRV 16
Kidston Rd SS
West Kal Rd
Kalamalka Secondary
Palfrey SS
Cosens Bay Rd SS
Cunliffe Reservoir
Ponderosa Lift Station
Deer Creek
7446 Hwy 6 SS
Brewer Rd SS
Warren Rd PS
Antwerp PS
Lavington Superette
Springfield Rd SS
Bessette Station
Brewer PH
DCWTP
Headgates Bldg

This map was compiled by RDNO, using data believed to be accurate; however, a margin of error is inherent in all maps. This product is distributed without warranties of any kind, either express or implied, including but not limited to warranties of sustainability or particular purpose or use.

# GVW Sampling Stations - East

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

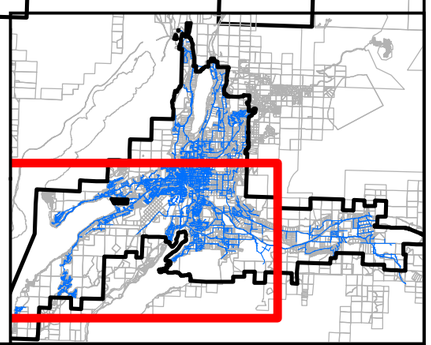
RDNO

## Legend

**Sampling Stations - Water System**

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well
- GVW Boundary
- Watermains
- Parcels

Turtle Mountain PS
McMechan Reservoir
Boss Creek PS #2
Vernon City Hall SS
South BX #1
Boss Creek PS #1
1101 Galiano Road B/O
Balsam Reservoir
Dunsmuir SS
Allenby Pump Station
35th Street SS
2702 15 St SS
2001 43 St SS
Vernon Jubilee Hospital
Amber Dr SS
1802 Pottery Rd
Nordic House SS
Kosmina SS
Tronson Rd SS
Ok. Landing SS
Upland Dr SS
Ravine Pumphouse
Tavistock Reservoir
Kal View Meter SS
Mt Grady Crt SS
Mt. Ida PRV
RDNO Lab
PRV #24
Claremont SS
Mt Grady Rd SS
8844 Oxford Road SS
OK #1
Weeks Rd SS
Husband Rd PS
PRV #1
Mission Hill Water Treatment Plant
Venables / Northcott SS
16506 Kalamalka Road SS
Kal Lake PS
9007 Aberdeen Rd SS
Commonage PS
Braeburn Dr SS
Grey Rd Station
Kirkland Dr
Kidston Rd SS
DOC Public Works Yard
Well 1
West Kal Rd
Pine Dr PRV 16
Well 2
OK #2
Kalamalka Secondary
Coldstream Creek Rd SS
Palfrey SS
Cosens Bay Rd SS
Deer Creek
Kokanee PS
Cunliffe Reservoir
Ponderosa Lift Station
Brassy Place SS
Delcliffe Lake Station
Delcliffe Booster Station
Longspoon Crt SS
Outback Reservoir
Outback PS





# GVW Sampling Stations - West

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

RDNO

## APPENDIX B - Parameters and Schedules

**Weekly Sampling**

**1st, 2nd, 4th (5th) Tuesdays**

| | | |
|---|---|---|
| Sources | Kalamalka Lake Intake | Freshet (Feb/March - June) |
| | Duteau Creek Intake | Summer (May - Nov) |
| Treatment Plants | DCWTP Post Treatment | Winter (October to April) |
| | MHWTP Post Treatment | Irrigation (April 15 to September 30) |
| Creek into Kal Lake | Coldstream Creek | Marl (mid June - ??) |
| Irrigation | Goose Lake | |
| Seasonal / potable | Coldstream Ranch Well 3 | |

***NOTE: take algae density sample if distinct odor to the water (fishy, septic, skunky and grassy)**

**Sources**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Kalamalka Lake Intake | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - 250 mL Caro | DOC (1st week of Month) |
| | 1 - TOC (2 bottles) | TOC (1st week of Month) |
| | 1 - 1 L (in house) | Algae Density (frequency evaluated regularly) |
| | 1 - 4 L Caro | chlorophyll a (2nd week) |
| Kalamalka Lake Intake Extra Sampling | 1 - 125 ml Caro (Yellow Lid) | TP |
| | 1 - 250 mL Caro | TN |
| Duteau Creek Intake | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| | 1 - Caro Bacterial | Total Coliform, E.Coli |
| Duteau Creek Intake Extra Sampling | 1 - 125 ml Caro (Yellow Lid) | TP |
| | 1 - 250 mL Caro | TN |

Extra Sampling:

Kal Source Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

Duteau Creek Intake during freshet and if turbidty or flows pick up take extra samples: TP, TN

**Treatment Plants**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| DCWTP Post Treatment | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - Caro Bacterial | Total Coliform, E.Coli |
| MHWTP Post Treatment | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - Caro Bacterial | Total Coliform, E.Coli |

**Coldstream Creek Sampling**

WEEKLY: February/March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January/February: Coldstream Creek will be sampled one per month (fourth Tuesday) and during any major rain events

**Monthly - Fourth or Fifth Tuesday of month** **also during events**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Creek at Krikland Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Howe Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Brewer Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at School Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |

**Coldstream Creek Sampling**

**1st, 2nd and 3rd & 5th Tuesday of month during freshet (March until June)**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Creek at Krikland Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| Coldstream Creek at Howe Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| Coldstream Creek at Brewer Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| Coldstream Creek at School Road | 1 - Caro Bacterial | Total Coliform, E.coli |

**Weekly Sampling**

**Irrigation** every week during irrigation season: April 15 to September 30

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Goose Lake Intake | 1 - 1 L Algae Density | |

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Goose Lake Shore | 1 - 1 L Algae Density | Approximately start Mid June until September 30 |
| | * Lake Observation visual / odor comments | |

**Seasonal Source** **sample if being used for potable water**

Annual to be completed prior to Well turn on for the season

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Ranch Well 3 | 1 - PA | Bacterial (Most ProbableNumber) |

**3rd Tuesday of every month** **Monthly Sampling**

| | | |
|---|---|---|
| Sources | Kalamalka Lake Intake | Freshet (Feb/March - June) |
| | Duteau Creek Intake | Summer (May - Nov) |
| Treatment Plants | DCWTP Post Treatment | Winter (October to April) |
| | MHWTP Post Treatment | Irrigation (April 15 to September 30) |
| Creek into Kal Lake | Coldstream Creek | |
| Irrigation | Goose Lake | |
| Seasonal / potable | Coldstream Ranch Well 3 | |

*NOTE: take algae density sample if distinct odor to the water (fishy, septic, skunky and grassy)

**Sources**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Kalamalka Lake Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | SRB (sulfur reducing bacteria)<br>IRB (Iron Related Bacteria) |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 250 mL Caro | DOC |
| | 1 - 1 L (in house) | Algae Density (frequency evaluated regularly) |
| Kalamalka Lake Intake Extra Sampling | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 250 mL Caro | TN |
| Duteau Creek Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| | 1 - Metals Caro | Al |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 250 mL Caro | dissolved Al |
| | 1 - 500 mL in house | Iron |
| | 1 - 1 L in house | Algae Density (June - October) |
| | 1 - 4 L Caro | chlorophyll a |
| Duteau Creek Intake Extra Sampling | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 250 mL Caro | TN |

Extra Sampling:

Kal Source Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

Duteau Creek Intake during freshet and if turbidty or flows pick up take extra samples: TP, TN

**3rd Tuesday of every month** **Monthly Sampling**

**Treatment Plants**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| DCWTP Post Treatment | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL Caro | dissolved Aluminum, UVT (Unfiltered) |
| | 1 - Metals Caro | Aluminum |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 500 mL in house | Iron |
| MHWTP Post Treatment | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | SRB (sulfur reducing bacteria)<br>IRB (Iron Related Bacteria) |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 250 mL Caro | DOC |

**Coldstream Creek Sampling**

WEEKLY: March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January: Coldstream Creek will be sampled one per month (first Tuesday) and during any major rain events

**Fourth or Fifth Tuesday of month**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Creek at Krikland Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Howe Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Brewer Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at School Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |

**3rd Tuesday of every month** **Monthly Sampling**

**Irrigation**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Goose Lake Intake | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 1 L Algae Density | in house - algae |
| | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 500 mL Caro | TN, DOC |
| | 1 - 4 L Caro | Chlorophyll A |
| Goose Lake Shore | 1 - 1 L Algae Density | Approximately start Mid June until September 30 |
| | * Lake Observation visual / odor comments | |

**Seasonal Source** **sample if being used for potable water**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Ranch Well 3 | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | ***1 - Caro Bacterial*** | ***HPC*** |
| | *1 - Caro Bacterial* | *Iron Related Bacteria (in house)* |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - Metals Caro | Manganese |
| | 1 - 500 mL in house | Sulphate, Iron, Manganese |

**3rd Tuesday of every 3rd month**

**Quarterly Sampling**

**Quarterly (Feb, May, Aug, Nov)**

| | | |
|---|---|---|
| Sources | Kalamalka Lake Intake | Freshet (Feb/March - June) |
| | Duteau Creek Intake | Summer (May - Nov) |
| Treatment Plants | DCWTP Post Treatment | Winter (October to April) |
| | MHWTP Post Treatment | Irrigation (April 15 to September 30) |
| Distribution | PRV 2 | Various Sample dates |
| | Allenby PS | |
| Seasonal / potable | Coldstream Ranch Well 3 | |
| Creek into Kal Lake | Coldstream Creek | |
| Irrigation | Goose Lake | |

*NOTE: take algae density sample if distinct odor to the water (fishy, septic, skunky and grassy)

**Sources**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Kalamalka Lake Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | SRB (sulfur reducing bacteria)<br>IRB (Iron Related Bacteria) |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 125 ml Caro (Yellow lid) | TP* (May & August only) |
| | 1 - 500 mL Caro | DOC, Bromide TN* (May & August only) |
| | 1 - 500 mL in house | Colour (true & apparent),<br>Alkalinity, Hardness |
| | 1 - 1 L (in house) | Algae Density (frequency evaluated regularly) |
| | 1 - 4 L Caro | chlorophyll a |
| Duteau Creek Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| | 1 - Metals Caro | Aluminum |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 500 mL Caro | DOC, TN, dissolved Aluminum, Chloride, Bromide |
| | 1 - 1 L in house | Iron |
| | 1 - 1 L in house | Algae Density (June - October) |
| | 1 - 4 L Caro | chlorophyll a |

Extra Sampling:

Kal Source Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

Duteau Creek Intake during freshet and if turbidty or flows pick up take extra samples: TP, TN

**3rd Tuesday of every 3rd month** **Quarterly Sampling**

**Treatment Plants**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| DCWTP Post Treatment | 1 - Caro Bacterial | Total Coliform, E. Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL Caro | dissolved Aluminum, DOC |
| | 1 - Metals Caro | Aluminum |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 1 L in house | Iron |
| MHWTP Post Treatment | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | SRB (sulfur reducing bacteria)<br>IRB (Iron Related Bacteria) |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL Caro | DOC |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 1 L in house | Colour (apparent), Sulfate |

**Distribution**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| PRV 3 | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 125 mL Caro | Dissolved Aluminum |
| | 1 - 125 mL Metals Caro | Aluminium |
| | 1 - 1 L in house | Iron, Colour (apparent), Alkalinity, Hardness |
| Allenby PS | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 1 L in house | Sulfate, Colour (apparent), Alkalinity, Hardness |

**3rd Tuesday of every 3rd month** **Quarterly Sampling**

**Coldstream Creek Sampling**

WEEKLY: March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January: Coldstream Creek will be sampled one per month (first Tuesday) and during any major rain events

## Fourth or Fifth Tuesday of month

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Creek at Krikland Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Howe Drive | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at Brewer Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |
| Coldstream Creek at School Road | 1 - Caro Bacterial | Total Coliform, E.coli |
| | 1 - 125 mL Caro (Yellow Lid) | TP, Ammonia |
| | 1 - 250 mL Caro | TN, Chloride, Sulphate |
| | 1 - TOC (2 bottles) | TOC |

**3rd Tuesday of every 3rd month** **Quarterly Sampling**

**Irrigation**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Goose Lake Intake | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 1 L Algae Density | in house - algae |
| | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 500 mL Caro | TN, DOC |
| | 1 - 4 L Caro | Chlorophyll A |

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Goose Lake Shore | 1 - 1 L Algae Density | Approximately start Mid June until September 30 |
| | * Lake Observation visual / odor comments | |

**Seasonal Source** **sample if being used for potable water**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Coldstream Ranch Well 3 | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | ***1 - Caro Bacterial*** | ***HPC*** |
| | *1 - Caro Bacterial* | *Iron Related Bacteria (in house)* |
| | weekly | Bacterial (Most Probable Number) |
| | 1 - Metals Caro | Manganese |
| | 1 - 500 mL in house | Sulphate, Iron, Manganese |

**3rd Tuesday** **Annual Comprehensive**

**Annually**

| | |
|---|---|
| Source | Kalamalka Lake Intake |
| Source | Duteau Creek Intake |
| Distribution | PRV 2 |
| Distribution | Allenby PS |
| Seasonal Source | Coldstream Ranch Well 3 |

**Every 5 Years (2024, 2029 etc)**

| | |
|---|---|
| Irrigation | Goose Lake Intake |
| Irrigation | Coldstream Ranch Well 2 |
| Irrigation | Deer Creek Intake |
| Emergency Well | Antwerp Springs PH 2 |

**Kalamalka Lake Intake:**

**every 2 years (2021, 2023 etc):**

Herbicides & Pesticides: June

Fuels: August

**Yearly:**

VOC's : July

**every 5 years (2019, 2023 etc):**

Herbicides & Pesticides, Fuels: July

VOC's : July **(Annually)**

**Sources**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| Kalamalka Lake Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | SRB (sulfur reducing bacteria)<br>IRB (Iron Related Bacteria) |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 125 mL Metals Caro | |
| | 1 - 40 mL mercury glass metals | |
| | 1 - Cyanide | |
| | 1 - 125 mL Caro (Yellow lid) | TP |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - VOC Caro (2 bottles) | VOC |
| | 1 - 1 L Caro | |
| | 1 - 4 L Caro | Chlorophyll a |
| Duteau Creek Intake | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL in house | Iron |
| | 1 - 125 mL Metals Caro | |
| | 1 - 40 mL mercury glass metals | |
| | 1 - Cyanide | |
| | 1 - 125 mL Caro (Yellow lid) | TP |
| | 1 - TOC Caro (2 bottles) | TOC |
| | 1 - 1 L Caro | |
| | 1 - 4 L Caro | Chlorophyll a |

**3rd Tuesday** **Annual Comprehensive**

**Distribution**

**3rd Tuesday in January and July** **Bi-Annually - January and July**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| PRV 2 | 1 - Caro Baterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL in house | Colour (true) |
| | 1 - 125 mL Metals Caro | |
| | 1 - 40 mL mercury glass metals | |
| | 1 - 125 mL Caro (Yellow lid) | TP |
| | 1 - Cyanide | Cyanide |
| | 1 - TOC (2 bottles) | TOC |
| | 1 - 1 L Caro | |
| Allenby PS | 1 - Caro Baterial | Total Coliform, E.Coli |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL in house | Colour (true) |
| | 1 - 125 mL Metals Caro | |
| | 1 - 40 mL mercury glass metals | |
| | 1 - 125 mL Caro (Yellow lid) | TP |
| | 1 - Cyanide | Cyanide |
| | 1 - TOC (2 bottles) | TOC |
| | 1 - 1 L Caro | |

**Seasonal Irrigation Source - annually (Well #3 can be used as an emergency potable source)**

| | | |
|---|---|---|
| Coldstream Ranch Well 3 | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - Caro Bacterial | HPC |
| | 1 - Caro Bacterial | Iron Reducing Bacteria |
| | 1 - Caro Bacterial | Sulfur Reducing Bacteria |
| | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL in house | Sulphate and Iron |
| | 1 - Cyanide | |
| | 1 - 125 mL Caro (Yellow lid) | |
| | 1 - 125 mL Metals Caro | |
| | 1 - 40 mL mercury glass metals | |
| | 1 - 1 L Caro | |
| | 1 - VOC Caro (2 bottles) | VOC's |
| | 2 - 1 L amber Caro* | Fuel Scan (HEPL/LEPL) (2021, 2023, 2028 etc) |
| | 2 - 1 L amber Caro* | Herbicides & Pesticides (2021, 2023, 2028 etc) |

**Note:** Palfrey is shut off during the winter. Please contact DoC a couple days prior to turn on for the December and March samples.
**NOTE:** Contact DCWTP a few days prior to sampling to let them know.

**THM's, HAA's & TOCs**

**(Mar, Jun, Sept, Nov)**

| **Sample Sites** | **Location** | **Most common Source** | **March, June, September, Decemember** |
|---|---|---|---|
| DCWTP Post Treatment | entry point | Duteau Creek | THM, HAA, PA, TOC |
| Palfrey Drive SS | mid point | Duteau Creek | THM, HAA, PA |
| Golfview Place SS | end point | Duteau Creek | THM, HAA, PA |
| Sunpeaks Reservoir SS | end point | Duteau Creek | THM, HAA, PA |
| MHWTP Post Treatment | entry point | Kalamalka Lake | THM, HAA, **200 ml PA**, TOC |
| Tavistock Reservoir SS | end point | Kalamalka Lake | THM, HAA, PA |
| Longspoon Reservoir SS | end point | Kalamalka Lake | THM, HAA, PA |
| Allenby PS | mid point | Kalamalka Lake | THM, HAA, PA |

| | | |
|---|---|---|
| Each site: | | 1 - PA |
| | | 2 - THM Bottles |
| | | 2 - HAA's |
| | DCWTP Post Treatment & MHWTP Post Treatment | 2 - TOC bottles |

**Sites:**

## Duteau Watershed

16 km Aberdeen Road Tributary
18 km Aberdeen Road Tributary
Haddo Weir
Duteau Creek Bridge

| |
|---|
| Peizometers and moisture content probes - first week of the month |
| For Peizometers and moisture bring: SDI-12 Reader and Water Level Reader |
| For Duteau Bridge bring: pump, tubing and weight |

## Bi-weekly

**1st Wednesday of the month**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| 16 km Aberdeen Road Tributary | 1 - PA | Bacterial (Most Probable Number) |
| 18 km Aberdeen Road Tributary | 1 - PA | Bacterial (Most Probable Number) |
| Haddo Weir | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| Duteau Creek Bridge | 1 - PA | Bacterial (Most Probable Number) |

**3rd Wednesday of the month** **Monthly**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| 16 km Aberdeen Road Tributary | 1 - PA | Bacterial (Most Probable Number) |
| 18 km Aberdeen Road Tributary | 1 - PA | Bacterial (Most Probable Number) |
| Haddo Weir | 1 - Caro Baterial | Total Coliform, E.Coli |
| | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| | 1 - 125 ml Caro (Yellow lid) | TP |
| | 1 - 125 ml Caro | TN |
| | 1 - TOC Caro | TOC |
| | 1 - 500 mL in house | Iron, Colour (true and apparent) |
| | **1 - 1 L Algae Density *if odor is present** | **Algae Density** |
| | 1 - 4 L Chlorophyll-a Caro | Chlorophyll a |
| Dutea Creek Bridge | 1 - PA | Bacterial (Most Probable Number) |

## Duteau Watershed

**Annuals - July**

| Sample Sites | Bottles | Parameters |
|---|---|---|
| 16 km Aberdeen Road Tributary | 1 - PA | Bacterial (Most Probable Number) |
| 18 km Aberdeen Road Tributary | 1 - PA | MPN |
| Haddo Weir | 1 - Caro Bacterial | Total Coliform, E.Coli |
| | 1 - 200 ml PA | Bacterial (Most Probable Number) |
| | 1 - 500 mL in house | Iron, Colour (true and apparent) |
| | 1 - Metals Caro | |
| | 1 - Metals Caro (glass) | |
| | 1 - Cyanide | |
| | 1 - 125 ml Caro (Yellow lid) | |
| | 1 - TOC Caro | TOC |
| | 1 - 1 L Caro | |
| | **1 - 1 L Algae Density *if odor is present** | **Algae Density** |
| | 1 - 4 L Caro | Chlorophyll a |
| Duteau Creek Bridge | 1 - PA | Bacterial (Most Probable Number) |
| | 1 - TOC Caro | TOC |

# Reactive Phosphate and Iron Sampling Program

| RDNO Operator Sampling | Frequency | Parameters | Comments |
|---|---|---|---|
| DCWTP Post Treatment | 3X/Week | DCWTP Lab:<br>Reactive Phosphate, Alkalinity | Weekly |

| DoC Sampling | Frequency | Parameters | Comments |
|---|---|---|---|
| Noble Canyon Road Hydrant | monthly | GVW Lab:<br>Reactive Phosphate & Iron | Week 3 |
| Aberdeen Road SS | weekly | GVW Lab:<br>Reactive Phosphate & Iron | Week 1, 2, 3 & 4 |

| CoV Sampling | Frequency | Parameters | Comments |
|---|---|---|---|
| Golfview SS | Monthly | GVW Lab:<br>Reactive Phosphate & Iron | Week 1 |
| Sunpeaks Reservoir SS | Monthly | GVW Lab:<br>Reactive Phosphate & Iron | Week 2 |

## 2023 Instrument Maintenance Schedule

| Date | Week | Instruments | | Date | Week | Instruments |
|---|---|---|---|---|---|---|
| Jan 2 - 6 | 4 | | | Jul 3 - 7 | 2 | |
| Jan 9 - 13 | 1 | | | Jul 10 - 14 | 3 | |
| Jan 16 - 20 | 2 | | | Jul 17 - 21 | 4 | |
| Jan 23 - 27 | 3 | pH, Conductivity | | Jul 24 - 28 | 1 | pH, Conductivity |
| Jan 30 - Feb 3 | 4 | | | Jul 31 - Aug 4 | 2 | |
| Feb 6 - 10 | 1 | | | Aug 7 - 11 | 3 | |
| Feb 13 - 17 | 2 | | | Aug 14 - 18 | 4 | |
| Feb 20 - 24 | 3 | pH, Conductivity, Turbidity | | Aug 21 - 25 | 1 | pH, Conductivity, Turbidity |
| Feb 27 - Mar 3 | 4 | | | Aug 28 - Sep 1 | 2 | |
| Mar 6 - 10 | 1 | | | Sep 4 - 8 | 3 | |
| Mar 13 - 17 | 2 | | | Sep 11 - 15 | 4 | |
| Mar 20 - 24 | 3 | pH, Conductivity | | Sep 18 - 22 | 1 | |
| Mar 27 - 31 | 4 | | | Sep 25 - 29 | 2 | pH, Conductivity |
| Apr 3 - 7 | 1 | | | Oct 2 - 6 | 3 | |
| Apr 10 - 14 | 2 | | | Oct 9 - 13 | 4 | |
| Apr 17 - 21 | 3 | | | Oct 16 - 20 | 1 | |
| Apr 24 - 28 | 4 | pH, Conductivity | | Oct 23 - 27 | 2 | pH, Conductivity |
| May 1 - 5 | 1 | | | Oct 30 - Nov 3 | 3 | |
| May 8 - 12 | 2 | | | Nov 6 - 10 | 4 | |
| May 15 - 19 | 3 | | | Nov 13 - 17 | 1 | |
| May 22 - 26 | 4 | pH, Conductivity, Turbidity | | Nov 20 - 24 | 2 | pH, Conductivity, Turbidity |
| May 29 - Jun 2 | 1 | | | Nov 27 - Dec 1 | 3 | |
| June 5 - 9 | 2 | | | Dec 4 - 8 | 4 | |
| Jun 12 - 16 | 3 | | | Dec 11 - 15 | 1 | pH, Conductivity |
| Jun 19 - 23 | 4 | | | Dec 18 - 22 | 2 | |
| Jun 26 - 30 | 1 | pH, Conductivity, **Pocket Colorimeter II** | | Dec 25 - 29 | 3 | |

Pocket Colorimeter II - secondary standard check bi-annually (June/September).
RDNO will do June and a HACH Service representative will do September.

**APPENDIX C – Operator Worksheets**

# Greater Vernon Water
## Winter Source Sampling

Date:_____
Operator:_____
Precipiation:_____ Sky Condition:_____

**DCWTP: 2nd and 4th week of the month pick up Whitevale samples from DCWTP**

**Laboratories:** Caro Analytical Services, RDNO Lab
**Protocols:** Field Sampling Protocol
**Sampling Objectives: Compliance Monitoring**

**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech
**Tools:** 1. Masterflex 2. Sampling Arm

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | KALAMALKA LAKE INTAKE | | | ----- | ----- | | | | | | | 100 ml PA |
| | | DUTEAU CREEK INTAKE | | | ----- | ----- | | | | | | | **200 ml PA** |
| | | 9848 ABERDEEN ROAD | | | | | | | | | ----- | ----- | |
| | | DCWTP POST TREATMENT | | | ----- | ----- | ----- | ----- | ----- | | | | 100 ml PA |
| | | MHWTP POST TREATMENT | | | ----- | ----- | ----- | ----- | ----- | ----- | | | 100 ml PA |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Revised 220103 JJ

# Greater Vernon Water
## Source Sampling

Date:_____

Operator:_____ **DCWTP: 2nd and 4th week of the month pick up Whitevale samples from DCWTP**

Precipitation:_____ Sky Condition:_____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech **Protocols:** Field Sampling Protocol

**Tools:** 1. Masterflex 2. Sampling Arm **Sampling Objectives: Compliance Monitoring**

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | KALAMALKA LAKE INTAKE | | | ----- | ----- | | | | | | | |
| | | DUTEAU CREEK INTAKE | | | ----- | ----- | | | | | | | **200 ml PA** |
| | | RDNO LAB | | | | | | | | | ----- | ----- | |
| | | DCWTP POST TREATMENT | | | ----- | ----- | ----- | ----- | ----- | | | | |
| | | MHWTP POST TREATMENT | | | ----- | ----- | ----- | ----- | ----- | ----- | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | GOOSE LAKE SHORE | | | ----- | ----- | | | | | | | |
| | | GOOSE LAKE INTAKE | | | ----- | ----- | | | | | | | |

Revised 220103 JJ

# Greater Vernon Water
## Coldstream Creek

Date:_____
Operator:_____
Precipitation:_____ Sky Condition:_____

**Laboratories:** Caro Analytical Services, RDNO Lab
**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech **Protocols:** Field Sampling Protocol
**Tools:** 1. Masterflex 2. Sampling Arm **Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | Coldstream Creek at Kirkland Drive | | | | | | | | | Upstream |
| | | Coldstream Creek at Howe Drive | | | | | | | | | Downstream |
| | | Coldstream Creek at Brewer Road | | | | | | | | | Downstream of culvert |
| | | Coldstream Creek at School Road | | | | | | | | | Upstream |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Revised 220104 JJ

# Greater Vernon Water
## Quarterly Distribution

Date:_____
Operator:_____
Precipitation:_____ Sky Condition:_____

**Laboratories:** Caro Analytical Services, RDNO Lab
**Protocols:** Field Sampling Protocol
**Sampling Objectives:** Compliance Monitoring

**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech
**Tools:** 1. Masterflex 2. Sampling Arm

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | PRV 2 | | | | | | | | | | | |
| | | Allenby PS | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
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Revised 220104 JJ

# Greater Vernon Water
## Duteau Watershed

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech **Protocols:** Field Sampling Protocol

**Tools:** 1. Masterflex 2. Sampling Arm **Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | 18 km Aberdeen Road Tributary | | | | | | | | | |
| | | Haddo Weir | | | | | | | | | **200 ml PA** |
| | | Duteau Creek Bridge | | | | | | | | | |
| | | 16 km Aberdeen Road Tributary | | | | | | | | | |
| | | | | | | | | | | | |
| | | Aberdeen Lake Outflow | | | | | | | | | 1 L algae density if odor present |
| | | Grizzly Lake Outflow | | | | | | | | | 1 L algae density if odor present |
| | | | | | | | | | | | |

Revised 220104 JJ

# Greater Vernon Water
## Trihalomethanes (THMs) and Haloacetic acids (HAAs)

Date:_____
Operator:_____
Precipitation:_____ Sky Condition:_____

**Kit:** ☐ Blue Kit GVW Tech ☐ Green Kit GVW Tech
**Tools:** 1. Masterflex 2. Sampling Arm

**Laboratories:** Caro Analytical Services, RDNO Lab
**Protocols:** Field Sampling Protocol
**Sampling Objectives:** Monitor Disinfection Byproduct

| Time (Start) | Time (End) | Site | Enki Context ID | Tools | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Total Coliform | E.coli | |
| - | - | - | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | |
| | | DCWTP Post Treatment | | | | | | | | | | | TOC |
| | | Palfrey Drive SS | | | | | | | | | | | |
| | | Golfview Place SS | | | | | | | | | | | |
| | | Sunpeaks Reservoir SS | | | | | | | | | | | Center Sample Port |
| | | MHWTP Post Treatment | | | | | | | | | | | TOC **200 ml PA** |
| | | Tavistock Reservoir SS | | | | | | | | | | | Cell #2 |
| | | Longspoon Reservoir SS | | | | | | | | | | | |
| | | Allenby PS | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Revised 220104 JJ

Revised 170904 CH

# Greater Vernon Water Utility
# District of Coldstream
## Week 1

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | | |
| This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| | | Springfield Road SS | | | | | | | | | Caro | |
| | | **Pine Road SS** | | | | | | | | | **P/A - 200 ml** | |
| | | College Way SS | | | | | | | | | Caro | "Kal View SS" |
| | | 7900 McClounie Road | | | | | | | | | Caro | "Kalamalka Secondary SS" |
| | | Aberdeen Road SS | | | | | | | | | 500 ml Btl | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Revised 230324 CH

| Notes | |
|---|---|
| **Aberdeen Road SS: 500 ml sample for reactive phosphate & iron** | |
| | |
| | |

# Greater Vernon Water Utility
# District of Coldstream
## Week 2

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | | |
| This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| | | Kidston Road SS | | | | | | | | | Caro | |
| | | **Ravine Drive PS** | | | | | | | | | **P/A - 200 ml** | |
| | | Braeburn Drive SS | | | | | | | | | Caro | |
| | | Cosens Bay Road SS | | | | | | | | | Caro | |
| | | Palfrey Drive SS | | | | | | | | | P/A | |
| | | Brewer Road PS | | | | | | | | | P/A | |
| | | Aberdeen Road SS | | | | | | | | | P/A 500 ml Btl | |
| | | | | | | | | | | | | |

Revised 230324 CH

| Notes | |
|---|---|
| **Aberdeen Road SS: 500 ml sample for reactive phosphate & iron** | |
| | |
| | |

# Greater Vernon Water Utility
# District of Coldstream
## Week 3

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | | |
| This time on bottle | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| | | West Kal Road SS | | | | | | | | | Caro | |
| | | Coldstream Creek Road SS | | | | | | | | | Caro | |
| | | **Ponderosa Way SS** | | | | | | | | | **P/A - 200 ml** | |
| | | Upland Drive SS | | | | | | | | | Caro | |
| | | Noble Canyon Road Hydrant | | | | | | | | | P/A 500 ml btl | |
| | | Aberdeen Road SS | | | | | | | | | 500 ml Btl | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Revised 230324 CH

| Notes | |
|---|---|
| **Aberdeen Road SS and Noble Canyon Road Hydrant: 500 ml sample for reactive phosphate & iron** | |
| | |
| | |

# Greater Vernon Water Utility
# District of Coldstream
## Week 4

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total Coliform | E.coli | | |
| This time on bottle | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| | | Cunliffe Reservoir SS | | | | | | | | | P/A | Sample from outlet |
| | | 6015 Highway 6 | | | | | | | | | Caro | "Lavington Superette" |
| | | **Husband Road PS** | | | | | | | | | **P/A - 200 ml** | |
| | | Kirkland Drive SS | | | | | | | | | Caro | |
| | | Brewer Road SS | | | | | | | | | Caro | |
| | | Highway 6 SS | | | | | | | | | P/A | |
| | | Aberdeen Road SS | | | | | | | | | 500 ml Btl | |
| | | | | | | | | | | | | |

Revised 230324 CH

| Notes | |
|---|---|
| **Aberdeen Road SS: 500 ml sample for reactive phosphate & iron** | |
| | |
| | |

# GVW Sampling City of Vernon - Week 1 (Routes 1 and 2)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 1 | | | Longspoon Court SS | | | | | | | | | Caro | |
| 1 | | | Weeks Road SS | | | | | | | | | Caro | |
| **1** | | | **Okanagan Landing 2 PS** | | | | | | | | | Caro **P/A 200 ml** | |
| 1 | | | Upper Commonage Booster | | | | | | | | | Caro | |
| 1 | | | Mission Road SS | | | | | | | | | Caro | "Noric House SS" |
| 2 | | | 43rd Street SS | | | | | | | | | P/A | |
| 2 | | | Okanagan Landing Road SS | | | | | | | ----- | ----- | ----- | |
| 2 | | | Amber Drive SS | | | | | | | | | P/A | |
| 2 | | | 21st Avenue SS | | | | | | | | | Caro | "Vernon Jubilee Hospital" |
| 2 | | | Anderson Way SS | | | | | | | | | P/A | |
| 2 | | | 35th Street SS | | | | | | | | | Caro | |

Revised 230327 CH

| Notes | |
|---|---|
| | |
| | |

# GVW Sampling City of Vernon - Week 2 (Routes 1 and 2)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RNDO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 1 | | | 21st Avenue SS | | | | | | | | | Caro | "Vernon Jubilee Hospital" |
| **1** | | | **Kokanee Booster** | | | | | | | | | **P/A 200 ml** | |
| 1 | | | Mission Road SS | | | | | | | | | P/A | "Noric House SS" |
| 1 | | | Okanagan Landing 1 PS | | | | | | | | | Caro | |
| 1 | | | Okanagan Landing Road SS | | | | | | | | | Caro | |
| 2 | | | Tavistock Reservoir SS | | | | | | | | | Caro | |
| 2 | | | 30th Street SS | | | | | | | | | Caro | "City Hall SS" |
| 2 | | | Balsam Reservoir SS | | | | | | | | | Caro | |
| 2 | | | Dunsmuir Road SS | | | | | | | | | Caro | |
| 2 | | | Tronson Road SS | | | | | | | | | Caro | |
| | | | | | | | | | | | | | |

Revised 230327 CH

| Notes | |
|---|---|
| | |
| | |

# GVW Sampling City of Vernon - Week 3 (Routes 1 and 2)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RNDO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 1 | | | Upper Commonage Booster | | | | | | | | | Caro | |
| 1 | | | Longspoon Court SS | | | | | | | | | P/A | |
| 1 | | | Weeks Road SS | | | | | | | | | P/A | |
| 1 | | | Okanagan Landing 2 PS | | | | | | | | | P/A | |
| 1 | | | Mission Road SS | | | | | | | | | Caro | "Noric House SS" |
| 2 | | | 43rd Street SS | | | | | | | | | Caro | |
| 2 | | | 21st Avenue SS | | | | | | | | | Caro | "Vernon Jubilee Hospital" |
| 2 | | | Amber Drive SS | | | | | | | | | Caro | |
| **2** | | | **Allenby PS** | | | | | | | | | Caro **P/A 200 ml** | |
| 2 | | | Okanagan Landing Road SS | | | | | | | | | P/A | |
| | | | | | | | | | | | | | |

Revised 230327 CH

| Notes | |
|---|---|
| | |
| | |

# GVW Sampling City of Vernon - Week 4 (Routes 1 and 2)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | - | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| **1** | | | **Kokanee Booster** | | | | | | | | | Caro **P/A 200 ml** | |
| 1 | | | Okanagan Landing 1 PS | | | | | | | | | P/A | |
| 1 | | | Brassey Place SS | | | | | | | | | Caro | |
| 1 | | | Longacre Drive SS | | | | | | | | | Caro | "Claremont Sample Station" |
| 1 | | | Mission Road SS | | | | | | | | | P/A | "Noric House SS" |
| 2 | | | 21st Avenue SS | | | | | | | | | P/A | "Vernon Jubilee Hospital" |
| 2 | | | Okanagan Landing Road SS | | | | | | | ----- | ----- | ----- | |
| 2 | | | Balsam Reservoir SS | | | | | | | | | P/A | |
| 2 | | | Tronson Road SS | | | | | | | | | Caro | |
| 2 | | | Dunsmuir Road SS | | | | | | | | | P/A | |

Revised 230327 CH

| Notes | |
|---|---|
| | |
| | |

# GVW Sampling City of Vernon - Week 1 (Routes 3 and 4)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 3 | | | Pleasant Valley Road SS | | | | | | | | | P/A | |
| 3 | | | McMechan Reservoir SS | | | | | | | | | Caro | Line: |
| **3** | | | **PRV 1** | | | | | | | | | **P/A 200 ml** | Sample inlet before re-chlorination |
| 3 | | | Boss Creek 1 PS Return | | | | | | | | | Caro | |
| 4 | | | Kosmina Road SS | | | | | | | | | Caro | |
| 4 | | | Old Kamloops Road SS | | | | | | | | | P/A | |
| 4 | | | Golfview Place SS | | | | | | | | | Caro + 500mL | |
| 4 | | | Rugg Road SS | | | | | | | | | Caro | |
| 4 | | | Turtle Mountain PS | | | | | | | | | P/A | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Revised 230327 CH

| Notes | |
|---|---|
| **Golfview Place SS: Extra 500mL or Caro bottle (rinse 3 times) - in-house sample for reactive phosphate & iron** | |
| | |
| | |

# GVW Sampling City of Vernon - Week 2 (Routes 3 and 4)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 3 | | | 4714 Pleasant Valley SS | | | | | | | | | Caro | "City Yard Fill Station" |
| 3 | | | Mt Grady Road SS | | | | | | | | | P/A | |
| **3** | | | **Foothills Booster** | | | | | | | | | **P/A 200 ml** | |
| 3 | | | South BX 1 PS | | | | | | | | | P/A | |
| 3 | | | Boss Creek 2 PS Return | | | | | | | | | Caro | |
| 4 | | | Pottery Road SS | | | | | | | | | Caro | |
| 4 | | | North BX 2 PS | | | | | | | | | Caro | |
| 4 | | | Haney Road SS | | | | | | | | | P/A | |
| 4 | | | Galiano Road B/O | | | | ----- | | ----- | ----- | ----- | ----- | Friday weekly flushing - record pre and post flush results |
| 4 | | | Brookside Road B/O | | | | ----- | | ----- | ----- | ----- | ----- | Friday weekly flushing - record pre and post flush results |
| | | | | | | | | | | | | | |

Revised 230327 CH

| Notes | |
|---|---|
| | |
| | |

# GVW Sampling City of Vernon - Week 3 (Routes 3 and 4)

Date:_____
Operator:_____
Precipitation:_____ Sky Condition:_____
Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab
**Protocols:** Field Sampling Protocol
**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 3 | | | Sunpeaks Reservoir SS | | | | | | | | | Caro + 500mL | |
| 3 | | | 15th Street SS | | | | | | | | | P/A | |
| 3 | | | 25th Street SS | | | | | | | | | Caro | |
| 3 | | | PRV 2 | | | | | | | | | P/A | |
| 3 | | | Boss Creek 1 PS Return | | | | | | | | | Caro | |
| 4 | | | Anderson Way SS | | | | | | | | | Caro | |
| 4 | | | Goose Lake Road PS | | | | | | | | | Caro | |
| **4** | | | **Turtle Mountain PS** | | | | | | | | | Caro **P/A 200 ml** | |
| 4 | | | PRV 076 | | | | | | | | | Caro | "Highland Place PRV 77" |
| | | | | | | | | | | | | | |

Revised 230327 CH

| Notes | |
|---|---|
| **Sunpeaks Reservoir SS: Extra 500mL or Caro bottle (rinse 3 times) - in-house sample for reactive phosphate & iron** | |
| | |
| | |

# GVW Sampling City of Vernon - Week 4 (Routes 3 and 4)

Date:_____

Operator:_____

Precipitation:_____ Sky Condition:_____

Kit (colour and #): _____

**Laboratories:** Caro Analytical Services, RDNO Lab

**Protocols:** Field Sampling Protocol

**Sampling Objectives:** Compliance Monitoring

| Route | Time (Start) | Time (End) | Site | Free Chlorine | Total Chlorine | Turbidity | pH | Temp | Cond | RDNO Lab | | Bottle Type | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Coliform | E.coli | | |
| | This time on bottle | - | - | mg/L | mg/L | NTU | pH units | °C | µS/cm | P-A/100ml or MPN/100ml | | - | |
| 3 | | | McMechan Booster | | | | | | | | | Caro | |
| 3 | | | 4714 Pleasant Valley SS | | | | | | | | | Caro | "City Yard Fill Station" |
| 3 | | | East Dedecker Road SS | | | | | | | | | P/A | "BX Park SS" |
| **3** | | | **South BX 2 PS** | | | | | | | | | Caro **P/A 200 ml** | |
| 3 | | | Marmot Court SS | | | | | | | | | P/A | |
| 3 | | | Boss Creek 2 PS Return | | | | | | | | | Caro | |
| 4 | | | 43rd Avenue SS | | | | | | | | | Caro | "Kin Race Track SS" |
| 4 | | | Pottery Road SS | | | | | | | | | P/A | |
| 4 | | | 30th Street SS | | | | | | | | | Caro | "City Hall SS" |
| 4 | | | Mt Grady Court SS | | | | | | | | | Caro | |
| 4 | | | Galiano Road B/O | | | | ----- | | ----- | ----- | ----- | ----- | Friday weekly flushing - record pre and post flush results |
| 4 | | | Brookside Road B/O | | | | ----- | | ----- | ----- | ----- | ----- | Friday weekly flushing - record pre and post flush results |

Revised 230327 CH

| Notes | |
|---|---|
| | |

REGIONAL DISTRICT
NORTH OKANAGAN

# Greater Vernon Water
# Water Quality
# Deviation Response and Notification Plan

Revised: March 6, 2025

# Table of Contents



# Tables

# Introduction

Greater Vernon Water (GVW) in cooperation with Interior Health Authority (IHA) has developed this Water Quality Deviation Response and Notification Plan (Plan) which works in conjunction with the GVW Emergency Response Plan (ERP).

The objective of the Plan is to provide a tool to:

1) guide operations, management and IH in identifying associated risks to human health
2) assist in determining the response for each incident identified
3) determine the level of public communication needed when water quality results deviate from acceptable levels

The Plan takes a risk evaluation approach to combat potential water borne diseases posing an associated risk to human health. The Plan links varying degrees of water quality degradation with investigative and operational responses.

The participants understand and agree this Plan will change in response to new research, technology and the understanding of water quality issues. Further, not all situations are outlined within this Plan and deviations that may affect water quality should be discussed with Regional District of North Okanagan (RDNO) management

The participants also understand the purpose of this document is not to replace the need for discussion with RDNO management and Interior Health Authority (IHA) when needed. As per the water quality protocol ENG-GVW-OP03:

> *the Owner, in consultation with Interior Health, will be responsible for determining the level of notification requirement during Water Quality events, and*
>
> *the Owner will consult with the Operator prior to issuing a notification of a Water Quality event if deemed appropriate by the Owner.*

This plan focuses on acceptable water quality as defined by The *Drinking Water Protection Act* and the *Drinking Water Protection Regulation*.

As defined by IHA, GVW must communicate deviations to the Drinking Water Officer (DWO) or Medical Health Officer (MHO) as determined in conjunction with the DWO.

# WATER QUALITY DEVIATION and NOTIFICATION

Drinking water notification is defined in the *Drinking Water Protection Act,* specifically, sections 12, 13, and 14. The levels of notification are:

- water quality advisory (WQA)
- boil water notice (BWN)
- do not use water notice

Triggers for drinking water notification or a deviation response are defined within *Drinking Water Protection Act and Regulation*. The triggers include but are not limited to:

- the presence of indicator bacteria, such as fecal coliform or *E.coli* in water samples
- treatment failure
- water main breaks or infrastructure works resulting in depressurization
- cross connections between potable and non-potable sources
- turbidity

Each of these triggers can lead to a deviation in water quality.

## Levels of Deviation

Deviations are categorized based on the severity and type of deviation from established guidelines and standards:

1. **Minor Deviations**: These are deviations that do not pose an immediate health risk but may indicate that water quality is not meeting the desired standards. Examples include slight changes in taste or odor. Minor deviations are not discussed in this DRP but may be noted on the field worksheets by operators/RDNO staff.
2. **Moderate Deviations**: These deviations indicate a change that may affect water quality but may not pose an immediate health risk. Examples include slightly elevated levels of certain chemicals or minor treatment process issues. **The tables** below outline some of the **moderate changes** from acceptable levels in the GVW system. At this level of deviation, **an identified or potential health risk** to drinking water users is determined as moderate and an operational response and notification is to be generated. The intent of the notification is to advise the drinking water user of a change to water quality and actions the user may consider. The checklist located in **ERP - APPENDIX J** should be used to implement a notification.
3. **Major Deviations**: These are serious deviations where there **is an identified or potential health risk** to consumers. For example, the potential presence of harmful bacteria. **The tables** below outline some of the **major changes** from acceptable levels in the GVW system. An investigation and operational response is determined. GVW and/or IHA will determine the notification level. The checklist located in **ERP - APPENDIX J** should be used to implement notification.
4. **Critical Deviations**: These are the most severe deviations, indicating a situation where the water is unsafe for consumption or use. Immediate action is required to protect public health. Examples include widespread contamination or a complete breakdown of the water treatment system. Critical deviations are not specifically mentioned in this DRP. All responses in a Critical Deviation would be in consultation with IHA.

The public notification levels and their definitions (as defined by the Province - https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/notices-boil-water-advisories) are as follows:

## Levels of Notification – Adapted from IHA Website

### Water Quality Advisory

A WQA is the lowest-level notification. A WQA is used in situations where the public health threat is modest, and actions can be taken to reduce the risks by ways other than requiring a BWN or do not use water notice.

### Boil Water Notice

A BWN is used in situations where the public health threat is significant, and the nature of the threat is one that can be effectively addressed by boiling the water.

### Do Not Use Water Notice

A do not use water notice is the highest-level notification. It is used in situations where a significant public health threat exists and the threat cannot be adequately addressed through a WQA or BWN.

# WATER QUALITY DEVIATION RESPONSE GUIDE

This Plan is to provide direction for the operator, staff, supervisors, and management when water quality or operational parameters deviate from normal conditions.

The intent of the Plan is to assess water quality changes and to mitigate risk to human health. An assessment of potential risk to human health will determine the level of notification. GVW may assist operations on an appropriate operational response and action plan to return water quality to a normal state.

## Operational Communications for Mission Hill and Duteau Water Treatment Plants

Tables 1-6 were developed to provide guidance for identification of a water quality deviation at the treatment plants. While these tables are meant as guides, it is understood that deviations are dealt with collaboratively.

The operator/supervisor should:

- Inform their immediate supervisor and assess the situation when water quality or operational parameters deviate from normal conditions.

- Follow the tables and if the deviation is:
  - Moderate - inform the call list below **within 24 hours** of the specific changes in water quality that occurred outside of acceptable levels.
  - Major - inform the call list below **immediately. If no response, try another contact or contact method using the contact list (ERP - Appendix H).**

  **Call List Order:**
  1. **Tricia Brett**
  2. **John Lord**
  3. **Zee Marcolin**

RDNO should:

- inform the DWO/MHO by phone, email, weekly reports, or monthly reports depending on the type of deviation.

## Water Distribution Operators Guidance

Tables 7-11 were developed to assist operators who are operating the GVW distribution system. These tables and notes provide guidance for water quality deviation within the water distribution system.

The operator should:

- Inform RDNO and assess the situation when water quality or operational parameters deviate from normal conditions

- Follow the tables and if the deviation is:
  - Moderate - inform GVW **within 24 hours** of the specific changes in water quality that occurred outside of acceptable levels.
  - Major - inform GVW **immediately. If no response, try another contact or contact method using the contact list (ERP - Appendix H).**

**Call List Order:**

1. **Tricia Brett**
4. **John Lord**
5. **Zee Marcolin**

**Note: After hours, call cell numbers FIRST - until you get a live RDNO voice. While RDNO has made an effort to ensure the calls are not affected by the do not disturb feature, please note** many RDNO employees use *Do Not Disturb Mode* on work cellphones. To ensure a call goes through after work hours, **phone twice within 3 minutes**.

- Inform their immediate supervisor of the situation if they wish

RDNO should:

- Inform the DWO/MHO by phone, email, weekly reports, or monthly reports depending on the type of deviation.

Communication through the comment section on water quality worksheets is required.

All corrective actions and abnormal observations are to be recorded in the comments section of the water quality worksheets. Corrective actions include, but are not limited to: additional sampling, water main flushing, increased chlorine levels, inspect sample site, and investigation of possible cross connection. For further direction on water quality emergencies follow the ***Greater Vernon Water Emergency Response Plan***.

**Tables 1** to **11** are intended as guidance as to what can trigger a deviation and indicate what may be the response. They are intended to support decision making and indicate critical points.

Table 1: Chlorine Treatment at the Treatment Plant

| **Deviation Type** | **Conditions / Actions** | | | | | |
|---|---|---|---|---|---|---|
| | Kalamalka Lake - Mission Hill Water Treatment Plant (MHWTP) | Duteau Creek Water Treatment Plant (DCWTP) | Okanagan Lake Outback | Okanagan Lake Delcliffe | Well#1/3 Coldstream Ranch | Deep Antwerp #2 Emergency Well |
| **Target** | 1.8-2.2 ppm for 483 PZ. 1.8- >2.20 ppm for 550 PZ. | 1.9 ppm (set by distribution) | 1.0 – 2.0 ppm | 1.2 – 2.0 ppm | 0.5 ppm | ~0.5 ppm |
| **Moderate Deviation** | Free chlorine residual below 0.80 ppm at outflow analyzer to 483 PZ or 550 PZ from MHWTP | Free chlorine residual below 1.00 ppm at Post - UV outflow | Free chlorine residual below 0.50 ppm | Free chlorine residual below 0.50 ppm | Free chlorine residual below 0.25 ppm | Free chlorine residual below 0.25 ppm |
| **Response** | Discuss:<br>- Why not achieving target<br>- Whether or not notification<br>- Look at distribution<br>- Take 200 mL bacterial sample at plant outflow | - Monitor distribution chlorine<br>- Take 200 mL bacterial sample at plant outflow | - Take 200 mL bacterial sample at reservoir outflow | - Take 200 mL bacterial sample at reservoir outflow and in distribution | - Is the source being used for drinking? | - Is the source being used for drinking? |
| **Major Deviation Initiates Investigation** | - Malfunction of chlorination - chlorine interruption and plant continues to run<br>- Unchlorinated water in distribution | - Malfunction of chlorination<br>- Unchlorinated water in distribution | - Free chlorine below 0.20 ppm at reservoir outflow to Outback strata | - Malfunction of chlorination<br>- Unchlorinated water in distribution | - Chlorine interruption and well continues to run | - Chlorine interruption and well continues to run |
| **Response** | - Can the unchlorinated water be isolated to an area and flushed?<br>- Untreated water into the distribution – notification to the public if needed | - Can the unchlorinated water be isolated to an area and flushed?<br>- Untreated water into the distribution – notification to the public if needed.<br>- Look at booster stations to isolate incident or to help with residuals | - Public notification if necessary | - Can the unchlorinated water be isolated to an area and flushed?<br>- Untreated water into the distribution – notification to the public if needed | - Is the source being used for drinking? | - Is the source being used for drinking? |

Table 2: Bacteria at Source

| **Deviation Type** | **Conditions / Actions** | | | | | |
|---|---|---|---|---|---|---|
| | Kalamalka Lake Raw water Sample Station | Duteau Creek (untreated line at Headgates Cl2 bldg.) | Okanagan Lake Outback Lake station | Okanagan Lake Delcliffe Lake Station | Well #1 at Coldstream Ranch | Deep Antwerp # 2 Emergency Well |
| **Moderate Deviation** | >20 *E.coli* bacteria per 100 mL<br>>50 Total Coliform per 100 mL | >20 *E.coli* bacteria per 100 mL<br>>200 Total Coliform per 100 mL | >20 *E.coli* bacteria per 100 mL<br>>50 Total Coliform per 100 mL | >20 *E.coli* bacteria per 100 mL<br>>50 Total Coliform per 100 mL | >1 *E.coli* bacteria per 100 mL | >1 *E.coli* bacteria per 100 mL |
| **Response** | Monitor the situation as an increase in bacteria counts may indicate a contamination event. | | | | | |
| **Major Deviation Initiates Investigation** | >50 *E.coli* bacteria per 100 mL in consecutive samples<br>>200 Total Coliform per 100 mL in consecutive samples | >50 *E.coli* bacteria per 100 mL in consecutive samples<br>>200 Total Coliform per 100 mL in consecutive samples | >50 *E.coli* bacteria per 100 mL in consecutive samples<br>>200 Total Coliform per 100 mL in consecutive samples | >50 *E.coli* bacteria per 100 mL in consecutive samples<br>>200 Total Coliform per 100 mL in consecutive samples | >1 *E.coli* bacteria per 100 mL in consecutive samples | >1 *E.coli* bacteria per 100 mL in consecutive samples |
| **Response** | May indicate watershed or groundwater contamination event. ***Inform Operations*** | | | | | |

Table 3: Turbidity after Treatment

| **Deviation Type** | **Conditions / Actions** | | | | | |
|---|---|---|---|---|---|---|
| | Kalamalka Lake - Post Mission Hill WTP | Duteau Creek WTP - Post UV | Okanagan Lake Outback Booster Station – Post UV | Okanagan Lake – Delcliffe | Deep Antwerp #2 – Before Chlorination | Well #3 Coldstream Ranch |
| **Moderate Deviation** ***Trended on a 24 hour average*** | > 3 NTU (Table 6) | >1 NTU | > 1 NTU | > 1 NTU | > 1 NTU | > 1 NTU |
| **Response** | - Confirm online monitoring accuracy.<br>- Turbidity follows Operational Guideline (Table 6).<br>- Notify Manager-Water Quality | - Confirm online monitoring accuracy.<br>- Notify Manager-Water Quality | - Confirm online monitoring accuracy.<br>- Notify Manager-Water Quality | - Confirm online monitoring accuracy.<br>- Notify Manager-Water Quality | - Confirm online monitoring accuracy.<br>- Notify Manager-Water Quality | - Confirm online monitoring accuracy.<br>- Notify Manager-Water Quality |
| **Major Deviation** **Initiates Investigation** ***Trending or Greater than 30 minutes*** | > 5 NTU | > 5 NTU | > 5 NTU | > 5 NTU | > 1 NTU | > 1 NTU |
| **Response** | Discussion with Water Quality Team | | | | | |

Table 4: UV Disinfection

| **Deviation Type** | **Conditions / Actions** | | |
|---|---|---|---|
| | Mission Hill Water Treatment Plant | Duteau Creek Water Treatment Plant | Okanagan Lake Outback Booster Station |
| **Moderate Deviation** ***Trended on a 24 hour average*** | Off- spec water over 10 minutes | Off- spec water over 10 minutes | <90 watts/$m^2$ under normal flow conditions |
| **Response** | - MHWTP UV Transmissivity follows Operational Guideline (Table 6).<br>- Notify Manager-Water Quality | - Notify Lead Water and Supply Operator.<br>- Notify Manager-Water Quality | - Consider restricting flow to bring dose back within UV reactor specifications.<br>- Notify Manager-Water Quality |
| **Major Deviation** ***Upward Trending or Greater than 30 minutes*** | Malfunction | Malfunction | UV Failure |
| **Response** | Discussion with Water Quality Team | | |

Table 5: DAF Treatment Only

| **Deviation Type** | **Conditions / Actions** |
|---|---|
| | Duteau Creek Water Treatment Plant |
| **Moderate Deviation** | Off-spec water over 10 minutes |
| **Major Deviation** | – Primary treatment bypass and turbidity <5 NTU blended water at reservoir – WQA<br>– Bypass with turbidity >5 NTU – BWN<br>– Water Quality Manager to discuss both situations with IHA |

Table 6: MHWTP Turbidity and UV Response

| | **Water Quality Parameters** | | **Operational Response** |
|---|---|---|---|
| Condition | Turbidity at Mission Hill *24 hour average* | UV Transmissivity | Chlorine Residual (leaving Mission Hill) |
| 1 | <1.0 NTU | >86% | Based on water quality set points |
| 2 | >1.0 NTU but <3.0 NTU | >86% | 0.2 mg/L higher than condition 1 set points* |
| 3 | >1.0 NTU but <3.0 NTU | <86% | Moderate Deviation |
| 4 | >3.0 NTU and rising | Any UVT | Moderate Deviation |
| 5 | >5.0 NTU | Any UVT | Major Deviation, follow Response Plan |

**Notes:**

- *If water quality parameters are moving from those outlined in condition 1 to those outlined in condition 2, residual should be raised by 0.2 mg/L unless residual has already been elevated due to an earlier event.
- The "Decision Tree" also includes the following scenarios that are relevant to our source but may not be covered above:
  - Has the turbidity level exceeded the level for which the system has been designed or validated (e.g., system designed to operate effectively for turbidity levels ≤3.5 NTU but the current turbidity level is 4 NTU)?
  - Have there been failures in the treatment train? For example:
    - Power outage
    - Existing treatment outcomes from chemical disinfection cannot be maintained (e.g., loss of chlorine residual)
    - Decrease in UV dose or lamp failure
    - Decrease in UV transmittance (the amount of light passing through the water)

Table 7: Chlorine in Distribution

| **Deviation Type** | **Conditions / Actions** | **Conditions / Actions** |
|---|---|---|
| | Duteau and Kalamalka Water System | Delcliffe Water System |
| **Moderate Deviation** | Free chlorine residual below 0.20 mg/L at sampling point | Free chlorine residual below 0.20 mg/L at sampling point |
| **Response** | - A bacterial sample should be taken at the water quality monitoring site.<br>- If a positive bacterial result occurs, corrective actions should be taken.<br>- Actions could include flushing, increasing chlorine levels, inspect sample site, and investigate possible cross-connection. | - A bacterial sample should be taken at the water quality monitoring site.<br>- If a positive bacterial result occurs, corrective actions should be taken.<br>- Actions could include flushing, increasing chlorine levels, inspect sample site, and investigate possible cross-connection. |
| **Major Deviation Initiates Investigation** | Free chlorine residual below 0.20 ppm in **high** volume mains (300 mm and larger) and reservoirs | Free chlorine residual below 0.20 ppm in **reservoir** |
| **Response** | – Take 200 mL bacterial sample.<br>– If positive bacterial sample, occurs corrective actions should be taken.<br>– Actions could include additional sampling, water main flushing, increasing chlorine dosing, issuing a WQA or BWN.<br>– Call IHA if needed. | – Take 200 mL bacterial sample.<br>– If all bacterial samples are negative, dose reservoir and issue a WQA.<br>– If positive, issue a BWN and dose reservoir.<br>– Call IHA if needed. |

Table 8: Bacteria in the Distribution System

| **Deviation Type** | **Conditions / Actions** | **Conditions / Actions** |
|---|---|---|
| | Total Coliform | Escherichia coli (*E.coli*) |
| **Target** | 0 Total Coliform per mL | 0 *E.coli* per mL |
| **Moderate Deviation** | - Presence of Total Coliform on consecutive samples<br>- >10 Total Coliform bacteria per 100 mL on one sample<br>- More than one (1) sample site from a set of samples having presence of Total Coliform on a given sampling date | |
| **Response** | - Check other parameters and note if there are changes in turbidity, pH, temperature or conductivity that could relate to change in the source or distribution water and report to water quality<br>- Corrective action(s) refers to but is not limited to additional sampling, water main flushing, increase chlorine levels, inspect sample site, and investigate possible cross-connection | |
| **Major Deviation Initiates Investigation** | - More than three (3) samples from a set of samples having presence of Total Coliform on a given sampling date<br>- The third consecutive sample refers to 1) initial sample, 2) re-sample to verify, 3) re-sampled after corrective action has been completed<br>- More than 10% based on a minimum of 10 samples show presence of Total Coliforms<br>- A third consecutive sample confirmed by a certified lab of Total Coliform count or MPN | Presence of *E.coli* bacteria |
| **Response** | - Trigger an investigation and type of advisory discussion between RDNO Management and IHA<br>- Trigger an investigation and resample<br>- Trigger an investigation and potential water quality advisory or boil water notice<br>- Check other parameters such as chlorine residual, pH, temperature and conductivity and report to water quality | - Immediately notify IHA<br>- Trigger an investigation and potential WQA or BWN<br>- Note if there is a low chlorine level or other abnormal parameter. Re-sample as soon as possible to confirm presence of E.coli bacteria<br>- Discussion with Management and IHA regarding a BWN |

Table 9: Turbidity in the Distribution System

| **Deviation Type** | **Conditions / Actions**<br>Within the Distribution System – Reservoir / Water Main |
|---|---|
| **Moderate Deviation** | - Turbidity is suspicious (Turbidity is significantly different than the post WTP value) |
| **Response** | - Make note if flushing is occurring in the area or other activities that may affect turbidity.<br>- Make note of Turbidity leaving the treatment plant.<br>- Check other parameters such as chlorine residual, pH, temperature and conductivity and record.<br>- Take a 200 mL bacterial sample. |
| **Major Deviation**<br>**Initiates Investigation**<br>***Trending or Greater than 30 minutes*** | - Turbidity in the distribution notably higher than other sites or > 5 NTU unless flushing is occurring. |
| **Response** | - Check other parameters such as chlorine residual, pH, temperature and conductivity and report to water quality.<br>- Call RDNO to report a deviation and note if related to the distribution water, maintenance or construction.<br>- Take corrective actions that could include the following: flushing and investigating possible cross connection.<br>- Take a 200 mL bacterial sample. |

Table 10: Moderate Deviation Break or Water Quality Event

| | **Type 1 Break** | **Responsibility** |
|---|---|---|
| **Definition** | • Positive pressure >20 PSI maintained during break and repair.<br>• No signs of contamination intrusion. | |
| **Steps:** | 1. Isolate and repair break following AWWA C651-23.<br>2. Flush water of concern out of pipe following AWWA C651-23 Flushing – 5.5.3.1<br>3. Verify chlorine residual, turbidity, pH, conductivity values align with pre break levels or nearby levels of the distribution system.<br>4. Report break to RDNO within 24 hours. | Operator |

Table 11: Major Deviation Break or Water Quality Event

| | Type 2 Break | Type 3 Break or Power Loss | Type 4 Break | Responsibility |
|---|---|---|---|---|
| **Definition** | • Positive pressure >20 PSI maintained until a controlled shutdown occurs.<br>• No sign of contamination intrusion. | • Loss of pressure (<20 PSI) at the break site or within the system prior to shutdown of area.<br>• Possible contamination at site or via cross connection. | • Loss of pressure (<20 PSI) at break site and/or widespread depressurization in the system.<br>• Probable or actual contamination at site or via cross connection | |
| **Steps** | 1. Contact RDNO Staff. Confirmation of contact is required. State expected affected area. | | | Operator |
| | 2. Isolate area and preform controlled shutdown.<br>3. Repair break following AWWA C651-23 protocols.<br>4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.2. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur. | 2. Isolate area around break.<br>3. Repair break following AWWA C651-23 protocols.<br>4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.3. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur. | 2. Isolate area around break and depressurized area.<br>3. Repair break following AWWA C651-23 protocols.<br>4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.3. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur. | Operator |
| | 5. Determine alert level:<br>• Water Quality Advisory if adequate flushing.<br>• Boil Water Notice if adequate flushing not preformed. | 5. Determine alert level:<br>• Water Quality Advisory if adequate flushing.<br>• Boil Water Notice if adequate flushing not preformed. | 5. Boil Water Notice | RDNO Staff |
| | 6. Delineate affected area with appropriate alert sandwich boards as designated by RDNO staff. If after hours, place generic “Water Quality Event” signs.<br>7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab.<br>8. Take 1 bacterial sample from at least 1 site if adequate flushing occurred. Take 2 samples at least 24 hours apart from at least 1 site if adequate flushing did not occur. Larger areas may require additional sample sites to delineate entire area.<br>9. Document Incident and actions taken and report to RDNO. | 6. Delineate affected area with appropriate alert sandwich boards as designated by RDNO staff. If after hours, place generic “Water Quality Event” signs.<br>7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab.<br>8. Take 1 bacterial sample from at least 1 site if adequate flushing occurred. Take 2 samples at least 24 hours apart from at least 1 site if adequate flushing did not occur. Larger areas may require additional sample sites to delineate entire area.<br>9. Document Incident and actions taken and report to RDNO. | 6. Delineate affected area with Boil Water Notice sandwich board signs.<br>7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab.<br>8. Take 2 samples at least 24 hours apart from at least 1 site. Larger areas may require additional sample sites to delineate entire area.<br>9. Document Incident and actions taken and report to RDNO. | Operator |