Water Operations

2022 Annual Report

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LAKE COUNTRY
Life. The Okanagan Way.

Contents

Water Operations

2022 Overview

The following is intended to inform and summarize 2022 data collections, observations, and work completed by DLC staff with regards to water operations and water quality.

Water operations highlights include:

- Main Line Valve Replacement
- Hare Road watermain replacement
- Oyama Hydrant Renewal
- Lake Pine Intake Repair
- Okanagan Lake Pump Motor Repair
- Fixed Meter Network
- Hach WIMS (Water Information Management System)
- Upgrades to DLC SCADA System

System Descriptions and Classification

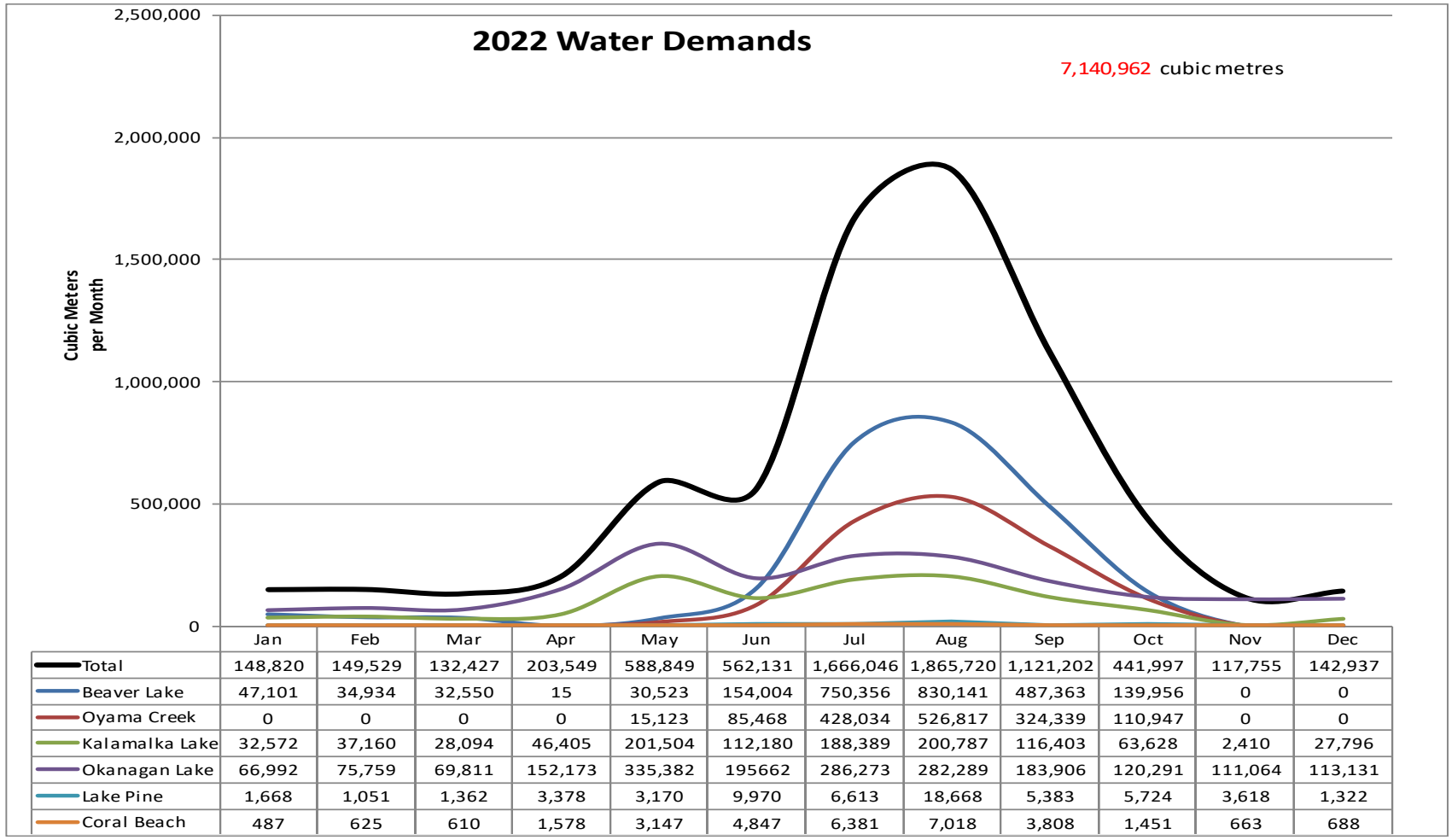
The District of Lake Country (DLC) is a growing municipality with an approximate population of 15,000 people. Not all 15,000 residents are connected to the DLC's public water systems. The primary upland sources used by the DLC include Beaver Lake, Crooked Lake, Oyama Lake, and Damer Lake. The lower elevation water sources are Okanagan Lake (3 separate intakes) and Kalamalka Lake.

Infrastructure within the DLC owned water systems includes 6 storage dams, 10 reservoirs, 6 chlorine injection systems, 9 pump houses, 2 UV disinfection systems, 6 pressure boosting stations, 39 pressure reducing stations, 85 pressure reducing valves, more than 508 hydrants, and approximately 200 km of water distribution mains.

Water Demands

Each water source within the DLC has varying levels of consumption demand. Factors that impact demand are the total number of connections to the water system and the type of water connection. Residential, commercial, industrial, institutional, seasonal irrigation and agricultural connections are all different types of customers connected to the different water systems. Total water usage among the sources and water systems in 2022 was 7,140,962 cubic meters (see Figure 1 for water consumption by source). Water demands in 2022 were slightly below average, which may be attributed to the cooler, wetter spring. September and October saw higher usage as these months were warmer and drier than historical averages. In fact, October saw the highest usage since the DLC started metering water consumption in 2017.

Each spring, Beaver and Oyama Lake experience higher turbidity levels in the water due to spring freshet. To address the increased turbidity, DLC supplies the Beaver Lake source with Okanagan Lake water, and the Oyama Lake source with Kalamalka Lake water. 2022 was the first year the Beaver Lake source was supplied with Okanagan Lake water during the non irrigation season. These operational changes lead to increased demand on the Beaver and Kalamalka Lake sources.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	148,820	149,529	132,427	203,549	588,849	562,131	1,666,046	1,865,720	1,121,202	441,997	117,755	142,937
Beaver Lake	47,101	34,934	32,550	15	30,523	154,004	750,356	830,141	487,363	139,956	0	0
Oyama Creek	0	0	0	0	15,123	85,468	428,034	526,817	324,339	110,947	0	0
Kalamalka Lake	32,572	37,160	28,094	46,405	201,504	112,180	188,389	200,787	116,403	63,628	2,410	27,796
Okanagan Lake	66,992	75,759	69,811	152,173	335,382	195662	286,273	282,289	183,906	120,291	111,064	113,131
Lake Pine	1,668	1,051	1,362	3,378	3,170	9,970	6,613	18,668	5,383	5,724	3,618	1,322
Coral Beach	487	625	610	1,578	3,147	4,847	6,381	7,018	3,808	1,451	663	688

Figure 1. *2022 DLC water demands from each source reported as cubic meters per month.*

- *Zero demand months on the Oyama Lake source is due to the DLC supplying the Oyama Lake source with the Kalamalka Lake source during periods of low consumption.*
- *Zero demand months on Beaver Lake source is due to the DLC supplying the Beaver Lake source with Okanagan Lake source during periods of low consumption.*

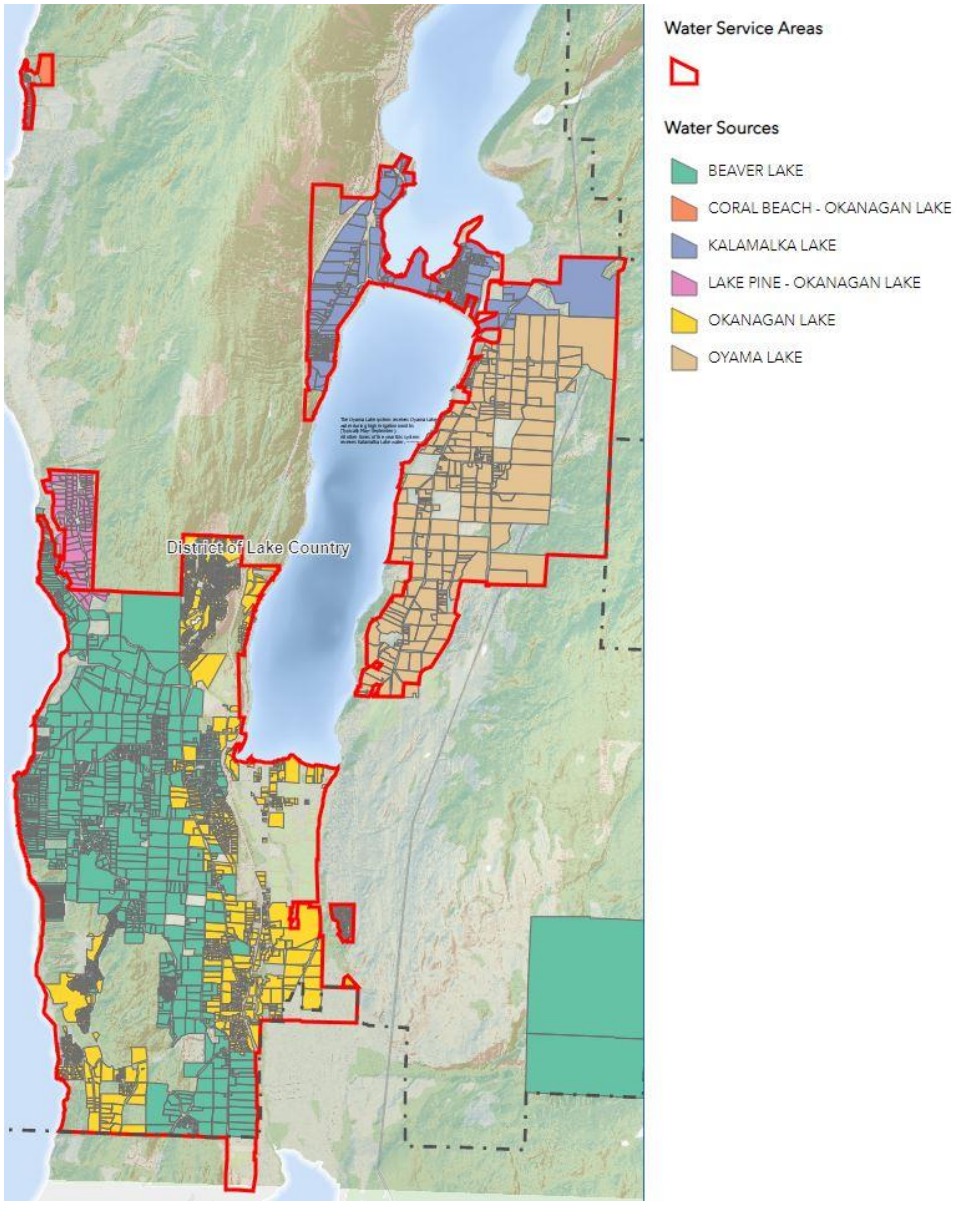
Water Sources

The DLC uses and monitors four separate water sources:

1. Beaver Lake (Crooked Lake chain flows into Beaver Lake)
2. Oyama Lake (Damer Lake flows into Oyama Creek)
3. Okanagan Lake
4. Kalamalka Lake

To review a water source area map, go to:

www.lakecountry.bc.ca/utilities → Click Water → then Water Source Map → Type in your address in the search bar to see which water source.



Crooked Lake Overflow Weir

Beaver Lake Intake Structure

Okanagan Lake UV Facility

Vernon Creek Intake

2022 Snowpack

The Oyama Lake snowpack was below average for the entirety of 2022, as seen in Figure 2. To see the historical snow survey data for Oyama Lake please visit the BC River Forecast Centers website, and search for the station ID "*2F19P*".

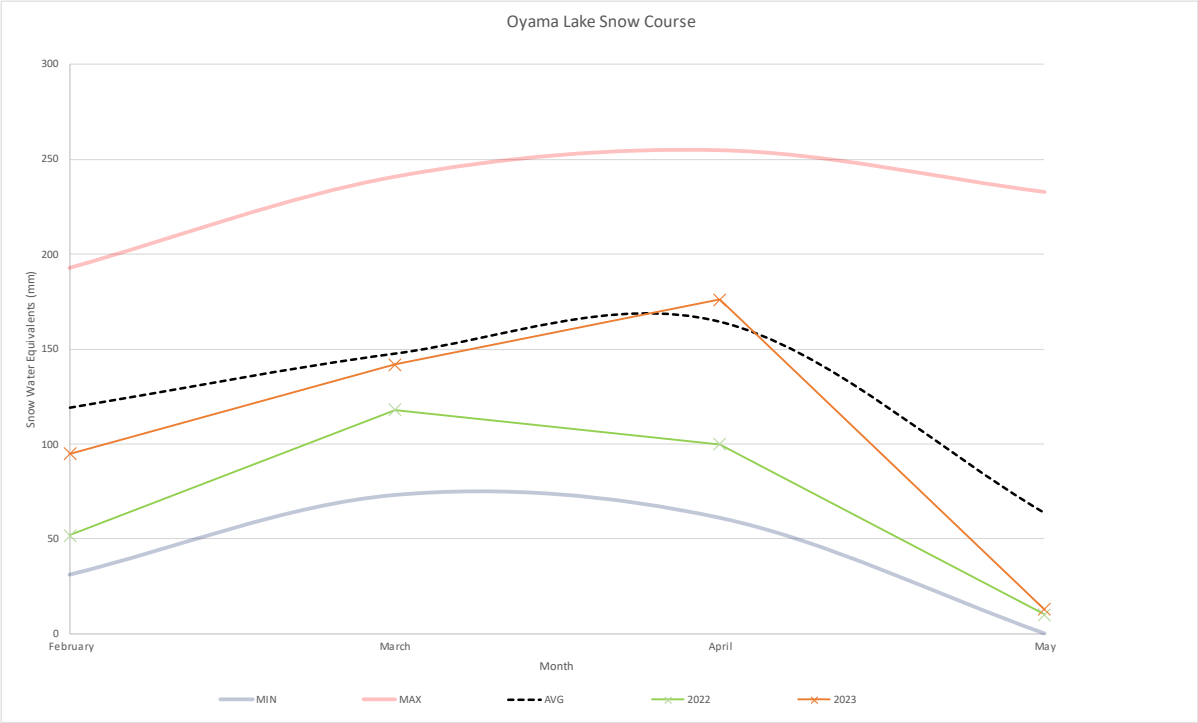


Figure 2. *2022 Oyama Lake Snowpack*

2022 was the third year the automated snow course was operational. The real time data that is collected from the automated weather station will be verified manually until 2023. The weather station will record humidity, ambient temperature, snow depth, and snow water equivalents required for proper watershed management. Once manual verification confirms accuracy, the automated snow course will reduce the need for DLC staff to travel to the upper elevation watershed during winter months, thereby reducing safety concerns.

2022 Freshet & Releases

Based on DLC and local snowpack information it was determined that spring flooding risks were projected to be low. Both Oyama and Beaver Lake were projected to fill without a large overflow volume. On May 11, 2022, staff reevaluated lake levels and flooding risks, as the spring proved to be cooler and wetter than normal. To mitigate the impacts of a rapid melt situation staff began precautionary releases from Beaver Lake and Oyama Lake until the risk was no longer present.

Cross Connection Control Program (CCCP)

Testing of known or required backflow prevention devices occurs in compliance with CSA Standard B64.10-11/B64.10.1-11 and amendments thereto. All new construction and businesses are required to meet or exceed DLC regulations related to Cross-Connection Control. Bylaw 984 (Water Rates & Regulations Bylaw) allows staff to inspect and enforce cross-connection control requirements in the BC Building Code and CSA Group standards. The program has become an integral part of the DLC's multi-barrier approach to protecting our community's drinking water. Existing facility assessments continue to take place on a rotating scheduled basis to ensure that any changes in ownership/usage are captured by the CCC program and protection devices are installed where required. As of 2022 the DLC tracks over 220 residential properties and over 200 Industrial/Commercial/Institutional (ICI) properties (2022 CCCP Report).

Annual Operations Summary

Annual operational duties that are completed by DLC staff:

- Service installation and repairs
- Collection and analysis of water sampling
- Upland dam inspections
- Maintenance and cleaning of all reservoirs, chlorination, and pumping facilities.
- Watermain flushing
- Air valve maintenance
- Pressure reducing valve maintenance
- Hydrant maintenance
- Line valve maintenance
- Main line leak repairs
- Seasonal irrigation turn on and offs
- Responding to customer complaints and inquiries
- Cross connection control assembly testing

Dam Inspection and Maintenance

Inspections of the upland dams (Beaver, Crooked, Oyama, and Damer) are completed by DLC staff weekly when the water levels are normal. Increased inspections occur when water levels increase. DLC staff along with the Provincial Dam Inspector performed an audit of both Beaver and Damer Lakes in October of 2022.

Damer Lake Dam

Beaver Lake Dam

Reservoir Cleaning, Inspection, & Repair

The DLC uses a diving company to conduct reservoir inspections with an ROV unit as needed. In some instances, the DLC also uses divers to clean the reservoirs. When using a diver is not possible, the DLC operations crew will drain and clean the reservoir.

In 2022 DLC staff cleaned, and inspected the Coral Beach reservoir, Lake Pine lower reservoir, Cells 1 and 2 at the Lower Lakes reservoir, and Cells 1 and 2 at the Upper Lakes reservoir.

Potable Water Emergency Response Plan

The DLC has a Potable Water Emergency Response Plan that is updated annually (or more often as required). The plan outlines operational response and communication procedures that are to be undertaken in an emergency event that may present health threats to people using the water system. Emergency events include, but are not limited to power outages, loss of supply, watermain breaks, and algae blooms. Both the Emergency Response Plan and Annual Water Operations Report are provided to IHA annually.

2022 Operations Project Highlights

Main Line Valve Replacement

A large diameter mainline valve was replaced on Middle Bench Road, as the existing valve was found to be inoperable in 2021. Replacement of this valve involved a full day water outage for the entire east bench of Oyama. A precautionary Boil Water Notice was issued along with this outage until water quality testing confirmed the water was safe to drink.

Hare Road Watermain Replacement

In 2021 a new pressure reducing valve (PRV) station was constructed on Hare Road. This was the first phase in a 3-phase program to bring increased fire flow to the lower Okanagan Centre area. 2022 saw the second phase of the project completed, which consisted of replacing and upsizing aging watermains running along the south end of Hare Road to the intersection of Sixth Street and halfway down Sixth Street.

Oyama Hydrant Renewal

In 2022 the DLC initiated replacement of many aging undersized hydrants. A total of 7 hydrants were replaced, all located in the Oyama area.

Lake Pine Intake Damage

In late June 2022 water quality monitoring indicated higher than normal water temperatures for the time of year on the Districts Lakepine water system. Upon investigation it was determined that the intake pipe had been damaged and required repairs. The repairs we subsequently completed in July 2022.

Overhead view showing 4 to 6 inch gap offshore

Newly installed PVC spacer spool between AC and HDPE intake pipe

Okanagan Lake Pump Motor Repair

During routine inspection staff noticed water leaking from the cooling jacket on the motor of pump 2 at the Okanagan Lake pumphouse. The 750HP motor was subsequently removed and underwent a significant overhaul and repair.

Fixed Meter Network

The DLC installed a fixed meter reading network tower at the Upper Lakes reservoir. Approximately 60% of all the District water meters are now able to be read from this one site. Installation of the meter reading network has both reduced operational hours required to manually read water meters each month and allowed DLC staff to provide enhanced, real-time customer service to residents who have inquiries about their water consumption or potential leaks. The long-term goal of the fixed meter reading network is to provide residents with their own means to access real-time water consumption data and leak alarm monitoring.

Hach WIMS (Water Information Management System)

Hach Water Information Management System (WIMS) is a cloud-based database that allows for more efficient data collection and analysis in one central place. Hach WIMS provides streamlined data collection, reporting, graphing, and operational alerts for the entire water system. Using Hach WIMS to manage water quality and operational data will help staff analyze information more efficiently.

In 2022, staff further developed databases for water infrastructure sampling locations for each of the six DLC operated distribution systems. Staff have been transitioning to entering all water quality sampling results into Hach WIMS while developing output reports for use in monthly and annual reporting.

Upgrades to DLC SCADA Network

The existing District of Lake Country Water Distribution Supervisory Control and Data Acquisition (SCADA) system relies on a combination of communication technologies to gather, record, and communicate data from the DLC's water facilities.

In 2018 a number of facilities were noted to have either outdated or obsolete equipment both in the water and wastewater departments. In 2019 upgrades to the SCADA system were initiated and these improvements were completed in 2022.

Service Disruptions

Under normal operating conditions many water utilities frequently experience minor disruptions for various reasons, such as leak repairs, water main breaks, seized valves, or installation of new infrastructure. In 2022 the water operations crew responded to 8 service repairs and 9 water main breaks.

Most repairs were completed with little disruption and as quickly as possible. Regular service was restored within the day and public health and safety was not compromised. In circumstances where public health and safety are at risk due to an interruption in water distribution services, the DLC reports the event to the Interior Health Authority (IHA) and the appropriate corrective actions are taken to protect public health.

In June 2022 water crews responded to an early morning watermain break on Middle Bench Road. The break eroded much of the bank, depositing dirt and debris on Middle Bench Road. Four properties were affected by the outage. Repairs were completed and water service was restored by that morning.

Whenever possible, customers in areas where service is disrupted are advised with notifications. In some emergency circumstances, notifications are not provided due to the size of the outage or the repairs urgent nature. In these circumstances efforts are made to notify customers using the DLC's website and various social media outlets.

Water Quality

Beaver Lake Watershed Environmental Releases

In the fall of 2022, the Province once again requested the District to release water from Beaver Lake that exceeded the agreed-upon environmental flow regime. These additional releases were necessary to support the Kokanee spawning in middle-Vernon creek. While the importance of spawning and environmental releases is recognized, this practice is not considered sustainable given the constantly changing climate. The District is actively collaborating with the Province to establish a water management plan aimed at developing a sustainable approach to ensure environmental flows during periods of drought.

Regulatory and Resources

Water purveyors are responsible for providing potable water to their users under the BC's Drinking Water Protection Act. In November 2012 the Province released version 1.1 for Drinking Water Treatment Objective (microbiological) for surface water supplies in British Columbia (BC Drinking water objectives). The treatment objectives ensure the provision of microbiologically-safe drinking water. It provides

minimum performance target for water suppliers to treat water to produce microbiologically-safe drinking water addressing enteric viruses, pathogenic bacteria, Giardia cysts and Cryptosporidium oocysts. This continues to follow the 4-3-2-1-0 treatment objectives:

- 4-log (99.99 percent) inactivation and/or removal of viruses,
- 3-log (99.9 percent) inactivation and/or removal of Giardia and *Cryptosporidia*,
- Two treatment processes for surface water
- Less than or equal to one nephelometric turbidity unit (NTU) of turbidity
- No detectable E.coli, fecal coliform and total coliforms

*Water **Master Plan** concept promotional marketing (above)*

Water suppliers should have an implementation plan to meet this as a standard. Risk to human health is substantially reduced when water suppliers meet this objective. Water suppliers in British Columbia are required to clearly identify the risks associated with these water supplies that do not meet the standards so the public can make an informed decision regarding additional steps they may need to take to protect themselves, their family, and their visitors.

The Oyama and Beaver Lake water treatment facilities are chlorination only and do not have 3-log (99.9 percent) inactivation and/or removal of Cryptosporidium. The health effects associated with exposure to some Protozoa such as Giardia and Cryptosporidium depends on the immune system of the individual ingesting. For this reason, the Oyama and Beaver Lake source are on a year round water quality advisory which recommends individuals with compromised immune systems boil the water for a minimum of 1 minute prior to drinking. These risks and concerns are addressed in our 2012 Water Master Plan (WMP) and we remain in discussions with IHA regarding the implementation and challenges of meeting these requirements. Customers that are immune compromised or potentially serve water to individuals that are immune compromised are encouraged to register for the sensitive customer list can connect with the

District of Lake Country (DLC): Engineering@lakecountry.bc.ca. This will ensure that they are contacted when changes in water quality occur.

The DLC will continue our work towards compliance with the drinking water treatment objectives.

Water Quality Testing

This section provides a review of the water quality testing performed in 2022 for the District of Lake Country's (DLC) water sources. The DLC's distribution sites are monitored throughout the year for water chemistry (free and total chlorine, turbidity, temperature, pH and conductivity), and for the presence of bacteria (total coliforms and E.coli).

Vernon Creek covered in snow.

Overall the majority of water chemistry and bacteriological results show that the majority of samples meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) with some parameters exceeding the maximum acceptable concentrations.

Instrument Calibration and Quality Control

Prior to collecting field data or equipment verification, field instruments are regularly checked against standards to ensure accuracy, are regularly maintained, and calibrated as required prior to use in the field. Additionally, a certified accredited agency (Hach) annually inspects and provides certification for all water quality monitoring field equipment.

On-line SCADA water quality monitoring equipment is verified weekly using the hand-held water quality equipment. The equipment is also maintained and calibrated as per manufacture directions and more so as required.

Water Chemistry

The DLC's two main upland drinking water reservoirs (Beaver and Oyama Lake) and their creek sources where our intakes are located (Vernon and Oyama Creek) exceeded the Guidelines for Canadian Drinking Water Quality GCDWQ for colour and turbidity. The Oyama and Beaver Lake sources had total annual disinfectant by-product averages (Trihalomethanes (THM) and Haloacetic Acids (HAA)) that exceeded the GCDWQ. The Lake Pine Water system on two occasions exceeded the GCDWQ for THM's.

Turbidity is naturally occurring in some areas and can be compounded by anthropogenic activities that occur above our intakes, such as recreation, cattle ranching and logging. Turbidity (a measure of the amount of particulate matter suspended in water) can harbour microorganisms, protecting them from disinfection, therefore increasing the chlorine demand. In the Canadian Drinking Water Guideline

(GCDWQ) the maximum allowable concentration for turbidity in water distribution systems has been set at 1 NTU.

Chlorine is the disinfectant used for all DLC water sources. Free and total chlorine are measured to ensure adequate disinfection process is occurring, and a residual is maintained throughout the distribution systems.

Ultraviolet (UV) water treatment works by inactivating pathogens in surface water (such as cryptosporidium, giardia lamblia and more) with UV radiation. The UV light radiation disrupts their DNA and disables their ability to replicate. UV disinfection provides no residual to prevent system regrowth. The Kalamalka and Okanagan Lake sources utilize ultraviolet water treatment as a secondary form of disinfection. Ultraviolet operations log sheets are contained in Appendix F.

Temperature and pH can impact odour and taste and can also has an affect the disinfection process. The potable water temperature should be less than 15 °C for palatability and to inhibit growth of nuisance organisms. GCDWQ for pH ranges between 7.0 and 10.5.

The pH is the measure of acidity or basicity of an aqueous solution. It is an Operational Guideline (OG) now set at 7.0- 10.5 in finished water (prior to 2017 was 6.5-8.5). pH is important to maximize treatment effectiveness, control corrosion and reduce leaching from distribution system and plumbing components GCDWQ.

Conductivity (the ability of an aqueous solution to carry an electrical current) is used as a quick indicator of changes occurring in the natural waters.

Colour creates high disinfectant demands and is an indicator of potential increased dissolved organic matter which, when combined with chlorine, forms disinfectant by-products. The GCDWQ for true colour is <15 TCU.

Water Chemistry Results

Water Chemistry Results For all sources, any water chemistry parameters that are recorded daily through supervisory control and data acquisition (SCADA) and are not included in the data below. SCADA information is reported monthly to IHA in the web posted Monthly Water Quality reports. The monitoring of source and distribution water is conducted weekly, rotating sampling through all sites as set out in the District of Lake Country Water Quality Monitoring and Reporting Plan.

Distribution water chemistry can vary for numerous reasons. Some of these changes can be attributed to seasonal changes to water demand, timing of sampling following system flushing or use of hydrant or mixing of water sources. It is not unusual within a distribution system to detect trace levels of free chlorine at dead ends or through low use areas. The free and total chlorine levels are closely monitored and if chlorine levels are low, turbidity and colour is elevated, or various other possible circumstances, steps are taken as per our Interior Health approved, Potable Water Quality Emergency Response protocols.

In 2017 the GCDWQ the treatment objectives of pH were changed from 6.5-8.5 to 7.0-10.5 as operational objectives for finished water. The Beaver and Oyama sources regularly did not meet these objectives whereas the lower elevation sources on Okanagan and Kalamalka were generally within this range. Temperature on all systems fluctuates with changing outdoor ambient temperature and raw water conditions. Although annual averages on all systems were well under the 15 degrees guidelines summer maximum temperatures exceeding the guideline.

Distribution water quality results are in tables 1 -6 below for DLC Water Systems. The list of sample sites for each distribution system is in Appendix B.

Beaver Lake Source

Table 1. *2022 Annual Distribution Water Chemistry Results: DLC Water System; Beaver Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). It should be noted that occasionally the distribution water sampled is a mixture of both sources (Okanagan Lake mixed into Beaver distribution) and variation from the norm occurs within the data. Note the Max turbidity of 11.90 is an isolated event post water main flushing.*

Beaver Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.07	0.18	0.30	2	6.0	51
MAX	2.90	3.40	8.00	21	7.6	91
AVG	1.31	1.44	1.03	13	7.1	71

Low chlorine was detected at end of the line sites including the upper Benchlands, Cooney and McCreight. When low chlorine or high turbidity occurs our standard deviation response plans are initiated. Follow up procedures may include further bacteriological sampling, flushing or other operational practices to improve water quality. At all times Bacteriological sampling was good and corrective measures as per our plan were followed. High turbidity at Cooney drain measured during flushing event.

Okanagan Lake Source

Table 2. *2022 Annual Distribution Water Chemistry Results: DLC Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Okanagan Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.01	0.02	0.20	4	6.5	200
MAX	4.30	4.60	279	17	8.2	312
AVG	1.04	1.16	0.40	9	7.9	286

Low chlorine was detected at the lakes reservoir which was immediately resolved with the addition hypochlorite and reservoir cycling. The high turbidity occurred when a contractor illegally connected to our hydrant and was obtaining water without permit. Operators were immediately notified, the situation rectified. This site was located near our end of the line. DLC operators flushed to reduce turbidity less

than 5 and follow up water quality sampling proved the chemistry was back to normal and bacteriological samples were good. This one-time value is shown in our table tables but excluded from the annual average turbidity reported. When low chlorine or high turbidity occurs our standard deviation response plans are initiated. Follow up procedures may include further bacteriological sampling, flushing or other operational practices to improve water quality. At all times Bacteriological sampling was good and corrective measures as per our plan were followed.

Oyama Lake Source

Table 3. *2022 Annual Distribution Water Chemistry Results: DLC Water System; Oyama Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). Occasionally the distribution water sampled is a mixture of both sources (Oyama Lake and Kalamalka Lake) and variation from the norm occurs within the data. Oyama water source is typically online mid-May through mid-October (mixing of sources in the Oyama reservoir occurs for a short time following the switch).*

Oyama Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.28	0.39	0.38	9	6.0	52
MAX	3.80	2.80	1.30	21	7.5	95
AVG	1.65	1.58	0.72	15	6.3	71

Kalamalka Lake Source

Table 4*. 2022 Annual Distribution Water Chemistry Results: DLC Water System; Kalamalka Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Kalamalka Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.11	0.31	0.30	3	7.9	331
MAX	5.70	4.70	9.80	19	8.5	448
AVG	1.59	1.84	0.83	10	8.1	389

Coral Beach Water System

Table 5. *2022 Annual Distribution Water Chemistry Results: Coral Beach Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Coral Beach (OK Lake) Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.27	0.38	0.17	4	7.5	298
MAX	1.38	1.5	0.93	18	8.3	533
AVG	0.71	1.17	0.44	12	7.8	344

Lake Pine Water System

Table 6. *2022 Annual Distribution Water Chemistry Results: Lake Pine Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Lake Pine (OK Lake) Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.14	0.23	0.15	4	7.5	285
MAX	2.11	2.25	0.65	17	8.3	345
AVG	0.96	1.10	0.40	11	8	310

Bacteriological Regulations and Results

The bacteriological water quality monitoring requirements that DLC follows measure against the Guidelines for Canadian Drinking Water Quality (GCDWQ) and the *Drinking Water Protection Act (DWPA)* and *Regulations (DWPR).* To disinfect for waterborne pathogens, all DLC water sources use Chlorine (either gas or hypochlorite) and chlorine residuals are measured in the distribution lines. On the Kalamalka and Okanagan Lake sources an additional measure of ultraviolet (UV) disinfection is used. See Appendix F for UV system off spec water.

Drinking water samples are collected on a weekly basis within each DLC Water System. Each water source is monitored for physical, chemical, and biological parameters. All membrane filtration microbiological samples are sent to an accredited and licensed laboratory for analysis. Additionally, samples are analyzed 'in-house' with Presence-Absence tests (P/A) for further measurement against the GCDWQ and for use in assessing trends, standards and emerging issues. The required numbers of monthly samples are detailed in the DWPR Schedule B (Table 7) and the DLC Water Quality and Monitoring Plan; Frequency of Monthly bacteriological tests (Table 8). All weekly Total coliform and E.coli results from raw water sources and throughout the distribution system (this includes both membrane filtration and Presence-Absence) are compiled and submitted to the Drinking Water Officer assigned to DLC. Results that do not meet the water quality standards in the DWPR, Schedule A **(Table 9)** are immediately reported to the Drinking Water Officer and corrective actions are implemented as per the DLC's Potable Water Emergency Response Plan.

Table 7: *Schedule B – Frequency of Monitoring Samples for Prescribed Water Supply Systems* (*section 8).*

Population Served by the Prescribed Water Supply System:	**# Samples per month:**
less than 5,000	4
5,000 to 90,000	1 per 1,000 of population
more than 90,000	90 plus 1 per 10,000 of population in excess of 90,000

Table 8: *Frequency of Monthly bacteriological tests: Membrane Filtration (MF) and Presence-Absence (P/A)*

System/Source	**MF Distribution # samples required per mo.**	**P/A**	**Total MF Distribution and Raw**	**Distribution Bacteriological/Chlorine test sites:**
DLC Water System: Beaver Lake source : Est. Population 3,000	4	2	8	15*
DLC Water System: Okanagan Lake source : Est. Population: 6,000	6	2	8	14**
DLC Water System: Oyama Lake source: Est. Population 625	4	2	8	5
DLC Water System: Kalamalka Lake source: Est Population 750	4	2	8	5
Coral Beach Water System: Okanagan Lake source Est Population 130	4	2	8	2
Lake Pine Water System: Okanagan Lake source Est Population 198	4	2	8	3**

- * Includes Camp Rd. Reservoir (Offline unless required)
- ** Includes 2 reservoirs

Table 9: *Schedule A - Water Quality Standards for Potable Water (sections 2 and 9) DWPR*

Parameter:	**Standard:**
Escherichia coli (*E.coli*)	No detectable Escherichia coli (*E.coli*) per 100 ml
Total coliform bacteria:	
(a) 1 sample in a 30 day period	No detectable total coliform bacteria per 100 ml
(b) more than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

Coliform bacteria are naturally occurring in the environment and generally are not harmful. However, their presence is an indicator for the presence of other types of disease-causing organisms. The presence of these bacteria is a sign that there may be problems with the water treatment, or the water distribution system. *Escherichia coli*, (E.coli) are a bacterium that is always present in the intestines of humans and other animals and whose presence in drinking water would indicate fecal contamination of the water. Most strains of E.coli do not cause illness in healthy humans, although some strains do cause cramps and

diarrhea. One particular strain named O157:H7 produces a powerful toxin that can cause severe illness. Under BC's Drinking Water Protection Regulation the maximum acceptable concentration (MAC) of *E.coli* in public, semi-public, and private drinking water systems is none detectable per 100 mL. At the time the samples are analyzed, the lab estimates the general bacterial population from background colony counts. Background bacteria are used as a general measure of the bacterial population present in a drinking water system or in the raw source water. Under ideal growth conditions, the background bacteria may increase and are indicators of the potential growth of coliforms. BC's Drinking Water Protection Regulations further state that samples should not contain Total coliforms or E. coli. If samples are positive, the Potable Water Quality Emergency Response Plan will be followed. To identify problem areas and in aiming to provide good water quality within the distribution systems, all events are recorded and reported with follow-up sampling and, when necessary, flushing to provide fresh water to the site.

In 2022, 333 MF bacteriological samples were collected and analyzed at Caro Analytical Services (CARO) in Kelowna for total coliforms and E.coli. Additionally, 155 P/A tests were analyzed in-house. The summary of the bacteriological results is in Appendix A. The P/A tests determine if total coliforms are present or absent from the sample but do not provide coliform counts should the test be positive. P/A tests are collected on alternate weeks from the MF samples. Should a P/A be positive, additional bacteriological testing and further water chemistry testing occurs. At no time was E.coli detected in any DLC distribution systems.

On four occasions in 2022 Total Coliform samples were detected on the Coral Beach water system both at the South end and Coral Beach Pumphouse.

South end June 1st two total coliforms detected and on August 4th one Total Coliform detected.

Coral Beach Pumphouse August 17th two total coliforms detected, and August 19th one total coliforms detected.

Both Sites and on every occasion, were re-sampled immediately following receipt of positive total coliform results; the South end had no further detection of coliforms occurring. The pumphouse did have 1 total coliform detected after subsequent sampling. No detection of total coliforms outside of this building were detected. The sampling port at this location was disconnected, rebuilt, disinfected, resampled and no further positive accounts occurred, thus leading DLC to believe this was a false positive event.

Lead

Under the Drinking Water Protection Act (DWPA), drinking water supply systems in BC are responsible for monitoring water they deliver to verify it is within acceptable limits for lead and other metals. The Guidelines for Canadian Drinking Water Quality (GCDWQ) suggest:

> *The GCDWQ maximum acceptable concentration (MAC) for total lead in drinking water is 0.005 mg/L (5 µg/L), based on a sample of water taken at the tap and using the appropriate protocol for the type of building being sampled. These guidelines further state that every effort should be made to maintain lead levels in drinking water as low as reasonably achievable.*

It is recognized that most drinking water supply systems in BC deliver water that has levels of lead well below 5 µg/L. Lead is usually not found in drinking water when it leaves the treatment plant. Instead lead tends to leach out of pipes and fixtures in buildings or homes, or service lines connecting homes to water mains. The District of Lake Country water supply sources are free of lead and DLC infrastructure has no lead pipes throughout the distribution network. Recently testing laboratories have now been able to measure lead to levels below 0.001 mg/L (1 part per billion (ppb)). In recent testing, we have detected very low levels of lead in various systems. These results are without consistency and measured in the ppb which are well below the guidelines. Testing and assessment remain in place for 2023 sampling program. In 1989, the BC Plumbing Code changed to restrict the use of lead in plumbing. The amount of lead released into the water depends on the plumbing materials used, the corrosiveness of the water, and the length of time the water sits in the plumbing.

Schools have been advised to sample water to ensure lead is at safe levels. IHA works directly with these facilities regarding monitoring and the DLC has had no reports of high lead levels in our communities' schools or daycares.

Owners of buildings are responsible for assessing their own plumbing and taking actions to reduce lead. A plumber can help identify if your home has leaded plumbing parts, and if the part of the service line on your property is made of lead.

To assess corrosion risks in community the DLC samples water for indicators of corrosivity including the presence of Lead. The results of Lead testing can be found in Table 10.

Further information can be found at

BC Health Link: Lead in Drinking Water, the Guidelines for Canadian Drinking Water Quality and Caro Analytical Services for in-home testing.

Table 10: Lead Sampling Results for Raw water intakes and distribution sources.

SITE	SYSTEM	DATE	RESULTS mg/L	GCDWQ mg/L
Vernon Creek Raw	Beaver (Vernon Ck)	1/26/2022	<0.00020	0.005
Vernon Creek Raw	Beaver (Vernon Ck)	3/29/2022	<0.00020	0.005
Vernon Creek Raw	Beaver (Vernon Ck)	8/10/2022	<0.00020	0.005
Vernon Creek Raw	Beaver (Vernon Ck)	10/24/2022	<0.00020	0.005
Cooney	Beaver (Vernon Ck)	1/26/2022	<0.00020	0.005
Cooney	Beaver (Vernon Ck)	8/29/2022	<0.00020	0.005
Cooney	Beaver (Vernon Ck)	10/24/2022	0.00035	0.005
Pow	Beaver (Vernon Ck)	1/26/2022	<0.00020	0.005
Pow	Beaver (Vernon Ck)	3/29/2022	<0.00020	0.005
Pow	Beaver (Vernon Ck)	10/24/2022	<0.00020	0.005
Okanagan Lake Raw	Okanagan	1/26/2022	<0.00020	0.005
Okanagan Lake Raw	Okanagan	3/28/2022	<0.00020	0.005
Okanagan Lake Raw	Okanagan	11/08/2022	<0.00020	0.005
Okanagan Lake Raw	Okanagan	11/28/2022	<0.00020	0.005
Glenmore Booster	Okanagan	1/26/2022	<0.00020	0.005
Glenmore Booster	Okanagan	3/28/2022	<0.00020	0.005
Glenmore Booster	Okanagan	08/11/2022	<0.00020	0.005
Glenmore Booster	Okanagan	12/20/2022	<0.00020	0.005
Jardine Booster	Okanagan	1/26/2022	<0.00020	0.005
Lakes Cell 1	Okanagan	1/26/2022	<0.00020	0.005
Lakes Upper Reservoir	Okanagan	1/26/2022	0.00034	0.005
Lakes Upper Reservoir	Okanagan	02/02/2022	0.00028	0.005
Lakes Upper Reservoir	Okanagan	3/28/2022	0.00027	0.005
Lakes Upper Reservoir	Okanagan	11/28/2022	<0.00020	0.005
Lakes Upper Reservoir	Okanagan	12/20/2022	<0.00020	0.005
CB Intake Raw	Okanagan (Coral Beach)	1/26/2022	<0.00020	0.005
CB Intake Raw	Okanagan (Coral Beach)	3/29/2022	<0.00020	0.005
CB Intake Raw	Okanagan (Coral Beach)	08/08/2022	<0.00020	0.005
CB Intake Raw	Okanagan (Coral Beach)	12/19/2022	<0.00020	0.005
CB S-end	Okanagan (Coral Beach)	1/26/2022	0.00023	0.005
CB S-end	Okanagan (Coral Beach)	3/29/2022	0.00030	0.005
CB S-end	Okanagan (Coral Beach)	05/04/2022	0.00042	0.005
CB S-end	Okanagan (Coral Beach)	08/08/2022	<0.00020	0.005
CB S-end	Okanagan (Coral Beach)	12/19/2022	<0.00020	0.005

Table 10: Lead Sampling Results for Raw water intakes and distribution sources.

SITE	SYSTEM	DATE	RESULTS mg/L	GCDWQ mg/L
LP Intake Raw	Okanagan (Lake Pine)	1/25/2022	0.00039	0.005
LP Intake Raw	Okanagan (Lake Pine)	3/28/2022	0.00090	0.005
LP Intake Raw	Okanagan (Lake Pine)	08/08/2022	0.00032	0.005
LP Intake Raw	Okanagan (Lake Pine)	12/21/2022	0.00030	0.005
LP PR Stn.	Okanagan (Lake Pine)	1/25/2022	<0.00020	0.005
LP PR Stn.	Okanagan (Lake Pine)	3/28/2022	<0.00020	0.005
LP PR Stn.	Okanagan (Lake Pine)	08/08/2022	<0.00020	0.005
LP PR Stn.	Okanagan (Lake Pine)	12/21/2022	<0.00020	0.005
Kal Lake Intake Raw	Kalamalka	1/27/2022	<0.00020	0.005
Kal Lake Intake Raw	Kalamalka	3/29/2022	<0.00020	0.005
Kal Lake Intake Raw	Kalamalka	09/08/2022	<0.00020	0.005
Kal Lake Intake Raw	Kalamalka	11/30/2022	<0.00020	0.005
Kal Lake Intake Raw	Kalamalka	12/19/2022	<0.00020	0.005
Cornwall	Kalamalka	1/28/2022	0.00031	0.005
Cornwall	Kalamalka	3/29/2022	0.00020	0.005
Cornwall	Kalamalka	09/08/2022	0.00038	0.005
Cornwall	Kalamalka	12/19/2022	0.00256	0.005
Ribbleworth	Kalamalka	1/27/2022	<0.00020	0.005
Ribbleworth	Kalamalka	3/29/2022	<0.00020	0.005
Ribbleworth	Kalamalka	12/19/2022	0.00043	0.005
Oyama Creek Intake Raw	Oyama	09/08/2022	<0.00020	0.005
Ribbleworth	Oyama	09/08/2022	0.00075	0.005
Easthill	Oyama	8/30/2022	0.00193	0.005

Water Quality Advisories and Boil Water Notices

IHA maintains the requirement of purveyors to issue a Water Quality Advisory when turbidity exceeds 1 NTU and to contact Interior Health as the turbidity approaches 5 NTU to discuss enhanced notification (i.e. a Boil Water Notice). Two of the DLC sources are on a Water Quality Advisory (WQA). Reminder notifications are sent to customers quarterly through water bill inserts as well as posted on the DLC web page and through our social media and local paper as required. Regardless of whether a source is on an Advisory or not, the distribution systems on all sources are regularly monitored as per the IHA approved Water Quality Monitoring and Reporting Plan.

The following sources throughout 2022 was on a **Water Quality Advisory (WQA)**:

- Beaver Lake Water Source
- Oyama Lake Water Source

The advisories on Beaver and Oyama Sources are on WQA's due to fluctuating turbidity and lack of multibarrier treatment. Both WQA's will remain in effect until infrastructure upgrades are made to improve water quality and reliability. To reduce time that customers are on a WQA in both these systems during the low flow (non-irrigation season) they are switched to the Okanagan and Kal sources respectively. 2022 was the first year we did this early switch over for the Beaver Lake Source.

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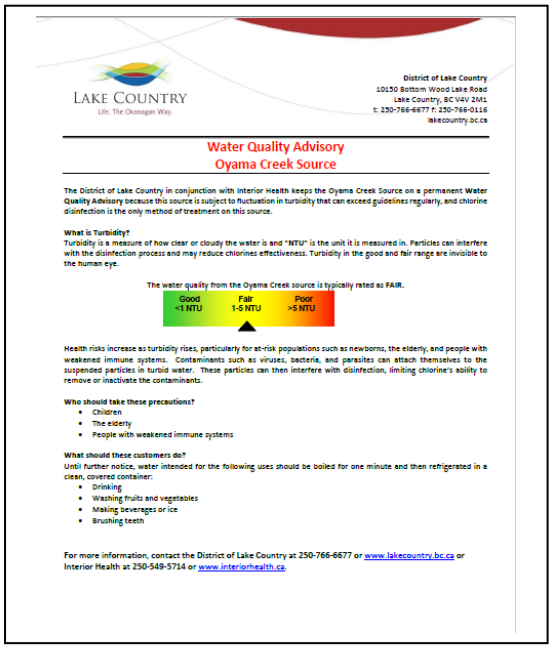
REMINDER
Water Quality Advisory
Sources: Beaver Lake (Vernon Creek)

"Interior Health recommends that children, the elderly, people with weakened immune systems and anyone seeking additional protection drink boiled water or a safe alternative until further notice. For these at-risk populations, water intended for drinking, washing fruits or vegetables, making juice or ice, or brushing teeth should be boiled for one minute."

What is Turbidity?

Good <1 NTU | Fair 1-5 NTU | Poor >5 NTU



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District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1
t: 250-766-6677 f: 250-766-0116
lakecountry.bc.ca

Water Quality Advisory
Oyama Creek Source

The District of Lake Country in conjunction with Interior Health keeps the Oyama Creek Source on a permanent Water Quality Advisory because this source is subject to fluctuation in turbidity that can exceed guidelines regularly, and chlorine disinfection is the only method of treatment on this source.

What is Turbidity?
Turbidity is a measure of how clear or cloudy the water is and "NTU" is the unit it is measured in. Particles can interfere with the disinfection process and may reduce chlorines effectiveness. Turbidity in the good and fair range are invisible to the human eye.

The water quality from the Oyama Creek source is typically rated as FAIR.

Good <1 NTU | Fair 1-5 NTU | Poor >5 NTU

Health risks increase as turbidity rises, particularly for at-risk populations such as newborns, the elderly, and people with weakened immune systems. Contaminants such as viruses, bacteria, and parasites can attach themselves to the suspended particles in turbid water. These particles can then interfere with disinfection, limiting chlorine's ability to remove or inactivate the contaminants.

Who should take these precautions?
- Children
- The elderly
- People with weakened immune systems

What should these customers do?
Until further notice, water intended for the following uses should be boiled for one minute and then refrigerated in a clean, covered container:
- Drinking
- Washing fruits and vegetables
- Making beverages or ice
- Brushing teeth

For more information, contact the District of Lake Country at 250-766-6677 or www.lakecountry.bc.ca or Interior Health at 250-549-5714 or www.interiorhealth.ca.

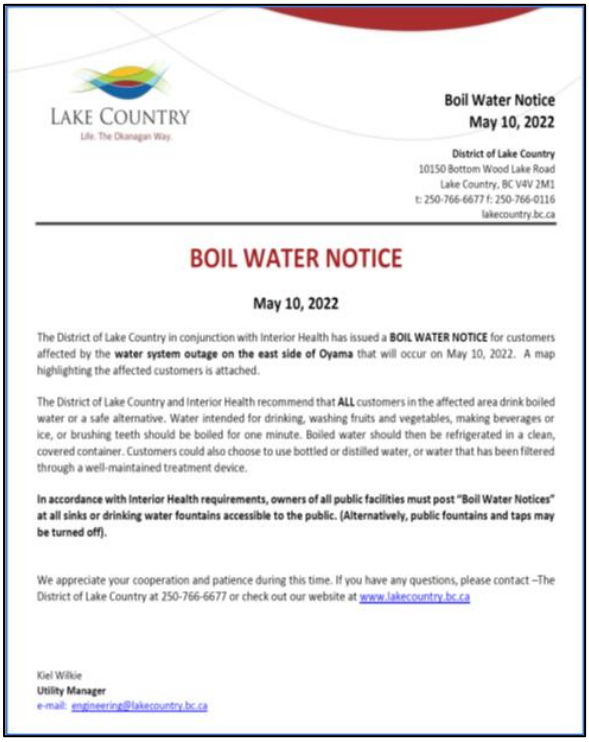
Notable Water Quality Events

Oyama Lake Source Boil Water Notice

One Boil Water Notice was issued on May 10th and rescinded on May 13th following comprehensive water quality sampling and bacteriological testing through an approved IHA plan. This BWN was in pace during a planned major water system shut down to replace a 500mm (20") mainline valve on the Oyama

Water System. The shutdown impacted approximately 290 homes and is a large portion of the Oyama water system. The homes impacted were on the east side of Wood Lake and were properties that typically receive Oyama Creek water during the peak irrigation months.

The DLC used various forms of communication including mail outs, the DLC website, local newspaper, social media platforms, customer email lists, and the sensitive customer list to inform residents of the water outage and Boil Water Notice (BWN). Sign boards were placed at the only two road accesses into this area of the community. A key message primer and public information document was created and distributed leading up to the May 10th shutdown.



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Boil Water Notice
May 10, 2022

District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1
t: 250-766-6677 f: 250-766-0116
lakecountry.bc.ca

BOIL WATER NOTICE

May 10, 2022

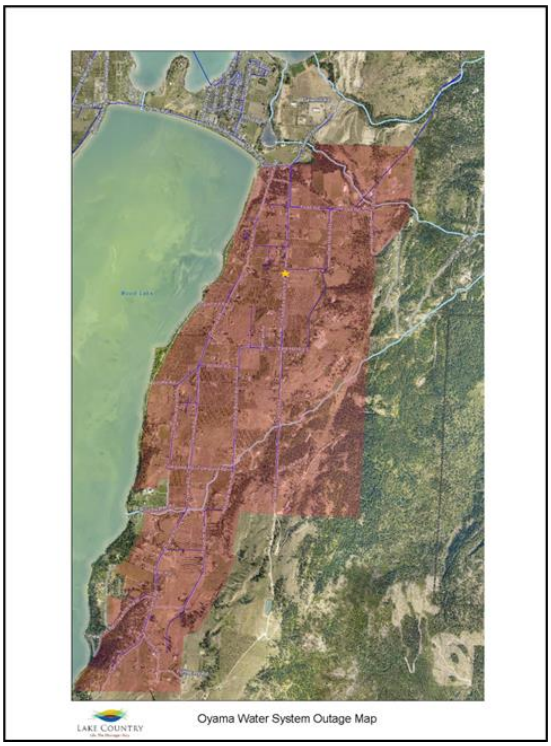
The District of Lake Country in conjunction with Interior Health has issued a **BOIL WATER NOTICE** for customers affected by the **water system outage on the east side of Oyama** that will occur on May 10, 2022. A map highlighting the affected customers is attached.

The District of Lake Country and Interior Health recommend that **ALL** customers in the affected area drink boiled water or a safe alternative. Water intended for drinking, washing fruits and vegetables, making beverages or ice, or brushing teeth should be boiled for one minute. Boiled water should then be refrigerated in a clean, covered container. Customers could also choose to use bottled or distilled water, or water that has been filtered through a well-maintained treatment device.

In accordance with Interior Health requirements, owners of all public facilities must post "Boil Water Notices" at all sinks or drinking water fountains accessible to the public. (Alternatively, public fountains and taps may be turned off).

We appreciate your cooperation and patience during this time. If you have any questions, please contact –The District of Lake Country at 250-766-6677 or check out our website at www.lakecountry.bc.ca

Kiel Wilkie
Utility Manager
e-mail: engineering@lakecountry.bc.ca



Oyama Water System Outage Map

Disinfectant By-Products:

Under the Guidelines for Canadian Drinking Water Quality: Haloacetic acids (HAAs) and Trihalomethanes (THM's)are disinfectant by-products and are a group of compounds that can form when the chlorine used to disinfect drinking water reacts with naturally occurring organic matter (e.g., decaying leaves and vegetation). The use of chlorine in the treatment of drinking water has virtually eliminated waterborne diseases, because chlorine can kill or inactivate most microorganisms commonly found in water. Most drinking water treatment plants in Canada use some form of chlorine to disinfect drinking water: to treat the water directly in the treatment plant and/or to maintain a chlorine residual in the distribution system to prevent bacterial regrowth. Disinfection is an essential component of public drinking water treatment; the health risks from disinfection by-products, including Trihalomethanes and haloacetic acids, are much less than the risks from consuming water that has not been appropriately disinfected. (GCDWQ)

Water quality results with high HAA's and THM's such as those from our upper elevation drinking water reservoirs are common throughout the Okanagan when untreated then chlorinated water is sourced from lakes with elevated natural organic matter. It is less common on our lower elevation lakes (Okanagan and Kalamalka) to see higher disinfectant by-products and turbidity. Water quality at our deep-water intakes is carefully being monitored for possible deviations following flooding years. It is common to have more than one season pass following a flooding event prior to detecting variations in water chemistry.

Haloacetic Acids (HAAs)

Total haloacetic acids refers to the total of monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid and dibromoacetic acid. The maximum acceptable concentration (MAC) for total haloacetic acids in drinking water is 0.08 mg/L (80 µg/L) based on a locational running annual average of a minimum of quarterly samples taken in the distribution system.

The DLC follows the GCDWQ for HAA's testing with minimum quarterly monitoring and sampling at intermediary sites. On our large water systems (Oyama, Beaver and Okanagan), we have additional sample points for the highest HAA formation potential. These areas are represented in the distribution system with the longest disinfectant retention time and located at re-chlorination sites or at the far end of the distribution system.

2022 haloacetic acids analysis in the DLC Water System showed Oyama and Beaver Lake sources had total annual HAA averages that exceeded the Guidelines for Canadian Drinking Water Quality (GCDWQ). All HAA results displayed as a running average for each site and as a distribution total are detailed in Tables 11 - 16.

Table 11. **Beaver Lake Source** Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Vernon Creek (Beaver Lake) Source HAA guideline <0.080 mg/L		
Date	**Cooney Drain**	**Pow Rd PRV**
1/26/2022	0.209	0.192
3/29/2022	0.229	0.189
8/29/2022	0.225	
10/24/2022	0.183	0.252
Quarterly Site Annual Average	0.211	0.192
Total Quarterly Annual Average		**0.201**

Table 12. **Okanagan Lake Source** Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Okanagan Lake Source HAA guideline <0.080 mg/L				
Date	**Glenmore Booster**	**Jardine**	**Lakes Lower Reservoir Cell 1**	**Lake Upper Reservoir**
1/26/2022	0.0384	0.0302	0.0521	0.0598
3/28/2022	0.0347			0.0704
8/11/2022	0.0405		0.0473	
12/20/2022	0.0245			0.0727
Quarterly Site Annual Average	0.035	0.030	0.050	0.068
Total Quarterly Annual Average				**0.046**

Table 13. **Oyama Water System**, Kal Lake Source Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Kalamalka Lake Source HAA guideline <0.080 mg/L		
Date	**Sheldon/Cornwall**	**Ribbleworth Drain**
1/28/2022	0.0299	0.0276
3/29/2022	0.0343	0.0303
8/9/2022	0.0244	
12/19/2022	0.0338	0.0553
Quarterly Site Annual Average	0.031	0.038
Quarterly Site Annual Average		**0.034**

`		
Date	**Sheldon/Cornwall**	**Ribbleworth Drain**
1/28/2022	0.0299	0.0276
3/29/2022	0.0343	0.0303
8/9/2022	0.0244	
12/19/2022	0.0338	0.0553
Quarterly Site Annual Average	0.031	0.038
Quarterly Site Annual Average		**0.034**

Table 14. **Oyama Lake Source** Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ). Note: Oyama Source only on-line during the irrigation season and quarterly annual samples are not possible

Oyama Lake Source HAA guideline <0.080 mg/L

Date	Easthill	Ribbleworth Drain
8/30/2022	0.200	0.282
Quarterly Site Annual Average	0.200	0.122
Total Quarterly Annual Average		**0.161**

Table 15. **Coral Beach Water System**, Okanagan Lake Source Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Coral Beach Okanagan Lake Source HAA guideline <0.080 mg/L	
Date	**South End**
1/26/2022	0.0335
3/29/2022	0.0394
8/8/2022	0.0312
12/19/2022	0.0393
Total Quarterly Annual Average	**0.036**

Table 16. **Lake Pine Water System**, Okanagan Lake Source Haloacetic Acid (HAA) data collected 2022. Average Total HAA data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Lake Pine Okanagan Lake Source HAA guideline <0.080 mg/L	
Date	**LP PR Station**
1/25/2022	0.0483
3/28/2022	0.108
8/8/2022	0.0357
12/21/2022	0.0809
Total Quarterly Annual Average	**0.068**

Trihalomethanes (THM's)

The maximum acceptable concentration (MAC) for trihalomethanes (*includes the total of chloroform, bromodichloromethane, dibromochloromethane and bromoform*) in drinking water is 0.100 mg/L (100 µg/L). This is based on a locational running annual average of a minimum of quarterly samples taken at the point in the distribution system with the highest potential THM levels.

The DLC follows the GCDWQ for THM testing with minimum quarterly monitoring and sampling at intermediary sites. On our large water systems (Oyama, Beaver and Okanagan), we have additional sample points for the highest THM formation potential. These areas are represented in the distribution system with the longest disinfectant retention time and located at re-chlorination sites or at the far end of the distribution system.

2022 trihalomethane analysis in the DLC Water System showed Oyama and Beaver Lake sources had total annual THM averages that exceeded the Guidelines for Canadian Drinking Water Quality (GCDWQ). On one occasion the Lake Pine water system had a result that exceeded the guidelines with an overall quarterly average under the GCDWQ. All THM results displayed as a running average for each site and as a distribution total are detailed in Tables 17 - 22**.**

Table 17. Beaver Lake Source trihalomethane (THM) data collected 2022. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Vernon Creek (Beaver Lake) Source THM guideline <0.100mg/L		
Date	**Cooney Drain**	**Pow Rd PRV**
	TTHM (as CHCL3)	TTHM (as CHCL3)
	mg/L	mg/L
1/26/2022	0.162	0.144
3/29/2022	0.233	0.201
8/29/2022	0.217	0.147
10/24/2022	0.232	0.274
Quarterly Site Annual Average	0.211	0.192
Total Quarterly Annual Average		**0.201**

Table 18. DLC **Okanagan Lake source** trihalomethane (THM) data collected 2022. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Okanagan Lake Source THM guideline <0.100 mg/L				
Date	**Glenmore Booster**	**Jardines**	**Lakes Lower Reservoir Cell 1**	**Lake Upper Reservoir**
	TTHM (as CHCL3)	TTHM (as CHCL3)	TTHM (as CHCL3)	TTHM (as CHCL3)
	mg/L	mg/L	mg/L	mg/L
1/26/2022	0.0552	0.0571	0.0767	0.0767
3/28/2022	0.0501			0.0972
8/11/2022	0.0442		0.0484	0.0568
12/20/2022	0.0349			0.0773
Quarterly Site Annual Average	0.046	0.057	0.063	0.077
Total Quarterly Annual Average				**0.061**

Table 19. Oyama Lake Source trihalomethane (THM) data collected 2022. Average Total THM data collected and calculated as per the Guidelines for Canadian Drinking Water Quality (GCDWQ). Note: Oyama Source only on-line during the irrigation season and quarterly annual samples are not possible.

Oyama Lake Source THM guideline <0.100 mg/L		
Date	**Easthill**	**Ribbleworth Drain**
	TTHM (as CHCL3)	TTHM (as CHCL3)
	mg/L	mg/L
8/30/2022	0.1410	0.1590
Quarterly Site Annual Average	0.141	0.1590
Total Quarterly Annual Average		**0.141**

Table 20. Kalamalka Lake source trihalomethane (THM) data collected 2022. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Kalamalka sampling includes sites within Oyama distribution lines during non-irrigation season (approximately October – May).

Kalamalka Lake Source THM guideline <0.100 mg/L		
Date	**Sheldon/Cornwall**	**Ribbleworth Drain**
	TTHM (as CHCL3)	TTHM (as CHCL3)
	mg/L	mg/L
1/28/2022	0.06	0.0478
3/29/2022	0.0796	0.075
8/9/2022	0.0301	
12/19/2022	0.0538	0.0754
Quarterly Site Annual Average	0.056	0.066
Quarterly Site Annual Average		**0.061**

Table 21. Coral Beach System (Okanagan Lake source) trihalomethane (THM) data collected 2022. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Coral Beach Okanagan Lake Source THM guideline <0.100 mg/L	
Date	**South End**
	TTHM (as CHCL3)
	mg/L
1/26/2022	0.05
3/29/2022	0.079
8/8/2022	0.051
12/19/2022	0.054
Total Quarterly Annual Average	**0.059**

Table 22. Lake Pine System (Okanagan Lake source) trihalomethane (THM) data collected 2022. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

Lake Pine Okanagan Lake Source THM guideline <0.100 mg/L	
Date	**LP PR Station**
	TTHM (as CHCL3)
	mg/L
1/25/2022	0.064
3/28/2022	0.131
8/8/2022	0.053
12/21/2022	0.115
Total Quarterly Annual Average	**0.091**

Source Water Sampling

The DLC draws water from four main primary drinking water reservoirs:

1. Beaver Lake (Crooked Lake chain flows into Beaver Lake) - upland source with a downstream intake on Vernon Creek.
2. Oyama Lake (Damer Lake flows into Oyama Creek) - upland source with a downstream intake on Oyama creek
3. Okanagan Lake (3) deep water intakes
4. Kalamalka Lake (1) deep water intake

Oyama Lake near earthfill dam (left) and Oyama Creek (right)

The Oyama and Beaver Lake watersheds together encompass approximately 141.1 km^2. Together, the two community watersheds supply the DLC with approximately 60-65% of their source water. Both watersheds are dependent on upland storage reservoirs that rely on snowpack for annual water regeneration and supply needs.

The DLC draws water from intakes both on Vernon and Oyama Creeks. In addition to monitoring and sampling at these intakes, the DLC also analyzes raw water from our upland drinking water reservoirs. These reservoirs have samples collected for other water quality parameters that would provide adequate measurement of chemical and physical water quality against the CDWG as per Conditions on Permit and recommendations in 2010 Oyama and Vernon Creek Source Water Assessment. Comprehensive reports (parameters tested at the drinking water intakes) are in Appendix C and the result for nutrient sampling (upland drinking water reservoirs (Beaver and Oyama)) is contained in Appendix D.

The District plans to update the Oyama and Vernon Creek Source Water Assessment in either 2024 or 2025.

Source water from these watersheds is high in organic matter which causes colour issues and elevated disinfectant by-products. Turbidity is naturally occurring in some areas and can be compounded by human activities that occur above our intakes, such as recreation, cattle-ranching and logging.

The water quality monitoring of these reservoirs may increase or decrease in response to varying water quality conditions and to provide adequate baseline data for future water treatment.

Beaver Lake at Dam outflow

Source Sampling (Raw Water)

Raw Water Sampling occurs at intakes, upland drinking water reservoirs, and at deep water intake pump stations.

Crooked Lake (left) Beaver Lake Dam (middle) and Vernon Creek (right)

At raw water intakes we analyze water quality parameters that will provide adequate measurement of chemical and physical water quality. This data is compared against the GCDWQ and the recommendations in Oyama and Vernon Creek Watersheds Source Water Assessment. Annually, comprehensive tests are collected at all intakes and nutrient testing occurs as deemed necessary. The DLC continually modifies parameters sampled to provide sufficient baseline data for future water treatment.

The DLC's two main upland drinking water reservoirs (Beaver and Oyama Lakes (Vernon and Oyama Creeks) exceeded the physical parameters of the GCDWQ for colour and turbidity. Such results are common throughout the Okanagan wherever water is sourced from highland watersheds. Additionally, Damer Lake is utilized as supplemental supply for Oyama Creek. Drainage from Damer Lake (North fork creek) is a tributary to the mainstream Oyama creek above our point of diversion. This source experiences high colour and exceeded the operation guideline for Aluminum. pmeger@lakecountry.bc.ca

All results are tabulated in the comprehensive reports in Appendix D.

Raw Water Data from intakes and pump stations are in Tables 23 through 28 (below). Data is collected from each source from the following sites:

- Beaver Lake source: Vernon Creek Intake (Table 23)
- Okanagan Lake Source: Okanagan Lake Pump Station (Table 24)
- Oyama Lake source: Oyama Creek Intake (Table 25)
- Kalamalka Lake source: Kalamalka Pump Station (Table 26)
- Okanagan Lake Source: Coral Beach Pump House (Table 27)
- Okanagan Lake Source: Lake Pine Pump House (Table 28)

Oyama Lake Dam Spillway

Table 23. *2022 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. (Data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)).*

Beaver Lake Source: Vernon Creek/Eldorado Reservoir									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**% of samples Less than 10 E.Coli/100mL (N=38)** %
MIN	40	0.45	2	6.9	55	<5	10	<1	
MAX	60	37	19	7.9	135	130	3,650	214	82
AVG	45	3.07	11	7.4	69	46	**38 Samples**		
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Table 24. *2022 Raw Water, Okanagan Lake Source: Okanagan Lake Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)).*

Okanagan Lake Source: Okanagan Intake										
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**% of samples Less than 10 E.Coli/100mL (N=48)** %	**UV Transmittance @ 254 nm unfiltered** %
MIN	120	0.19	5	7.5	269	<5	<1	<1		85
MAX	180	0.79	10	8.3	290	10	13	<1	100	88
AVG	150	0.37	7	7.9	278		**48 Samples**			86
WQ Guidelines			15	7.0-10.5			<1	<1		
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**		

Table 25. *2022 Raw Water Oyama Creek Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)). Oyama source on-line during irrigation season only.*

Oyama Lake Source: Oyama Creek Intake									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**% of samples Less than 10 E.Coli/100mL (N=15)** %
MIN	40	0.38	7	7.4	46	45	705	<1	
MAX	40	0.99	18	7.8	66	84	9,800	28	60
AVG	40	0.72	14	7.6	52	61	**15 Samples**		
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Table 26. *2022 Raw Water Kalamalka Lake Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)).*

Kalamalka Lake Source: Kalamalka Intake										
Weekly sampling & online water quality equipment verification	Hardness	Turbidity	Temp	pH	Conductivity	True Color	Total Coliforms	E.Coli	% of samples Less than 10 E.Coli/100mL (N=50)	UV Transmittance @ 254 nm unfiltered
	mg/L As CaCO3	NTU	Deg C		uS/cm	TCU	CFU/100mL	CFU/100mL	%	%
MIN	200	0.24	5	7.4	387	<5	<1	<1		88
MAX	220	1.58	11	8.4	429	16	19	3	100	90
AVG	213	0.62	8	8	400		**50 Samples**			90
WQ Guidelines			15	7.0-10.5			<1	<1		
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**		

Table 27. *Coral Beach Water System, 2022 Raw Water Coral Beach Intake (Okanagan Lake source). (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO).*

Okanagan Lake Source: Coral Beach Intake										
Weekly sampling & online water quality equipment verification	Hardness	Turbidity	Temp	pH	Conductivity	True Color	Total Coliforms	E.Coli	% of samples Less than 10 E.Coli/100mL (N=45)	UV Transmittance @ 254 nm unfiltered
	mg/L As CaCO3	NTU	Deg C		uS/cm	TCU	CFU/100mL	CFU/100mL	%	%
MIN	140	0.27	6	7.6	269	<5	<1	<1		82
MAX	160	2.13	14	8.5	294	6	42	2	100	88
AVG	150	0.55	10	7.9	279	5	**45 Samples**			86
WQ Guidelines			15	7.0-10.5			<1	<1		
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**		

Table 28. *Lake Pine Water System, 2022 Raw Water Lake Pine Intake (Okanagan Lake source). (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO).*

Okanagan Lake Source: Lake Pine Intake										
Weekly sampling & online water quality equipment verification	Hardness	Turbidity	Temp	pH	Conductivity	True Color	Total Coliforms	E.Coli	% of samples Less than 10 E.Coli/100mL (N=41)	UV Transmittance @ 254 nm unfiltered
	mg/L As CaCO3	NTU	Deg C		uS/cm	TCU	CFU/100mL	CFU/100mL	%	%
MIN	140	0.13	5	7.3	270	<5	<1	<1		82
MAX	160	0.82	18	8.3	295	8	91	3	100	87
AVG	156	0.41	11	7.9	282		**41 Samples**			85
WQ Guidelines			15	7.0-10.5			<1	<1		
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**		

Other raw water chemistry data collected throughout the year and brought to Caro for analysis are in the Tables below. This data is our averages per month and is used operationally as well are our ongoing base line data collection for understanding our water sources as we move towards filtration exclusion and/or filtration. Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) are a measure of the natural organic materials in the water. They are precursors for disinfection by-products and can reduce the effectiveness of the UV disinfection. The Ultra Violet Transmissivity (UVT) is the Ultra Violet Transmissivity (measured in %) is the amount of ultraviolet light at 254 nanometers (nm) that is able to pass through 10 mm of water. The Total Suspended Solids (TSS) refer to waterborne particles that exceed 2 microns in size and are not filtered. The true colour is the colour measurement prior to filtration and the Aesthetic Objective in the GCDWQ are less than or equal to 15 True colour units.

Table 29. Beaver Lake Water Source - Monthly average water chemistry analysis.

Beaver Lake

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	6.36	Off line: Ok Lake is the Primary source during this period	7.24	Off line, Okanagan Lake is the Primary source during this period			8.95	8.25	9.23	5.79	Off Line Okanagan Lake is primary source	
DOC	mg/L	6.22		7.13				8.69	8.1	8.76	5.54		
TRU	Co-Pt			23.5				70	41	35	33		
TSS	mg/L	24		2				5.2	<3.3	<2.0	<2.0		

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

Table 30. Okanagan Lake Water Source - Monthly average water chemistry analysis

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	4.21	4.6	4.07	4.28	4.61	3.6	4.33	4.07	4.73		3.99	3.95
DOC	mg/L	3.99	4.33	3.91	4.16	4.48	3.59	4.12	3.83	4.28		3.97	3.88
UVT	/cm^-1	85.90	86.20	87.60	86.50	84.80	85.80	85.20	85.40	85.60		84.70	85.70
TSS	mg/L					<2.9	<2.0		<2.0	<2.4		<4.0	<2.0
TRU	Co-Pt	<5	<5	5	<5	7	10	<5	<5	<5		<5	<5

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

Table 31. Oyama Lake Water Source - Monthly average water chemistry analysis

Oyama Lake

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	Off Line Kalamalka is Primary Source						11.50	10.00	11.10		Off Line Kalamalka Lake is Primary Source	
DOC	mg/L							11.00	9.53	10.90			
TSS	mg/L							5.0	4.8	2.0	2.0		
TRU	Co-Pt							84	55	64	60		

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

Table 32. Kalamalka Lake Water Source. Monthly average water chemistry analysis

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	3.61		3.83	4.27	4.16	4.05	3.72	3.77	3.78	3.89	3.59	3.61
DOC	mg/L	3.55		3.73	3.96	4.13	3.98	3.7	3.74	3.71	3.6	3.44	3.56
UVT	/cm^-1	90.1		89.9	90.2	89.0	90.2	89.1	89.4	88.2	90.0	90.0	89.9
TSS	mg/L					2.0	3.3		2.0		2.0	2.0	2.0
TRU	Co-Pt	5		<5	<5	<5	<5	<5	16	<5	<5	<5	<5

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

Table 33. Coral Beach (Okanagan Lake Water Source) - Monthly average water chemistry analysis

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	3.88		4.08	4.30	4.64	3.71	4.00	4.13	4.33	4.45		3.69
DOC	mg/L	3.86		3.83		4.52	3.59	3.94	3.97	3.93	3.92		3.64
UVT	/cm^-1	85.0		87.8	87.5	86.3	87.4	81.5	86.0	85.4	85.7		87.5
TSS	mg/L				3.3		3.3		2.0	2.0			2.0
TRU	Co-Pt	5		5	5	6	5	5	5	5	5		5

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

T**able 34.** Lake Pine (Okanagan Water Source) - Monthly average water chemistry analysis

	UNITS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TOC	mg/L	4.12		4.22	4.23	5.44	4.08	3.99	4.25	4.01			3.96
DOC	mg/L	4.04		3.92	4.04	5.42	4.06	3.95	3.91	3.70			3.92
UVT	/cm^-1	85.0		85.3	86.1	83.6	87.4	83.9	85.2	85.6			84.5
TSS	mg/L						3.7		2.0				2.0
TRU	Co-Pt	5		5	5	8	6	5	5	5			5

TOC, total organic carbon, DOC: dissolved organice carbon, UVT: ultra violet transmisivity, TSS: total suspended solids, TRU True Colour

Algae

Although the DLC does not have any water intakes on Wood Lake, it is part of our ongoing monitoring program with Kalamalka Lake. In 2022 Wood Lake experienced algae blooms as it has in the past years however, it did not impact our intake on Kalamalka Lake. A monitoring program is in place and frequent monitoring and sampling were collected at the DLC's Kalamalka Lake intake. Algae monitoring continued on our Kal intake through to mid-December and will restart this program again in the Spring or at any point if conditions change. At all times samples indicated that this source water was within acceptable drinking water standards. Monitoring for algae is a year-round process as algae blooms can occur in winter months.

Algae monitoring is ongoing throughout the year at all DLC drinking water intakes. Should an observed or other reported condition require further action, the appropriate response would be followed as per the DLC's Potable Water Quality Emergency Response Plan. As required, results would be discussed with IHA.

In 2021, the Province launched an Algae Watch Website (https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/algae-watch) . Algae Watch is an educational program for citizen science data gathering. The goal is to help people recognize, identify and report algae blooms in B.C. lakes.

Watershed Management

The DLC supplies domestic and irrigation water for the communities of Oyama, Winfield, Okanagan Centre, and Carr's Landing. Sixty-five (65%) percent of the water delivered to the Lake Country communities originates from the Oyama and Beaver Lake watersheds.
Infrastructure within these watersheds was constructed approximately 100 years ago for irrigation and in the 1970's the systems were improved and evolved to become a major domestic and agricultural water supply. Both the Oyama and Beaver Lake watersheds are multi-use and have numerous ongoing activities (e.g. forestry, range, recreation, etc.). Under the BC Government's Action Plan for Safe Drinking Water, the primary responsibility for protecting drinking water from land-use activities lies with the agency responsible for approving those activities. This can create complex governance that makes addressing source water concerns a significant challenge.

In 2022 the DLC participated in a workshop with the Province regarding their new Watershed Security Strategy and funding (discussion paper). The focus was on watershed planning/protection and resource extraction. The DLC also provided further on-line feedback to the Province reiterating our concerns with watershed protection, planning, governance, water quality and quantity.
For many years, including 2022, the DLC has worked closely with many stakeholders that work or have interests within our local watersheds. The DLC continues to collaborate and work with stakeholders (Forestry, Ranchers etc.) throughout the year to address matters as they arise and maintain working

partnerships on various projects and/or action items from the various watershed protection plans and source to tap assessments.

Source to Tap Assessments

The purpose of the Source to Tap Assessments on the DLC distribution systems Kalamalka and Okanagan Lake sources were to conduct research and compile known data for use in identifying the DLC'S intake strengths, liabilities and planning for water quality protection and improvement. One of the most important recommendations in these assessments was the identification of an Intake Protection Zone. This zone defines the area where the intake should take precedence over every other use of consideration. It also defines the areas of land and water where special care must be taken in the use and handling of potential contaminants to prevent them from accidentally entering the lake and affecting the intake.

Okanagan Lake

In 2022 the DLC, in partnership with Larratt Aquatics, to obtain a $30,000 OBWB Water Conservation and Quality Improvement Grant from Okanagan Basin Water Board (OBWB). Funds were used to study the effects of the 2021 White Rock Lake wildfire on source waters. The aim of this report is to determine how the effects of the wildfire, such as more severe freshet, runoff, erosion, and sediment and nutrient loading of the lake will affect our source water quality as well as to update the DLC's 2010 Source to Tap Assessment of Okanagan Lake Intake (2010 SWP).

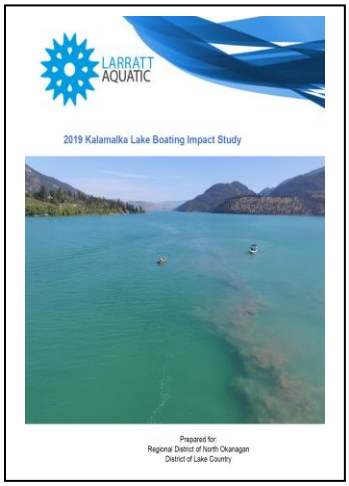
Updates into the 2010 SWP include reassessing hazards and vulnerabilities with the potential to affect the safety and sustainability of the DLC water supply, and to recommend risk management actions to address them. The addressed risks will include climate change predictions of storm severity, wildfire, flooding, and drought.

This report is in process and will be available the spring of 2023.

Kalamalka & Wood Lake Monitoring

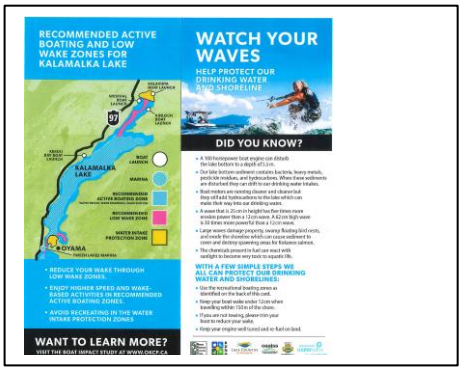
Since 1998, when a taste and odour complaint occurred on Kalamalka Lake, the DLC, Greater Vernon Water/North Okanagan Regional District and the Ministry of Environment have partnered to acquire water quality data on this source. The information obtained defines the physical and biological impact at the DLC'S existing intakes; accumulates baseline water chemistry for future additional water treatment; provides information on the ideal depth of intakes for the best water quality; shows fluctuations in nutrients and algae production; and the implications of changes for water resources. This research is evaluated and re-directed on an annual basis. This marks the 23rd year of this comprehensive and collaborative study.

In 2022 the DLC remained focused on potential impacts from previous years' flooding and/or high-water levels and other climate change impacts such as particulates from wildfires and effects of photosynthetic organisms such as algae, diatoms and cyanobacteria. It is common for a gap in response time to occur from previous years' events. This is due to the time for particulates and additional materials to accumulate and decompose at the deep-water depths.



The DLC, Regional District of North Okanagan and District of Coldstream partnered from 2019 - 2021 in addressing recommendations of research projects completed between 2017-2019 that examined the impacts of motorized boating on water quality. This research identified; lake bottom sediments contain contaminates (hydrocarbons, bacteria and heavy metals), that wakeboard boats can disturb and re-suspend the lake bottom to a depth of 8 meters and the re-suspended sediments from motorized boating can drift to municipal and domestic intakes and negatively impact water quality. The research also identified erosion impacts on property and damage to fish spawning habitat and bird nesting areas on the shoreline. In 2022, it was clear we were unable to continue at our current capacity with this project. Were also did not secure additional funding to maintain the 2021 collaborative messaging campaign that focused on minimizing the impacts of boat wakes on water quality, wildlife habitat and shoreline erosion. To date, we have developed a campaign that can be utilized and distributed by local governments and have brought this strategy to the OBWB for support. Further information can be found at https://www.imawake.ca/

In June the OBWB hosted a boating impact workshop to identify impacts, solutions, and develop a list of possible actions from the impacts from boating and supporting infrastructure (e.g. marinas) on Okanagan lakes. Invitations were sent to many stakeholders including First Nations, local and senior government staff and post-secondary representatives working in water, boating industry representatives, boating clubs, dock builders, and conservation groups. We are hopeful that the information collected from this meeting will support OBWB to lead the Valley on this undertaking.



Watershed Protection Plans

The Source Water Assessments for the Oyama and Vernon Creek watersheds promotes sustainable management of our ecosystems through collaborative efforts of all stakeholders. The most valuable management tool from this plan is the identification of the various vulnerability zones that indicate the potential for risk to water quality. When considering any high-risk activities within our community watershed, these high-risk areas are the first to be evaluated for potential impacts of the activities along with the associated levels of risk. These activities may include forestry management, sports and/or recreational and mining activities.

Throughout the process of completing these plans, stakeholder involvement was a key component to ensuring a broad range of aspects were considered. The goal for stakeholders is to be aware of the vulnerability zones and to recognize the recommendations specific to them when planning further watershed activities.

The Source Water Assessment continues to play an important role in the management and planning in our community watersheds. In 2022 a specific stakeholder meeting to follow up on identified risks and actions in the SWA was not held. DLC staff instead maintained communications and meetings with many key stakeholders. DLC staff maintains connections and active participation with several watershed related organizations some of which are the Okanagan Basin Water Board (OBWB), Okanagan Water Stewardship Council and the BC Water Supply Association. The District intends to hold the stakeholders meeting in 2023.

The DLC endeavors to maintain and improve relationships with major licensees as well as all SWA stakeholders' group, striving to implement recommendations and recognize improvements as we move forward. Our watersheds are multipurpose, multi-jurisdictional. all activities are contributing to the overall cumulative impact on the environment, water quality and quantity. All stakeholders have a responsibility to recognize this and use best practices maintaining sustainable resources for all users.

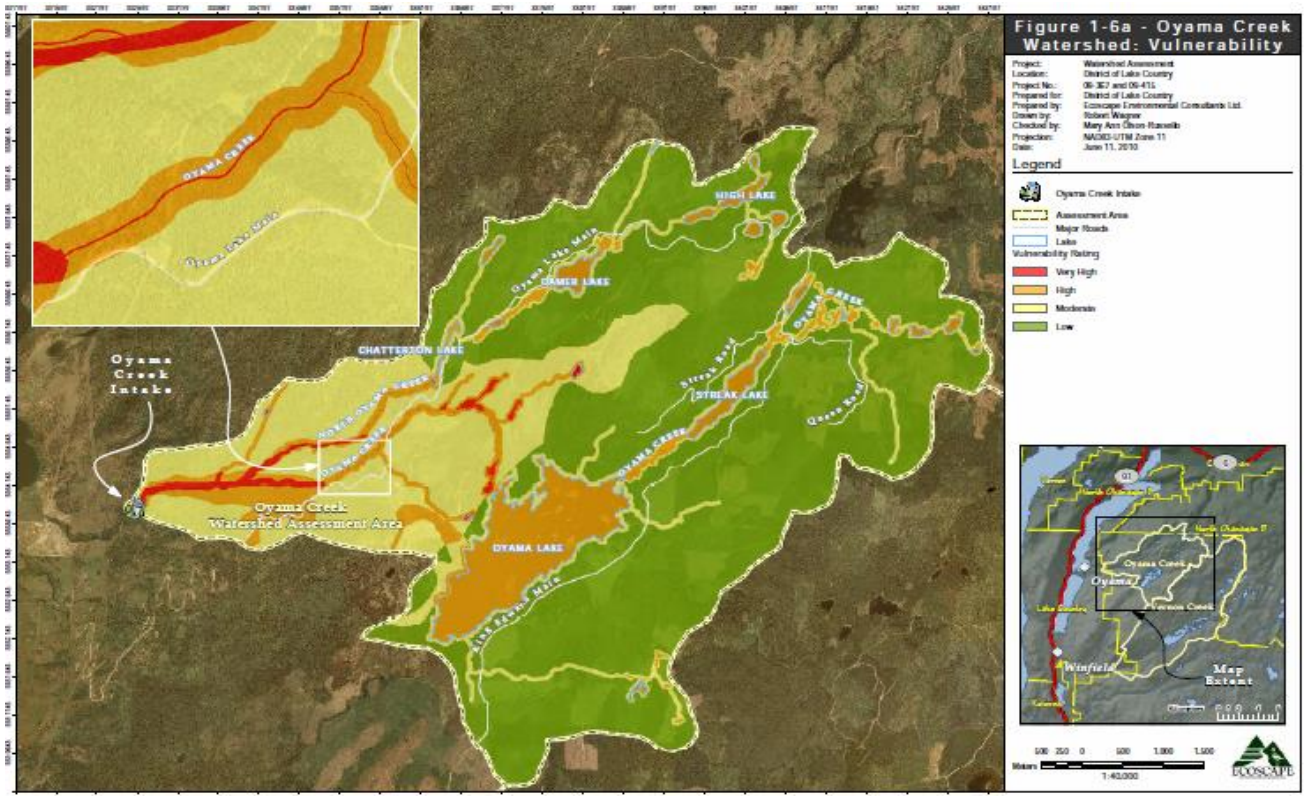
Off Road Vehicle

Again in 2022, a tremendous volume of motor vehicle traffic and unsanctioned (illegal and environmentally harmful) activities occurred in our community watersheds. Of the thousands of cars venturing into these crown lands many were roadside parking/camping for days and weeks having illegal fires and dumping their garbage. The lease lot resorts continued to report an abundant of activity and interest of people wanting to stay and access our drinking water reservoirs. As with the previous year, large amounts of garbage and other debris such as abandon and burnt vehicles were not only dumped into the forest but also left burnt on the roadside. Illegal activity in our community watershed including motorized vehicle activity in the drainage of our intakes could adversely impact our water quality through soil disturbance, creation of new drainage pathways among other concerns in these vulnerable areas adding to the cumulative impact, on the elevated particulates loading into our drinking water source. We were also very fortunate with our exceptionally hot and dry conditions that no forest fires were attributed to these roadside fires and other activities.

If you notice questionable activities in our Community Watersheds **Report All Poachers and Polluters** (RAPP) Violations to the Conservation Officer Service 24-hour **hotline: 1-877-952-7277**. or #7277 on the TELUS Mobility Network Additionally, you can register complaints online through RAPP

Range Management

The Okanagan Shuswap District Range Program's annual meeting did not take place this year due to change in the regional Agrologist position. The DLC did request and offer to set up the meeting once the new lead was determined; however, due to timing it was not possible due to calving season in process. Instead, the DLC contacted with the stakeholders including ranchers, major licensees, and others if necessary, requesting we stay connected and advise each other of any changes in grazing plans or notable events. In Late 2022 the DLC confirmed with the Province we would host and organize the communications for the 2023 meeting.



All range use holders, major licensees, and the Small-Scale Salvage Program (SSSP) have agreed to use the DLC vulnerability zone mapping in their planning and development process.

Forestry

Tolko and BC Timber Sales are the two major Licensees in our watersheds.

Both Tolko and BCTS have opted out of public advisory group and are now obtaining their certification through the Sustainable Forestry Initiative (SFI). This process is not open to public input or consultation in the development and reporting of targets and indicators and there is no open consultation process as the DLC previously had when participating with them in with the former Sustainable Forest Management Public Advisory Group. The DLC must maintain a concerted effort to be informed about Major Licensee activities.

Major Licensees in our community watersheds are aware of our Watershed Protection Plan and they have agreed to use the vulnerability layer as a planning tool when developing harvest plans. Tolko and BCTS have agreed to meet annually for an update on harvesting or other known activities in our watersheds. Additionally, harvest/site plans are reviewed by DLC staff and recommendations are provided as needed to address issues such as access (cattle and unsanctioned motorized vehicle activities), wildfire management, drainage concerns, and rehabilitation of roads to decrease the amount of non-status roads accumulating in our community watersheds. There are no regulations or obligation to adhere to our plans or recommendations and we rely on them using best management practice in high-risk areas.

Both Beaver and Oyama watersheds have various old and proposed Tolko and BCTS harvest blocks the DLC monitors and is involved with on different levels. All proposed harvesting works in the Beaver and Oyama watershed are within the high and very high vulnerability zones. These sites are all located directly below the outflow of our dam's and above our drinking water intakes. We are interested in these activities and maintain active involvement to understand how Licensees will ensure access management will be maintained while ensuring immediate and long-term water quality and supply are not impacted.

In 2022 both Tolko and BCTS had proposed harvest sites directly below the outflow of Beaver and Oyama Lake Dams and above our drinking water intakes; these are the highest vulnerability zones in our community watersheds. The DLC has advised both Licensees, Tolko and BCTS, of the risk and consequences of activities in these high vulnerability zones. For all sensitive areas we require block walks with our subject matter experts and the licensee. We had field trips into these areas and many discussions including a consented review of Tolko's Watershed Assessment. We remain engaged with our regulatory authority and the Province and when required seek their assistance in providing feedback or assistance with regulation interpretation regarding referrals and major licensee's sensitive watershed plans. This is a very active and on-going process.

Small Scale Salvage (SSSP) is a program that is regulated and operates through the Province. Private companies can apply for a small-scale salvage license through the Ministry of Forest Lands and Natural Resources Operations and Rural Development (FLNRORD). These companies can then harvest small volumes of timber that would otherwise not have been harvested and/or address forest health objectives. Small scale salvage operations do not follow Forest Stewardship Plans (FSP) or belong to a certification process. The DLC has requested referrals from the Province for all SSSP activities in our community watersheds. The DLC has not received any referrals from the Province over the past four years.

In July 2019 the Government of B.C. provided a public engagement opportunity to help The FRPA framework define how legislation, regulations, and policy work. The intent was to gather information for improvements to the Forest and Range Practices Act (FRPA) that will support the health and sustainability of B.C.'s forests and rangelands, while strengthening public confidence in how these vital resources are managed. FRPA governs on-the-ground forest and range activities on B.C.'s public forests and rangelands. The Province advised they are improving FRPA to ensure it will effectively manage and conserve our forests and rangelands in the face of change. The DLC provided comments on all aspects of FRPA as many improvements are required for a more integrative management approach that will consider cumulative impacts at a landscape level within our community watersheds. DLC provided input into the Water Supply Association White Paper addressing the proposed FRAP changes. The DLC hopes this information shared will help to improve legislation required to protect water quality and quantity and effectively manage and conserve our forests and rangelands.

Wildfire Planning

The possibility of a catastrophic wildfire occurring in our community watershed is of high concern. A devastating fire in the Beaver or Oyama watersheds would not only degrade water quality, but post-fire floods and landslides are typical impacts seen directly following the first storm event (or freshet) and occur for decades following. The DLC has recognized Wildfire as a risk to our community and have identified a process for communication with the BC Wildfire Service (BCWS) during the wildfire season.

No major wildfire activities occurred in our community watershed in 2022 however, there were two human caused fires < 0.10 ha in the Oyama and Beaver Watersheds (information provided to DLC at the time as well as stats collected from the BC Wildfire App).

In 2022 we received the final report on *Reducing Wildfire Risk in our Community Watersheds*. Neighboring purveyors on the Aberdeen Plateau along with FESBC funding joined forces to address wildfire risks to our water resources. The report identifies strategic locations for shaded landscape level fuel breaks to buffer the watershed from valley bottom interface fires, interrupt fire flow across watersheds, and anchor suppression activities. This long-term planning and prescriptions include collaborative works with our indigenous neighbors, the Province and key stakeholders to protect our communities and vital infrastructure from the potential devastation of wildfire in and around our water infrastructure.

Photos by Frontline Operations in the 2019-2021: Reducing Wildfire Risk to the Okanagan Basin Water Supply – Aberdeen Plateau Report. *A low intensity surface fire typical of discontinuous fuels in an open stand as compared to a crown fire associated with dense, continuous fuels resulting from fire exclusion.*

Wildfire reduction planning and mitigation measures in community watersheds outside of the wildland urban interface are not directly managed by the Province. Provincial funding for wildfire reduction planning and operations is provided to the Forest Enhancement Society of BC (FESBC) and dispersed through process grants. These grants are dependent on a variety of factors including the collaboration and consent of major stakeholders. In 2022 these grants were not available to municipalities however, we were provided an opportunity to collaborate with OKIB as they were qualified to apply for this funding resource to implement select next phases of planning and prescription in the RDNO and DLC watersheds.

Appendices

Appendix A – Summary of Positive Bacteriological Results in Distribution

Lake Country Water System & Source	Total Coliforms CFU/100mL	E. Coli CFU/100mL	Presence Absence (Total Coliforms)	Presence Absence (E. Coli)	Sample Date	Number of TC/E.Coli Samples	Number of P/A Samples
Beaver Lake Source						37	20
Okanagan Lake Source						92	36
Kalamalka Lake Source						75	29
Oyama Lake Source						24	22
Coral Beach (Okanagan Lake Source)						53	22
South end	2	<1			01-Jun		
South end	1	<1			04-Aug		
Pumphouse	2	<1			17-Aug		
Pumphouse	2	<1			19-Aug		
Lake Pine (Okanagan Lake Source)						52	26
					Total:	**333**	**155**

Appendix B – District of Lake Country Sampling Sites

District of Lake Country Water System: Beaver Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Frost Free Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Vernon Creek Intake **RAW**	Beaver Lk			x									x											
Eldorado **RAW**	Beaver Lk			x			x		x															
Eldorado Balancing Reservoir	Beaver Lk			x			x				x													
Eldorado Reservoir chlorination facility (reservoir inlet & outlet)	Beaver Lk						x				x		x	x										
Camp Road Works Yard	Beaver Lk			x												x				x		x		
Camp Rd Reservoir (off line)	Beaver Lk			x	x						x					x			x					
Chase Rd future	Beaver Lk			x	x						x													
Cooney Drain	Beaver Lk	x	x	x								x					x					x		
Glenmore Booster Station	Beaver Lk			x			x				x				x									
Mulbery	Beaver Lk			x				x								x								
Lakestone Beacon Hill PRV	Beaver Lk			x							x													
Hare Road PRV	Beaver Lk			x							x													
Long	Beaver Lk			x				x									x							
McCreight	Beaver Lk			x		x											x	x				x		
Monte Carlo	Beaver Lk			x				x								x								
Nighthawk	Beaver Lk			x		x											x	x	x					
North View/Chase	Beaver Lk			x				x									x	x						
Nygren	Beaver Lk			x				x									x							
Pow Rd PRV Stn	Beaver Lk	x	x	x								x				x								
PR2	Beaver Lk			x	x	x										x								
Shanks Road (Future site)	Beaver Lk			x													x					x		
Williams	Beaver Lk			x		x		x									x	x	x					

Appendix B continued– District of Lake Country Sampling Sites

District of Lake Country Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Frost Free Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Ok Lk Intake **RAW**	Ok Lk			x							x		x										x	
Ok Lk Pump Stn/chlorination facility	Ok Lk						x				x		x	x										
UV Treatment Facility	Ok Lk						x																	
Copper Hill	Ok Lk			x		x											x					x		
4th Street (future site)																						x		
Glenmore Booster Station	Ok Lk		x	x			x				x				x									
Jardine	Ok Lk			x						x						x								
Kelwin	Ok Lk				x						x						x							
Lakes Lower Reservoir (cell 1)	Ok Lk			x			x				x					x								
Lakes Upper Reservoir	Ok Lk			x					x															
Lakes Upper Zone (Shoreline Park)	Ok Lk			x																		x		
Lake Stone Benchlands	Ok Lk			x				x									x							
Future site: Lake Stone original development	Ok Lk			x					x															
McCoubrey	Ok Lk			x				x								x								
Roberts Road PRV	Ok Lk			x												x								
Oceola PRV	Ok Lk			x							x						x							
Ottley Rd (off Stubbs)	Ok Lk			x				x							x									
Ponderosa pumphouse	Ok Lk			x				x									x							
Ponderosa PRV stn	Ok Lk			x							x					x								
Woodsdale Lift Stn	Ok Lk			x		x											x							

Appendix B continued – District of Lake Country Sampling Sites

District of Lake Country Water System: Oyama Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Easthill	Oyama Lk	x	x	x		x		x								x								
Oyama Rd S	Oyama Lk	x		x				x									x	x	x					
Oyama Rd N	Oyama Lk			x				x									x	x	x					
Oyama Lk/Hayton Rd	Oyama Lk				x												x	x		x				x
Oyama Creek Intake **RAW**	Oyama Lk			x									x											
Oyama Reservoir	Oyama Lk			x							x			x									x	
Oyama Creek intake/Chlorination Facility - Chlorinator post reservoir	Oyama Lk						x						x	x										
5410 Todd Rd. (Oyama: First customer Fall (Sawmill online: Kal) could be either from Sawmill or from reservoir	Oyama Lk			x							x				x	x	x							

District of Lake Country Water System: Kalamalka Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Irvine B-2 Reservoir	Kal				x				x							x						x		
Cornwall/ Sheldon	Kal	x	x	x				x								x		x						
Evans	Kal			x				x									x							
Kal Lk Intake **RAW**	Kal			x							x		x											
Kal Pump Stn	Kal			x			x				x			x	x						x			
Sawmillpump station	Kal			x							x					x								
Oyama Creek Chlorination Facility (distribtuion water fromKal Source (Sawmill) to Oyama reservoir)	Kal						x						x	x										

Appendix B continued – District of Lake Country Sampling Sites

Coral Beach Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Coral Beach Intake **RAW**	CB Ok Lk			x			x						x										x	
Coral Beach Pump Stn	CB Ok Lk						x				x			x	x						x			
Coral Beach Pump Stn (distrib sample site)	CB Ok Lk			x					x					x	x									
Coral Beach Reservoir (Future)	CB Ok Lk			x												x						x		
Coral Beach North End (Future)	CB Ok Lk				x																	x		
Coral Beach South End	CB Ok Lk	x	x	x		x											x					x		

Lake Pine Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Lake Pine Intake RAW	LP Ok Lk			x					x														x	
Lake Pine chlorination facility	LP Ok Lk		x				x				x			x	x									
Lake Pine Booster/Lower Res	LP Ok Lk		x	x			x				x			x	x						x			
Lake Pine PR Stn.	LP Ok Lk	x		x													x					x		
Lake Pine Upper Reservoir	LP Ok Lk			x							x					x								
Lake Pine Road (Future)	LP Ok Lk																					x		
Moberly South (Future Site)	LP Ok Lk																x							

Appendix C – Comprehensive Test Results

2022 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	Lake Pine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pump House
Date		01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22
Anions							
Chloride	mg/L	1.13	0.18	10.40	5.62	5.81	6.20
Chloride (AO)	mg/L	250	250	250	250	250	250
Fluoride	mg/L	<0.10	<0.10	0.25	0.13	0.10	0.16
Fluoride (MAC)	mg/L	1.5	1.5	1.5	1.5	1.5	1.5
Nitrogen, Nitrate as N	mg/L	0.02	<0.01	0.08	0.03	0.04	0.05
Nitrate (MAC)	mg/L	10	10	10	10	10	10
Nitrogen, Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite (MAC)	mg/L	1.0	1.0	1.0	1.0	1.0	1.0
Sulphate	mg/L	3.30	2.80	51.30	30.30	31.10	33.50
Sulphate (AO)	mg/L	500	500	500	500	500	500
General Parameters							
Alkalinity (total)	mg/L	24.10	21.70	151.00	118.00	105.00	108.00
No current guidelines							
True Colour	CU	**51.00**	**61.00**	<5.00	7.50	6.90	6.10
True Colour (AO)	CU	<15	<15	<15	<15	<15	<15
Conductivity	uS/cm	58.60	53.00	396.00	277.00	280.00	272.00
No current guidelines							
Cyanide	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide (MAC)	mg/L	0.2	0.2	0.2	0.2	0.2	0.2
pH	pH units	7.21	7.17	8.19	8.25	8.18	8.04
pH (OG)	pH units	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5
Turbidity	NTU	**1.26**	0.73	0.44	**2.03**	0.60	0.32
Turbidity Guideline (OG)	NTU	<1	<1	<1	<1	<1	<1
Trans. 254 nm (unfiltered)	% T			90.40	84.50	84.30	85.40
No current guidelines. Note the lab did not report for Beaver and Oyama Lake sources							
Calculated Parameters							
Hardness (mg/L as CaCO3)	mg/L	24.30	22.80	175.00	113.00	114.00	113.00
No current guidelines see glossary below							
Total Dissolved Solids/TDS	mg/L	30.40	27.50	235.00	161.00	155.00	158.00
TDS (AO)	mg/L	500	500	500	500	500	500

Appendix C continued – Comprehensive Test Results

2022 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	Lake Pine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pump House
Date		01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22
Total Recoverable Metals							
Aluminium (total)	mg/L	**0.12**	0.07	0.01	0.02	<0.01	0.01
Aluminium (OG)	mg/L	0.1	0.1	0.1	0.1	0.1	0.1
Antimony (total)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Antimony (MAC)	mg/L	0.00600	0.00600	0.00600	0.00600	0.00600	0.00600
Arsenic (total)	mg/L	<0.0005	<0.0005	0.0009	0.0005	<0.0005	<0.0005
Arsenic (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Barium (total)	mg/L	0.01	0.01	0.03	0.02	0.02	0.02
Barium (MAC)	mg/L	2	2	2	2	2	2
Boron (total)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron (MAC)	mg/L	5	5	5	5	5	5
Cadmium (total)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Cadmium (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Calcium (total)	mg/L	6.10	5.89	39.80	29.90	30.50	30.80
No current guidelines							
Chromium (total)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (MAC)	mg/L	0.050	0.050	0.050	0.050	0.050	0.050
Cobalt (total)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
No current guidelines							
Copper (total)	mg/L	0.0011	0.0016	0.0012	0.0009	0.0058	0.0007
Copper (MAC)	mg/L	2	2	2	2	2	2
Iron (total)	mg/L	0.23	0.12	<0.01	0.03	<0.01	<0.01
Iron (AO)	mg/L	<=0.3	<=0.3	<=0.3	<=0.3	<=0.3	<=0.3
Lead (total)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00028	0.00020
Lead (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Magnesium (diss.)	mg/L	2.21	1.95	18.40	9.19	9.24	8.83
No current guidelines							
Manganese (total)	mg/L	0.00831	0.00438	0.00173	0.00358	0.00121	0.00097
Manganese (MAC)	mg/L	0.12	0.12	0.12	0.12	0.12	0.12
Mercury (total)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Mercury (MAC)	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Molybdenum (total)	mg/L	0.00019	0.00017	0.00482	0.00313	0.00327	0.00335
No current guidelines							

Appendix C continued – Comprehensive Test Results

2022 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	Lake Pine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pump House
Date		01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22	01-Jun-22
Total Recoverable Metals							
Nickel	mg/L	0.0008	0.0014	<0.0004	0.0005	0.0007	0.0004
No current guidelines							
Potassium (total)	mg/L	0.85	1.17	4.84	2.32	2.36	2.28
No current guidelines							
Selenium (total)	mg/L	<0.0005	<0.0005	0.0009	<0.0005	<0.0005	<0.0005
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Sodium (total)	mg/L	2.10	2.27	18.00	11.70	11.90	10.90
Sodium (AO)	mg/L	<200	<200	<200	<200	<200	<200
Strontium (total)	mg/L	0.04	0.04	0.44	0.27	0.27	0.27
Strontium (MAC)	mg/L	7	7	7	7	7	7
Uranium (total)	mg/L	0.000040	0.000092	0.003020	0.002050	0.002500	0.002300
Uranium (MAC)	mg/L	0.020	0.020	0.020	0.020	0.020	0.020
Zinc (total)	mg/L	<0.004	<0.004	<0.004	<0.004	0.010	<0.004
Zinc (AO)	mg/L	<=5	<=5	<=5	<=5	<=5	<=5

Glossary of Terms, GCDWQ:	
<	Less than. Reported when result is less than the reported detection limit
≤	Less than or equal to. Reported when result is less or equal to the reported detection limit
AO	Aesthetic objective. Refer to GCDWQ
MAC	Maximum acceptable concentration. Refer to GCDWQ
OG	Operational guidance values. Refer to GCDWQ
TCU	True color unit. Color referenced against a platinum cobalt standard
NTU	Nephelometric turbidity unit
uS/cm	Microsiemens per centimeter
Hardness	The degree of hardness of drinking water may be classified in terms of its calcium carbonate concentration as follows: soft, 0 to <60 mg/L; medium hard, 60 to <120 mg/L; hard, 120 to < 180 mg/L; and very hard, 180 mg/L and

Appendix D – Nutrient Sampling Upland Drinking Water Reservoirs

2022 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		21-Oct-22	21-Oct-22	21-Oct-22
Anions				
Nitrogen (Nitrate as N)	mg/L	<0.01	0.04	<0.01
Nitrate (MAC)	mg/L	10	10	10
Nitrogen (Nitrite as N)	mg/L	<0.01	<0.10	<0.01
Nitrite (MAC)	mg/L	1	1	1
Phosphate (as P)	mg/L	<0.01	<0.01	<0.01
No current guidelines				
Sulfate	mg/L			
Sulfate (AO)	mg/L	500	500	500
General Parameters				
Alkalinity, Total (as CaCO3)	mg/L	17.50	28.40	2.20
No current guidlines				
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	<1.00	<1.00	<1.00
No current guidelines				
Alkalinity, Bicarbonate (as CaCO3)	mg/L	17.50	28.40	24.10
No current guidelines				
Alkalinity, Carbonate (as CaCO3)	mg/L	<1.00	<1.00	<1.00
No current guidelines				
Alkalinity, Hydroxide (as CaCO3)	mg/L	<1.00	<1.00	<1.00
No current guidelines				
Ammonia (as N)	mg/L	0.06	<0.05	<0.05
No current guidelines				
Total Organic Carbon	mg/L	10.20	15.60	9.87
No current guidelines				
Chlorophyll-a	ug/L	1.35	1.13	<1.00
No current guidelines				
Colour, True	CU	45.00	110.00	43.00
No current guidelines				
Nitrogen, Total Kjeldahl	mg/L	0.46	0.54	0.40
No current guidelines				
Phosphorus, Total (as P)	mg/L	0.02	0.02	0.02
No current guidelines				
TDS	mg/L			
TDS (AO)	mg/L	500	500	500
TSS	mg/L	<2.00	<2.00	<4.00
No current guidelines				
Calculated Parameters				
Hardness, Total (as CaCO3)	mg/L	17.50	25.30	21.80
No current guidelines				
Nitrate+ Nitrite (as N)	mg/L	<0.0100	0.0362	<0.0100
No current guidelines				
Total Nitrogen	mg/L	0.46	0.57	0.40
No current guidelines				
Organic Nitrogen	mg/L	0.40	0.54	0.40
No current guidelines				

Appendix D continued– Nutrient Sampling Upland Drinking Water Reservoirs

2022 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		21-Oct-22	21-Oct-22	21-Oct-22
Metals				
Total Dissolved Aluminium	mg/L	0.02	0.07	0.02
Total Recoverable Aluminium	mg/L	0.03	0.11	0.05
Aluminium (OG)	mg/L	0.1	0.1	0.1
Total Dissolved Antimony	mg/L	<0.0002	<0.0002	<0.0002
Total Recoverable Antimony	mg/L	<0.0002	<0.0002	<0.0002
Antimony (MAC)	mg/L	0.006	0.006	0.006
Total Dissolved Arsenic	mg/L	<0.0005	<0.0005	<0.0005
Total Recoverable Arsenic	mg/L	<0.0005	<0.0005	<0.0005
Arsenic (MAC)	mg/L	0.01	0.01	0.01
Total Dissolved Barium	mg/L	0.0067	0.0084	0.0055
Total Recoverable Barium	mg/L	0.0072	0.0097	0.0061
Barium (MAC)	mg/L	2	2	2
Total Dissolved Beryllium	mg/L	<0.00010	<0.00010	<0.00010
Total Recoverable Beryllium	mg/L	<0.00010	<0.00010	<0.00010
No current guidelines				
Total Dissolved Bismuth	mg/L	<0.00010	<0.00010	<0.00010
Total Recoverable Bismuth	mg/L	<0.00010	<0.00010	<0.00010
No current guidelines				
Total Dissolved Boron	mg/L	<0.05	<0.05	<0.05
Total Recoverable Boron	mg/L	<0.05	<0.05	<0.05
Boron (MAC)	mg/L	5	5	5
Total Dissolved Cadmium	mg/L	<0.000010	<0.000010	<0.000010
Total Recoverable Cadmium	mg/L	<0.000010	<0.000010	<0.000010
Cadmium (MAC)	mg/L	0.005	0.005	0.005
Total Dissolved Calcium	mg/L	4.38	5.84	5.86
Total Recoverable Calcium	mg/L	4.44	6.02	5.81
No current guidelines				
Total Dissolved Chromium	mg/L	<0.00050	<0.00050	<0.00050
Total Recoverable Chromium	mg/L	<0.00050	0.00057	<0.00050
Chromium (MAC)	mg/L	0.05	0.05	0.05
Total Dissolved Cobalt	mg/L	<0.00010	<0.00010	<0.00010
Total Recoverable Cobalt	mg/L	<0.00010	0.00011	<0.00010
No current guidelines				
Total Dissolved Copper	mg/L	0.00102	0.00146	0.00079
Total Recoverable Copper	mg/L	0.00115	0.00173	0.00092
Copper (AO)	mg/L	2	2	2
Total Dissolved Iron	mg/L	0.08	0.22	0.08
Total Recoverable Iron	mg/L	0.12	0.30	0.14
Iron (AO)	mg/L	0.3	0.3	0.3
Total Dissolved Lead	mg/L	<0.00020	<0.00020	<0.00020
Total Recoverable Lead	mg/L	<0.00020	<0.00020	<0.00020
Lead (MAC)	mg/L	0.005	0.005	0.005
Total Dissolved Lithium	mg/L	0.00065	0.00125	0.00046
Total Recoverable Lithium	mg/L	0.00064	0.00132	0.00047
No current guidelines				
Total Dissolved Magnesium	mg/L	1.58	2.59	1.72
Total Recoverable Magnesium	mg/L	1.71	2.91	1.85
No current guidelines				

Appendix D continued– Nutrient Sampling Upland Drinking Water Reservoirs

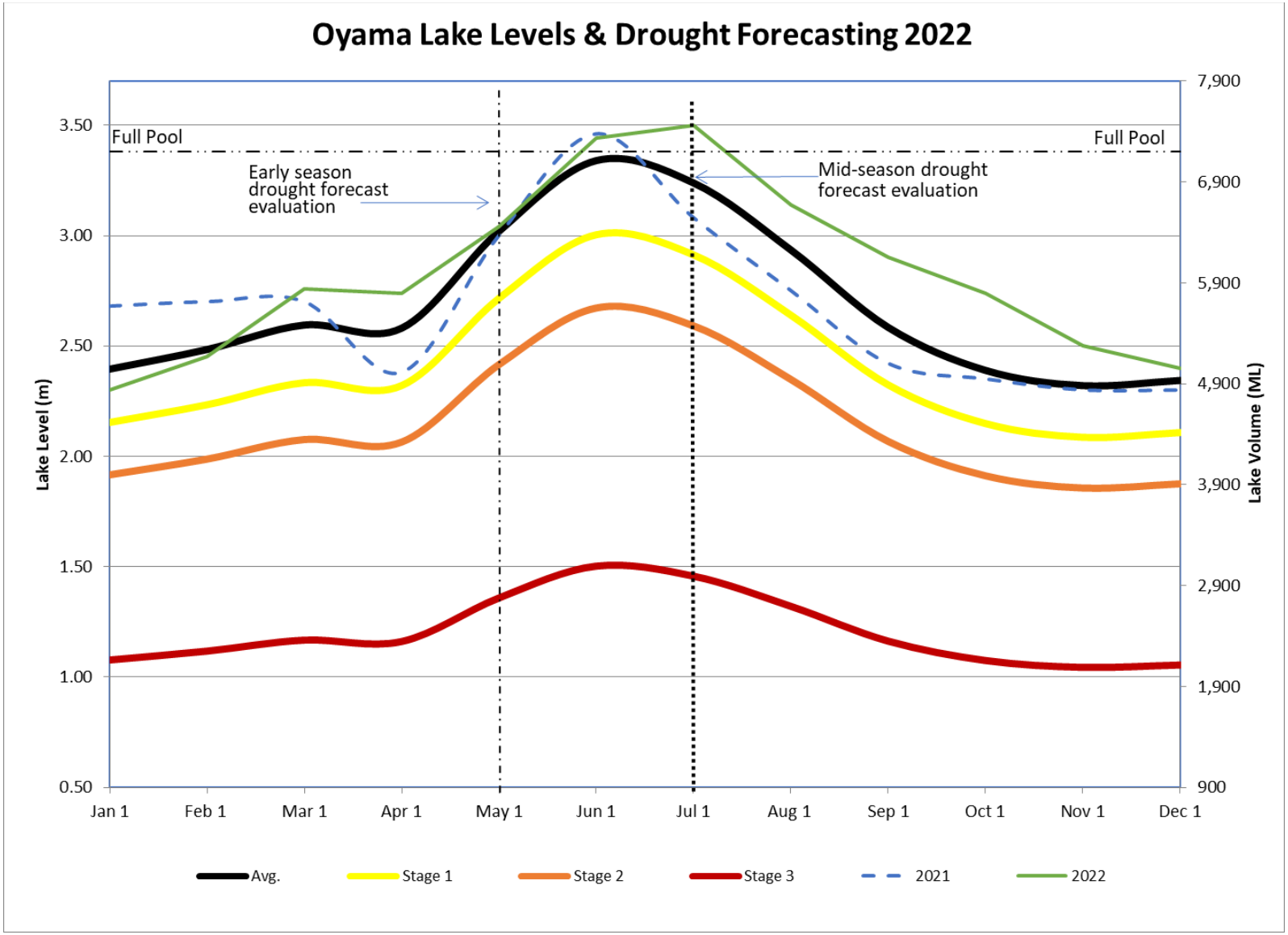
2022 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		21-Oct-22	21-Oct-22	21-Oct-22
Metals Continued				
Total Dissolved Manganese	mg/L	0.00	0.01	0.00
Total Recoverable Manganese	mg/L	0.02	0.02	0.01
Manganese (MAC)	mg/L	0.12	0.12	0.12
Total Dissolved Mercury	mg/L	<0.000040	<0.000040	<0.000040
Total Recoverable Mercury	mg/L	<0.000010	<0.000010	<0.000010
Mercury (MAC)	mg/L	0.001	0.001	0.001
Total Dissolved Molybdenum	mg/L	0.00013	0.00017	0.00017
Total Recoverable Molybdenum	mg/L	0.00013	0.00019	0.00017
No current guidelines				
Total Dissolved Nickel	mg/L	0.00107	0.00200	0.00061
Total Recoverable Nickel	mg/L	0.00110	0.00230	0.00073
No current guidelines				
Total Dissolved Phosphorus	mg/L	<0.05	<0.05	<0.05
Total Recoverable Phosphorus	mg/L	<0.05	<0.05	<0.05
No current guidelines				
Total Dissolved Potassium	mg/L	0.96	1.38	0.83
Total Recoverable Potassium	mg/L	1.04	1.51	0.88
No current guidelines				
Total Dissolved Selenium	mg/L	<0.00050	<0.00050	0.00050
Total Recoverable Selenium	mg/L	<0.00050	<0.00050	<0.00050
Selenium (MAC)	mg/L	0.05	0.05	0.05
Total Dissolved Silicon	mg/L	2.70	5.60	3.40
Total Recoverable Silicon	mg/L	3.00	6.40	3.70
No current guidelines				
Total Dissolved Silver	mg/L	<0.000050	<0.000050	<0.000050
Total Recoverable Silver	mg/L	<0.000050	<0.000050	<0.000050
No current guidelines				
Total Dissolved Sodium	mg/L	1.97	2.42	1.93
Total Reocoverable Sodium	mg/L	2.19	2.71	2.16
Sodium (AO)	mg/L	200	200	200
Total Dissolved Strontium	mg/L	0.03	0.04	0.04
Total Recoverable Strontium	mg/L	0.03	0.04	0.04
No current guidelines				
Total Dissolved Sulfur	mg/L	<3.00	<3.00	<3.00
Total Recoverable Sulfur	mg/L	<3.00	<3.00	<3.00
No current guidelines				
Total Dissolved Tellurium	mg/L	<0.00050	<0.00050	<0.00050
Total Recoverable Tellerium	mg/L	<0.00050	<0.00050	<0.00050
No current guidelines				
Total Dissolved Thallium	mg/L	<0.000020	<0.000020	<0.000020
Total Recoverable Thallium	mg/L	<0.000020	<0.000020	<0.000020
No current guidelines				

Appendix D continued– Nutrient Sampling Upland Drinking Water Reservoirs

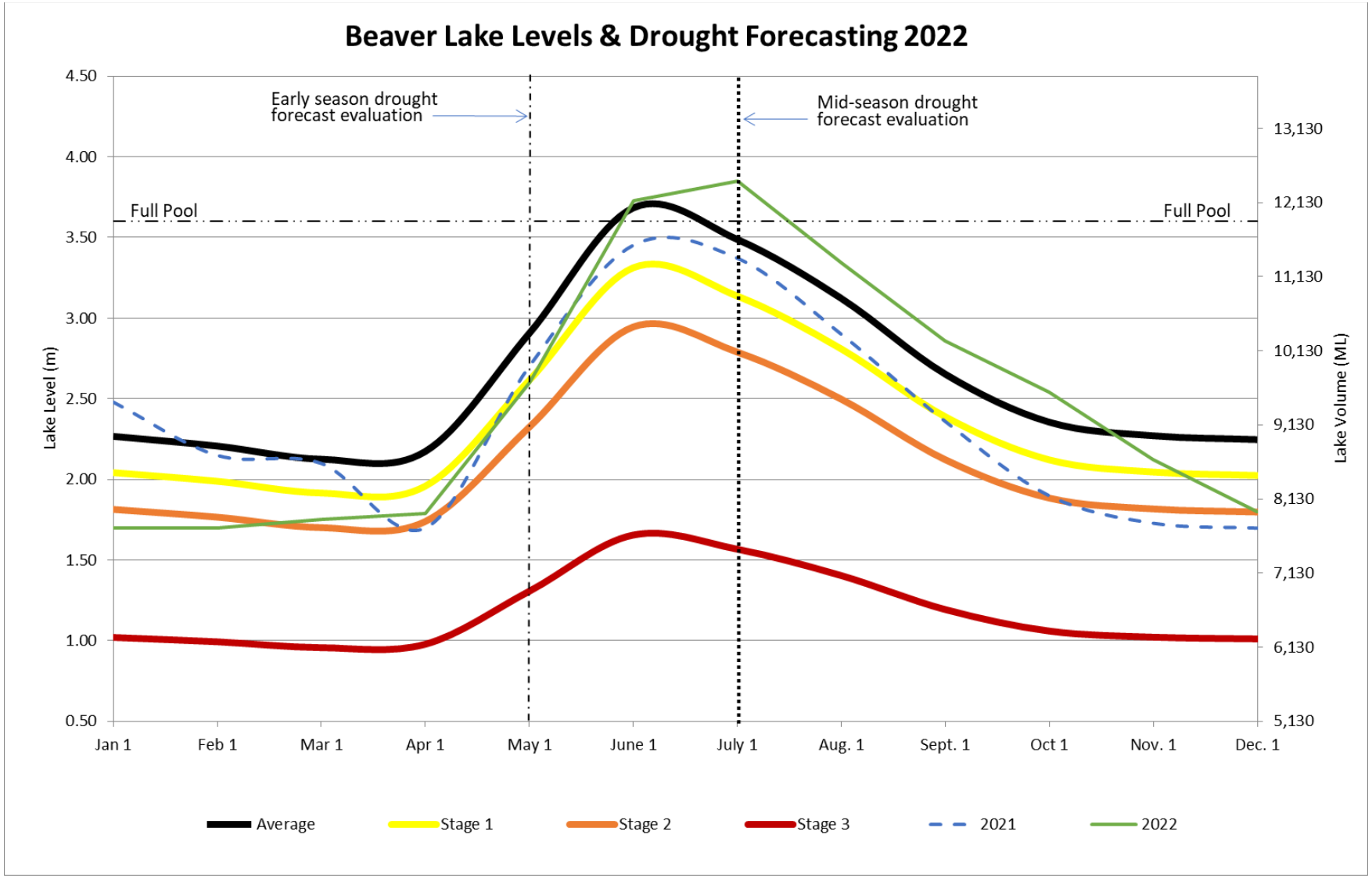
2022 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		21-Oct-22	21-Oct-22	21-Oct-22
Metals Continued				
Total Dissolved Thorium	mg/L	<0.00010	<0.00010	<0.00010
Total Recoverable Thorium	mg/L	<0.00010	<0.00010	<0.00010
No current guidelines				
Total Dissolved Tin	mg/L	<0.00020	<0.00020	<0.00020
Total Recoverable Tin	mg/L	<0.00020	<0.00020	<0.00020
No current guidelines				
Total Dissolved Titanium	mg/L	<0.01	<0.01	<0.01
Total Recoverable Titanium	mg/L	<0.01	<0.01	<0.01
No current guidelines				
Total Dissolved Uranium	mg/L	0.000032	0.000095	0.000027
Total Recoverable Uranium	mg/L	0.000034	0.000109	0.000030
Uranium (MAC)	mg/L	0.02	0.02	0.02
Total Dissolved Vanadium	mg/L	<0.00500	<0.00500	<0.00500
Total Recoverable Vanadium	mg/L	<0.00500	<0.00500	<0.00500
No current guidelines				
Total Dissolved Zinc	mg/L	<0.0040	<0.4000	<0.0040
Total Recoverable Zinc	mg/L	<0.0040	<0.0040	<0.0040
Zinc (AO)	mg/L	5	5	5
Total Dissolved Zirconium	mg/L	0.00057	0.00152	0.00056
Total Recoverable Zirconium	mg/L	0.00054	0.00139	0.00052
Zirconium (MAC)	mg/L			

Glossary of Terms, GCDWQ:	
<	Less than. Reported when result is less than the reported detection limit
≤	Less than or equal to. Reported when result is less or equal to the reported detection limit
AO	Aesthetic objective. Refer to GCDWQ
MAC	Maximum acceptable concentration. Refer to GCDWQ
OG	Operational guidance values. Refer to GCDWQ
TCU	True color unit. Color referenced against a platinum cobalt standard
NTU	Nephelometric turbidity unit
uS/cm	Microsiemens per centimeter
Hardness	The degree of hardness of drinking water may be classified in terms of its calcium carbonate concentration as follows: soft, 0 to <60 mg/L; medium hard , 60 to <120 mg/L; hard, 120 to < 180 mg/L; and very hard, 180 mg/L and above.

Appendix E – Drought Forecast for Beaver Lake & Oyama Lake



Appendix E continued – Drought Forecast for Beaver Lake & Oyama Lake



Appendix F – UV system off spec water

The configuration and design of the UV system at Kalamalka Lake does not automatically permit off spec water to pass into the distribution system. In order for this facility to operate outside of validated conditions (i.e., 5% off spec) the system would need to be manually adjusted to bypass the UV reactor setting to operate outside of the spec conditions. This did not occur.

Appendix G – Environmental Operators Certification Program (EOCP)

The EOCP Board of Directors, with the approval of the Ministry of Health, recently changed the water treatment facility definition. As such, since our chlorination facilities are method of *primary disinfection*, to produce potable water, they are now classified as water treatment facilities.

According to the EOCP, primary disinfection can include chlorination and ultraviolet of which we utilize alone or combined in our facilities. With this new definition, Operators are now required to update their certification to include water treatment. With the EOCP and Ministry of Health changing our facility classifications to Water Treatment facilities, Section 12 of the BC Drinking Water Protection Regulation requires that our operators now must now also obtain Water Treatment Certification through the EOCP. All operators now are also required to accumulate operator experience toward Water Distribution and Water Treatment certification.

Name	Certification No.	Level
Mike Mitchell	1839	WD-IV, CH, WT-II
Patti Meger	4838	WT-I, CH, WD-II
Kiel Wilkie	6503	WD-III, CH
Tyler Friedrich	7697	WD-III, WT-I
Mike Kristensen	8344	WD-II, WT-I, CH
Krista Winram	1001349	WD-I, CH
Evan Kemp	8114	WWT-III, WWC-I, CH, WT-II
Kyle Barker	Pending	WD-I
Lorne Hradecki	Pending	WT-I