LAKE COUNTRY
Life. The Okanagan Way.

Water Operations

2020 Annual Report

10150 Bottom Wood Lake Road

Lake Country, British Columbia V4V 2M1

Ph: 250-766-6677 Fax: 250-766-0200

Prepared For:
INTERIOR HEALTH AUTHORITY
1440 – 14th Avenue
Vernon, BC V1B 2T1

Prepared By:

District of Lake Country Utility Department

For further details contact Patti Meger, District of Lake County Water Quality Technician
pmeger@lakecountry.bc.ca

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Water Operations

2020 Overview

The following is intended to inform and summarize 2020 data collections, observations, and work completed by District of Lake Country staff with regards to water operations and water quality.

Water operations highlights include:

- Camp Road, Floral Court, and Coral Beach Road watermain improvements
- Upgrades to the Supervisory Control and Data Acquisition (SCADA) system.
- Okanagan Lake Pump Station and UV Treatment system
- Ponderosa Pumphouse demolition
- Automated Weather Station (Oyama Lake)
- HACH Wims (Water Information management system)

System Descriptions and Classification

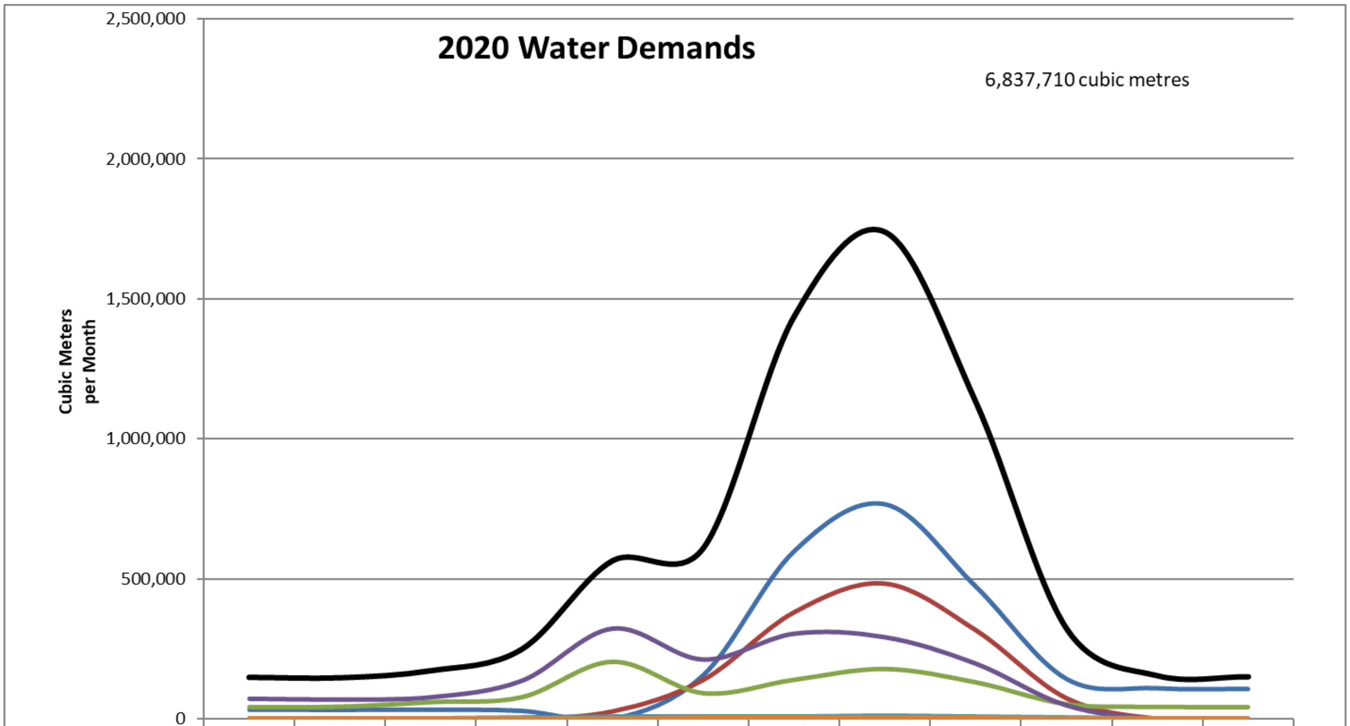
The District of Lake Country (DLC) is a growing municipality with an approximate population of 14,000 people. Not all 14,000 residents are connected to the DLC's public water systems. The primary upland sources used by the DLC include Beaver Lake, Crooked Lake, Oyama Lake, and Damer Lake. The lower elevation 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, 4 pressure boosting stations, 37 pressure reducing stations, 81 pressure reducing valves, more than 500 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 use among the sources and water systems in 2020 was 6,837,710 cubic meters (see Figure 1 for water consumption by source). Water demands in 2020 were the lowest in the previous decade. The DLC largely attributes this to the universal metering program, and a wetter than normal July..

Each spring, Beaver and Oyama Lake have increased turbidity in the water from spring freshet. Due to the increased turbidity, DLC will supplement the Beaver and Oyama Lake sources with Okanagan and Kalamalka Lake water. This operational change can lead to increased demands on these sources.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	149,427	147,761	173,142	249,448	566,087	611,015	1,438,605	1,740,339	1,132,619	322,661	155,111	151,495
Beaver Lake	32,851	32,167	32,843	28,710	0	156,862	599,505	767,681	474,006	143,221	109,572	106,886
Oyama Creek	0	0	0	0	26,005	138,518	379,470	481,762	316,044	73,079	0	0
Kalamalka Lake	42,153	43,661	60,053	78,025	205,509	92,390	140,537	179,414	131,629	52,944	43,033	41,998
Okanagan Lake	72,324	69,678	77,616	136,710	323,694	212,562	305,172	292,824	198,450	48,510	0	0
Lake Pine	1,481	1,468	1,665	4,443	7,788	6,820	8,973	13,195	8,368	3,481	1,717	2,124
Coral Beach	618	787	965	1,560	3,091	3,863	4,948	5,463	4,122	1,426	789	487

Figure 1 . *2020 DLC water demands from each source reported as cubic meters per month.*

Zero demand on the Oyama lake source is due to the DLC supplementing the Oyama lake source with the Kalamalka lake source in low consumption months.

Zero demand for Okanagan lake source is due to the switchover to Beaver source for upgrades to the Okanagan chlorination facility and uv treatment.

Zero demands for Beaver Lake Source in May due to switchover to Okanagan Lake source during Spring freshet.

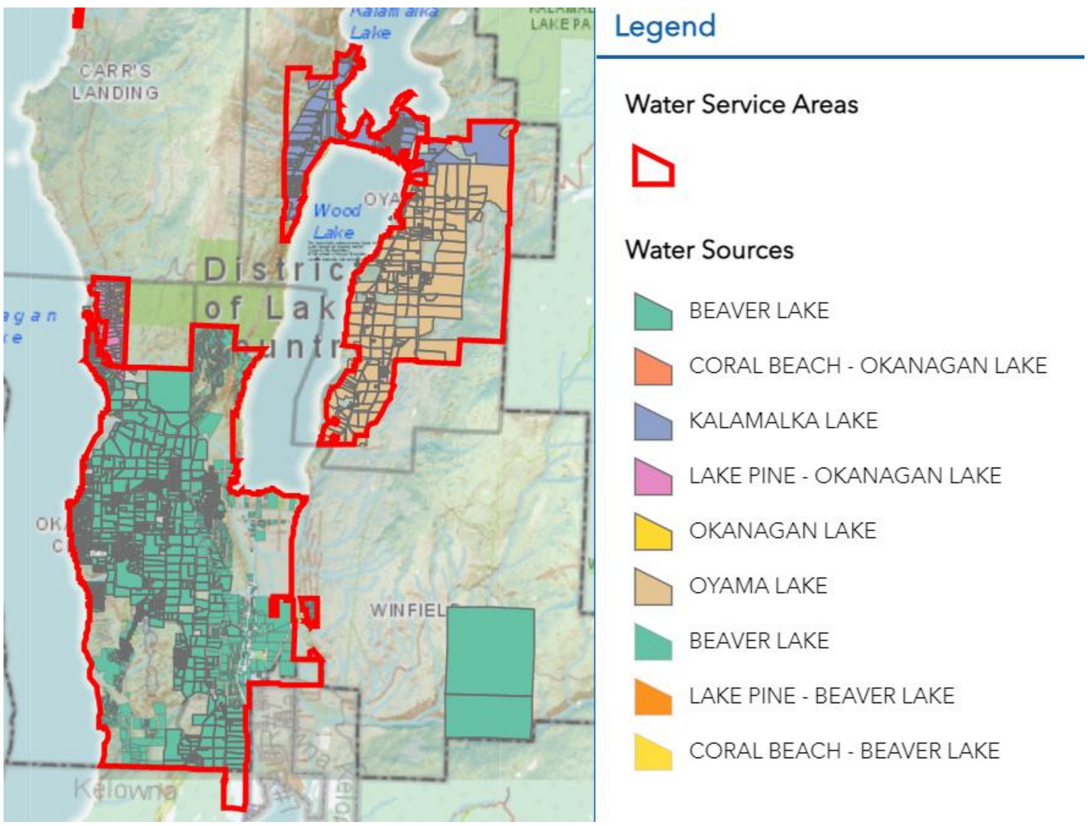
Water Sources

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.



Left: Crooked Lake dam spillway ***Right: Oyama Lake dam spillway.***

Left: Eldorado drinking water reservoir ***Right: Vernon Creek Intake***

***See Appendix E & F for 2020 Oyama and Beaver Lake level and Discharge* and Drought Management Graphs**

2020 Snowpack

The Oyama Lake snowpack for 2020 was above average. As seen in Figure 1, the end of March measurement was 50% above average. To see the historical snow survey data for Oyama Lake please visit the *BC River Forecast Centers website*, under the 2020 (PDF), number 2F19.

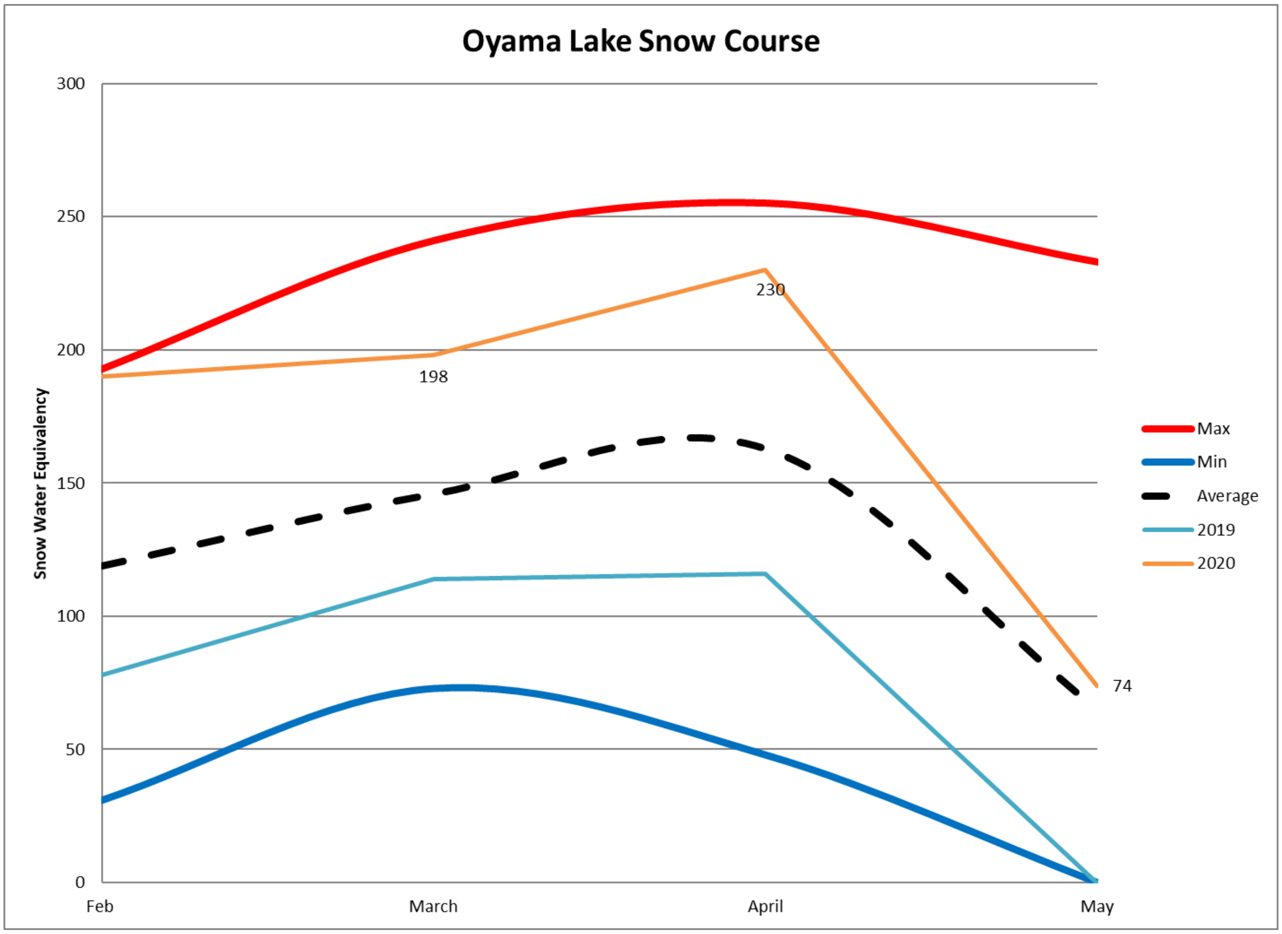


Figure 2. *2020 Oyama Lake Snowpack*

2020 Freshet

Using the information from the snow course we were able to monitor and anticipate a higher-than-average yield from the snowpack. District staff released water from the upland lakes to accommodate the increase of runoff from the spring freshet. This allowed the lakes to fill over a longer period of time and can lessen the risk of flooding. Beaver and Oyama Lake filled and overflowed, but due to the corrective measures taken by staff to lower the reservoirs prior, abnormally large flows were not noted in either Oyama Creek or Upper Vernon Creek..

Cross Connection Control Program (CCCP)

Testing of known or required backflow prevention devises occurs in compliance with CSA Standard B64.10-11/B64.10.1-11 and amendments thereto. All new construction and new business are required to meet or exceed DLC regulations related to Cross Connection Control. In 2019, an assessment of all existing businesses was initiated, and on-site inspections are occurring as needed. The inspections are not substantially complete, and the District is looking to implement any of the required improvements.

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
- Maintain and clean all reservoir, chlorination, and pumping facilities.
- Water main flushing
- Air valve maintenance
- Pressure reducing valve maintenance
- Hydrant maintenance
- Line valve maintenance
- Main line leak repairs
- Seasonal irrigation turn on & off
- Respond to customer complaints and inquiries
- Cross connection control assembly testing

Dam Inspections

Inspections of Upland Dams (Beaver, Crooked, Oyama, and Damer) are completed by the DLC weekly when the water levels are normal. Increased inspections occur when water levels are high.

Reservoir Cleaning

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.

DLC staff drained, cleaned, and inspected the Coral Beach reservoir, the Lower Lakes Reservoir, top cells at the Upper Lakes Reservoir, and the one cell at the upper Lake Pine reservoir. There were no issues of note at any of the reservoirs cleaned.

In December 2019, one of our operators noticed a leak in the north cell of the Upper Lakes Reservoir. The cell was drained immediately, and concrete repairs commenced in early 2020. Upon completion of the repair, the reservoir was cleaned and put back into service.

Emergency Response Plan

The DLC has an Emergency Response Plan that is updated annually (or more often as required). This report is seperate from the Annual Water Operations Report. Both the Emergeny Response Plan and Annual Water Operations Report are provided to IHA annually.

2020 Operations Project Highlights

Water Distribution Upgrades

In 2020 the District continued efforts to replace aging water distribution infrastructure.

Key projects associated with this work include:

- Coral Beach Rd - 150 meters of galvanized steel watermain replaced with 100mm C900 PVC pipe.
- Camp Rd – decommissioned 100mm AC watermain
- Floral Court – 50 meters of galvanized steel watermain replaced with 100mm C900 PVC pipe.

Upgrades to the Districts 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 District's water facilities.

In 2018 a number of facilities were noted to have either outdated or obsolete equipment. In 2019 upgrades to the SCADA system were initiated and are expected to be complete by 2022.

Okanagan Lake Pump Station and UV Treatment System

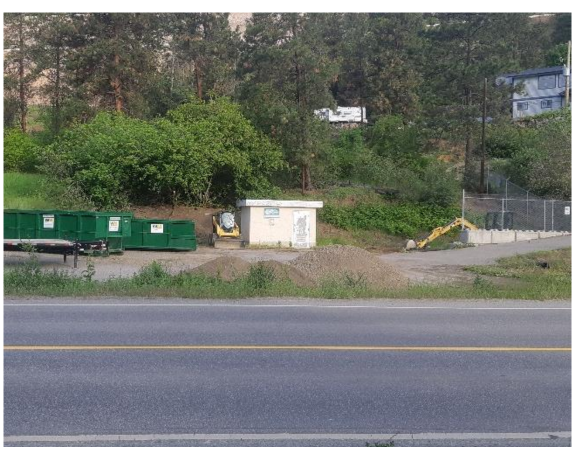
In April 2020, construction began on the Okanagan Lake Pump station and UV treatment building. The Okanagan Lake Pump Station and Treatment System project is comprised of two main components; retrofit upgrades to the existing Pump Station (located in the lower Lakestone subdivision beside Okanagan Lake), and the construction of a new UV treatment facility on Okanagan Center Road West. The project provides a water system upgrade that will improve reliability and supply capacity for the residents connected to the Districts Okanagan Lake source. This project is expected to be complete in early May 2021.

New UV building under construction.

For information about the required switch over of Okanagan Lake source to the Beaver Lake source, See the *Water Quality Advisory and Boil Water Notice* section of this Annual Report.

Ponderosa Pumphouse Demolition

In April 2020, the District Utilites crew removed the old pumphouse on the intersection of Pelmewash Parkway and Ponderosa Drive. This water system facility became obsolete in 2007 and was decommissioned in 2010.



Before and after Pumphouse demolition

Automated Snow Course Installation

Throughout 2020, the District of Lake Country worked with the Snow Survey Program Coordinator from the BC Ministry of Environment and Climate Change Strategy to have an automated weather station installed at Oyama Lake. Last fall the automated weather station was installed adjacent to the Oyama Lake manual snow course. The newly installed weather station transmits hourly data via satellite and records relative humidity, ambient temperature, snow depth, and snow water equivalents. This real time data is collected and tracked by the Province and can now be accessed online. The data is used by the District to help determine water availability in that specific area of the watershed and can help project potential flooding issues the District may face during spring freshet.

Oyama Lake Automated snow course

Verifying the collected data from the automated weather station will take approximately three years. Once data is validated the manual process which dates back to 1969, can be phased out. Implementation of the automated weather station will reduce the need for District staff to travel to the upper elevation watershed during winter months, reducing safety concerns. The technology is not new as automated weather stations are already being used in the region. Mission Creek, Brenda Mines and Silverstar have implemented similar technology.

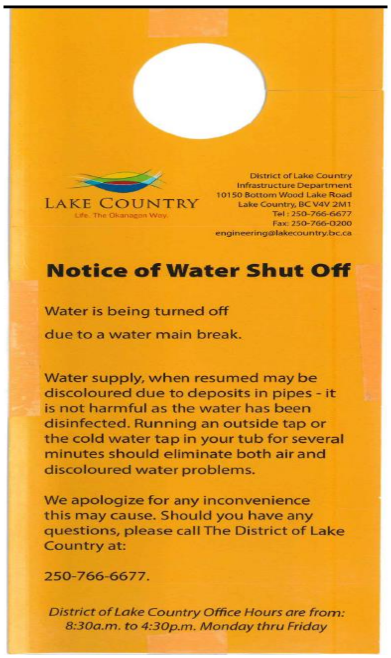
HACH WIMS

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 better help staff analyze information more efficiently.

Service Disruptions

Under normal operating conditions many water utilities frequently experience minor disruptions due to various reasons such as repairs to leaks, water main breaks, seized valves or installation of new infrastructure. In 2020 water operations crew responded to 493 service requests including 3 service repairs and 8 main breaks.

All repairs in 2020 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 an interruption in water distribution services, the DLC reports the event to Interior Health Authority (IHA), the appropriate corrective action is taken to protect public health, and it is documented in the Monthly Water Quality Reports under *Notable Events*.



Except for an emergency repair or break, customers are provided advanced notice. When this is not possible, customers in the affected area are advised and notifications are left on the doors of the residents.

WATER QUALITY

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 BC Drinking water objectives provide an overview of the *framework towards achieving goals for drinking water treatment of pathogens in surface water supply systems in BC and for a general reference for assessing progress towards updating or improving existing water supply systems*. This general overview was developed using the BC's Drinking Water Protection Act, the Drinking Water Protection Regulation, and objectives in the *Guidelines for Canadian Drinking Water Quality* (GCDWQ). It will be used as a general reference for assessing progress towards updating or improving existing water supply systems. 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)*

All water suppliers serving populations greater than 500 people 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 at this time are chlorination only and do not have 3-log (99.9 percent) inactivation and/or removal of Cryptosporidium. *Most Protozoa are free-living organisms that can reside in fresh water and pose no risk to human health. Some enteric protozoa, such as Giardia and Cryptosporidium, are pathogenic and have been associated with drinking water related outbreaks. The health effects associated with exposure to Giardia and Cryptosporidium, like those of other pathogens, depend upon features of the host, pathogen and environment. The host's immune status, the (oo)cyst's infectivity and the degree of exposure are all key determinants of infection and illness. Infection with Giardia or Cryptosporidium can result in both acute and chronic health effects.*(Page 2: Guidelines for Canadian Drinking Water Quality: Guideline Technical Document - Enteric Protozoa: Giardia and Cryptosporidium). 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.

The 2012 Water Master Plan is under revision and can be accessed on the District's website. Public engagement on the revised plan is solicited and encouraged throughout the process. Subscribe to District news to ensure you are notified of engagement

In June 2019 the Provincial Health Officer submitted a report on Clean, Safe, and Reliable Drinking Water: An Update on Drinking Water Protection in BC and the Action Plan for Safe Drinking water in British Columbia, for the years 2012/2013 to 2016/2017 (PHO 2019 Report) to the BC Mister of Health. It provides a comprehensive assessment of the framework, multi-barrier approach, and quality management required to supply water. The recommendations identified many challenges for all water suppliers

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In July 2019 the office of the Auditor General of BC (AG 2019 Report) released their independent Audit on The Protection of Drinking Water. This review provides recommendations for the Provincial Health Officer (PHO) and the PHO 2019 Report including the need for leadership and coordination of the many Ministries involved and the need for integration of the Ministries with local governments to ensure sustainable drinking water.

The DLC recognizes that implementing all recommendations in the PHO 2019 Report requires resources both financially and through an integrative and coordinated plan with the Province (including all key Ministries), Health Authorities, and local government. As the Province and Ministry of Health work towards this integrative management, the DLC remains committed to working with our Local Health Authority and each of the various Ministries involved to provide safe, secure and accessible drinking water for our community.

In June 2017, IHA released a report as part of public awareness campaign called Drinking Water in Interior Health. It is an "Assessment of Drinking Water Systems, Risks to Public Health, and Recommendations for Improvement." (January 2017). The Chief Medical Health officer, Dr. Corneil, advises that "This report should be viewed as an opportunity to renew and rejuvenate conversations between drinking water officers, water supply managers, municipal leaders, and members of the community," and is "An opportunity to ensure we are moving forward, together, towards a common goal: access to clean, safe, and reliable tap water for all people at all times."

For the DLC we will continue our communications with IHA as we work towards achieving goals in our Water Master Plan and look forward to learning more about IHA's public awareness campaign. Currently IHA has developed a series of educational videos providing information on how the water systems work, how water is treated, and what safety issues the community should be aware of.

Water Quality Testing

This section provides a review of the water quality testing performed in 2020 for the District of Lake Country's (DLC) water sources. Overall water chemistry and bacteriological results show that the majority of samples meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ); however, some parameters exceeded the maximum acceptable concentrations.

Vernon Creek covered in snow.

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 GCDWQ for colour and turbidity. Both Oyama and Beaver lake sources had total annual disinfectant by-product averages (Trihalomethanes (THM) and Haloacetic Acids (HAA)) that exceeded the Guidelines for Canadian Drinking Water Quality (GCDWQ). Again, this year the Lake Pine system, Okanagan Lake source narrowly exceeded the THM guidelines by 0.07mg/L.

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. The DLC is working towards treatment (as outlined in our Water Master Plan) and at present, our primary form of disinfection is chlorination on all DLC water sources with secondary ultraviolet disinfection on the Kalamalka Lake source.

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).

Chlorine is the disinfectant used for all DLC water sources. Free and total chlorine are measured to ensure a residual is maintained throughout the distribution systems. The Kalamalka Lake source also utilizes ultraviolet water treatment radiation as a secondary form of disinfection. Ultraviolet operations log sheets are contained in Appendix G.

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.

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.

Temperature and pH affect the strength of the disinfectant. 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 CDWQG .

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. There is no GCDWQ for apparent colour however the aesthetic objective in 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 quality results are in tables 5 -10 below for District of Lake Country Water Systems. The list of sample sites for each distribution system is in Appendix B.

Beaver Lake Source

Table 1. *2020 Annual Distribution Water Chemistry Results: District of Lake Country 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.*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.02	0.22	0.42	3	6.5	69
MAX	3.40	2.90	3.02	18	8.2	296
AVERAGE	1.04	1.14	0.90	10	7.0	98
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

Okanagan Lake Source

Table 2. *2020 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). Note: October 14th this source offline - switched to Beaver Lake Source*

On-line Water chemistry equipment at Glenmore Booster Station

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.25	0.38	0.22	5	7.7	267
MAX	3.40	2.70	0.70	18	8.3	327
AVERAGE	1.03	1.18	0.43	9	8.0	294
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

Oyama Lake Source

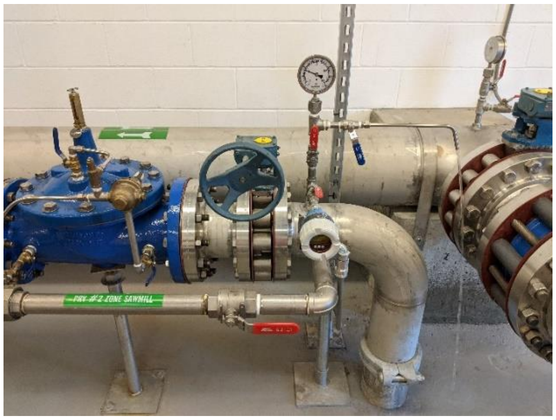
Table 3. *2020 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Oyama Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). Occasionally the distribution water sampled is a mixture of both sources (Oyama Lake and Kalamalka Lake) and variation from the norm occurs within the data. Oyama water source is online approximately mid-May through mid-October (mixing of sources in the Oyama reservoir occurs for a short time following the switch).*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.95	1.10	0.53	7	6.0	51
MAX	4.06	4.18	2.27	20	8.2	402
AVERAGE	2.45	2.75	1.22	14	6.6	93
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15 AO***	***7.0-10.5 OG***	

Kalamalka Lake Source

Table 4*. 2020 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Kalamalka 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 (i.e. Kalamalka Lake water in Oyama distribution lines and not the reverse).*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.13	0.35	0.22	4	7.5	259
MAX	2.48	3.14	1.80	16	8.4	416
AVERAGE	1.26	1.51	0.73	9	8.1	399
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15 AO***	***7.0-10.5 OG***	



New water sample site for Kalamalka Lake source at Sawmill Booster Station.

Coral Beach Water System

Table 5. *2020 Annual Distribution Water Chemistry Results: Coral Beach Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.20	0.38	0.22	5	7.6	222
MAX	3.08	3.28	0.88	17	8.3	490
AVERAGE	1.26	1.47	0.45	10	8.0	306
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

New water chemistry equipment (residual chlorine and turbidity meters) at Coral Beach chlorination Facility

Lake Pine Water System

Table 6. *2020 Annual Distribution Water Chemistry Results: Lake Pine Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.13	0.19	0.19	4	7.2	274
MAX	3.18	3.18	0.96	18	8.3	245
AVERAGE	1.19	1.34	0.39	10	7.9	216
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

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. The last circumstance is only applicable to the Districts Beaver/Okanagan Lake sources and Oyama/Kalamalka Lake sources. Under normal operating procedures Beaver Lake and Okanagan Lake sources do not mix. However, should Beaver Lake source water experience an undesirable water quality event (i.e. high turbidity that usually occurs during freshet), and if the system demands are within an operational range, we will supplement or switch Beaver Lake source customers with Okanagan Lake water. Since early February 2013 the Kalamalka Lake source has been the primary supply for customers on the Oyama source during the non-irrigation season (non-irrigation season: approximately October through May). Under normal daily operating conditions, at no times are the Beaver or Oyama sources mixed into Okanagan or Kalamalka source distribution systems. If this were ever to occur it would be under a water emergency with the appropriate Water Quality Advisory Notification issued.

It is not unusual within a distribution system to detect trace levels of free chlorine at dead ends or through low use areas. The Beaver, Okanagan and Coral Beach distribution lines all had at least one sample of less than 0.20 ppm free chlorine. 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. Dependent on the situation responses could include increasing chlorine dosing and/or flushing of the distribution lines. Follow-up sampling confirms residuals and turbidity levels.

In 2017 the GCDWQ changed and the Aesthetic 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 deep-water intakes on Okanagan and Kalamalka were generally within this range. Temperature on all systems fluctuates with changing outdoor ambient temperature and raw water conditions. All systems at some point had at least one sample that was at or above the aesthetic temperature guidelines. Overall annual averages on all systems were well under the 15 degrees guidelines.

Bacteriological Regulations and Results

The DLC in cooperation with the Interior Health Authority, Okanagan Service Area (IHA) has developed a Water Quality Monitoring and Reporting Plan. It includes the criteria set by the Province to ensure standards for the monitoring the delivery of safe drinking water are being met. 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 Lake source an additional measure of ultraviolet (UV) disinfection is used. See Appendix G 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 District of Lake Country 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, Coral Beach and Lake Pine water systems. Results that do not meet the water quality standards in the DWPR, Schedule A **(Table 9)** are immediately reported to the Drinking Water Officer.

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.	MF Raw Water # samples recommended 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	4	2	8	13*
DLC Water System: Okanagan Lake source : Est. Population: 6,000	6	4	2	8	9**
DLC Water System: Oyama Lake source: Est. Population 625	4	4	2	8	5
DLC Water System: Kalamalka Lake source: Est Population 750	4	4	2	8	5
Coral Beach Water System: Okanagan Lake source Est Population 130	4	4	2	8	2
Lake Pine Water System: Okanagan Lake source Est Population 195	4	4	2	8	4**
*includes Camp Rd. Reservoir (offline until 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 Regulations 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 no sample may contain more than 10 total coliforms per 100 ml, and that at least 90% of samples must have no detectable total coliform bacteria in a sample over a 30-day period. As such, initial counts within this regulation are not reportable under our Permit to Operate. 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 2020, 270 MF bacteriological samples were collected and analyzed at Caro Environmental Labs in Kelowna for total coliforms and E.coli. Additionally, 139 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. The P/A tests provide quick feedback on the bacteriological quality of the water during the week that MF samples are not collected. 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.

In 2020 two samples on the Beaver Lake source and one sample on the Kalamalka Lake source were positive for total Coliforms. At the Copper Hill water quality site, total coliforms were detected on two occasions. One positive Presence Absence test was detected at the McCoubrey site. Results were unusual, site specific and not consistent with all other distribution sampling. Although sampling occurred during high wind and rain events it was established that the sampling device was possibly compromised with a defective part and will not be used again until repaired. Re-sampling with a new device returned results consistent with all other results in the distribution system being negative for total coliforms and E. coli. This distribution line was thoroughly flushed the week prior and follow up sampling returned results with no detection of coliforms. The Kalamalka Lake pumphouse sample was resampled the following day after receiving results and returned negative with no detection of coliforms. This sampling location inside the pumping station with high condensation and can be a problem during sample collection. Appendix A contains a summary of the total bacteriological tests collected in each water system and overall.

Water Quality Advisory and Boil Water Notice

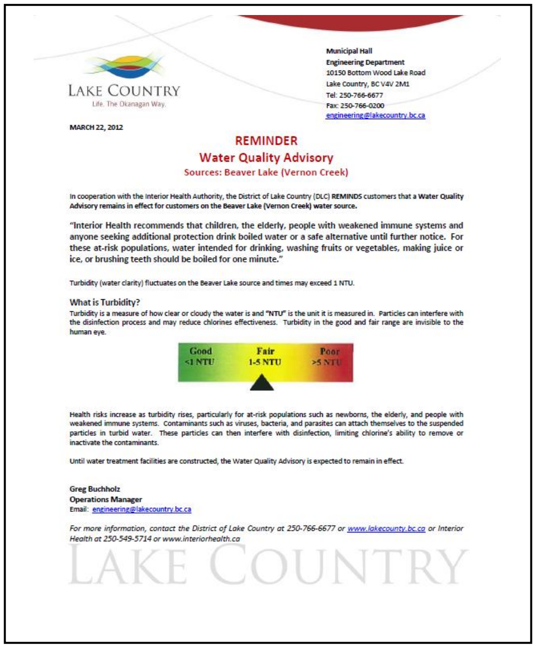
In the spring of 2006 IHA initiated the Turbidity Notification Campaign. To date, IHA maintains the requirement of purveyors to issue a Water Quality Advisory when turbidity exceeds 1 NTU and to contact Interior Health as the turbidity approaches 5 NTU to discuss enhanced notification (i.e. a Boil Water 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 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 2020 were on a **Water Quality Advisory (WQA)**:

- Beaver Lake Water Source , DLC Water System. (Special note: October 14, 2020 – March 2021 Okanagan Lake distribution lines also supplied by Beaver Lake Source water)

- Oyama Lake, DLC Water System. Oyama source Off-line May 4 – October 17 and Kalamalka Lake water supply as primary source with No Water Quality Advisory.

The advisories on Beaver and Oyama Sources are on WQA's due to fluctuating turbidity from our upland drinking water reservoirs . Both WQA's will remain in effect until infrastructure upgrades are made to improve water quality and reliability.



LAKE COUNTRY
Life. The Okanagan Way.

Municipal Hall
Engineering Department
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1
Tel: 250-766-6677
Fax: 250-766-0200
engineering@lakecountry.bc.ca

MARCH 22, 2012

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

In cooperation with the Interior Health Authority, the District of Lake Country (DLC) **REMINDS** customers that a **Water Quality Advisory remains in effect for customers on the Beaver Lake (Vernon Creek) water source.**

"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."

Turbidity (water clarity) fluctuates on the Beaver Lake source and times may exceed 1 NTU.

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.

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

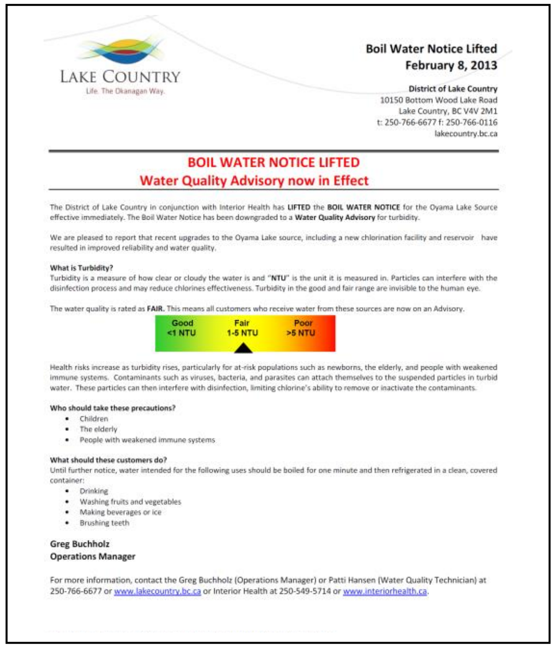
Health risks increase as turbidity rises, particularly for at-risk populations such as newborns, the elderly, and people with weakened immune systems. Contaminants such as viruses, bacteria, and parasites can attach themselves to the suspended particles in turbid water. These particles can then interfere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

Until water treatment facilities are constructed, the Water Quality Advisory is expected to remain in effect.

Greg Buchholz
Operations Manager
Email: engineering@lakecountry.bc.ca

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

LAKE COUNTRY



LAKE COUNTRY
Life. The Okanagan Way.

Boil Water Notice Lifted
February 8, 2013

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 LIFTED
Water Quality Advisory now in Effect

The District of Lake Country in conjunction with Interior Health has **LIFTED** the **BOIL WATER NOTICE** for the Oyama Lake Source effective immediately. The Boil Water Notice has been downgraded to a **Water Quality Advisory** for turbidity.

We are pleased to report that recent upgrades to the Oyama Lake source, including a new chlorination facility and reservoir have resulted in improved reliability and water quality.

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 is rated as **FAIR.** This means all customers who receive water from these sources are now on an Advisory.

Good	Fair	Poor
<1 NTU	1-5 NTU	>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

Greg Buchholz
Operations Manager

For more information, contact the Greg Buchholz (Operations Manager) or Patti Hansen (Water Quality Technician) at 250-766-6677 or www.lakecountry.bc.ca or Interior Health at 250-549-5714 or www.interiorhealth.ca.

Notice to customers on the Oyama and Beaver sources as to when their water supplies will be switched over or supplemented with an alternate water source of better water quality does not occur. The DLC will continue to supply customers with the best water quality possible and normal operations includes the switching and supplementation of alternate sources to optimize water quality. In a situation where there is a higher water quality deviation event, such as a Boil Water Notice, customers would be notified as per the Interior Health Authority (IHA) approved Potable Water Supply Emergency Response Plan for the DLC.

Okanagan Lake Switch Over and WQA in Place

Detailed information below and more was provided to our customers via Canada Post, social media.

The District of Lake Country water utility supplies Okanagan Lake source water to 2800 properties from the Okanagan Lake Pumphouse. The pumphouse was originally built in 1968 for the Hiram-Walker Distillery and Okanagan Lake became a water source for the District in 1994 through the acquisition of intake infrastructure and a water license from the Hiram-Walker Distilleries. The Okanagan Lake pumphouse is being upgraded in 2020/21 to increase pumping capacity, add a new ultraviolet treatment system and replace the existing chlorine disinfection system, in addition to electrical upgrades required.

Water quality is strictly regulated through Interior Health Authority and the District of Lake Country takes the provision of drinking water to the community very seriously.

Beginning October 14th water supplied to the 2,800 properties was supplied from the District's Beaver Lake water source. Residents interested in knowing more about the water quality from the Beaver Lake source and impacts of the Okanagan Lake Pumphouse upgrade project are encouraged to read through the Q&A on the Districts Web site: https://www.lakecountry.bc.ca/en/living-in-our-community/water-switchover-faq.aspx.

DLC web link for projects: Okanagan Lake Pump House Upgrades and UV Treatment Facility

Throughout this event numerous calls and emails were returned, social media comments responded to and DLC Web continued to report and support various questions arising in the community. The DLC'S Switch over Q & A site is a valuable resource and well received with 365 unique page views throughout this event until the end of 2020. If there are additional questions to be answered in regards to the switchover our communications team is available at communications@lakecountry.bc.ca .

2020 notable water quality events:

In February a letter of notice delivered to each Coral Beach Resident to notify of a malfunction in the chlorine dosage system on this Water system, which caused higher than normal chlorine residual.

District staff responded immediately to mitigate the situation flushing the entire system and testing for chlorine. It was believed very little high chlorinated water entered the system. Additional mechanical operation upgrades were completed on the chlorination system to reduce potential of future mechanical system failures. The DLC is currently looking at an extensive servicing strategy for the overall Carrs Landing area as part of the Water Master Plan update.

This year was a season with heavy rains and storm events from the spring through to mid July. Beaver and Oyama drinking water reservoirs had high water levels and we did not utilize storage until mid-July. This lead to prolonged high colour with water sourced from the high elevation lakes that lasted well into the late summer. Many citizens took time to communicate their opinion about this yellow colour to the DLC. Lower elevation lakes also experienced high water levels that along with the storms and cumulative impacts from previous years' flooding add to the effect on the physical and biological processes in and around our lakes. Lower elevation lakes experienced increased turbidity at various times throughout the summer. As well we noticed an increase in productivity (ie the rate at which organic matter is produced; related to amount of nutrients available) on the Kalamalka lake source as was evident by the higher than normal levels of algae. This site was closely watched and regularly sampled. Moderate algae counts were detected, typical for the time of year, unlike the North end of Kalamalka Lake where samples showed elevated counts. Beaver Lake source (Eldorado balancing reservoir) also experienced a mild algae bloom, both were closely watched and analysis determined they were not excessive or required further action during the monitoring of these events.

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. The majority of 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 District has recently initiated HAA's sampling and will present graphs in the following annual report once adequate data has been collected.

2020 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 are displayed as a running average in the table below and will be graphed following another year of data collection.

Table 10 . Haloacitic Acids for all water sources 2019 and 2020.

	2019	2020
Source	Total Haloacetic Acids mg/L	Total Haloacetic Acids mg/L
Beaver lake	**0.2340**	**0.298**
Okanagan Lake	0.04528	0.048225
Okanagan Lake (Coral Beach)	0.03943	0.0368
Okanagan Lake (Lake Pine)	0.0510	0.06895
Oyama Creek	**0.1080**	**0.3215**
Kalamalka Lake	0.03637	0.035867
WQ Guidelines (MAC) mg/L	**0.08**	**0.08**

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. *(GCDWQ)*

The DLC follows the *GCDWQ* for HAA's and THM's with a minimum quarterly monitoring samples taken at intermediary sites as well as on large water systems (Oyama, Beaver and Okanagan), at a point in the distribution system with the highest THM formation potential. These sites are represented in areas of the distribution system with the longest disinfectant retention time, which are located at the far end of the distribution system.

2020 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). Additionally, the Lake Pine Water System (Okanagan Lake source), narrowly exceeded the guideline again this year by 0.07mg/L (based on MAC of 1.0 mg/L). All THM results displayed as a running average are detailed in Figures 3-8 **.**

Figure 3. DLC Beaver lake source trihalomethane (THM) data collected 2002 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). *2002 and 2003 data limited to one sample date.

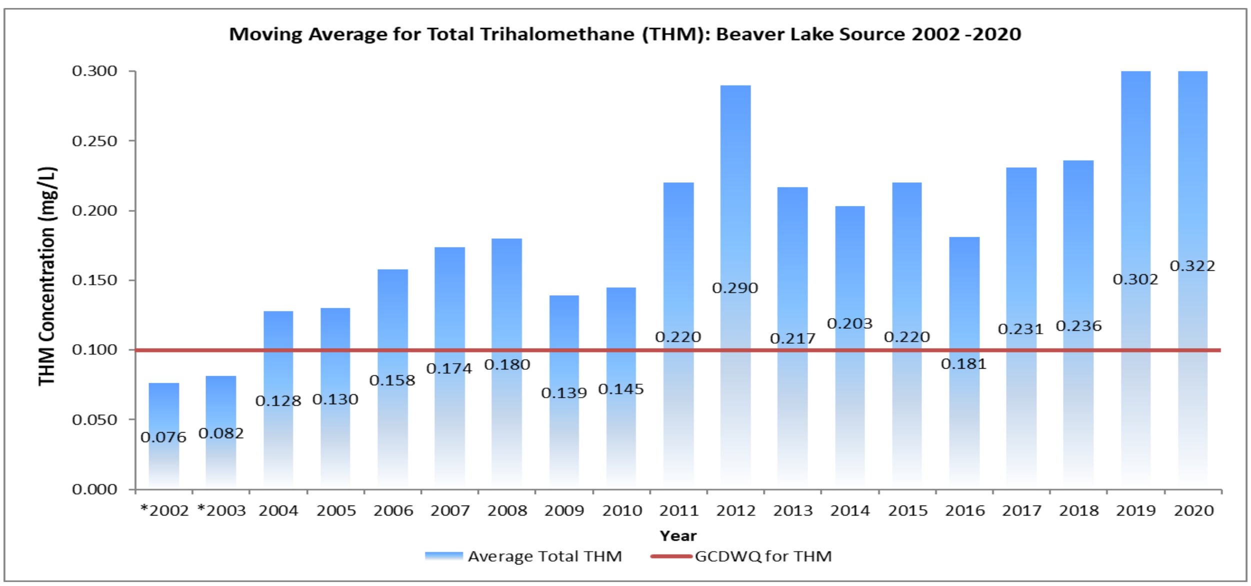


Figure 4. DLC Oyama Lake source trihalomethane (THM) data collected 2004 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Sampling of Oyama source occurs only during irrigation season (approximately May – October) due to Kalamalka source in distribution lines during non-irrigation season. *2016 and 2017 limited to one sample date.

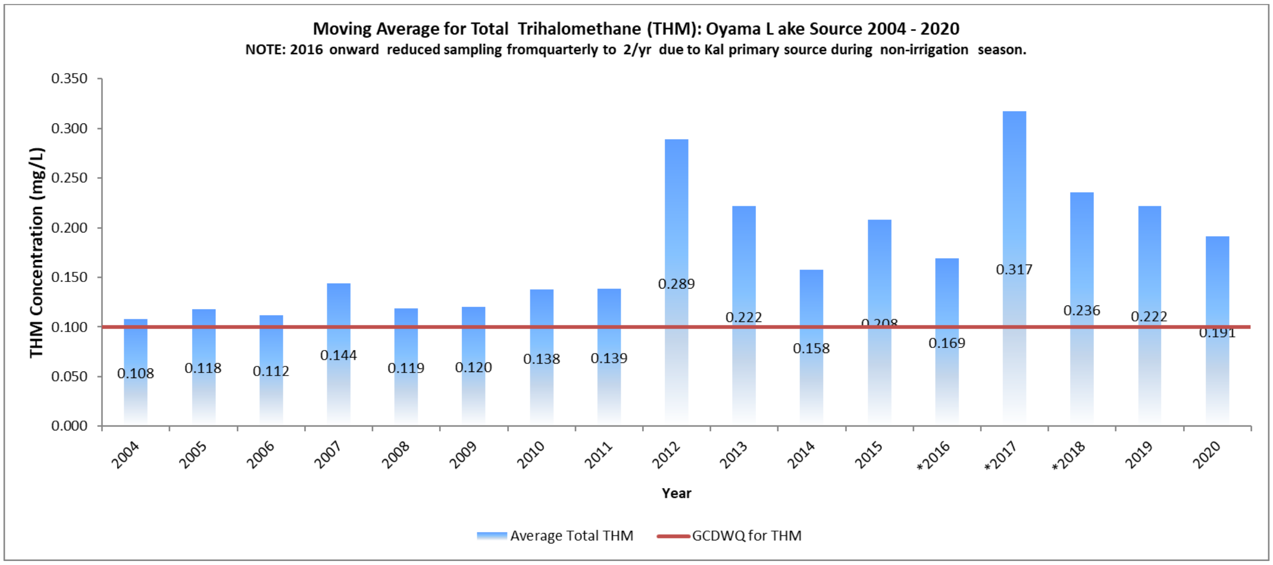


Figure 5. DLC Kalamalka lake source trihalomethane (THM) data collected 2006 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Kalamalka sampling includes sites within Oyama distribution lines during non-irrigation season (approximately October – May).

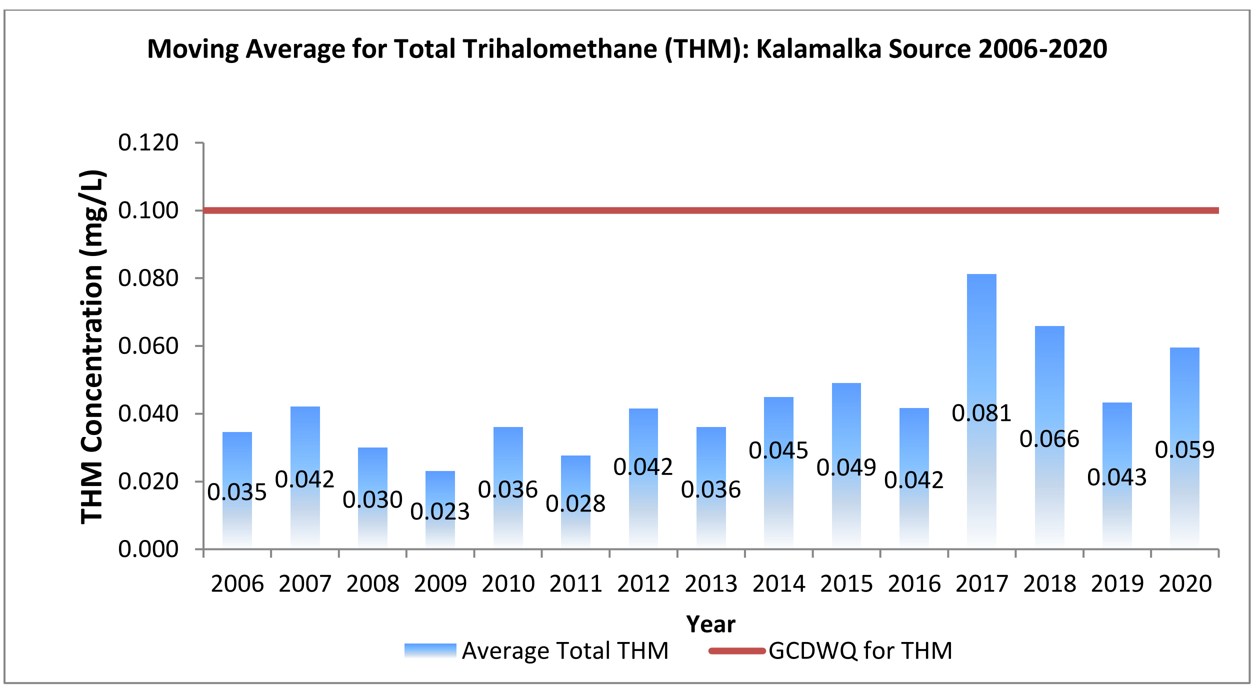


Figure 6. DLC Okanagan Lake source trihalomethane (THM) data collected 2006 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

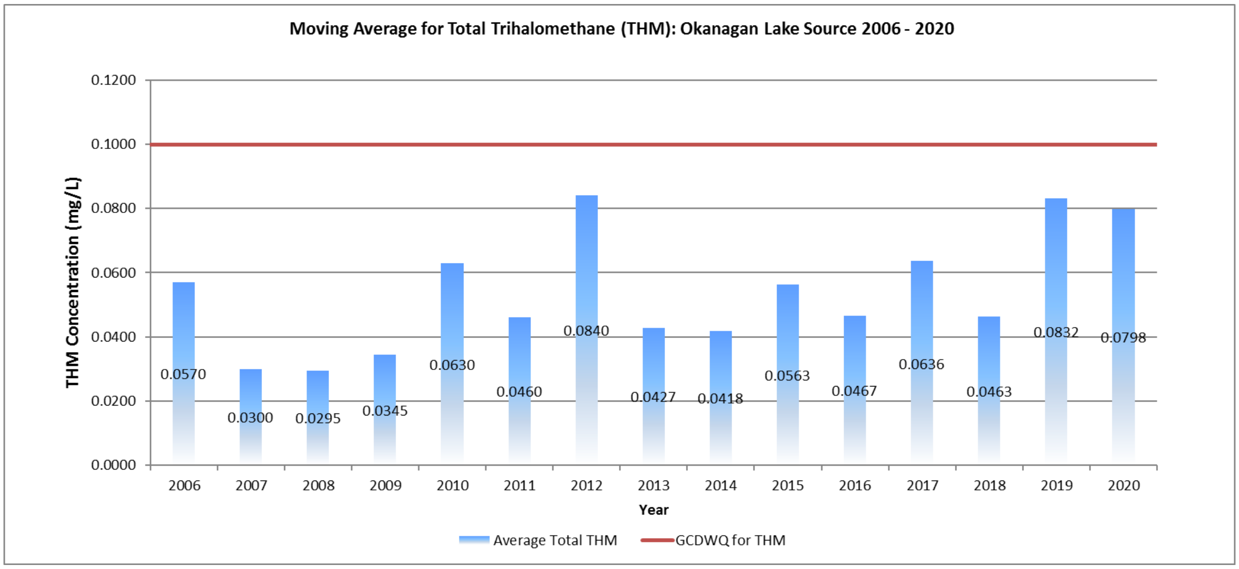


Figure 7. DLC Coral Beach System (Okanagan lake source) trihalomethane (THM) data collected 2009 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

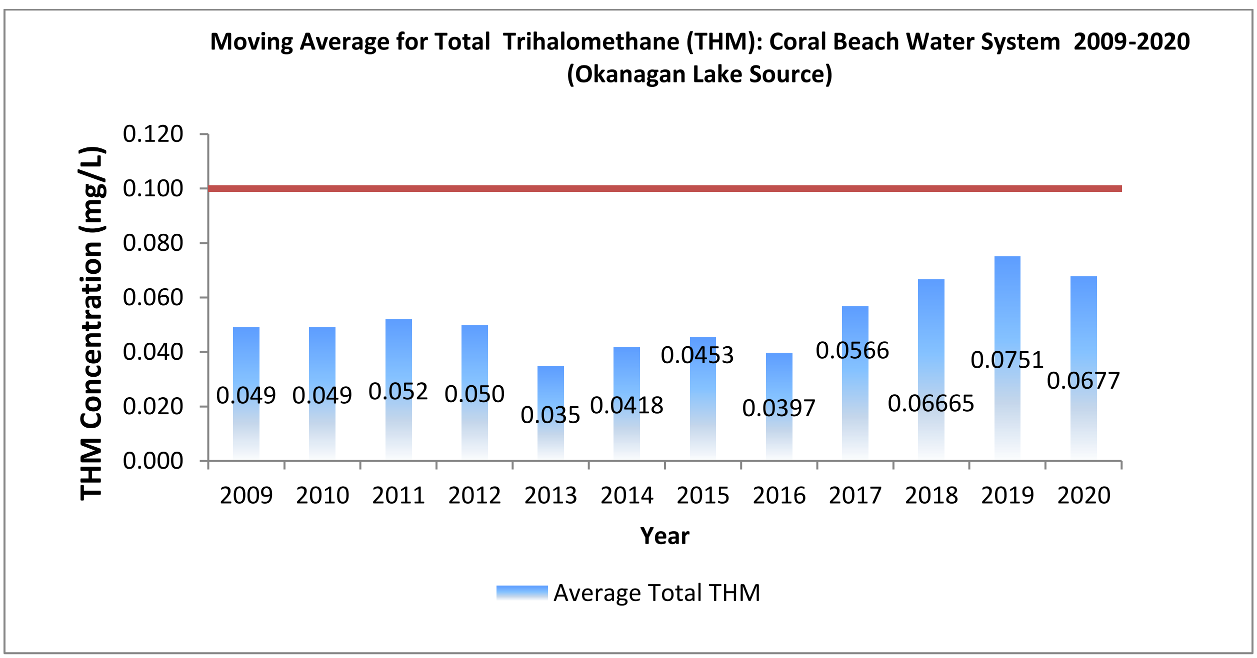
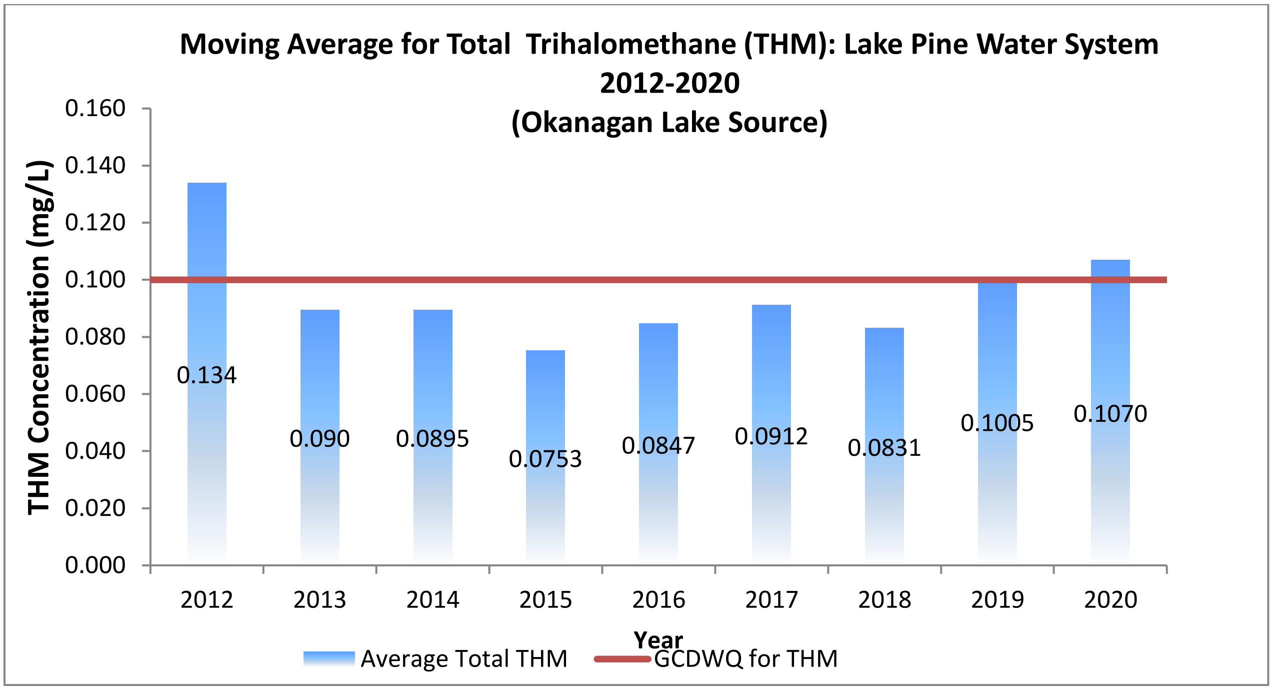


Figure 8. DLC Lake Pine System (Okanagan Lake source) trihalomethane (THM) data collected 2012 – 2020. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).



Raw Water Reservoirs/Intakes

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 intake
4. Kalamalka Lake (1) deep water intake

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

The Oyama and Vernon Creek watersheds together encompass approximately 141.1 km2. 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

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. Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. The data is used to characterize the raw water quality from our upland drinking water reservoirs, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish trends in drinking water quality, identify and track the occurrence of concerns such as increased turbidity, positive bacteriological results or changes in nutrient loading, provide background data for future additional forms of disinfection and water treatment plant(s) and to assess and report on the state of the DLC's distribution and raw water quality.

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 CDWG 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.

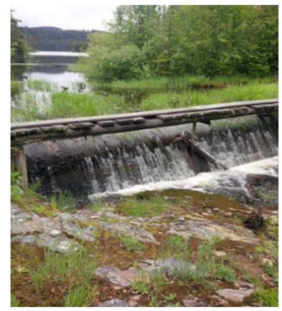
The DLC's two main upland drinking water reservoirs (Beaver and Oyama Lakes) and creek sources (Vernon and Oyama Creeks) exceeded the physical parameters of the GCDWQ for colour and turbidity. Such results are common throughout the Okanagan wherever water is sourced from highland watersheds. Additionally, this year we saw an increase in metals on all sources although the only parameters that exceeded the chemical GCDWQ were Aluminum on the Beaver Lake Source and Oyama Sources and

Copper and Lead on the Lake Pine source. The GCDWC for Aluminum is <0.1mg/L: Beaver 0.119 mg/L and Oyama 0.143mg/L. The GCDWC for Lead is 0.005mg/L: Lake Pine 0.00549mg/L. The guideline for Copper is 2mg/L (MAC): Lake pine 0.280mg/L. The increase in these metals are unusual and additional sampling will occur to verify and reassess results.

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

Raw Water Data from intakes and pump stations are in Tables 11 through 16 (below). Data is collected from each source from the following sites:

- Beaver Lake source: Vernon Creek Intake (Table 11)
- Okanagan Lake Source: Okanagan Lake Pump Station (Table 12)
- Oyama Lake source: Oyama Creek Intake (Table 13)
- Kalamalka Lake source: Kalamalka Pump Station (Table 14)
- Okanagan Lake Source: Coral Beach Pump House (Table 15)
- Okanagan Lake Source: Lake Pine Pump House (Table 16)



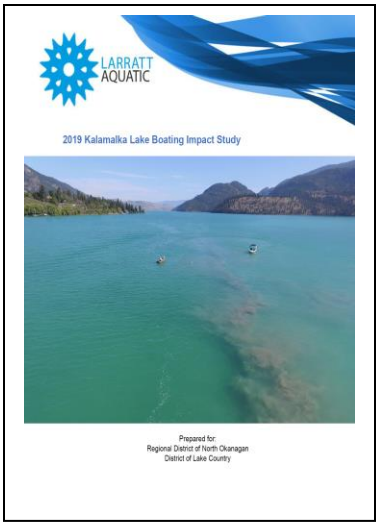
Oyama Lake Dam Spillway

Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. This data are used to characterize the quality of raw water intakes, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish trends in drinking water quality, identify and track the occurrence of concerns such as increased turbidity, positive bacteriological results or changes in nutrient loading. As well provide background data for future additional forms of disinfection and water treatment plant(s), assess and report on the state of the DLC's distribution and raw water quality.

Kalamalka Lake

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 22nd year of this comprehensive and collaborative study.

At the time of writing this report, this year's report was not yet completed. Details will be summarized in the following year. In 2021 the Aquatic biologist will again focus on potential impacts from the previous years' flooding and/or high water levels. It is common for gap for the response to occur from flooding events. This is due to the time for particulates and additional materials to accumulate and decompose at the deep-water depths. Most notable during 2020 at our raw water intake were moderate algae densities that we monitored closely.



The DLC, Regional District of North Okanagan and District of Coldstream partnered again in 2020 receiving a $25,000 for an *Okanagan Basin Water Board Water Quality and Conservation Grant*. The funds will be used to address 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.

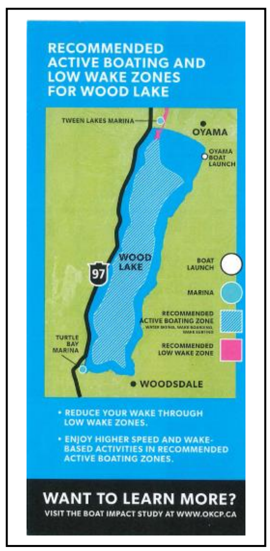


Table 11. *District of Lake Country Water System, 2020 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (Caro Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	[3] % of samples less than 10 E.coli/100mL (N=40)
MIN	60	0.48	1.4	6.6	43	24	<1	<1	88%
MAX	80	7.90	19	8.1	96	130	2420	41	
AVERAGE	70	2.00	9	7.0	71	45	52 samples		
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	acceptable	1 (max) ≤ 5 NTU AO	AO	OG		AO	MAC	MAC	

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 Criteria is set out in the 2020 Source Drinking Water Quality Guidelines SDWQG Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

Table 12. *District of Lake Country Water System, 2020 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 Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond mS/cm	[3] TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UV Transmittance @ 254 nm unflitered	[4] % of samples less than 10 E.coli/100mL (N=44)
MIN	160	0.22	5	7.8	257	<5	<1	<1	84	100%
MAX	180	0.89	10	8.2	370	9	980	6	87	
AVERAGE	170	0.39	6	8.0	276	n/a	38 Samples		85	
WQ Guidelines			15	7-10.5			<1	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	acceptable	1 (max) ≤ 5 NTU AO	AO	OG		AO	MAC	MAC		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 Average unavaliable: 8 of 18 sample results reported at <5

4 Criteria is set out in the 2020 Source Drinking Water Quality Guidelines SDWQG Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

Okanagan Lake was Offline October 14th and Beaver Lake Source the Primary Supply. Further details on this under Water Quality Advisory and Boil Water Notice Section.

Table 13. *District of Lake Country Water System, 2020 Raw Water Oyama Creek Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (Caro Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] *Hardness mg/L as CaCO3*	[2] Turbidity NTU	Temp °C	pH	Cond mS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	[3] % of samples less than 10 E.coli/100mL (N=26)
MIN	40	0.7	6	7.3	42	43	1	<1	83%
MAX	60	3.06	18	8.2	80	140	6130	38	
AVERAGE	50	1.29	13	7.6	52	69	22 samples		
WQ Guidelines			*15*	*7.0-10.5*			*<1*	*<1*	
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*OG*		*AO*	*MAC*	*MAC*	

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3. Criteria is set out in the 2020 Source Drinking Water Quality Guidelines SDWQG Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

Table 14. *District of Lake Country Water System, 2020 Raw Water Kalamalka Lake Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (Caro Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] *Hardness mg/L as CaCO3*	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	[3] TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UV Transmittance @ 254 nm unflitered	[4] % of samples less than 10 E.coli/100mL (N=49)
MIN	200	0.30	4	7.9	370	<5	<1	<1	88	100%
MAX	220	2.46	14	8.7	488	5.2	2420	<10	91	
AVERAGE	212	0.88	8	8.1	392		55 Samples		90	
WQ Guidelines			*15*	*7-10.5*			*<1*	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*OG*		*AO*	*MAC*	*MAC*		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 Average unavaliable: eleven of 13 sample results reported as <5

Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

In 2020 the Kalamalka lake source turbidity meter raw water line was temporarily disconnected and re-established with the chlorinated line August through mid-October following irrigation shut down. Both the chlorinated and raw water lines pull water from the same pipe however, the dedicated raw water sampling line requires replacement this fall. This priority action is expected to take place in the winter during non-irrigation and low flow season.

Table 15. *Coral Beach Water System, 2020 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 Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] *Hardness* *mg/L as* *CaCO3*	[2] Turbidity NTU	Temp °C	pH	Cond mS/cm	[3] TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[4] % of samples less than 10 E.coli/100mL (N=55)
MIN	160	0.20	5	7.8	168	<5	<1	<1	84	100%
MAX	180	0.98	16	8.2	297	6.4	129	1	87	
AVERAGE	170	0.44	9	8.0	272	n/a	52 Samples		86	
WQ Guidelines			***15***	***7-10.5***			***<1***	<1		
Maximum Allowable	***acceptable***	**≤ 5 NTU**	***AO***	***OG***		***AO***	***MAC***	***MAC***		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 Average unavaliable: 10 of 17 sample results reported as <5

4 Criteria is set out in the 2020 Source Drinking Water Quality Guidelines SDWQG Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

Table 16. *Lake Pine Water System, 2020 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 Analytical Services).*

weekly sampling and on-line water quality eqiupment verification	[1] *Hardness* *mg/L as* *CaCO3*	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	[3] TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UV Transmittance @ 254 nm unflitered	[4] % of samples less than 10 E.coli/100mL (N=49)
MIN	140	0.25	6	7.8	264	<5	<1	<1	84	100%
MAX	160	0.75	14	8.2	301	6	120	3	89	
AVERAGE	150	0.41	10	8.0	280		48 Samples		86	
WQ Guidelines			***15***	***7.0-10.5***			***<1***	***<1***		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	***acceptable***	***1 (max)*** **≤ 5 NTU AO**	***AO***	***OG***		***AO***	***MAC***	***MAC***		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 Average unavaliable: 7 of 16 sample results reported as <5

4. Criteria is set out in the 2020 Source Drinking Water Quality Guidelines SDWQG Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch British Columbia. The SDWQG of ≤ 10 E. coli /100 mL is a benchmark to protect current and future drinking water sources; it is the minimum performance target for water suppliers to treat water to produce microbiologically safe drinking water. Results are % of samples less than 10 E.coli/100mL

Instrument Calibration and Quality Control

Field instruments are checked against standards to ensure accuracy, are regularly maintained and calibrated as required prior to use in the field. 2020 Hach certification was obtained for all water quality monitoring field equipment.

On-line Water Quality monitoring equipment is verified weekly using the hand-held water quality equipment, maintained, and calibrated as per manufacture directions and if possible, certified by an outside agency as scheduled in the automated operational maintenance program.

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 Vernon Creek watersheds.

Infrastructure within these watersheds was constructed approximately 100 years ago for irrigation, but in the 1970's the systems were improved and evolved to become a major domestic and agricultural water supply. Both the Oyama and Vernon Creek 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 2010 the DLC secured an Okanagan Basin Water Board Water Quality and Conservation Grant that provided us with the substantial financial support to complete Watershed Source Water Assessment Plans. Following this the DLC meet with stakeholders to review the plan, the intentions and recommendations/action items that were completed and other actions that have occurred or are required. In 2015, the DLC fulfilled the second watershed related requirement of condition on permit to produce an implementation plan. 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 Source Water Assessment Plan

Damer Lake (above).

Watershed Source Water Assessment Plans:

2010 Oyama and Vernon Creek Source Water Assessment (Watershed Protection Plan)]

2010 Source to Tap Assessment South Kalamalka Lake Intake (DLC water system)

2010 Source to Tap Assessment of the Okanagan lake Intake (DLC water system)

2015 Source Water Assessment and implementation Plan: Oyama and Vernon Creek

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 accidently entering the lake and affecting the intake.

The Watershed Protection plan 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 2019 a specific stakeholder meeting to follow up on identified risks and actions in the SWA was not held. DLC staff instead maintains communications and meetings with stakeholders. As well DLC staff maintains connections and direct involvement with several watershed related organizations some of which are the Okanagan Basin Water Board (OBWB), Okanagan Water Stewardship Council, BC Water Supply Association, OBWB and source protection committee.

Since Major licencees in our watershed have opted out of public advisory group for sustainable forest management process, there is now reduced information sharing between the forestry stakeholders and local government water purveyors. Considering this the DLC endeavors to maintain and improve relationships with major licencees as well as all SWA stakeholders' group, striving to implement recommendations and recognize improvements as we move forward. Our watersheds are multipurpose, multi-jurisdictional and cumulatively all activities are making an impact. All stakeholders have a responsibility to recognize this and use best practices maintaining sustainable resources for all users.

Off Road Vehicle

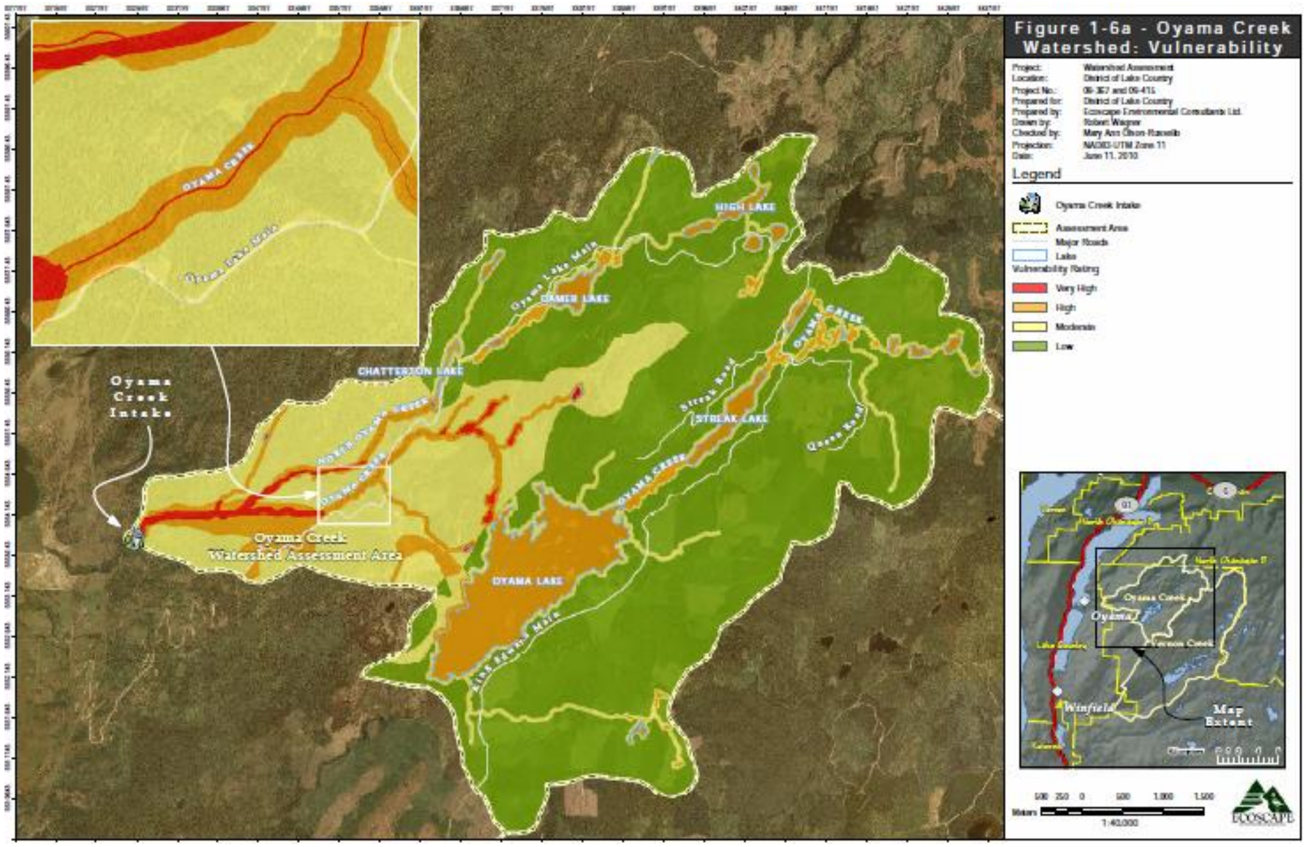
In 2020, with increased Provincial orders and other measures to reduce the spread of the Covid19 Pandemic, we noticed an unprecedented increase of motor vehicle traffic in our community watersheds. Of the thousands of cars venturing into these crown lands many were roadside parking/camping for days and weeks. The lease lot resorts reported an exceptional increase of activity and interest of people wanting to stay and access our drinking water reservoirs. Large amounts of garbage and other debris such as abandon and burnt vehicles were not only dumped into the forest but even left burnt on the roadside. This increased illegal activity caught the attention of local watershed protection group that initiated roadside clean up crews and garbage/heavy removing over 10,000 pounds of roadside garbage and 13,600 pounds of metal**.** 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 that we experienced a low fire rating season and no forest fires were ignited in the DLC's community watersheds.

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 took place in the spring at the DLC. The range meeting included the RDNO and the DLC watersheds. works much better for individual discussions and specific updates with range use permit holders in our community watersheds. The Province reviewed the community watershed monitoring projects and Best Management Practices with discussions around key areas, targeted grazing and heard health to mitigate water quality concerns. Concern remains on the impact from (non-sanctioned) recreation and off-road vehicle activities in our watershed as well as forestry development. Outside of this meeting, the DLC connects with ranchers (and others) throughout the year working to maintain open lines of communication with updates on projects, opportunities, or situations that either party should be aware of.



All Range use holders, major licencees 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 licencees in our watersheds:. Although there were no communicated logging blocks directly within the Beaver or Oyama Lake Community watershed this year, an exceptionally high volume of industrial traffic was reported and observed on the main road directly adjacent to our communities drinking water supply.

As both Tolko and BCTS have opted out of public advisory group planning they 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.

Major Licencees in our community watersheds are aware of our Watershed Protection Plan and the DLC has requested it be used as a planning tool when developing harvest plans. 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), wild fire management, drainage concerns, and rehabilitation of roads to decrease the amount of non-status roads accumulating in our community watersheds.

In 2020 both Tolko and BCTS agreed that their new on-line mapping and referral process would not be used for local government. Instead we will continue with In person meetings to determine details and locate proposed harvest sites. Within Tolko's mapping it was determined there were 4 main blocks of concern located within the drainage of the outflow of our drinking water reservoir and intake. Two were from previous referrals in very high vulnerability zones and already under review with DLC. The DLC has advised Tolko of the high vulnerability zones, our position regarding this sensitive area, that we require block walks with our subject matter expert, and we have not yet received comments back from this Licencee.

Within the drainage of the Oyama Reservoir outflow and Vernon Creek Intake BCTS has one proposed block. It was necessary for on-site discussion and the DLC and BCTS met under safe Covid 19 Protocols. It was an opportunity to express how important this high vulnerability area is to our community's drinking water supply. This drainage area has been a key concern for the DLC with cattle access, road drainage and flows from this zone having direct impact to Oyama Creek. Since a block walk was not possible, it was decided by all that a snow free field assessment and that no decisions on plans will be made until after that time.

Both Tolko and BCTS were reminded to provide the DLC with any referral in our watersheds located above our communities. Drainage from these zones could have considerable impact on our drainage systems below and we should be involved in that referral 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 licencee through the Ministry of Forest Lands and Natural Resources Operations and Rural Development (FLNRORD). These smaller operations apply to the FLNRORD, harvest small volumes of timber that would otherwise not have been harvested and/or to 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. In 2020 the DLC did not receive any referrals from the Province.

When any licencee proposes logging in our community watershed, the DLC ensures the licencee is aware of the vulnerability zone, water quality, quantity, access and other concerns such as long-term effects and cumulative impacts associated with harvesting in the area. DLC also involves other stakeholders such as Provincial Agrologists, Ranchers and other Crown land lease lot owners for a combined field review. Many areas within the DLC's community watersheds have high vulnerability zones with issues of terrain stability that range from natural formation to effects from historic harvest practices.

The DLC requests that each prescription includes fuel mitigation planning, access management (cattle and recreation) and the immediate through long-term management of the road networks travelled including the complete road rehabilitation following harvest. We ask that licencees plan and mitigate post-harvest for restricted motorized vehicle access into these high-risk areas and complete road rehabilitation to reduce cumulative impact sources of sediment that contribute to high turbidly and other contaminants in our in our drinking water source.

In July 2019 the Government of B.C. provided a public engagement opportunity to help *inform 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*. The FRPA framework defines how legislation, regulations and policy work together across the landscape. It 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. At this time, 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 within our community watersheds. Improved legislation is required to protect water quality and quantity and effectively manage and conserve our forests and rangelands. The DLC has a Director position in the Water Supply Association providing another opportunity to communicate additional feedback on proposed changes to FRPA. In 2020 no details or Feedback on the discussion papers to inform of proposed changes to FRPA were released. This may be due to the set back in managing the Covid 19 Pandemic.

In 2020, the DLC staff actively participated and presented updates at various on-line meetings, for range, water stewardship, watershed protection, forestry planning and source water protection and planning committees throughout 2020. These presentations, workshops and organizations are important for conveying and gaining further understanding the complexity of integrated watershed land use. Science based research and collaborative partnerships have been the key to identifying and developing solutions for resolving water quality and quantity issues.

Wildfire Planning:

The DLC continued our collaborative partnerships with the Regional District of North Okanagan (RDNO), the Black Mountain Irrigation District (BMID) and Glenmore Ellison Improvement District (GEID) in the Forest Enhancement Society funding, integrating and collaborative fire risk management planning. These four local governments have neighboring watershed and aim to work together modifying each of our wildfire protection and mitigation plans to develop one that includes priorities of all stakeholders and to meet new expectations of the land manager and BC Wildfire Service. Wildfire reduction planning and mitigation measures 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. This is an extensive process with a small window of opportunity and requires input from many stakeholders.

On July 31st the DLC received a $142,860 grant for wildfire reduction planning and mitigation works in the Beaver and Oyama Community Watersheds. This funding provided by (FESBC) is in part to $663,910 granted to the three other water purveyors in this collaboration: the BMID, GEID, and the RDNO.

There are five community watersheds on the Aberdeen Plateau (from Vernon through to Highway 33 that will be under one massive wildfire reduction landscape management plan). This is a remarkably large area so the plan and operations will need to extend over multiple years. The Planning, prescriptions and operations will require a unique team of specialized subject matter experts with extensive knowledge in wildfire behavior, planning and management, mapping, LiDAR proficiency, hydrogeology, forestry, and several other areas of expertise to establish a coordinated wildfire reduction plan and carry out prescriptions of this scale.

To reiterate from the FESBC press release, *the outcome for each project will be to produce management plans that are operationally feasible, ecologically appropriate, and account for all values and constraints within the watershed while ultimately protecting water quality and quantity as a resource. The long-term planning and prescription works will also include collaborative works with our indigenous neighbors, provincial ministry and key stakeholders to protect our communities and vital infrastructure from the potential devastation of wildfire in and around our water infrastructure*. More details are provided through the FESBC press release https://www.fesbc.ca/wildfire-risk-reduction-projects-obtain-funding-to-protect-critical-okanagan-watersheds/.

2020 was a low fire season however, the possibility of a catastrophic wildfire occurring in our community watershed remains very high. 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 and is identified in our Potable Water Emergency Response Plan (Section 3.10 provided to IHA February 2021). For the 2021 wildfire season we expect to receive new contact information and to continue to work with BCWS.

Appendices

Appendix A – Summary of Positive Bacteriological Results in Distribution

	Total coliforms CFU/100 mL	E.coli CFU/100 mL	Presence Absence (total coliforms)	Presence Absence (E.coli)	Sample date	Number of TC/E.coli Samples	Number of P/A samples
District of Lake Country Water System:							
Beaver Lake Source (WQA)	3 CFU/100ml and >2 CFU/100ml Total coliforms and NO E.Coli detected in distribution system December 2020		>1 PA Total coliforms and NO E.Coli detected in distribution system Dec. 8 2020			53	32
Okanagan Lake Source	none detected in distribution system					41	20
Oyama Lake Source (WQA)	none detected in distribution system					21	7
Kalamalka Lake Source	18 CFU/100ml Total coliforms and NO E.Coli detected in distribution system July 22 2020					48	26
Coral Beach Water System: Okanagan Lake Source	none detected in distribution system					53	25
Lake Pine Water System: Okanagan Lake Source	none detected in distribution system					54	29
					TOTAL:	***270***	***139***

* Background Colonies > 200 CFU/100 mL

1 Overgrown with visible Total Coliforms detected however due to interference from high concentration of background bacteria the total coliforms cannot be determined.

2 Overgrown without visible E.coli. Due to interference from high concentrations of background bacteria the presence or absence of E.coli cannot be determined.

Two Total Coliform samples on the Beaver Lake source and one sample on the Kalamalka Lake source were positive for total Coliforms. One positive Presence Absence test detected at the McCoubrey site.

December 8 & 11, 2020 Copper Hill water quality site

Results were unusual, site specific and not consistent with all other distribution sampling. Although sampling occurred during high wind and rain events it was established that the sampling device was possibly compromised with a defective part and will not be used again until repaired. Re-sampling with a new device returned results consistent with all other results in the distribution system being negative for total coliforms and E. coli. This distribution line was thoroughly flushed the week prior and follow up sampling returned results with no detection of coliforms.

July 22, 2020: The Kalamalka Lake pumphouse sample was resampled the following day after receiving results and returned negative with no detection of coliforms. This sampling location inside the pumping station with high condensation and can be a problem during sample collection.

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 Ci2/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
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 Rd shop Yard hydrant	Beaver Lk			x												x				x		x		
Camp Rd shop inside building	Beaver Lk			x						x						x								
Camp Rd Reservoir (off line)	Beaver Lk			x	x						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								
Dewar Park	Beaver Lk			x		x											x							x
Fire Admin Building	Beaver Lk			x		x										x								
Jammery	Beaver Lk				x					x														x
Long	Beaver Lk			x				x									x							
McCreight	Beaver Lk			x		x											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								
Williams	Beaver Lk			x		x		x									x	x	x					x
Lakestone Beacon Hill PRV	Beaver Lk			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 Ci2/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
Ok Lk Intake **RAW**	Ok Lk			x							x		x										x	
Ok Lk Pump Stn/chlorination facility	Ok Lk						x				x		x	x										
Arena	Ok Lk				x											x				x			x	
New Station (replace Clement - Future)	Ok Lk																							
Copper Hill	Ok Lk			x		x											x					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								
Middleton and Pretty Road PRV	Ok Lk			x												x						x		
Ok Bio Fuels (Jim Bailey Rd)	Ok Lk			x		x																		
Oceola PRV	Ok Lk			x							x						x							
Ottley Rd (off Stubbs)	Ok Lk			x				x							x						x			
Ponderosa pumphouse	Ok Lk			x				x									x							
Ponderosa PRV 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 Ci2/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	
Ribbleworth	Oyama Lk			x				x								x							x	
Sawmill Rd at Middlebench (Future)	Oyama Lk				x							x				x							x	
Talbot Rd Booster Stn (future)	Oyama Lk				x				x								x							
5410 Todd Rd. (summer: First customer Fall (Sawmill online) could be either from Sawmill or from reservoir	Oyama Lk			x							x				x	x	x							
Oyama Creek intake/Chlorination Facility - Chlorinator post reservoir	Oyama Lk						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 Ci2/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
B-2 Reservoir	Kal				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 Ci2/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 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 Ci2/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 Lower Res	LP Ok Lk		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								
Moberly South (Future Site)	LP Ok Lk																x							

Appendix C – Comprehensive Test Results

2020 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	LakePine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pumphouse
Date		29-Jun-20	29-Jun-20	30-Jun-20	30-Jun-20	30-Jun-20	2-Jul-20
Anions							
Chloride	mg/L	1.52	0.15	9.11	5.67	5.35	5.07
Chloride (AO)	mg/L	<250	<250	<250	<250	<250	<250
Fluoride	mg/L	<0.10	<0.10	0.22	0.13	0.14	0.13
Fluoride (MAC)	mg/L	1.5	1.5	1.5	1.5	1.5	1.5
Nitrogen, Nitrate as N	mg/L	<0.010	<0.010	0.066	0.032	0.045	0.052
Nitrate (MAC)	mg/L	10	10	10	10	10	10
Nitrogen, Nitrite as N	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrite (MAC)	mg/L	1	1	1	1	1	1
Sulphate	mg/L	2.9	2.3	50.6	30.4	31.4	30.4
Sulphate (AO)	mg/L	<500	<500	<500	<500	<500	<500
General Parameters							
Alkalinity (total)	mg/L	27.8	22	143.0	106	107	104
No current guidelines							
Total Organic Carbon	mg/L	9.92	12.3	3.94	4.09	3.79	4.28
No current guidelines							
Dissolved Organic Carbon	mg/L	9.62	12.20	3.38	3.68	3.49	3.72
No current guidelines							
True Colour	CU	**52.0**	**71**	<5.0	<5.0	<5.0	7.0
True Colour (AO)	CU	<15	<15	<15	<15	<15	<15
Conductivity	uS/cm	72.8	54.5	387	272	277	272
No current guidelines							
Cyanide	mg/L	<0.0020	0.002	<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	7.71	7.55	8.23	8.16	8.15	8.14
pH (OG)	pH units	7.10-10.5	7.10-10.5	7.10-10.5	7.10-10.5	7.10-10.5	7.10-10.5
Turbidity	NTU	**1.81**	**1.31**	**0.90**	4.42	0.41	0.44
Turbidity Guide	NTU	<1	<1	<1	<1	<1	<1
Trans. 254 nm (unfiltered)	nm			89.8	83.8	85.6	84.2
No current guidelines. Note the lab did not report for Beaver and Oyama Lake sources							
Calculated Parameters							
Hardness (mg/L as $CaCO_3$)	mg/L	29	25	179	125	131	120
No current guidelines see glossary below							
Total Dissolved Solids/TDS	mg/L	34.6	28	230.0	159	164	155
TDS (AO)	mg/L	<500	<500	<500	<500	<500	<500

Appendix C continued– Comprehensive Test Results

2020 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	LakePine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pumphouse
Date		29-Jun-20	29-Jun-20	30-Jun-20	30-Jun-20	30-Jun-20	2-Jul-20
Total Recoverable Metals							
Aluminium (total)	mg/L	**0.119**	**0.143**	0.0061	**0.117**	0.013	0.0112
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	0.006	0.006	0.006	0.006	0.006	0.006
Arsenic (total)	mg/L	<0.00050	<0.00050	0.00	0.00056	0.00056	0.00061
Arsenic (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Barium (total)	mg/L	<0.0050	*	0.0288	*	*	0.0228
Barium (MAC)	mg/L	2	2	2	2	2	2
Boron (total)	mg/L	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
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	7.06	6.39	38.4	33.2	33.7	31.4
No current guidelines							
Chromium (total)	mg/L	<0.00050	0.00055	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Cobalt (total)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
No current guidelines							
Copper (total)	mg/L	0.00202	0.0018	0.00137	0.00139	0.28	0.00093
Copper (MAC)	mg/L	2	2	2	2	2	2
Iron (total)	mg/L	0.195	0.227	0.011	0.124	0.017	0.013
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	0.005	<0.00020
Lead (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Magnesium (diss.)	mg/L	2.76	2.2	20.10	10.10	11.40	10.1
No current guidelines							
Manganese (total)	mg/L	0.00827	0.0104	0.00224	0.00813	0.00162	0.00134
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	0.00028	0.00019	0.00491	0.0033	0.00386	0.00368
No current guidelines							

Appendix C continued – Comprehensive Test Results

2020 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Oyama	Kal lake	Coral Beach	LakePine	Okanagan Lake
Site		VERNON CREEK Intake	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House	OKANAGAN Lake Pumphouse
Date		29-Jun-20	29-Jun-20	30-Jun-20	30-Jun-20	30-Jun-20	2-Jul-20
Total Recoverable Metals Continued							
Nickel	mg/L	0.00078	0.0018	0.00042	0.00057	0.00088	0.00045
No current guidelines							
Potassium (total)	mg/L	0.92	1.22	4.92	2.37	2.56	2.56
No current guidelines							
Selenium (total)	mg/L	<0.00050	<0.00050	0.001	<0.00050	<0.00050	<0.00050
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Sodium (total)	mg/L	2.47	2.34	19.2	12.8	13.8	12.4
Sodium (AO)	mg/L	<200	< 200	<200	< 200	< 200	< 200
Strontium (total)	mg/L	0.0391	0.040	0.4680	0.274	0.307	0.292
Strontium (MAC)	7	7	7	7	7	7	7
Uranium (total)	mg/L	0.000084	0.000133	0.00324	0.00257	0.00346	0.00252
Uranium (MAC)	mg/L	0.02	0.02	0.02	0.02	0.02	0.02
Zinc (total)	mg/L	<0.0040	0.0055	<0.0040	<0.0040	0.0292	<0.0040
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

Appendix D – Nutrient Sampling Upland Drinking Water Reservoirs

2020 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		23-Jul-2020	23-Jul-2020	28-Jul-2020
Anions				
Nitrogen (Nitrate as N)	mg/L	<0.010	<0.010	<0.010
Nitrate (MAC)	mg/L	10	10	10
Nitrogen (Nitrite as N)	mg/L	<0.010	<0.010	<0.010
Nitrite (MAC)	mg/L	1	1	1
Phosphate (as P)	mg/L	<0.0050	<0.0050	<0.0050
No current guidelines				
Sulfate	mg/L	1.2	1.4	1.9
Sulfate (AO)	mg/L	<500	<500	<500
General Parameters				
Alkalinity, Total (as CaCO3)	mg/L	15.8	28.0	22.5
No current guidelines				
Alkalinity,Phenolphthalein (as CaCO3)	mg/L	<1.0	<1.0	<1.0
No current guidelines				
Alkalinity, Bicarbonate (as CaCO3)	mg/L	15.8	28.0	22.5
No current guidelines				
Alkalinity, Carbonate (as CaCO3)	mg/L	<1.0	<1.0	<1.0
No current guidelines				
Alkalinity, Hydroxide (as CaCO3)	mg/L	<1.0	<1.0	<1.0
No current guidelines				
Ammonia (as N)	mg/L	<0.050	<0.050	<0.050
No current guidelines				
Total Organic Carbon	mg/L	12.2	21.0	11.7
No current guidelines				
Dissolved Organic Carbon	mg/L	12.10	19.1	10.6
No current guidelines				
Chlorophyll-a	ug/L	3.09	1.25	*
No current guidelines				
Colour, True	CU	55	100	53
No current guidelines				
Nitrogen, Total Kjeldahl	mg/L	0.381	0.564	0.379
No current guidelines				
Phosphorus, Total (as P)	mg/L	0.0286	0.0294	0.0294
No current guidelines				
TDS	mg/L	*	*	63
TDS (AO)	mg/L			<500
TSS	mg/L	<8.2	<10.9	<7.0
No current guidelines				
Calculated Parameters				
Hardness, Total (as CaCO3)	mg/L	17.5	27.0	20.0
No current guidlines				
Nitrate+ Nitrite (as N)	mg/L	<0.0100	<0.0100	<0.0100
No current guidelines				
Total Nitrogen	mg/L	0.381	0.564	0.379
No current guidelines				
Organic Nitrogen	mg/L	0.381	0.564	0.379
No current guidelines				

Appendix D continued – Nutrient Sampling Upland Drinking Water Reservoirs

2020 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		23-Jul-2020	23-Jul-2020	28-Jul-2020
Metals				
Total Dissolved Aluminium	mg/L	0.0458	**0.104**	0.0332
Total Recoverable Aluminium	mg/L	0.0544	**0.120**	0.0683
Aluminium (OG)	mg/L	<0.1	<0.1	<0.1
Total Dissolved Antimony	mg/L	<0.00020	<0.00020	<0.00020
Total Recoverable Antimony	mg/L	<0.00020	<0.00020	<0.00020
Antimony (MAC)	mg/L	0.006	0.006	0.006
Total Dissolved Arsenic	mg/L	<0.00050	<0.00050	<0.00050
Total Recoverable Arsenic	mg/L	<0.00050	<0.00050	<0.00050
Arsenic (MAC)	mg/L	0.01	0.01	0.01
Total Dissolved Barium	mg/L	0.0073	0.0096	0.0057
Total Recoverable Barium	mg/L	0.0071	0.0098	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	<0.0500	<0.0500	<0.0500
Total Recoverable Boron	mg/L	<0.0500	<0.0500	<0.0500
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	4.46	6.29	5.17
Total Recoverable Calcium	mg/L	5.02	6.35	5.66
No current guidelines				
Total Dissolved Chromium	mg/L	<0.00050	<0.00050	<0.00050
Total Recoverable Chromium	mg/L	0.00082	0.00083	0.00052
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	0.00117	0.00174	0.00117
Total Recoverable Copper	mg/L	0.00120	0.00174	0.00098
Copper (AO)	mg/L	2	2	2
Total Dissolved Iron	mg/L	0.103	0.206	0.094
Total Recoverable Iron	mg/L	0.14	0.250	0.163
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	0.00055	0.00140	0.00053
Total Recoverable Lithium	mg/L	0.0006	0.00139	0.00058
No current guidelines'				
Total Dissolved Magnesium	mg/L	1.53	2.74	1.73
Total Recoverable Magnesium	mg/L	1.78	2.97	1.86
No current guidelines'				

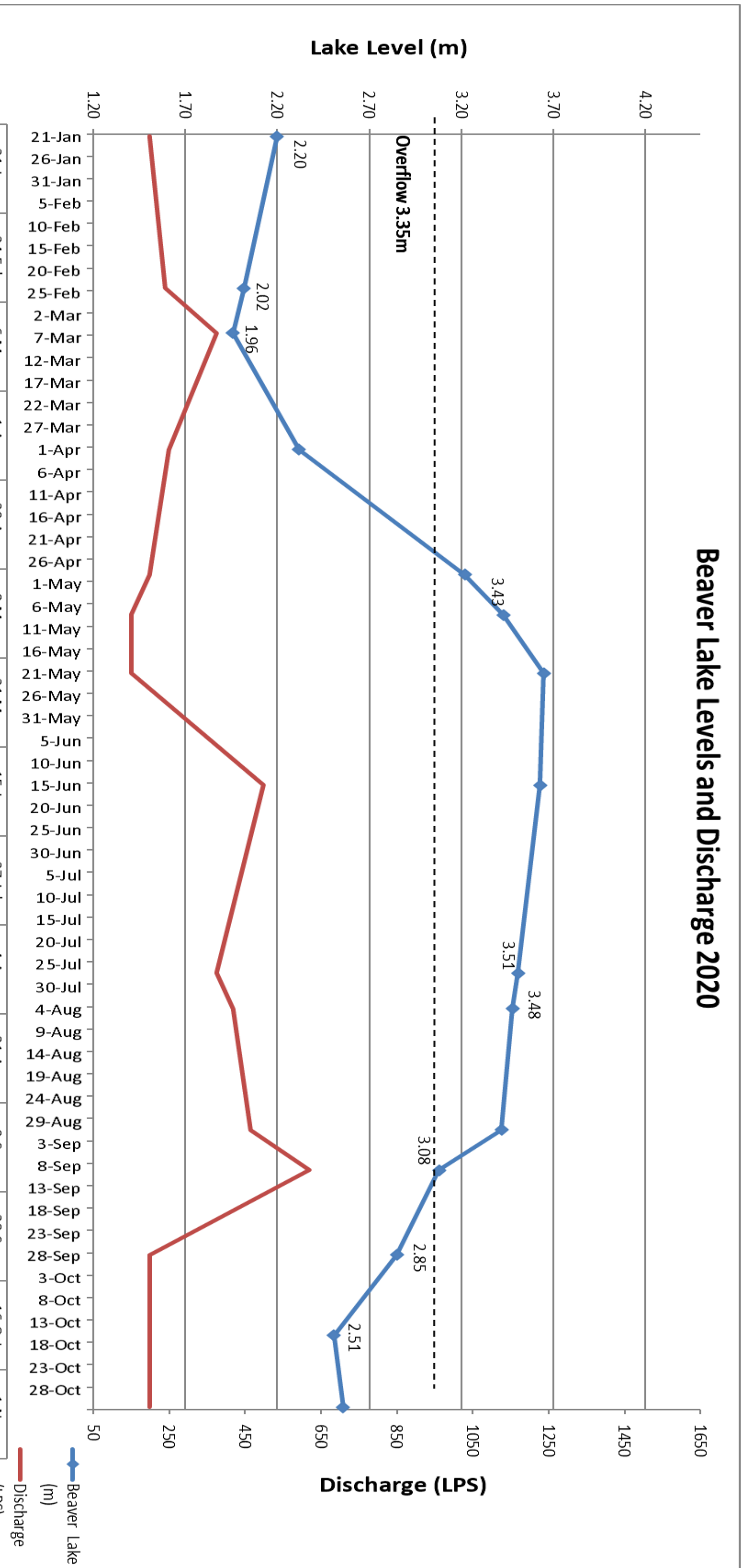
Appendix D continued – Nutrient Sampling Upland Drinking Water Reservoirs

2020 Nutrients				
Site		OYAMA	DAMER	BEAVER
Date		23-Jul-2020	23-Jul-2020	28-Jul-2020
Metals Continued				
Total Dissolved Manganese	mg/L	0.00193	0.00133	0.00057
Total Recoverable Manganese	mg/L	0.00937	0.0121	0.00703
Manganese (MAC)	mg/L	0.12	0.12	0.12
Total Dissolved Mercury	mg/L	0.000016	0.000017	*
Total Recoverable Mercury	mg/L	<0.000010	<0.000010	*
Mercury (MAC)	mg/L	0.001	0.001	
Total Dissolved Molybdenum	mg/L	0.00012	0.00022	0.0002
Total Recoverable Molybdenum	mg/L	0.00014	0.00021	0.00020
No current guidelines				
Total Dissolved Nickel	mg/L	0.00115	0.00234	0.00068
Total Recoverable Nickel	mg/L	0.00103	0.00207	0.00077
No current guidelines				
Total Dissolved Phosphorus	mg/L	<0.050	<0.050	<0.050
Total Recoverable Phosphorus	mg/L	<0.050	<0.050	<0.050
No current guidelines				
Total Dissolved Potassium	mg/L	0.97	1.47	0.76
Total Recoverable Potassium	mg/L	1.04	1.53	0.80
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	4.1	6.9	4.3
Total Recoverable Silicon	mg/L	4.7	7.5	4.5
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	1.90	2.55	1.86
Total Reocoverable Sodium	mg/L	2.21	2.68	1.96
Sodium (AO)	mg/L	<200	<200	<200
Total Dissolved Strontium	mg/L	0.0307	0.0372	0.0358
Total Recoverable Strontium	mg/L	0.0294	0.0354	0.0379
No current guidelines				
Total Dissolved Sulfur	mg/L	<3.0	<3.0	<3.0
Total Recoverable Sulfur	mg/L	<3.0	<3.0	<3.0
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

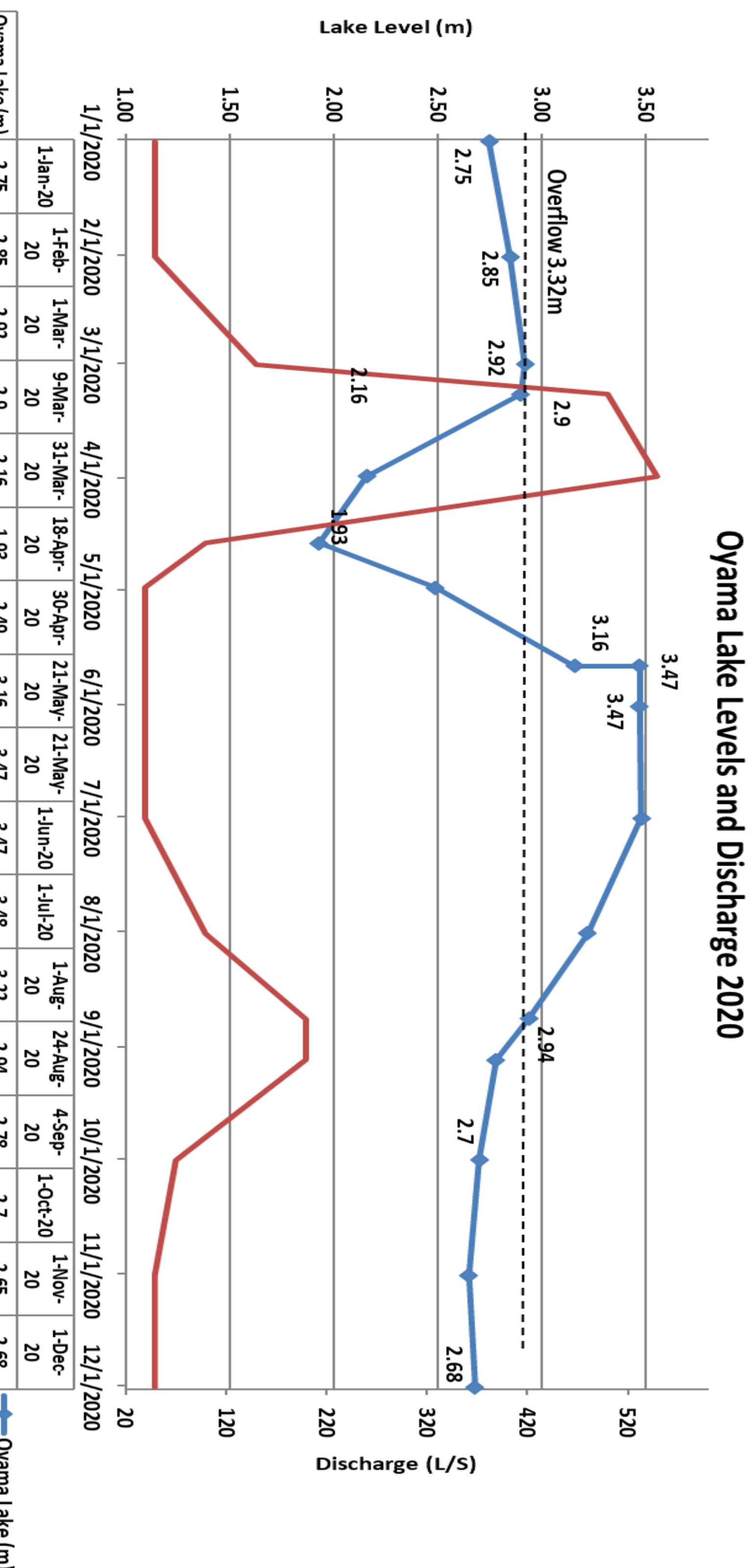
2020 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		18-Jul-2019	18-Jul-2019	18-Jul-2019
Metals Continued				
Total Dissolved Thorium	mg/L	<0.00010	<0.00010	<0.00010
Total Recoverable Thorium	mg/L	<0.00010	<0.00010	<0.00010
No current guidelines				
Total Dissolved Tin	mg/L	<0.00020	<0.00020	<0.00020
Total Recoverable Tin	mg/L	<0.00020	<0.00020	<0.00020
No current guidelines				
Total Dissolved Titanium	mg/L	<0.0050	<0.0050	<0.0050
Total Recoverable Titanium	mg/L	<0.0050	<0.0050	<0.0050
No current guidelines				
Total Dissolved Uranium	mg/L	0.000043	0.000124	0.000035
Total Recoverable Uranium	mg/L	0.000047	0.000122	0.000042
Uranium (MAC)	mg/L	0.02	0.02	0.02
Total Dissolved Vanadium	mg/L	<0.0010	<0.0010	0.0018
Total Recoverable Vanadium	mg/L	<0.0010	0.0035	<0.0010
No current guidelines				
Total Dissolved Zinc	mg/L	<0.0040	<0.0040	<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	0.00045	0.00138	0.00044
Total Recoverable Zirconium	mg/L	0.00058	0.00139	0.00055
0.00045				
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 – Beaver Lake & Oyama Lake Levels and Discharge



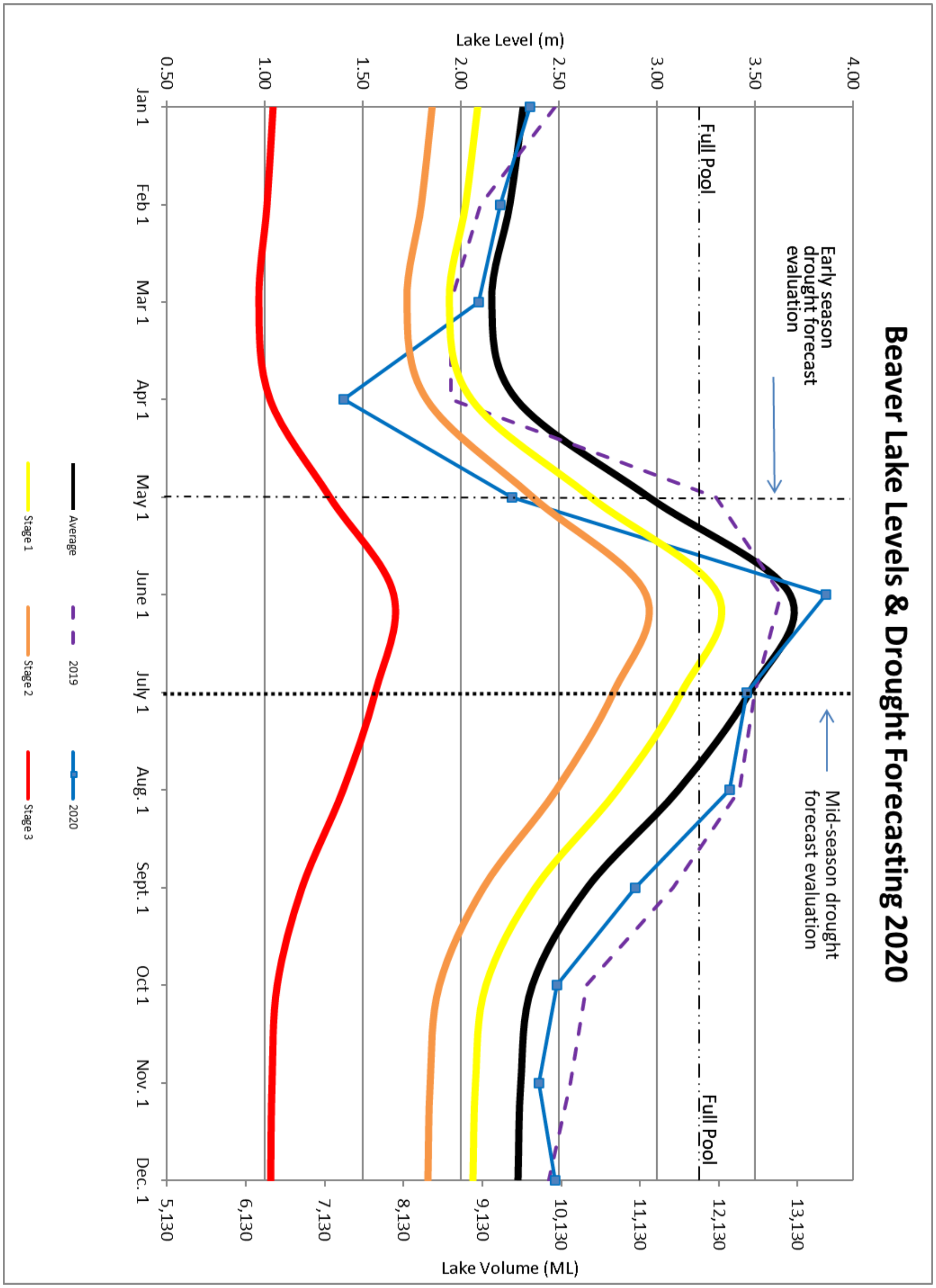
	21-Jan	24-Feb	6-Mar	1-Apr	29-Apr	8-May	21-May	15-Jun	27-Jul	4-Aug	31-Aug	9-Sep	28-Sep	16-Oct	1-Nov
Beaver Lake (m)	2.20	2.02	1.96	2.32	3.22	3.43	3.65	3.63	3.51	3.48	3.42	3.08	2.85	2.51	2.56
Discharge (LPS)	200	240	375	250	200	150	150	500	375	420	465	620	200	200	200

Appendix E continued – Beaver Lake & Oyama Lake Levels and Discharge

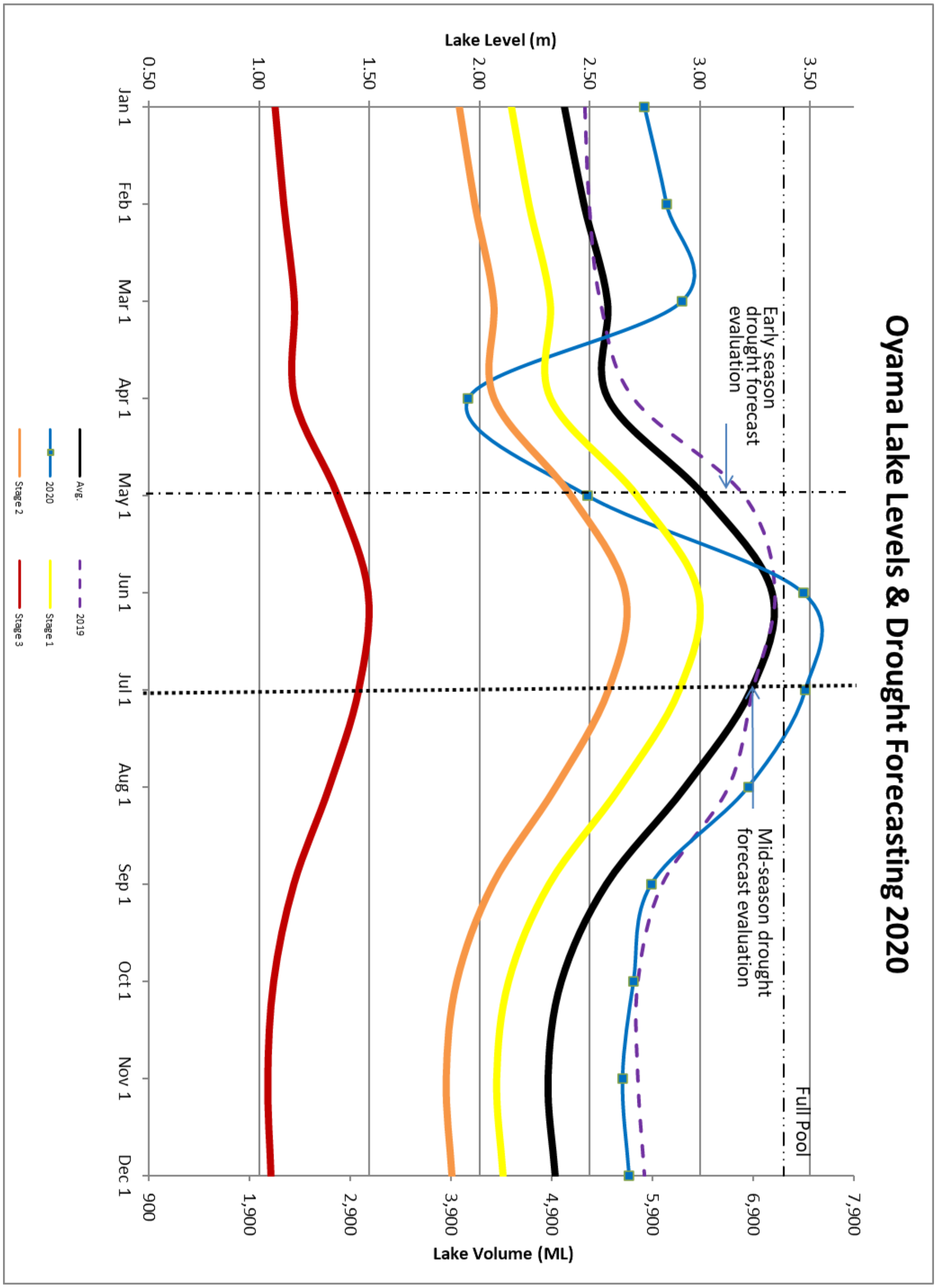


	1-Jan-20	1-Feb-20	1-Mar-20	9-Mar-20	31-Mar-20	18-Apr-20	30-Apr-20	21-May-20	21-May-20	1-Jun-20	1-Jul-20	1-Aug-20	24-Aug-20	4-Sep-20	1-Oct-20	1-Nov-20	1-Dec-20
Oyama Lake (m)	2.75	2.85	2.92	2.9	2.16	1.93	2.49	3.16	3.47	3.47	3.48	3.22	2.94	2.78	2.7	2.65	2.68
Discharge (LPS)	50	50	150	500	550	100	40	40	40	40	40	100	200	200	70	50	50

Appendix F – Drought Forecast for Beaver Lake & Oyama Lake



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



Appendix G – 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 (ie. 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 H – 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-I
Kiel Wilkie	6503	WD-III, CH
Tyler Friedrich	7697	WD-II, WT-I
Mike Kristensen	8344	WD-I, WT-I
Tessa Luison	1000130	WD-I, CH
Evan Kemp	8114	WWT-III, WWC-I, CH, WT-I