Water Operations
2019 Annual Report

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LAKE COUNTRY

DISTRICT OF LAKE COUNTRY

Water Operations Annual Report - 2019

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LAKE COUNTRY
Life. The Okanagan Way.

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Water Operations

2019 Overview

The following is intended to inform and summarize 2019 data collections, observations, and work completed by District of Lake Country staff with regards to water operations and water quality.

Water operations highlights include:

- Kalamalka Lake pumphouse backup power installation
- Camp Road and Lakewood Road main upgrade/replacements
- Upgrades to the supervisory control and data acquisition (SCADA) system backbone
- Okanagan Lake Pump Station and UV Treatment system commissioning Plan begins

System Descriptions and Classification

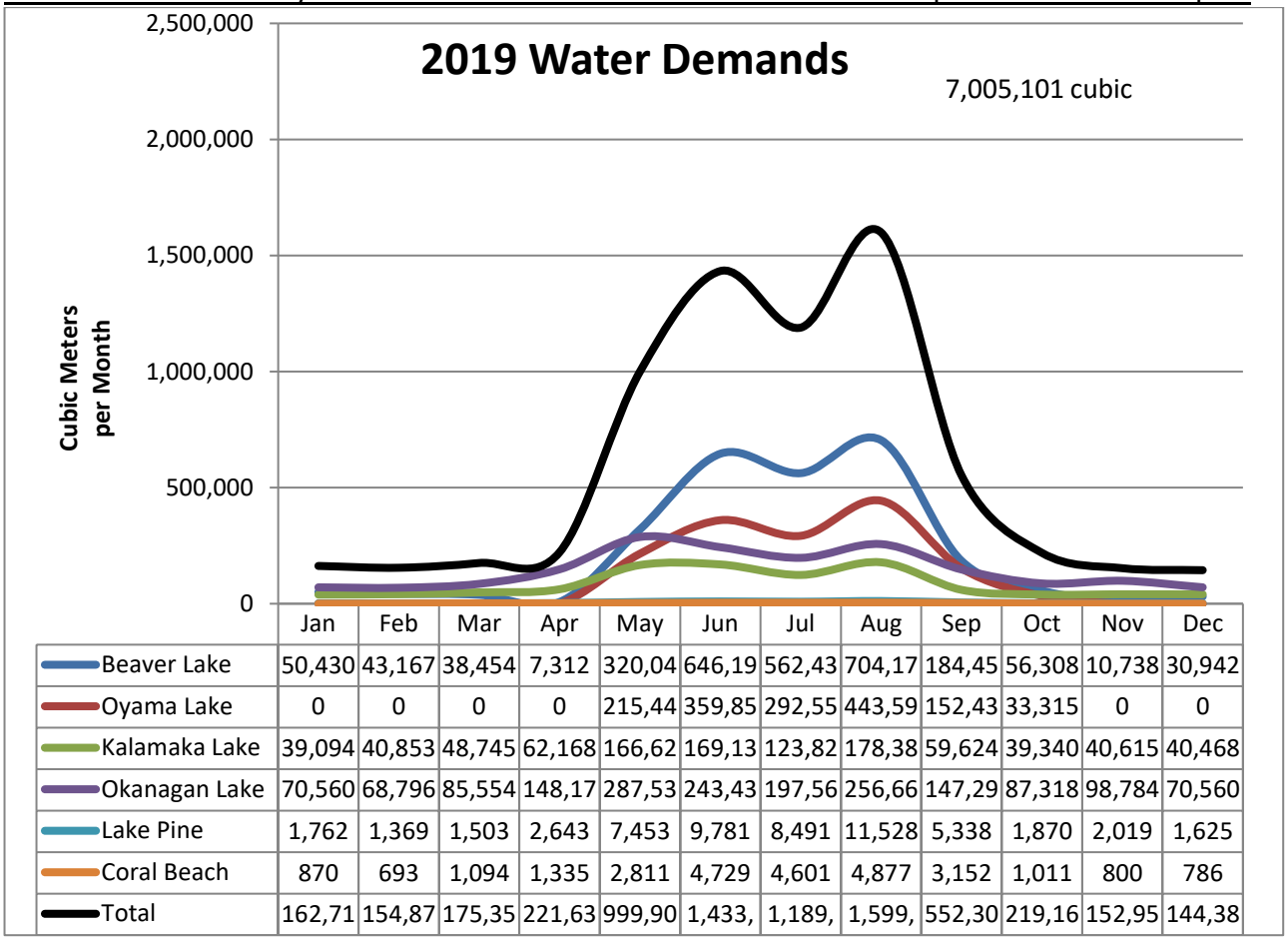
The District of Lake Country (DLC) is a growing municipality with an approximate population of 14,000 people. Not all 14,000 residents are connected to the DLC's public water systems. The primary upland sources used by the DLC include Beaver Lake, Crooked Lake, Oyama Lake, and Damer Lake. The lower elevation 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 2019 was 7,005,101 cubic meters (see Figure 1 for water consumption by source). Water demands in 2019 were the lowest in the previous decade. The DLC largely attributes this to the universal metering program, which was fully implemented by 2017.

Each spring, Beaver and Oyama Lake have increased turbidity in the water from spring freshet. Because of 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
Beaver Lake	50,430	43,167	38,454	7,312	320,04	646,19	562,43	704,17	184,45	56,308	10,738	30,942
Oyama Lake	0	0	0	0	215,44	359,85	292,55	443,59	152,43	33,315	0	0
Kalamaka Lake	39,094	40,853	48,745	62,168	166,62	169,13	123,82	178,38	59,624	39,340	40,615	40,468
Okanagan Lake	70,560	68,796	85,554	148,17	287,53	243,43	197,56	256,66	147,29	87,318	98,784	70,560
Lake Pine	1,762	1,369	1,503	2,643	7,453	9,781	8,491	11,528	5,338	1,870	2,019	1,625
Coral Beach	870	693	1,094	1,335	2,811	4,729	4,601	4,877	3,152	1,011	800	786
Total	162,71	154,87	175,35	221,63	999,90	1,433,	1,189,	1,599,	552,30	219,16	152,95	144,38

Figure 1 . 2019 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.

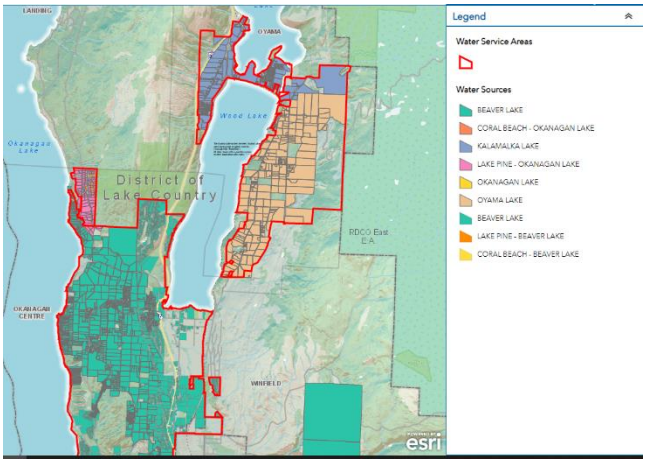
Water Sources

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 2019 Oyama and Beaver Lake level and Discharge **and Drought Management Graphs**

2019 Snowpack

The Oyama Lake snowpack for 2019 was below average. As seen in Figure 1, the end of March measurement was 30% below average. To see the historical snow survey data for Oyama Lake please visit the *BC River Forecast Centers website*, under the 2019(PDF), number 2F19.

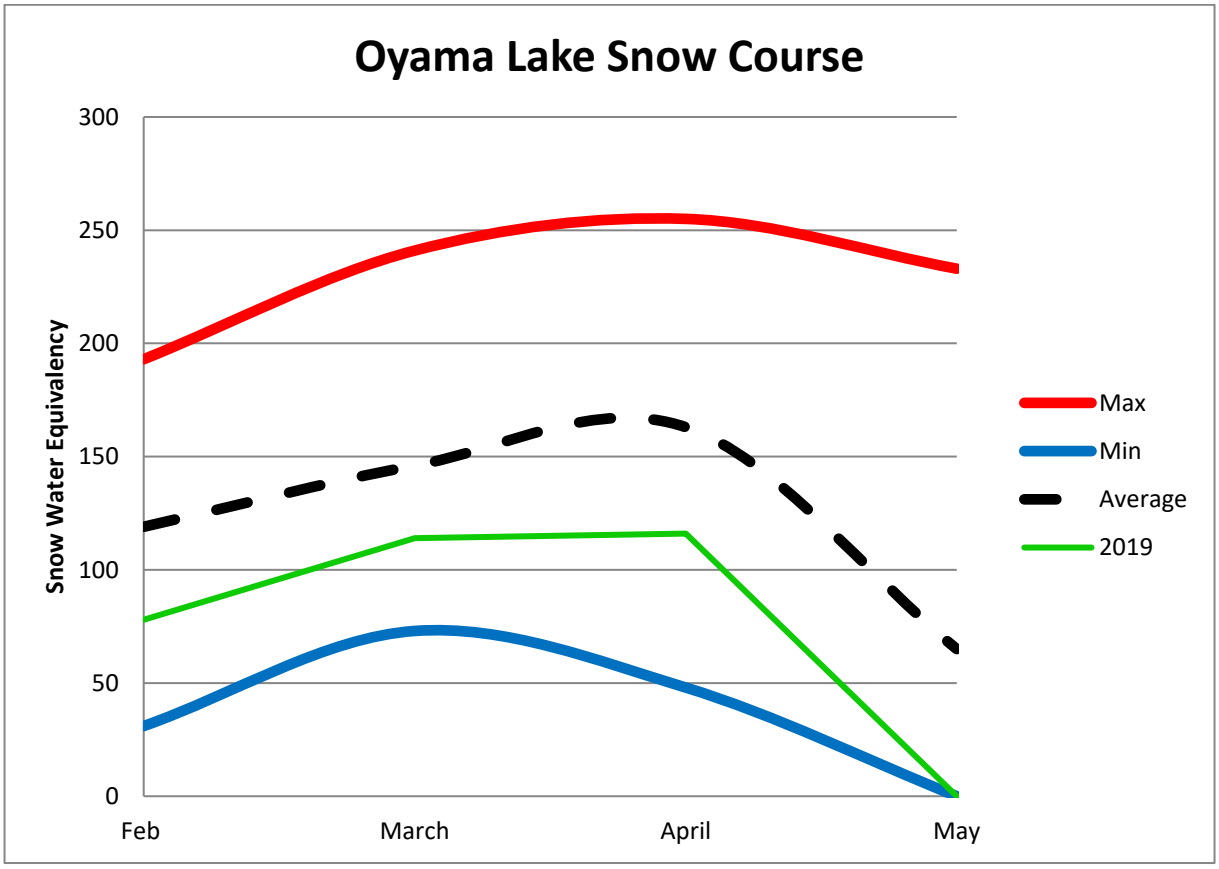


Figure 2. *2019 Oyama Lake Snowpack*

2019 Freshet

Due to the below average snowpack this year, there was no concern of flooding from spring freshet. Beaver Lake filled and spilled mildly, and Oyama Lake was within 2cm of spilling. Large flows were not noted in either Oyama Creek or Upper Vernon Creek due to freshet.

Cross Connection Control Program (CCCP)

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.

Table 1. *Status of cross connection control program noting the severity of hazards and the number of those that were surveyed as being compliant*.

Hazards	Quantity	Not Surveyed	Surveyed	Vacant	Compliant
High	33	0	33	0	33
Medium	88	12	76	0	69
Low	61	7	54	0	43
None	8	8	0	5	0
Totals	190	27	163	5	145

**Note this table is only representative of industrial, intuitional, and commercial customers. The table does not include residential, seasonal irrigation, and agricultural irrigation customers.*

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.

In 2019, the DLC had divers clean the Irvine reservoir. There were no issues of note.

DLC staff drained, cleaned, and inspected the Coral Beach reservoir and the South cell at the upper Lake Pine reservoir. There were no issues of note for any inspection or cleaning.

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.

2019 Operations Project Highlights

Water Distribution Upgrades

In 2019 the District continued efforts to replace aging water distribution infrastructure.

Key projects associated with this work include:

- Lakewood Rd - 90 meters of galvanized steel watermain replaced with 150mm C900 PVC pipe.
- Camp Rd - 90 meters galvanized steel watermain replaced with 200mm C900 PVC pipe.
- East Bench of Oyama – 25 air valves were refurbished with new valves and access chambers.

Upgrades to the Districts SCADA Network

In 2018 the District highlighted a number of upgrades required to improve the District SCADA network. The Districts SCADA network is the automated system that controls both the water and wastewater systems. In 2019 a multi-year project was initiated to improve the radio speed of this network and replace aging and obsolete equipment at various water and wastewater facilities.

Okanagan Lake Pump Station and UV Treatment System Project

The Okanagan Lake Pump Station and Treatment System project is comprised of two main components; retrofit upgrades to the existing Pump Station located beside Okanagan Lake (which will increase the pumping capacity), and the construction of a new UV Facility located beside Okanagan Center Road West. The design of the project began in 2018 and will be complete in early 2021.

Notable event

Glenmore Road Water Main Break

On the morning of May 23, 2019, DLC operators responded to a major water main break on Glenmore Road. The break caused significant damage to adjacent properties and required the District to issue a Boil Water Notice for all customers connected to our Okanagan Lake source. More information about the Boil Water Notice is provided in the “Water Quality Advisory and Boil Water Notice” section of this annual report.

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)*

The DLC has addressed these concerns in our Water Master Plan and we remain in discussions with IHA regarding the implementation and challenges of meeting these requirements.

In 2019 the Provincial Health Officer and The Office of the Auditor General of British Columbia released a report and audit respectively concerning drinking water protection in BC.

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.

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.

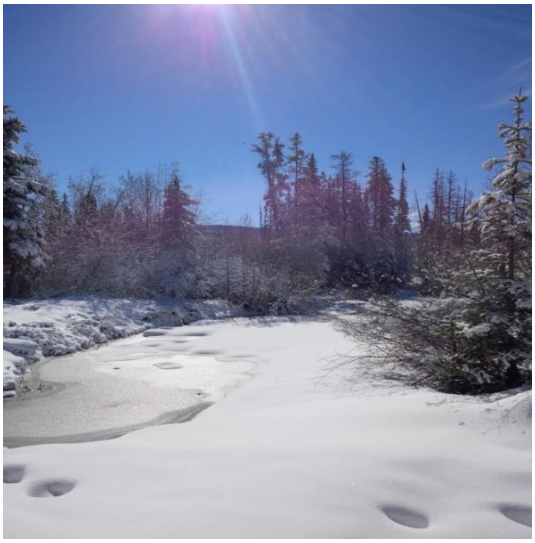
In June 2017, IHA released a report as part of public awareness campaign called Drinking Water in Interior Health. It is an "Assessment of Drinking Water Systems, Risks to Public Health, and Recommendations for Improvement." (January 2017). The Chief Medical Health officer, Dr. Corneil, advises that "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 2019 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.

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 THM averages that exceeded the Guidelines for Canadian Drinking Water Quality (GCDWQ). This year the Lake Pine system, Okanagan Lake source narrowly exceeded the THM guidelines by 0.05mg/L.



Vernon Creek covered in snow.

Water quality results with high THM's such as those from our upper elevation drinking water reservoirs are widespread throughout the Okanagan when untreated then chlorinated water is sourced from lakes with elevated natural organic matter. Generally lower elevation lakes (Okanagan and Kalamalka) have lower THMS 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. All THM results displayed as a running average are detailed in Figures 2-7.

Unlike our two lower elevation reservoir lakes, the source water from the upper watersheds are high in natural organic matter which causes high colour issues and elevated disinfectant by-products. 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) to UV radiation, via a special UV light bulb, which 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

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 5. *2019 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	0.03	0.07	0.46	3	6.4	64
MAX	3.28	3.64	3.8	19	7.5	168
AVERAGE	1.21	1.49	0.98	12	6.9	85
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

Water chemistry equipment (residual chlorine and turbidity meters) at Eldorado Balancing Reservoir

Okanagan Lake Source

Table 6. *2019 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). It should be noted that there was one occasion where the distribution water sampled is a mixture of both sources (Beaver (Vernon Creek) source water) in the Okanagan Lake lines due to the June 25th power outage at Okanagan Lake Pump house. On June 26th Okanagan Lake Source water was again restored through the lines and normal operations resumed.*

	Free Chlorine mg/L	Total Chlorine mg/L	NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.15	0.25	0.21	4	7.5	210
MAX	1.81	2.13	2.06	19	8.2	300
AVERAGE	0.82	1.01	0.42	9	8.0	289
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max) ≤ 5 NTU AO***	***15 AO***	***7.0-10.5 OG***	

Oyama Lake Source

Table 7. *2019 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 offline approximately May 12 – October 15th (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	0.18	0.45	0.28	8	6.2	52
MAX	5.10	5.00	2.5	21	6.7	185
AVERAGE	2.62	2.90	0.86	14	6.4	60
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

Kalamalka Lake Source

Table 8*. 2019 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	0.40	0.61	0.36	3	7.9	275
MAX	2.68	3.06	2.9	17	8.5	454
AVERAGE	1.27	1.53	0.79	9	8.2	405
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***7.0-10.5*** ***OG***	

Table 9. *2019 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	0.11	0.22	0.28	5	7.6	282
MAX	4.20	4.93	3.00	15	8.2	440
AVERAGE	1.17	1.40	0.54	10	8.0	312
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max) ≤ 5 NTU AO***	***15 AO***	***7.0-10.5 OG***	

Lake Pine Water System

Table 10. *2019 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	0.30	0.49	0.20	4.0	7.7	286
MAX	3.28	3.64	0.65	16	8.1	330
AVERAGE	1.35	1.58	0.34	10	8.0	308
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, Coral Beach and Oyama 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. Until additional treatment measures are established to reduce the risk of waterborne illness (3-log (99.9 percent) inactivation and/or removal of Giardia and *Cryptosporidia)* those individuals that have compromised immune systems or other health concerns should take additional steps to reduce risks. Additional information on this can be found in the GCDWQ technical document for Enteric Protozoa: Giardia and Cryptosporidium.

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 2) and the District of Lake Country Water Quality and Monitoring Plan; Frequency of Monthly bacteriological tests (Table 3). 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 4)** are immediately reported to the Drinking Water Officer.

Table 2: *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 3: *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 4: *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. However, in order 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 2019, 270 MF bacteriological samples were collected and analyzed at Caro Environmental Labs in Kelowna for total coliforms and E.coli. Additionally, 128 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 2019 one sample was positive for one (1) Total Coliforms and no E.coli. was detected in any distribution sampling. The sample for one total coliform present at the Coral Beach South End site and follow up sampling returned results with no detection of coliforms. Appendix A contains a summary of the total bacteriological tests collected in each water system and overall.

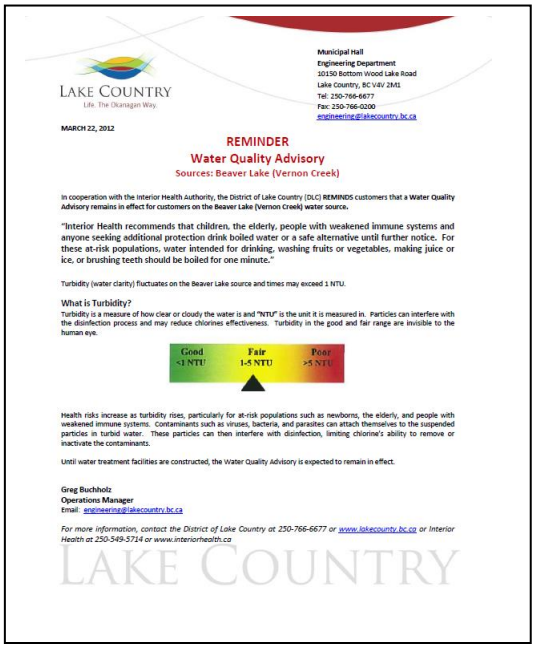
Water Quality Advisory and Boil Water Notice

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 2019 were on a **Water Quality Advisory (WQA)**:

- Beaver Lake (District of Lake Country Water System)
- Oyama Lake (District of Lake Country Water System) (Oyama source Off-line May 12 – October 15 Kalamalka is the primary source and therefore not on advisory during this time)
- Okanagan Lake Source (On June 25th and rescinded June 26th) due to power outage and emergency temporary switch to Beaver Lake Source

The advisories on Beaver and Oyama Sources will remain in effect until infrastructure upgrades are made to improve water quality and reliability.



LAKE COUNTRY
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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

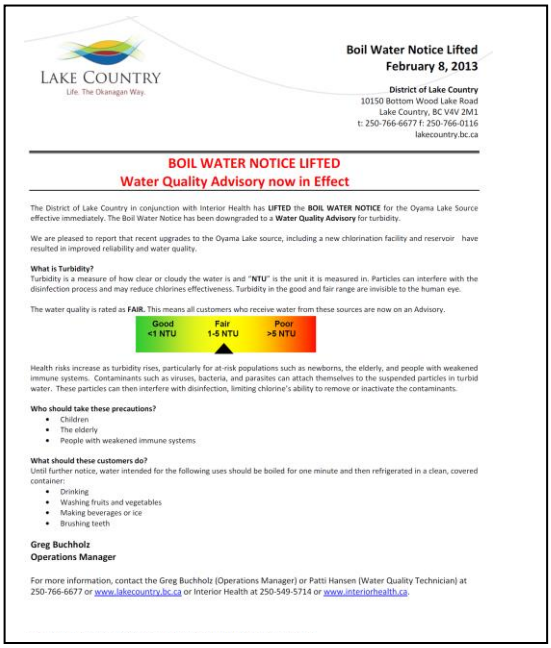
Health risks increase as turbidity rises, particularly for at-risk populations such as newborns, the elderly, and people with weakened immune systems. Contaminants such as viruses, bacteria, and parasites can attach themselves to the suspended particles in turbid water. These particles can then interfere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



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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.

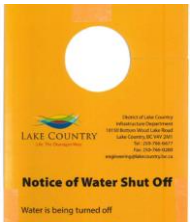
Notice to customers on the Oyama and Beaver sources as to when their water supplies will be switched over or supplemented with an alternate water source of better water quality does not occur. The DLC will continue to supply customers with the best water quality possible and normal operations includes the switching and supplementation of alternate sources to optimize water quality. WQA Reminder notifications are sent to customers on their water bills, it is permanently posted on our web and is publicized on various occasions in our local newspaper paper (The View), DLC social media and on-line through Interior Health Drinking Water Quality Advisory map. In a situation where there is a higher water quality 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.

On June 25th a power outage occurred at the Okanagan Lake Pumphouse following an intense storm event. Until Fortis was able to restore power, an emergency and temporary water supply from the Beaver Lake was supplied to the Okanagan Lake customers. Customers on the Okanagan Lake water supply were then placed on an immediate Water Quality Advisory. When power was restored system checks occurred the following day showing the water quality was acceptable to remove the Water Quality Advisory. On June 26th the Water Quality Advisory for the Okanagan Lake customers was rescinded.

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 2019 water operations crew responded to numerous service repairs and 6 water main breaks.

All repairs in 2019 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*.



LAKE COUNTRY

Notice of Water Shut Off

Water is being turned off

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.

2019 notable water quality events:

Glenmore Watermain Break

On May 23rd, a significant water main break occurred on Glenmore Rd. This main leak impact the Districts Okanagan Lake source significantly enough that a Boil Water Notice was issued immediately, following the procedures from the District's Potable Water Emergency Response Plan.

Notification of this BWN was posted at all DLC facilities, on social media, web page (where you could not move past the first page without removing that notification) and a press release to newspapers, radio stations and local TV news broadcasts. Emails were also sent to all affected customers where the District had their email on file. The BWN stated that this would remain in place until further notice and that updates would be provided as further information became available.

On May 29th, in consultation with Interior Health Authority, the Boil Water Notice was rescinded after water quality sampling demonstrated it was safe to do so. Notification again was provided in the same way it was initiated.

Throughout this event numerous calls and emails were returned, social media comments responded to and DLC Web continued to report and show the BWN in effect throughout event.

Camp Road Watermain Replacement:

In consultation with Interior Health, a temporary, localized Boil Water Notice was issued for residents at 1679, 1685 & 1693 Camp Road during watermain improvements. The order was in place on June 11th and rescinded on June 18th once water quality sampling demonstrated it was safe to do so.

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Boil Water Notice
June 11, 2019

District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1
t: 250-766-6677 f: 250-766-0200
lakecountry.bc.ca

BOIL WATER NOTICE
1679, 1685 & 1693 Camp Road Only

The District of Lake Country in conjunction with Interior Health has issued a **BOIL WATER NOTICE** for the following customers only – **1679, 1685 & 1693 Camp Road** due to the installation of a new water main. A map highlighting the affected customers is below:

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

The District of Lake Country is taking additional measures to reduce risk, and a notification will be issued when water quality has improved.

We appreciate your cooperation and patience during this time. For more information contact Mike Mitchell (Utility Superintendent) or Patti Meger (Water Quality Technician) at 250-766-6677, or www.lakecountry.bc.ca or Interior Health at 250-469-7070 Ext 12274 at www.interiorhealth.ca.

Mike Mitchell
Utility Superintendent
250-766-6677
e-mail: engineering@lakecountry.bc.ca

S:\Engineering\3000 Water Supply & Distribution\30 REPORTS\Monthly Health Report\2019\portable events 2019\2019-06-11 BWN Camp Rd .docx

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Boil Water Noti
June

District of L
10150 Bottom Woo
Lake Country,
t: 250-766-6677 f: 2
lake

BOIL WATER NOTICE LIFTED
1679, 1685 & 1693 Camp Road Only

June 18, 20

The District of Lake Country in conjunction with Interior Health has **LIFTED** the recent **I NOTICE** effective immediately.

Recent testing and monitoring has shown water quality has improved and disinfection (chl have recovered.

Customers are encouraged to run their cold water systems for five (5) minutes to flush the plumbing.

We appreciate your cooperation and patience during this time. For more information c Mitchell (Utility Superintendent) or Patti Meger (Water Quality Technician) at 25 or www.lakecountry.bc.ca or Interior Health at 250-469-7070 Ext 12274 at www.interiorhea

Mike Mitchell
Utility Superintendent
250-766-6677
e-mail: engineering@lakecountry.bc.ca

Trihalomethanes (THM's)

Trihalomethanes (THM's) are a by-product of the water disinfection process. They form when natural organic matter (i.e. decaying vegetation commonly found in lakes and reservoirs) reacts with the chlorine used to treat the water. This reaction produces organic chlorites that include suspected carcinogenic "disinfection by-products," the most common of which are 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 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. In 2019 the DLC posted an article on *details and facts* on mitigating THM's in Lake Country that can also be accessed under our FAQ page on THM's.

2019 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). This year the Lake Pine system, Okanagan Lake source narrowly exceeded the THM guidelines by 0.05mg/L.

Water quality results with high 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 THMS 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. All THM results displayed as a running average are detailed in Figures 2-7.

Figure 3. DLC Beaver lake source trihalomethane (THM) data collected 2002 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). *2002 and 2003 data limited to one sample date.

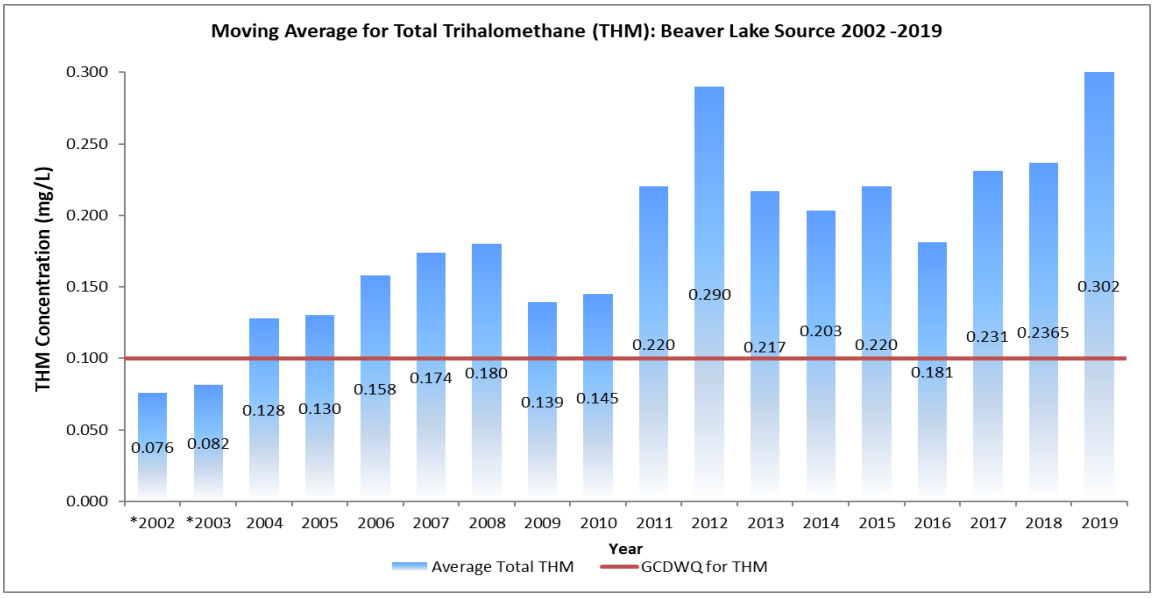


Figure 4. DLC Oyama Lake source trihalomethane (THM) data collected 2004 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Sampling of Oyama source occurs only during irrigation season (approximately May – October) due to Kalamalka source in distribution lines during non-irrigation season. *2016 and 2017 limited to one sample date.

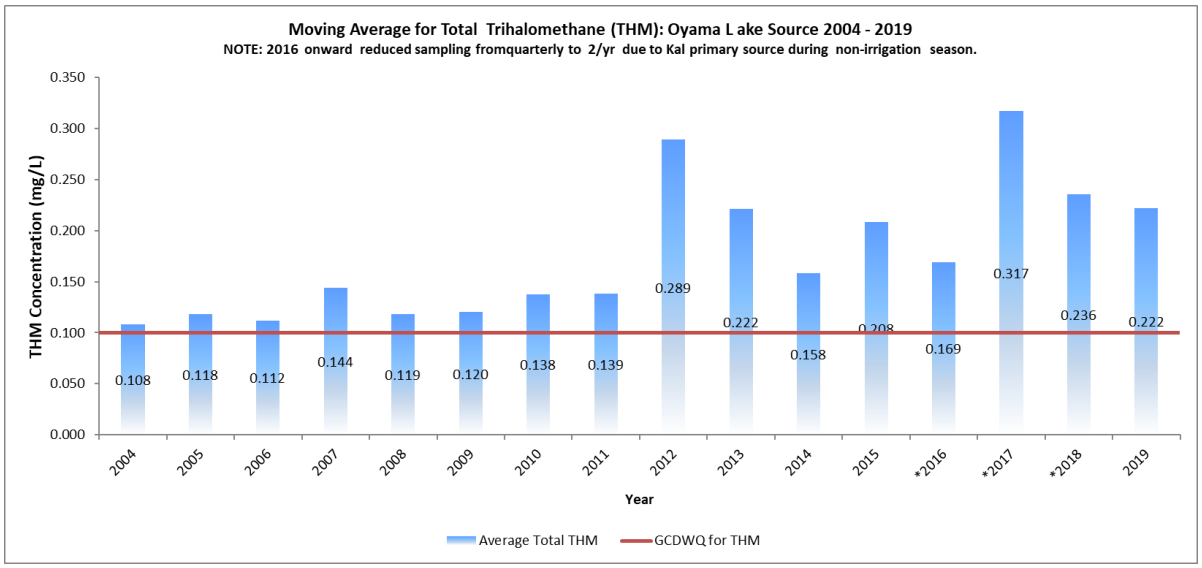


Figure 5. DLC Kalamalka lake source trihalomethane (THM) data collected 2006 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Kalamalka sampling includes sites within Oyama distribution lines during non-irrigation season (approximately October – May).

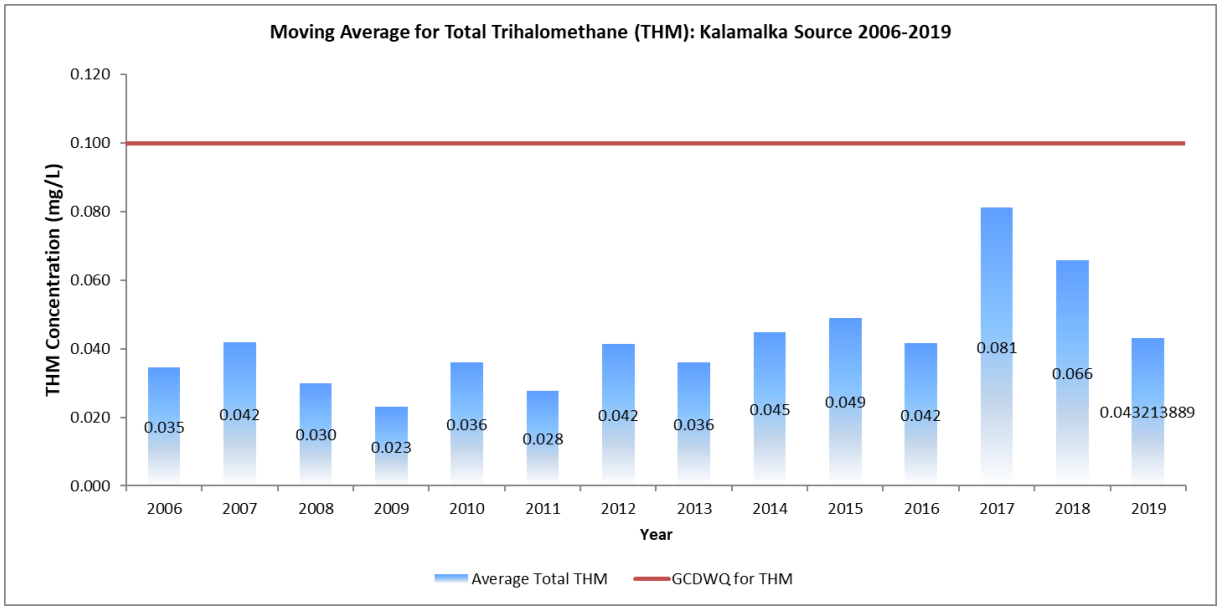


Figure 6. DLC Okanagan Lake source trihalomethane (THM) data collected 2006 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

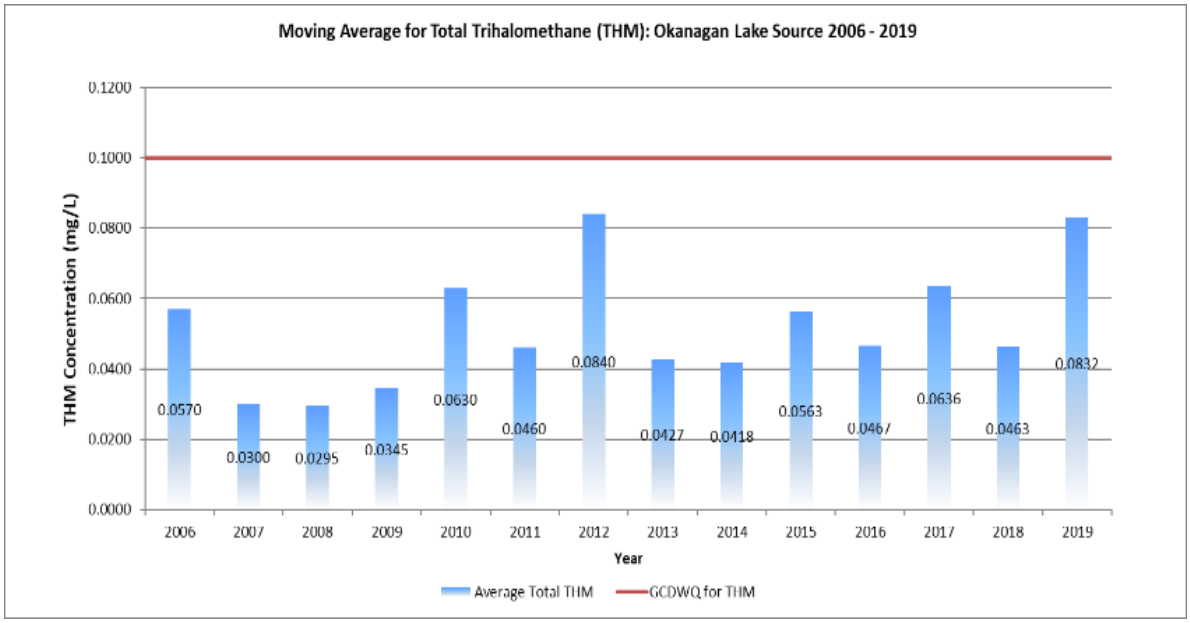


Figure 7. DLC Coral Beach System (Okanagan lake source) trihalomethane (THM) data collected 2009 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

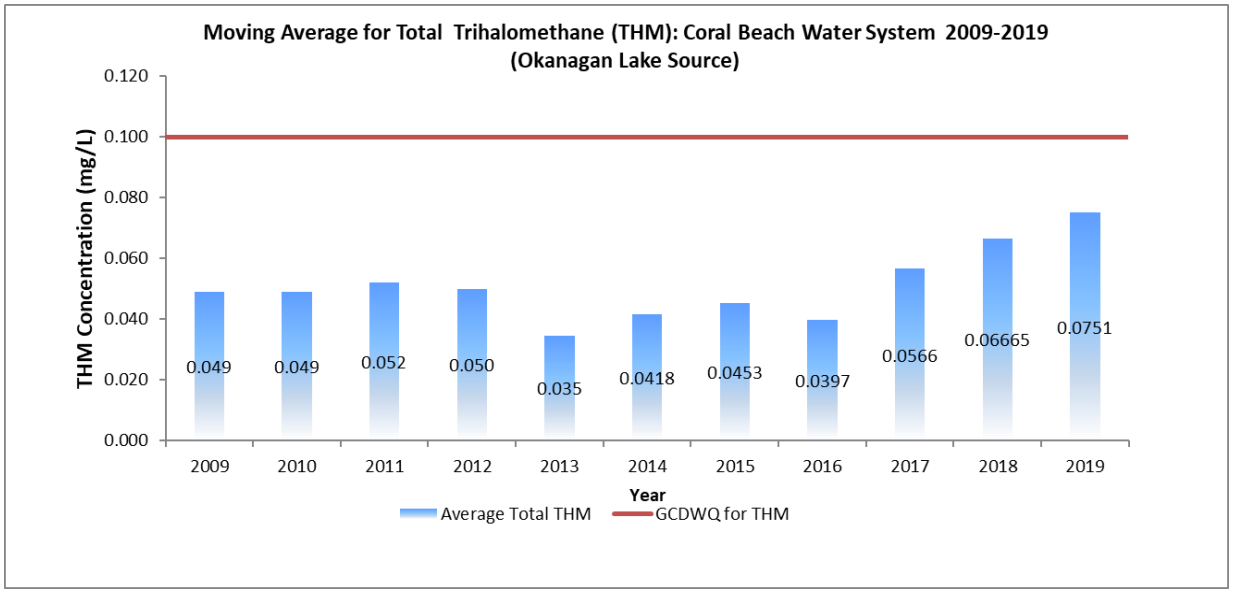
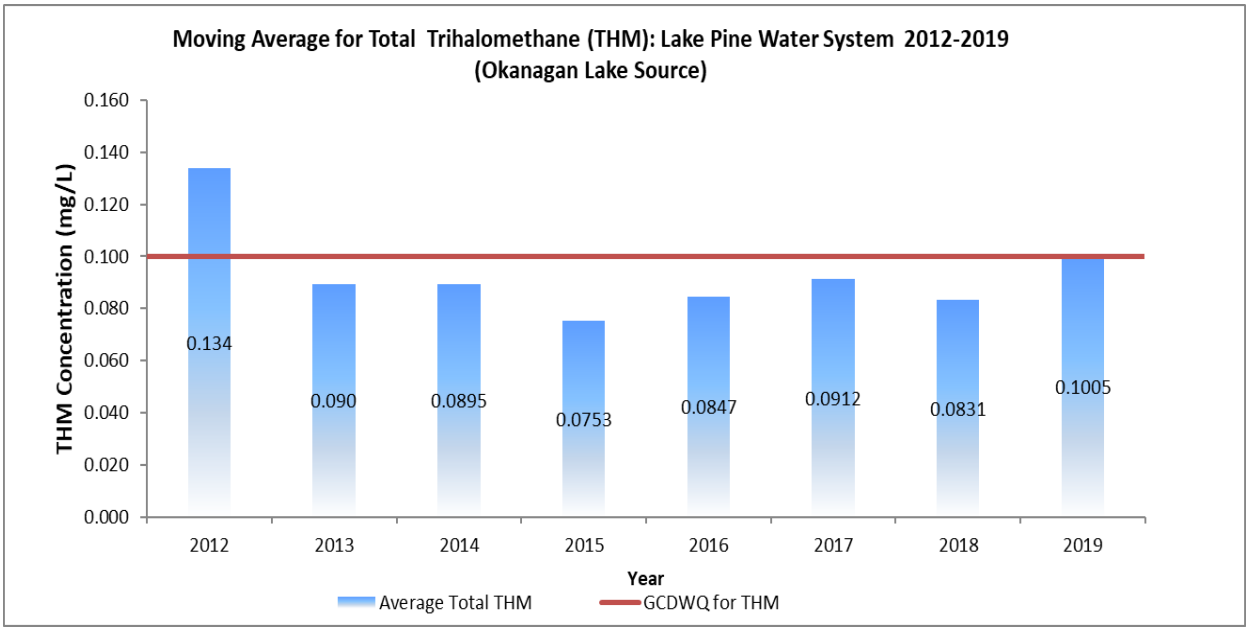


Figure 8. DLC Lake Pine System (Okanagan Lake source) trihalomethane (THM) data collected 2012 – 2019. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).



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 D and the result for nutrient sampling (upland drinking water reservoirs (Beaver and Oyama)) is contained in Appendix E

The DLC's two main upland drinking water reservoirs (Beaver and Oyama Lakes) and creek sources (Vernon and Oyama Creeks) exceeded the GCDWQ for colour and turbidity. Such results are common throughout the Okanagan wherever water is sourced from highland watersheds.

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.
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

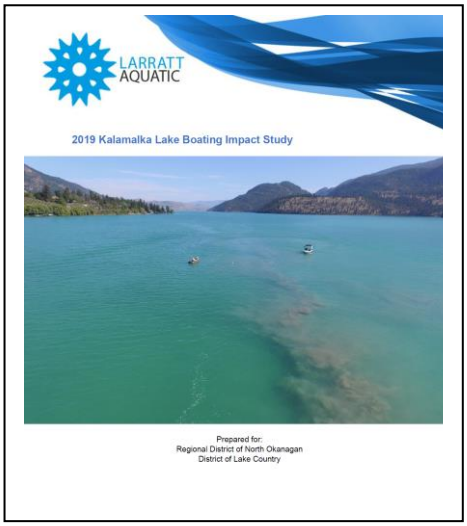
Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. This data are used to characterize the quality of raw water intakes, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish 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 21st year of collaboration on this comprehensive study.

This year the Aquatic biologists looked closer at potential impacts from the 2017 and 2018 flooding. 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 2019 was the record high algae densities reported in the deeper water levels.

The RDNO and DLC also commissioned Larratt Aquatic Consulting to expand on the 2017 Kalamalka and Wood Lakes Boating Capacity Study (Schleppe, Larratt, & Plewes, 2017). That report had identified large power boats as a risk to water quality in the shallow areas of Kalamalka Lake and the intent of the follow-up study was to answer the question of how deep a boat wake can be observed impacting the sediment and what does that impact look like.



The key finding from this study identified the very fine sediment in Kalamalka Lake are very easily re-suspended and the entire south bay is highly vulnerable to re-suspension. The trials demonstrated that water as deep as 8 m can still be impacted by the wake, particularly of a large wake-surf boat.

These significant findings will be used in the current public outreach program on Kalamalka Lake.
Background on the Kalamalka Lake Public Outreach Program:

In June 2018, DLC council officially received the Kalamalka and Wood Lake Boat Impact Study (March 2018) and it was requested that this report be referred to staff to develop a committee to devise implementation strategies and public consultation initiatives to review the recommendations of the report.

Under this direction, DLC staff (Strategic & Support Services Manager and Water Quality Technician) partnered with the RDNO, District of Coldstream and RDCO with an initial step of further public engagement. An OBWB grant was awarded and the Okanagan Collaborative Conservation Program retained to help lead this project. The Boat Impact Study was undertaken to investigate the long-term potential threats of boating activity on the water quality in Wood Lake and Kalamalka Lake, as well as determine potential impacts from boating on environmental values. The study also recorded the number of boats on the lake during the summer at peak times to determine if the lakes were reaching maximum recreational capacity. This grant will cover the costs for developing the public education materials, disseminating information on the awareness of the importance to protect our drinking water intakes and shorelines.

It is anticipated that this report will be a major driver in our drafting of a comprehensive plan for source water protection as we also work towards Council's directive to further engage with the public and to craft a comprehensive source water protection plan for Kalamalka Lake and Okanagan Lake intakes including an implementation plan.

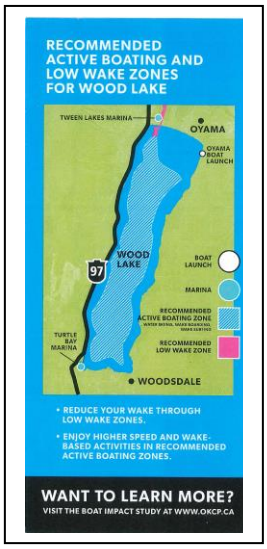


Table 11. *District of Lake Country Water System, 2019 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (Caro Analytical Services).*

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	40	0.28	1.5	6.7	59	24	1	<1	83%
MAX	80	2.35	18	7.8	82	55	1600	43	
AVERAGE	57	1.00	10	7.4	70	33	40 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 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Vernon Creek Intake

Table 12. *District of Lake Country Water System, 2019 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 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=44)
MIN	120	0.20	3.6	7.8	260	<5	<1	<1	84	100%
MAX	160	0.50	10.1	8.1	299	8.5	15	2	87	
AVERAGE	139	0.33	5.9	8.0	273	n/a	44 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 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 13. *District of Lake Country Water System, 2019 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 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=26)
MIN	34	0.29	6	7.2	40	33	18	<1	69%
MAX	40	1.77	20	7.7	65	71	3400	36	
AVERAGE	37	0.84	13	7.5	53	43	26 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 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 14. *District of Lake Country Water System, 2019 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	188	0.34	3	7.9	375	<5	<1	<1	87	100%
MAX	220	1.86	12	8.6	405	13	2	7	92	
AVERAGE	204	0.70	7	8.1	392		49 Samples		90	
WQ Guidelines			*15*	*7-10.5*			*<1*	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max) ≤ 5 NTU AO*	*AO*	*AO*		*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

4 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 15. *Coral Beach Water System, 2019 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 µS/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	136	0.25	5	7.9	261	<5	<1	<1	83	100%
MAX	140	0.89	16	8.5	285	9.3	>390	2	89	
AVERAGE	138	0.41	8	8.0	273	n/a	55 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 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 16. *Lake Pine Water System, 2019 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	136	0.26	7	7.7	263	<5	<1	<1	82	100%
MAX	160	0.60	15	8.1	282	11	75	3	87	
AVERAGE	148	0.35	11	7.9	278		49 Samples		85	
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 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Instrument Calibration and Quality Control

Prior to sampling, field instruments are checked against standards to ensure accuracy. All equipment is regularly maintained and calibrated as required prior to use in the field. Annually, a representative from Hach Services personally attends the DLC to inspect, recalibrate and re-certify water quality hand-held equipment. 2019 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 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

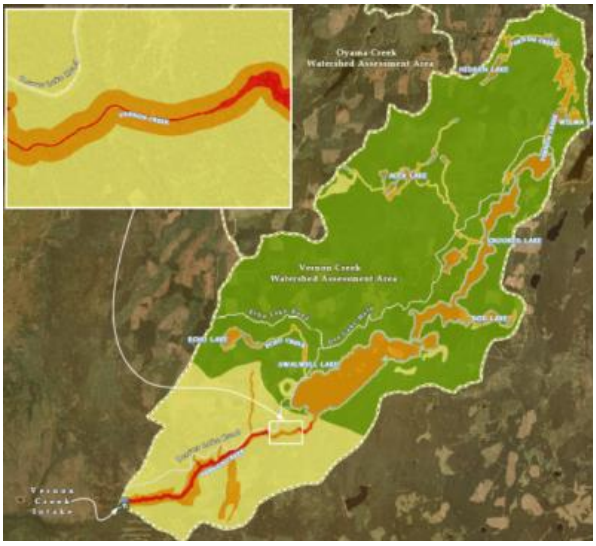
Watershed Source Water Assessment Plans:
2010 Oyama and Vernon Creek Source Water Assessment
(Watershed Protection Plan)]

Damer Lake (above).

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. In light of 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, multijurisdictional 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 2019, the DLC continued to respond and investigate complaints of unsanctioned off-road activities in high vulnerability areas within our community watersheds. A high-risk area was addressed through the logging company's prescription that allowed for fencing. This was a zone directly within the drainage along Vernon Creek and Beaver Lake Road, below our drinking water reservoir and above the drinking water intake. This fencing also helps with restricting cattle access into this zone. 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 particulate loading into our drinking water source.

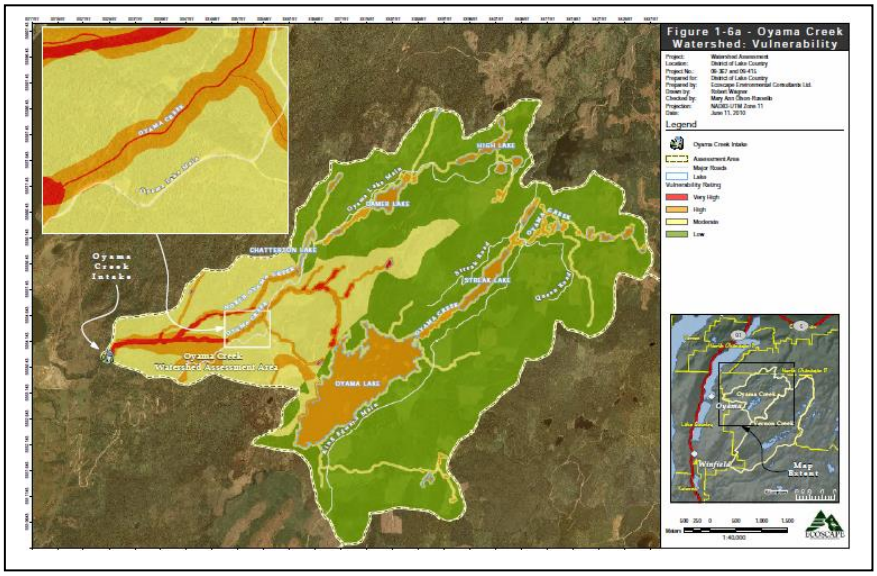
If you notice questionable activities in our Community Watersheds Report All Poachers and Polluters (RAPP)
Violations to the Conservation Officer Service 24-hour hotline: 1-877-952-7277. or #7277 on the TELUS Mobility Network

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 only the RDNO and the DLC watersheds: Duteau, Oyama and Beaver. This setting works much better for individual discussions and specific updates with range use permit holders in our community watersheds. 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.

At this meeting, IHA attended with an update from the Environmental Health Officer. The DLC and RDNO provided updates on general operations, snowpack, multi-purpose watershed concerns, wildfire reduction works and communications with ranchers. 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. The focus on this meeting was on herd health, one of the best management practices ranchers can employ to reduce the risk of livestock impact to water quality. Ranchers each gave an overview of their range management, discussed their herd health and their cattle numbers with respect to water quality and the range use plans for 2020 grazing season. The final part of this meeting provided an opportunity for timber licensees and range tenure holders to review harvest plans and potential issues with cattle management. Concern remains on the impact from (non-sanctioned) recreational and off-road vehicle activities in our watershed as well as forestry development.



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

Shown left is the Oyama Creek Vulnerability zone map.

In July 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. 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.

DLC staff also 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 2019. 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.

Forestry

Harvest activities in our community watersheds continued in 2019. There are two major licencees in our watersheds: Tolko and BC Timber Sales, both of which had harvest operations in 2019. As mentioned under the watershed section, both Tolko and BCTS have opted out of public advisory group planning. Both Tolko and BCTS are now obtaining their certification through the Sustainable Forestry Initiative (SFI) that is not open to public input or consultation in the development and reporting of targets and indicators in the open consultation process as the DLC had previously participated in with the SFMP.

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.

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.

As with major licencees, when small scale salvage operations occur in DLC'S watersheds, DLC staff review the referral for comment/recommendations and remind or provide the applicant a copy of our Watershed Protection Plan highlighting the importance of recognizing our vulnerability zones and properly planning and working within these zones. The DLC's highest concerns are within high vulnerability zones regardless of type of the proposed activity. The DLC continues to express concern with the Province authorizing approval for small scale salvage logging in high vulnerability zones (commonly within a major licensee's Lakeshore protection).

When a licencee proposes logging in our community watershed, the DLC ensures the licencee is aware of the 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. We intend to work with all parties involved on this land base to ensure that potential landslides areas are addressed and to have the least amount of impact from drainage and access. It is imperative that any work within our high vulnerability zones have these important considerations. Additionally, The DLC requests that prescriptions include 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 2019 the focus of concern for the DLC remained the two blocks above the Vernon Creek Intake. In 2017 the DLC hired a specialized hydrologist with forestry expertise to specifically address our apprehension with these sites. One site is situated directly above our drinking water intake and the other in the drainage adjacent to the steep slopes. Both could have potentially catastrophic impact to our community drinking water supply with immediate impact at our intake. In the first block directly above our intake, in 2018 and 2019 discussions and block walks continued to ensure that DLC's specific water management prescriptions were being addressed in Tolko's plans. Tolko is now fully aware of this high vulnerability area and the sensitivities of this block. The DLC has now been advised they have harvested this site and have confirmed our concerns were addressed. The other high-risk area site above our intake generated various field trips and discussions as well. The DLC, our subject matter expert and Tolko met in person with Tolko's Area Supervisor, Area Manager and their geoscientist regarding the sensitivity of this proposed area. The DLC wanted to understand the need for logging in this high risk, high vulnerability area and for us to clearly communicate our concerns and consequences should a slope failure occurred in this area. No further communications followed our meeting and we await the next stage.

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 and 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/

2017 and 2018 were the worst wildfire seasons on record (over 2 million Ha lost to wildfires) with a provincial state of emergency being declared each year. 2019 was low fire activity in BC with 21,138 Hectares lost and 206 wildfires in our region, the Kamloops Fire Centre (Note BCWS year is April and March).

Regardless of one low fire season, 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 expected impacts seen directly following the first storm event (or freshet) and 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. This is identified in our Potable Water Emergency Response Plan (Section 3.10 provided to IHA July 2018). Currently (throughout the wildfire season) the DLC maintains contact weekly with the BCWS to obtain information for the Zone Wildfire Commanding Officer should a strike occur in our community watersheds. This officer would then provide direct communication with our primary contact for information on our infrastructure and provide progress reports. This protocol was extended in 2019 as the extreme dry season went well into the fall. We will continue to work with BCWS to have the DLC updated in their BCWS Pre-Organization book (i.e. for primary contact if wildfire occurs in Beaver or Oyama Watersheds).

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)	none detected in distribution system					42	22
Okanagan Lake Source	none detected in distribution system					52	20
Oyama Lake Source (WQA)	none detected in distribution system					24	13
Kalamalka Lake Source	none detected in distribution system					46	23
Coral Beach Water System: Okanagan Lake Source	1 CFU/100ml Total coliforms and NO E.Coli detected in distribution system Sept. 3 2019					54	27
Lake Pine Water System: Okanagan Lake Source	none detected in distribution system					52	24
					TOTAL:	***270***	***129***

* 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.

Appendix B – District of Lake Country Sampling Sites

District of Lake Country Water System: Beaver Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	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										
Artella	Beaver Lk				x	x											x							x
Breakwater	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							
Middleton Rd (Future)	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

Appendix B continued – District of Lake Country Sampling Sites

District of Lake Country Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	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	
Clement	Ok Lk			x					x								x			x		x	x	
New Station replace Clement	Ok Lk																							
Copper Hill	Ok Lk			x		x											x					x		
Glenmore Booster Station	Ok Lk		x	x			x				x				x									
Jardine Pump Stn	Ok Lk			x						x						x								
Kelwin	Ok Lk				x						x						x							
Lower Lakes Reservoir (cell 1)	Ok Lk			x			x				x					x								
McCoubrey	Ok Lk			x				x								x								
Ok Bio Fuels (Jim Bailey Rd)	Ok Lk			x		x																		
Ponderosa pumphouse	Ok Lk			x				x									x							
Ponderosa PRV stn	Ok Lk			x							x					x								
Ottley Rd (off Stubbs)	Ok Lk			x				x							x						x			
Upper Lakes Reservoir	Ok Lk			x					x															
Upper Zone (Future)	Ok Lk			x																		x		
Lake Stone (Future)	Ok Lk			x																		x		

District of Lake Country Water System: Oyama Lake Source

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

Appendix B continued – District of Lake Country Sampling Sites

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							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			
Sawmill Rd Booster (Future)	Kal			x												x	x							
Oyama Creek Chlorination Facility (distribtuion water fromKal Source (Sawmill) to Oyama reservoir)	Kal						x						x	x										
Old Oyama Pumphouse	Kal				x						x		x			x								x
Teddy Bear (seasonal)	Kal			x							x						x			x				x

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		

Appendix B continued– District of Lake Country Sampling Sites

Lake Pine Water System: Okanagan Lake Source

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

2019 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Okanagan	Oyama	Kal Lake	Coral Beach	LakePine
Site		VERNON CREEK Intake	OK Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House
Date		25-Jun-19	24-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	24-Jun-19
Anions							
Chloride	mg/L	1.55	4.83	0.30	8.71	4.65	5.07
Chloride (AO)	mg/L	< 250	< 250	< 250	< 250	< 250	< 250
Fluoride	mg/L	<0.10	0.18	<0.10	0.29	0.18	0.19
Fluoride (MAC)	mg/L	1.5	1.5	1.5	1.5	1.5	1.5
Nitrogen, Nitrate as N	mg/L	0.118	0.082	0.035	0.068	0.052	0.088
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	3.8	30.4	3.0	50.4	29.8	31.6
Sulphate (AO)	mg/L	< 500	< 500	<500	<500	<500	<500
General Parameters							
Alkalinity (total)	mg/L	36.3	112	23.4	161	115	113
No current guidelines							
True Colour	CU		<5.0	**46**	<5.0	5.7	6.0
True Colour (AO)	CU	< 15	< 15	< 15	< 15	< 15	< 15
Conductivity	uS/cm	80.3	271	51.2	394	268	278
No current guidelines							
Cyanide	mg/L	<0.0020	<0.0020	<0.0050	<0.0050	<0.0020	<0.0020
Cyanide (MAC)	mg/L	0.2	0.2	0.2	0.2	0.2	0.2
pH	pH units	7.54	8.10	7.44	8.20	8.04	8.09
pH (OG)	pH units	7.0-10.5	7.0-10.5	7.0-10.5	7.0-10.5	7.0-10.5	7.0-10.5
Turbidity	NTU	0.75	0.27	0.56	0.39	0.39	0.28
Turbidity Guide	NTU	<1	<1	<1	<1	<1	<1
Calculated Parameters							
Hardness (mg/L as $CaCO_3$)	mg/L	35.7	120	23	174	118	121
No current guidelines see glossary below							
Total Dissolved Solids/TDS	mg/L	43.6	162	29.1	238	159	164
TDS (AO)	mg/L	< 500	< 500	< 500	< 500	< 500	< 500

Appendix C continued– Comprehensive Test Results

2019 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Okanagan	Oyama	Kal Lake	Coral Beach	LakePine
Site		VERNON CREEK Intake	OK Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House
Date		25-Jun-19	24-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	24-Jun-19
Total Recoverable Metals							
Aluminium (total)	mg/L	0.0388	<0.0050	0.0524	<0.0050	<0.0050	0.0064
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	0.00060	<0.00050	0.00090	0.00050	0.00059
Arsenic (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Barium (total)	mg/L	<0.0050	0.0243	0.0088	0.0277	0.0215	0.0250
Barium (MAC)	mg/L	1	1	1	1	1	1
Beryllium (total)	mg/L	<0.00010	<0.00010	*	*	<0.00010	<0.00010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Bismuth (total)	mg/L	<0.00010	<0.00010	*	*	<0.00010	<0.00010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal Lake)							
Boron (total)	mg/L	<0.0050	0.0145	<0.0050	0.0158	0.0095	0.0132
Boron (MAC)	mg/L	5	5	5	5	5	5
Cadmium (total)	mg/L	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	0.000013
Cadmium (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Calcium (total)	mg/L	7.75	34.1	5.53	37.4	30.1	33.4
No current guidelines							
Chromium (total)	mg/L	<0.00050	<0.00050	<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							

Appendix C continued – Comprehensive Test Results

2019 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Okanagan	Oyama	Kal Lake	Coral Beach	LakePine
Site		VERNON CREEK Intake	OK Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House
Date		25-Jun-19	24-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	24-Jun-19
Total Recoverable Metals cont.							
Copper (total)	mg/L	0.00108	0.00084	0.00443	0.00081	0.00086	0.00863
Copper (MAC)	mg/L	2	2	2	2	2	2
Iron (total)	mg/L	0.088	<0.010	0.109	0.022	<0.010	<0.010
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	<0.00020	0.00051
Lead (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Lithium (total)	mg/L	0.00075	0.00335	*	*	0.00347	0.00352
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal Lake)							
Magnesium (diss.)	mg/L	3.68	10.1	2.23	19.60	9.59	10.2
No current guidelines							
Manganese (total)	mg/L	0.00664	0.00095	0.00502	0.00211	0.00103	0.00124
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	0.00033	0.00378	0.00024	0.00525	0.00348	0.00397
No current guidelines							
Nickel	mg/L	0.00067	0.00041	0.00142	0.00043	<0.00040	0.00107
No current guidelines							
Phosphorus	mg/L	<0.050	<0.050	*	*	<0.050	<0.050
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Potassium (total)	mg/L	1.08	2.39	1.24	4.85	2.40	2.40
No current guidelines							
Selenium (total)	mg/L	<0.00050	<0.00050	<0.00050	0.00105	<0.00050	<0.00050
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Silicon	mg/L	5.4	3.7	*	*	3.7	3.7
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Silver	mg/L	<0.000050	<0.000050	*	*	<0.000050	<0.000050
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Sodium (total)	mg/L	3.08	11.9	2.39	18.8	11.8	12.2
Sodium (AO)	mg/L	< 200	< 200	< 200	< 200	< 200	< 200
Strontium (total)	mg/L	0.0470	0.311	0.0398	0.460	0.274	0.322
No current guidelines							
Sulfur (total)	mg/L	<3.0	11.7	*	*	10.1	11.7
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Tellurium (total)	mg/L	<0.00050	<0.00050	*	*	<0.00050	<0.00050
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Thallium (total)	mg/L	<0.000020	<0.000020	*	*	<0.000020	<0.000020
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Thorium (total)	mg/L	<0.00010	<0.00010	*	*	<0.00010	<0.00010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Tin (total)	mg/L	<0.00020	<0.00020	*	*	<0.00020	<0.00020
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Titanium (total)	mg/L	<0.0050	<0.0050	*	*	<0.0050	<0.0050
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							

Appendix C continued– Comprehensive Test Results

2019 Water Potability Test (aka Comprehensive Results)							
Distribution Source		Beaver	Okanagan	Oyama	Kal Lake	Coral Beach	LakePine
Site		VERNON CREEK Intake	OK Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House	CORAL BEACH Pump House	LAKEPINE Pump House
Date		25-Jun-19	24-Jun-19	26-Jun-19	26-Jun-19	26-Jun-19	24-Jun-19
Tungsten (total)	mg/L	<0.0010	<0.0010	*	*	<0.0010	<0.0010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Uranium (total)	mg/L	0.000049	0.00266	0.000082	0.00328	0.00251	0.00349
Uranium (MAC)	mg/L	0.02	0.02	0.02	0.02	0.02	0.02
Vanadium (total)	mg/L	<0.0010	<0.0010	*	*	<0.0010	<0.0010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							
Zinc (total)	mg/L	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0379
Zinc (AO)	mg/L	< 5	< 5	< 5	< 5	< 5	< 5
Zirconium (total)	mg/L	0.00013	<0.00010	*	*	<0.00010	<0.00010
No current guidelines *Additional Note: Lab did not report this parameter for Oyama and Kal lake)							

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

2019 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		18-Jul-2019	18-Jul-2019	18-Jul-2019
Anions				
Nitrogen (Nitrate as N)	mg/L	<0.010	<0.010	0.069
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	0.0116	0.0206
No current guidelines				
Sulfate	mg/L	2.5	1.3	2.6
Sulfate (AO)	mg/L	≤ 500	≤ 500	≤ 500
General Parameters				
Alkalinity, Total (as CaCO3)	mg/L	15.5	15.4	24.8
No current guidelines				
Alkalinity,Phenolphthalein (as CaCO3)	mg/L	<1.0	<1.0	<1.0
No current guidelines				
Alkalinity, Bicarbonate (as CaCO3)	mg/L	15.5	15.4	24.8
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 guideline				
Total Organic Carbon	mg/L	9.18	9.9	15.6
No current guidelines				
Dissolved Organic Carbon	mg/L	9.12	9.38	15
No current guidelines				
Chlorophyll-a	ug/L	2.21	2.46	8.49
No current guidelines				
Colour, True	CU	37	43	98
Colour(AO)	CU	≤15	≤15	≤15
Phosphorus, Total (as P)	mg/L	0.013	0.0192	0.0213
No current guidelines				
Calculated Parameters				
Hardness, Total (as CaCO3)	mg/L	18.9	15.1	22.8
No current guidelines see definition below				
Total Dissolved Aluminium	mg/L	0.0187	0.0207	0.0562
Total Recoverable Aluminium	mg/L	0.0343	0.0301	0.0874
Aluminium (OG)	mg/L	< 0.1	< 0.1	< 0.1
Total Dissolved Antimony	mg/L	<0.00020	<0000020	<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	<0.0050	0.0066	0.0094
Total Recoverable Barium	mg/L	0.0057	0.007	0.0105
Barium (MAC)	mg/L	1	1	1
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				

Appendix D continued – Nutrient Sampling Upland Drinking Water Reservoirs

2019 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		18-Jul-2019	18-Jul-2019	18-Jul-2019
Metals				
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	<0.0050	<0.0050	<0.0050
Total Recoverable Boron	mg/L	0.005	0.0077	0.0064
Boron (MAC)	mg/L	5	5	5
Total Dissolved Cadmium	mg/L	0.000055	<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	4.92	3.66	5.00
Total Recoverable Calcium	mg/L	5.07	3.64	5.26
No current guidelines				
Total Dissolved Chromium	mg/L	<0.00050	<0.00050	<0.00050
Total Recoverable Chromium	mg/L	<0.00050	<0.00050	<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	<0.00010	<0.00010
No current guidelines				
Total Dissolved Copper	mg/L	0.00051	<0.00040	0.00049
Total Recoverable Copper	mg/L	0.00101	<0.00040	0.00053
Copper (AO)	mg/L	2	2	2
Total Dissolved Iron	mg/L	0.08	0.084	0.146
Total Recoverable Iron	mg/L	0.125	0.111	0.255
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	0.00046	0.00059	0.00127
Total Recoverable Lithium	mg/L	0.00051	0.00062	0.00147
No current guidelines				
Total Dissolved Magnesium	mg/L	1.61	1.44	2.50
Total Recoverable Magnesium	mg/L	1.67	1.35	2.56
No current guidelines				

Appendix D continued – Nutrient Sampling Upland Drinking Water Reservoirs

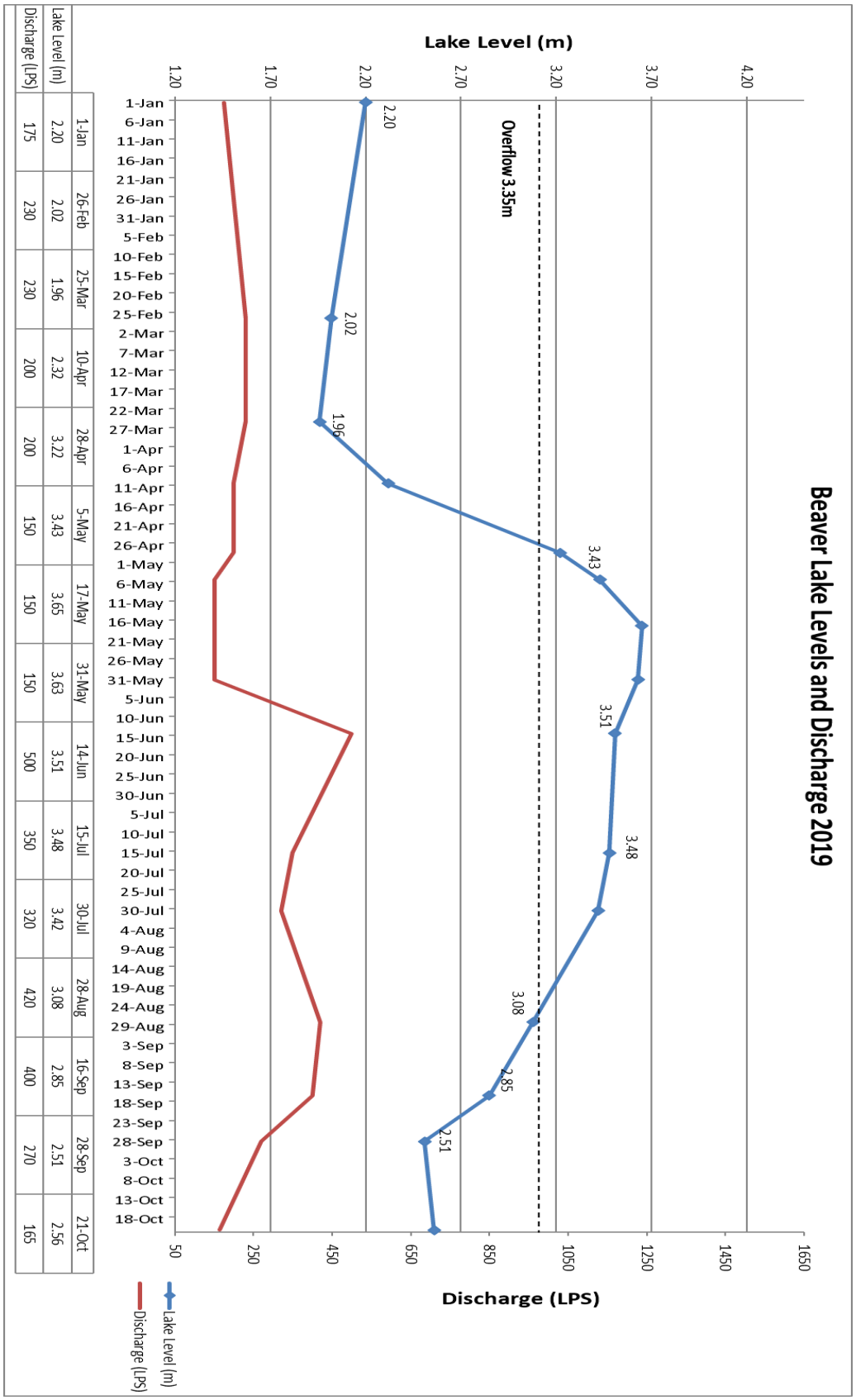
2019 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		18-Jul-2019	18-Jul-2019	18-Jul-2019
Metals Continued				
Total Dissolved Manganese	mg/L	0.00121	0.00094	0.00599
Total Recoverable Manganese	mg/L	0.0057	0.00823	0.00969
Manganese (AO)	mg/L	0.12	0.12	0.12
Total Dissolved Mercury	mg/L	<0.000010	<0.000010	<0.000010
Total Recoverable Mercury	mg/L	<0.000010	<0.00010	<0.00010
Mercury (MAC)	mg/L	0.001	0.001	0.001
Total Dissolved Molybdenum	mg/L	0.00015	0.00014	0.0029
Total Recoverable Molybdenum	mg/L	0.00017	0.00039	0.00041
No current guidelines				
Total Dissolved Nickel	mg/L	<0.00040	0.00067	0.00178
Total Recoverable Nickel	mg/L	0.0007	0.00101	0.00201
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	0.80	0.84	1.22
Total Recoverable Potassium	mg/L	0.83	0.79	1.24
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	3.2	2.4	3.9
Total Recoverable Silicon	mg/L	3.2	2.7	4.3
No current guidelines				
Total Dissolved Silver	mg/L	<0.000050	<0.000050	<0.000050
Total Recoverable Silver	mg/L	<0.00050	<0.000050	<0.000050
No current guidelines				
Total Dissolved Sodium	mg/L	1.85	1.81	2.31
Total Reocoverable Sodium	mg/L	1.94	1.66	2.27
Sodium (AO)	mg/L	≤ 200	≤ 200	≤ 200
Total Dissolved Strontium	mg/L	0.0345	0.0312	0.0368
Total Recoverable Strontium	mg/L	0.0356	0.0303	0.0397
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

2019 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	0.000030	0.000032	0.000103
Total Recoverable Uranium	mg/L	0.000032	0.000032	0.000106
Uranium (MAC)	mg/L	0.02	0.02	0.02
Total Dissolved Vanadium	mg/L	<0.0010	<0.0010	<0.0010
Total Recoverable Vanadium	mg/L	<0.0010	<0.0010	<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	0.00041	0.00142
Total Recoverable Zirconium	mg/L	0.0004	0.00037	0.00106
No current guidelines				
Glossary of Terms, GCDWQ:				

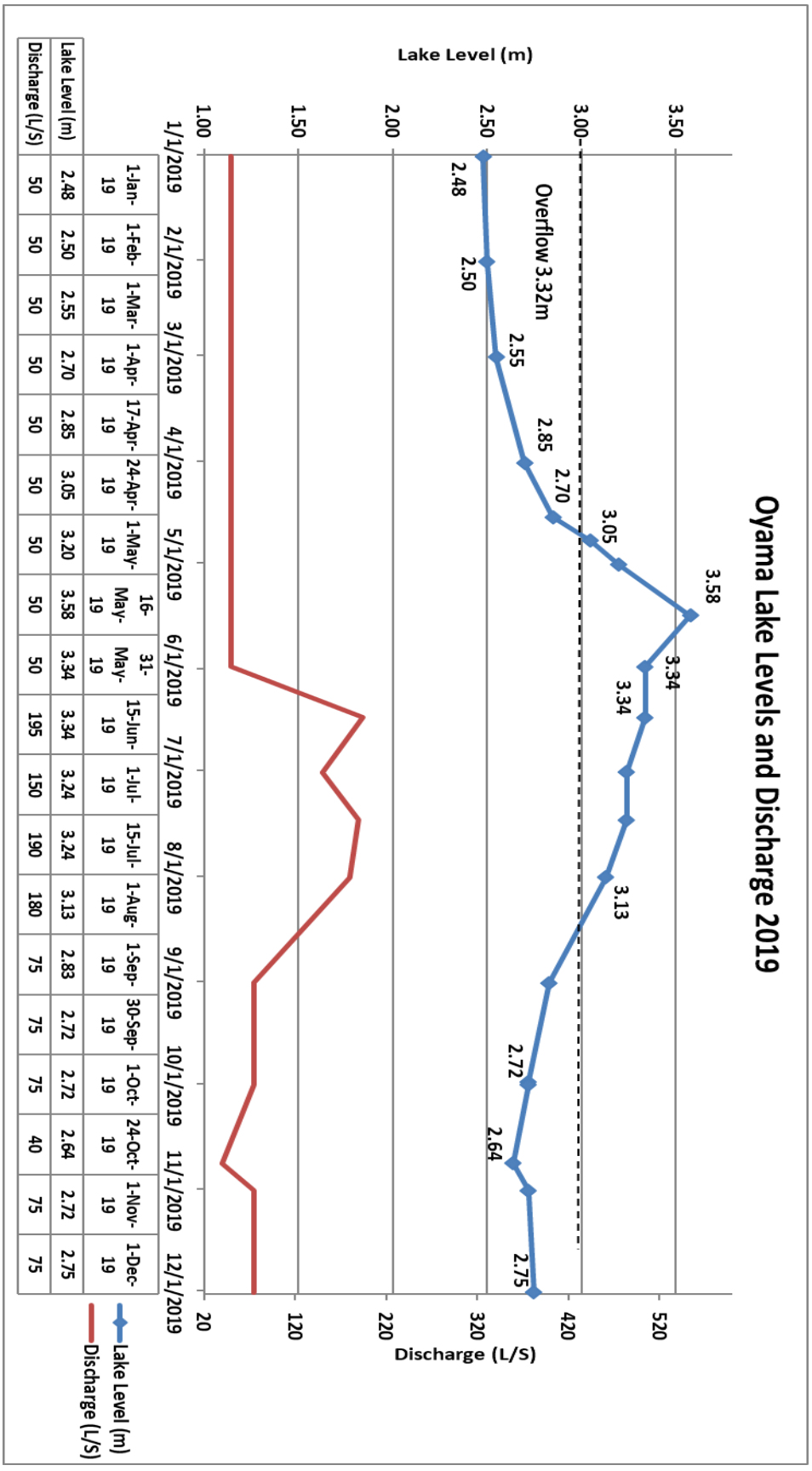
<	Less than. Reported when result is less than the reported detection limit
≤	Less than or equal to. Reported when result is less or equal to the reported detection limit
AO	Aesthetic objective. Refer to GCDWQ
MAC	Maximum acceptable concentration. Refer to GCDWQ
OG	Operational guidance values. Refer 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



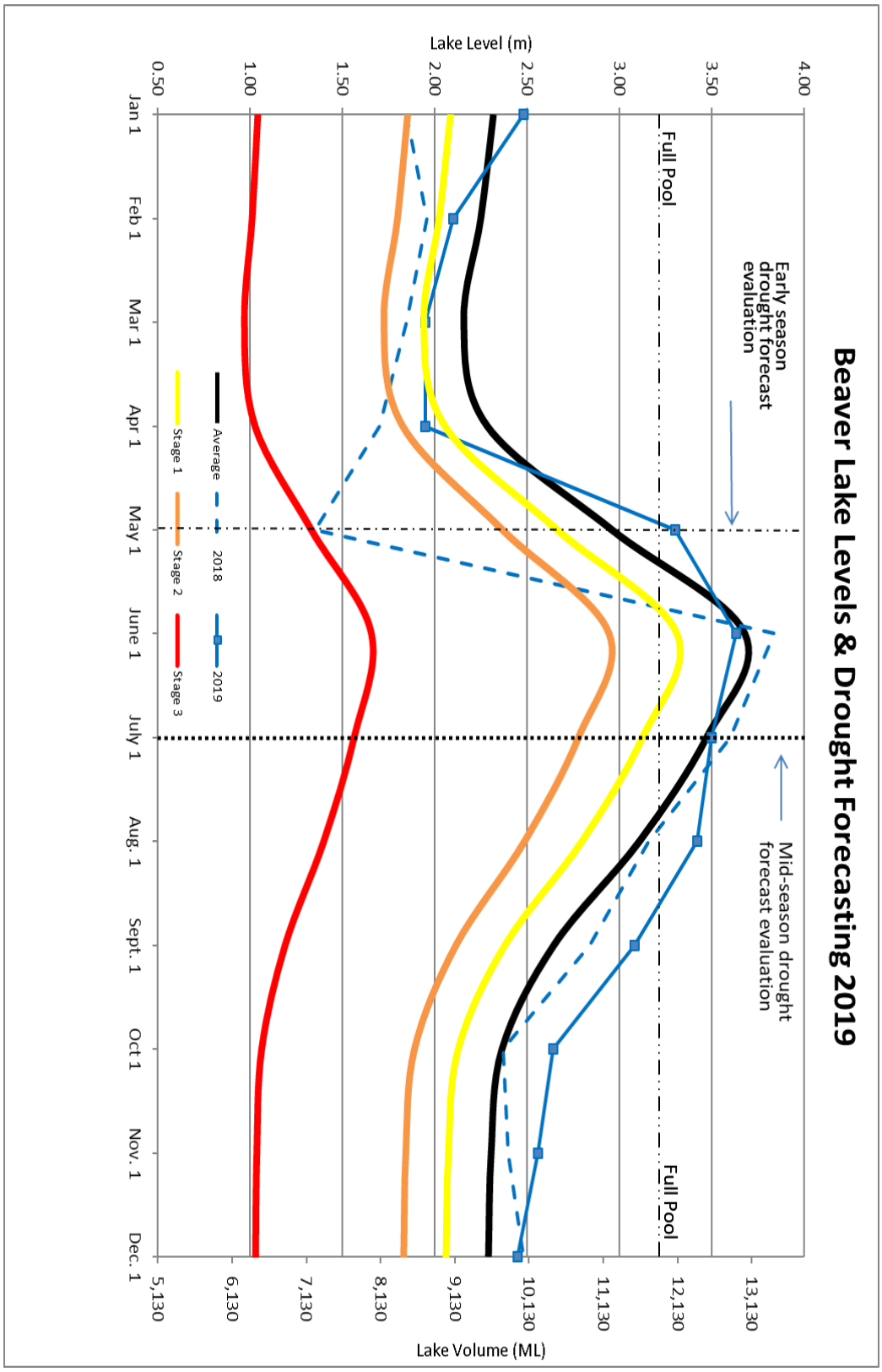
	1-Jan	26-Feb	25-Mar	10-Apr	28-Apr	5-May	17-May	31-May	14-Jun	15-Jul	30-Jul	28-Aug	16-Sep	28-Sep	21-Oct
Lake Level (m)	2.20	2.02	1.96	2.32	3.22	3.43	3.65	3.63	3.51	3.48	3.42	3.08	2.85	2.51	2.56
Discharge (LPS)	175	230	230	200	200	150	150	150	500	350	320	420	400	270	165

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

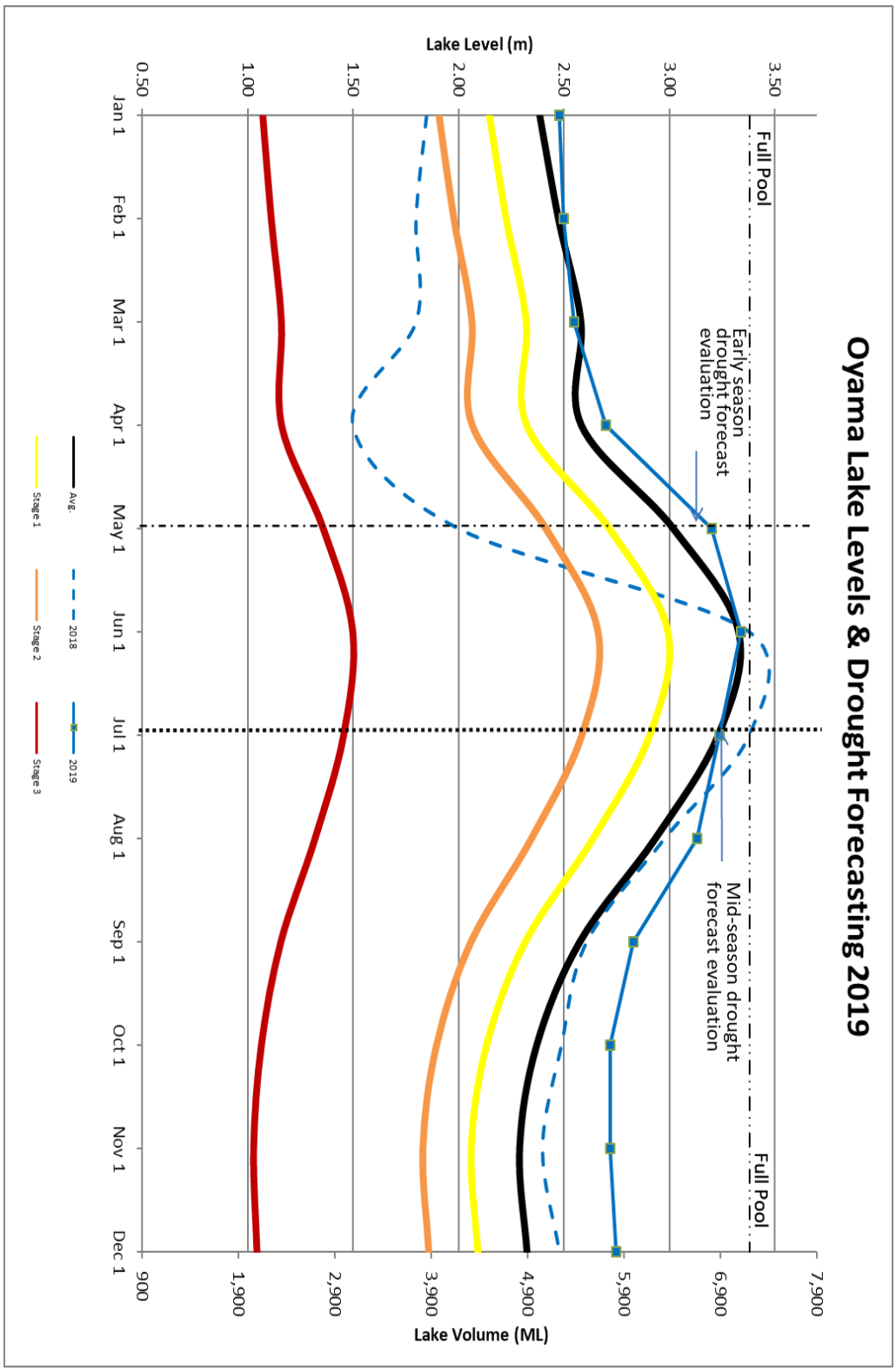


	1-Jan-19	1-Feb-19	1-Mar-19	1-Apr-19	17-Apr-19	24-Apr-19	1-May-19	16-May-19	31-May-19	15-Jun-19	1-Jul-19	15-Jul-19	1-Aug-19	1-Sep-19	30-Sep-19	1-Oct-19	24-Oct-19	1-Nov-19	1-Dec-19
Lake Level (m)	2.48	2.50	2.55	2.70	2.85	3.05	3.20	3.58	3.34	3.34	3.24	3.24	3.13	2.83	2.72	2.72	2.64	2.72	2.75
Discharge (L/S)	50	50	50	50	50	50	50	50	50	195	150	190	180	75	75	75	40	75	75

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
Rob Witzke (Retired April 2019)	1841	WD-II, CH
Patti Meger	4838	WT-I, CH, WD-I, WT-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