GLENMORE-ELLISON IMPROVEMENT DISTRICT

2019 Annual Water Quality Report

Author unknown

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INTRODUCTION

The Glenmore Ellison Improvement District continually strives to provide high quality drinking water to its rate payers through responsible operation, monitoring, evaluation and management of its water system.

As required by the British Columbia Drinking Water Protection Act and Regulation, the Glenmore Ellison Improvement District (GEID) provides the following Annual Report that includes:

- System Description
- Source Assessment Synopsis
- Annual consumption data
- Water Quality Results
- Updates to Water System Assessment and Capital Works Plan
- Updates to Water Monitoring Plan
- Updates to Emergency Response Plan
- Provide Environmental Operators Certification Program updates

This report also describes where your water comes from, how it is distributed, and how we ensure it is safe to drink. The information in this report will allow people, especially those with special health needs to be better informed about their drinking water. Please contact GEID (250)-763-6506 or email dwilliams@geid.org if you have any questions.

This report discusses water quality parameter with potential health effects. For more information on drinking water health effects, the following websites are suggested.

Health Canada

https://www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water.html

US EPA

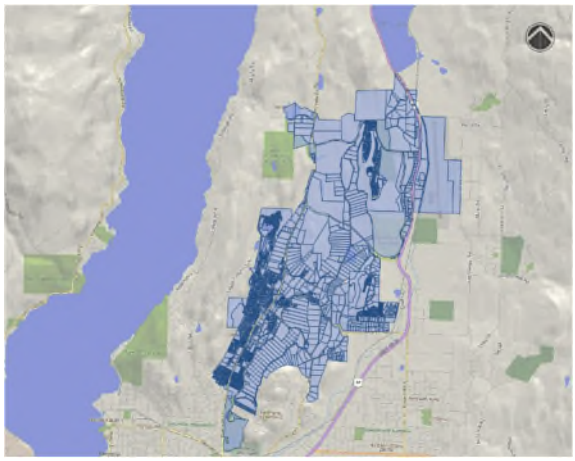
http://www.epa.gov/safewater/mcl.html

World Health Organization

http://www.who.int/water_sanitation_health/publications/2011/dwq_guidelines/en/index.html

The annual report covers the period from January 1st, 2019 to December 31st, 2019.

GLENMORE ELLISON IMPROVEMENT DISTRICT - DRINKING WATER SYSTEM



The Glenmore-Ellison Improvement District (GEID) is one of four main water purveyors in Kelowna, British Columbia. The District boundaries extend across an area of approximately 3,686 hectares (9,107.22 acres). Of the 1,750 hectares (4,330 acres) serviced with water, 817 hectares (2017.67 acres) are bonafide agricultural land. GEID supplies water to approximately 8,587 residential service connections and an additional 138 commercial accounts, serving an estimated population of 21,500 people. GEID operates and maintains two potable water distribution systems - The Glenmore Distribution System, and the Ellison Distribution System.

Glenmore Distribution System

Okanagan Lake

The Glenmore Distribution system is sourced by Okanagan Lake from which water is pumped directly to the McKinley UV Treatment Plant where the water is treated with UltraViolet (UV) light to achieve a minimum 3 log removal (99.9%) of Cryptosporidium and Giardia Lamblia cysts. After UV treatment, the water is chlorinated to kill any bacteria or viruses that may be present and stored the 9 million-liter (ML) Rojem Reservoir (Clearwell). From the Clearwell, water is allowed to flow via gravity into the distribution system. The Glenmore Distribution System includes eight additional storage reservoirs and eleven pump/booster stations.

The Glenmore system services Glenmore, McKinley Landing, the Sexsmith, UBCO, and Quail Ridge areas, Kelowna International Airport and a portion of Ellison.

Ellison Distribution System

The Ellison Distribution System is sourced by Mill Creek. The water flows by gravity from an intake pond on the creek through coarse screens to Postill Pump Station where it is treated with chlorine gas, then pumped into the 2ML Postill Reservoir. From the reservoir, water flows by gravity into the distribution system. There are no additional storage reservoirs or pump stations in the Ellison System.

Mill Creek Intake

The Ellison Distribution System is currently transitioning into agricultural-only water system through the Ellison Separation Project. In 2019, only 113 properties remained on the Mill Creek sourced system as the final phase of the project began and the majority of properties in the Ellison area (Map 1.0) received domestic water from the Glenmore Distribution System (properties shown in blue).

The project is slated for completion in the summer of 2020.

The Ellison Distribution System also has the ability to use Ellison Well as a water source as required. When utilized, Ellison Well water is treated with sodium hypochlorite, a liquid form of chlorine.

Ellison Well was utilized on three separate occasions in 2019.

Map 1.0 - Modified Ellison Distribution System

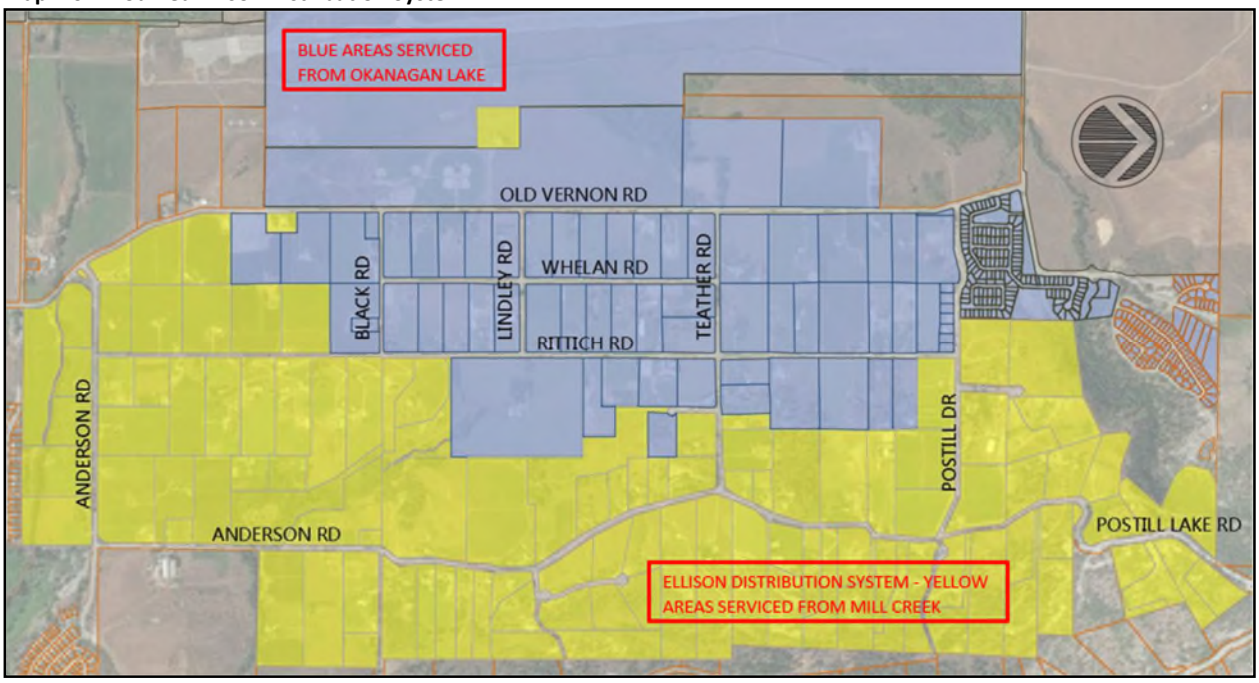


Table 1.0 - Non-Separated Addresses

3510 ANDERSON RD	5274 ANDERSON RD	4291 BLACK RD	6221 POSTILL LAKE RD
3660 ANDERSON RD	5290 ANDERSON RD	4315 BLACK RD	6260 POSTILL LAKE RD
3675 ANDERSON RD	5371 ANDERSON RD	4333 BLACK RD	6320 POSTILL LAKE RD
3727 ANDERSON RD	5390 ANDERSON RD	4431 BLACK RD	6357 POSTILL LAKE RD
3750 ANDERSON RD	5450 ANDERSON RD	4450 BLACK RD	6503 POSTILL LAKE RD
3811 ANDERSON RD	5481 ANDERSON RD	4451 BLACK RD	4561 RITTICH RD
3820 ANDERSON RD	5530 ANDERSON RD	4521 BLACK RD	4771 RITTICH RD
3921 ANDERSON RD	5571 ANDERSON RD	5014 BOOTH RD	4801 RITTICH RD
4120 ANDERSON RD	5580 ANDERSON RD	5031 BOOTH RD	4751 TEATHER CRT
4121 ANDERSON RD	5630 ANDERSON RD	6105 FATHERS PL	4730 TEATHER RD
4170 ANDERSON RD	5671 ANDERSON RD	6127 FATHERS PL	4790 TEATHER RD
4210 ANDERSON RD	5675 ANDERSON RD	3911 OLD VERNON RD	4791 TEATHER RD

4280 ANDERSON RD	5731 ANDERSON RD	4053 OLD VERNON RD	5020 WHITETAIL DR
4350 ANDERSON RD	5760 ANDERSON RD	4401 OLD VERNON RD	5025 WHITETAIL DR
4425 ANDERSON RD	5771 ANDERSON RD	4665 POSTILL DR	5152 WHITETAIL DR
4475 ANDERSON RD	5777 ANDERSON RD	4720 POSTILL DR	5157 WHITETAIL DR
4490 ANDERSON RD	5781 ANDERSON RD	4775 POSTILL DR	5284 WHITETAIL DR
4610 ANDERSON RD	5831 ANDERSON RD	5955 POSTILL LAKE RD	5289 WHITETAIL DR
4660 ANDERSON RD	5850 ANDERSON RD	6030 POSTILL LAKE RD	5115 WHITETAIL RD
4781 ANDERSON RD	5861 ANDERSON RD	6051 POSTILL LAKE RD	
4787 ANDERSON RD	5951 ANDERSON RD	6091 POSTILL LAKE RD	
4851 ANDERSON RD	4150 BLACK RD	6131 POSTILL LAKE RD	
4891 ANDERSON RD	4151 BLACK RD	6160 POSTILL LAKE RD	
4918 ANDERSON RD	4240 BLACK RD	6161 POSTILL LAKE RD	
4951 ANDERSON RD	4261 BLACK RD	6191 POSTILL LAKE RD	
5210 ANDERSON RD	4281 BLACK RD	6220 POSTILL LAKE RD	

Alternate Sources

In the event of an emergency, GEID has two inactive wells (Airport Wells #1 and #2) that can be brought online, and a total of six interconnects with adjacent water suppliers that can be opened. Two of the six interconnections are with the Black Mountain Irrigation District water system and the remaining four are with the City of Kelowna water system.

SOURCE ASSESSMENT SYNOPSIS

Okanagan Lake

In October 2017, the McKinley open bodied reservoir was taken off line and completely bypassed. With the bypass in place, the District began pumping Okanagan Lake water directly to the McKinley UV Plant to supply the Glenmore Distribution System. The Okanagan Lake intake is currently the deepest intake on Okanagan Lake, providing consistently high quality water with low turbidity. The intake is situated in a desirable location, far from creek inlets making it less susceptible to seasonal fluctuations.

By utilizing low turbidity water from deep within Okanagan Lake, along with the state-of-the-art UV disinfection facility, GEID is providing safe, cost effective, high quality drinking water that meets both, Canadian Drinking Water Guidelines and the Drinking Water Treatment Objectives for Surface Water Supplies in BC.

Mill (Kelowna) Creek

Mill Creek originates in the Kelowna Creek Watershed and is sourced mainly from Postill Lake, with the outlets Bulman Lake and South Lake also tributary. GEID operates earthfill dams on each of these lakes to ensure adequate water is available in the creek.

Being a watershed sourced creek with a small intake pond, the water quality of Mill Creek can be highly variable depending on various factors such as weather and seasonal changes.

Due to turbidity levels >1.0NTU and sustained periods of time >5.0NTU, GEID was forced to operate the Mill Creek sourced Ellison Distribution System under a Water Quality or Boil Water Advisory for the entirety of 2019.

In addition, General Potability analysis from an accredited lab in November 2019, showed that several other parameters exceeded the standards set in the Guidelines for Canadian Drinking Water Quality (GCDWQ); True Colour, Total Aluminum, and Total Iron.

UPDATES TO WATER MONITORING PLAN

In 2019, GEID continued to monitor its water supply with a Water Quality Sampling Program that was developed in 2018 with Interior Health (IH) approval. The program includes monthly reports submitted to IH contain information on sampling locations, sampling frequency, bacteriological testing results, turbidity levels, chlorine residuals, operational activities, treatment objectives achieved, customer complaints and response, variances of normal operation and monthly laboratory results.

The goals of the sampling program are to:

- meet or exceed the minimum sampling frequency for microbiological parameters set out in the BC Drinking Water Protection Regulation.
- update general water quality parameters such as dissolved iron and manganese on a periodic basis
- assess source water quality. This includes an assessment of reservoir lake conditions which will be completed by a consultant. The consultant conducts ongoing sampling to identify microorganisms such as algae in the lakes, and nutrient conditions that can affect water quality; and
- assess quality of water delivered to customers. This includes measurement of parameters that directly impact water quality, such as disinfection by-products, and measurement for parameters that are indirectly related to water system maintenance.

GEID continued to work on improving the reliability of online instrumentation and real-time monitoring in 2019.

REGULATORY REQUIREMENTS

Several projects GEID has implemented over the past 5 years include those that are related to water quality improvements. Interior Health (IH) requires all water suppliers meet Drinking Water Objectives for Surface Water Supplies in BC. This means providing drinking water that meets the following objectives:

- 4 log inactivation of viruses;
- 3 log removal or inactivation of *Giardia lamblia* and Cryptosporidium;
- 2 treatment processes for all surface drinking water systems;
- 1 refers to less than 1 NTU of turbidity with a target of 0.1 NTU;
- 0 Total Coliforms and E coli.

GEID was able to meet these treatment requirements for the Glenmore System by effectively operating the McKinley UV Plant.

GEID was unable to meet the treatment requirements for the Ellison System due to turbidity levels >1.0NTU and because chlorination was the sole treatment process. Due to these conditions, the Ellison System was operated under a Water Quality or Boil Water Advisory.
With the completion of the Ellison Separation Project expected in the summer of 2020, GEID looks forward to providing water to all of its ratepayers that meets treatment objectives.

WATER QUALITY MONITORING

Water sampling and testing is carried out regularly at each source and throughout the distribution systems to ensure the drinking water remains safe and meets legislated drinking water requirements.

According to the Guidelines for Canadian Drinking Water Quality parameters are either health based and listed as *Maximum Acceptable Concentrations (MAC),* based on aesthetic considerations and listed as *Aesthetic Objectives (AO)* or established based on operational considerations and listed as *Operational Guidance Values (OG).*

The Guidelines for Canadian drinking water quality are based on current, published scientific research related to health effects, aesthetic effects, and operational considerations. Health-based guidelines are established on the basis of comprehensive review of the known health effects associated with each contaminant, on exposure levels and the availability of treatment and analytical techniques. Operational considerations are factored in when the

presence of a substance may interfere with or impair a treatment process or technology (e.g. turbidity interfering with chlorination) or adversely affect drinking water infrastructure (e.g. corrosion in pipes).

In general, the highest priority guidelines are those dealing with microbiological contaminants such as bacteria, protozoa and viruses. Any measures taken to reduce concentrations of chemical contaminants should not compromise the effectiveness of disinfection.

The GEID's water quality sampling and testing program has been set up in conjunction with Interior Health . The program outlines the collection of samples for water quality at source, reservoirs, test stations, dead end/low use zones, and various pressure zones. GEID operations staff as well as outside consultants are utilized to collect the samples.

For samples requiring third party analysis, collected water samples are uniquely identified and sent to a provincially approved laboratory for testing. Once completed, test results are uploaded by the lab into a data management system for GEID staff to review.

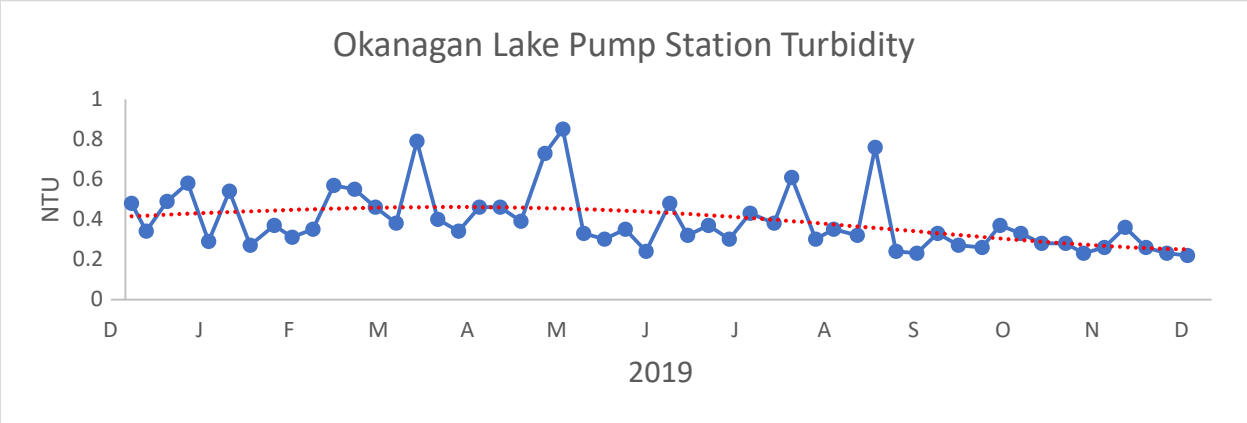
Key water quality parameters such as turbidity, free chlorine residual and %UVT are continuously monitored with online analyzers. The data from these analyzers is viewable remotely on the GEID SCADA system and is also stored in the SCADA Database. To ensure the analyzers are providing reliable and accurate data, samples are collected and analyzed in-house and compared to the online values.

Source Water Turbidity

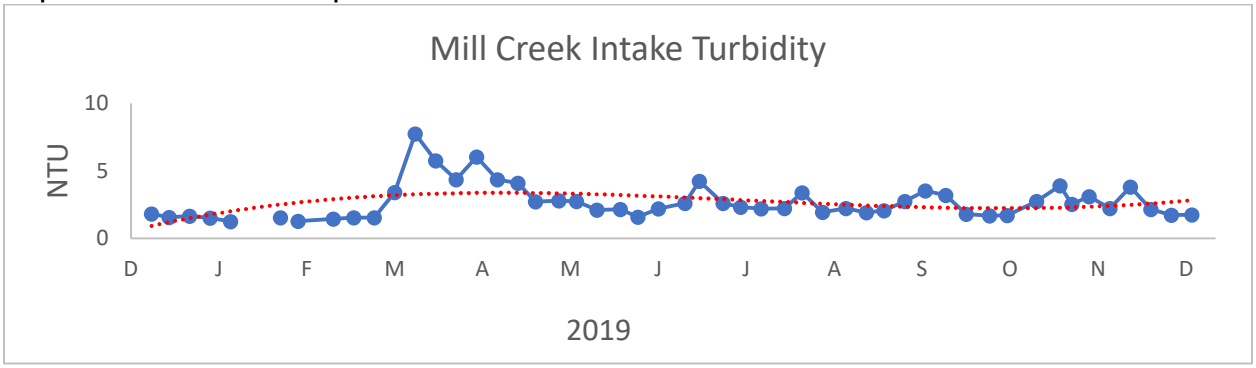
The Guidelines for Canadian Drinking Water Quality recommend a maximum acceptable concentration (MAC) of 1.0 Nephelometric Turbidity unit (NTU) for water entering the distribution system. Turbidity can harbour microorganisms, protecting them from disinfection. If turbidity exceeds 1.0NTU on average for 24 hours, GEID, in consultation with IH will call a Water Quality Advisory or a Boil Water Notice (>5.0NTU) for the affected water system.

The following graphs illustrate turbidity grab sample results at Okanagan Lake Pump Station (Graph 1.0) and at the Mill Creek Intake Pond (Graph 2.0)

Graph 1.0 - Raw Water Grab Samples from Okanagan Lake



Graph 2.0 - Raw Water Grab Samples from Mill Creek



Boil Water Notice (BWN) called on March 31, BWN downgraded to a Water Quality Advisory October 18

Source Water Bacteriological

Okanagan Lake

Okanagan Lake is sampled weekly for Total Coliforms and Escherichia Coli (E. Coli). There are two sample sites, (one at Okanagan Lake Pump station, the other at the McKinley UV plant) that are drawn from on a bi-weekly rotation. In 2019 a total of 54 samples were taken that show a consistent quality of raw water in terms of bacteriological quality. E. Coli results were either 1 or <1 CFU/100mL for all samples taken, while Total Coliform results ranged from <1 to 120 CFU/100mL with a mean of 2 CFU/100mL.

Mill Creek

Mill Creek is sampled on a bi-weekly basis for Total Coliforms and E. Coli. 2019 saw 26 samples collected with a wide range of results. The mean results for Total Coliforms and E. Coli were 150 CFU/100mL and 6 CFU/100mL respectively. A minimum count of Total coliforms was >4

CFU/100mL, while minimum E. Coli counts were <1 CFU/100mL. At the other end of the spectrum, maximum Total Coliform counts were 5700 CFU/100mL, and E. Coli 99 CFU/100mL.

Comprehensive Water Quality Results

Table 2.0 - Raw and Treated Water Quality for Glenmore and Ellison Water Systems

		Glenmore System		Ellison System		
		Okanagan Lake P/S (Raw Source)	Union Rd Reservoir	Mill Creek (Raw Source)	Ellison Well T/S	
	Date	2019-10-29	2019-10-29	2019-11-21	2019-11-21	
Parameter	**Units**					**Std (GCDWQ)**
Anions						
Chloride	**mg/L**	5.01	7.28	1.48	8.78	**AO<=250**
Fluoride	**mg/L**	0.17	0.17	<0.10	<0.10	**MAC=1.5**
Nitrate (as N)	**mg/L**	0.037	0.066	<0.010	<0.010	**MAC=10**
Nitrite (as N)	**mg/L**	<0.010	<0.010	<0.010	<0.010	**MAC=1**
Sulfate	**mg/L**	30.8	30.9	3.4	4.3	**AO<=500**
Calculated Parameters						
Langelier Index	-	0.2	-0.03	-1.7	-1.8	**N/A**
Hardness, Total (as CaCO3)	**mg/L**	123	123	32	40.9	**None Required**
Solids, Total Dissolved (calc)	**mg/L**	162	155	35.1	45.2	**AO<=500**
General Parameters						
Temperature, at pH	**°C**	21.8	22	22.1	22.2	**N/A**
Colour, True	**CU**	<5.0	<5.0	63	24	**AO<=15**
Alkalinity, Total (as CaCO3)	**mg/L**	114	97.9	26.4	23.6	**N/A**
Alkalinity, Phenolphthalein (as CaC	**mg/L**	<1.0	<1.0	<1.0	<1.0	**N/A**
Alkalinity, Bicarbonate (as CaCO3)	**mg/L**	114	97.9	26.4	23.6	**N/A**
Alkalinity, Carbonate (as CaCO3)	**mg/L**	<1.0	<1.0	<1.0	<1.0	**N/A**
Alkalinity, Hydroxide (as CaCO3)	**mg/L**	<1.0	<1.0	<1.0	<1.0	**N/A**
Cyanide, Total	**mg/L**	<0.0020	<0.0020	<0.0020	<0.0020	**MAC=0.2**
Turbidity	**NTU**	0.35	0.27	2.62	1.99	**OG<1**
pH	**pH units**	8.03	7.9	7.4	7.28	**7.0-10.5**
Conductivity (EC)	**uS/cm**	276	276	67.3	93.7	**N/A**
Total Metals						
Aluminum, total	**mg/L**	<0.0050	0.0073	0.13	0.149	**OG<0.1**
Antimony, total	**mg/L**	<0.00020	<0.00020	<0.00020	<0.00020	**MAC=0.006**
Arsenic, total	**mg/L**	0.00055	0.00058	<0.00050	<0.00050	**MAC=0.01**
Barium, total	**mg/L**	0.0226	0.023	0.0052	0.0084	**MAC=2**
Boron, total	**mg/L**	0.0176	0.0149	0.0197	0.0187	**MAC=5**
Cadmium, total	**mg/L**	<0.000010	<0.000010	<0.000010	<0.000010	**MAC=0.005**
Calcium, total	**mg/L**	33.1	33.1	8.19	9.98	**None Required**
Chromium, total	**mg/L**	<0.00050	<0.00050	<0.00050	<0.00050	**MAC=0.05**
Cobalt, total	**mg/L**	<0.00010	<0.00010	<0.00010	<0.00010	**N/A**
Copper, total	**mg/L**	0.0031	0.00245	0.00124	0.00466	**MAC=2**
Iron, total	**mg/L**	<0.010	<0.010	0.358	0.369	**AO<=0.3**
Lead, total	**mg/L**	<0.00020	<0.00020	<0.00020	<0.00020	**MAC=0.005**
Magnesium, total	**mg/L**	9.71	9.76	2.81	3.87	**None Required**
Manganese, total	**mg/L**	0.00082	0.00095	0.00884	0.0149	**MAC=0.12**
Mercury, total	**mg/L**	<0.000040	<0.000040	<0.000010	<0.000010	**MAC=0.001**
Molybdenum, total	**mg/L**	0.00375	0.00371	0.00027	0.00126	**N/A**
Nickel, total	**mg/L**	0.00043	0.00045	0.00113	0.00085	**N/A**
Potassium, total	**mg/L**	2.36	2.41	0.67	0.79	**N/A**
Selenium, total	**mg/L**	<0.00050	<0.00050	<0.00050	<0.00050	**MAC=0.05**
Sodium, total	**mg/L**	11.6	11.7	2.54	3.07	**AO<=200**
Strontium, total	**mg/L**	0.29	0.292	0.049	0.0674	**7**
Uranium, total	**mg/L**	0.00253	0.00259	0.000098	0.000225	**MAC=0.02**
Zinc, total	**mg/L**	<0.0040	<0.0040	0.0144	0.0044	**AO<=5**

AO: Aesthetic Objective, MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.
OG: Operational Guideline

Table 2.1 - Ellison Well Raw Water Quality

		Ellison Well 2019-10-19	
Analyte	**Units**		**Std (CDWQG)**
Anions			
Chloride	mg/L	3.76	AO<=250
Fluoride	mg/L	0.54	MAC=1.5
Nitrate (as N)	mg/L	<0.010	MAC=10
Nitrite (as N)	mg/L	<0.010	MAC=1
Sulfate	mg/L	96.9	AO<=500
Calculated Parameters			
Hardness, Total (as CaCO3)	mg/L	281	None Required
Solids, Total Dissolved (calc)	mg/L	387	AO<=500
General Parameters			
Alkalinity, Total (as CaCO3)	mg/L	272	N/A
Cyanide, Total	mg/L	<0.0020	MAC=0.2
Turbidity	NTU	3.05	OG<1
pH	pH units	8.08	7.0-10.5
Conductivity (EC)	uS/cm	644	N/A
Total Metals			
Aluminum, total	mg/L	<0.0050	OG<0.1
Antimony, total	mg/L	<0.00020	MAC=0.006
Arsenic, total	mg/L	0.00329	MAC=0.01
Barium, total	mg/L	0.0578	MAC=2
Boron, total	mg/L	0.0271	MAC=5
Cadmium, total	mg/L	0.000011	MAC=0.005
Calcium, total	mg/L	61.1	None Required
Chromium, total	mg/L	<0.00050	MAC=0.05
Copper, total	mg/L	0.00111	MAC=2
Iron, total	mg/L	0.495	AO<=0.3
Lead, total	mg/L	<0.00020	MAC=0.005
Magnesium, total	mg/L	31	None Required
Manganese, total	mg/L	0.172	MAC=0.12
Potassium, total	mg/L	3.39	N/A
Selenium, total	mg/L	<0.00050	MAC=0.05
Sodium, total	mg/L	25.6	AO<=200
Uranium, total	mg/L	0.00762	MAC=0.02
Zinc, total	mg/L	<0.0040	AO<=5

AO: Aesthetic Objective
MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.
OG: Operational Guideline

Parameters that exceed the CGDWQ are highlighted in red. The raw and treated water in the Glenmore System meet or exceed the standard values for all parameters analyzed.

Both the raw and treated water in the Ellison System exceed the Aesthetic Guideline standard values for True Colour, and Total Iron. It should be noted that these values refer to the aesthetic condition of the water and do not have health issues directly associated with them.
The Operational Guideline for Aluminum applies to water treatment plants that use aluminum-based coagulants, and not to naturally occurring aluminium in a water source. According the GCDWQ 'There is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans'[1]. The elevated Aluminum levels can be traced back to Bulman and Postill Reservoirs which had concentrations of 0.415mg/L and 0.130mg/L, respectively. Comprehensive results from Upland Reservoir sampling in September 2019 are available at the end of this report in Appendix 1.0.
The exceedance if the Turbidity standard causes GEID to operate the Ellison System under a WQA (>1.0 NTU) or a BWN (>5.0) NTU for the entirety of 2019.

Ellison Well was utilized as the source water for the Ellison System from October 16-19 for cleaning of the Mill Creek Intake Pond, October 29 due to freezing conditions on Mill Creek causing inadequate flows, and once more from November 2-13 for maintenance of the Mill Creek Intake works.
Notably, Ellison Well exceeds the Maximum Acceptable Concentration (MAC) for manganese as is common for groundwater sources in the region. The MAC was revised in 2019 and according to the GCDWQ, Manganese has 'effects on neurological development and behavior; deficits in memory, attention, and motor skills'[2] at levels above the MAC. Additionally, the manganese, as well as the iron in the water precipitates out of solution over time causing increased turbidity levels as illustrated in the Table 5.1. For these reasons, Ellison Well is only used when required for maintenance projects and emergency situations.

[1] Guidelines for Canadian Drinking Water Quality Summary Table, June 2019.
[2] Guidelines for Canadian Drinking Water Quality Summary Table, June 2019

Hardness

A parameter commonly inquired upon by ratepayers is Hardness. Water in the Glenmore system is typically moderately hard to hard (~120mg/L). In Okanagan Lake there is natural calcium and magnesium as well as natural limestone in the Okanagan valley that contributes to the hardness of our source water.
Ellison Well, while used for only a small portion of the year, has very hard water (~280m/L). Very hard water is typical of groundwater sources due to high concentrations of dissolved minerals.
An indicator of hard water is taking more soap to form a lather and a slight scum will appear while washing. Hard water can also form a limescale on the inside of kettles and water fittings. Hard water is not a health concern and is perfectly safe for consumption.

Table 3.0 - Water Hardness Classification

Classification	Hardness (mg/L)
Soft	0-60
Moderately Hard	61-120
Hard	121-180
Very Hard	>180

Trihalomethanes (THM's) / Halo Acetic Acids (HAAs)

South Lake Reservoir

GEID, like most water purveyors, uses chlorine as the primary disinfection agent. While chlorine has proven to be effective for ensuring potable water systems are safe for consumption, it can also produce disinfection by-products when organic matter is present in the source water.
THMs and HAAs are the most commonly monitored disinfection by-products (DBPs). The level of THMs and HAAs in treated water will depend on numerous factors including: total organic carbon, temperature, pH, chlorine dose and water age within the distribution system.
In the Glenmore System, GEID monitors for THMs and HAAs at three locations of the distribution system, representing beginning (Clearwell Outflow), middle (GEID Office) and end points (Shayler Rd. South T/S) of the system.
Historically the Ellison has been monitored only at the beginning of the distribution system, however, the end point was also sampled in November as an additional datapoint.

Table 4.0 - THM and HAA Summary

Total Trihalomethane Summary						
Sample Date	Distribution System THM Results (**mg/L Total Trihalomethanes**)					
	Ellison Postill T/S	Ellison Well T/S	Glenmore GEID Office/Lab	Glenmore Shayler Rd. T/S South	Glenmore Clearwell Outflow	Standard Guideline
5-Jun-19	0.259	-	0.0705	0.0935	0.0519	MAC = 0.1
12-Aug-19	0.268	-	0.0638	0.0838	0.0511	MAC = 0.1
18-Nov-19	-	-	0.0667	0.0886	0.0567	MAC = 0.1
21-Nov-19	0.331	0.417	-	-	-	MAC = 0.1
Running Average	**0.286**	**0.417**	**0.067**	**0.0886**	**0.0532**	**MAC = 0.1**
Total Haloacetic Acids Summary						
Sample Date	Distribution System HAA Results (**mg/L HAA5**)					
	Ellison Postill T/S	Ellison Well T/S	Glenmore GEID Office/Lab	Glenmore Shayler Rd. T/S South	Glenmore Clearwell Outflow	Standard Guideline
5-Jun-19	0.21	-	-	0.0761	0.0252	MAC = 0.08
12-Aug-19	0.283	-	0.0601	0.057	0.0313	MAC = 0.08
18-Nov-19	-	-	0.0521	0.0671	0.0421	MAC = 0.08
21-Nov-19	0.307	0.385	-	-	-	MAC = 0.08
Running Average	**0.267**	**0.385**	**0.0561**	**0.0667**	**0.0329**	**MAC = 0.08**

*MAC: Maximum Acceptable Concentration as per Canadian Drinking Water Guidelines.

According to The Guidelines for Canadian Drinking Water Quality, the Glenmore Distribution meets the DBP standards based on the yearly running average. The exceedance for Total THMs in June at Shayler Rd. T/S demonstrates the effects that water age and organic levels.

The Ellison Distribution System greatly exceeds the GCDWQ for each sample set. As the water source has relatively high levels of organics and elevated turbidity, a high chlorine dose is required to achieve acceptable free chlorine residuals throughout the system. The combination of these variables produces elevated levels of DBPs.

Distribution System Bacteriological Results

Tables 5.0 and 5.1 illustrate how GEID's distribution systems met the bacteriological standards for potable water as set out in Schedule A of the Drinking Water Protection Regulation. Positive results for Total Coliforms occurred on three occasions. A new sample from the same location was collected following laboratory confirmation and each time, the result came back with no detectable total coliforms.

Table 5.0 - Glenmore System Microbiological Results

Parameter	Number of Samples	Number of Exceedances	Drinking Water Regulations
Total Coliforms	436	3*	No detectable CFU/100 (ml)
E. coli	436	0	No detectable CFU/100 (ml)

*** maximum count 2 CFU/100ml. Each location resampled, showing <1 CFU/100mL**

Table 5.1 - Ellison System Microbiological Results

Parameter	Number of Samples	Number of Exceedances	Drinking Water Regulations
Total Coliforms	63	0	No detectable CFU/100 (ml)
E. coli	63	0	No detectable CFU/100 (ml)

Table 5.2 - Microbiological Standards for Potable Water

Parameter	Standard
Escherichia Coli	No detectable Escherichia Coli per 100 ml
Total Coliform Bacteria	At least 90% of samples have no detectable total coliform bacteria per 100ml and no sample has more than 10 total coliform bacteria per 100 ml

Postill Pump Station Log-i

The Ellison Water System is treated only with chlorine and therefor relies on chlorine dosage to achieve 3log inactivation Cryptosporidium and Giardia Lamblia cysts. Field data is collected on a weekly basis and Concentration Time (CT) is calculated to ensure that the 3log-i treatment objectives are being met. Table X.X summarizes the weekly calculations.

Table 6.0 - Weekly CT Calculation Data for the Ellison Water System

Date	pH (from Intake)	Water Temp (°C) (at T/S)	Postill Outflow (GPM)	Res. % Full	Effective Res. Vol. (US Gal)	Effective Tot. Vol. (US gal)	Contact Time (mins)	Chlorine Residual at T/S	CT achieved	CT required	CT Ratio (must be > 1)
2-Jan-19	7.26	1.0	209	39	61823.0	100780	482	2.62	1263.4	267.8	4.7
8-Jan-19	7.87	1.5	134	40	63249.7	102207	763	2.53	1929.7	319.6	6.0
15-Jan-19	7.42	1.2	120	40	63408.2	102365	853	2.62	2235.0	280.0	8.0
22-Jan-19	7.90	3.0	113	40	63408.2	102365	906	2.85	2581.8	296.3	8.7
27-Jan-19	8.02	1.4	122	40	63408.2	102365	839	2.95	2475.2	346.5	7.1
5-Feb-19	7.61	1.0	142	42	66579	105536	743	2.67	1984.4	304.8	6.5
12-Feb-19	7.61	1.2	130	40	63408	102365	787	3.02	2378.0	306.2	7.8
20-Feb-19	7.61	1.2	120	40	63408	102365	853	2.62	2235.0	299.7	7.5
26-Feb-19	7.61	1.0	135	40	63408	102365	758	2.76	2092.8	306.3	6.8
5-Mar-19	7.67	0.8	137	40	63408	102365	747	2.89	2159.4	319.4	6.8
12-Mar-19	7.78	0.9	92	40	63408	102365	1113	2.87	3193.4	329.2	9.7
19-May-19	7.70	1.1	116	40	63408	102365	882	3.38	2982.7	323.6	9.2
26-Mar-19	7.60	1.5	116	40	63408	102365	882	2.18	1923.8	284.6	6.8
2-Apr-19	7.63	2.2	106	40	63408	102365	966	2.24	2163.2	275.1	7.9
9-Apr-19	7.17	2.7	127	40	63408	102365	806	2.55	2055.4	229.2	9.0
16-Apr-19	7.23	2.9	261	39	61823	100780	386	3.17	1224.0	238.8	5.1
23-Apr-19	7.22	4.5	398	38	60238	99195	249	3.41	849.9	215.3	3.9
30-Apr-19	7.24	3.4	490	53	84016	122973	251	2.86	717.8	228.0	3.1
7-May-19	7.75	7.3	804	53	84016	122973	153	3.53	539.9	215.6	2.5
13-May-19	7.65	9.4	1112	58	91942	130899	118	3.29	387.3	178.1	2.2
21-May-19	7.31	9.0	1315	59	93527	132484	101	3.35	337.5	162.5	2.1
27-May-19	7.77	10.6	1028	60	95112	134069	130	2.10	273.9	159.8	1.7
3-Jun-19	7.89	12.9	1551	60	95112	134069	86	3.01	260.2	149.8	1.7
11-Jun-19	7.90	10.9	1673	59	93527	132484	79	2.35	186.1	166.4	1.1
17-Jun-19	7.89	13.4	1983	62	98283	137240	69	2.86	197.9	143.6	1.4
24-Jun-19	7.81	11.8	980	65	103038	141995	145	2.60	376.7	153.9	2.4
3-Jul-19	7.77	12.3	1047	62	98283	137240	131	2.63	344.7	146.9	2.3
8-Jul-19	7.74	12.3	875	70	110964	149921	171	3.32	568.8	150.5	3.8
16-Jul-19	7.81	13.7	1284	65	103038	141995	111	2.82	311.9	136.6	2.3
22-Jul-19	7.75	13.2	1135	57	90357	129314	114	2.50	284.8	136.0	2.1
29-Jul-19	7.75	13.2	1586	76	120476	159433	101	2.76	277.4	138.0	2.0
6-Aug-19	7.79	13.8	2021	74	117305	156262	77	2.07	160.1	128.6	1.2
12-Aug-19	7.62	14.2	693	78	123646	162603	235	1.53	359.0	112.6	3.2
20-Aug-19	7.73	12.3	1817	74	117305	156262	86	3.21	276.1	149.3	1.8
27-Aug-19	7.74	11.5	1395	76	120476	159433	114	2.49	284.6	152.4	1.9
3-Sep-19	7.67	13.4	1028	74	117305	156262	152	2.11	320.7	127.2	2.5
9-Sep-19	7.80	13.9	483	70	110964	149921	310	2.24	695.3	129.7	5.4
16-Sep-19	7.69	12.6	330	69	109379	148336	450	2.11	948.5	135.4	7.0
23-Sep-19	7.70	10.9	257	70	110964	149921	583	2.58	1505.0	157.5	9.6
30-Sep-19	7.61	8.6	183	67	106209	145166	793	2.13	1689.6	173.9	9.7
7-Oct-19	7.74	7.9	314	60	95112	134069	427	2.66	1135.7	197.6	5.7
15-Oct-19	7.51	5.3	220	60	95112	134069	609	3.16	1925.7	223.9	8.6
21-Oct-19	7.82	7.0	200	32	50727	89684	448	2.62	1174.9	215.7	5.4
28-Oct-19	7.85	6.2	122	38	60238	99195	813	2.42	1967.6	227.6	8.6
14-Nov-19	7.49	5.0	231	45	71334	110291	477	1.55	740.0	203.9	3.6
18-Nov-19	7.43	4.1	420	45	71334	110291	263	2.09	548.8	222.2	2.5
25-Nov-19	7.28	2.9	195	45	71334	110291	566	2.35	1329.2	232.6	5.7
2-Dec-19	7.34	1.8	193	45	71334	110291	571	2.66	1520.077	261.4773	5.8
9-Dec-19	7.24	1.9	473	45	71334	110291	233	2.15	501.324	242.3986	2.1
16-Dec-19	7.32	2.3	171	45	71334	110291	645	1.89	1219.009	238.1904	5.1
23-Dec-19	7.42	2.5	187	45	71334	110291	590	1.88	1108.811	243.4483	4.6

WATER QUALITY CONCERNS

Occasionally the GEID receives concerns from the rate payers regarding the quality of their drinking water. During the course of 2019, the district minimal enquiries with most common issue of concern related to water color and odour. Every individual enquiry was investigated by the districts water supply and distribution operations staff and the appropriate action was taken to resolve the appropriate water quality concern.

Typical examples of water quality concerns such as colored water arise as a result of the following:

- Freshet
- Water main flushing
- Fire fighting
- Water main breaks
- Local construction/development
- Lake turnover/algae blooms
- Changes in flows and system dynamics

McKINLEY UV TREATMENT PLANT PERFORMANCE

McKinley UV Treatment Plant receives raw water directly from Okangan Lake via the Okangan Lake Pump Station. The water comes from a deep intake structure and provides GEID with a consistant water source in terms of organics, turbidity, % UltraViolet Transmittance (%UVT) and temperature.

The UV Plant is operated to provide 3 Log (99.9%) inactivation of Cryptosporidium and Giardia Lamblia cysts. The plant has two UV Reactors, with one reactor able to provide adeqaute treatment during regular operation, while the other acts as a stand-by reactor to provide redundancy if an issue arises. If the reactors fail to adeqautely treat the water (<3.0 Log-i), Off-spec water is produced. The Off-spec water volumes and event durations are logged and recorded. A minimum of 95% of the water flowing through the reactors must meet the validated treatment criteria[3].

Additionally, log inactivation for viruses (4log-I required) is calculated on a daily basis. The calculation uses data collected by online chlorine analyzers, temperature and pH probes, level transmitters and flow meters to calculated the required Concentration Time (CT value) that must be maintained in order the achieve the treatment goal.

[3] US EPA UV Disinfection Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule

The following tables show the 2019 raw water Ultra Violet Transmittance (%UVT), reactor log inactivation performance (Logi), 4log-i summary for viruses, and treatment performance of the two UV Reactors. Overall, the UV Plant operated within the required parameters as set by IH.

McKinley Reservoir, future agricultural water source.

Table 7.0 - %UVT and Average Log-i

	Raw Water %UVT			Avg. Log-i	
Month	Min	Max	Average	Reactor 110	Reactor 120
January	84.3	86.8	86.0	3.08	3.09
February	71.4	87.0	86.2	3.11	3.07
March	84.6	86.6	85.9	3.13	3.12
April	83.3	87.8	86.7	3.17	3.26
May	82.9	87.9	86.6	3.20	3.24
June	84.1	87.5	86.2	3.23	3.27
July	83.0	87.0	86.2	3.24	3.31
August	85.2	87.8	86.5	3.20	3.25
September	83.6	87.1	86.3	3.19	3.21
October	84.9	87.1	86.3	3.27	3.19
November	83.9	86.9	86.1	3.15	3.21
December	85.3	87.2	86.4	3.17	3.25

Values taken hourly from the GEID SCADA Database and averaged on a monthly basis

Table 7.1 - Glenmore Distribution System 4-Log-I Virus Summary

Month	Daily 4-Log-i Achieved
January	Yes
February	Yes
March	Yes
April	Yes
May	Yes
June	Yes
July	Yes
August	Yes
September	Yes
October	Yes
November	Yes
December	Yes

Table 7.2 - UV Reactor 110 Performance Summary

McKinley UV Treatment Plant - Train 110						
Month	OFF-SPEC by TIME (%)	OFF-SPEC by Volume (%)	OFF-SPEC by Time (Minutes)	Total Run Time (Minutes)	OFF-SPEC by Volume (ML)	Total Treated Volume (ML)
January	0	0	0	6393	0.000	86.54
February	0	0	0	5724	0.000	74.53
March	0	0	0	6375	0.000	84.12
April	0	0	0	7491	0.000	98.40
May	0	0	2	22804	0.027	375.14
June	0	0	3	28384	0.018	568.08
July	0	0	0	16211	0.000	274.91
August	0	0	1	14547	0.011	267.92
September	0	0	6	13510	0.046	206.65
October	0	0	2	5007	0.027	99.25
November	0.1	0.1	6	5032	0.059	67.25
December	0.1	0	8	6614	0.025	89.31

Table 7.3 - UV Reactor 120 Performance Summary

McKinley UV Treatment Plant - Train 120						
Month	OFF-SPEC by TIME (%)	OFF-SPEC by Volume (%)	OFF-SPEC by Time (Minutes)	Total Run Time (Minutes)	OFF-SPEC by Volume (ML)	Total Treated Volume (ML)
January	0	0	0	6226	0.000	82.25
February	0	0	0	5919	0.000	77.51
March	0	0	0	6673	0.000	88.84
April	0	0	0	9601	0.000	128.09
May	0	0	8	17658	0.093	297.12
June	0	0	3	13987	0.039	255.81
July	0	0	0	24547	0.000	440.92
August	0	0	5	27881	0.091	561.54
September	0	0	3	11829	0.051	182.28
October	0	0	0	4858	0.000	89.51
November	0	0	0	6718	0.000	91.11
December	0	0	0	5183	0.000	70.34

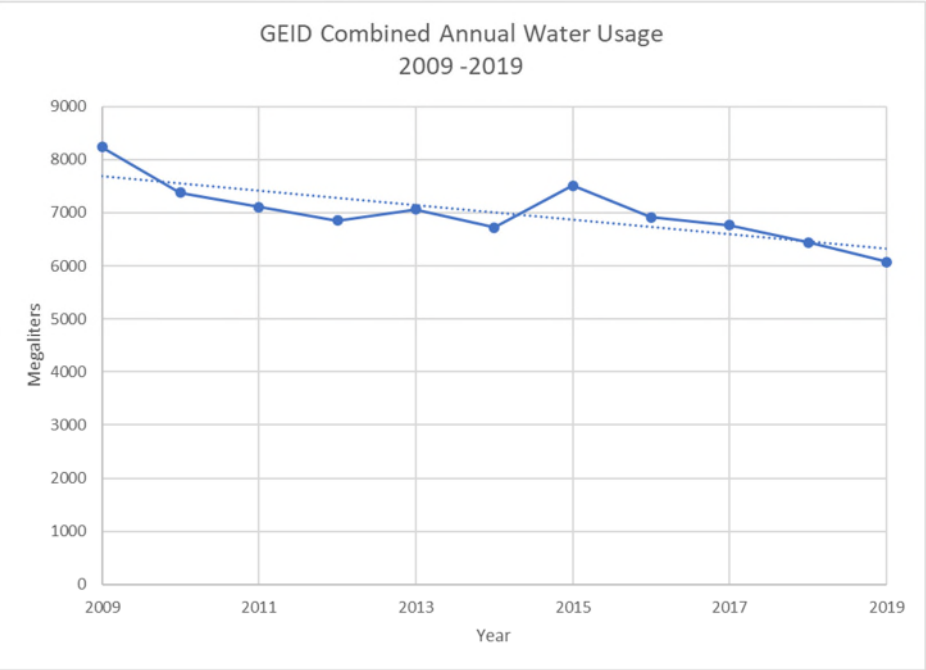
ANNUAL WATER CONSUMPTION STATISTICS

Table 13.0 shows the historic GEID water consumption over the past ten years in MegaLiters (ML). Of note, the McKinley Landing Water Works system was switched over to the Glenmore distribution system in 2017.

In 2019, the combined total water usage for GEID was 6076ML. The Glenmore System accounts for approximately 4962ML (82%), while the Ellison System accounts for the remaining 1114ML, with Mill Creek Intake supplying 1105ML and Ellison Well supplying just under 9ML.

Table 8.0 – Combined Annual Water Usage

Year	Combined Usage (Megaliters)
2009	8240
2010	7381
2011	7107
2012	6852
2013	7062
2014	6722
2015	7513
2016	6915
2017	6763
2018	6446
2019	6076



MAINTENANCE AND FLUSHING PROGRAM

Flushing in Progress

Regular inspections, maintenance and water quality testing is performed by certified operators to ensure optimal operation of the GEID water systems. The district performed uni-directional flushing of each system in the fall of 2019 and conducted isolated area flushing as required due to maintenance, repair activities, and to maintain water quality.

EMERGENCY RESPONSE PLAN

The emergency response plan is updated annually, and copies of the updated plan were provided to IH in 2019. Updates include changes to contact numbers (including GEID staff, consultants, contractors and regulatory agencies), as well as changes to the plans that may be required including the addition of new facilities.

CROSS CONNECTION CONTROL PROGRAM

The cross-connection control program for GEID and the Kelowna Joint Water Committee is administered by the City of Kelowna and results are reported annually to IH in order to protect the quality of the water in our distribution systems.

The City of Kelowna employs a full time Cross Connection Control Coordinator to develop, implement and maintain a program which focuses an all Industrial, Commercial, Institutional, and Agricultural water customers in our water utility.

The Cross-Connection Control Coordinator checks connections (industrial, commercial, institutional and agricultural) to determine whether pipes, vessels or other devices exist that would allow fluid contaminants to enter the water system by backflow. Potentially hazardous cross connections are eliminated or backflow prevention assemblies (testable) or devices (non-testable) are installed. All installations are subject to yearly testing and inspection programs administered by the Cross-Connection Control Coordinator.

OPERATOR CERTIFICATION

GEID's water distribution system (Facility 497) is classified as a Level IV system by the Environmental Operators Certification Program (EOCP). Additionally, the McKinley UV Treatment Plant (Facility 2276) is classified as a Level II Facility by the EOCP.

Water system operators are the first line of defense for water quality issues, as they identify, manage, and remedy risks to the water supply. The tasks completed by GEID's operators are essential in ensuring safe, reliable, water supply, including:

- Bi-weekly system checks of critical infrastructure such as pump stations and chlorinators
- Daily monitoring of SCADA system to assess system performance
- Response to system alarms 24 hours a day, seven days a week
- Water main flushing as needed to enhance water quality
- Completion of water system maintenance, repair and renewal works
- Instrument testing and calibration

- Water Quality Sampling
- Watershed monitoring and protection

Four of the operators are graduates of Okanagan College's Water Quality and Environmental Engineering Technology program. The two-year water engineering technology diploma program is designed for the water and wastewater industry and provides instruction in areas such as water system design, maintenance, water treatment, and water quality testing and analysis.

Table 14.0 shows the certification levels of GEID employees as of the end of 2019.

Table 9.0 - Current Operations Staff

Name	Certification Level	Position
Kevin Burtch	Water Distribution Level 1	Operations Manager
Mike Rojem	Water Distribution Level 3 Water Treatment 1	Projects Coordinator
Brandon Fletcher	Water Distribution 4 Water Treatment 1	Projects Assistant
Shawn McGaw	Water Distribution Level 3 Water Treatment Level 1	System Operator
Chris Mackay	Water Distribution Level 3 Water Treatment Level 1	System Operator
Kelvin Giesbrecht	Water Distribution Level 2 Water Treatment Level 1	System Operator
Julius Rideg	Water Distribution Level 2 Water Treatment Level 1	System Operator
Brad Wallace	Water Distribution Level 1	Water Meter Technician / System Operator
Brain Krause	Water Distribution Level 2	Equipment Operator / System Operator
Chris Tucker	Water Treatment Level 4 Water Distribution Level 2	Water Quality Technician / System Operator

STAFF CONTACTS

Table 10.0 - Staff Contacts

Name	Title	Telephone
Dawn Williams	Administrator	250-763-6506 ext. 102
Kevin Burtch	Operations Manager	250-763-6506 ext. 109
Garry Filafilo	Administrative Treasurer	250-763-6506 ext. 104
Mike Rojem	Projects Coordinator	250-763-6506 ext. 103
Chris Tucker	Water Quality Technician	250-763-6506

COMPLETED PROJECTS 2019

The Glenmore Ellison Improvement District saw the progression of the Ellison Separation Project into Phase 3 during 2019.

AVAILABILITY OF THE REPORT

This report may be found on the district's website at www.geid.ca under the water quality tab.

GLOSSARY

Aesthetic Objective (AO) – In terms of drinking water quality, refers standards above which, objectional taste, odour and/or appearance may occur.

Bacteria – many different types of bacterial organisms are found in drinking water. Most municipal treated water is essentially bacteria free due to the addition of chlorine. Some forms of cyst type bacteria have a degree of immunity to chlorine due to the cocoon-like shell around the organism, such as Giardia Lamblia, and Cryptosporidium.

Chemical Parameter – properties of water relating to the molecular composition, such as mineral or metal concentrations.

Chlorine – widely used in the disinfection of water available as a gas, a liquid in sodium hypochlorite, or as a solid in calcium hypochlorite.

Coliform Bacteria – a group of organisms primarily found in human and animal intestines and wastes, and thus widely used as an indicator organism to show the presence of such wastes in water and the possible presence of pathogenic bacteria.

Color (Apparent Color (PtCo) – to determine the color of water within a sample without turbidity removal.

Contact Time – the time from when the chlorine is added to the water, to when the water reaches the first customers.

Corrosion – the deterioration of a material, specifically metals in water, caused by reactions and affected by complex interactions between pH, hardness, alkalinity and temperature of the water.

CT Values – the product of contact time and free chlorine concentration. It is used to calculate the percent removal of viruses and bacteria.

Disinfection by-products (DBP) – are created when the chlorine added to water reacts with naturally occurring matter in the water.

Disinfection – a process used to eliminate any harmful substance or micro-organism in water.

Drinking Water Protection Regulation (DWPR) – defines regulatory standards under the Provincial Water Act that must be met to ensure water is safe to drink and fit for domestic purposes.

Escherichia coli (E. Coli) – are bacteria present in the intestine and feces of warm blooded animals. E. Coli are a member species of the fecal coliform group of indicator bacteria. Their concentrations are expressed as number of colonies per 100 mL of sample.

Free Chlorine – the quantity of chlorine remaining which has not been consumed in reactions with microorganisms or organic matter. Also referred to as residual chlorine.

Guidelines for Canadian Drinking Water Quality – A document established by Health Canada that recommends standards for potable water. The standards include; Maximum Acceptable Concentrations (MAC), Aesthetic Objectives (AO) and Operational Guidance (OG) for physical, microbiological, chemical and radiological substances in drinking water.

Haloacetic Acid (HAA) - a type of disinfection by-product resulting from the reaction of chlorine and organic matter in the water. The MAC for HAAs in drinking water is 0.0800mg/L.

Hardness – a characteristic of natural water due to the presence of dissolved calcium and magnesium.

Inactivation – to destroy or ensure the loss of the ability to cause disease.

Log Removal – indicates how effective disinfection is in eliminating protozoa. For example, 4-log-i removal guarantees 99.99% disinfection of pathogenic organism, 3-log-i removal guarantees 99.9%, and 2-log-i removal guarantees 99% removal.

Maximum Acceptable Concentration (MAC) – defines the upper most limit of a parameter before it can become a health concern.

NTU (Nephelometric Turbidity Units) – the standard unit of measurement for turbidity (cloudiness) in water. It detects the amount of light that is scattered by fine suspended particles in water.

Organic – derived from plant or animal matter, as opposed to inorganic matter which is derived from rocks and minerals. Organic matter is characterized by it carbon-hydrogen structure.

pH – the expression of the acidity of a solution by the negative logarithm of the hydrogen ion concentration; pH of 1 is very acidic; pH of 14 is very basic (alkaline); pH of 7 is neutral. The neutral point of 7 indicates the presence of equal concentrations of free hydrogen and free hydroxide ions.

Physical Parameters – these are often observable properties such as color, taste and odour.

Potable Water – water which is considered safe and fit for human consumption, culinary

and domestic purposes and meets the requirements of the health authority having jurisdiction which is the Vancouver Island Health Authority in this region.

Raw Water – untreated water from wells, surface sources (i.e. lakes and rivers) or any water before it reaches a water treatment device or process.

Reservoir – a receptacle used for storing water within the water system.

Residual Chlorine – the quantity of chlorine remaining which has not been consumed in reactions with microorganisms or organic matter. Also referred to as free chlorine.

Surface Water – water collecting on the ground or in a stream, river, lake sea or ocean, as opposed to groundwater, which is contained in underground aquifers.

Trihalomethanes (THMs) – the major category of disinfection by-products in chlorinated drinking water. They are caused by the reaction of chlorine with organic matter present in the water. The MAC for THMs in drinking water is 0.100mg/L

Total Coliform – an indicator group of organisms mostly of intestinal origin used to appraise the microbiological risks to drinking water.

Turbidity – the cloudiness or haziness of water caused by suspended solids that are usually invisible to the naked eye. Its measurement relates to the optical property of water that causes light to be scattered, rather than transmitted through the sample in a straight line. Measured in NTU (Nephelometric Turbidity Units).

Virus – the smallest form of life known to be capable of producing disease or infection, usually considered to be of large molecular size. They multiple by assembly of component fragments in living cells, rather than by cell division as do most bacteria.

Appendix

Upland Reservoir Water Quality Results

CERTIFICATE OF ANALYSIS

REPORTED TO	Glenmore Ellison Improvement District 445 Glenmore Road KELOWNA, BC V1V 1Z6		
ATTENTION	Chris Mackay	**WORK ORDER**	9090124
PO NUMBER	GEID sampled by LAC	**RECEIVED / TEMP**	2019-09-03 15:04 / 11°C
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10
PROJECT INFO	Annual High Elevation Res	**COC NUMBER**	43706.63108

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at acrump@caro.ca

Authorized By:

Alana Crump
Junior Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Bulman Outflow (9090124-01) | Matrix: Water | Sampled: 2019-09-03 13:30					
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2019-09-05	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-09-05	
Calculated Parameters					
Hardness, Total (as CaCO3)	**22.1**	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**0.528**	0.0500	mg/L	N/A	
Nitrogen, Total Dissolved	**0.508**	0.0500	mg/L	N/A	
General Parameters					
Alkalinity, Total (as CaCO3)	**22.7**	1.0	mg/L	2019-09-06	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Bicarbonate (as CaCO3)	**22.7**	1.0	mg/L	2019-09-06	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Ammonia, Total (as N)	**0.131**	0.020	mg/L	2019-09-04	
Carbon, Total Organic	**16.2**	0.50	mg/L	2019-09-10	
Colour, True	**130**	5.0	CU	2019-09-04	
Nitrogen, Total Kjeldahl	**0.528**	0.050	mg/L	2019-09-06	
Nitrogen, Dissolved Kjeldahl	**0.508**	0.050	mg/L	2019-09-06	
pH	**6.93**	0.10	pH units	2019-09-06	HT2
Phosphorus, Total (as P)	**0.136**	0.0020	mg/L	2019-09-06	
Phosphorus, Total Dissolved	**0.120**	0.0020	mg/L	2019-09-06	
Solids, Total Dissolved	**58**	15	mg/L	2019-09-09	
Turbidity	**4.72**	0.10	NTU	2019-09-04	
UV Transmittance @ 254nm	**18.1**	0.10	% T	2019-09-04	
Microbiological Parameters					
Coliforms, Total	**53**	1	CFU/100 mL	2019-09-04	
Background Colonies	**> 200**	200	CFU/100 mL	2019-09-04	
E. coli	< 1	1	CFU/100 mL	2019-09-04	
Total Metals					
Aluminum, total	**0.415**	0.0050	mg/L	2019-09-06	
Antimony, total	< 0.00020	0.00020	mg/L	2019-09-06	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-09-06	
Barium, total	**0.0093**	0.0050	mg/L	2019-09-06	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-09-06	
Boron, total	< 0.0050	0.0050	mg/L	2019-09-06	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-09-06	
Calcium, total	**4.80**	0.20	mg/L	2019-09-06	
Chromium, total	**0.00091**	0.00050	mg/L	2019-09-06	
Cobalt, total	**0.00080**	0.00010	mg/L	2019-09-06	

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Bulman Outflow (9090124-01) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
Total Metals, Continued					
Copper, total	**0.00214**	0.00040	mg/L	2019-09-06	
Iron, total	**2.04**	0.010	mg/L	2019-09-06	
Lead, total	< 0.00020	0.00020	mg/L	2019-09-06	
Lithium, total	**0.00059**	0.00010	mg/L	2019-09-06	
Magnesium, total	**2.45**	0.010	mg/L	2019-09-06	
Manganese, total	**0.197**	0.00020	mg/L	2019-09-06	
Molybdenum, total	**0.00033**	0.00010	mg/L	2019-09-06	
Nickel, total	**0.00124**	0.00040	mg/L	2019-09-06	
Phosphorus, total	**0.122**	0.050	mg/L	2019-09-06	
Potassium, total	**0.84**	0.10	mg/L	2019-09-06	
Selenium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Silicon, total	**9.3**	1.0	mg/L	2019-09-06	
Silver, total	< 0.000050	0.000050	mg/L	2019-09-06	
Sodium, total	**2.49**	0.10	mg/L	2019-09-06	
Strontium, total	**0.0328**	0.0010	mg/L	2019-09-06	
Sulfur, total	< 3.0	3.0	mg/L	2019-09-06	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Thallium, total	< 0.000020	0.000020	mg/L	2019-09-06	
Thorium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Tin, total	< 0.00020	0.00020	mg/L	2019-09-06	
Titanium, total	**0.0158**	0.0050	mg/L	2019-09-06	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-09-06	
Uranium, total	**0.000077**	0.000020	mg/L	2019-09-06	
Vanadium, total	**0.0030**	0.0010	mg/L	2019-09-06	
Zinc, total	< 0.0040	0.0040	mg/L	2019-09-06	
Zirconium, total	**0.00161**	0.00010	mg/L	2019-09-06	
South Outflow (9090124-02) | Matrix: Water | Sampled: 2019-09-03 13:30					
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2019-09-05	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-09-05	
Calculated Parameters					
Hardness, Total (as CaCO3)	**21.8**	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**0.585**	0.0500	mg/L	N/A	
Nitrogen, Total Dissolved	**0.283**	0.0500	mg/L	N/A	
General Parameters					
Alkalinity, Total (as CaCO3)	**20.2**	1.0	mg/L	2019-09-06	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Bicarbonate (as CaCO3)	**20.2**	1.0	mg/L	2019-09-06	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
South Outflow (9090124-02) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
General Parameters, Continued					
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Ammonia, Total (as N)	**0.023**	0.020	mg/L	2019-09-04	
Carbon, Total Organic	**10.4**	0.50	mg/L	2019-09-10	
Colour, True	**41**	5.0	CU	2019-09-04	
Nitrogen, Total Kjeldahl	**0.585**	0.050	mg/L	2019-09-06	
Nitrogen, Dissolved Kjeldahl	**0.283**	0.050	mg/L	2019-09-06	
pH	**7.24**	0.10	pH units	2019-09-06	HT2
Phosphorus, Total (as P)	**0.0638**	0.0020	mg/L	2019-09-06	
Phosphorus, Total Dissolved	**0.0158**	0.0020	mg/L	2019-09-06	
Solids, Total Dissolved	**55**	15	mg/L	2019-09-09	
Turbidity	**1.22**	0.10	NTU	2019-09-04	
UV Transmittance @ 254nm	**46.1**	0.10	% T	2019-09-04	
Microbiological Parameters					
Coliforms, Total	**190**	1	CFU/100 mL	2019-09-04	
Background Colonies	**> 200**	200	CFU/100 mL	2019-09-04	
E. coli	**3**	1	CFU/100 mL	2019-09-04	
Total Metals					
Aluminum, total	**0.0560**	0.0050	mg/L	2019-09-06	
Antimony, total	< 0.00020	0.00020	mg/L	2019-09-06	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-09-06	
Barium, total	**0.0053**	0.0050	mg/L	2019-09-06	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-09-06	
Boron, total	< 0.0050	0.0050	mg/L	2019-09-06	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-09-06	
Calcium, total	**6.52**	0.20	mg/L	2019-09-06	
Chromium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-09-06	
Copper, total	**0.00111**	0.00040	mg/L	2019-09-06	
Iron, total	**0.123**	0.010	mg/L	2019-09-06	
Lead, total	< 0.00020	0.00020	mg/L	2019-09-06	
Lithium, total	**0.00042**	0.00010	mg/L	2019-09-06	
Magnesium, total	**1.34**	0.010	mg/L	2019-09-06	
Manganese, total	**0.0106**	0.00020	mg/L	2019-09-06	
Molybdenum, total	**0.00187**	0.00010	mg/L	2019-09-06	
Nickel, total	< 0.00040	0.00040	mg/L	2019-09-06	
Phosphorus, total	< 0.050	0.050	mg/L	2019-09-06	
Potassium, total	**0.59**	0.10	mg/L	2019-09-06	
Selenium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Silicon, total	**2.9**	1.0	mg/L	2019-09-06	

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
South Outflow (9090124-02) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
Total Metals, Continued					
Silver, total	< 0.000050	0.000050	mg/L	2019-09-06	
Sodium, total	**1.80**	0.10	mg/L	2019-09-06	
Strontium, total	**0.0458**	0.0010	mg/L	2019-09-06	
Sulfur, total	< 3.0	3.0	mg/L	2019-09-06	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Thallium, total	< 0.000020	0.000020	mg/L	2019-09-06	
Thorium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Tin, total	< 0.00020	0.00020	mg/L	2019-09-06	
Titanium, total	< 0.0050	0.0050	mg/L	2019-09-06	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-09-06	
Uranium, total	**0.000026**	0.000020	mg/L	2019-09-06	
Vanadium, total	**0.0015**	0.0010	mg/L	2019-09-06	
Zinc, total	< 0.0040	0.0040	mg/L	2019-09-06	
Zirconium, total	**0.00036**	0.00010	mg/L	2019-09-06	
Postill Outflow (9090124-03) | Matrix: Water | Sampled: 2019-09-03 13:30					
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2019-09-05	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-09-05	
Calculated Parameters					
Hardness, Total (as CaCO3)	**13.5**	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**0.244**	0.0500	mg/L	N/A	
Nitrogen, Total Dissolved	**1.29**	0.0500	mg/L	N/A	
General Parameters					
Alkalinity, Total (as CaCO3)	**10.3**	1.0	mg/L	2019-09-06	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Bicarbonate (as CaCO3)	**10.3**	1.0	mg/L	2019-09-06	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Ammonia, Total (as N)	< 0.020	0.020	mg/L	2019-09-04	
Carbon, Total Organic	**9.87**	0.50	mg/L	2019-09-10	
Colour, True	**57**	5.0	CU	2019-09-04	
Nitrogen, Total Kjeldahl	**0.244**	0.050	mg/L	2019-09-06	
Nitrogen, Dissolved Kjeldahl	**1.29**	0.050	mg/L	2019-09-06	
pH	**6.77**	0.10	pH units	2019-09-06	HT2
Phosphorus, Total (as P)	**0.0579**	0.0020	mg/L	2019-09-06	
Phosphorus, Total Dissolved	**0.0349**	0.0020	mg/L	2019-09-06	
Solids, Total Dissolved	**45**	15	mg/L	2019-09-09	
Turbidity	**1.20**	0.10	NTU	2019-09-04	

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Postill Outflow (9090124-03) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
General Parameters, Continued					
UV Transmittance @ 254nm	**42.4**	0.10	% T	2019-09-04	
Microbiological Parameters					
Coliforms, Total	**≥ 120**	1	CFU/100 mL	2019-09-04	
Background Colonies	**> 200**	200	CFU/100 mL	2019-09-04	
E. coli	< 1	1	CFU/100 mL	2019-09-04	
Total Metals					
Aluminum, total	**0.130**	0.0050	mg/L	2019-09-06	
Antimony, total	< 0.00020	0.00020	mg/L	2019-09-06	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-09-06	
Barium, total	**0.0060**	0.0050	mg/L	2019-09-06	
Beryllium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-09-06	
Boron, total	< 0.0050	0.0050	mg/L	2019-09-06	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-09-06	
Calcium, total	**3.89**	0.20	mg/L	2019-09-06	
Chromium, total	**0.00052**	0.00050	mg/L	2019-09-06	
Cobalt, total	**0.00015**	0.00010	mg/L	2019-09-06	
Copper, total	**0.00112**	0.00040	mg/L	2019-09-06	
Iron, total	**0.425**	0.010	mg/L	2019-09-06	
Lead, total	< 0.00020	0.00020	mg/L	2019-09-06	
Lithium, total	**0.00022**	0.00010	mg/L	2019-09-06	
Magnesium, total	**0.904**	0.010	mg/L	2019-09-06	
Manganese, total	**0.0622**	0.00020	mg/L	2019-09-06	
Molybdenum, total	**0.00020**	0.00010	mg/L	2019-09-06	
Nickel, total	< 0.00040	0.00040	mg/L	2019-09-06	
Phosphorus, total	< 0.050	0.050	mg/L	2019-09-06	
Potassium, total	**0.39**	0.10	mg/L	2019-09-06	
Selenium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Silicon, total	**4.2**	1.0	mg/L	2019-09-06	
Silver, total	< 0.000050	0.000050	mg/L	2019-09-06	
Sodium, total	**2.01**	0.10	mg/L	2019-09-06	
Strontium, total	**0.0296**	0.0010	mg/L	2019-09-06	
Sulfur, total	< 3.0	3.0	mg/L	2019-09-06	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Thallium, total	< 0.000020	0.000020	mg/L	2019-09-06	
Thorium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Tin, total	< 0.00020	0.00020	mg/L	2019-09-06	
Titanium, total	< 0.0050	0.0050	mg/L	2019-09-06	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-09-06	
Uranium, total	**0.000035**	0.000020	mg/L	2019-09-06	
Vanadium, total	**0.0015**	0.0010	mg/L	2019-09-06	

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Postill Outflow (9090124-03) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
Total Metals, Continued					
Zinc, total	< 0.0040	0.0040	mg/L	2019-09-06	
Zirconium, total	**0.00190**	0.00010	mg/L	2019-09-06	
Mill Creek @ Intake (9090124-04) | Matrix: Water | Sampled: 2019-09-03 13:30					
Anions					
Nitrate (as N)	**0.059**	0.010	mg/L	2019-09-05	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-09-05	
Calculated Parameters					
Hardness, Total (as CaCO3)	**29.3**	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0594**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.320**	0.0500	mg/L	N/A	
Nitrogen, Total Dissolved	**0.319**	0.0500	mg/L	N/A	
General Parameters					
Alkalinity, Total (as CaCO3)	**27.7**	1.0	mg/L	2019-09-06	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Bicarbonate (as CaCO3)	**27.7**	1.0	mg/L	2019-09-06	
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L	2019-09-06	
Ammonia, Total (as N)	< 0.020	0.020	mg/L	2019-09-04	
Carbon, Total Organic	**9.83**	0.50	mg/L	2019-09-10	
Colour, True	**50**	5.0	CU	2019-09-04	
Nitrogen, Total Kjeldahl	**0.261**	0.050	mg/L	2019-09-06	
Nitrogen, Dissolved Kjeldahl	**0.260**	0.050	mg/L	2019-09-06	
pH	**7.39**	0.10	pH units	2019-09-06	HT2
Phosphorus, Total (as P)	**0.0344**	0.0020	mg/L	2019-09-06	
Phosphorus, Total Dissolved	**0.0296**	0.0020	mg/L	2019-09-06	
Solids, Total Dissolved	**51**	15	mg/L	2019-09-09	
Turbidity	**1.55**	0.10	NTU	2019-09-04	
UV Transmittance @ 254nm	**44.9**	0.10	% T	2019-09-04	
Microbiological Parameters					
Coliforms, Total	**≥ 2100**	1	CFU/100 mL	2019-09-04	
Background Colonies	**> 200**	200	CFU/100 mL	2019-09-04	
E. coli	**12**	1	CFU/100 mL	2019-09-04	
Total Metals					
Aluminum, total	**0.107**	0.0050	mg/L	2019-09-06	
Antimony, total	< 0.00020	0.00020	mg/L	2019-09-06	
Arsenic, total	< 0.00050	0.00050	mg/L	2019-09-06	
Barium, total	< 0.0050	0.0050	mg/L	2019-09-06	

TEST RESULTS

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Mill Creek @ Intake (9090124-04) | Matrix: Water | Sampled: 2019-09-03 13:30, Continued					
Total Metals, Continued					
Beryllium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Bismuth, total	< 0.00010	0.00010	mg/L	2019-09-06	
Boron, total	< 0.0050	0.0050	mg/L	2019-09-06	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-09-06	
Calcium, total	**7.39**	0.20	mg/L	2019-09-06	
Chromium, total	**0.00054**	0.00050	mg/L	2019-09-06	
Cobalt, total	< 0.00010	0.00010	mg/L	2019-09-06	
Copper, total	**0.00147**	0.00040	mg/L	2019-09-06	
Iron, total	**0.290**	0.010	mg/L	2019-09-06	
Lead, total	< 0.00020	0.00020	mg/L	2019-09-06	
Lithium, total	**0.00060**	0.00010	mg/L	2019-09-06	
Magnesium, total	**2.62**	0.010	mg/L	2019-09-06	
Manganese, total	**0.00749**	0.00020	mg/L	2019-09-06	
Molybdenum, total	**0.00040**	0.00010	mg/L	2019-09-06	
Nickel, total	**0.00081**	0.00040	mg/L	2019-09-06	
Phosphorus, total	< 0.050	0.050	mg/L	2019-09-06	
Potassium, total	**0.78**	0.10	mg/L	2019-09-06	
Selenium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Silicon, total	**6.4**	1.0	mg/L	2019-09-06	
Silver, total	< 0.000050	0.000050	mg/L	2019-09-06	
Sodium, total	**2.22**	0.10	mg/L	2019-09-06	
Strontium, total	**0.0482**	0.0010	mg/L	2019-09-06	
Sulfur, total	< 3.0	3.0	mg/L	2019-09-06	
Tellurium, total	< 0.00050	0.00050	mg/L	2019-09-06	
Thallium, total	< 0.000020	0.000020	mg/L	2019-09-06	
Thorium, total	< 0.00010	0.00010	mg/L	2019-09-06	
Tin, total	< 0.00020	0.00020	mg/L	2019-09-06	
Titanium, total	< 0.0050	0.0050	mg/L	2019-09-06	
Tungsten, total	< 0.0010	0.0010	mg/L	2019-09-06	
Uranium, total	**0.000087**	0.000020	mg/L	2019-09-06	
Vanadium, total	**0.0015**	0.0010	mg/L	2019-09-06	
Zinc, total	< 0.0040	0.0040	mg/L	2019-09-06	
Zirconium, total	**0.00061**	0.00010	mg/L	2019-09-06	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	Kelowna
Coliforms, Total in Water	SM 9222 B (2017)	Membrane Filtration / m-Endo Agar	Kelowna
Colour, True in Water	SM 2120 C (2017)	Spectrophotometry (456 nm)	Kelowna
E. coli in Water	SM 9222 G (2017)	Membrane Filtration / Nutrient Agar with MUG	Kelowna
Hardness in Water	SM 2340 B* (2017)	Calculation: 2.497 [total Ca] + 4.118 [total Mg] (Est)	N/A
Nitrogen, Dissolved Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	Kelowna
Phosphorus, Total Dissolved in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna
Solids, Total Dissolved in Water	SM 2540 C* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Transmittance at 254 nm in Water	SM 5910 B* (2017)	Ultraviolet Absorption	Kelowna
Turbidity in Water	SM 2130 B (2017)	Nephelometry	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
% T	Percent Transmittance
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
>	Greater than the specified Result
>=	Greater than or equal to the specified Result
CFU/100 mL	Colony Forming Units per 100 millilitres
CU	Colour Units (referenced against a platinum cobalt standard)
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
pH units	pH < 7 = acidic, ph > 7 = basic
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Glenmore Ellison Improvement District	**WORK ORDER**	9090124
PROJECT	GEID sampled by LAC	**REPORTED**	2019-09-10 11:10

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing. The quality control (QC) data is available upon request

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:acrump@caro.ca