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DISTRICT OF LOGAN LAKE 2022 ANNUAL WATER REPORT

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2022 Annual Water Report

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2022 Annual Water Report

1.0 Introduction

This report was prepared in compliance with the requirements under the British Columbia *Drinking Water Protection Act* (DWPA) and the District of Logan Lake Operating Permit. This report includes an overview of source water and distribution system that supplies the District, a summary of the total water consumption and water quality analysis completed, and a recap of projects and related operations. This report has been provided to Interior Health and posted on the District's website.

2.0 The District of Logan Lake Water System

The District of Logan Lake takes pride in its water source and is continually working towards improvements and operations that safely distribute that water to the community. For the 2022 calendar year the District had three operational wells, two of which were in production, and a fourth that came online in February of 2022 and began regular production in May of that year. All four wells extract water from the Guichon Aquifer that is not under the influence of surface water. The unchlorinated groundwater is pumped up to two reservoirs which is distributed through 26.1 km of water mains throughout the community. The water utility for Logan Lake is classified by the Environmental Operators Certification Program (EOCP) as a Level II Water Distribution System.

2.1 The Wells

The District of Logan Lake's water distribution system is supplied from four deep wells located on the west side of the District. All wells draw water from the Guichon Aquifer, located within the Guichon Creek Valley immediately west of the town site. There are two main pumphouses which are situated approximately 200 m apart. The first pumphouse contains Well #5 which was being developed to replace production Well #1. The second pump house contains Well's #2, #3 and #4. Well #2 and #4 are the current production wells in the second pumphouse and Well #3 currently operates as backup for Well #4.

2.1.1 Well Projects and Upgrades

The biggest upgrades to the District's water system for 2022 was the completion and commissioning of the Well #5 pumphouse project and bringing the new well online in February. We also completed a pump and motor replacement for the Well #2 in December of 2022. The fencing was also completed around the Breccia reservoir and Well #5.

2.1.2 Source Water Protection

The District of Logan Lake employs a series of test wells and continuously monitors water levels within the wells used for production to monitor any changes within the source water. These measures came about through a series of reports. In 2007 the District had a study done which developed a "Framework for Wellhead Protection". This study developed from a series of tests, provided the flow rate and geotechnical profiles of each well. A further study produced in 2019 which used data from 2012 to 2015 provided "Groundwater Supply Evaluation, Monitoring and a Protection Plan." The District also registered a common groundwater license for all wells that now allows for a combined extraction volume instead of individual amounts attributed to each well.

2.2 Water Storage

The District operates two reservoirs within the community's water system, the Jasper Reservoir and the Breccia Reservoir, which have full water levels at an elevation of 1166m. The Jasper Reservoir has a total volume of 1900m^3 and the Breccia Reservoir has a total volume of 690m^3. The Jasper Reservoir is located off Jasper drive on the east side of town and the Breccia Reservoir is located east of Breccia Drive on the North side of town. The total water storage capacity for the Districts water distribution system is 2590m^3.

2.3 Distribution System

The District's distribution system provides potable water to over 2200 residents and multiple businesses and contains approximately 1200 service connections within the District's boundaries. The distribution system extends for approximately 26.1 km and the composition of pipe material can be seen in Figure 1.

Figure 1: District of Logan Lake Pipe Material Breakdown

Material	Total Length (m)	Total Length as %
AC	8018.7	30.76%
CMP Casing	15.0	0.06%
DI	1634.9	6.27%
HDPE	974.7	3.74%
PVC	15349.4	58.87%
STEEL	9.00	0.03%
unknown	70.0	0.27%
Grand Total	**26071.7**	**100.00%**

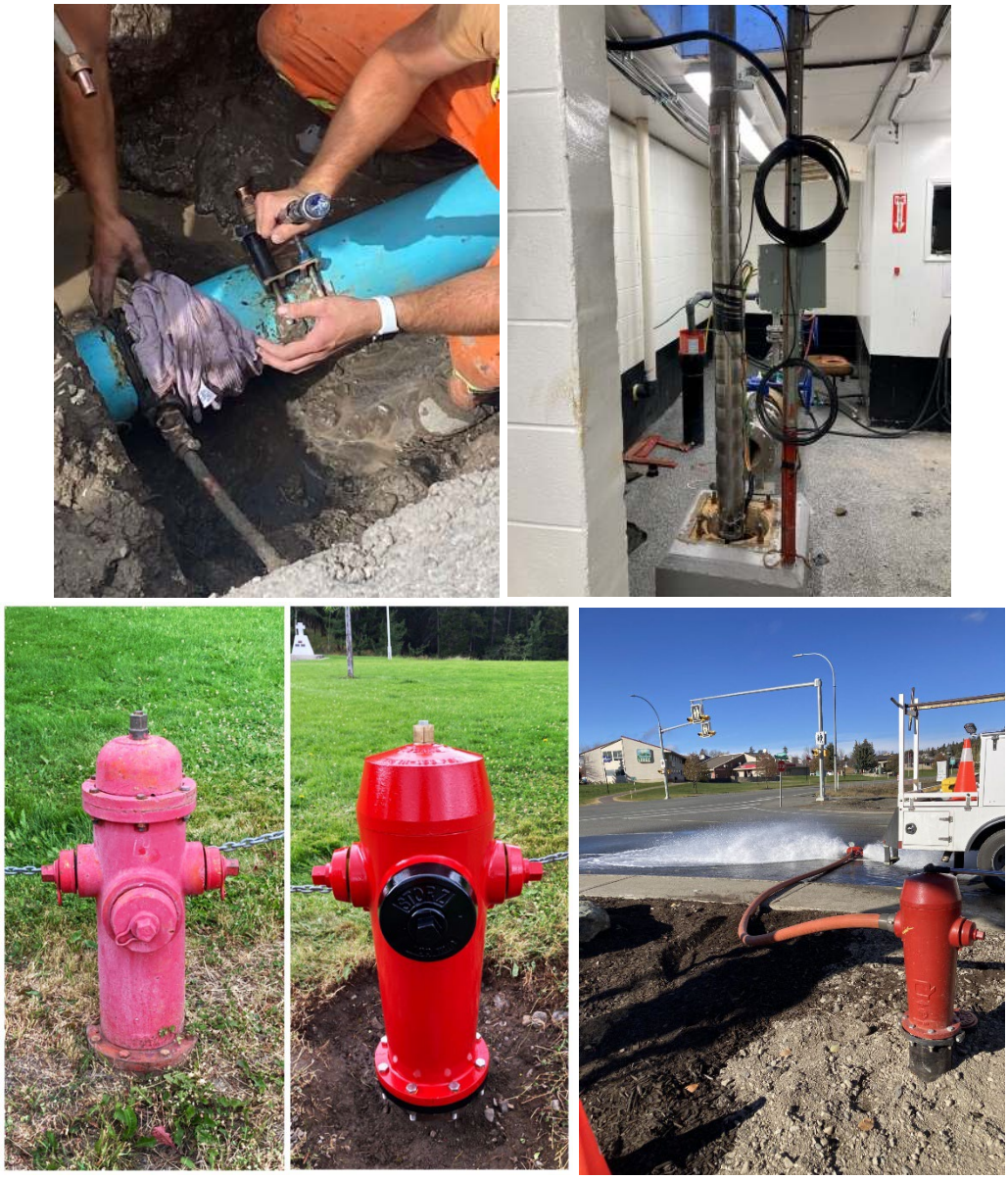
The system comprises of two pressure zones. Zone 1 has pressures established by 5 pressure reducing valve stations (PRVs) throughout the system. Zone 2 has pressures established by the levels of the Jasper and Breccia Reservoirs.

2.3.1 Distribution Maintenance and Events

Normal operations for the District distribution system consists of a mix of service requests for water connections and water on/offs, annual valve and hydrant maintenance, sampling events, flushing programs and response to small repairs such as curb stops and larger events such as water main breaks. As with most years 2022 contained a fair share of regular maintenance was completed.

Figure 2 includes a couple pictures of some of the maintenance and repairs completed within the District for 2022.

Figure 2: Water Main Repair, Well Pump 2 replacement and Hydrant Maintenance and Flushing



3.0 Cross Connection Control Program (CCCP)

The District of Logan Lake has a CCCP that targets industrial, commercial, and multi-family residential buildings. The District uses a contractor to manage the program which includes processing test reports and follow up with non-compliant businesses. The District maintains 39 backflow prevention assemblies (BFA) and has two staff certified in cross connection control testing. Figure 3 provides a summary of the District CCCP at the end of 2022 calendar year.

Figure 3: Summary of District CCCP Status for 2022 Year End

Cross-Connection Control Program

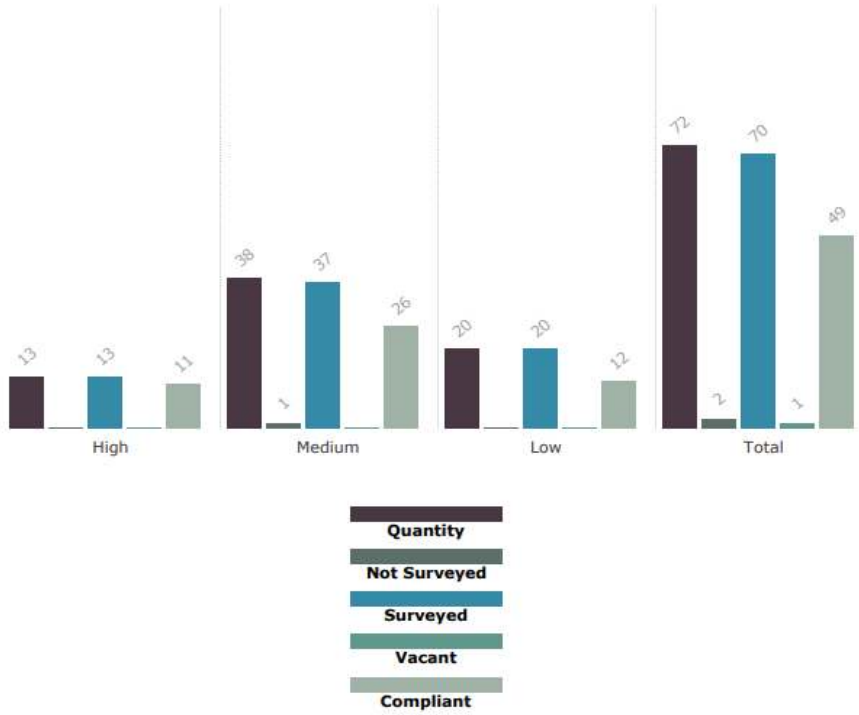
District of Logan Lake

Summary Report - Jan 04, 2023

Customers	72
Total BFPs Tracked	84
Past Due BFP Test Reports	8

Facilities

Hazards	Quantity	Not Surveyed	Surveyed	Vacant	Compliant
High	13	0	13	0	11
Medium	38	1	37	0	26
Low	20	0	20	0	12
None	1	1	0	1	0
Totals	72	2	70	1	49



4.0 Operator Training and Certification

The District of Logan water utility is classified as a Level II system by the EOCP. As the system is classified as Level II the District must employee at least one Level II certified Operator. Currently the District has two Level II Operators and one level I Operator. Training of operators is a top priority for the District which is reflected by employees the hold a variety of EOCP certifications including a Level IV in Water Treatment and a Level III and Level II in Wastewater Treatment.

5.0 Water Consumption

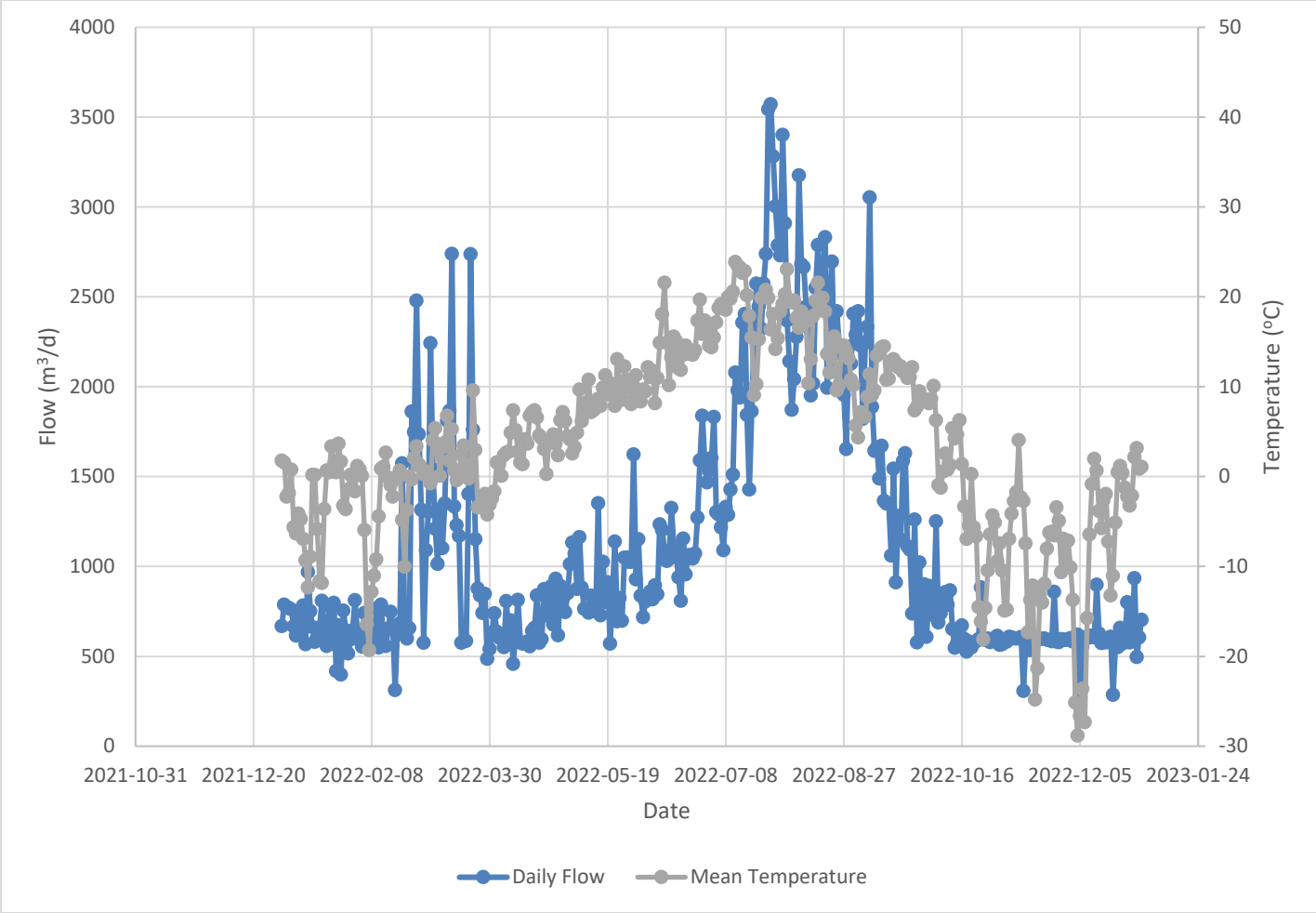
The Districts water consumption is monitored and recorded through SCADA systems for each of the supply wells. The following Figure 4 presents the total volume of water pumped in cubic meters monthly for the 2012 to 2022 calendar year.

Figure 4: District of Logan Lake Water Monthly Water Use for the Past 10 Years

	Year										Year to year Average		
Month	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	10 Year Average	10 Year Max	10 Year Min
January	26,234	22,253	21,262	22,206	24,058	25,673	22,657	21,210	22,969	20,788	22,931	26,234	20,788
February	22,437	19,874	19,999	20,343	18,910	23,225	22,057	18,574	21,136	24,130	21,069	24,130	18,574
March	26,099	22,766	20,321	20,986	22,319	25,644	24,167	21,711	23,130	38,021	24,516	38,021	20,321
April	21,891	21,382	24,171	30,969	20,700	26,214	24,562	21,122	25,588	20,632	23,723	30,969	20,632
May	45,645	30,900	45,813	42,991	29,846	60,686	39,343	34,832	38,362	28,698	39,712	60,686	28,698
June	43,679	39,861	52,752	50,682	62,299	55,350	47,460	29,152	82,856	32,746	49,684	82,856	29,152
July	80,295	82,699	56,370	46,754	95,181	71,442	43,625	46,710	84,544	65,225	67,284	95,181	43,625
August	58,179	58,375	69,975	51,920	82,229	56,664	60,430	62,427	50,012	73,985	62,420	82,229	50,012
September	50,507	34,687	48,691	29,530	42,931	30,112	26,822	47,674	30,346	45,335	38,663	50,507	26,822
October	32,622	22,730	24,161	22,176	24,222	23,022	19,767	26,588	21,396	21,131	23,782	32,622	19,767
November	31,604	19,670	20,176	22,070	23,053	22,496	19,680	25,250	20,132	17,703	22,183	31,604	17,703
December	23,453	22,069	22,720	22,984	24,975	22,342	20,661	26,876	21,871	18,700	22,665	26,876	18,700
Total Volume	462,646	397,266	426,412	383,612	470,722	442,869	371,230	382,128	442,343	407,096	418,632	470,722	371,230
Peak Day	3,295	4,353	4,218	2,431	3,739	4,368	2,497	2,764	4,178	3,574	3,542	4,368	2,431
Date	Jul-23	Jul-16	Jul-25	Jun-05	Jul-07	May-26	Aug-07	Aug-17	28-Jun	27-Jul	42,916	46,143	38,504
Average Daily Use	1,268	1,088	1,168	1,051	1,290	1,213	1,017	1,047	1,212	1,115	1,147	1,290	1,017
Average Indoor Use	870	711	721	763	746	795	724	761	737	760	759	870	711

The 2022 Calendar year seen production levels return to similar numbers experienced in 2017 after the 2021 increase in production due to the heat dome event. The Daily Water production can be seen in Figure 5.

Figure 5: Average Daily Water Use for 2022



6.0 Water Quality Sampling and Analysis

The water quality from the source wells through to the distribution system is analyzed regularly as part of the measures to ensure safe drinking water. Samples are taken weekly from within the distribution system and the wells are sampled annually for a multitude of parameters and sent off to an accredited lab.

6.1 Distribution Water Quality

The District is committed to providing safe drinking water throughout the Distribution System. To ensure this happens two sites are sampled for bacteriological analysis weekly. The sample locations are rotated between summer and winter locations at spots on the furthest points within the distribution system. These bacteriological analyses include background bacterial counts, total coliforms, and E. coli.

6.1.1 Background Bacterial Monitoring

Background bacteria monitoring is done through what is called a heterotrophic plate count (HPC). Heterotrophic bacteria are a group of bacteria that use carbon as a food source and can be found in a variety of water sources. Most bacteria found in water are actually heterotrophic. In general, these bacteria are not pathogenic, and the HPC test in itself will not tell you whether the water is bad to drink. Because of this, there is no maximum acceptable concentration (MAC), as stated in the GCDWQ. This test tells us if there are conditions within the system that bacteria can regrow or thrive in.

The District uses this test to monitor for growth within the distribution system which may indicate need for flushing.

6.1.2 Coliform Bacterial Monitoring

Coliform bacteria are a group of bacteria that is a little more of a narrow focus from the HPC test. These bacteria again represent a large group of bacteria found in water and soil, on vegetation, and in the feces of mammals. Most of these bacteria are not harmful to humans, but because of the ease of testing of these bacteria, it makes for a great indicator of contamination.

In water treatment systems, there is a zero-threshold allowance for coliforms within water samples. If a sample shows up positive for coliforms, the site is immediately resampled and, if coliforms are found again further steps are introduced which include system flushing and may lead to boil water advisories.

6.1.3 E. Coli Bacterial Monitoring

E. coli bacteria are a subsection of coliform bacteria. These bacteria may not be harmful to human health, but specific strains can cause serious health issues and even death in some instances. These bacteria are also found almost exclusively in the feces of mammals; therefore, they are a definite sign of contamination. Any positive counts for coliforms or E. coli result in an immediate boil water advisory, resampling, and cleaning of the affected area. The results for the 2022 distribution system can be seen in Figure 6 and 7.

Figure 6: Distribution Bacteriological Testing

Date	Lab	Total Coliform (cfu/100mL)	E Coli (cfu/100mL)	Background Bacteria Counts (cfu/100mL)	Location	Notes
04-Jan	ALS	>1	>1	>1	District Office	
04-Jan	ALS	>1	>1	>1	PW Shop	
10-Jan	ALS	>1	>1	>1	District Office	
10-Jan	ALS	>1	>1	>1	PW Shop	
17-Jan	ALS	>1	>1	>1	District Office	
17-Jan	ALS	>1	>1	>1	PW Shop	
24-Jan	ALS	>1	>1		District Office	MPN/100 mL
24-Jan	ALS	>1	>1		PW Shop	MPN/100 mL
01-Feb	ALS	>1	>1		District Office	MPN/100 mL
01-Feb	ALS	>1	>1		PW Shop	MPN/100 mL
07-Feb	ALS	>1	>1	>1	District Office	
07-Feb	ALS	>1	>1	>1	PW Shop	
14-Feb	ALS	>1	>1	>1	District Office	
14-Feb	ALS	>1	>1	>1	PW Shop	
22-Feb	ALS	>1	>1	>1	District Office	
22-Feb	ALS	>1	>1	>1	PW Shop	
28-Feb	ALS	>1	>1	>1	District Office	
28-Feb	ALS	>1	>1	>1	PW Shop	Well 5 Commissioned and online
07-Mar	ALS	>1	>1	>1	PW Shop	Well 5 in manual mode due to communication loss
07-Mar	ALS	>1	>1	>1	District Office	
14-Mar	ALS	>1	>1	>1	PW Shop	
14-Mar	ALS	>1	>1	>1	District Office	
21-Mar	ALS	>1	>1	>1	District Office	
21-Mar	ALS	>1	>1	>1	PW Shop	
28-Mar	ALS	>1	>1	>1	District Office	
28-Mar	ALS	>1	>1	>1	PW Shop	
04-Apr	ALS	>1	>1	>1	District Office	
04-Apr	ALS	>1	>1	>1	PW Shop	
11-Apr	ALS	>1	>1	>1	District Office	
11-Apr	ALS	>1	>1	>1	PW Shop	
19-Apr	ALS	>1	>1	>1	District Office	
19-Apr	ALS	>1	>1	>1	PW Shop	
25-Apr	ALS	>1	>1	>1	District Office	
25-Apr	ALS	>1	>1	>1	PW Shop	
02-May	ALS	>1	>1	>1	District Office	
02-May	ALS	>1	>1	>1	PW Shop	
09-May	ALS	>1	>1	>1	District Office	
09-May	ALS	>1	>1	>1	PW Shop	
16-May	ALS	>1	>1	>1	District Office	
16-May	ALS	>1	>1	>1	PW Shop	
24-May	ALS	>1	>1	>1	District Office	
24-May	ALS	>1	>1	>1	PW Shop	
30-May	ALS	>1	>1	>1	Calcite	
30-May	ALS	>1	>1	>1	Lea Rig	
06-Jun	ALS	>1	>1	>1	Lea Rig	
06-Jun	ALS	>1	>1	1	Calcite	
20-Jun	ALS	>1	>1	>1	Lea Rig	
20-Jun	ALS	2	>1	>1	Calcite	
22-Jun	ALS	>1	>1		Lea Rig	MPN/100ml Resample form June 6
22-Jun	ALS	>1	>1		Calcite	MPN/100ml Resample form June 6
27-Jun	ALS	>1	>1	>1	Lea Rig	
27-Jun	ALS	>1	>1	>1	Calcite	
04-Jul	ALS	>1	>1	>1	Calcite	
04-Jul	ALS	>1	>1	>1	Lea Rig	
11-Jul	ALS	>1	>1	>1	Calcite	
11-Jul	ALS	>1	>1	>1	Lea Rig	
19-Jul	ALS	1	>1	>1	Lea Rig	
19-Jul	ALS	>1	>1	>1	Lea Rig	Resample form July 19
21-Jul	ALS	>1	>1		Lea Rig	MPN/ 100ml Resample form July 19
25-Jul	ALS	>1	>1	>1	Calcite	
25-Jul	ALS	>1	>1	4	Lea Rig	
25-Jul	ALS	>1	>1	>1	191 Gowan	Resample form July 25
25-Jul	ALS	>1	>1	>1	Lea Rig PRV	Resample form July 25
02-Aug	ALS	2	>1	1	Lea Rig	
02-Aug	ALS	>1	>1	>1	Calcite	
04-Aug	ALS	>1	>1	>1	191 Gowan	MPN/100ml Resample form August 2
04-Aug	ALS	>1	>1	>1	Lea Rig PRV	MPN/100ml Resample form August 2
04-Aug	ALS	>1	>1		Lea Rig	MPN/100ml mL
04-Aug	ALS	>1	>1		283 Gowan	MPN/100ml mL

Figure 7: Distribution Bacteriological Testing Continued

Date	Lab	Total Coliform (cfu/100mL)	E Coli (cfu/100mL)	Background Bacteria Counts (cfu/100mL)	Location	Notes
08-Aug	ALS	23	>1	5	Lea Rig	
08-Aug	ALS	>1	>1	>1	Calcite	
10-Aug	ALS	>1	>1	>1	Lea Rig	Resample from August 8
10-Aug	ALS	>1	>1	>1	Lea Rig PRV	Resample from August 8
10-Aug	ALS	>1	>1	>1	191 Gowan	Resample form August 8
10-Aug	ALS	>1	>1	>1	283 Gowan	Resample from August 8
15-Aug	ALS	>1	>1		Lea Rig	MPN/100 mL
15-Aug	ALS	>1	>1		Calcite	MPN/100 mL
22-Aug	ALS	>1	>1		Lea Rig	MPN/100 mL
22-Aug	ALS	>1	>1		Calcite	MPN/100 mL
29-Aug	ALS	>1	>1		Lea Rig	MPN/100 mL
29-Aug	ALS	>1	>1		Calcite	MPN/100 mL
06-Sep	ALS	>1	>1		Calcite	MPN/100 mL
06-Sep	ALS	>1	>1		Lea Rig	MPN/100 mL
08-Sep	ALS	>1	>1		Calcite	MPN/100 mL
12-Sep	ALS	>1	>1		Lea Rig	MPN/100 mL
12-Sep	ALS	>1	>1		Calcite	MPN/100 mL
20-Sep	ALS	>1	>1		Lea Rig	MPN/100 mL
20-Sep	ALS	>1	>1		Calcite	MPN/100 mL
26-Sep	ALS	>1	>1		Lea Rig	MPN/100 mL
26-Sep	ALS	>1	>1		Calcite	MPN/100 mL
04-Oct	ALS	>1	>1	>1	Lea Rig	
04-Oct	ALS	>1	>1	>1	Calcite	
11-Oct	ALS	1	>1		Lea Rig	MPN/100 mL
11-Oct	ALS	>1	>1		Calcite	MPN/100 mL
13-Oct	ALS	>1	>1	>1	Lea Rig	MPN/ 100 ml Resample from Oct 11
17-Oct	ALS	>1	>1		Shop	MPN/100 mL
17-Oct	ALS	>1	>1		Office	MPN/100 mL
24-Oct	ALS	>1	>1		Shop	MPN/100 mL
24-Oct	ALS	>1	>1		Office	MPN/100 mL
31-Oct	ALS	>1	>1		Shop	MPN/100 mL
31-Oct	ALS	>1	>1		Office	MPN/100 mL
07-Nov	ALS	>1	>1		Shop	MPN/100 mL
07-Nov	ALS	>1	>1		Office	MPN/100 mL
14-Nov	ALS	>1	>1		Shop	MPN/100 mL
14-Nov	ALS	>1	>1		Office	MPN/100 mL
21-Nov	ALS	>1	>1		Shop	MPN/100 mL
21-Nov	ALS	>1	>1		Office	MPN/100 mL
28-Nov	ALS	>1	>1		Shop	MPN/100 mL
28-Nov	ALS	>1	>1		Office	MPN/100 mL
05-Dec	ALS	>1	>1		Shop	MPN/100 mL
05-Dec	ALS	>1	>1		Office	MPN/100 mL
12-Dec	ALS	>1	>1		Shop	MPN/100 mL
12-Dec	ALS	>1	>1		Office	MPN/100 mL
20-Dec	ALS	>1	>1		Shop	MPN/100 mL
20-Dec	ALS	>1	>1		Office	MPN/100 mL
28-Dec	ALS	>1	>1		Shop	MPN/100 mL
28-Dec	ALS	>1	>1		Office	MPN/100 mL

6.2 Source Water Quality

Water quality monitoring for the wells consists of routine turbidity analysis and a yearly in depth of analysis of the wells which are in production. The results of the routine turbidity analysis can be seen in Figure 8, 9 and 10 while the results from the annual in-depth analysis can be found in Figure 10, 11,12 and 13.

Figure 8: Turbidity Analysis For 2022

Date	Location	NTU	Date	Location	NTU
04-Jan	PW Shop	0.10	28-Feb	PW Shop	0.07
04-Jan	Office	0.09	28-Feb	District Office	0.09
10-Jan	Well # 2	0.11	01-Mar	Well #4	0.12
04-Jan	Well #4	0.10	04-Mar	Pump #5	0.55
07-Jan	PW Shop	0.09	04-Mar	Pump #2	0.14
10-Jan	Office	0.08	07-Mar	PW Shop	0.08
10-Jan	Well # 2	0.13	07-Mar	District Office	0.09
11-Jan	Well #4	0.10	08-Mar	Pump #4	0.08
14-Jan	PW Shop	0.09	11-Mar	Pump # 5	0.55
17-Jan	Office	0.10	11-Mar	Pump #2	0.20
17-Jan	Well # 2	0.13	14-Mar	Shop	0.07
18-Jan	Well #4	0.12	14-Mar	Office	0.06
21-Jan	PW Shop	0.09	15-Mar	Pump #4	0.09
24-Jan	Office	0.09	17-Mar	Pump #5	0.16
24-Jan	Well # 2	0.15	18-Mar	Pump #2	0.15
25-Jan	Well #4	0.12	21-Mar	PW Shop	0.10
01-Feb	PW Shop	0.09	21-Mar	District Office	0.11
01-Feb	Office	0.09	22-Mar	Pump #4	0.11
01-Feb	Well # 2	0.17	24-Mar	Pump #2	0.10
04-Feb	Well #4	0.14	24-Mar	Pump #5	0.17
07-Feb	PW Shop	0.10	28-Mar	PW Shop	0.07
07-Feb	Office	0.09	28-Mar	Office	0.07
08-Feb	Well # 2	0.16	29-Mar	Pump #2	0.17
11-Feb	Well #4	0.15	01-Apr	Pump #4	0.06
14-Feb	PW Shop	0.09	04-Apr	Shop	0.06
14-Feb	Office	0.08	04-Apr	District Office	0.10
15-Feb	Well2	0.18	05-Apr	Pump #2	0.16
18-Feb	Well4	0.16	08-Apr	Pump #4	0.07
22-Feb	Shop	0.08	11-Apr	Shop	0.07
22-Feb	Office	0.10	11-Apr	Office	0.07
22-Feb	Well #2	0.16	12-Apr	Pump #2	0.14
25-Feb	Well 4	0.18	14-Apr	Pump #4	0.08

Figure 9: Turbidity Analysis for 2022 Continued

Date	Location	NTU	Date	Location	NTU
19-Apr	Shop	0.07	14-Jun	Well #2	0.15
19-Apr	Office	0.10	17-Jun	Well #4	0.09
19-Apr	Pump #2	0.17	20-Jun	Calcite	0.11
22-Apr	Pump #4	0.07	20-Jun	Lea Rig	0.10
25-Apr	Shop	0.07	21-Jun	Well #2	0.15
25-Apr	Office	0.07	22-Jun	Well #5	0.07
26-Apr	Pump #2	0.15	24-Jun	Well #2	0.13
29-Apr	Pump #4	0.11	27-Jun	Calcite	
02-May	PW Shop	0.07	27-Jun	Lea Rig	
02-May	District Office	0.07	30-Jun	Well #2	0.11
03-May	Pump #2	0.14	04-Jul	Well # 4	0.08
06-May	Pump #4	0.13	04-Jul	Lea Rig	0.17
09-May	PW Shop	0.07	04-Jul	Calcite	0.11
09-May	District Office	0.11	08-Jul	Well #2	0.09
10-May	Pump #2	0.16	11-Jul	Lea Rig	0.08
13-May	Pump #4	0.14	11-Jul	Calcite	0.10
16-May	PW Shop	0.08	12-Jul	Well #4	0.13
16-May	District Office	0.16	13-Jul	Well #5	0.07
17-May	Pump #2	0.13	15-Jul	Well #2	0.10
20-May	Pump #4	0.15	19-Jul	Lea Rig	0.08
23-May	PW Shop	0.08	19-Jul	Calcite	0.10
23-May	District Office	0.11	19-Jul	Well #4	0.11
24-May	Pump #2	0.11	20-Jul	Well #5	0.08
25-May	Pump #5	0.08	22-Jul	Well #2	0.11
27-May	Pump #4	0.21	25-Jul	Lea Rig	0.10
30-May	Calcite	0.13	25-Jul	Calcite	0.15
30-May	Lea Rig	0.14	26-Jul	Well #4	0.12
31-May	Pump #2	0.12	27-Jul	Well #5	0.07
03-Jun	Well # 4	0.09	29-Jul	Well #2	0.18
06-Jun	Calcite	0.10	02-Aug	Calcite	0.16
06-Jun	Lea Rig	0.08	02-Aug	Lea Rig	0.10
07-Jun	Well #2	0.14	02-Aug	Well #4	0.07
10-Jun	Well # 4	0.10	03-Aug	Well #5	0.08
14-Jun	Calcite	0.37	05-Aug	Well #2	0.16
14-Jun	Lea Rig	0.08	08-Aug	Calcite	0.43

Figure 10: Turbidity Analysis for 2022 Continued

Date	Location	NTU	Date	Location	NTU
08-Aug	Lea Rig	0.09	21-Sep	Well #5	0.12
09-Aug	Well #4	0.10	23-Sep	Well #4	0.13
10-Aug	Well #5	0.07	26-Sep	Calcite	0.09
12-Aug	Well #2	0.15	26-Sep	Lea Rig	0.10
15-Aug	Calcite	0.12	28-Sep	Well #5	0.17
15-Aug	Lea Rig	0.10	29-Sep	Well #4	0.17
16-Aug	Well #4	0.08	04-Oct	Calcite	0.10
17-Aug	Well #5	0.07	04-Oct	Lea Rig	0.10
19-Aug	Well #2	0.19	05-Oct	Well #5	0.17
22-Aug	Calcite	0.11	07-Oct	Well #4	0.10
22-Aug	Lea Rig	0.13	11-Oct	Calcite	0.07
23-Aug	Well #4	0.09	11-Oct	Lea Rig	0.09
24-Aug	Well #5	0.08	12-Oct	Well #5	0.18
26-Aug	Well #2	0.18	14-Oct	Well #4	0.09
29-Aug	Calcite	0.13	17-Oct	District Office	0.10
29-Aug	Lea Rig	0.13	17-Oct	PW Shop	0.08
30-Aug	Well #4	0.10	19-Oct	Well #5	0.17
31-Aug	Well #2	0.13	21-Oct	Well #4	0.10
02-Sep	Well #4	0.07	24-Oct	District Office	0.12
06-Sep	Calcite	0.09	24-Oct	PW Shop	0.10
06-Sep	Lea Rig	0.14	26-Oct	Well #5	0.20
06-Sep	Well #2	0.12	28-Oct	Well #4	0.10
07-Sep	Well #5	0.07	31-Oct	District Office	0.07
09-Sep	Well #4	0.11	31-Oct	PW Shop	0.06
12-Sep	Calcite	0.16	01-Nov	Well #4	0.12
12-Sep	Lea Rig	0.09	02-Nov	Well #5	0.08
13-Sep	Well #5	0.10	07-Nov	District Office	0.08
16-Sep	Well #4	0.11	07-Nov	PW Shop	0.08
20-Sep	Calcite	0.10	09-Nov	Well #5	0.09
20-Sep	Lea Rig	0.07	10-Nov	Well #4	0.11

Figure 11: Physical Tests

Parameters	Lowest Detection Limit	Units	Well #2	Well #4	Well #5
Conductivity	2.0	µS/cm	533	569	393
Absorbance, UV (@ 254nm), unfiltered	0.0050	AU/cm	0.0310	0.0130	0.0560
Alkalinity, bicarbonate (as CaCO3)	1.0	mg/L	240	254	190
Alkalinity, carbonate (as CaCO3)	1.0	mg/L	<1.0	<1.0	<1.0
Alkalinity, hydroxide (as CaCO3)	1.0	mg/L	<1.0	<1.0	<1.0
Alkalinity, phenolphthalein (as CaCO3)	1.0	mg/L	<1.0	<1.0	<1.0
Alkalinity, total (as CaCO3)	1.0	mg/L	240	254	190
Colour, true	5.0	CU	<5.0	<5.0	<5.0
Hardness (as CaCO3), from total Ca/Mg	0.60	mg/L	241	253	172
Langelier index (@ 4°C)	0.010		0.631	0.791	0.373
Solids, total dissolved [TDS]	10	mg/L	328	337	253
Turbidity	0.10	NTU	<0.10	<0.10	<0.10
pH	0.10	pH units	8.18	8.28	8.14
Langelier index (@ 15°C)	0.010		0.805	0.964	0.548
Transmittance, UV (@ 254nm), unfiltered	1.0	% T/cm	93.1	97.0	87.9
Langelier index (@ 20°C)	0.010		0.879	1.04	0.621
Langelier index (@ 25°C)	0.010		0.948	1.11	0.692
Langelier index (@ 60°C)	0.010		1.39	1.55	1.14
Langelier index (@ 77°C)	0.010		1.59	1.74	1.34
pH, saturation (@ 4°C)	0.010	pH units	7.55	7.49	7.77
pH, saturation (@ 15°C)	0.010	pH units	7.38	7.32	7.59
pH, saturation (@ 20°C)	0.010	pH units	7.30	7.24	7.52
pH, saturation (@ 25°C)	0.010	pH units	7.23	7.17	7.45
pH, saturation (@ 60°C)	0.010	pH units	6.79	6.73	7.00
pH, saturation (@ 77°C)	0.010	pH units	6.59	6.53	6.80

Figure 12: Anions and Nutrients

Parameters	Lowest Detection Limit	Units	Well #2	Well #4	Well #5
Ammonia, total (as N)	0.0050	mg/L	<0.0050	<0.0050	<0.0050
Bromide	0.050	mg/L	<0.050	<0.050	<0.050
Chloride	0.50	mg/L	20.0	25.2	8.10
Fluoride	0.020	mg/L	0.104	0.110	0.114
Kjeldahl nitrogen, total [TKN]	0.050	mg/L	0.158	0.227	0.104
Nitrate (as N)	0.0050	mg/L	0.918	1.43	0.133
Nitrite (as N)	0.0010	mg/L	<0.0010	<0.0010	<0.0010
Nitrogen, total organic	0.050	mg/L	0.158	0.227	0.104
Sulfate (as SO4)	0.30	mg/L	19.4	11.3	10.5
Cyanide, strong acid dissociable (Total)	0.0050	mg/L	<0.0050	<0.0050	<0.0050
Carbon, total organic [TOC]	0.50	mg/L	2.31	1.31	4.31
Coliforms, total	1	MPN/100mL	<1	<1	<1
Coliforms, Escherichia coli [E. coli]	1	MPN/100mL	<1	<1	<1
Ion Balance (Matrix: Water)					
Anion sum	0.10	meq/L	5.84	6.13	4.26
Cation sum (total)	0.10	meq/L	5.60	5.92	4.14
Ion balance (APHA)	0.010	%	-2.10	-1.74	-1.43

Figure 10: Metals

Parameters	Lowest Detection Limit	Units	Well #2	Well #4	Well #5
Aluminum, total	0.0030	mg/L	<0.0030	<0.0030	<0.0030
Antimony, total	0.00010	mg/L	<0.00010	<0.00010	<0.00010
Arsenic, total	0.00010	mg/L	0.00086	0.00075	0.00093
Barium, total	0.00010	mg/L	0.0302	0.0312	0.0204
Beryllium, total	0.000100	mg/L	<0.000100	<0.000100	<0.000100
Bismuth, total	0.000050	mg/L	<0.000050	<0.000050	<0.000050
Boron, total	0.010	mg/L	0.011	0.014	<0.010
Cadmium, total	0.0000050	mg/L	<0.0000050	<0.0000050	<0.0000050
Calcium, total	0.050	mg/L	56.7	61.9	41.2
Cesium, total	0.000010	mg/L	<0.000010	<0.000010	<0.000010
Chromium, total	0.00050	mg/L	0.00165	0.00132	<0.00050
Cobalt, total	0.00010	mg/L	<0.00010	<0.00010	<0.00010
Copper, total	0.00050	mg/L	0.00352	0.00402	0.00255
Iron, total	0.010	mg/L	<0.010	<0.010	0.010
Lead, total	0.000050	mg/L	0.000219	<0.000050	0.000052
Lithium, total	0.0010	mg/L	<0.0010	<0.0010	<0.0010
Magnesium, total	0.0050	mg/L	24.2	24.0	16.8
Manganese, total	0.00010	mg/L	0.00015	0.00016	0.00030
Mercury, total	0.0000050	mg/L	<0.0000050	<0.0000050	<0.0000050
Molybdenum, total	0.000050	mg/L	0.00302	0.00260	0.00505
Nickel, total	0.00050	mg/L	<0.00050	<0.00050	<0.00050
Phosphorus, total	0.050	mg/L	0.087	0.095	0.091
Potassium, total	0.050	mg/L	3.04	2.74	2.90
Rubidium, total	0.00020	mg/L	0.00130	0.00122	0.00104
Selenium, total	0.000050	mg/L	0.000646	0.000264	0.000100
Silicon, total	0.10	mg/L	12.8	9.94	13.2
Silver, total	0.000010	mg/L	<0.000010	<0.000010	<0.000010
Sodium, total	0.050	mg/L	16.1	18.1	14.4
Strontium, total	0.00020	mg/L	0.287	0.302	0.195
Sulfur, total	0.50	mg/L	7.29	4.22	3.97
Tellurium, total	0.00020	mg/L	<0.00020	<0.00020	<0.00020
Thallium, total	0.000010	mg/L	<0.000010	<0.000010	<0.000010
Thorium, total	0.00010	mg/L	<0.00010	<0.00010	<0.00010
Tin, total	0.00010	mg/L	<0.00010	<0.00010	<0.00010
Titanium, total	0.00030	mg/L	<0.00030	<0.00030	<0.00030
Tungsten, total	0.00010	mg/L	<0.00010	<0.00010	<0.00010
Uranium, total	0.000010	mg/L	0.00174	0.00199	0.00118
Vanadium, total	0.00050	mg/L	0.00404	0.00354	0.00425
Zinc, total	0.0030	mg/L	0.0116	0.0070	0.0112
Zirconium, total	0.00020	mg/L	<0.00020	<0.00020	<0.00020