# 2022 ANNUAL REPORT

# VERNON WATER RECLAMATION CENTRE



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BOD <sub>5</sub>	5-day Biochemical Oxygen Demand (mg/L)
FC	Fecal Coliform (MPN/100ml)
L	liters
mg	milligrams
m <sup>3</sup>	cubic meters
MPN	most probable number
OC	Operating Certificate
OP	Ortho Phosphate (mg/L)
TN	Total Nitrogen (mg/L)
TP	Total Phosphorus (mg/L)
TSS	Total Suspended Solids (mg/L)
VWRC	Vernon Water Reclamation Centre
Fasl	Feet above sea level
EMS	Environmental Monitoring System

#### Introduction

This report is submitted as per Section 9.3.1 of the Ministry of Environment and Climate Change Strategy Operational Certificate ME 12215(OC) for the City of Vernon Water Reclamation Centre (VWRC).

The Vernon Water Reclamation Centre (VWRC) is designated as a Class IV Wastewater Treatment Center. The current plant was commissioned in 2004 as a Modified Johannesburg Biological Nutrient Removal (BNR) process.

There are four major treatment stages that complete the VWRC process. First, pretreatment of the influent at the fine screen and grit removal. Second, primary settling where solids are further settled out and removed. Third, nutrients and BOD are removed by the organisms in the bioreactors and settled out in the secondary clarifiers. Lastly, sand filters and ultraviolet lights are utilized for disinfection and the fully treated reclaimed water is ready for discharge.

Under the provisions of the Operational Certificate, the Corporation of the City of Vernon is authorized to discharge reclaimed wastewater from the VWRC located at 2100 43rd Street, Vernon, B.C., to a water storage reservoir (MacKay Reservoir) and then to the ground by irrigation. The discharge of treated reclaimed water to Okanagan Lake via the deep lake outfall is only authorized when:

a) Unforeseen conditions or circumstances beyond the City's control prevent the City from pumping treated reclaimed water from the Vernon Water Reclamation Centre to MacKay Reservoir. Such conditions would include but not be limited to power outages, pump station or pipeline failures,

Or;

b) The elevation in MacKay Reservoir exceeds 1935 feet above mean sea level and it is projected that the level of MacKay Reservoir will exceed 1939 feet above mean sea level prior to the start of the next irrigation season.

VWRC is further authorized to discharge biosolids. Biosolids from the VWRC are processed by the Regional Compost Facility located at 551 Commonage Road, Vernon, B.C., into a Class A soil compost.

# Reclaimed Water Quality Requirements

Reclaimed water discharged from the VWRC to MacKay Reservoir to be used for irrigation may not exceed the following limits:

- 26 mg/L 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>) and
- 25 mg/L Total Suspended Solids (TSS)

Reclaimed water may be discharged from the VWRC to Okanagan Lake via the deep lake outfall if the quality is better than or equivalent to the following parameters:

- 10 mg/L 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>)
- 10 mg/L Total Suspended Solids (TSS)
- Not to exceed 2.0 mg/L of Total Phosphorus (TP) (as P)
- Annual average of 0.25 mg/L of Total Phosphorus (TP) (as P)
- 6.0 mg/L Total Nitrogen (TN) (as N)
- 50 MPN /100ml Fecal Coliform (FC)

The analytical requirements stipulated by the OC and reported in this annual report were conducted by Caro Analytical Services in Kelowna, BC, and Nautilus Environmental in Burnaby, BC. The lab reports are attached in the appendices. Analysis data stipulated by the OC is downloaded annually to the Ministry of Environment and Climate Change Strategy Environmental Monitoring System (EMS) site.

# **VWRC Influent**

The VWRC continuously monitors influent flow at the headworks parshall flume. Table 1 shows the average daily flow of 12,552 m³/day with a maximum daily flow of 15,386 m³/day occurring in July. The VWRC influent flow is below the maximum authorized daily volume to discharge at 28,100 m³/day, as per section 2.1 of the OC. Figure 1 shows the total influent flows from 1992 to 2022.

Table 1. Influent Flow Table - EMS site # E228537

2022	Average Daily flow	Min	Max	Monthly
2022	(m³/day)	(m³/day)	(m³/day)	$(m^3)$
January	12,295	11,400	13,558	381,145
February	12,777	11,920	13,982	357,764
March	13,015	12,330	13,725	403,453
April	12,734	12,181	13,224	382,016
May	12,653	11,911	13,943	392,257
June	13,518	12,486	15,020	405,529
July	13,494	12,256	15,386	418,315
August	12,705	12,111	13,233	393,860
September	12,049	11,384	12,732	361,469
October	11,780	11,183	12,740	365,189
November	11,734	11,239	12,862	352,012
December	11,866	10,075	14,273	367,839
	12,552	10,075	15,386	4,580,848

Figure 1. Annual Influent flow 1992 - 2022



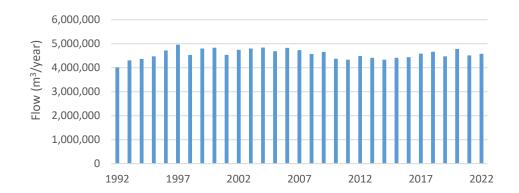


Figure 2 shows the flow changes each year from 2018 - 2022. Table 2 summarizes the influent quality treated at the VWRC. A monthly 24-hour composite sample is sent to CARO Analytical services for analysis (Appendix A – Influent Results).

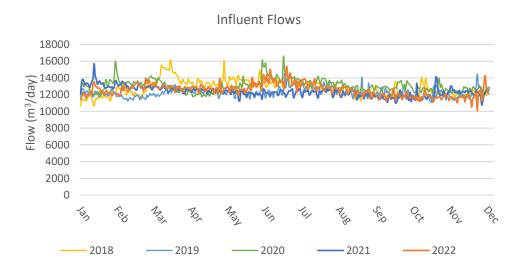


Figure 2. Daily Influent Flows 2018 - 2022

Table 2. 2022 Monthly Sampling of Influent Quality - EMS site # E228537

2022	BOD₅	TSS	Total Phosphorus	Total Nitrogen	рН
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	pH units
January	360	242	8.03	57.6	6.8
February	703	250	8.35	57.7	7.2
March	702	328	9.27	61.3	7.3
April	667	302	9.59	59.6	6.6
May	500	348	9.10	54.2	6.9
June	430	420	9.38	58.2	7.3
July	614	490	8.61	56.4	7.3
August	509	306	9.30	57.9	7.4
September	525	338	9.02	51.3	6.6
October	537	330	8.65	60.3	7.3
November	721	376	9.42	62.1	7.0
December	404	364	9.54	66.0	7.3
Average	556	341	9.02	58.6	7.1

#### **VWRC Reclaimed Water**

#### Summary

The VWRC has three distribution options for reclaimed water. One option, the VWRC delivers reclaimed water to MacKay Reservoir through the year. Second option, under certain conditions the VWRC can discharge to the lake following tertiary treatment. Lastly, during irrigation season the sand filters, Ultra-Violet (UV) lights, and chlorination are utilized for disinfection of reclaimed water used for direct irrigation. Table 3 summarizes the monthly distribution of the VWRC reclaimed water in 2021.

The quantity of reclaimed water discharged to MacKay Reservoir and Okanagan Lake is measured at the VWRC headworks parshall flume as per section 2 and 3 of the OC at EMS site # E229537. Table 4 summarizes the reclaimed water quality to MacKay Reservoir (Appendix B – Reclaimed Water Quality Results). Monthly, 24hr composite samples are submitted to CARO Analytical Services. The VWRC reclaimed water met the permit requirements in 2022 as per section 2.2 for discharge to MacKay Reservoir.

**Table 3. 2022 Reclaimed Water Distribution** 

2022	MacKa	y Reservoir	Direct to Irrigation
2022	Inflow (m <sup>3</sup> )	Outflow (m <sup>3</sup> )	$(m^3)$
January	381,145		
February	357,764		
March	403,453		
April	382,016		
May	378,745	513,660	13,512
June	402,440	134,790	3,089
July	395,145	679,180	23,170
August	356,885	1,325,640	36,975
September	342,446	731,160	19,023
October	365,189		
November	352,012		
December	367,839		
Total	4,485,079	3,384,430	95,769
Daily Average (m <sup>3</sup> /day)	12,288	22,120	626

Table 4. Quality of Reclaimed Water to MacKay Reservoir in 2022 - EMS site # E105004

		-												
				VWF	RC Treate	d Effluent	to MacK	ay Reserv	oir e					
2022		OC Limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
BOD <sub>5</sub>	(mg/L)	26	>15	14.0	12.7	8.7	18.6	<7.1	5.0	7.9	6.9	<7.1	<6.5	<7.0
TSS	(mg/L)	25	12.0	16.3	13.2	9.2	3.7	<3.3	4.4	5.2	7.0	7.4	4.3	8.6
pН	ph units		7.5	8.0	8.0	7.3	7.1	7.9	8.0	7.9	7.9	7.9	7.7	7.8
Total Phosphorus	(mg/L)		0.537	0.528	0.507	0.263	0.221	0.142	0.453	0.325	0.396	0.534	0.468	0.343
Total Dissolved Phosphorus	(mg/L)		0.097	0.094	0.092	0.064	0.070	0.056	0.357	0.153	0.160	0.429	0.229	0.076
Orthophosphorus	(mg/L)		< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	<0.0050	< 0.0050	0.017	0.013	0.194	0.071	<0.0050
Total Nitrogen	(mg/L)		5.62	5.7	4.73	4.85	7.55	5.5	5.05	6.1	6.16	6.67	6.11	6.2
Organic Nitrogen	(mg/L)		2.89	2.54	2.37	2.07	2.28	1.57	1.57	1.88	2.19	1.71	2.02	1.90
Ammonia Nitrogen	(mg/L)		0.375	0.722	0.156	<0.050	0.630	<0.050	0.071	0.077	0.090	0.065	<0.05	0.212
Nitrate Nitrogen	(mg/L)		2.27	2.27	2.15	2.68	4.21	3.90	3.34	4.11	3.78	4.87	4.09	4.07
Nitrite Nitrogen	(mg/L)		0.076	0.173	0.059	0.109	0.430	0.028	0.069	0.023	0.102	0.027	<0.010	0.016
Sodium	(mg/L)		85.6	81.0	99.3	79.5	68.3	74.8	77.3	78.5	84.1	80.6	85.8	115.0
Chloride	(mg/L)		83.6	86.2	85.3	82.1	87.5	82.2	80.1	68.1	94.7	88.9	87.0	96.1
Specific Conductivity	(µS/cm)		839	869	900	789	640	833	829	817	859	839	825	850

# Spray Irrigation Program

#### MacKay Reservoir

Since 1977 the VWRC has been utilizing MacKay Reservoir as a reclaimed water storage basin for the Spray Irrigation Program. The Spray Irrigation Program is operational from May to October, as per section 7.2 of the OC. MacKay Reservoir levels and use are dependent on the weather, the volume of reclaimed water treated at the VWRC and the volume used for beneficial reuse. Currently, beneficial reuse of reclaimed water is provided to four seed orchards, three golf courses, grazing lands, pastures, soccer fields, baseball diamonds, regional compost facility, and residential landscape irrigation (Appendix C – Spray Irrigation Areas). The City of Vernon continues to look for ways to manage MacKay Reservoir levels. (Appendix D - Liquid Waste Management Plan Update)

MacKay Reservoir level is measured weekly at EMS site # E228540. Figure 3 shows the annual supply of reclaimed water and irrigation demand at MacKay Reservoir for the last 5 years. 2020 and 2021 the VWRC released to Okanagan Lake. Figure 4 shows the MacKay Reservoir elevation minimum levels and maximum levels from 2018 – 2022. In conclusion, the Spray Irrigation Program was able to utilize 3,384,430m³ from MacKay Reservoir in the 2022 irrigation season.

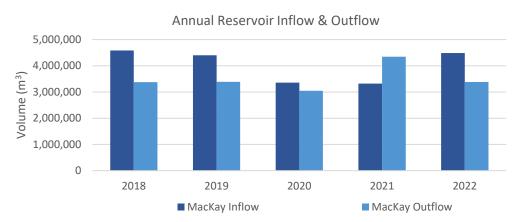
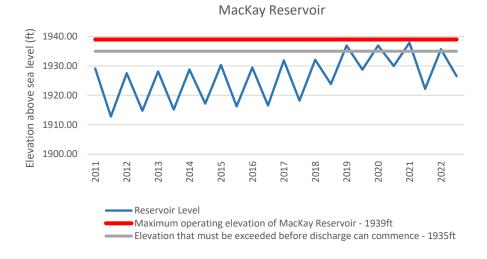


Figure 3. VWRC Influent Flow and Irrigation Usage 2018 - 2022

Figure 4. MacKay Reservoir Minimum and Maximum Elevations 2011 to 2022 - EMS E228540



#### Irrigation

Water is withdrawn from MacKay Reservoir and distributed to users during the irrigation season. It is chlorinated prior to use. Chlorine residuals are tested weekly at Clay Valve #4 throughout the irrigation season and the chlorine residual was above 0.5mg/L. As per section 2.2 of the OC, Table 6 displays the monthly water quality results from the distribution system at Clay Valve #4. EMS site # 228539 (Appendix E – Irrigation Water Quality Results).

Table 6. 2022 Irrigation Quality at Clay Valve #4

	Irrigation f	from MacKa	/ Reserv	oir			
2022		OC Permit	May	June	July	Aug	Sept
BOD <sub>5</sub>	mg/L	10	<7.1	<7.1	<6.2	<7.0	<7.4
TSS	mg/L	10	<2.0	<3.3	<3.3	<2.0	2.6
рН	pH units	6 to 9	7.61	7.54	8.11	8.12	7.94
Total Phosphorus	mg/L		0.691	0.725	0.779	0.854	0.922
Total Dissolved Phosphorus	mg/L		0.69	0.72	0.77	0.83	0.72
Ortho Phosphate	mg/L		0.452	0.334	0.419	0.408	0.764
Total Nitrogen	mg/L		2.81	2.65	3.04	3.29	2.84
Organic Nitrogen	mg/L		1.04	0.83	0.91	1.18	1.04
Ammonia N	mg/L		0.555	1.15	1.02	0.869	1.08
Nitrate N	mg/L		1.2	0.674	1.1	1.2	0.704
Nitrite N	mg/L		0.014	< 0.010	0.013	0.031	0.024
Total Coliform	(MPN/100mL)		1	<1	1	<1	<1
Fecal Coliform	(MPN/100mL)	2.2	<1	<1	<1	<1	<1

Table 7 summarizes the reclaimed water quality for direct irrigation. Reclaimed water is supplied to the Rise Golf Course from VWRC following sand filtration, UV disinfection and chlorination. The turbidity samples were less than 2 NTU. As per section 2.2 of the OC, the reclaimed water quality used for direct irrigation meets the OC requirements.

Table 7. 2022 Irrigation Quality to The Rise Golf Course – EMS site # 229578

	Direct to Irrigation										
2022		OC Limits	May	June	July	Aug	Sept				
BOD <sub>5</sub>	(mg/L)	10	<7.8	<5.2	<1.0	<1.2	<7.4				
TSS	(mg/L)	10	<2.0	<2.0	<2.0	<2.0	<2.0				
pH	ph units	6 to 9	6.85	7.91	7.78	8	7.88				
Fecal Coliforms	(MPN/100mL)	2.2	<1	<1	<1	<1	<1				

# **Groundwater Monitoring Program**

Monthly grab samples of Bailey Springs, EMS site # 0500578, are analyzed at CARO Analytical Services. Table 8 summarizes the results of the grab samples (Appendix F – Bailey Spring Water Quality Results). The annual groundwater monitoring program was completed by Associated Environmental and attached as Appendix G – Reclaimed Water Irrigation 2022 Groundwater Monitoring Program.

Table 8. 2022 Bailey Springs Results – EMS Site # 0500578

	Bailey Springs													
2022		AVG	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Phosphorus	mg/L	0.130	0.131	0.128	0.122	0.103	0.148	0.152	0.148	0.167	0.182	0.111	0.093	0.073
Total Dissolved Phosphorus	mg/L	0.112	0.120	0.119	0.113	0.089	0.133	0.115	0.121	0.132	0.152	0.096	0.086	0.067
Ortho Phosphorus	mg/L	0.038	0.052	0.071	0.053	0.013	0.032	<0.005	0.029	0.037	0.075	0.026	0.011	0.015
Total Nitrogen	mg/L	0.884	0.994	0.951	1.410	0.943	1.190	0.678	0.713	0.711	0.778	0.718	0.755	0.772
Organic Nitrogen	mg/L	0.565	0.530	0.490	0.656	0.512	0.564	0.591	0.652	0.619	0.707	0.595	0.500	0.364
Ammonia Nitrogen	mg/L	0.058	<0.05	< 0.050	< 0.050	<0.050	<0.050	0.05	<0.050	0.06	<0.050	<0.050	<0.050	0.059
Nitrate Nitrogen	mg/L	0.305	0.464	0.461	0.756	0.431	0.622	0.036	0.061	0.028	0.071	0.123	0.255	0.350
Nitrite Nitrogen	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium	mg/L	125	127	138	140	120	113	118	119	122	122	124	123	128
Chloride	mg/L	146	152	156	151	144	148	152	134	136	128	140	159	150
Specific Conductivity	uS/cm	1218	1350	1320	1290	1160	1140	1240	1160	1160	1130	1200	1230	1240
Total Coliform	MPN/ 100 mL	3913	156	387	75	326	>2420	2460	11200	24200	122	3650	271	201
Fecal Coliform	MPN/ 100 mL	307	3	2	2	70	1200	770	575	579	435	31	11	1
рН	pH units	8.40	8.28	8.41	8.39	8.47	8.24	8.36	8.47	8.50	8.47	8.41	8.37	8.38

# Sanitary Sewer Use Bylaw

The City of Vernon Sanitary Use Bylaw (#4863) is attached as Appendix H – Sanitary Use Bylaw.

# Contingency Plan

An Emergency Response Manual is available for the Staff of the VWRC to refer to in such case of emergency.

#### **Authorized Works**

Attached in Appendix I is an updated VWRC schematic of the treatment process.

# VWRC Discharge Plan

Appendix J provides the VWRC annual discharge plan.

# **Biosolids Management**

Biosolids from the Vernon Water Reclamation Center is made up of thickened primary sludge and secondary sludge. Regional Compost Facility processes the biosolids into nutrient rich Ogogrow Compost. The VWRC samples monthly for Biosolids from the Vernon Water Reclamation Centre.

# Operation and Maintenance

The staff at the Vernon Water Reclamation Center perform routine preventive and corrective maintenance. Maintenance records are kept daily and software programs are used for tracking purposes.

**Table 9. Facility Staffing** 

Position	Name	EOCP Designation
Manager	Serge Kozin	MWWT IV
Operator III	Mark Hawthorne	MWWT III
Operator II	Kevin Holman	MWWT III
Operator II	Nick Morrison	MWWT II
Operator II	Ryan Powell	MWWT III
Operator II	Kevin Walters	MWWT III
Operator I	Rob Morris	MWWT III
Operator I	Dustan Hoff	MWWT I
Reclaimed Operator	Derek Anderson	MWWT I
<b>Reclaimed Operator</b>	David McGean	WD II
Lab Technician	Amanda Summerfelt	MWWT III
Instrumentation Tech/electrician	Darren Roesler	
Instrumentation Tech/electrician	Trevor Schikowski	

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# **Appendices**

Appendix A – Influent Results

Appendix B – Reclaimed Water Quality Results

Appendix C –Spray Irrigation Areas

Appendix D – Liquid Waste Management Plan Update

Appendix E – Irrigation Water Quality Results

Appendix F – Bailey Springs Water Quality Results

Appendix G – Reclaimed Water Irrigation 2022 Groundwater Monitoring Report

Appendix H – Sanitary Use Bylaw

Appendix I – VWRC Process Schematic

Appendix J – VWRC Discharge Plan

# Appendix A

*Influent Results* 

Caro Analytical Services



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22A2555

**REPORTED** 2022-01-31 11:34

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
VWRC Influent (24hr Comp.) E22853 2022-01-21 00:00	7 (22A2555-01)   Ma	trix: Fresh Water	Sampled: 2022	-01-20 00:00	То	FILT, PRES
Anions						
Chloride	78.0	± 4.3	0.10	mg/L	2022-01-23	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-01-23	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-01-23	
Phosphate (as P)	4.30	± 0.75	0.0050	mg/L	2022-01-23	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	57.6		1.00	mg/L	N/A	
Nitrogen, Organic	21.7		1.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	35.9	± 3.2	0.050	mg/L	2022-01-26	
BOD, 5-day	360	± 203	2.0	mg/L	2022-01-27	
Conductivity (EC)	1060	± 26	2.0	μS/cm	2022-01-25	
Nitrogen, Total Kjeldahl	57.6	± 7.1	0.050	mg/L	2022-01-25	
pH	6.78	± 0.02	0.10	pH units	2022-01-25	HT2
Phosphorus, Total (as P)	8.03	± 0.89	0.0050	mg/L	2022-01-26	
Phosphorus, Total Dissolved	5.32	± 0.63	0.0050	mg/L	2022-01-26	
Solids, Total Suspended	242	± 21	2.0	mg/L	2022-01-27	
Total Metals						
Sodium, total	76.1	± 13.9	0.10	mg/L	2022-01-28	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22B2255

**REPORTED** 2022-02-24 15:09

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E22853 2022-02-16 00:00	7 (22B2255-01)   Mat	rix: Fresh Water	Sampled: 2022	-02-15 00:00	То	FILT, PRES
Anions						
Chloride	84.4	± 4.7	0.10	mg/L	2022-02-18	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-02-18	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-02-18	
Phosphate (as P)	4.78	± 0.83	0.0050	mg/L	2022-02-18	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	57.7		1.00	mg/L	N/A	
Nitrogen, Organic	23.8		1.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	34.0	± 3.1	0.050	mg/L	2022-02-22	
BOD, 5-day	703	± 233	2.0	mg/L	2022-02-22	
Conductivity (EC)	1090	± 26	2.0	μS/cm	2022-02-17	
Nitrogen, Total Kjeldahl	57.7	± 7.1	0.050	mg/L	2022-02-23	
pH	7.15	± 0.02	0.10	pH units	2022-02-17	HT2
Phosphorus, Total (as P)	8.35	± 0.93	0.0050	mg/L	2022-02-24	
Phosphorus, Total Dissolved	5.34	± 0.63	0.0050	mg/L	2022-02-24	
Solids, Total Suspended	250	± 21	2.0	mg/L	2022-02-22	
Total Metals						
Sodium, total	85.9	± 15.7	0.10	mg/L	2022-02-19	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of

**PROJECT** OC 12215 EMS E228537

WORK ORDER REPORTED 22C3435 2022-03-31 15:08

Analyte	Result	RL	Units	Analyzed	Qualifie
VWRC Influent E228537 (22C3435-01	)   Matrix: Water   Sampled: 202	2-03-22 00:00 To 2022	-03-23 00:00		FILT, PRES
Anions					
Chloride	83.0	0.10	mg/L	2022-03-26	
Nitrate (as N)	< 0.010	0.010	mg/L	2022-03-26	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-03-26	
Phosphate (as P)	4.79	0.0050	mg/L	2022-03-26	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	61.3	2.00	mg/L	N/A	
Nitrogen, Organic	29.4	2.00	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	31.9	0.050	mg/L	2022-03-29	
BOD, 5-day	702	2.0	mg/L	2022-03-30	
Conductivity (EC)	1150	2.0	μS/cm	2022-03-29	
Nitrogen, Total Kjeldahl	61.3	0.050	mg/L	2022-03-30	
рН	7.30	0.10	pH units	2022-03-29	HT2
Phosphorus, Total (as P)	9.27	0.0050	mg/L	2022-03-29	
Phosphorus, Total Dissolved	6.24	0.0050	mg/L	2022-03-29	
Solids, Total Suspended	328	2.0	mg/L	2022-03-30	
Total Metals					
Sodium, total	89.4	0.10	mg/L	2022-03-30	

#### Sample Qualifiers:

FILT The sample has been filtered for Diss Phos in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22D1855

**REPORTED** 2022-04-25 11:09

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 2022-04-14 00:00	7 (22D1855-01)   Ma	trix: Fresh Water	Sampled: 2022	-04-13 00:00	То	FILT, PRES
Anions						
Chloride	95.1	± 5.3	0.10	mg/L	2022-04-20	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-04-20	HT1
Nitrite (as N)	< 0.010		0.010	mg/L	2022-04-20	HT1
Phosphate (as P)	3.47	± 0.60	0.0050	mg/L	2022-04-20	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	59.6		2.00	mg/L	N/A	
Nitrogen, Organic	26.8		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	32.8	± 3.0	0.050	mg/L	2022-04-21	
BOD, 5-day	667	± 219	2.0	mg/L	2022-04-19	
Conductivity (EC)	1080	± 26	2.0	μS/cm	2022-04-22	
Nitrogen, Total Kjeldahl	59.6	± 7.5	0.050	mg/L	2022-04-22	
pH	6.60	± 0.02	0.10	pH units	2022-04-23	HT2
Phosphorus, Total (as P)	9.59	± 1.06	0.0050	mg/L	2022-04-21	
Phosphorus, Total Dissolved	4.72	± 0.56	0.0050	mg/L	2022-04-21	
Solids, Total Suspended	302	± 26	2.0	mg/L	2022-04-22	HT1
Total Metals						
Sodium, total	79.4	± 14.5	0.10	mg/L	2022-04-21	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

recommended.



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22E1927

**REPORTED** 2022-05-20 15:39

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
VWRC Influent E228537 (22E1927-01	)   Matrix: Water   S	ampled: 2022-05-12	2 00:00 To 2022	2-05-13 00:00		PRES
Anions						
Chloride	72.4	± 4.0	0.10	mg/L	2022-05-14	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-05-14	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-05-14	
Phosphate (as P)	3.35	± 0.58	0.0050	mg/L	2022-05-14	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	54.2		2.00	mg/L	N/A	
Nitrogen, Organic	16.7		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	37.5	± 3.4	0.050	mg/L	2022-05-16	
BOD, 5-day	500	± 188	2.0	mg/L	2022-05-19	
Conductivity (EC)	916	± 22	2.0	μS/cm	2022-05-18	
Nitrogen, Total Kjeldahl	54.2	± 6.9	0.050	mg/L	2022-05-20	
pH	6.90	± 0.02	0.10	pH units	2022-05-18	HT2
Phosphorus, Total (as P)	9.10	± 1.01	0.0050	mg/L	2022-05-19	
Phosphorus, Total Dissolved	5.53	± 0.65	0.0050	mg/L	2022-05-19	
Solids, Total Suspended	348	± 28	2.0	mg/L	2022-05-19	
Total Metals						
Sodium, total	63.6	± 11.6	0.10	mg/L	2022-05-18	

#### Sample Qualifiers:

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



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22F2782

**REPORTED** 2022-06-24 14:14

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E22853 2022-06-17 00:00	7 (22F2782-01)   Ma	trix: Fresh Water   \$	Sampled: 2022	-06-16 00:00	То	FILT, PRES
Anions						
Chloride	69.1	± 3.8	0.10	mg/L	2022-06-17	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-06-17	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-06-17	
Phosphate (as P)	2.44	± 0.42	0.0050	mg/L	2022-06-17	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	58.2		2.00	mg/L	N/A	
Nitrogen, Organic	26.1		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	32.1	± 2.9	0.050	mg/L	2022-06-20	
BOD, 5-day	430	± 197	2.0	mg/L	2022-06-23	
Conductivity (EC)	983	± 24	2.0	μS/cm	2022-06-24	
Nitrogen, Total Kjeldahl	58.2	± 7.4	0.050	mg/L	2022-06-24	
pH	7.34	± 0.02	0.10	pH units	2022-06-24	HT2
Phosphorus, Total (as P)	9.38	± 1.04	0.0050	mg/L	2022-06-22	
Phosphorus, Total Dissolved	4.02	± 0.48	0.0050	mg/L	2022-06-22	
Solids, Total Suspended	420	± 37	2.0	mg/L	2022-06-21	
Total Metals						
Sodium, total	69.9	± 12.8	0.10	mg/L	2022-06-22	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22G2140

**REPORTED** 2022-07-22 11:36

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 2022-07-15 00:00	7 (22G2140-01)   Ma	trix: Fresh Water	Sampled: 2022	-07-14 00:00	То	FILT, PRES
Anions						
Chloride	76.1	± 4.2	0.10	mg/L	2022-07-19	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-07-19	HT1
Nitrite (as N)	< 0.010		0.010	mg/L	2022-07-19	HT1
Phosphate (as P)	3.06	± 0.53	0.0050	mg/L	2022-07-19	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	56.4		1.00	mg/L	N/A	
Nitrogen, Organic	26.4		1.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	30.0	± 2.7	0.050	mg/L	2022-07-19	
BOD, 5-day	614	± 213	2.0	mg/L	2022-07-21	
Conductivity (EC)	1060	± 25	2.0	μS/cm	2022-07-20	
Nitrogen, Total Kjeldahl	56.4	± 7.0	0.050	mg/L	2022-07-21	
pH	7.30	± 0.02	0.10	pH units	2022-07-20	HT2
Phosphorus, Total (as P)	8.61	± 0.96	0.0050	mg/L	2022-07-21	
Phosphorus, Total Dissolved	6.18	± 0.73	0.0050	mg/L	2022-07-21	
Solids, Total Suspended	490	± 38	2.0	mg/L	2022-07-22	
Total Metals						
Sodium, total	80.5	± 14.7	0.10	mg/L	2022-07-21	

#### Sample Qualifiers:

FILT The sample has been filtered for Diss phos in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

recommended.



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22H1605

**REPORTED** 2022-08-18 10:58

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 2022-08-10 00:00	7 (22H1605-01)   Ma	trix: Fresh Water	Sampled: 2022	-08-09 00:00	То	FILT, PRES
Anions						
Chloride	76.8	± 4.2	0.10	mg/L	2022-08-12	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-08-12	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-08-12	
Phosphate (as P)	4.79	± 0.83	0.0050	mg/L	2022-08-12	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	57.9		2.00	mg/L	N/A	
Nitrogen, Organic	23.9		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	34.0	± 3.1	0.050	mg/L	2022-08-12	
BOD, 5-day	509	± 118	2.0	mg/L	2022-08-16	
Conductivity (EC)	1070	± 26	2.0	μS/cm	2022-08-12	
Nitrogen, Total Kjeldahl	57.9	± 7.1	0.050	mg/L	2022-08-17	
pH	7.43	± 0.02	0.10	pH units	2022-08-12	HT2
Phosphorus, Total (as P)	9.30	± 1.03	0.0050	mg/L	2022-08-15	
Phosphorus, Total Dissolved	5.94	± 0.70	0.0050	mg/L	2022-08-15	
Solids, Total Suspended	306	± 23	2.0	mg/L	2022-08-13	
Total Metals						
Sodium, total	77.6	± 14.2	0.10	mg/L	2022-08-18	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

2211259

**REPORTED** 2022-09-16 16:25

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 2022-09-09 00:00	7 (22l1259-01)   <b>M</b> at	rix: Fresh Water   S	ampled: 2022-	ד 00:00 80-08	o	FILT, PRES
Anions						
Chloride	71.8	± 3.9	0.10	mg/L	2022-09-14	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-09-14	HT1
Nitrite (as N)	< 0.010		0.010	mg/L	2022-09-14	HT1
Phosphate (as P)	2.80	± 0.49	0.0050	mg/L	2022-09-14	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	51.3		2.00	mg/L	N/A	
Nitrogen, Organic	23.3		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	28.0	± 2.5	0.050	mg/L	2022-09-15	
BOD, 5-day	525	± 125	2.0	mg/L	2022-09-15	
Conductivity (EC)	985	± 24	2.0	μS/cm	2022-09-16	
Nitrogen, Total Kjeldahl	51.3	± 6.3	0.050	mg/L	2022-09-15	
pH	6.61	± 0.02	0.10	pH units	2022-09-16	HT2
Phosphorus, Total (as P)	9.02	± 1.00	0.0050	mg/L	2022-09-15	
Phosphorus, Total Dissolved	5.92	± 0.70	0.0050	mg/L	2022-09-15	
Solids, Total Suspended	338	± 26	2.0	mg/L	2022-09-14	
Total Metals						
Sodium, total	77.7	± 14.2	0.10	mg/L	2022-09-15	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

recommended.



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22J0872

**REPORTED** 2022-10-14 12:20

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E22853	7 (22J0872-01)   Mat	rix: Fresh Water   S	ampled: 2022	-10-06		PRES
Anions						
Chloride	83.9	± 4.6	0.10	mg/L	2022-10-12	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-10-12	HT1
Nitrite (as N)	< 0.010		0.010	mg/L	2022-10-12	HT1
Phosphate (as P)	3.78	± 0.66	0.0050	mg/L	2022-10-12	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	60.3		2.00	mg/L	N/A	
Nitrogen, Organic	25.6		2.00	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	34.7	± 3.1	0.050	mg/L	2022-10-12	
BOD, 5-day	537	± 118	2.0	mg/L	2022-10-13	
Conductivity (EC)	1120	± 27	2.0	μS/cm	2022-10-13	
Nitrogen, Total Kjeldahl	60.3	± 7.4	0.050	mg/L	2022-10-14	
рН	7.33	± 0.02	0.10	pH units	2022-10-13	HT2
Phosphorus, Total (as P)	8.65	± 0.96	0.0050	mg/L	2022-10-13	
Phosphorus, Total Dissolved	5.10	± 0.60	0.0050	mg/L	2022-10-13	
Solids, Total Suspended	330	± 25	2.0	mg/L	2022-10-14	
Total Metals						
Sodium, total	96.7	± 17.7	0.10	mg/L	2022-10-13	RS1

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

PRES Sample has been preserved for TDP in the laboratory and the holding time has been extended.

RS1 The Reporting Limits for this sample have been raised due to high analyte concentration and/or matrix interference.



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22K0743

**REPORTED** 2022-11-14 12:40

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 (22I 2022-11-04 00:00	(0743-01)   Ma	trix: Fresh Water	Sampled: 2022	-11-03 00:00 <sup>-</sup>	Го	FILT, PRES
Anions						
Chloride	72.6	± 4.0	0.10	mg/L	2022-11-07	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-11-07	
Nitrite (as N)	0.012	± 0.001	0.010	mg/L	2022-11-07	
Phosphate (as P)	4.41	± 0.77	0.0050	mg/L	2022-11-07	
Calculated Parameters						
Nitrate+Nitrite (as N)	0.0125		0.0100	mg/L	N/A	
Nitrogen, Total	62.1		2.00	mg/L	N/A	
Nitrogen, Organic	30.6		2.00	mg/L	N/A	
General Parameters						
Alkalinity, Total (as CaCO3)	255	± 14	1.0	mg/L	2022-11-10	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0		1.0	mg/L	2022-11-10	
Alkalinity, Bicarbonate (as CaCO3)	255		1.0	mg/L	2022-11-10	
Alkalinity, Carbonate (as CaCO3)	< 1.0		1.0	mg/L	2022-11-10	
Alkalinity, Hydroxide (as CaCO3)	< 1.0		1.0	mg/L	2022-11-10	
Ammonia, Total (as N)	31.5	± 2.8	0.050	mg/L	2022-11-07	
BOD, 5-day	721	± 156	2.0	mg/L	2022-11-14	HT1
Conductivity (EC)	977	± 24	2.0	μS/cm	2022-11-10	
Nitrogen, Total Kjeldahl	62.1	± 7.6	0.050	mg/L	2022-11-10	
рН	7.03	± 0.02	0.10	pH units	2022-11-10	HT2
Phosphorus, Total (as P)	9.42	± 1.04	0.0050	mg/L	2022-11-09	
Phosphorus, Total Dissolved	5.59	± 0.66	0.0050	mg/L	2022-11-09	
Solids, Total Suspended	376	± 29	2.0	mg/L	2022-11-09	
Total Metals						
Sodium, total	71.4	± 13.1	0.10	mg/L	2022-11-10	

#### Sample Qualifiers:

FILT The sample has been filtered for Diss P in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

recommended.



**REPORTED TO** Vernon Water Reclamation, City of

PROJECT Influent (ME12215) - EMS

CARO WO#

22L0773

**REPORTED** 2022-12-14 13:45

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Influent (24hr Comp.) E228537 (22 2022-12-07 00:00	L0773-01)   Mat	rix: Fresh Water	Sampled: 2022	-12-06 00:00	То	FILT, PRES
Anions						
Chloride	111	± 6	0.10	mg/L	2022-12-09	
Nitrate (as N)	< 0.010		0.010	mg/L	2022-12-09	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-12-09	
Phosphate (as P)	4.46	± 0.78	0.0050	mg/L	2022-12-09	
Calculated Parameters						
Nitrate+Nitrite (as N)	< 0.0100		0.0100	mg/L	N/A	
Nitrogen, Total	66.0		2.00	mg/L	N/A	
Nitrogen, Organic	26.6		2.00	mg/L	N/A	
General Parameters						
Alkalinity, Total (as CaCO3)	301	± 17	1.0	mg/L	2022-12-10	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0		1.0	mg/L	2022-12-10	
Alkalinity, Bicarbonate (as CaCO3)	301		1.0	mg/L	2022-12-10	
Alkalinity, Carbonate (as CaCO3)	< 1.0		1.0	mg/L	2022-12-10	
Alkalinity, Hydroxide (as CaCO3)	< 1.0		1.0	mg/L	2022-12-10	
Ammonia, Total (as N)	39.3	± 3.5	0.050	mg/L	2022-12-10	
BOD, 5-day	404	± 109	2.0	mg/L	2022-12-13	
Conductivity (EC)	1170	± 28	2.0	μS/cm	2022-12-10	
Nitrogen, Total Kjeldahl	66.0	± 8.1	0.050	mg/L	2022-12-13	
pH	7.29	± 0.02	0.10	pH units	2022-12-10	HT2
Phosphorus, Total (as P)	9.54	± 1.06	0.0050	mg/L	2022-12-12	
Phosphorus, Total Dissolved	5.51	± 0.65	0.0050	mg/L	2022-12-12	
Solids, Total Suspended	364	± 28	2.0	mg/L	2022-12-08	
Total Metals						
Sodium, total	97.3	± 17.8	0.10	mg/L	2022-12-13	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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

# Appendix B

# Reclaimed Water Quality Results

Caro Analytical Services



REPORTED TO Vernon Water Reclamation, City of PROJECT Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22A3508 2022-02-07 15:26

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
VWRC Final Treated Effluent - 24hr C 2022-01-26 00:00 To 2022-01-27 00:00	•	A3508-01)   Matrix	: Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	83.6	± 4.6	0.10	mg/L	2022-01-28	
Nitrate (as N)	2.27	± 0.14	0.010	mg/L	2022-01-28	
Nitrite (as N)	0.076	± 0.008	0.010	mg/L	2022-01-28	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-01-28	
Calculated Parameters						
Nitrate+Nitrite (as N)	2.35		0.0100	mg/L	N/A	
Nitrogen, Total	5.62		0.100	mg/L	N/A	
Nitrogen, Organic	2.89		0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.375	± 0.039	0.050	mg/L	2022-02-02	
BOD, 5-day	> 15		2.0	mg/L	2022-02-03	BOD5, HT
Conductivity (EC)	839	± 20	2.0	μS/cm	2022-01-31	
Nitrogen, Total Kjeldahl	3.27	± 0.41	0.050	mg/L	2022-02-04	
pH	7.40	± 0.02	0.10	pH units	2022-01-31	HT2
Phosphorus, Total (as P)	0.537	± 0.060	0.0050	mg/L	2022-02-03	
Phosphorus, Total Dissolved	0.0971	± 0.0115	0.0050	mg/L	2022-02-03	
Solids, Total Suspended	14.7	± 1.9	2.0	mg/L	2022-02-03	HT1
Total Metals						
Sodium, total	85.6	± 15.7	0.10	mg/L	2022-02-03	



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22B2620 2022-02-28 15:43

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-02-17 00:00 To 2022-02-18 00:00	•	B2620-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	86.2	± 4.8	0.10	mg/L	2022-02-22	
Nitrate (as N)	2.27	± 0.14	0.010	mg/L	2022-02-22	HT1
Nitrite (as N)	0.173	± 0.018	0.010	mg/L	2022-02-22	HT1
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-02-22	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	2.44		0.0100	mg/L	N/A	
Nitrogen, Total	5.70		0.100	mg/L	N/A	
Nitrogen, Organic	2.54		0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.722	± 0.068	0.050	mg/L	2022-02-24	
BOD, 5-day	14.0	± 3.8	2.0	mg/L	2022-02-24	
Conductivity (EC)	869	± 21	2.0	μS/cm	2022-02-27	
Nitrogen, Total Kjeldahl	3.26	± 0.41	0.050	mg/L	2022-02-28	
рН	8.00	± 0.02	0.10	pH units	2022-02-27	HT2
Phosphorus, Total (as P)	0.528	± 0.059	0.0050	mg/L	2022-02-28	
Phosphorus, Total Dissolved	0.0937	± 0.0111	0.0050	mg/L	2022-02-28	
Solids, Total Suspended	16.3	± 1.5	2.0	mg/L	2022-02-26	HT1
Total Metals						
Sodium, total	81.0	± 14.8	0.10	mg/L	2022-02-25	

#### Sample Qualifiers:

**PRES** 

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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



REPORTED TO Vernon Water Reclamation, City of
PROJECT Final Treated Effluent (ME12215) - EMS

**CARO WO#** 22C2619 **REPORTED** 2022-03-25 11:19

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-03-17 00:00 To 2022-03-18 00:00	•	2C2619-01)   Matrix	Fresh Water	Sampled:		
Anions						
Chloride	85.3	± 4.7	0.10	mg/L	2022-03-21	
Nitrate (as N)	2.15	± 0.13	0.010	mg/L	2022-03-21	
Nitrite (as N)	0.059	± 0.006	0.010	mg/L	2022-03-21	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-03-21	
Calculated Parameters						
Nitrate+Nitrite (as N)	2.21		0.0100	mg/L	N/A	
Nitrogen, Total	4.73		0.100	mg/L	N/A	
Nitrogen, Organic	2.37		0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.156	± 0.024	0.050	mg/L	2022-03-22	
BOD, 5-day	12.7	± 3.6	2.0	mg/L	2022-03-24	
Conductivity (EC)	900	± 22	2.0	μS/cm	2022-03-22	
Nitrogen, Total Kjeldahl	2.52	± 0.32	0.050	mg/L	2022-03-23	
рН	8.02	± 0.02	0.10	pH units	2022-03-22	HT2
Phosphorus, Total (as P)	0.507	± 0.056	0.0050	mg/L	2022-03-23	
Phosphorus, Total Dissolved	0.0922	± 0.0109	0.0050	mg/L	2022-03-23	
Solids, Total Suspended	13.2	± 1.4	2.0	mg/L	2022-03-23	
Total Metals						
Sodium, total	99.3	± 18.2	0.10	mg/L	2022-03-23	

#### Sample Qualifiers:

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



REPORTED TO Vernon Water Reclamation, City of PROJECT Final Treated Effluent (ME12215) - EMS

CARO WO#

22D2708

**REPORTED** 2022-04-29 15:10

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifi
VWRC Final Treated Effluent - 24hr C 2022-04-21 00:00 To 2022-04-22 00:00	•	2D2708-01)   Matrix:	Fresh Water	Sampled:		
Anions						
Chloride	82.1	± 4.5	0.10	mg/L	2022-04-22	
Nitrate (as N)	2.68	± 0.17	0.010	mg/L	2022-04-22	
Nitrite (as N)	0.109	± 0.011	0.010	mg/L	2022-04-22	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-04-22	
Calculated Parameters						
Nitrate+Nitrite (as N)	2.78		0.0100	mg/L	N/A	
Nitrogen, Total	4.85		0.0500	mg/L	N/A	
Nitrogen, Organic	2.07		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050		0.050	mg/L	2022-04-27	
BOD, 5-day	8.7	± 2.1	2.0	mg/L	2022-04-28	
Conductivity (EC)	789	± 19	2.0	μS/cm	2022-04-28	
Nitrogen, Total Kjeldahl	2.07	± 0.26	0.050	mg/L	2022-04-29	
рН	7.29	± 0.02	0.10	pH units	2022-04-28	HT2
Phosphorus, Total (as P)	0.263	± 0.029	0.0050	mg/L	2022-04-29	
Phosphorus, Total Dissolved	0.0636	± 0.0076	0.0050	mg/L	2022-04-29	
Solids, Total Suspended	9.2	± 1.2	2.0	mg/L	2022-04-29	
Total Metals						
Sodium, total	79.5	± 14.5	0.10	mg/L	2022-04-29	

#### Sample Qualifiers:

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22E3811 2022-06-03 10:35

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-05-26 00:00 To 2022-05-27 00:00	•	E3811-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	87.5	± 4.8	0.10	mg/L	2022-05-28	
Nitrate (as N)	4.21	± 0.26	0.010	mg/L	2022-05-28	
Nitrite (as N)	0.430	± 0.044	0.010	mg/L	2022-05-28	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-05-28	
Calculated Parameters						
Nitrate+Nitrite (as N)	4.64		0.0100	mg/L	N/A	
Nitrogen, Total	7.55		0.100	mg/L	N/A	
Nitrogen, Organic	2.28		0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.630	± 0.060	0.050	mg/L	2022-05-29	
BOD, 5-day	18.6	± 8.6	2.0	mg/L	2022-06-02	
Conductivity (EC)	640	± 16	2.0	μS/cm	2022-05-31	
Nitrogen, Total Kjeldahl	2.91	± 0.37	0.050	mg/L	2022-06-03	
pH	7.06	± 0.02	0.10	pH units	2022-05-31	HT2
Phosphorus, Total (as P)	0.221	± 0.025	0.0050	mg/L	2022-06-01	
Phosphorus, Total Dissolved	0.0698	± 0.0083	0.0050	mg/L	2022-06-01	
Solids, Total Suspended	3.7	± 1.6	2.0	mg/L	2022-06-01	
Total Metals						
Sodium, total	68.3	± 12.5	0.10	mg/L	2022-05-31	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22F3446 2022-06-28 14:12

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifi
VWRC Final Treated Effluent - 24hr C 2022-06-21 00:00 To 2022-06-22 00:00	•	:F3446-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	82.2	± 4.6	0.10	mg/L	2022-06-25	
Nitrate (as N)	3.90	± 0.25	0.010	mg/L	2022-06-25	
Nitrite (as N)	0.028	± 0.004	0.010	mg/L	2022-06-25	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-06-25	
Calculated Parameters						
Nitrate+Nitrite (as N)	3.93		0.0100	mg/L	N/A	
Nitrogen, Total	5.50		0.100	mg/L	N/A	
Nitrogen, Organic	1.57		0.100	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050		0.050	mg/L	2022-06-27	
BOD, 5-day	< 7.1		2.0	mg/L	2022-06-28	
Conductivity (EC)	833	± 20	2.0	μS/cm	2022-06-27	
Nitrogen, Total Kjeldahl	1.57	± 0.21	0.050	mg/L	2022-06-28	
pH	7.89	± 0.02	0.10	pH units	2022-06-27	HT2
Phosphorus, Total (as P)	0.142	± 0.016	0.0050	mg/L	2022-06-27	
Phosphorus, Total Dissolved	0.0564	± 0.0067	0.0050	mg/L	2022-06-27	
Solids, Total Suspended	< 3.3		2.0	mg/L	2022-06-28	
Total Metals						
Sodium, total	74.8	± 13.7	0.10	mg/L	2022-06-25	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22G1660 2022-07-19 15:12

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-07-12 00:00 To 2022-07-13 00:00	•	G1660-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	80.1	± 4.4	0.10	mg/L	2022-07-14	
Nitrate (as N)	3.34	± 0.21	0.010	mg/L	2022-07-14	
Nitrite (as N)	0.069	± 0.007	0.010	mg/L	2022-07-14	
Phosphate (as P)	0.0988	± 0.0173	0.0050	mg/L	2022-07-14	
Calculated Parameters						
Nitrate+Nitrite (as N)	3.41		0.0100	mg/L	N/A	
Nitrogen, Total	5.05		0.0500	mg/L	N/A	
Nitrogen, Organic	1.57		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.071	± 0.021	0.050	mg/L	2022-07-17	
BOD, 5-day	5.0	± 1.4	2.0	mg/L	2022-07-19	
Conductivity (EC)	829	± 20	2.0	μS/cm	2022-07-15	
Nitrogen, Total Kjeldahl	1.64	± 0.21	0.050	mg/L	2022-07-17	
рН	7.95	± 0.02	0.10	pH units	2022-07-15	HT2
Phosphorus, Total (as P)	0.453	± 0.050	0.0050	mg/L	2022-07-15	
Phosphorus, Total Dissolved	0.357	± 0.042	0.0050	mg/L	2022-07-15	
Solids, Total Suspended	4.4	± 1.0	2.0	mg/L	2022-07-15	
Total Metals						
Sodium, total	77.3	± 14.1	0.10	mg/L	2022-07-19	

#### Sample Qualifiers:

FILT The sample has been filtered for Diss phos in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22H0862 2022-08-12 22:56

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-08-04 00:00 To 2022-08-05 00:00	•	H0862-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	68.1	± 3.7	0.10	mg/L	2022-08-08	
Nitrate (as N)	4.11	± 0.26	0.010	mg/L	2022-08-08	
Nitrite (as N)	0.023	± 0.002	0.010	mg/L	2022-08-08	
Phosphate (as P)	0.0166	± 0.0030	0.0050	mg/L	2022-08-08	
Calculated Parameters						
Nitrate+Nitrite (as N)	4.14		0.0100	mg/L	N/A	
Nitrogen, Total	6.10		0.0500	mg/L	N/A	
Nitrogen, Organic	1.88		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.077	± 0.010	0.050	mg/L	2022-08-08	
BOD, 5-day	7.9	± 2.7	2.0	mg/L	2022-08-11	
Conductivity (EC)	817	± 20	2.0	μS/cm	2022-08-10	
Nitrogen, Total Kjeldahl	1.96	± 0.24	0.050	mg/L	2022-08-10	
pH	7.94	± 0.02	0.10	pH units	2022-08-10	HT2
Phosphorus, Total (as P)	0.325	± 0.036	0.0050	mg/L	2022-08-09	
Phosphorus, Total Dissolved	0.153	± 0.018	0.0050	mg/L	2022-08-09	
Solids, Total Suspended	5.2	± 0.5	2.0	mg/L	2022-10-08	
Total Metals						
Sodium, total	78.5	± 14.4	0.10	mg/L	2022-08-11	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO#

22l3186

**REPORTED** 2022-09-30 11:44

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-09-22 00:00 To 2022-09-23 00:00	•	3186-01)   Matrix:	Fresh Water   \$	Sampled:		FILT, PRES
Anions						
Chloride	94.7	± 5.2	0.10	mg/L	2022-09-29	
Nitrate (as N)	3.78	± 0.24	0.010	mg/L	2022-09-29	HT1
Nitrite (as N)	0.102	± 0.010	0.010	mg/L	2022-09-29	HT1
Phosphate (as P)	0.0126	± 0.0024	0.0050	mg/L	2022-09-29	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	3.88		0.0100	mg/L	N/A	
Nitrogen, Total	6.16		0.0500	mg/L	N/A	
Nitrogen, Organic	2.19		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.090	± 0.011	0.050	mg/L	2022-09-27	
BOD, 5-day	6.9	± 1.4	2.0	mg/L	2022-09-29	
Conductivity (EC)	859	± 21	2.0	μS/cm	2022-09-28	
Nitrogen, Total Kjeldahl	2.28	± 0.28	0.050	mg/L	2022-09-30	
pH	7.91	± 0.02	0.10	pH units	2022-09-28	HT2
Phosphorus, Total (as P)	0.396	± 0.044	0.0050	mg/L	2022-09-29	
Phosphorus, Total Dissolved	0.160	± 0.019	0.0050	mg/L	2022-09-29	
Solids, Total Suspended	7.0	± 0.6	2.0	mg/L	2022-09-27	
Total Metals						
Sodium, total	84.1	± 15.4	0.10	mg/L	2022-09-29	

#### Sample Qualifiers:

FILT The sample has been filtered for Diss phos in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22J0703 2022-10-17 12:26

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-10-04	omp E105004 (22	2J0703-01)   Matrix:	Fresh Water	Sampled:		PRES
Anions						
Chloride	88.9	± 4.9	0.10	mg/L	2022-10-09	
Nitrate (as N)	4.87	± 0.31	0.010	mg/L	2022-10-09	HT1
Nitrite (as N)	0.027	± 0.003	0.010	mg/L	2022-10-09	HT1
Phosphate (as P)	0.194	± 0.034	0.0050	mg/L	2022-10-09	HT1
Calculated Parameters						
Nitrate+Nitrite (as N)	4.90		0.0100	mg/L	N/A	
Nitrogen, Total	6.67		0.0500	mg/L	N/A	
Nitrogen, Organic	1.71		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.065	± 0.009	0.050	mg/L	2022-10-11	
BOD, 5-day	< 7.1		2.0	mg/L	2022-10-12	
Conductivity (EC)	839	± 20	2.0	μS/cm	2022-10-10	
Nitrogen, Total Kjeldahl	1.78	± 0.22	0.050	mg/L	2022-10-13	
pH	7.91	± 0.02	0.10	pH units	2022-10-10	HT2
Phosphorus, Total (as P)	0.534	± 0.059	0.0050	mg/L	2022-10-12	
Phosphorus, Total Dissolved	0.429	± 0.051	0.0050	mg/L	2022-10-12	
Solids, Total Suspended	7.4	± 0.6	2.0	mg/L	2022-10-14	HT1
Total Metals						
Sodium, total	80.6	± 14.7	0.10	mg/L	2022-10-13	

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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



REPORTED TO Vernon Water Reclamation, City of PROJECT Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22K0567 2022-11-10 14:28

Analyte	Result Und	ertainty	RL	Units	Analyzed	Qualifie
VWRC Final Treated Effluent - 24hr C 2022-11-02 00:00 To 2022-11-03 00:00	•	67-01)   Matrix: Fı	resh Water	Sampled:		FILT, PRES
Anions						
Chloride	<b>81.8</b> ± 4.	5	0.10	mg/L	2022-11-05	
Nitrate (as N)	<b>4.09</b> ± 0.	26	0.010	mg/L	2022-11-05	
Nitrite (as N)	< 0.010		0.010	mg/L	2022-11-05	
Phosphate (as P)	<b>0.0706</b> ± 0.	0123	0.0050	mg/L	2022-11-05	
Calculated Parameters						
Nitrate+Nitrite (as N)	4.09		0.0100	mg/L	N/A	
Nitrogen, Total	6.11		0.0500	mg/L	N/A	
Nitrogen, Organic	2.02		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	< 0.050		0.050	mg/L	2022-11-06	
BOD, 5-day	< 6.5		2.0	mg/L	2022-11-10	
Conductivity (EC)	<b>835</b> ± 20	)	2.0	μS/cm	2022-11-08	
Nitrogen, Total Kjeldahl	<b>2.02</b> ± 0.	25	0.050	mg/L	2022-11-08	
pH	<b>7.74</b> ± 0.	02	0.10	pH units	2022-11-08	HT2
Phosphorus, Total (as P)	<b>0.468</b> ± 0.	052	0.0050	mg/L	2022-11-08	
Phosphorus, Total Dissolved	<b>0.229</b> ± 0.	027	0.0050	mg/L	2022-11-08	
Solids, Total Suspended	<b>4.3</b> ± 0.	6	2.0	mg/L	2022-11-09	
Total Metals						
Sodium, total	84.7 ± 15	5.5	0.10	mg/L	2022-11-08	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



REPORTED TOVernon Water Reclamation, City ofCARO WO#22L1091PROJECTFinal Treated Effluent (ME12215) - EMSREPORTED2022-12-16 14:07

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
VWRC Final Treated Effluent - 24hr C 2022-12-08 00:00 To 2022-12-09 00:00	•	2L1091-01)   Matrix:	Fresh Water	Sampled:		FILT, PRES
Anions						
Chloride	96.1	± 5.3	0.10	mg/L	2022-12-12	
Nitrate (as N)	4.07	± 0.26	0.010	mg/L	2022-12-12	
Nitrite (as N)	0.016	± 0.002	0.010	mg/L	2022-12-12	
Phosphate (as P)	< 0.0050		0.0050	mg/L	2022-12-12	
Calculated Parameters						
Nitrate+Nitrite (as N)	4.08		0.0100	mg/L	N/A	
Nitrogen, Total	6.20		0.0500	mg/L	N/A	
Nitrogen, Organic	1.90		0.0500	mg/L	N/A	
General Parameters						
Ammonia, Total (as N)	0.212	± 0.020	0.050	mg/L	2022-12-14	
BOD, 5-day	< 7.0		2.0	mg/L	2022-12-15	
Conductivity (EC)	850	± 20	2.0	μS/cm	2022-12-13	
Nitrogen, Total Kjeldahl	2.12	± 0.26	0.050	mg/L	2022-12-15	
pH	7.77	± 0.02	0.10	pH units	2022-12-13	HT2
Phosphorus, Total (as P)	0.343	± 0.038	0.0050	mg/L	2022-12-15	
Phosphorus, Total Dissolved	0.0756	± 0.0089	0.0050	mg/L	2022-12-15	
Solids, Total Suspended	8.6	± 0.7	2.0	mg/L	2022-12-15	
Total Metals						
Sodium, total	115	± 21	0.10	mg/L	2022-12-14	



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Final Treated Effluent (ME12215) - EMS

CARO WO# REPORTED 22L1091 2022-12-16 14:07

2022-12-14

Analyte	Result Uncertainty	RL	Units	Analyzed	Qualifier
VWRC Final Treated Effluent - 24hr ( Sampled: 2022-12-08 00:00 To 2022-		1091-02)   Matrix: Fre	sh Water		FILT, PRES
Anions					
Chloride	<b>97.1</b> ± 5.3	0.10	mg/L	2022-12-12	
Nitrate (as N)	<b>4.07</b> ± 0.26	0.010	mg/L	2022-12-12	
Nitrite (as N)	<b>0.010</b> ± 0.001	0.010	mg/L	2022-12-12	
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-12-12	
Calculated Parameters					
Nitrate+Nitrite (as N)	4.08	0.0100	mg/L	N/A	
Nitrogen, Total	6.33	0.0500	mg/L	N/A	
Nitrogen, Organic	2.02	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	<b>0.220</b> ± 0.021	0.050	mg/L	2022-12-14	
BOD, 5-day	< 7.0	2.0	mg/L	2022-12-15	
Conductivity (EC)	<b>846</b> ± 20	2.0	μS/cm	2022-12-13	
Nitrogen, Total Kjeldahl	<b>2.24</b> ± 0.28	0.050	mg/L	2022-12-15	
pH	<b>7.78</b> ± 0.02	0.10	pH units	2022-12-13	HT2
Phosphorus, Total (as P)	<b>0.346</b> ± 0.038	0.0050	mg/L	2022-12-15	
Phosphorus, Total Dissolved	<b>0.0795</b> ± 0.0094	0.0050	mg/L	2022-12-15	
Solids, Total Suspended	<b>8.0</b> ± 0.7	2.0	mg/L	2022-12-15	

#### Sample Qualifiers:

Sodium, total

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

**115** ± 21

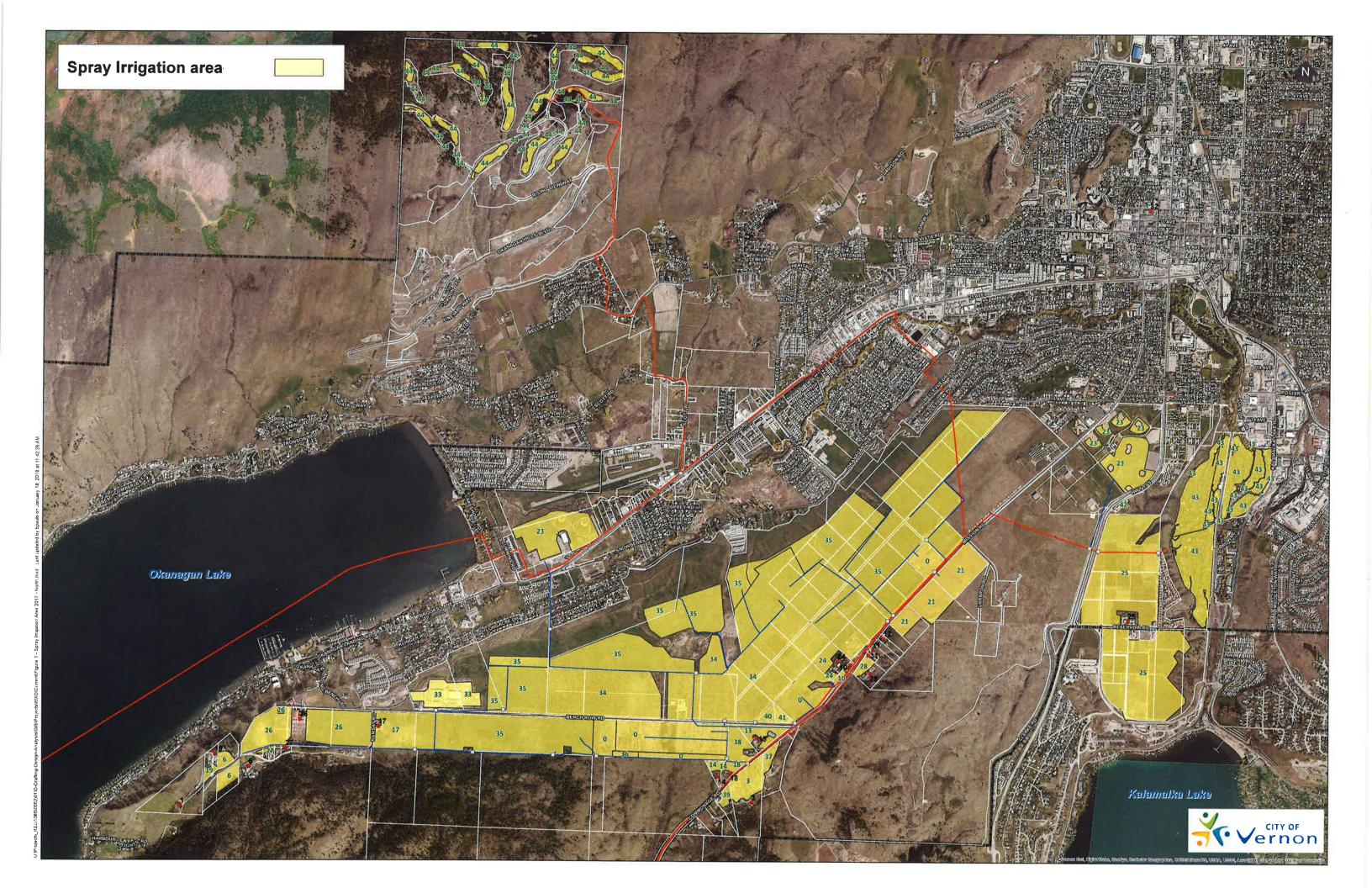
HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is

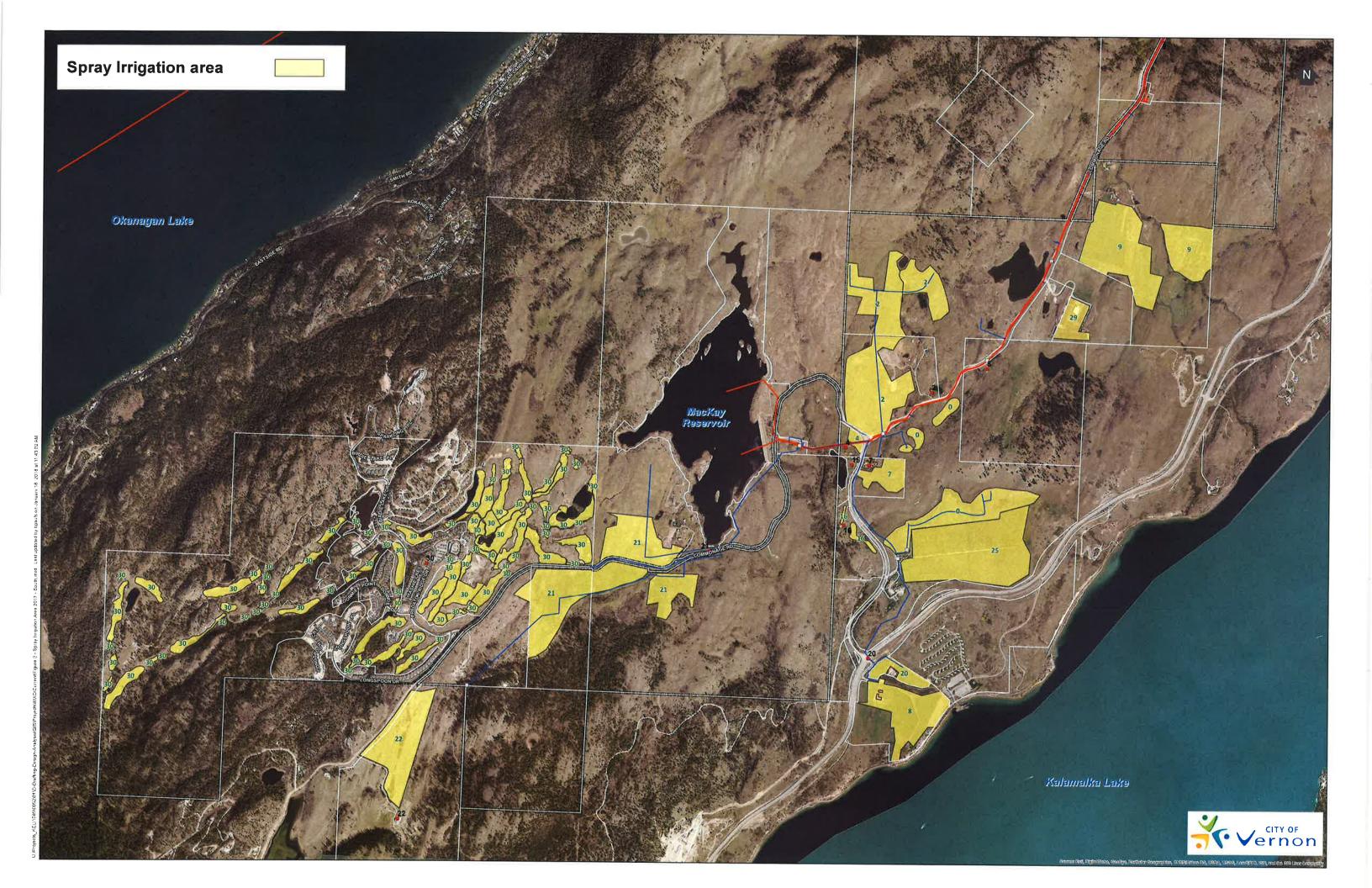
0.10 mg/L

PRES Sample has been preserved for TDP in the laboratory and the holding time has been extended.

# Appendix C

Spray Irrigation Areas





# Appendix D

Liquid Waste Management Plan Update

City of Vernon

3400 30th Street



File: 5350

Email: (melanie.mamoser@gov.bc.ca) January 11, 2023

Dear Ms. Mamoser:

## Re: Update City of Vernon Liquid Waste Management Plan (LWMP) Commitments

Please accept the following letter as an update regarding the City of Vernon's current status of LWMP commitments regarding reclaimed water and the reply letter titled "Discharge Plan to Okanagan Lake During Winter 2020/2021", dated January 27, 2021.

In the letter the Ministry made note of items identified in the City of Vernon LWMP and inquired about their current status. The items included were:

- Explore a partnership with the RDNO of supplying reclaimed water to agricultural customers in the regional system (non-potable supply).
- Market reclaimed water as an incentive for economic development for industrial commercial and agricultural customers.
- Report on the cost-benefit of extending the system for various areas throughout the region.
- Determine the suitability of a city program for private-building, on site reclamation of grey water through the B.C. Building Code.

Since 2021, City Administration have continued to make progress on the action items identified in the Liquid Waste Management Plan and the continued improvement, expansion and optimization of the City's Spray Irrigation program. Items of note include the following:

- The Spray Irrigation System has been added to the City's Asset Management plan, ensuring the long-term reliability and performance of the spray irrigation system with a stable long-term funding source. Seven (7) irrigation hose reels purchased in 2021 and 2022 at a cost of \$250,000 as part of this program.
- The purchase of six (6) additional hose reels have been included in the 2023 capital budget at a cost of \$240,000.
- Three (3) additional low volume residential use customers were added to the system.
- In 2021 the City Administration made a request to the Department of National Defense (DND) to lease approximately 150 acres of additional land





- to include in the spray irrigation program. This land had been used for this purpose in the past, but was removed by the DND in 2005. DND officials have yet to respond to our request
- City Administration met with RDNO Administration to discuss the potential
  of partnering with the RDNO on expanding use of non-potable water supply
  into RDNO jurisdiction. RDNO administration has provided a formal
  response as per the attached letter.
- RDNO Administration have committed to including supply and expansion discussions for future development applications in their jurisdictions. This has already occurred for two recent proposed developments including the proposed Gondola project, Aquilini Development and Okanagan Indian Band (OKIB) O'Keefe property.
- City Administration is currently in preliminary discussion with the Okanagan Indian Band (OKIB) regarding potential expansion of the Spay Irrigation Program into the O'Keefe Ranchlands (2,310 acres) recently purchased by OKIB.
- City Administration has instituted new processes for development review, where potential spray irrigation customers are identified during the development review process and applicants are informed of the spray irrigation program and the use of spray irrigation as an alternative source.
- City building officials are currently in the process of reviewing the use of onsite grey water reclamation for new developments. A detailed response will be provided to the Ministry this year regarding the feasibility of this item.
- City Administration is preparing to engage a qualified professional to complete a report regarding the cost benefits of extending the Spray Irrigation Program into surrounding areas. This report is scheduled to be completed by the end of the year and will be provided to the Ministry when available.

Thank you for your time and guidance as the City of Vernon continues to address LWMP objectives. If you require any other information please contact myself.

Yours truly,

Chris Ovens City of Vernon General Manager, Public Works

Attached: RDNO response letter





### REGIONAL DISTRICT NORTH OKANAGAN

MEMBER MUNICIPALITIES: CITY OF ARMSTRONG

CITY OF ENDERBY DISTRICT OF COLDSTREAM

CITY OF VERNON TOWNSHIP OF

VILLAGE OF LUMBY

**SPALLUMCHEEN** 

**ELECTORAL AREAS:** 

"B" - SWAN LAKE

"C" - BX DISTRICT "D" - LUMBY (RURAL)

"E" - CHERRYVILLE "F" - ENDERBY (RURAL)

OFFICE OF: UTILITIES

January 19, 2023

City of Vernon Att: Chris Ovens, BBA 1900 48 Avenue Vernon, BC V1T 8Y7

OUR FILE No.: 5730.15.15

Toll Free: 1.855.650.3700

E-Mail: utilities@rdno.ca

250.550.3700

250.550.3701

www.rdno.ca

Phone:

Fax:

Web:

Via e-mail: covens@vernon.ca

Dear Mr. Ovens:

RE: **Reclaimed Water** 

Thank you for your inquiry regarding a partnership with the RDNO with regards to supplying reclaimed water to agricultural customers in the regional system (non-potable supply). As discussed at our meeting on January 6, 2023, the priority for Greater Vernon Water is the construction of the Mission Hill Water Filtration Plant (MHWFP); however, after commissioning of the MHWFP, Greater Vernon Water will be updating their Master Water Plan and would be amenable to include review of this issue in detail with the City of Vernon during that process.

Please do not hesitate to include us in your planning exercises as a preliminary to this review. Due to the uncertainties of climate change in the future, secure water sources will be important for our region and we appreciate the opportunity to work on this important issue with your team in the future.

Sincerely

Zee Marcolin, P. Englines General Manager, Utilities Permit to Practice #1002639

MARCOUNUM 1202

ZM/Is



**Associated Environmental Consultants Inc.** 

Suite 200, 2800 29 Street Vernon, BC V1T 9P9 Canada

www.ae.ca | ISO 9001 & 14001 Certified

TEL: 250.545.3672 FAX: 250.545.3654

March 15, 2023

File: 2021-8917.000

Serge Kozin Manager, Vernon Water Reclamation Center City of Vernon 2100 - 43rd Street, Vernon, BC

Re: MACKAY RESERVOIR POTENTIAL INFLOW ASSESSMENT (OPERATIONAL CERTIFICATE 12215)

Dear Mr. Kozin:

Associated Environmental Consultants Inc. (AE) is pleased to provide this report for the assessment of the provincially mapped streams that are shown to enter MacKay Reservoir. AE completed a field visit on March 2, 2023, to confirm the preliminary desktop review of the mapped streams.

Details of the desktop review and field assessment are provided in Section 2 and 3, with field photos located in Appendix A.

#### 1 BACKGROUND

The City of Vernon (the City) is authorized to discharge treated effluent into MacKay Reservoir or directly to Okanagan Lake (under specific circumstances) by the Ministry of Environment and Climate Change Strategy (ENV) under Operational Certificate (OC) ME 12215<sup>1</sup>. Section 4.16 of the OC requires that surface water inflows be intercepted and diverted away from the reservoir to the greatest extent possible. Following a recent notification to ENV of the intent for a lake discharge, ENV requested clarification on the provincially mapped streams entering MacKay Reservoir, including quantifying the potential effects of the streams on the water balance of the reservoir.

In response, the City requested that AE complete a field assessment of the provincially mapped streams entering the reservoir. The purpose of the assessment was to determine if the mapped streams were indeed streams as defined under the *Water Sustainability Act*, and to assess their effect on reservoir levels. Under the *Water Sustainability Act*, a stream is defined as "a natural watercourse... or a natural body of water, whether or not the stream channel of the stream has been modified"<sup>2</sup>.

<sup>&</sup>lt;sup>2</sup> Water Sustainability Act, SBC 2014, c. 15.





<sup>&</sup>lt;sup>1</sup> British Columbia Ministry of Environment. 2008. Operational Certificate ME 12215. Issued to the Corporation of the City of Vernon. Date issued: October 31, 1997. Date amended: January 14, 2008.



#### 2 DESKTOP REVIEW

A review of available orthophotography was completed to evaluate the existence of the provincially mapped streams that appear to enter the reservoir. The provincial database<sup>3</sup> was first reviewed to confirm the number of mapped streams, and four were identified.<sup>4</sup> Three are shown to enter on the southwest side of the reservoir, one from Graham's Pond within Predator Ridge, and the other two from a private property (Plan No. KAP82974). The fourth stream is shown to enter the reservoir to the west, initiated from a small waterbody in the Commonage Ridge area. Appendix B shows the location of these mapped watercourses, as shown on Habitat Wizard. A review of historical air photos of the reservoir location was completed to assess if these mapped streams showed visual signs of surface flow, channel definition, or deposition into the reservoir. Air photos from 1949, 1990, and 2001 were assessed to determine the presence of these stream features and refine the scope of the field assessment.

#### 3 FIELD VISIT ASSESSMENT

The field assessment was completed by Samuel Grenier, RBIT, CESCL, of AE on March 2, 2023. The provincially mapped streams were assessed for channel definition, evidence of substrate scouring and deposition, and the presence of surface flows. The four streams were assessed at the mapped inlet into MacKay Reservoir and upstream approximately 25 m with the reservoir property boundaries. The shoreline of the reservoir had areas of snow cover; however, this did not inhibit the ability to monitor for visible surface water as the area along the reservoir just upslope was relatively snow free.

#### 4 RESULTS

The review of the historical air photos from 1949, 1990, and 2001 do not show any visible stream channels or zones of deposition into the reservoir from Graham's Pond, the adjacent pond on private land to the southwest, or the waterbody on Commonage Ridge to the west. Based on the field visit completed on March 2, 2023, no surface water flows were noted and no indication of a defined channel, substrate scouring, or deposition of sediment where they connect with the reservoir was observed. The results from the field assessment suggests that the four mapped stream may only have water in rare occasions. The air photos support the field observations that these mapped streams are likely only topographical depressions and may only have surface flows periodically during high intensity rain events, and that surface discharge from these ponds and drainage areas were likely negligible prior to developing the reservoir.

<sup>&</sup>lt;sup>3</sup> Government of British Columbia. 2023. Habitat Wizard (Public). Available at: https://maps.gov.bc.ca/ess/hm/habwiz/

<sup>&</sup>lt;sup>4</sup> Previously, AE stated that there were two mapped streams; this information was based on a different provincial database. An updated review using Habitat Wizard identified a third stream, which was included in our assessment.



Overall, this suggests that the contribution from these inflows to the reservoir is likely negligible and that they are not streams, as defined by the *Water Sustainability Act*. Our team does not believe this warrants any further field investigation nor does it warrant any efforts to intercept and divert flow, given that the environmental impacts of such actions would outweigh the negligible (if at all) effect on the reservoir level.

Prepared by,

SG

Samuel Grenier, RBIT., CESCL.

**Environmental Scientist** 

Reviewed by,

Heather Taylor, R.P.Bio., P.Ag.

Senior Biologist



#### APPENDIX A - FIELD PHOTOS

**Photograph 1** View of the mapped stream from Commonage Ridge on the west side of MacKay Reservoir



**Photograph 2** View looking upslope of the mapped stream on the Commonage Ridge.



**Photograph 3** View of the mapped inlet location for the mapped stream from Graham's Pond.



Photograph 4 View of the mapped stream from Graham's Pond. Note the absence of channel definition, flow, or scouring.



**Photograph 5** View of the mapped inlet location for the stream from the private property on the southwest side of MacKay Reservoir. Note the absence of depositional material typical of a stream inlet.

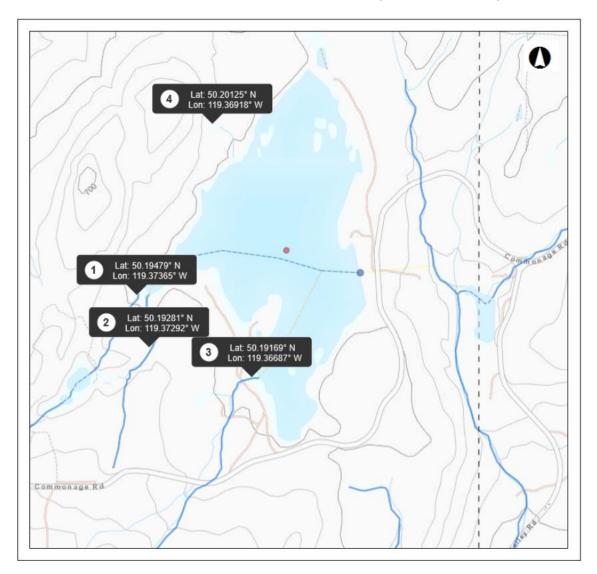


**Photograph 6** View upslope of the mapped stream from the private property to the southwest of MacKay Reservoir.





#### APPENDIX B - PROVINCIALLY MAPPED WATERCOURSES (HABITAT WIZARD)



# Appendix E

# Irrigation Water Quality Results

Caro Analytical Services



REPORTED TO	Vernon Water Reclamation, City of	<b>WORK ORDER</b>	22E2272
PROJECT	MacKay Reservoir Effluent (ME 12215) - EMS	REPORTED	2022-06-01 16:27

Analyte	Result	RL	Units	Analyzed	Qualifier
Reclaimed Water - Mackay Reservo Water   Sampled: 2022-05-17 09:30	oir Effluent to Irrigation (Clay Va	ilue 4) E228539 (22E227	72-01)   Mat	rix:	
Anions					
Chloride	101	0.10	mg/L	2022-05-18	
Fluoride	0.30		mg/L	2022-05-27	
Nitrate (as N)	1.20	0.010		2022-05-18	
Nitrite (as N)	0.014	0.010		2022-05-18	
Phosphate (as P)	0.452	0.0050		2022-05-18	
Sulfate	94.3		mg/L	2022-05-18	
Calculated Parameters					
Hardness, Total (as CaCO3)	214	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	1.21	0.0100		N/A	
Nitrogen, Total	2.81	0.0500		N/A	
Nitrogen, Organic	1.04	0.0500		N/A	
Dissolved Metals					
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2022-05-28	
Antimony, dissolved	0.00023	0.00020	mg/L	2022-05-28	
Arsenic, dissolved	0.00082	0.00050	mg/L	2022-05-28	
Barium, dissolved	0.0314	0.0050		2022-05-28	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2022-05-28	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2022-05-28	
Boron, dissolved	0.155	0.0500	mg/L	2022-05-28	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2022-05-28	
Calcium, dissolved	51.8		mg/L	2022-05-28	
Chromium, dissolved	< 0.00050	0.00050		2022-05-28	
Cobalt, dissolved	0.00034	0.00010		2022-05-28	
Copper, dissolved	0.00278	0.00040		2022-05-28	
Iron, dissolved	0.033	0.010	mg/L	2022-05-28	
Lead, dissolved	< 0.00020	0.00020		2022-05-28	
Lithium, dissolved	0.00907	0.00010		2022-05-28	
Magnesium, dissolved	20.6	0.010		2022-05-28	
Manganese, dissolved	0.103	0.00020		2022-05-28	
Molybdenum, dissolved	0.00255	0.00010		2022-05-28	
Nickel, dissolved	0.00154	0.00040		2022-05-28	
Phosphorus, dissolved	0.689	0.050		2022-05-28	
Potassium, dissolved	19.0		mg/L	2022-05-28	
Selenium, dissolved	< 0.00050	0.00050		2022-05-28	
Silicon, dissolved	1.2		mg/L	2022-05-28	
Silver, dissolved	< 0.000050	0.000050		2022-05-28	
Sodium, dissolved	87.0		mg/L	2022-05-28	
Strontium, dissolved	0.561	0.0010		2022-05-28	
Sulfur, dissolved	30.7		mg/L	2022-05-28	
Tellurium, dissolved	< 0.00050	0.00050		2022-05-28	
Thallium, dissolved	< 0.000020	0.000020		2022-05-28	
· · · ·					Page 2 of



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22E2272PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-06-01 16:27

Analyte	Result	RL	Units	Analyzed	Qualifi
Reclaimed Water - Mackay Reservo Nater   Sampled: 2022-05-17 09:30,	• • • •	ue 4) E228539 (22E227	/2-01)   Matrix	c:	
Dissolved Metals, Continued					
Thorium, dissolved	< 0.00010	0.00010	mg/L	2022-05-28	
Tin, dissolved	< 0.00020	0.00020	mg/L	2022-05-28	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2022-05-28	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2022-05-28	
Uranium, dissolved	0.00142	0.000020	mg/L	2022-05-28	
Vanadium, dissolved	< 0.0050	0.0050	mg/L	2022-05-28	
Zinc, dissolved	0.0268	0.0040	mg/L	2022-05-28	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2022-05-28	
General Parameters					
Ammonia, Total (as N)	0.555	0.050	mg/L	2022-05-18	
BOD, 5-day	< 7.1	2.0	mg/L	2022-05-23	
Nitrogen, Total Kjeldahl	1.60	0.050	mg/L	2022-05-25	
рН	7.61	0.10	pH units	2022-05-26	HT2
Phosphorus, Total (as P)	0.691	0.0050	mg/L	2022-05-25	
Phosphorus, Total Dissolved	0.685	0.0050	mg/L	2022-05-25	
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-05-23	
Turbidity	0.59	0.10	NTU	2022-05-18	
Total Metals					
Sodium, total	87.6	0.10	mg/L	2022-05-25	



Coliforms, Fecal (Q-Tray)

REPORTED TO Vernon Water Reclamation, City of WORK ORDER

< 1

PROJECT MacKay Reservoir Effluent (ME 12215) - EMS REPORTED 2022-06-03 15:21

Analyte Result RL Units Analyzed Qualifier

Reclaimed Water - Mackay Reservoir Effluent to Irrigation (Clay Value 4) E228539 (22E3782-01) | Matrix:

Water | Sampled: 2022-05-27 09:30

Microbiological Parameters

Coliforms, Total (Q-Tray) 1 MPN/100 mL 2022-05-27

22E3782

2022-05-27

1 MPN/100 mL



REPORTED TO	Vernon Water Reclamation, City of	<b>WORK ORDER</b>	22F1509
PROJECT	MacKay Reservoir Effluent (ME 12215) - EMS	REPORTED	2022-06-16 10:44

Analyte	Result	RL	Units	Analyzed	Qualifi
Reclaimed Water - Mackay Reservo Water   Sampled: 2022-06-09 09:15	r Effluent to Irrigation (Clay Va	lue 4) E228539 (22F150	9-01)   Matr	ix:	
Anions					
Chloride	94.8	0.10	mg/L	2022-06-13	
Fluoride	< 0.10		mg/L	2022-06-13	
Nitrate (as N)	0.674	0.010		2022-06-13	HT1
Nitrite (as N)	< 0.010	0.010		2022-06-13	HT1
Phosphate (as P)	0.334	0.0050		2022-06-13	HT1
Sulfate	68.8		mg/L	2022-06-13	
Calculated Parameters					
Hardness, Total (as CaCO3)	216	0.500	ma/l	N/A	
Nitrate+Nitrite (as N)	0.674	0.0100		N/A	
Nitrogen, Total	2.65	0.0500		N/A	
Nitrogen, Organic	0.830	0.0500		N/A	
Dissolved Metals	0.000	0.0000	mg/L	14// (	
Aluminum, dissolved	< 0.0050	0.0050	ma/I	2022-06-13	
		0.0030		2022-06-13	
Antimony, dissolved Arsenic, dissolved	0.00023	0.00020		2022-06-13	
· · · · · · · · · · · · · · · · · · ·	0.00084	0.0050		2022-06-13	
Barium, dissolved	0.0279	0.00010			
Beryllium, dissolved	< 0.00010			2022-06-13	
Bismuth, dissolved	< 0.00010	0.00010		2022-06-13	
Boron, dissolved	0.169	0.0500		2022-06-13	
Cadmium, dissolved	< 0.000010	0.000010		2022-06-13	
Calcium, dissolved	52.2		mg/L	2022-06-13	
Chromium, dissolved	< 0.00050	0.00050		2022-06-13	
Cobalt, dissolved	0.00032	0.00010		2022-06-13	
Copper, dissolved	0.00256	0.00040		2022-06-13	
Iron, dissolved	0.035	0.010		2022-06-13	
Lead, dissolved	< 0.00020	0.00020		2022-06-13	
Lithium, dissolved	0.00911	0.00010		2022-06-13	
Magnesium, dissolved	20.7	0.010		2022-06-13	
Manganese, dissolved	0.123	0.00020		2022-06-13	
Molybdenum, dissolved	0.00336	0.00010		2022-06-13	
Nickel, dissolved	0.00158	0.00040		2022-06-13	
Phosphorus, dissolved	0.695	0.050		2022-06-13	
Potassium, dissolved	18.7		mg/L	2022-06-13	
Selenium, dissolved	0.00060	0.00050		2022-06-13	
Silicon, dissolved	1.4		mg/L	2022-06-13	
Silver, dissolved	< 0.000050	0.000050		2022-06-13	
Sodium, dissolved	87.1		mg/L	2022-06-13	
Strontium, dissolved	0.497	0.0010		2022-06-13	
Sulfur, dissolved	31.4		mg/L	2022-06-13	
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2022-06-13	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2022-06-13	



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22F1509PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-06-16 10:44

Analyte	Result	RL	Units	Analyzed	Qualific
Reclaimed Water - Mackay Reservoi Nater   Sampled: 2022-06-09 09:15, 0		ue 4) E228539 (22F150	9-01)   Matrix:		
Dissolved Metals, Continued					
Thorium, dissolved	< 0.00010	0.00010	mg/L	2022-06-13	
Tin, dissolved	< 0.00020	0.00020	mg/L	2022-06-13	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2022-06-13	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2022-06-13	
Uranium, dissolved	0.00172	0.000020	mg/L	2022-06-13	
Vanadium, dissolved	< 0.0050	0.0050	mg/L	2022-06-13	
Zinc, dissolved	0.0261	0.0040	mg/L	2022-06-13	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2022-06-13	
General Parameters	1.15	0.050	ma/l	2022-06-13	
Ammonia, Total (as N)	< 7.1	0.050		2022-06-13	
BOD, 5-day	1.98		mg/L	2022-06-15	
Nitrogen, Total Kjeldahl		0.050		2022-06-15	HT2
pH	7.54		•		піг
Phosphorus, Total (as P)	0.725	0.0050		2022-06-15	
Phosphorus, Total Dissolved	<b>0.717</b> < 3.3	0.0050		2022-06-15	
Solids, Total Suspended			mg/L		LITA
Turbidity	0.50	0.10	NTU	2022-06-13	HT1
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2022-06-10	HT1
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-06-10	HT1
Total Metals					
Sodium, total	87.9	0.10	mg/L	2022-06-15	

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



REPORTED TO	Vernon Water Reclamation, City of	<b>WORK ORDER</b>	22G1571
PROJECT	MacKay Reservoir Effluent (ME 12215) - EMS	REPORTED	2022-07-19 15:16

Analyte	Result	RL	Units	Analyzed	Qualifie
Reclaimed Water - Mackay Reservo Water   Sampled: 2022-07-12 09:45	ir Effluent to Irrigation (Clay Va	ilue 4) E228539 (22G15	71-01)   Matı	rix:	
Anions					
Chloride	93.7	0.10	mg/L	2022-07-14	
Fluoride	0.28		mg/L	2022-07-14	
Nitrate (as N)	1.10	0.010		2022-07-14	
Nitrite (as N)	0.013	0.010		2022-07-14	
Phosphate (as P)	0.419	0.0050		2022-07-14	
Sulfate	90.9		mg/L	2022-07-14	
Calculated Parameters					
Hardness, Total (as CaCO3)	230	0.500	ma/L	N/A	
Nitrate+Nitrite (as N)	1.11	0.0100		N/A	
Nitrogen, Total	3.04	0.0500		N/A	
Nitrogen, Organic	0.910	0.0500		N/A	
Dissolved Metals					
Aluminum, dissolved	< 0.0050	0.0050	ma/l	2022-07-17	
Antimony, dissolved	0.00027	0.00020		2022-07-17	
Arsenic, dissolved	0.00089	0.00050		2022-07-17	
Barium, dissolved	0.0300	0.0050		2022-07-17	
Beryllium, dissolved	< 0.00010	0.00010		2022-07-17	
Bismuth, dissolved	< 0.00010	0.00010		2022-07-17	
Boron, dissolved	0.175	0.0500		2022-07-17	
Cadmium, dissolved	0.000028	0.000010		2022-07-17	
Calcium, dissolved	55.7		mg/L	2022-07-17	
Chromium, dissolved	< 0.00050	0.00050		2022-07-17	
Cobalt, dissolved	0.00033	0.00010		2022-07-17	
Copper, dissolved	0.00334	0.00040		2022-07-17	
Iron, dissolved	0.043	0.010		2022-07-17	
Lead, dissolved	< 0.00020	0.00020		2022-07-17	
Lithium, dissolved	0.0105	0.00020		2022-07-17	
Magnesium, dissolved	22.1	0.010		2022-07-17	
Manganese, dissolved	0.154	0.00020		2022-07-17	
Molybdenum, dissolved	0.00222	0.00020		2022-07-17	
Nickel, dissolved		0.00010		2022-07-17	
Phosphorus, dissolved	0.00173 0.828	0.00040		2022-07-17	
Potassium, dissolved	19.2		mg/L	2022-07-17	
Selenium, dissolved	0.00053	0.00050		2022-07-17	
Silicon, dissolved	1.8		mg/L	2022-07-17	
Silver, dissolved	< 0.000050	0.000050		2022-07-17	
Sodium, dissolved	94.1		mg/L	2022-07-17	
Strontium, dissolved	0.553	0.0010		2022-07-17	
<u> </u>					
Sulfur, dissolved	<b>32.4</b>		mg/L	2022-07-17	
Tellurium, dissolved Thallium, dissolved	< 0.00050 < 0.000020	0.00050		2022-07-17	
mailium, uissuiveu	< U.UUUU2U	0.000020	mg/L	2022-07-17	Page 2 c



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22G1571PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-07-19 15:16

Analyte	Result	RL	Units	Analyzed	Qualifie
Reclaimed Water - Mackay Reservoi Nater   Sampled: 2022-07-12 09:45,		ue 4) E228539 (22G15	71-01)   Matrix:		
Dissolved Metals, Continued					
Thorium, dissolved	< 0.00010	0.00010	mg/L	2022-07-17	
Tin, dissolved	< 0.00020	0.00020	mg/L	2022-07-17	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2022-07-17	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2022-07-17	
Uranium, dissolved	0.00124	0.000020	mg/L	2022-07-17	
Vanadium, dissolved	< 0.0050	0.0050	mg/L	2022-07-17	
Zinc, dissolved	0.0285	0.0040	mg/L	2022-07-17	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2022-07-17	
General Parameters					
Ammonia, Total (as N)	1.02	0.050	mg/L	2022-07-16	
BOD, 5-day	< 6.2	2.0	mg/L	2022-07-19	
Nitrogen, Total Kjeldahl	1.93	0.050	mg/L	2022-07-17	
рН	8.11	0.10	pH units	2022-07-13	HT2
Phosphorus, Total (as P)	0.779	0.0050	mg/L	2022-07-15	
Phosphorus, Total Dissolved	0.772	0.0050	mg/L	2022-07-15	
Solids, Total Dissolved	102	15	mg/L	2022-07-18	
Solids, Total Suspended	< 3.3	2.0	mg/L	2022-07-18	
Turbidity	0.61	0.10	NTU	2022-07-13	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	1	1	MPN/100 mL	2022-07-13	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2022-07-13	
Total Metals					
Sodium, total	88.1	0.10	mg/L	2022-07-19	

#### Sample Qualifiers:



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22H0698PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-08-16 15:35

Analyte	Result	RL	Units	Analyzed	Qualifier
Reclaimed Water - Mackay Reservo Water   Sampled: 2022-08-04 10:00	ir Effluent to Irrigation (Clay Va	lue 4) E228539 (22H069	98-01)   Mat	rix:	
Anions					
Chloride	87.7	0.10	mg/L	2022-08-05	
Fluoride	< 0.10		mg/L	2022-08-05	
Nitrate (as N)	1.20	0.010		2022-08-05	
Nitrite (as N)	0.031	0.010		2022-08-05	
Phosphate (as P)	0.408	0.0050		2022-08-05	
Sulfate	81.2		mg/L	2022-08-05	
Calculated Parameters					
Hardness, Total (as CaCO3)	218	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	1.24	0.0100		N/A	
Nitrogen, Total	3.29	0.0500		N/A	
Nitrogen, Organic	1.18	0.0500		N/A	
Dissolved Metals					
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2022-08-13	
Antimony, dissolved	0.00025	0.00020	mg/L	2022-08-13	
Arsenic, dissolved	0.00082	0.00050	mg/L	2022-08-13	
Barium, dissolved	0.0272	0.0050		2022-08-13	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
Boron, dissolved	0.161	0.0500	mg/L	2022-08-13	
Cadmium, dissolved	0.000014	0.000010	mg/L	2022-08-13	
Calcium, dissolved	54.2		mg/L	2022-08-13	
Chromium, dissolved	< 0.00050	0.00050		2022-08-13	
Cobalt, dissolved	0.00031	0.00010		2022-08-13	
Copper, dissolved	0.00364	0.00040		2022-08-13	
Iron, dissolved	0.045	0.010	mg/L	2022-08-13	
Lead, dissolved	< 0.00020	0.00020		2022-08-13	
Lithium, dissolved	0.00915	0.00010		2022-08-13	
Magnesium, dissolved	20.1	0.010		2022-08-13	
Manganese, dissolved	0.123	0.00020		2022-08-13	
Molybdenum, dissolved	0.00267	0.00010		2022-08-13	
Nickel, dissolved	0.00175	0.00040		2022-08-13	
Phosphorus, dissolved	0.809	0.050		2022-08-13	
Potassium, dissolved	18.1		mg/L	2022-08-13	
Selenium, dissolved	0.00052	0.00050		2022-08-13	
Silicon, dissolved	1.9		mg/L	2022-08-13	
Silver, dissolved	< 0.000050	0.000050		2022-08-13	
Sodium, dissolved	83.1		mg/L	2022-08-13	
Strontium, dissolved	0.480	0.0010		2022-08-13	
Sulfur, dissolved	30.6		mg/L	2022-08-13	
Tellurium, dissolved	< 0.00050	0.00050		2022-08-13	
Thallium, dissolved	< 0.000020	0.000020		2022-08-13	
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REPORTED TO Vernon Water Reclamation, City of WORK ORDER 22H0698

PROJECT MacKay Reservoir Effluent (ME 12215) - EMS REPORTED 2022-08-16 15:35

Analyte	Result	RL	Units	Analyzed	Qualifie
Reclaimed Water - Mackay Reservoi Nater   Sampled: 2022-08-04 10:00, 0		ue 4) E228539 (22H069	98-01)   Matri	к:	
Dissolved Metals, Continued					
Thorium, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
Tin, dissolved	< 0.00020	0.00020	mg/L	2022-08-13	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2022-08-13	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2022-08-13	
Uranium, dissolved	0.00150	0.000020	mg/L	2022-08-13	
Vanadium, dissolved	< 0.0050	0.0050	mg/L	2022-08-13	
Zinc, dissolved	0.0301	0.0040	mg/L	2022-08-13	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
General Parameters					
Ammonia, Total (as N)	0.869	0.050	mg/L	2022-08-08	
BOD, 5-day	< 7.0	2.0	mg/L	2022-08-10	
Nitrogen, Total Kjeldahl	2.05	0.050	mg/L	2022-08-10	
pH	8.12	0.10	pH units	2022-08-08	HT2
Phosphorus, Total (as P)	0.854	0.0050	mg/L	2022-08-09	
Phosphorus, Total Dissolved	0.829	0.0050	mg/L	2022-08-09	
Solids, Total Dissolved	537	15	mg/L	2022-08-19	HT1
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-08-10	
Turbidity	0.85	0.10	NTU	2022-08-06	
otal Metals					
Sodium, total	84.7	0.10	mg/L	2022-08-14	

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22H0698PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-08-15 08:31

Analyte	Result	RL	Units	Analyzed	Qualifier
Reclaimed Water - Mackay Reservo Water   Sampled: 2022-08-04 10:00	ir Effluent to Irrigation (Clay Va	alue 4) E228539 (22H069	98-01)   Mat	rix:	
Anions					
Chloride	87.7	0.10	mg/L	2022-08-05	
Fluoride	< 0.10		mg/L	2022-08-05	
Nitrate (as N)	1.20	0.010		2022-08-05	
Nitrite (as N)	0.031	0.010		2022-08-05	
Phosphate (as P)	0.408	0.0050		2022-08-05	
Sulfate	81.2		mg/L	2022-08-05	
Calculated Parameters			<del>-</del>		
Hardness, Total (as CaCO3)	218	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	1.24	0.0100		N/A	
Nitrogen, Total	3.29	0.0500		N/A	
Nitrogen, Organic	1.18	0.0500		N/A	
Dissolved Metals					
Aluminum, dissolved	< 0.0050	0.0050	ma/L	2022-08-13	
Antimony, dissolved	0.00025	0.00020		2022-08-13	
Arsenic, dissolved	0.00082	0.00050		2022-08-13	
Barium, dissolved	0.0272	0.0050		2022-08-13	
Beryllium, dissolved	< 0.00010	0.00010		2022-08-13	
Bismuth, dissolved	< 0.00010	0.00010		2022-08-13	
Boron, dissolved	0.161	0.0500		2022-08-13	
Cadmium, dissolved	0.000014	0.000010		2022-08-13	
Calcium, dissolved	54.2		mg/L	2022-08-13	
Chromium, dissolved	< 0.00050	0.00050		2022-08-13	
Cobalt, dissolved	0.00031	0.00010		2022-08-13	
Copper, dissolved	0.00364	0.00040		2022-08-13	
Iron, dissolved	0.045	0.010		2022-08-13	
Lead, dissolved	< 0.00020	0.00020		2022-08-13	
Lithium, dissolved	0.00915	0.00010		2022-08-13	
Magnesium, dissolved	20.1	0.010		2022-08-13	
Manganese, dissolved	0.123	0.00020		2022-08-13	
Molybdenum, dissolved	0.00267	0.00010		2022-08-13	
Nickel, dissolved	0.00175	0.00040		2022-08-13	
Phosphorus, dissolved	0.809	0.050		2022-08-13	
Potassium, dissolved	18.1		mg/L	2022-08-13	
Selenium, dissolved	0.00052	0.00050		2022-08-13	
Silicon, dissolved	1.9		mg/L	2022-08-13	
Silver, dissolved	< 0.000050	0.000050		2022-08-13	
Sodium, dissolved	83.1		mg/L	2022-08-13	
Strontium, dissolved	0.480	0.0010		2022-08-13	
Sulfur, dissolved	30.6		mg/L	2022-08-13	
Tellurium, dissolved	< 0.00050	0.00050		2022-08-13	
Thallium, dissolved	< 0.000000	0.000020		2022-08-13	
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REPORTED TO Vernon Water Reclamation, City of

PROJECT MacKay Reservoir Effluent (ME 12215) - EMS

WORK ORDER

22H0698

**REPORTED** 2022-08-15 08:31

Analyte	Result	RL	Units	Analyzed	Qualifie
Reclaimed Water - Mackay Reservo Nater   Sampled: 2022-08-04 10:00,		ue 4) E228539 (22H069	98-01)   Matri	x:	
Dissolved Metals, Continued					
Thorium, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
Tin, dissolved	< 0.00020	0.00020	mg/L	2022-08-13	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2022-08-13	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2022-08-13	
Uranium, dissolved	0.00150	0.000020	mg/L	2022-08-13	
Vanadium, dissolved	< 0.0050	0.0050	mg/L	2022-08-13	
Zinc, dissolved	0.0301	0.0040	mg/L	2022-08-13	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2022-08-13	
General Parameters					
Ammonia, Total (as N)	0.869	0.050	mg/L	2022-08-08	
BOD, 5-day	< 7.0	2.0	mg/L	2022-08-10	
Nitrogen, Total Kjeldahl	2.05	0.050	mg/L	2022-08-10	
рН	8.12	0.10	pH units	2022-08-08	HT2
Phosphorus, Total (as P)	0.854	0.0050	mg/L	2022-08-09	
Phosphorus, Total Dissolved	0.829	0.0050	mg/L	2022-08-09	
Solids, Total Dissolved	537	15	mg/L	2022-08-19	HT1
Solids, Total Suspended	< 2.0	2.0	mg/L	2022-08-10	
Turbidity	0.85	0.10	NTU	2022-08-06	
Total Metals					
Sodium, total	84.7	0.10	mg/L	2022-08-14	

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



REPORTED TO Vernon Water Reclamation, City of WORK ORDER 22H2602

PROJECT MacKay Reservoir Effluent (ME 12215) - EMS REPORTED 2022-08-24 13:46

**Analyte** Result **RL** Units Analyzed Qualifier Reclaimed Water - Mackay Reservoir Effluent to Irrigation (Clay Value 4) E228539 (22H2602-01) | Matrix: Water | Sampled: 2022-08-17 10:00 Microbiological Parameters Coliforms, Total (Q-Tray) < 1 1 MPN/100 mL 2022-08-17 Coliforms, Fecal (Q-Tray) < 1 1 MPN/100 mL 2022-08-17



REPORTED TO	Vernon Water Reclamation, City of	<b>WORK ORDER</b>	2211070
PROJECT	MacKay Reservoir Effluent (ME 12215) - EMS	REPORTED	2022-09-19 12:58

Analyte	Result	RL	Units	Analyzed	Qualifie
Mackay Reservoir Effluent to Irrigat 2022-09-08 10:15	ion (Clay Valve 4) E228539 (22	1070-01)   Matrix: Wate	r   Sampled:		
Anions					
Chloride	89.6	0.10	mg/L	2022-09-12	
Fluoride	0.21		mg/L	2022-09-12	
Nitrate (as N)	0.704	0.010		2022-09-12	HT1
Nitrite (as N)	0.024	0.010		2022-09-12	HT1
Phosphate (as P)	0.764	0.0050		2022-09-16	HT1
Sulfate	83.9		mg/L	2022-09-12	
Calculated Parameters					
Hardness, Total (as CaCO3)	213	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	0.728	0.0100		N/A	
Nitrogen, Total	2.84	0.0500		N/A	
Nitrogen, Organic	1.04	0.0500		N/A	
Dissolved Metals					
Aluminum, dissolved	< 0.0050	0.0050	mg/L	2022-09-13	
Antimony, dissolved	< 0.00020	0.00020		2022-09-13	
Arsenic, dissolved	0.00081	0.00050		2022-09-13	
Barium, dissolved	0.0279	0.0050		2022-09-13	
Beryllium, dissolved	< 0.00010	0.00010		2022-09-13	
Bismuth, dissolved	< 0.00010	0.00010		2022-09-13	
Boron, dissolved	0.197	0.0500		2022-09-13	
Cadmium, dissolved	< 0.000010	0.000010		2022-09-13	
Calcium, dissolved	49.2		mg/L	2022-09-13	
Chromium, dissolved	< 0.00050	0.00050		2022-09-13	
Cobalt, dissolved	0.00033	0.00010		2022-09-13	
Copper, dissolved	0.00291	0.00040		2022-09-13	
Iron, dissolved	0.075	0.010		2022-09-13	
Lead, dissolved	< 0.00020	0.00020		2022-09-13	
Lithium, dissolved	0.00971	0.00010		2022-09-13	
Magnesium, dissolved	21.9	0.010		2022-09-13	
Manganese, dissolved	0.166	0.00020		2022-09-13	
Molybdenum, dissolved	0.00297	0.00010		2022-09-13	
Nickel, dissolved	0.00183	0.00040		2022-09-13	
Phosphorus, dissolved	0.895	0.050		2022-09-13	
Potassium, dissolved	18.1		mg/L	2022-09-13	
Selenium, dissolved	0.00055	0.00050		2022-09-13	
Silicon, dissolved	1.9		mg/L	2022-09-13	
Silver, dissolved	< 0.000050	0.000050		2022-09-13	
Sodium, dissolved	89.7		mg/L	2022-09-13	
Strontium, dissolved	0.492	0.0010		2022-09-13	
Sulfur, dissolved	28.4		mg/L	2022-09-13	
Tellurium, dissolved	< 0.00050	0.00050		2022-09-13	
Thallium, dissolved	< 0.000020	0.000020		2022-09-13	
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REPORTED TOVernon Water Reclamation, City ofWORK ORDER22/1070PROJECTMacKay Reservoir Effluent (ME 12215) - EMSREPORTED2022-09-19 12:58

Result	RL	Units	Analyzed	Qualifie
on (Clay Valve 4) E228539 (22l1	070-01)   Matrix: Wate	r   Sampled:		
< 0.00010	0.00010	mg/L	2022-09-13	
< 0.00020	0.00020	mg/L	2022-09-13	
< 0.0050	0.0050	mg/L	2022-09-13	
< 0.0010	0.0010	mg/L	2022-09-13	
0.00144	0.000020	mg/L	2022-09-13	
< 0.0050	0.0050	mg/L	2022-09-13	
0.0285	0.0040	mg/L	2022-09-13	
< 0.00010	0.00010	mg/L	2022-09-13	
1.08	0.050	mg/L	2022-09-15	
< 7.4	2.0	mg/L	2022-09-14	
2.12	0.050	mg/L	2022-09-14	
7.94	0.10	pH units	2022-09-15	HT2
0.922	0.0050	mg/L	2022-09-13	
0.716	0.0050	mg/L	2022-09-13	
494	15	mg/L	2022-09-13	
2.6	2.0	mg/L	2022-09-13	
0.77	0.10	NTU	2022-09-10	
88.4	0.10	mg/L	2022-09-12	
88.4	0.10	NTU mg/L		
< 1		MPN/100 mL	2022-09-09	
	<ul> <li>con (Clay Valve 4) E228539 (2211</li> <li>con (Clay Valve 4) E228539 (2211</li> <li>con (00020</li> <li>con (00050</li> <li>con (000144</li> <li>con (00050)</li> <li>con (00010)</li> <li>1.08</li> <li>con (00010)</li> <li>1.08</li> <li>con (00010)</li> <li>1.092</li> <li>con (00010)</li> <li>con (00010)</li> <li>do (00010)</li> <li>do</li></ul>	Clay Valve 4) E228539 (22I1070-01)   Matrix: Wate	Clay Valve 4) E228539 (22I1070-01)   Matrix: Water   Sampled:	Clay Valve 4) E228539 (22l1070-01)   Matrix: Water   Sampled:

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



REPORTED TOVernon Water Reclamation, City ofCARPROJECTFinal Treated Effluent (ME12215) - EMSREP

**CARO WO#** 22E3675 **REPORTED** 2022-06-02 23:47

Analyte	Result Uncertainty	RL Units	Analyzed	Qualifier
VRWC Treated Effluent to Direct Irrig 2022-05-26 09:00	gation FFE E229578 (22E3675-01)   Mat	rix: Water   Sampled:		
General Parameters				
BOD, 5-day	< 7.8	2.0 mg/L	2022-06-02	
pH	<b>6.85</b> ± 0.02	0.10 pH units	2022-05-31	HT2
Solids, Total Suspended	< 2.0	2.0 mg/L	2022-05-30	
Turbidity	<b>0.76</b> ± 0.07	0.10 NTU	2022-05-27	
Microbiological Parameters				
Coliforms, Total (Q-Tray)	< 1	1 MPN/100 mL	2022-05-27	
Coliforms, Fecal (Q-Tray)	< 1	1 MPN/100 mL	2022-05-27	

#### Sample Qualifiers:



**Analyte** 

Vernon Water Reclamation, City of **REPORTED TO PROJECT** Final Treated Effluent (ME12215) - EMS

**CARO WO# REPORTED** 

**RL** Units

22F3602 2022-06-29 15:50

Qualifier

Analyzed

# VRWC Treated Effluent to Direct Irrigation FFE E229578 (22F3602-01) | Matrix: Water | Sampled:

General Parameters				
BOD, 5-day	< 5.2	2.0 mg/L	2022-06-29	
рН	<b>7.91</b> ± 0.02	0.10 pH units	2022-06-27	HT2
Solids, Total Suspended	< 2.0	2.0 mg/L	2022-06-29	
Turbidity	<b>0.65</b> ± 0.07	0.10 NTU	2022-06-24	
Microbiological Parameters				
Coliforms, Total (Q-Tray)	3	1 MPN/10	00 mL 2022-06-24	
Coliforms, Fecal (Q-Tray)	< 1.6	1 MPN/10	00 mL 2022-06-25	HT1, RS2
E. coli (Q-Tray)	< 1	1 MPN/10	00 mL 2022-06-24	

Result Uncertainty

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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

RS2 The Reporting Limits for this sample have been raised due to limited sample volume.



REPORTED TOVernon Water Reclamation, City ofCARO WO#22G1659PROJECTFinal Treated Effluent (ME12215) - EMSREPORTED2022-07-20 10:13

Analyte	Result Uncertainty	RL Units	Analyzed	Qualifier
VRWC Treated Effluent to Direct Irrig 2022-07-13 08:30	ation FFE E229578 (22G1659-01)   Matr	ix: Water   Sampled:		
General Parameters				
BOD, 5-day	< 1.0	2.0 mg/L	2022-07-19	
pH	<b>7.78</b> ± 0.02	0.10 pH units	2022-07-15	HT2
Solids, Total Suspended	< 2.0	2.0 mg/L	2022-07-15	
Turbidity	<b>0.65</b> ± 0.07	0.10 NTU	2022-07-14	
Microbiological Parameters				
Coliforms, Total (Q-Tray)	18	1 MPN/100 mL	2022-07-14	
Coliforms, Fecal (Q-Tray)	<1	1 MPN/100 mL	2022-07-14	

#### Sample Qualifiers:



REPORTED TOVernon Water Reclamation, City ofCARO WO#22H0690PROJECTFinal Treated Effluent (ME12215) - EMSREPORTED2022-08-11 15:38

Analyte	Result Uncertainty	RL Uni	ts Analyzed	Qualifier
VRWC Treated Effluent to Direct Irrig 2022-08-04 10:15	ation FFE E229578 (22H0690-01)   Ma	ntrix: Water   Sample	d:	
General Parameters				
BOD, 5-day	< 1.2	2.0 mg/	L 2022-08-10	
pH	8.00 ± 0.02	0.10 pH (	units 2022-08-08	HT2
Solids, Total Suspended	< 2.0	2.0 mg/	L 2022-08-10	
Turbidity	<b>0.67</b> ± 0.07	0.10 NTL	J 2022-08-06	
Microbiological Parameters				
Coliforms, Total (Q-Tray)	< 1	1 MPI	N/100 mL 2022-08-05	
Coliforms, Fecal (Q-Tray)	< 1	1 MPI	N/100 mL 2022-08-05	

#### Sample Qualifiers:



**REPORTED TO** Vernon Water Reclamation, City of CARO WO# Final Treated Effluent (ME12215) - EMS **PROJECT REPORTED** 

2211064 2022-09-15 15:26

Analyte	Result	Uncertainty	RL	Units	Analyzed	Qualifier
VRWC Treated Effluent to Direct Irrig 2022-09-08 09:45	gation FFE E229578	(22l1064-01)   Matri	x: Water   San	npled:		
General Parameters						
BOD, 5-day	< 7.4		2.0	mg/L	2022-09-14	
рН	7.88	± 0.02	0.10	pH units	2022-09-11	HT2
Solids, Total Suspended	< 2.0		2.0	mg/L	2022-09-13	
Turbidity	0.65	± 0.04	0.10	NTU	2022-09-10	
Microbiological Parameters						
Coliforms, Total (Q-Tray)	1		1	MPN/100 mL	2022-09-09	
Coliforms, Fecal (Q-Tray)	< 1		1	MPN/100 mL	2022-09-09	

#### Sample Qualifiers:

### Appendix F

Bailey Springs Water Quality Results
Caro Analytical Services



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22A3136PROJECTBailey Springs (ME12215) - EMSREPORTED2022-02-03 16:16

Analyte	Result	RL	Units	Analyzed	Qualifier
Bailey Springs (0500578) (22A3136-0	1)   Matrix: Fresh Water   Samp	led: 2022-01-26 08:00			PRES
Anions					
Chloride	152	0.10	mg/L	2022-01-26	
Nitrate (as N)	0.464	0.010	mg/L	2022-01-26	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-01-26	
Phosphate (as P)	0.0515	0.0050	mg/L	2022-01-26	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.464	0.0100	mg/L	N/A	
Nitrogen, Total	0.994	0.0500	mg/L	N/A	
Nitrogen, Organic	0.530	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-01-31	
Conductivity (EC)	1350	2.0	μS/cm	2022-01-27	
Nitrogen, Total Kjeldahl	0.530	0.050	mg/L	2022-02-01	
рН	8.28	0.10	pH units	2022-01-27	HT2
Phosphorus, Total (as P)	0.131	0.0050	mg/L	2022-02-01	
Phosphorus, Total Dissolved	0.120	0.0050	mg/L	2022-02-01	
Solids, Total Dissolved	778	15	mg/L	2022-02-03	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	156	1	MPN/100 mL	2022-01-27	
Coliforms, Fecal (Q-Tray)	3	1	MPN/100 mL	2022-01-27	
Total Metals					
Sodium, total	127	0.10	mg/L	2022-01-30	

### Sample Qualifiers:

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Bailey Springs (ME12215) - EMS

WORK ORDER REPORTED 22B2516 2022-02-25 15:34

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22B2516-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-02-17 09:00			FILT, PRES
Anions					
Chloride	156	0.10	mg/L	2022-02-20	
Nitrate (as N)	0.461	0.010	mg/L	2022-02-20	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-02-20	
Phosphate (as P)	0.0710	0.0050	mg/L	2022-02-20	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.461	0.0100	mg/L	N/A	
Nitrogen, Total	0.951	0.0500	mg/L	N/A	
Nitrogen, Organic	0.490	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-02-23	
Conductivity (EC)	1320	2.0	μS/cm	2022-02-24	
Nitrogen, Total Kjeldahl	0.490	0.050	mg/L	2022-02-24	
pH	8.41	0.10	pH units	2022-02-24	HT2
Phosphorus, Total (as P)	0.128	0.0050	mg/L	2022-02-24	
Phosphorus, Total Dissolved	0.119	0.0050	mg/L	2022-02-24	
Solids, Total Dissolved	817	15	mg/L	2022-02-22	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	387	1	MPN/100 mL	2022-02-18	
Coliforms, Fecal (Q-Tray)	2	1	MPN/100 mL	2022-02-18	
Total Metals					
Sodium, total	138	0.10	mg/L	2022-02-22	

### Sample Qualifiers:

FILT The sample has been filtered for Diss P in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Bailey Springs (ME12215) - EMS

WORK ORDER REPORTED 22C1399 2022-03-16 12:05

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22C1399-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-03-09 09:00			FILT, PRES
Anions					
Chloride	151	0.10	mg/L	2022-03-11	
Nitrate (as N)	0.756	0.010	mg/L	2022-03-11	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-03-11	
Phosphate (as P)	0.0526	0.0050	mg/L	2022-03-11	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.756	0.0100	mg/L	N/A	
Nitrogen, Total	1.41	0.0500	mg/L	N/A	
Nitrogen, Organic	0.656	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-03-11	
Conductivity (EC)	1290	2.0	μS/cm	2022-03-13	
Nitrogen, Total Kjeldahl	0.656	0.050	mg/L	2022-03-16	
pH	8.39	0.10	pH units	2022-03-13	HT2
Phosphorus, Total (as P)	0.122	0.0050	mg/L	2022-03-15	
Phosphorus, Total Dissolved	0.113	0.0050	mg/L	2022-03-15	
Solids, Total Dissolved	762	15	mg/L	2022-03-10	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	75	1	MPN/100 mL	2022-03-10	
Coliforms, Fecal (Q-Tray)	2	1	MPN/100 mL	2022-03-10	
Total Metals					
Sodium, total	140	0.10	mg/L	2022-03-13	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Bailey Springs (ME12215) - EMS

WORK ORDER REPORTED 22D2444 2022-05-11 12:11

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22D2444-0	1)   Matrix: Fresh Water   Samp	led: 2022-04-20 09:30			FILT, PRES
Anions					
Chloride	144	0.10	mg/L	2022-04-22	
Nitrate (as N)	0.431	0.010	mg/L	2022-04-22	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-04-22	
Phosphate (as P)	0.0127	0.0050	mg/L	2022-04-22	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.431	0.0100	mg/L	N/A	
Nitrogen, Total	0.943	0.0500	mg/L	N/A	
Nitrogen, Organic	0.512	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-04-25	
Conductivity (EC)	1160	2.0	μS/cm	2022-04-22	
Nitrogen, Total Kjeldahl	0.512	0.050	mg/L	2022-04-27	
рН	8.47	0.10	pH units	2022-04-23	HT2
Phosphorus, Total (as P)	0.103	0.0050	mg/L	2022-04-26	
Phosphorus, Total Dissolved	0.0892	0.0050	mg/L	2022-04-26	
Solids, Total Dissolved	719	15	mg/L	2022-04-25	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	326	1	MPN/100 mL	2022-04-21	
Coliforms, Fecal (Q-Tray)	70	1	MPN/100 mL	2022-04-21	
Total Metals					
Sodium, total	120	0.10	mg/L	2022-04-27	

### Sample Qualifiers:

FILT The sample has been filtered for Diss P in the laboratory. Results may not reflect conditions at the time of sampling.

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22E2266PROJECTBailey Springs (ME12215) - EMSREPORTED2022-05-26 16:02

Analyte	Result	RL	Units	Analyzed	Qualifier
Bailey Springs (0500578) (22E2266-0	1)   Matrix: Fresh Water   Samp	ed: 2022-05-17 09:00			PRES
Anions					
Chloride	148	0.10	mg/L	2022-05-18	
Nitrate (as N)	0.622	0.010	mg/L	2022-05-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-05-18	
Phosphate (as P)	0.0319	0.0050	mg/L	2022-05-18	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.622	0.0100	mg/L	N/A	
Nitrogen, Total	1.19	0.0500	mg/L	N/A	
Nitrogen, Organic	0.564	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-05-18	
Conductivity (EC)	1140	2.0	μS/cm	2022-05-26	
Nitrogen, Total Kjeldahl	0.564	0.050	mg/L	2022-05-25	
pH	8.24	0.10	pH units	2022-05-26	HT2
Phosphorus, Total (as P)	0.148	0.0050	mg/L	2022-05-25	
Phosphorus, Total Dissolved	0.133	0.0050	mg/L	2022-05-25	
Solids, Total Dissolved	713	15	mg/L	2022-05-24	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	> 2420	1	MPN/100 mL	2022-05-18	
Coliforms, Fecal (Q-Tray)	1200	1	MPN/100 mL	2022-05-18	
Total Metals					
Sodium, total	113	0.10	mg/L	2022-05-25	

### Sample Qualifiers:

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDERPROJECTBailey Springs (ME12215) - EMSREPORTED

ORK ORDER 22F1511 EPORTED 2022-06-16 10:46

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22F1511-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-06-09 09:30			FILT, PRES
Anions					
Chloride	152	0.10	mg/L	2022-06-13	
Nitrate (as N)	0.036	0.010	mg/L	2022-06-13	HT1
Nitrite (as N)	< 0.010	0.010	mg/L	2022-06-13	HT1
Phosphate (as P)	< 0.0050	0.0050	mg/L	2022-06-13	HT1
Calculated Parameters					
Nitrate+Nitrite (as N)	0.0359	0.0100	mg/L	N/A	
Nitrogen, Total	0.678	0.0500	mg/L	N/A	
Nitrogen, Organic	0.591	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	0.051	0.050	mg/L	2022-06-13	
Conductivity (EC)	1240	2.0	μS/cm	2022-06-14	
Nitrogen, Total Kjeldahl	0.642	0.050	mg/L	2022-06-15	
рН	8.36	0.10	pH units	2022-06-14	HT2
Phosphorus, Total (as P)	0.152	0.0050	mg/L	2022-06-15	
Phosphorus, Total Dissolved	0.115	0.0050	mg/L	2022-06-15	
Solids, Total Dissolved	721	15	mg/L	2022-06-13	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	2460	1	MPN/100 mL	2022-06-10	HT1
Coliforms, Fecal (Q-Tray)	770	1	MPN/100 mL	2022-06-10	HT1
Total Metals					
Sodium, total	118	0.10	mg/L	2022-06-13	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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



Vernon Water Reclamation, City of

### **TEST RESULTS**

**REPORTED TO** 

Nitrite (as N)

Phosphate (as P)

Calculated Parameters

Nitrate+Nitrite (as N)

Microbiological Parameters

Coliforms, Total (Q-Tray)

Coliforms, Fecal (Q-Tray)

PROJECT	Bailey Springs (ME12215) - EMS	REPORTED	2022-06-27 14:38	
Analyte	Result	RL Units	Analyzed	Qualifier
Bailey Springs	(0500578) (22F3146-01)   Matrix: Fresh Water   Sampled: 20	22-06-21 09:30		
Anions				

< 0.010

0.0590

0.101

3280

613

**WORK ORDER** 

0.010 mg/L

0.0050 mg/L

0.0200 mg/L

1 MPN/100 mL

1 MPN/100 mL

22F3146

2022-06-22

2022-06-22

N/A

2022-06-22

2022-06-22



REPORTED TO	Vernon Water Reclamation, City of	<b>WORK ORDER</b>	22G1408
PROJECT	Bailey Springs (ME12215) - EMS	REPORTED	2022-07-19 13:23

Analyte	Result	RL	Units	Analyzed	Qualifier
Bailey Springs (0500578) (22G1408-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-07-12 10:00			
Anions					
Chloride	134	0.10	mg/L	2022-07-13	
Nitrate (as N)	0.061	0.010	mg/L	2022-07-13	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-07-13	
Phosphate (as P)	0.0290	0.0050	mg/L	2022-07-13	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.0610	0.0100	mg/L	N/A	
Nitrogen, Total	0.713	0.0500	mg/L	N/A	
Nitrogen, Organic	0.652	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-07-16	
Conductivity (EC)	1160	2.0	μS/cm	2022-07-13	
Nitrogen, Total Kjeldahl	0.652	0.050	mg/L	2022-07-17	
pH	8.47	0.10	pH units	2022-07-13	HT2
Phosphorus, Total (as P)	0.148	0.0050	mg/L	2022-07-13	
Phosphorus, Total Dissolved	0.121	0.0050	mg/L	2022-07-13	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	11200	1	MPN/100 mL	2022-07-13	
Coliforms, Fecal (Q-Tray)	575	1	MPN/100 mL	2022-07-13	
Total Metals					
Sodium, total	119	0.10	mg/L	2022-07-15	

### Sample Qualifiers:

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22H0694PROJECTBailey Springs (ME12215) - EMSREPORTED2022-08-11 20:07

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22H0694-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-08-04 09:45			FILT, PRES
Anions					
Chloride	136	0.10	mg/L	2022-08-05	
Nitrate (as N)	0.028	0.010	mg/L	2022-08-05	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-08-05	
Phosphate (as P)	0.0369	0.0050	mg/L	2022-08-05	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.0281	0.0100	mg/L	N/A	
Nitrogen, Total	0.711	0.0500	mg/L	N/A	
Nitrogen, Organic	0.619	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	0.064	0.050	mg/L	2022-08-06	
Conductivity (EC)	1160	2.0	μS/cm	2022-08-08	
Nitrogen, Total Kjeldahl	0.683	0.050	mg/L	2022-08-10	
pH	8.50	0.10	pH units	2022-08-08	HT2
Phosphorus, Total (as P)	0.167	0.0050	mg/L	2022-08-09	
Phosphorus, Total Dissolved	0.132	0.0050	mg/L	2022-08-09	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	24200	1	MPN/100 mL	2022-08-05	
Coliforms, Fecal (Q-Tray)	579	1	MPN/100 mL	2022-08-05	
Total Metals					
Sodium, total	122	0.10	mg/L	2022-08-11	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22/1078PROJECTBailey Springs (ME12215) - EMSREPORTED2022-09-19 12:44

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22l1078-01	)   Matrix: Fresh Water   Sample	d: 2022-09-08 10:00			FILT, PRES
Anions					
Chloride	128	0.10	mg/L	2022-09-12	
Nitrate (as N)	0.071	0.010	mg/L	2022-09-12	HT1
Nitrite (as N)	< 0.010	0.010	mg/L	2022-09-12	HT1
Phosphate (as P)	0.0753	0.0050	mg/L	2022-09-16	HT1
Calculated Parameters					
Nitrate+Nitrite (as N)	0.0708	0.0100	mg/L	N/A	
Nitrogen, Total	0.778	0.0500	mg/L	N/A	
Nitrogen, Organic	0.707	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-09-15	
Conductivity (EC)	1130	2.0	μS/cm	2022-09-12	
Nitrogen, Total Kjeldahl	0.707	0.050	mg/L	2022-09-14	
pH	8.47	0.10	pH units	2022-09-12	HT2
Phosphorus, Total (as P)	0.182	0.0050	mg/L	2022-09-13	
Phosphorus, Total Dissolved	0.152	0.0050	mg/L	2022-09-13	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	11800	1	MPN/100 mL	2022-09-09	
Coliforms, Fecal (Q-Tray)	435	1	MPN/100 mL	2022-09-09	
Total Metals					
Sodium, total	122	0.10	mg/L	2022-09-12	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

HT1 The sample was prepared and/or analyzed past the recommended holding time.

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22J3757PROJECTBailey Springs (ME12215) - EMSREPORTED2022-10-31 13:50

	·				
Analyte	Result	RL	Units	Analyzed	Qualifier
Bailey Springs (0500578) (22J3757-	01)   Matrix: Fresh Water   Sample	d: 2022-10-28 10:00			
Microbiological Parameters					
Coliforms, Total (Q-Tray)	3650	1	MPN/100 mL	2022-10-28	
Coliforms, Fecal (Q-Tray)	31	1	MPN/100 mL	2022-10-28	



**REPORTED TO** Vernon Water Reclamation, City of **PROJECT** Bailey Springs (ME12215) - EMS

WORK ORDER REPORTED 22J2547 2022-10-26 12:17

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22J2547-0	1)   Matrix: Fresh Water   Samp	led: 2022-10-19 10:00			FILT, PRES
Anions					
Chloride	140	0.10	mg/L	2022-10-21	
Nitrate (as N)	0.123	0.010	mg/L	2022-10-21	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-10-21	
Phosphate (as P)	0.0259	0.0050	mg/L	2022-10-21	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.123	0.0100	mg/L	N/A	
Nitrogen, Total	0.718	0.0500	mg/L	N/A	
Nitrogen, Organic	0.595	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-10-20	
Conductivity (EC)	1200	2.0	μS/cm	2022-10-24	
Nitrogen, Total Kjeldahl	0.595	0.050	mg/L	2022-10-25	
рН	8.41	0.10	pH units	2022-10-24	HT2
Phosphorus, Total (as P)	0.111	0.0050	mg/L	2022-10-24	
Phosphorus, Total Dissolved	0.0962	0.0050	mg/L	2022-10-24	
Total Metals					
Sodium, total	124	0.10	mg/L	2022-10-23	

#### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



REPORTED TOVernon Water Reclamation, City ofWORK ORDER22K2184PROJECTBailey Springs (ME12215) - EMSREPORTED2022-11-24 16:07

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22K2184-0	1)   Matrix: Fresh Water   Sampl	ed: 2022-11-17 10:00			FILT, PRES
Anions					
Chloride	159	0.10	mg/L	2022-11-18	
Nitrate (as N)	0.255	0.010	mg/L	2022-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-11-18	
Phosphate (as P)	0.0109	0.0050	mg/L	2022-11-18	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.255	0.0100	mg/L	N/A	
Nitrogen, Total	0.755	0.0500	mg/L	N/A	
Nitrogen, Organic	0.500	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2022-11-19	
Conductivity (EC)	1230	2.0	μS/cm	2022-11-23	
Nitrogen, Total Kjeldahl	0.500	0.050	mg/L	2022-11-23	
рН	8.37	0.10	pH units	2022-11-23	HT2
Phosphorus, Total (as P)	0.0927	0.0050	mg/L	2022-11-24	
Phosphorus, Total Dissolved	0.0859	0.0050	mg/L	2022-11-24	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	271	1	MPN/100 mL	2022-11-18	
Coliforms, Fecal (Q-Tray)	11	1	MPN/100 mL	2022-11-18	
Total Metals					
Sodium, total	123	0.10	mg/L	2022-11-22	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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



REPORTED TO Vernon Water Reclamation, City of PROJECT Bailey Springs (ME12215) - EMS

WORK ORDER REPORTED 22L1592 2022-12-21 12:41

Analyte	Result	RL	Units	Analyzed	Qualifie
Bailey Springs (0500578) (22L1592-0	1)   Matrix: Fresh Water   Sample	ed: 2022-12-14 10:00			FILT, PRES
Anions					
Chloride	150	0.10	mg/L	2022-12-16	
Nitrate (as N)	0.350	0.010	mg/L	2022-12-16	
Nitrite (as N)	< 0.010	0.010	mg/L	2022-12-16	
Phosphate (as P)	0.0153	0.0050	mg/L	2022-12-16	
Calculated Parameters					
Nitrate+Nitrite (as N)	0.350	0.0100	mg/L	N/A	
Nitrogen, Total	0.772	0.0500	mg/L	N/A	
Nitrogen, Organic	0.364	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	0.059	0.050	mg/L	2022-12-16	
Conductivity (EC)	1240	2.0	μS/cm	2022-12-18	
Nitrogen, Total Kjeldahl	0.423	0.050	mg/L	2022-12-20	
рН	8.38	0.10	pH units	2022-12-18	HT2
Phosphorus, Total (as P)	0.0733	0.0050	mg/L	2022-12-16	
Phosphorus, Total Dissolved	0.0673	0.0050	mg/L	2022-12-16	
Microbiological Parameters					
Coliforms, Total (Q-Tray)	201	1	MPN/100 mL	2022-12-15	
Coliforms, Fecal (Q-Tray)	1	1	MPN/100 mL	2022-12-15	
Total Metals					
Sodium, total	128	0.10	mg/L	2022-12-17	

### Sample Qualifiers:

FILT The sample has been filtered for TDP in the laboratory. Results may not reflect conditions at the time of sampling.

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

### Appendix G

## Reclaimed Water Irrigation 2022 Groundwater Monitoring Program

Associated Environmental Consultants Inc.



### **REPORT**

### **City of Vernon**

### Reclaimed Water Irrigation 2022 Groundwater Monitoring Program





**MARCH 2023** 





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### 1 INTRODUCTION

### 1.1 Background

The City of Vernon (the City) treats municipal wastewater to an advanced (tertiary) level at the Vernon Water Reclamation Centre. The treated wastewater is stored in the MacKay Reservoir and meets the criteria of "reclaimed water" under the BC *Municipal Wastewater Regulation* (MWR) because it meets the MWR standards for use in irrigation (BC Reg. 87/2012). The reclaimed water is used to irrigate approximately 1,500 ha of agricultural land on the south side of the City. The irrigation program is authorized by the BC Ministry of Environment and Climate Change Strategy (ENV) through Operational Certificate (OC) ME 12215 (MOE 2008). Under the OC, groundwater monitoring is to be completed each year and an annual report submitted to ENV.

In 2010, the City retained Summit Environmental Consultants Inc. (now Associated Environmental Consultants Inc. [Associated]) to implement a groundwater monitoring program to assess the potential impacts of its reclaimed water irrigation operations on groundwater. Since then, Associated has conducted the annual groundwater monitoring program on behalf of the City. This report presents the results of the 2022 monitoring program. For more details on the historical program, see the previous annual reports (Summit 2010, 2012, 2013, 2015; Associated 2016, 2017, 2018, 2019, 2020, 2021, 2022).

### 1.2 Objective and Scope

Section 8.6 of the OC requires that a groundwater monitoring program be conducted by a Qualified Professional to "establish if irrigation with reclaimed water is impacting groundwater" (MOE 2008). The objective of the 2022 monitoring program is to monitor for potential effects of irrigation operations on groundwater. To meet this objective, Associated conducted the following scope of work:

- Completed the annual groundwater sampling program from a network of monitoring and domestic wells;
- Compared the water quality data to applicable guidelines and historical data;
- Summarized the conceptual model of groundwater flow completed by Associated in previous years;
- Reviewed groundwater level data collected from data loggers installed in two monitoring wells (DMW-3 and MW-2) to better understand groundwater fluctuations;
- Summarized the groundwater "types" determined by Associated (2022); and
- Prepared an annual report that discusses the results of the 2022 monitoring program.

In addition, Associated compared water quality data for Bailey Springs<sup>1</sup> (provided by the City) to applicable guidelines and historical data, and included the results in this report.

### 1.3 Study Area

The City's reclaimed water irrigation distribution system is located on the lands between Kalamalka and Okanagan Lakes, as indicated by the orange areas in Figure 1-1. The study area includes lands within and south of the City limits to just beyond the MacKay Reservoir, including Townships 9, 10, 13, and 14.

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1-1

<sup>&</sup>lt;sup>1</sup> In addition to conducting a groundwater monitoring program, Section 8.9 of the OC also requires the is required to collect samples from a stream referred to as Bailey Springs (EMS 500578) (MOE 2008). Bailey Springs is a surface watercourse that originates south of the MacKay Reservoir and discharges to Kalamalka Lake.

The study area includes a northeast- to southwest-trending ridge (hereafter referred to as the Commonage Ridge) (Figure 1-1), where Commonage Road bisects the top of the ridge that descends to Okanagan Lake (northwest) and Kalamalka Lake (southeast). Several gullies, which have ephemeral streams draining toward Okanagan Lake, are located on the bench lands to the west and east of Commonage Road.

Reclaimed wastewater is applied to five major areas: the Rise Golf Course, Vernon Golf and Country Club, Predator Ridge Golf Resort, individual private properties in the Commonage area, and the City-managed area on the hillside northwest of Commonage Road (Figure 1-1). The current groundwater monitoring program focuses on the reclaimed water that is applied to the City-managed area on the hillside northwest of Commonage Road. The agricultural and horticultural land use in the irrigation area that is managed by the City includes forage production, livestock grazing, irrigated pasture, and forest tree seedling nursery production. The OC states that the "general philosophy of the operation of the reclaimed water irrigation system shall be for beneficial reuse of reclaimed water" (OC Section 11.5.1). The City has control over irrigation rates in the City-managed area. For all other areas, the City manages irrigation use through Bylaw 4899 (COV 2005) and by providing all lessees with a copy of Appendix A of the OC each year (as required) to remind them of their requirements regarding irrigation rates, aerosol drift, buffers, prevention of surface runoff, and other factors. Over the past few years, the City has been working with lessees to improve water use practices and reduce instances of over-irrigation that could cause saturated soils or surface runoff.

1-2

### 2 CONCEPTUAL MODEL OF GROUNDWATER FLOW

Associated (2019) completed an in-depth review of available information to create a conceptual model of groundwater flow. The review focused on the study area north of the Commonage Ridge as this is where the larger aquifers are located and where the more complex groundwater flow patterns are likely to occur. The following sections provide a summary of that review, with additional data collected from 2019 to 2022.

### 2.1 Lithology

Associated (2019) reviewed borehole lithology data from publicly available sources and from well logs of monitoring wells drilled by Associated for other City projects in the area. The lithology observed in the boreholes is consistent with that described by Nasmith (1962) and Fulton et al. (1965). The study area north of the Commonage Ridge comprises undivided glacial deposits (i.e., sand, gravel, clay, and till) along the hillside and predominantly fluvial/alluvial deposits in the valley bottom, which is commonly called Priest Valley.

ENV most recently updated the aquifer mapping for the North Okanagan in 2019; these updates were based on extensive work completed by Hassan et al. (2019). Four aquifers are mapped in the study area (ENV 2023) (Table 2-1).

Aguifer 346 Aguifer 347 Aquifer 1227 Aguifer 471 South Vernon South Vernon Okanagan Landing **Aquifer name** No name given Unconfined Confined Deep Confined **Productivity** Moderate High Low High **Vulnerability** Moderate Moderate Low Low Sand and gravel Fractured Likely alluvium or Sands and gravels from dominated, but can crystalline Lithology stream terrace alluvium or stream be silty; contact with bedrock; granite deposits terrace deposits bedrock and alkali feldspar Assumed to be Predominantly from Likely occurs from from leakage through Expected direct infiltration precipitation, overlying confining predominantly from of precipitation at leakage from unit from Aquifer 346; mountain block bedrock outcrops, **Groundwater recharge** creeks/alluvial also mountain block recharge via seepage slow leakage. fans, and from fractures and and/or from recharge and leakage mountain block from sediments along faults surface water recharge the valley margins features Size (km<sup>2</sup>) 14.7 6.8 3.75 127.6 Number of registered wells correlated to the 105 114 6 116 aquifer Median well depth (m) 13.7 38.1 112.8 85.34

47 (41% of wells)

2 (33% of wells)

Table 2-1 Aquifers in the Study Area

Source: ENV 2023

Number of registered

flowing artesian wells

17 (16% of wells)

Æ

1 (<1% of wells)

Cross-sections generated by Associated (2019) are provided in Appendix A.<sup>2</sup> Figure A-1 shows the locations of the cross-sections. Cross-section A-A' (Figure A-2) has been updated from Associated (2019) given the information in Hassan et al. (2019) and shows the distinction between the South Vernon Confined Aquifer (Aquifer 347), the South Vernon Unconfined Aquifer (Aquifer 347), and the Okanagan Landing Deep Confined Aquifer (Aquifer 1227) (boundaries between these units are extrapolated and not confirmed, except where wells are).

Cross-sections B-B' and C-C' (Figures A-3 and A-4, respectively) show that the lithology on the hillside is complex and that lithology units are not laterally extensive east—west.

#### 2.2 Groundwater Levels

In October 2017, Associated installed pressure-transducer data loggers in monitoring wells MW-2 (WTN 58804) and DMW-3 (WTN 58803), both of which are included in the long-term groundwater monitoring program (Section 3), to measure and record groundwater levels every 6 hours. Approximately once every 3 months since that time, the City has retrieved data from the loggers and recorded a manual groundwater level reading. Data are available between October 25, 2017, and December 31, 2022 (Figure 2-1).

Monitoring well DMW-3 is located south of Bench Row Road and north of the Commonage Ridge (Figure 1-1). It is the only well in the monitoring program that is not within the area irrigated with reclaimed water. The monitoring well was installed in May 1989, and the well log indicates 1.83 m of red, sandy clay overlying fractured bedrock. The borehole was drilled to 5.79 m below ground (m bg), and the monitoring well was screened between 2.74 and 5.79 m bg (across the fractured bedrock).

DMW-3 is situated near an ephemeral drainage that drains north. Groundwater levels in the well are typically at approximately 2.5 m below top of casing (m btoc) throughout the year, except in spring (March–May), when groundwater levels rise to approximately 0.75 to 0.90 m btoc. Throughout period of record, groundwater levels rise rapidly in March, during freshet (e.g., groundwater levels rose by as much as 0.76 m in a period of 24 hours [March 17, 2018]). Fieldwork completed at the well (e.g., water sampling) suggests that the surface seal of the well head is competent and that the increased water level is due to an increase in water level of the aquifer, not just an increase of water level in the well. In October 2021, groundwater levels dropped to the lowest on record (3.592 m btoc).

Monitoring well MW-2 is located approximately 35 m south of Okanagan Avenue, in the eastern portion of the study area within the area irrigated by reclaimed water (Figure 1-1). It is at a higher elevation than some of the other wells in the valley bottom, and the groundwater level in this well is comparable to the perceived potentiometric level in the flowing artesian wells located at lower elevations.<sup>3</sup> The well log indicates that the well is partially screened across a semi-confined layer of coarse gravel from 12.8 to 14.3 m bg (likely Aquifer 347). The static groundwater level is between 2.6 and 3.6 m btoc throughout the period of record. The response to freshet in this well is less noticeable, which is expected due to the overlying confining layers inhibiting direct recharge of the aquifer. Recharge to this

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<sup>&</sup>lt;sup>2</sup> The accuracy of the cross-sections relies on the lithology information from publicly available well logs and the accuracy of elevation data available. Monitoring wells installed for the Hesperia Landfill groundwater monitoring program (MW17-1, MW17-5, MW17-6, MW2018-1, MW2018-2, MW2018-3) have been surveyed to geodetic datum (+/- 1 cm) (Associated 2019). The ground elevations for other wells used were determined based on elevation data available from the City and have an accuracy of +/- 1 m (COV 2016). The borehole logs used to develop the cross-sections are provided in Associated (2019).

<sup>&</sup>lt;sup>3</sup> The potentiometric level is the imaginary level to which water in a confined aquifer would rise if it were completely pierced with a well. When the potentiometric level is above ground, a flowing artesian well results. Associated does not have confirmed data on the potentiometric levels of the flowing artesian wells on Okanagan Avenue, but a level of 1–2 m above ground would line up with the groundwater elevation at MW-2.

aquifer likely comes from the highlands to the south. Because coarse gravel aquifers typically have large storativity values,<sup>4</sup> changes in water levels, which would indicate recharge and discharge of water from the aquifer, are less noticeable. There seems to be a strong seasonal lag from freshet to high groundwater levels in this well; this is consistent with a well in a confined aquifer that is a large distance away from the recharge zone. Previous trilinear diagrams (Stiff diagrams) (Associated 2021), summarized in Section 2.3, confirm that groundwater in MW-2 is consistent with water having a long residence time.

The "sawtooth" pattern observed in MW-2 in Figure 2-1 indicates that the well is being influenced by a neighbouring pumping well. The minimal drawdown/recovery observed here suggests that the pumping well is a great distance away, and/or the aquifer has a high transmissivity.<sup>5</sup>

<sup>&</sup>lt;sup>5</sup> Transmissivity is a measure of an aquifer's ability to transmit water.



<sup>&</sup>lt;sup>4</sup> Storativity is a measure of an aquifer's ability to store water.

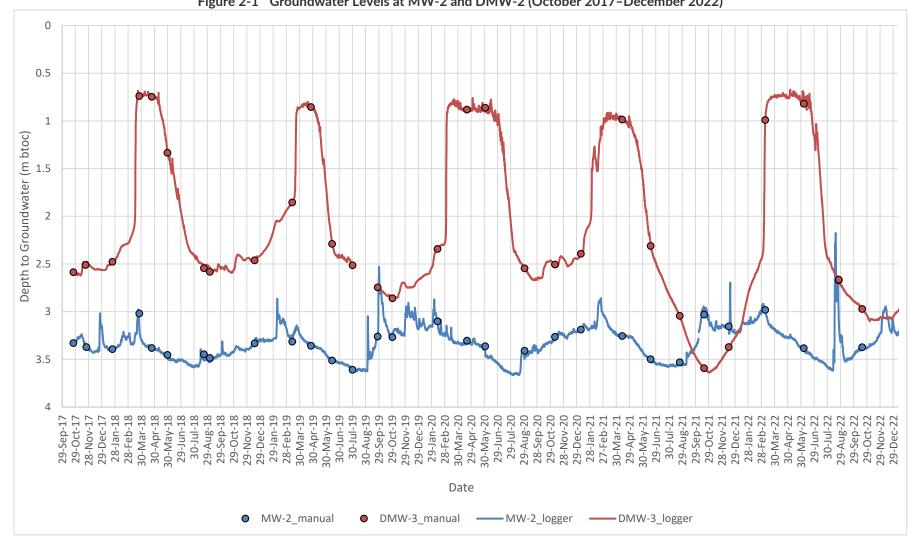


Figure 2-1 Groundwater Levels at MW-2 and DMW-2 (October 2017-December 2022)

### 2.3 Groundwater Chemistry

In Associated (2021), tri-linear diagrams (i.e., Piper, Extended Durov, and Stiff Diagrams) were developed as part of our conceptual model interpretation using data from 2011 to 2020. Trilinear diagrams aid in assessing groundwater "type" and can help to classify different groundwater regimes. Groundwater flowing in an aquifer during the natural cycle is influenced by residence time and interaction with the host rock or material along the flow path, and can be generally classified as more freshly recharged (i.e., low mineralization) or having a longer residence time (i.e., higher mineralization). Details of this assessment, including the trilinear diagrams, are provided in Associated (2021). Updated trilinear plots were not developed for this report; the following provides a summary of the findings from Associated (2021):

- Groundwater wells north of the Commonage Ridge typically plot as calcium-bicarbonate, calcium-magnesium, and calcium-sulphate water types, which suggests younger to moderate residence times. Wells south of the Commonage Ridge (i.e., DMW-4 and DMW-5) plot as mainly calcium-sulphate.
- Five different chemistry signatures were evident in the Stiff Diagrams:
  - MW11-02 is at the western extent of the study area and has higher concentrations of all ions.
  - WTN 24991 and MW-5 are located centrally along Okanagan Avenue and are flowing artesian. These
    wells show younger, more recently recharged groundwater. MW-5 has higher magnesium and
    sulphate levels and less calcium and alkalinity than WTN 24991.
  - DMW-1, MW-2, WTN 39421, and DMW18-1 are located at the eastern end of the study area, and all except for DMW-1 are installed to relatively similar depths. MW-2, although similar to the others, has slightly different source influencing its chemistry and may be isolated from the other wells.
  - DMW-3 is the upgradient well and, based on groundwater level data (Section 2.2), it is closely tied to surface water. It contains high concentrations of ions and is therefore potentially influenced by other upgradient activities (e.g., road salt, animal pasture).
  - DMW-4 and DMW-5 are located south of the Commonage Ridge and are unique from the others, based on their higher levels of sodium, potassium, and alkalinity.
- Some of the deeper, flowing artesian wells (WTN 24991 and MW-5) exhibit water that is typical of freshly recharged (i.e., younger) groundwater. This is counterintuitive since deeper aquifers typically host older groundwater.<sup>6</sup> A potential cause of this groundwater is due to a pathway of higher transmissivity (e.g., fracture or fault within the bedrock). WTN 39421 is a flowing artesian well located on Okanagan Avenue that has higher equivalents of sulphate and calcium, suggesting a different aquifer from WTN 24991 and MW-5.
- Although there is no confirmed lithological log for DMW-1, it is much shallower than WTN 39421 and is likely installed across a different aquifer. Based on the available lithological data for the study area, DMW-1 and WTN 39421 are likely separated by a 30–40 m thick unit of clay (Figure A-2, in Appendix A). Both wells have similar water quality and similar signatures, which may be due to similar material hosting the aquifers (i.e., although these two wells are separated by a thick clay unit, the geological depositional environment for the aquifers could have been similar).

Since groundwater chemistry throughout the study area varies spatially and with depth, it is difficult to ascertain true background water quality for the area and, therefore, the impacts from anthropogenic sources. Monitoring well DMW-3 is upgradient of the reclaimed water irrigation area but is installed across a bedrock aquifer and is closely tied to surface water. This makes it unique among other wells within the irrigation area that are typically much deeper and installed within unconsolidated aquifers. Monitoring well MW11-02 is within the irrigation area and has several

<sup>&</sup>lt;sup>6</sup> While this is typically the case, deeper aquifers can host younger groundwater when the hydraulic conductivity and/or hydraulic gradient is higher.



2-5

parameters that are orders of magnitude higher than other wells, suggesting some additional influence(s) compared to other monitoring wells.

Water quality data from 2022 are summarized in Section 3, including a comparison to applicable guidelines and discussion on changes in water quality over time.

2-6

### 3 GROUNDWATER QUALITY

### 3.1 Methods

### 3.1.1 Monitoring Network

The groundwater monitoring network consists of monitoring wells and domestic water supply wells, as listed in Table 3-1 and shown in Figure 1-1. Sampling in 2022 occurred on October 5 and 6, at the end of the irrigation season, which aligns with previous sampling programs. Table 3-1 also summarizes the depth to water and depth to bottom of each well in the monitoring program, and indicates whether a well log is available. All available well logs are provided in Appendix A.

Table 3-1 2022 Groundwater Monitoring Network and Well Details

Leastien ID	ocation ID Well Type Well Log Depth to Water We		Well Depth	UTM Coordinates (11U)ª		
Location ID	vveii Type	Available?	Depth to water	weii Depth	Easting	Northing
MW-2	Monitoring well	Yes (WTN 58804)	3.31 m btoc <sup>b</sup>	14.71 m <sup>b</sup>	335363	5568422
MW-5	Flowing artesian well	No	Flowing artesian	49.8 m btoc <sup>b</sup>	334066	5567984
MW11-02	Monitoring well	Yes	32.90 m btoc <sup>b</sup>	34.6 m btoc	332740	5567306
DMW-1	Private domestic well (dug well)	Possibly WTN 8414 <sup>c</sup>	0.41 m btoc <sup>b</sup>	2.4 m <sup>d</sup>	335045	5568305
DMW-3	Monitoring well	Yes (WTN 58803)	2.92 m btoc <sup>b</sup>	6.31 m btoc <sup>b</sup>	334351	5566559
DMW-4	Private domestic well	No	0.6 m btoc <sup>e</sup>	4 m (estimated) <sup>f</sup>	332092	5563015
DMW-5	Private domestic well	No	Flowing artesian	Unknown	332398	5561078
WTN 39421	Water supply well	Yes (WTN 39421)	Flowing artesian	45 m <sup>d</sup>	334975	5568344
WTN 24991	Water supply well	Yes (WTN 24991)	Flowing artesian	113 m <sup>d</sup>	333994	5567989
DMW18-1	Private domestic well	Yes (WTN 1950)	6 m <sup>d</sup>	8.5 m <sup>d</sup>	334611	5568228

Notes: m = metre (taken from registered well log; therefore, unknown whether measurement is below top of casing or below ground); m = metre below top of casing; m = metre below ground

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 $<sup>^{\</sup>rm a}$  UTM coordinates collected using a hand-held GPS, with an estimated accuracy of +/– 5 m

<sup>&</sup>lt;sup>b</sup> Based on field measurements (October 2022)

<sup>&</sup>lt;sup>c</sup> Assumed WTN based on well location and field measured depth to bottom, but not confirmed.

<sup>&</sup>lt;sup>d</sup> Based on information in the registered well log

<sup>&</sup>lt;sup>e</sup> Depth to water measured in September 2018; well head inaccessible since that time

<sup>&</sup>lt;sup>f</sup> Based on anecdotal information from the property owner

This monitoring network is the same one used in 2020 and 2021 (Associated 2021, 2022). Groundwater well DMW18-1 is tested biannually (quarterly, before 2022) as part of the City's Hesperia Landfill Monitoring Program (Associated 2023), but data are included in this report for interpretation as it is a potential domestic receptor in the study area.

### 3.1.2 Sampling Methodology and Parameters Tested

Groundwater samples were collected following standard BC methods (MOE 2013a). Before sampling, groundwater wells were purged to remove at least three times the well volume, until dry or until field parameters stabilized, using a submersible pump, peristaltic pump, or foot-valve inertial pumping system, depending on well depth. Field parameters (i.e., temperature, conductivity, pH, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured using field meters during purging. Domestic wells were generally purged using existing pumps until field parameters stabilized. DMW-1, which is a dug well that cannot be purged, was sampled directly using a bailer. MW-5 was purged using an inertial pumping system, MW11-02 was purged using a bailer, and MW-2 was purged using a peristaltic pump.

Groundwater samples were collected as grab samples in laboratory-supplied bottles, filtered and preserved in the field (where necessary), and shipped via chain-of-custody protocol to CARO Analytical Services (CARO), an accredited laboratory in Kelowna, BC, for analysis of the following parameters:<sup>7</sup>

- alkalinity, bromide, chloride, fluoride, sodium, sulphate, total dissolved solids (TDS), and hardness (total as CaCO<sub>3</sub>);
- ammonia-N, nitrate-N, nitrite-N, total Kjeldahl nitrogen (TKN), organic nitrogen, and total nitrogen;
- orthophosphate, dissolved phosphorus, and total phosphorus; and
- dissolved metals.

A quality assurance and quality control (QA/QC) program was also followed, which included the collection of field duplicate and blank samples. Detailed methods are provided in Section 3.1.5 and results are in Section 3.2.3.

### 3.1.3 Comparison to Guidelines

Given the objective of the groundwater monitoring program (i.e., to establish whether irrigating with reclaimed water is impacting groundwater), the groundwater quality results were assessed relative to water quality guidelines. To protect nearby receptors (i.e., domestic wells used for drinking water and irrigation purposes, and groundwater discharging to surface waterbodies), the 2022 groundwater quality results were compared to the following water quality guidelines:

- Guidelines for Canadian Drinking Water Quality (Health Canada DW) (Health Canada 2022);
- British Columbia Source Drinking Water Quality Guidelines (BC DW) (ENV 2020);
- BC Approved and Working Water<sup>8</sup> Quality Guidelines for aquatic life (BC AL; acute guidelines only), irrigation water (BC IW), and livestock water (BC LW) (ENV 2021a, ENV 2021b); and
- BC Contaminated Sites Regulation (CSR) Schedule 3.2, Generic Numerical Water Standards for Drinking Water (DW), Irrigation (IW), Livestock (LW), and Freshwater Aquatic Life (AW) (BC Reg. 253/16).

3-2

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<sup>&</sup>lt;sup>7</sup> DMW18-1, which is sampled quarterly as part of a different monitoring program (Associated 2023), was tested for the same parameters listed here, with the exception of bromide, fluoride, organic nitrogen, total nitrogen, dissolved phosphorus, and orthophosphate.

<sup>&</sup>lt;sup>8</sup> Some of the BC water quality guidelines are considered "working," but for purposes of discussion in this report, they are given equal weight as approved guidelines.

#### **BC Water Quality Guidelines**

Exceeding a BC water quality guideline does not imply there are unacceptable risks, but rather the potential for adverse effects may be increased and additional investigation may be required (ENV 2021a). Comparison of the groundwater results to the BC Approved and Working Water Quality Guidelines (BC AL, BC IW, and BC LW) in addition to the CSR standards is considered a conservative approach, particularly for the protection of aquatic life. As per ENV (2017), the CSR AW standards apply to groundwater that is more than 10 m inland from the high-water mark of aquatic receiving environments, and the BC AL guidelines apply below the high-water mark. For the area between 10 m inland and the high-water mark, "concentration limits are not specified" (ENV 2017). Given that numerous aquatic receiving environments (e.g., streams) exist throughout the project area, an investigation to confirm sample points relative to the high-water mark has not been completed, results were compared to both the BC AL and CSR AW.

#### **Drinking Water**

For drinking water, comparison was made to CSR DW standards as well as Health Canada DW and BC DW guidelines, as the monitoring program includes domestic wells that are used for drinking water purposes. The Health Canada DW and BC DW guideline levels are designated as either a maximum acceptable concentration (MAC) or an aesthetic objective (AO) (Health Canada 2022, ENV 2020). The MAC guidelines are health risk-based and determined based on the known health effects associated with the substance. The AO guidelines apply to those variables that adversely affect taste or the intended, typical water uses (e.g., staining of laundry) but do not pose a health hazard. For interpretation purposes, whichever guideline (Health Canada or BC) is more stringent was used and referred to as the DW guideline.

After sampling, the results from domestic supply wells were compared with the Health Canada DW and BC DW guidelines. Associated provided the well owners with a summary of any exceedances and the original laboratory report, as a courtesy for participating in the study and to notify residents of any drinking water guideline exceedances.

### 3.1.4 Comparison to Background, Reclaimed Water Quality, and Historical Data

Water quality data and guideline exceedances are assessed and interpreted by comparing them to available background water quality, reclaimed water quality, and historical data.

#### **Background Groundwater Quality**

Obtaining background water quality for the area is difficult because the irrigation area is extensive. Of the wells included in the standard monitoring program (Table 3-1), only monitoring well DMW-3 is located upgradient of the reclaimed water irrigation area. However, as described in Section 2, DMW-3 likely does not represent background water quality for most wells because it is closely tied to surface water and is installed across fractured bedrock, which has a different chemistry signature than the downgradient wells (which are generally installed in unconsolidated sand and gravel material). A review of the lithology in the area indicates that any additional monitoring wells intended as representative upgradient samples would also likely need to be installed across fractured bedrock (similar to DMW-3) because the unconsolidated sediments are very thin on the upper valley walls and are typically not water bearing.

ENV (2021c) provides regional background concentrations for select metals for the Thompson-Okanagan Region; these concentrations were used to aid in the interpretation of exceeding values (Section 3.2.2.4).

#### **Reclaimed Water Quality**

In addition to the wells listed in Table 3-1, water quality data collected for the program also included Clay Valve #4, which is at the distribution point after the MacKay Reservoir (i.e., samples reflect the quality of the reclaimed water before irrigation). This location is sampled monthly by City staff during the irrigation season, as required by the OC (MOE 2008).

In 2022, City staff collected samples at Clay Valve #4 monthly during the irrigation season (i.e., between May and September), and submitted the samples to CARO for analysis of the following parameters:

- biochemical oxygen demand;
- pH, total suspended solids, chloride, sodium, sulphate, and fluoride;
- nitrogen (ammonia-N, nitrate-N, nitrite-N, TKN, organic nitrogen, and total nitrogen);
- phosphorus (orthophosphate, dissolved phosphorus, and total phosphorus);
- total coliforms and fecal coliforms; and
- dissolved metals (including hardness; all months except June).

The Clay Valve #4 analytical list includes the parameters required under Section 8.3.4 of the OC, plus fluoride, chloride, sodium, sulphate, and dissolved metals. These were added to make the list more consistent with groundwater analyses, to aid with interpretation.

Each year, the City provides Associated with the water quality results from this location for inclusion in the water quality database.

#### **Historical Water Quality Data**

For most of the groundwater sampling locations, the dataset begins in 2011, when the groundwater monitoring program was initiated. The exceptions are DMW18-1 (first tested in 2018) and DMW-3 and MW-2 (part of a previous monitoring program conducted by ENV between 1979 and 1995). The prior program collected data for DMW-3 from 1989 to 1995 and for MW-2 from 1979 to 1995.

#### 3.1.5 Quality Assurance and Quality Control

The QA/QC measures applied as part of the sampling program included calibrating instruments before sampling, wearing nitrile gloves, and using either dedicated well equipment or thoroughly decontaminating and rinsing equipment between wells. In addition, a blind duplicate sample was collected at DMW-4. Collection and analysis of duplicate samples provides information on the combined (field and analytical) precision of the sampling and the analytical program. The individual analytical results for each analyte in each sample of the duplicate pair were compared, and the relative percent difference (RPD) value was calculated for each analyte pair as follows:

$$RPD = \left(\frac{(a-b)}{\left(\frac{a+b}{2}\right)}\right) \times 100$$

where *a* and *b* are duplicate pair values in identical units. An RPD value of 20% or less is generally considered acceptable, whereas an RPD value greater than 20% may indicate a problem with either sampling or analysis (MOE 2013a). This limit may vary depending on the analysis involved and the concentration of the analyte. The RPD value

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also tends to increase as the result approaches the detection limit. Therefore, use of this threshold is restricted to duplicate pair values that are greater than five times their detection limit (MOE 2013a).

In addition to the collection of duplicate samples, trip and field blank samples was collected. Trip blanks are deionized water in sealed containers that are provided by the laboratory. These are taken into the field and remain in sample coolers during sampling; they are not opened. Field blank samples are deionized water provided by the laboratory, but these samples are handled the same way as monitoring well samples. Bottles are filled in the field using the same procedure for the samples being collected. Laboratory analytical results for both sample types are then compared to the analytical results expected for deionized water.

### 3.2 Results and Discussion

#### 3.2.1 Guideline Exceedances

Table 3-2 identifies the parameters that exceeded the applicable drinking water, aquatic life, irrigation water, and/or livestock water guidelines and/or standards in the 2022 groundwater samples. All 2022 results, tabulated and compared with all applicable guidelines, are included in Appendix B. The original laboratory reports for 2022 are provided in Appendix D.

Table 3-2 Exceedances of Applicable Guidelines or Standards in Groundwater in 2022

Parameter	DMW-1	DMW-3	DMW-4	DMW-5	MW-2	MW11-02	MW-5	WTN 24991	WTN 39421	DMW18-1
Conductivity (field-measured)	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>		<u>X</u>			<u>X</u>	<u>X</u>
pH (field-measured)			Χ	X						
Chloride		X	<u>X</u>	X		X				
Fluoride				<u>X</u>						
Total dissolved solids	<u>X</u>	<u>X</u>	<u>X</u>	<u>x</u>	<u>X</u>	<u>X</u>			<u>X</u>	<u>X</u>
Sulphate						X				
Nitrate-N										Х
Chromium (dissolved)	<u>X</u>					Χ			X	X
Cobalt (dissolved)						X				
Lithium (dissolved)	Χ	X	Χ	X		X			X	X
Manganese (dissolved)				X	X			X		
Molybdenum (dissolved)			<u>X</u>	X		X	X	<u>X</u>		X
Selenium (dissolved)	<u>X</u>					<u>X</u>			<u>X</u>	X
Sodium (dissolved)				Χ						
Uranium (dissolved)	X			<u>X</u>		X				<u>X</u>

Notes: X indicates an exceedance of the applicable guidelines and/or standards, differentiated as follows:

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X = exceedance of the applicable drinking water guidelines/standards

X = exceedance of the applicable irrigation and/or livestock water guidelines/standards

<sup>=</sup> exceedance of the applicable aquatic life guidelines/standards

Although dissolved oxygen was below the BC aquatic life guideline in groundwater, it is not included as an exceedance in this table as dissolved oxygen in groundwater is not representative of dissolved oxygen in surface water.

The DW MAC exceedances are considered to represent the highest concern, because much of the study area is not serviced by public water supply, and domestic wells are used for consumption purposes. Exceedances of DW MAC in 2022 included:

- Cobalt (MW11-02);
- Manganese (DMW-5);
- Nitrate-N (DMW18-1);
- Selenium (DMW-1, MW11-02, WTN 39421, and DMW18-1); and
- Uranium (DMW-1, DMW-5, and MW11-02).

These parameters are discussed further in Section 3.2.2.

# 3.2.2 Comparison to Background, Reclaimed Water Quality, and Historical Data

The following sections provide a brief interpretation and historical comparison of parameters that exceeded guidelines in groundwater in 2022 (Table 3-2) and key wastewater parameters. Plots showing temporal changes in concentrations for these parameters are included in Appendix C. Historical data can be found in Associated (2018). As described in Section 3.1.4, Clay Valve #4 is the distribution point after the MacKay Reservoir (i.e., samples collected at Clay Valve #4 reflect quality of the reclaimed water before irrigation). Results from Clay Valve #4 in 2022 are provided in Appendix B (Table B-3).

#### 3.2.2.1 Routine Parameters

#### Conductivity

There are no DW, AW, or LW guidelines for conductivity. The BC IW guideline for conductivity varies based on crop type (ENV 2021b). The guideline is <700  $\mu$ S/cm for low-tolerance crops, <1,200  $\mu$ S/cm for slightly tolerant crops, <2,200  $\mu$ S/cm for moderately tolerant crops, <3,600  $\mu$ S/cm for tolerant crops, and <5,000  $\mu$ S/cm for very tolerant crops. In 2022, conductivity exceeded the BC IW guideline for low-tolerance crops in all wells except MW-2, MW-5, and WTN 24991 (Figure C-1 [Appendix C]). Conductivity also exceeded the BC IW guideline for slightly tolerant crops in DMW-5 and MW11-02. All conductivity results met the guidelines for moderately tolerant, tolerant, and very tolerant crops. Between 2011 and 2019, conductivity levels in DMW-1 and DMW-5 had been increasing. From 2020 to 2022, they decreased to levels similar to those first measured in 2011. Conductivity was not measured in Clay Valve #4 (and is not required, according to the OC).

#### pН

In 2022, field-measured pH (Figure C-2) in DMW-4 and DMW-5 was slightly below the DW AO guideline range (7.0–10.5). All other pH guidelines were met in 2022. In 2022, laboratory-measured pH in Clay Valve #4 water ranged from 7.5 to 8.1.

### **Chloride**

Anthropogenic sources of chloride to the environment include road salt, industrial activities, municipal wastewater, leachate from refuse disposal sites, and fertilizers (MOE 2003). The DW AO and CSR DW for chloride is 250 mg/L, the BC and CSR IW is 100 mg/L, the BC LW and AW is 600 mg/L, and the CSR AW is 1,500 mg/L.

<sup>&</sup>lt;sup>9</sup> <u>Low-tolerance crops</u> include strawberry, raspberry, bean, and carrot; <u>slightly tolerant crops</u> include all other fruits and berries, corn, sweet corn, onion, parsnip, radish, pea, pumpkin, lettuce, pepper, muskmelon, sweet potato, potato, celery, cabbage, kohlrabi, cauliflower, cowpea, broadbean, flax, sunflower, and clover; <u>moderately tolerant crops</u> include spinach, cantaloupe, cucumber, tomato, squash, Brussel sprout, broccoli, turnip, brome, alfalfa, big trefoil, beardless wildrye, vetch, timothy, and crested wheatgrass (ENV 2021b).



In 2022, chloride concentrations (Figure C-3) exceeded the BC and CSR IW of 100 mg/L in DMW-3, DMW-4, DMW-5, and MW11-02. Chloride concentrations in DMW-5 were elevated with respect to other wells and generally increased between 2011 and 2016, but have decreased since then and met the DW AO in 2021 and 2022 for the first time in several years. Chloride concentrations in DMW-3 were higher than in all other wells in 2013 and 2014, but have generally decreased since that time. In DMW-4, chloride peaked in 2013 and has been decreasing since then, remaining stable from 2017–2022. In DMW-1, chloride has been increasing over time, but remained below all applicable guidelines in 2022. In other wells, chloride has generally remained stable or decreased since monitoring began.

Chloride in Clay Valve #4, which was tested in 2003 and 2015-2022, has remained relatively consistent, ranging from 75.9 to 175 mg/L, with an average of 93.6 mg/L. The maximum concentration of 175 mg/L occurred in July 2003 and is inconsistent with other results, which have remained less than 105 mg/L. Given that concentrations are lower in the reclaimed water and in wells other than DMW-5, the elevated concentrations in this well are likely related to other sources. DMW-5 is located in a cattle pasture (i.e., near sources of manure and urea) and close to a major roadway (i.e., a source of road salt), which could contribute to the elevated chloride.

### **Fluoride**

Fluoride is naturally occurring in Canada and can reach the water supply through the degradation and erosion of fluoride-containing rocks (Health Canada 2010). The applicable guidelines range from 1.0 mg/L (CSR IW and LW) to 2.0 mg/L (BC IW).

In 2022, fluoride met the guidelines in all wells except DMW-5 (1.26 mg/L), which exceeded the CSR IW and CSR LW. Trends in fluoride have been relatively stable in all wells, with the exception of DMW-3 (upgradient of irrigation) and DMW-5, where concentrations generally increased between 2016 and 2019, but both have decreased since 2020 (Figure C-4). Concentrations in DMW-4 increased between 2016 and 2018, but have decreased since then. Both of these wells are located on the south side of the Commonage Ridge, near the MacKay Reservoir. Fluoride testing in Clay Valve #4 was previously not required as per the OC, but testing began in 2020 to support the understanding of potential impacts on groundwater, and concentrations since 2020 have ranged from <0.10 to 0.29 mg/L. The higher concentrations in DMW-5 are likely not a result of the reclaimed water.

### **Sodium**

Sodium compounds are widely present in nature and can be present in treated municipal wastewater. The DW AO and CSR DW are 200 mg/L. There are no IW, LW, or AL guidelines for sodium.

In 2022, sodium met the DW AO and CSR DW in all wells except DMW-5, where it slightly exceeded (202 mg/L). The pattern of sodium in DMW-5 is similar to that of chloride (i.e., increasing from 2011–2016, and generally stabilizing since that time) in the same well (Figure C-5). Sodium has decreased since 2014 in DMW-4 and MW-2. In other wells, it has remained relatively consistent.

Sodium in Clay Valve #4 in 2022 ranged from 87.6 mg/L to 88.4 mg/L (total) and 83.1 to 94.1 mg/L (dissolved), and the concentrations are mid-range compared to the concentrations in the wells.

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### **Sulphate**

Sulphate enters the water cycle through weathering of parent rocks, atmospheric deposition, and discharges from anthropogenic sources, such as mining operations, agricultural runoff, and municipal wastewater (MOE 2013b). The DW AO and CSR DW are 500 mg/L. The BC LW and CSR LW are 1,000 mg/L. The CSR AW is calculated based on water hardness; in this case, the standard is 3,090 mg/L for MW-2 and 4,290 mg/L for all other wells. There is no IW guideline.

In 2022, sulphate concentrations met the guidelines in all wells except MW11-02 (Figure C-6), which had a concentration of 913 mg/L and exceeded the DW AO and CSR DW but not the CSR LW or CSR AW. Historically, sulphate concentrations in MW11-02 have been approximately double the concentrations detected in other monitoring wells in the network. There is no apparent upward trend overall in MW11-02; rather, it fluctuated between 500 and 800 mg/L between 2011 and 2021; however, the 2022 concentration is the highest recorded to date. Of all sites, WTN 24991 and Clay Valve #4 generally continue to have the lowest sulphate concentrations, ranging from 68.8 mg/L to 94.3 mg/L in Clay Valve #4 in 2022. The lower concentrations of sulphate in Clay Valve #4 suggest that the concentrations in MW11-02 are unrelated to reclaimed water irrigation operations, and are likely naturally occurring or caused by other anthropogenic sources. Sulphate concentrations in the other wells have remained relatively consistent since 2011.

#### **Total Dissolved Solids**

TDS (Figure C-7) was added to the monitoring program in 2019. The DW AO and BC IW are 500 mg/L, and the BC LW is 1,000 mg/L. In 2022, TDS in all wells except artesian wells MW-5 and WTN 24991 exceeded the DW AO and BC IW guidelines. In DMW-5 and MW11-02, TDS exceeded the BC LW guideline.

### 3.2.2.2 Nitrogen

The different forms of nitrogen that make up the total nitrogen in soils and water are organic nitrogen, nitrate, nitrite, ammonia, and ammonium. A portion of the organic nitrogen in soils and shallow groundwater is converted by microbes to ammonia and ammonium through the process of mineralization. Ammonium is converted to nitrite and then nitrate through the process of microbial nitrification. Because of these processes, nitrogen in groundwater is typically found primarily as nitrate. Of the nitrogen forms, ammonia is most toxic to aquatic life, whereas nitrate is of higher concern for human health (i.e., drinking water). In addition, nitrate is an anion (negatively charged particle) and tends not to bind with clay and organic matter, both of which are also mostly negatively charged. Therefore, it can travel readily through groundwater.

### Clay Valve #4

Because inorganic nitrogen converts readily between forms, it is important to assess all forms of nitrogen in reclaimed water, including total nitrogen. The City is not specifically required to treat for nitrogen under the OC (i.e., no maximum acceptable level is specified), nor are limits set for nitrogen in reclaimed water under the MWR. However, in 2005, the treatment system at the Vernon Water Reclamation Centre was upgraded to include biological nutrient removal (BNR), which reduces the nitrogen and phosphorus content of wastewater.

Table 3-3 lists the average concentrations of key nitrogen parameters in Clay Valve #4 before BNR (pre-2006) and after BNR (i.e., 2006–2022), and the range of concentrations in 2022. The most stringent applicable guidelines are provided in Table 3-3 for context, but it is important to note that these guidelines apply to the receiving environment (i.e., groundwater and surface water), not to Clay Valve #4. In 2022, the concentrations of nitrate-N, nitrite-N, and total nitrogen were lower than the average concentrations after BNR.

As reported in Associated (2022), in the last Clay Valve #4 sample from 2021 (i.e., September 2021), all forms of nitrogen were elevated compared to the average concentration, with nitrate-N reaching a concentration of 10.9 mg/L. The nitrate-N concentration was more than 10 times the average for the year, and the reason it is elevated is unknown. Nitrate-N results were re-run by the lab, confirming that the elevated concentration was not a result of lab error (Associated 2022). The City tested nitrate-N before irrigating in 2022 (i.e., May 2022) and the result was 1.2 mg/L. The cause of the elevated nitrate in September 2021 remains unknown, as it was inconsistent with historical data.

Table 3-3 Average and 2022 Nitrogen Concentrations in Clay Valve #4

Nitrogen Form	Average Before BNR <sup>1</sup>	Average After BNR <sup>2</sup>	Average in 2022	Range in 2022	Guideline for Comparison Purposes Only
Ammonia-N (mg/L)	9.8	0.53	0.93	0.56-1.15	Drinking water: none Aquatic life <sup>3</sup> : 0.681 to 21.6 mg/L (BC); 1.3 to 18.5 mg/L (CSR)
Nitrate-N (mg/L)	2.0	1.24	0.99	0.67-1.20	Drinking water: 10 mg/L Aquatic life: 32.8 mg/L (BC); 400 mg/L (CSR)
Nitrite-N (mg/L)	0.17	0.033	0.018	<0.010- 0.031	Drinking water: 1 mg/L Aquatic life <sup>4</sup> : 0.06 to 0.60 mg/L (BC); 0.2 to 2.0 mg/L (CSR)
Total nitrogen (mg/L)	13.9	2.97	2.93	2.65-3.29	None

Notes: BNR = biological nutrient removal; CSR = Contaminated Sites Regulation. For further information on guidelines, refer to Section 3.1.3.

### Nitrogen (in Groundwater)

In 2022, ammonia-N, nitrite-N, and nitrate-N in groundwater met all applicable guidelines, except for nitrate-N in DMW18-1. Ammonia-N was detected only in MW-5 and WTN 24991, but concentrations remained below the BC AL acute guideline and CSR AW, both of which are calculated based on the sample pH and temperature. There are no DW, IW, or LW guidelines for ammonia-N. Nitrite-N was below the laboratory detection limit in all wells in 2022.

As described above, nitrogen in groundwater is most readily found as nitrate. Nitrate can occur naturally in groundwater at low levels, but it mostly results from anthropogenic sources. The local baseline concentration of nitrate is difficult to determine due to the long history of development and agriculture in the area; however, natural processes typically result in nitrate concentrations of less than 1 mg/L in groundwater in BC, and concentrations above 3 mg/L usually suggest anthropogenic effects (Gov BC 2021, Rivera 2014). Key anthropogenic sources of nitrate include agricultural activities (e.g., cattle manure, fertilizers) and human wastewater (e.g., from municipal treatment systems and private septic systems) (Health Canada 2013).

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<sup>&</sup>lt;sup>1</sup> The average is based on all available pre-2006 data, which include two samples from 1979 and samples from 1996 to 2005.

<sup>&</sup>lt;sup>2</sup> The average is based on data from 2006 to 2022.

<sup>&</sup>lt;sup>3</sup> The guideline/standard varies based on the water pH and temperature; the range for all temperatures and for pH range of 7.1 to 9.0 is shown (historical pH range for Clay Valve #4).

<sup>&</sup>lt;sup>4</sup> The guideline/standard varies based on the chloride concentration; the range based on chloride concentrations is shown.

The applicable guidelines/standards for nitrate-N range from 10 mg/L (DW MAC and CSR DW) to 400 mg/L (CSR AW). In 2022, nitrate-N concentrations in all wells except DMW18-1 (Figure C-8) met the guidelines/standards. DMW18-1 exceeded the nitrate-N DW MAC and CSR DW limits in September (12.7 mg/L). Nitrate-N in this well has fluctuated since testing began, starting at 8.59 mg/L in April 2018 and increasing to 11.9 mg/L (above the guideline) in June 2018. From 2019 until May 2022, nitrate-N decreased and appeared to have stabilized around 1 to 2 mg/L. However, in 2022, it increased from 1.48 mg/L in May to 12.7 mg/L in September. Associated collected a follow-up sample on November 24, 2022, at which time nitrate-N had decreased to 5.53 mg/L. Although the latest concentration is below the DW guideline, it is not considered to be naturally occurring.

Nitrate-N is also elevated in MW11-02 and historically exceeded the DW MAC. It has consistently decreased since early 2012, when the measured concentration was approximately 20 mg/L. In 2022, nitrate-N in MW11-02 was 8.69 mg/L and met the DW guideline.

The elevated nitrate in DMW18-1 and MW11-02 is not likely related to the use of reclaimed water, given that it is notably higher than in other monitoring locations and higher than the nitrate-N in Clay Valve #4. As described above, total nitrogen and nitrate concentrations in the reclaimed water entering the irrigation system at Clay Valve #4 have decreased since BNR was brought online. However, as discussed above, there was an elevated nitrate-N concentration in September 2021 that was above 10 mg/L.

MW11-02 is downgradient of the PRT commercial tree nursery, and elevated nitrate-N concentrations may be an indication of the use of nitrogen-based fertilizers in the nursery's operations. The general decrease in concentrations in this well since 2011 is a positive sign and may reflect on-site improvements implemented by PRT.<sup>10</sup>

DMW18-1 is a private domestic well that has experienced fluctuating and elevated nitrate levels not seen in other wells, and the source of the nitrate is unknown. There is another well located within 100 m and within the same hydrogeological unit as DMW18-1 that is tested as part of a different monitoring program for the City (Associated 2023). Nitrate-N in this well on the same day (September 14, 2022) was 0.053 mg/L (Associated 2023).

Nitrate-N concentrations in all other wells in 2022 met guidelines, but the levels in DMW-5 (2.72 mg/L), WTN 39421 (2.65 mg/L), and DMW-1 (3.29 mg/L) are likely not naturally occurring. Nitrate-N in DMW-5 has historically met guidelines but increased steadily from <1 mg/L in 2011 to >6 mg/L in 2017; however, levels have decreased since that time. In WTN 39421, nitrate has ranged from 2.11 mg/L, when it was first tested in 2017, to 2.65 mg/L in 2022. In DMW-1, nitrate has increased from 2.43 mg/L in 2011 to 3.29 mg/L in 2022.

Nitrogen flux (movement) through groundwater can vary depending on crop cover, soil texture and organic matter content, and geology and infiltration rate. In some cases, nitrate that infiltrates below the rooting zone can remain in a groundwater system for a long time. Although the reclaimed water use may be contributing somewhat to the detected nitrate levels, the fluctuations (e.g., in DMW18-1) are more likely the result of land use activities (i.e., horticulture, livestock, local residential septic fields, or lawn care products). Ongoing monitoring of nitrate at all sites, but particularly at the wells noted above, is needed.

<sup>&</sup>lt;sup>10</sup> Based on conversations with PRT in 2021, as reported in Associated (2022), they have expanded in recent years and require more liquid fertilizer, and are aware of the elevated nitrate concentrations (O. Bonnefoy, personal communication, 2021). As part of water and nutrient management, PRT has been making improvements to their irrigation management plan including further source control (i.e., testing the water before adding nitrogen fertilizer) and adding a ditch downslope of their operations to better capture runoff (O. Bonnefoy, personal communication, 2021). The ditch has been planted with willows in an effort to extract water and nutrients from the runoff before it infiltrates below the rooting zone.



## 3.2.2.3 Phosphorus

The MWR does not set standards for phosphorus for reclaimed water, and there are no applicable guidelines for phosphorus in groundwater. The BC DW AO (0.01 mg/L) and BC AL (0.015 mg/L) guidelines apply only to lakes (ENV 2020, 2021a), and the other guidelines do not specify limits for total or dissolved phosphorus. However, it is discussed in this section as it is a key wastewater parameter. As a comparison, at ground dispersal sites (septic fields), inorganic phosphorus (orthophosphate) readily adsorbs onto soil particle surfaces, reducing the likelihood of transport in groundwater.

Figures C-9 and C-10 show the concentrations of total and dissolved phosphorus in groundwater since 2011. Similar to previous years, the highest concentrations of phosphorus in 2022 were in DMW-4, at 0.274 mg/L (total) and 0.27 mg/L (dissolved), but concentrations have remained relatively consistent over the 2011–2022 monitoring period. With the exception of MW11-02, which has shown notable fluctuations in total phosphorus only, concentrations of both total phosphorus and dissolved phosphorus have remained relatively steady in all wells.

Total phosphorus in the reclaimed water at Clay Valve #4 in 2022 ranged from 0.691 to 0.922 mg/L, and dissolved phosphorus ranged from 0.685 to 0.829 mg/L, similar to previous years.

### 3.2.2.4 Metals

Exceedances of the guidelines for metals have occurred since groundwater testing began in 2011. Metals are not typically contaminants of concern in most municipal wastewaters, and the MWR sets no specific standards for metals in treated effluent. There are two possible mechanisms by which irrigation with treated effluent could influence metal concentrations in groundwater:

- 1. Metals can be added to groundwater if they are present at elevated levels in the irrigation water. To assess this condition, the City has been testing metals periodically in Clay Valve #4 samples since 2016.
- 2. Metals that are naturally present in the soil can be mobilized by the infiltration of irrigation water and may result in elevated concentrations in groundwater over time. Note, however, that the average pH of the irrigation water (at Clay Valve #4) has been typically near-neutral, and heavy metal mobilization generally tends to be more significant when the pH of the water is lower (more acidic) than the observed range (USGS 2016). Some metals, such as selenium, are mobilized more readily when the pH is higher (more alkaline) (WHO 2003).

In 2022, dissolved metals that exceeded the applicable guidelines included chromium, cobalt, lithium, manganese, molybdenum, selenium, and uranium. Exceedances of dissolved metals guidelines are common in BC, and many metals are naturally occurring. Obtaining representative upgradient samples to assess the range of background levels is difficult, as described in Section 2. Exceedances in groundwater are interpreted by comparing with the concentrations in Clay Valve #4. Regional background concentrations for the Thompson-Okanagan Region, provided in Protocol 9 for Contaminated Sites (ENV 2021c) and summarized in Table 3-4, were also used to assess potential background concentrations for the project area.

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Table 3-4 Regional Background Concentrations of Exceeding Metals for the Thompson-Okanagan Region

Parameter	Regional Background Concentration (mg/L)
Chromium	0.019
Cobalt	0.016
Manganese	7.6
Molybdenum	0.045
Lithium	0.096
Selenium	0.120
Uranium	0.087

Source: ENV 2021c

Provincial mapping (iMap BC) shows the area in which these background concentrations apply. The boundary of the applicable area encompasses all wells included in the program except MW11-02, DMW-3, DMW-4, and DMW-5. These background concentrations generally suggest that these metals can be found in the Thompson-Okanagan Region at levels above the applicable guidelines/standards. Based on the levels in Clay Valve #4 and using these regional background concentrations, all of the metals exceedances are attributed, at least in part, to background concentrations, and are discussed further below.

- Dissolved chromium (Figure C-11) was below the regional background concentration of 0.019 mg/L and met the DW and LW guidelines and standards (both 0.05 mg/L) in all wells in 2022. The concentration in DMW-1 (0.00555 mg/L) exceeded the BC IW and CSR IW (0.0049 and 0.005 mg/L) and the BC AL (0.001 mg/L). The concentrations in MW11-02, WTN 39421, and DMW18-1 exceeded the BC AL only, but none exceeded the CSR AW standard of 0.01 mg/L. These results are consistent with the findings from previous monitoring programs. Historically, the highest chromium concentration has been detected in DMW-1, where concentrations have fluctuated around 0.006 mg/L. In the other wells, concentrations have remained below 0.004 mg/L. Chromium concentrations in groundwater depend on bedrock–groundwater interactions, and the AL and IW guideline for chromium is low; therefore, it is relatively common to find naturally occurring concentrations in groundwater that are near the guideline. Also, chromium in Clay Valve #4 has been consistently below the detection limit of 0.0005 mg/L since it was first tested in 2016.
- Dissolved cobalt (Figure C-12) met guidelines in all wells in 2022, except in MW11-02 (0.00196 mg/L), where it exceeded the BC DW MAC and CSR DW (both 0.001 mg/L) but was below the regional background concentration (0.016 mg/L) and other guidelines. Similar to other parameters, cobalt has historically been elevated in MW11-02 with respect to the other wells, and concentrations have decreased since 2011. In Clay Valve #4, cobalt in 2022 ranged from 0.00031 to 0.00034 mg/L.
- Dissolved lithium (Figure C-13) exceeded the CSR DW (0.008 mg/L) in DMW-1, DMW-3, DMW-4, DMW-5, DMW18-1, and MW11-02. No wells exceeded IW, LW, or AL guidelines, which range from 0.75 mg/L to 5.0 mg/L, or the regional background concentration of 0.096 mg/L. Lithium concentrations in all wells have remained relatively consistent over time, with the exception of DMW-5, where it increased between 2011

<sup>&</sup>lt;sup>11</sup> There are separate guidelines for Cr(III) and Cr(VI). Because speciated chromium was not tested as part of the program, the most stringent value (Cr[III]) was used for comparison purposes.

- and 2015. Since 2016, it has remained relatively stable, at approximately 0.06 mg/L, and has decreased slightly since 2019. In Clay Valve #4 in 2022, dissolved lithium ranged from 0.00907 to 0.0105 mg/L.
- Dissolved manganese (Figure C-14) met guidelines and standards in all wells except DMW-5 (0.299 mg/L), MW-2 (0.0389 mg/L), and WTN 24991 (0.0809 mg/L), where it exceeded the DW AO (0.02 mg/L) but met the CSR DW (1.5 mg/L) and the regional background concentration (7.6 mg/L). DMW-5 also exceeded the DW MAC (0.12 mg/L) and IW guidelines (0.2 mg/L). None of the wells exceeded the AL guidelines. The exceedances at DMW-5, MW-2, and WTN 24991 may reflect natural conditions, as such exceedances are common for groundwater throughout the BC Interior. Although concentrations of manganese in DMW-5 have fluctuated, they have consistently been above guidelines since testing began in 2011. Since testing of manganese began in Clay Valve #4 in 2016, dissolved manganese has ranged from 0.0114 to 0.224 mg/L.
- Dissolved molybdenum (Figure C-15) exceeded the CSR IW<sup>12</sup> and BC IW (0.01 mg/L) in DMW18-1, DMW-4, DMW-5, MW11-02, MW-5, and WTN 24991 in 2022, and exceeded the BC LW (0.016 mg/L) in DMW-5. All wells met the CSR and BC DW guidelines, and all had molybdenum levels below the regional background concentration of 0.045 mg/L. Dissolved molybdenum in DMW18-1 appears to be trending upward since testing of this well began in 2018, in contrast to the other wells, where it has remained more stable. In MW-5, molybdenum peaked at 0.0143 mg/L in 2022. Historically, dissolved molybdenum has been lower in Clay Valve #4 (consistently less than 0.005 mg/L, with the exception of an elevated concentration in September 2021) than in the monitoring wells.
- Dissolved selenium (Figure C-16) exceeded the BC DW MAC, CSR DW, and BC IW (0.01 mg/L) in four wells: DMW-1, DMW18-1, MW11-02, and WTN 39421. DMW-1, MW11-02, and WTN 39421 also exceeded the CSR IW and AW of 0.02 mg/L, and DMW-1 and WTN 32421 exceeded the CSR LW of 0.03 mg/L. Concentrations in all wells were below the regional background concentration of 0.120 mg/L, and levels have generally remained stable or decreased since monitoring began. Selenium concentrations in Clay Valve #4 have remained below guidelines, with concentrations ranging from <0.00050 mg/L to 0.00091 mg/L since 2016, and at lower concentrations than in the groundwater samples. This suggests selenium is likely naturally occurring in the Vernon area.</p>
- Dissolved uranium (Figure C-17) exceeded the DW MAC and CSR DW (0.02 mg/L), IW (BC and CSR; 0.010 mg/L), and BC AL (0.0085 mg/L) in DMW-1, DMW-5, and MW11-02 in 2022. Concentrations in DMW18-1 exceeded the BC AL, BC IW, and CSR IW, but not the DW MAC, CSR AW, or CSR LW. Concentrations in all wells remained below the regional background concentration of 0.087 mg/L. Concentrations have been generally consistent over time in most wells, with a few exceptions. In MW-2 and DMW18-1, uranium has largely decreased. In MW11-02, it has fluctuated from below the MAC of 0.02 mg/L to as high as 0.0669 mg/L in 2013. In DMW-1, it has increased. The uranium exceedances may be the result of localized groundwater reacting with the parent rock material in the soil, causing dissolution of uranium. Uranium concentrations in Clay Valve #4 have remained below guidelines, ranging from 0.00124 mg/L to 0.00306 mg/L (since 2016), and at lower concentrations than in the groundwater samples.

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<sup>&</sup>lt;sup>12</sup> The CSR molybdenum standard is 0.010–0.030 mg/L, which varies with crop, soil drainage, and molybdenum-copper ratio, and refers to a note to "consult a director for further advice" (BC Reg. 253/16).

# 3.2.3 Quality Assurance and Quality Control

A duplicate sample was collected at DMW-4 in October. After values less than five times their respective detection limit were removed (Section 3.1.5), the RPD ranged from 0 to 16.1% (average 3.2%).

Results from the trip blank sample were consistent with those expected for deionized water (i.e., below detection limits). In the field blank, total and dissolved phosphorus (0.0083 and 0.0052 mg/L) were detected, but at levels less than five times their respective detection limits.

Overall, the QA/QC results indicate acceptable precision of the analytical data. Further information about the laboratory's QA/QC is provided in the laboratory reports (Appendix D).

# 4 BAILEY SPRINGS WATER QUALITY

# 4.1 Methods

# 4.1.1 Sampling Location, Frequency, and Methodology

Section 8.9 of the OC requires monthly sampling of Bailey Springs. In 2022, samples from Bailey Springs were collected monthly by City staff and submitted to CARO for analysis of the following parameters:

- pH, conductivity, chloride, and sodium;
- nitrogen (ammonia-N, nitrate-N, nitrite-N, TKN, organic nitrogen, and total nitrogen);
- phosphorus (orthophosphate, dissolved phosphorus, and total phosphorus); and
- total coliforms and fecal coliforms.

The analytical list includes the parameters required under Section 8.9 of the OC. Testing of dissolved metals was discontinued in 2020, based on the recommendations of Associated (2020). Metals are not required by the OC, and based on the results of the previous monitoring programs, there does not appear to be an effect on metals in Bailey Springs from the reclaimed water program (Associated 2020). Field-measured temperature was recorded at the time of sampling.

Each year, the City provides Associated with the water quality results from Bailey Springs for inclusion in the water quality database, and Associated compares the data to applicable guidelines and historical data.

## 4.1.2 Comparison to Guidelines and Historical Data

To assess potential risk to aquatic life receptors, results from Bailey Springs were compared with the BC AL (ENV 2021a, 2021b). CSR AW standards were not applied to surface water, as they are designed for groundwater that flows to surface water. For this reason, in many cases, the CSR AW standards apply a dilution factor and are therefore less stringent than the BC AL. The BC AL guideline represents the levels of constituents that are considered protective for aquatic life (e.g., in a stream).

For some parameters, the BC AL guideline includes two maximum levels: chronic (or long-term average) and acute (or short-term maximum). Compliance with chronic guidelines is typically assessed by calculating the average concentration over a specified period (e.g., five samples in 30 days). The chronic guidelines are more stringent than the acute guidelines because they are designed to protect aquatic life from ongoing exposure. For screening purposes, the individual measured concentrations in Bailey Springs were assessed against both the chronic and the acute AL guidelines.

Results from Bailey Springs were also compared with the BC Recreational Water Quality Guidelines (BC REC) (ENV 2019), as the outflow to Kalamalka Lake is located next to a commercial campground, beach area, and boat launch (Figure 1-1).

### 4.2 Results and Discussion

### 4.2.1 Guideline Exceedances

In 2022, all tested parameters in Bailey Springs met the BC AL and/or BC REC guidelines except for chloride (Section 4.2.2). All results, tabulated and compared with guidelines, are included in Appendix B. The sample point for Bailey Springs is downstream of where the creek crosses Highway 97 and is within an agricultural area.

## 4.2.2 Comparison to Historical Data

Bailey Springs has been tested since 1976; therefore, there is a significant historical dataset. The following sections provide a brief interpretation and historical comparison of parameters that exceeded guidelines in Bailey Springs in 2022 and/or are considered key parameters of interest for reclaimed water. Plots showing temporal changes in concentrations for these parameters are included in Appendix C. Historical data are found in Associated (2018).

### 4.2.2.1 Chloride

In 2022, chloride concentrations at Bailey Springs met the BC acute AL guideline of 600 mg/L but exceeded the BC chronic AL guideline of 150 mg/L in 5 of the 12 months it was tested in 2022. There are no BC REC guidelines for chloride. Historically, chloride concentrations at Bailey Springs increased from 1980 (<50 mg/L) to 2013 (239 mg/L) (Figure C-18). However, since 2013, concentrations have decreased (Figure C-19) and have been mostly below all guidelines. As a comparison, chloride in the irrigation water at Clay Valve #4 has averaged 93.6 mg/L since testing began.

# 4.2.2.2 Nitrogen

In 2022, nitrite-N was not detected in Bailey Springs.

Nitrate-N ranged from 0.028 mg/L (in August) to 0.756 mg/L (in March), and all concentrations remained well below the BC chronic and acute AL of 3.0 and 32.8 mg/L, respectively, and the BC REC guideline of 10 mg/L. Nitrate-N concentrations have been relatively consistent in Bailey Springs over time (Figure C-20).

Ammonia-N in Bailey Springs was below the laboratory detection limit in 9 of the 12 months it was tested in 2022. It was detected only in June, August, and December, when it ranged from 0.051 mg/L (June) to 0.064 mg/L (December). These levels remained an order of magnitude lower than the BC AL chronic guideline for ammonia-N, which is calculated for each sample based on the water pH and temperature. Similar to nitrate, concentrations of ammonia-N have remained relatively stable over the period of record, although concentrations have increased slightly since 2017 (Figure C-21).

### 4.2.2.3 Phosphorus

Phosphorus is not toxic to aquatic life in the concentrations found in municipal effluent; however, compared to other macronutrients required by aquatic plants, phosphorus is the least abundant and commonly the first nutrient to limit biological productivity (e.g., algal growth). It is a concern primarily for lakes, where an increase in phosphorus inputs can lead to increased algal growth that can sometimes lead to reduced dissolved oxygen levels in water to levels that are harmful to aquatic life. There are no BC AL or REC guidelines for phosphorus in streams because there are other factors (e.g., flow velocity, light, temperature, and invertebrate grazing pressure) that affect algal growth.

Bailey Springs flows into Kalamalka Lake, so the concern is whether the spring contributes phosphorus-elevated water to the lake. The BC AL for total and dissolved phosphorus applies to lakes, and the guideline states that it is not possible to specify a single acceptable phosphorus concentration to protect aquatic life, but it suggests a range of 0.005 to 0.015 mg/L (ENV 2021a). Furthermore, ENV has proposed a Water Quality Objective (WQO) for total phosphorus in Kalamalka Lake of 0.008 mg/L (MOE 2001). The BC REC guideline for total and dissolved phosphorus in lakes is 0.01 mg/L.

In 2022, total and dissolved phosphorus in Bailey Springs were higher than the Kalamalka Lake WQO, BC AL, and BC REC during all months of the year except December. In December, total and dissolved phosphorus exceeded only the BC AL and Kalamalka Lake WQO. These are not considered exceedances because the guidelines do not apply to streams. Total phosphorus in Bailey Springs in 2022 ranged from 0.0733 mg/L (in December) to 0.182 mg/L (in September), and dissolved phosphorus ranged from 0.0673 mg/L (in December) to 0.152 mg/L (in September). Total and dissolved phosphorus in Bailey Springs increased between 1976 and 2001; since that time, concentrations have been more stable (Figure C-22 and C-23).

Before 2006, when the treatment process was improved to include BNR, the average concentration of total (Figure C-24) and dissolved (Figure C-25) phosphorus in the irrigation water at Clay Valve #4 was 3.66 and 3.26 mg/L, respectively. Since 2006, total and dissolved phosphorus concentrations have averaged 1.35 and 1.81 mg/L, respectively. In 2022, total phosphorus in Clay Valve #4 ranged from 0.691 to 0.922 mg/L, and dissolved phosphorus ranged from 0.685 to 0.829 mg/L. These levels are slightly lower than in 2019, 2020, and 2021.

The increasing trend noted in total and dissolved phosphorus in Bailey Springs from 1976 to the early 2000s may be related to reclaimed water use, as concentrations in Clay Valve #4 water were historically higher. Concentrations appear to be more stable over the past 10 years, possibly relating to the improved treatment processes since 2006, but statistical trend analysis has not been completed. Furthermore, it is difficult to ascertain the source of the phosphorus in Bailey Springs in more recent years, as it is in the reclaimed water use area and downstream of the MacKay Reservoir, but also within an agricultural area, where cattle are present and farmers may use phosphorus fertilizers.

#### 4.2.2.4 Coliform Bacteria

Fecal coliforms and total coliforms are tested by the City at Bailey Springs and Clay Valve #4, as per the requirements in the OC. There is no BC AL guideline for fecal coliforms or total coliforms, unless the water is used for growing and harvesting shellfish (ENV 2021a). There is also no BC REC guideline for fecal or total coliforms. The BC REC guideline for *Escherichia coli* is a maximum of  $\leq$ 400 colony-forming units (CFU) per 100 mL and a geometric mean (based on a minimum of five samples) of  $\leq$ 200 CFU/100 mL. Testing of *E. coli* at Bailey Springs is not required under the OC. <sup>13</sup>

In 2022, fecal coliforms in Bailey Springs ranged from 1 MPN/100 mL (in December) to 1,200 MPN/100 mL (in May) (Figure C-26). Total coliforms ranged from 75 MPN/100 mL (in March) to 24,200 MPN/100 mL (in August). If it was assumed that all the fecal coliforms present are *E. coli*, concentrations in May, June, July, August, and September (ranging from 435 to 1,200 MPN/100 mL) would have exceeded the BC REC guideline. Coliforms are commonly found in surface water, especially where agriculture activity and cattle are present, as at Bailey Springs.

Given that the water from Clay Valve #4 is disinfected before use and that coliform counts are generally low or below detection, elevated fecal coliforms in Bailey Springs are not attributed to the use of reclaimed water. The OC requires disinfection such that fecal coliforms are <2.2 CFU/100 mL for irrigation water in unrestricted public access areas and <200 CFU/100 mL for use in restricted public access areas (MOE 2008). In 2022, fecal coliforms were non-detectable (<1 MPN/100 mL) in all Clay Valve #4 irrigation water samples except in August (2 MPN/100 mL).

<sup>&</sup>lt;sup>13</sup> Historically, guidelines were based on fecal coliforms, which were considered an indicator of disease risk from pathogenic bacteria; more recently, guidelines have shifted to specify *E. coli*.



# 5 SUMMARY AND RECOMMENDATIONS

# 5.1 Summary

On behalf of the City of Vernon, Associated completed the 2022 groundwater monitoring program for the City's reclaimed water irrigation operations to meet Section 8.6 of OC 12215. The monitoring program in 2022 followed the program completed in previous years and consisted of groundwater sampling once in 2022 (October) from a network of monitoring wells and domestic wells, comparing the results to applicable water quality guidelines and historical data, and preparing the annual monitoring report (this document).

Under Section 8.9 of the OC, the City is also required to collect monthly samples from a surface watercourse (Bailey Springs). Data from those samples, which were collected directly by the City, were provided to Associated for inclusion in the 2022 groundwater monitoring program report. The City also provided data from Clay Valve #4, which represent the quality of the water before irrigation, to Associated to aid in interpretation.

### 5.1.1 Conceptual Model of Groundwater Flow

The conceptual model of groundwater flow in the study area can be divided into two parts: flow south of the Commonage Ridge and flow north of the Commonage Ridge. Groundwater flow south of this hydraulic divide is toward the south and is predominantly constrained to shallow surficial sediments and fractured bedrock. Groundwater eventually discharges to Kalamalka Lake. Flow north of the Commonage Ridge is more complex. Groundwater recharge occurs around Bench Row Road, as evidenced by the large influx of water at DMW-3 during freshet. Groundwater then flows toward the north, where it enters a deeper flow regime. From here, groundwater recharges the unconfined and confined valley aquifers before finally discharging to Vernon Creek and/or Okanagan Lake. Groundwater flow on the hillside is complicated by lithological units that are not laterally extensive, and perched aquifers can exist on top of some units with lower permeability.

The water chemistry of the downgradient wells further suggests variable flow paths; all of the wells along Okanagan Avenue show variable concentrations of constituents and variable water types. Data are inconsistent and, in some cases, counterintuitive. For example, deeper wells indicate younger groundwater, which suggests a shorter residence time in the aquifer, so it is possible that there is a pathway of high transmissivity (high porosity) at deeper depths. If the younger water was associated with reclaimed water irrigation, higher concentrations of nitrate-N and chloride would be expected. However, these constituents are lowest in some of these wells. The variety of groundwater types evident suggests that aquifers and lithological units are not connected throughout the study area.

### **5.1.2** Groundwater Quality

The complex hydrogeological setting north of Commonage Ridge makes it difficult to assess background water quality. All of the wells within the irrigated lands are in unconsolidated materials, but upgradient from the irrigation areas, the unconsolidated materials are too thin to host any appreciable aquifers. Therefore, upgradient monitoring wells have to be installed in the bedrock (such as DMW-3, the only current upgradient well), which can show different chemistry than wells installed in unconsolidated aquifers. However, even though background wells are difficult to install outside the irrigation area and in the unconsolidated aquifers, the results can be interpreted in several ways. Given the available water quality data, the monitoring program is likely sufficient to identify potential widespread impacts on groundwater.

Potential groundwater receptors include downgradient domestic wells and aquatic life in surface waterbodies to which groundwater may discharge. To address potential risks to these receptors, groundwater results were compared with drinking water, aquatic life, irrigation, and livestock guidelines. Of highest concern are the following parameters, which exceeded a human health-based (MAC) drinking water guideline in groundwater:

- Cobalt (MW11-02);
- Manganese (DMW-5);
- Nitrate-N (DMW18-1);
- Selenium (DMW-1, MW11-02, WTN 39421, and DMW18-1); and
- Uranium (DMW-1, DMW-5, and MW11-02).

Although it is difficult to assess background groundwater quality, it is unlikely that these exceedances are related to reclaimed water use. Cobalt, manganese, selenium, and uranium concentrations in all wells were below regional background concentrations established for the Thompson-Okanagan Region, which suggests that these parameters are naturally occurring in the Vernon area. Furthermore, the concentrations are lower in Clay Valve #4 (reclaimed water) than in the groundwater samples.

Nitrate-N in DMW18-1 has fluctuated significantly since monitoring began, ranging from around 1 to 12.7 mg/L. The cause of these fluctuations is unknown. Consistent with previous years, concentrations of nitrate in other wells met guidelines but were higher than what is likely to occur naturally (i.e., more than approximately 3 mg/L), particularly in MW11-02, DMW-1, WTN 39421, and DMW-5. Some of this nitrate may have resulted from the City irrigation program; however, the spatial variability of these above-background nitrate-N levels across the study area indicates that other localized sources are likely contributing, particularly where there are notable fluctuations. Nonetheless, the ongoing assessment of nitrate-N in groundwater remains an important component of this annual monitoring program.

Generally, concentrations of most parameters appear to be relatively consistent, but a few trends are apparent. However, they are not consistent across the monitoring program with respect to parameter or location. For example, some of the parameters that were previously noted to be increasing over time in DMW-5 appear to be stabilizing or decreasing (e.g., chloride, sodium, conductivity, lithium, and uranium). In DMW18-1, some metals (e.g., molybdenum) have increased and others (e.g., selenium and uranium) have decreased. In DMW-1, selenium has decreased, but uranium, chloride, and nitrate have increased. In MW11-02, several parameters are elevated with respect to the other wells (e.g., sulphate, nitrate, cobalt, and uranium), but trends are not consistent (e.g., sulphate and uranium have increased, and nitrate and cobalt have decreased).

### 5.1.3 Bailey Springs

Results from Bailey Springs in 2022 met applicable guidelines, with the exception of chloride. Chloride had previously exceeded chronic BC AL guidelines regularly from 2003 to 2016, but had mostly been below guidelines until 2022. Similar to previous years, dissolved and total phosphorus in Bailey Springs (which discharges to Kalamalka Lake approximately 450 m below the sampling point) consistently exceeded the WQO for Kalamalka Lake in 2022 during all months except December. Total and dissolved phosphorus in Bailey Springs increased between 1976 and 2001; since that time, concentrations have been more stable. The improved treatment processes since 2005, which resulted in reduced total and dissolved phosphorus, may have contributed to the phosphorus concentrations levelling off over the past 10 years. It is difficult to ascertain the source(s) of the phosphorus in Bailey Springs, as it is in the reclaimed water use area and downstream of the MacKay Reservoir, but also within an agricultural area, where cattle are present.

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# 5.2 Recommendations for 2023

Associated recommends that the City continue the monitoring program in 2023 to remain compliant with Sections 8.6 and 8.9 of the OC. Specifically:

- Sample groundwater annually, at the end of the irrigation season, from the same monitoring well network and for the same parameters that were tested in 2022.
- Continue to test Clay Valve #4 for chloride, sodium, sulphate, fluoride, TDS, and dissolved metals monthly
  during the irrigation season, in addition to the parameters required by the OC. These data are necessary to
  compare concentrations in groundwater.
- Test Bailey Springs for the same parameters tested in 2022, including field temperature (needed to calculate the guideline for ammonia).

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# **CLOSURE**

This report was prepared for the City of Vernon to document the results of the 2022 groundwater monitoring program for the City's reclaimed water use program.

The services provided by Associated Environmental Consultants Inc. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

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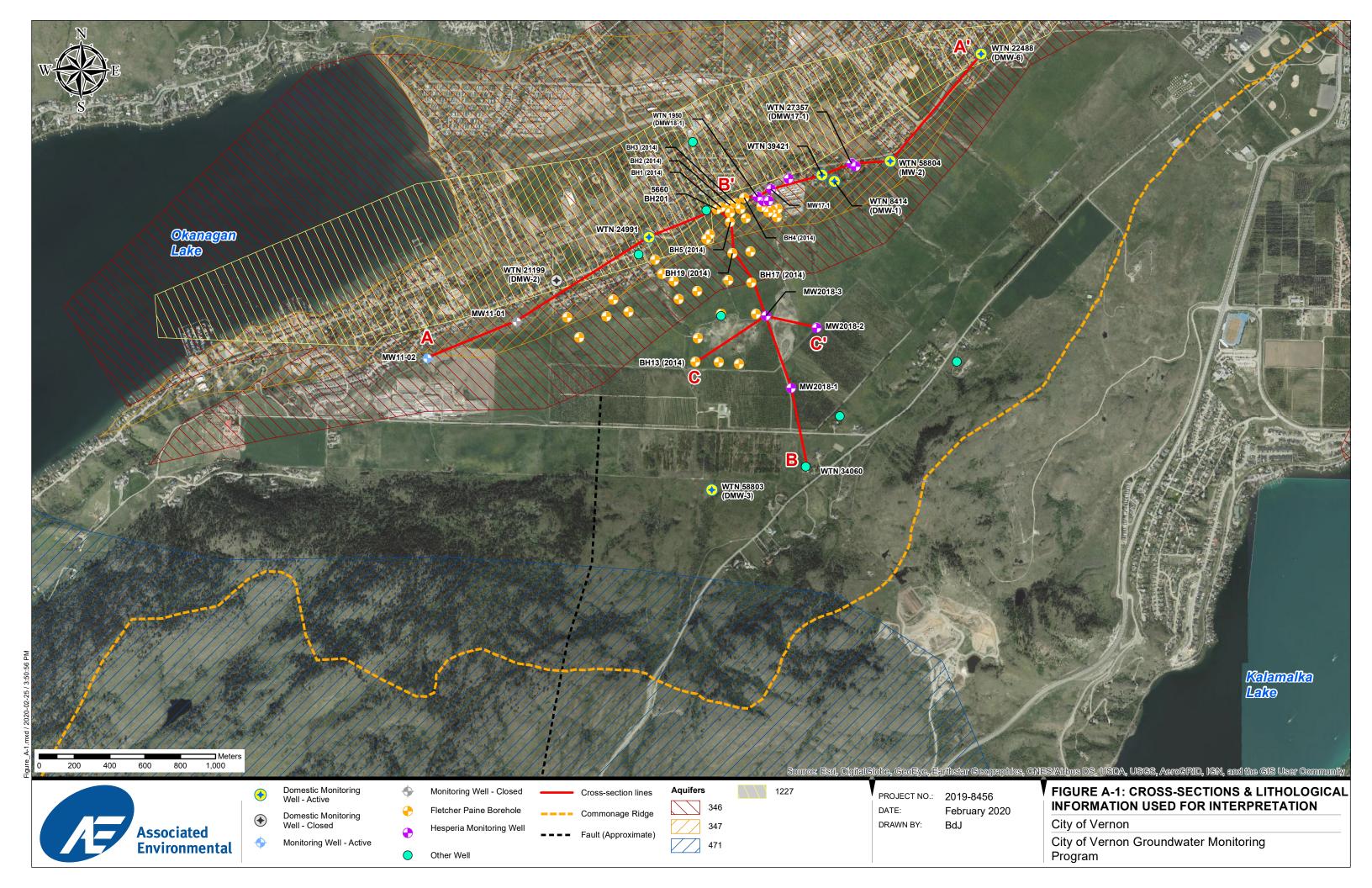
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# **APPENDIX A - CROSS-SECTIONS AND WELL LOGS**





PROJECT NO.: 2019-8456

February 2020

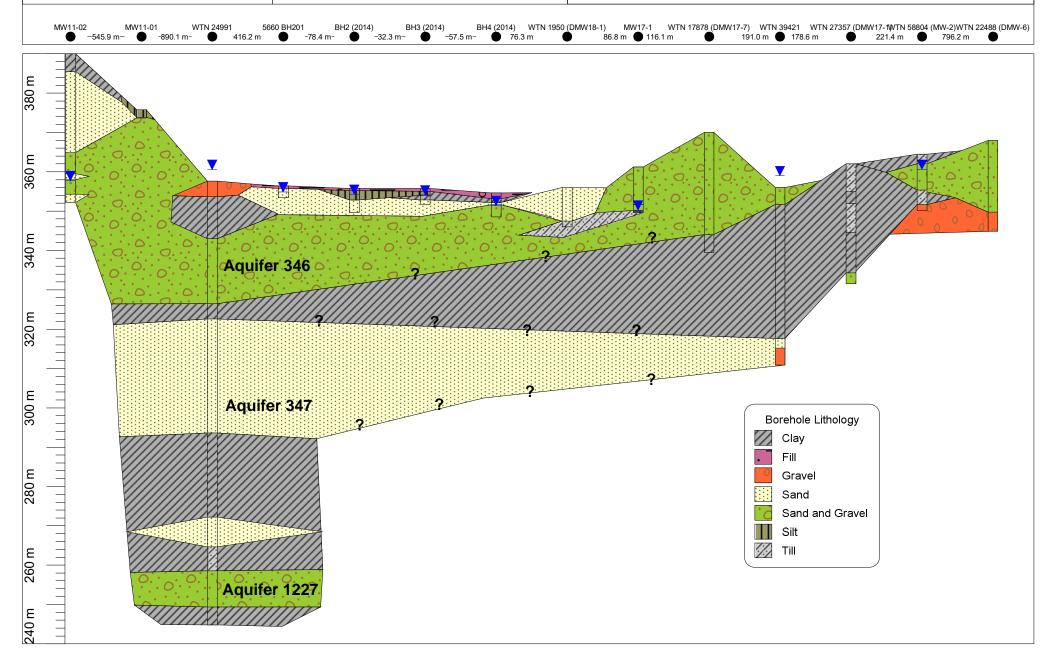
DRAWN BY: MW

DATE:



City of Vernon

2019 Spray Irrigation Monitoring





PROJECT NO.: 2019-8456.000

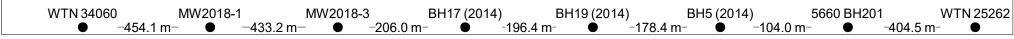
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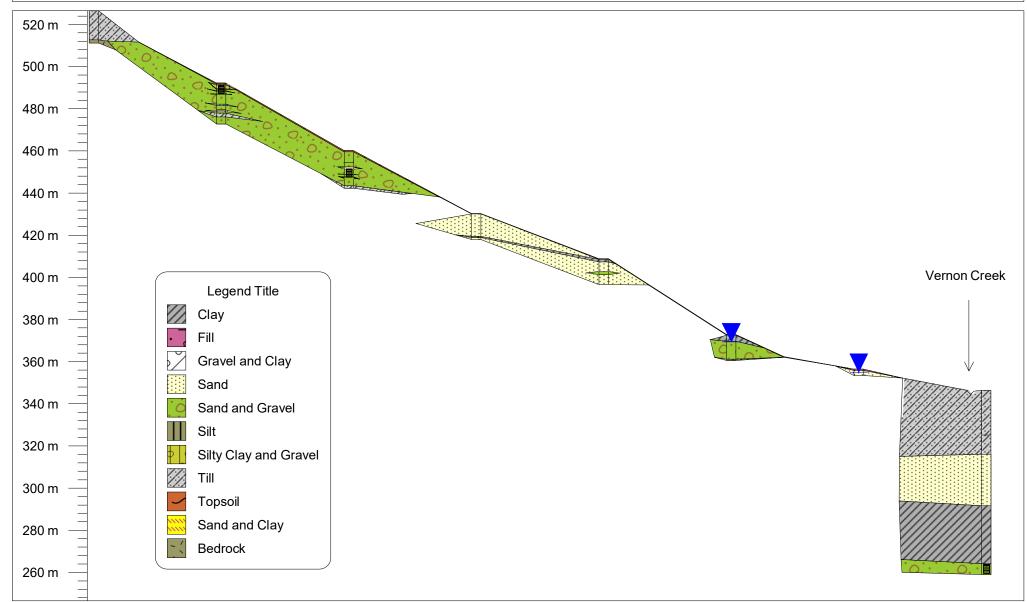
DRAWN BY: MW

FIGURE A-3: CROSS SECTION B-B'

City of Vernon

2019 Groundwater Monitoring Program - Reclaimed Water Use







PROJECT NO.: 2019-8456.000

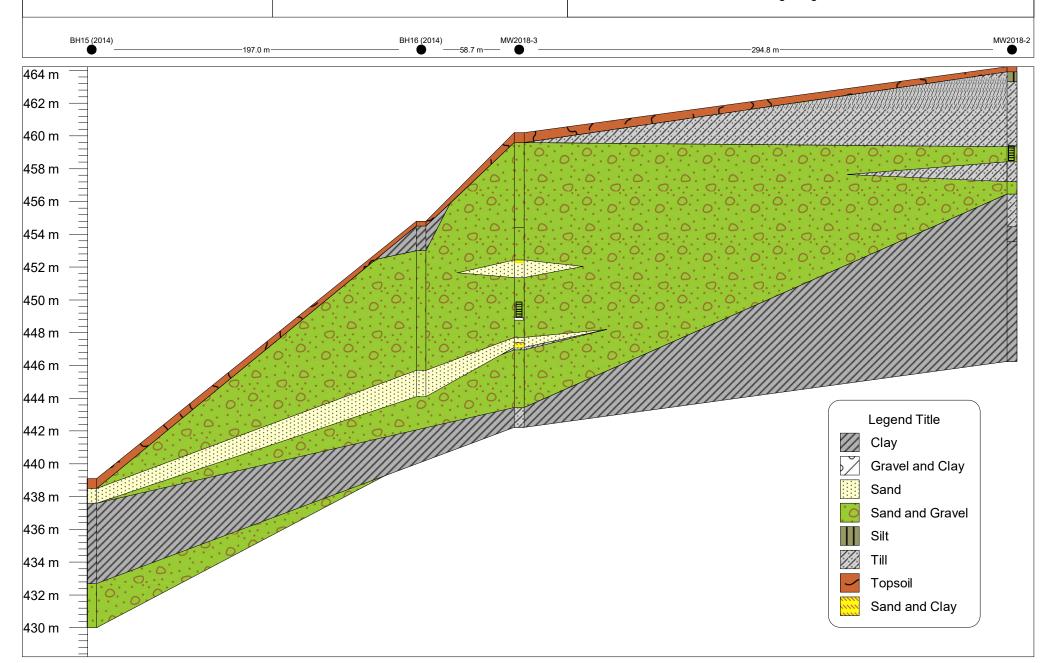
DATE: February 2019

DRAWN BY: MW

### FIGURE A-4: CROSS SECTION C-C'

City of Vernon

2019 Groundwater Monitoring Program - Reclaimed Water Use



Project No: 2010-8911.010

**Client: City of Vernon** 

Location: Okanagan Landing, Vernon, BC

Logged by/ Checked by: CDH

Test Hole / Borehole I.D.: BH11-05

Well I.D.: MW11-02

Location on site: Below PRT site

Northing/ Easting: 0

Elevation: 0

	SU	BSURFACE PROFILE		SAMPLE			WELL
Depth	Symbol	Description	Туре	I.D.	flag for analysis	Well Details	Well Completion
-5 <u>ft</u> m		Ground Surface				Monument stick-up casing protector	
5_		SILTY CLAY Dk. brown silty clay -some f-m gravel @ 7'					Bentonite Seal 0.3-1.5m
15		SAND Brown v.fm sand, trsome lt. brown silt SAND					Cuttings (clayey) 1.5-9.1m
25 9		Brown- It. brown+ tan f-c sand, tr. moist, tr. v.f. gravel -siltier section @ 30'				-slightly more silty 30-32'	Bentonite Seal 9.1-9.8m
35		SAND Lt. brown v.f-m sand, tr. silt, tr. v.c. sand, sl. moist					
55_		SAND Lt. brown v.f-m sand, tr. v.c. sand, tr. silt, drysome f. gravel, well rounded, dry.				- f. gravel 52-55'	Bentonite Seal 15.2-15.8m
		SAND Tan-brown f-m sand, tr. c sand, tr. silt, sl. moist -dry, less silt					



Contractor: Kel Drilling Date: Oct. 15, 2011

Operator(s): Kelvin Marte Time:

Drill Method: ODEX Temperature:
Ground conditions: clay over sand Sheet: 1 of 2

Project No: 2010-8911.010

**Client: City of Vernon** 

Location: Okanagan Landing, Vernon, BC

Logged by/ Checked by: CDH

Test Hole / Borehole I.D.: BH11-05

Well I.D.: MW11-02

Location on site: Below PRT site

Northing/ Easting: 0

Elevation: 0

	SU	BSURFACE PROFILE		SAMPLE	1		WELL
Depth	Symbol	Description	Type	I.D.	flag for analysis	Well Details	Well Completion
75 85 95 29		SAND Brown-lt. brown v.f-m sand, some silt, moist - some-tr. f-gravel, dry  SAND Lt. brown -brown v.f-m sand, trsome f. gravel  SAND + GRAVEL Lt. brown f-c sand + f. gravel, coated gravels				- moist silt, not wet 68'  - granule - v.f. gravel 71- 73'  - f-c sand + f gravel 83-84'  - moist, coated sands and gravels 98-100'	Bentonite Seal 21.3-21.9m  Bentonite Seal 27.1-28.3m  Silica Sand 28.3-34.6m
105		Lt. brown f-v.c. sand, some f. gravel  SAND + GRAVEL Brown f-v.c. sand + f. gravel - some gravel moist -wet  SILTY SAND Blue-brown silty f-c sand, loss of water in return  End of Borehole				Drilled using ODEX 4" casing with NWJ rods, 10' lengths. Rental 175-400 compressor pushing under 400 cfm.	Screen Interval 31.5-34.6m



Contractor: Kel Drilling Date: Oct. 15, 2011

Time:

Operator(s): Kelvin Marte

Drill Method: ODEX Temperature:
Ground conditions: clay over sand Sheet: 2 of 2

# DMW18-1



# Report 1 - Detailed Well Record

Well Tag Number: 1950	Construction Date: 1940-01-01 00:00:00
Owner: L FUHR	Driller: Unknown
	Well Identification Plate Number:
Address:	Plate Attached By:
	Where Plate Attached:
Area: VERNON	
	PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:	Well Yield: 0 (Driller's Estimate)
OSOYOOS (ODYD) Land District	Development Method:
District Lot: Plan: Lot:	Pump Test Info Flag: N
Township: Section: Range:	Artesian Flow:
Indian Reserve: Meridian: Block:	Artesian Pressure (ft):
Quarter:	Static Level: 20 feet
Island:	
BCGS Number (NAD 83): 082L024144 Well: 45	WATER QUALITY:
	Character:
Class of Well:	Colour:
Subclass of Well:	Odour:
Orientation of Well:	Well Disinfected: N
Status of Well: New	EMS ID:
Licence General Status: UNLICENSED	Water Chemistry Info Flag:
Well Use: Private Domestic	Field Chemistry Info Flag:
Observation Well Number:	Site Info (SEAM):
Observation Well Status:	
Construction Method: Dug	Water Utility:
Diameter: 0.0 inches	Water Supply System Name:
Casing drive shoe:	Water Supply System Well Name:
II	II II

```
Well Depth: 28 feet
Elevation: 0 feet (ASL)
                                         SURFACE SEAL:
Final Casing Stick Up: inches
                                         Flag: N
Well Cap Type:
                                         Material:
Bedrock Depth: feet
                                         Method:
Lithology Info Flag: N
                                         Depth (ft):
File Info Flag: N
                                         Thickness (in):
Sieve Info Flag: N
Screen Info Flag: N
                                         WELL CLOSURE INFORMATION:
                                         Reason For Closure:
Site Info Details:
                                         Method of Closure:
Other Info Flag:
                                         Closure Sealant Material:
Other Info Details:
                                         Closure Backfill Material:
                                          Details of Closure:
                                                Slot Size
Screen from
                to feet
                                Type
                                                                Drive Shoe
Casing from
                to feet
                                Diameter
                                                Material
GENERAL REMARKS:
LITHOLOGY INFORMATION:
From
                     28
             to
                                 SANDY CLAY
             Ft.
From
             to
                      0
                                 HARDPAN, WATER ON TOP OF
28
             Ft.
                                HARDPAN
```

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DMW-1



# Report 1 - Detailed Well Record

Well Tag Number: 8414	Construction Date: 1950-01-01 00:00:00
Owner: W E DOUGLAS	Driller: Unknown
	Well Identification Plate Number:
Address:	Plate Attached By:
	Where Plate Attached:
Area:	
	PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:	Well Yield: 0 (Driller's Estimate)
OSOYOOS (ODYD) Land District	Development Method:
District Lot: Plan: Lot:	Pump Test Info Flag:
Township: Section: Range:	Artesian Flow:
Indian Reserve: Meridian: Block:	Artesian Pressure (ft):
Quarter:	Static Level: 3 feet
Island:	
BCGS Number (NAD 83): 082L024144 Well: 5	WATER QUALITY:
	Character:
Class of Well:	Colour:
Subclass of Well:	Odour:
Orientation of Well:	Well Disinfected: N
Status of Well: New	EMS ID:
Licence General Status: UNLICENSED	Water Chemistry Info Flag:
Well Use: Private Domestic	Field Chemistry Info Flag:
Observation Well Number:	Site Info (SEAM):
Observation Well Status:	
Construction Method: Dug	Water Utility:
Diameter: 0.0 inches	Water Supply System Name:
Casing drive shoe:	Water Supply System Well Name:

```
Well Depth: 8 feet
Elevation: 0 feet (ASL)
                                          SURFACE SEAL:
Final Casing Stick Up: inches
                                          Flag:
Well Cap Type:
                                          Material:
Bedrock Depth: feet
                                          Method:
Lithology Info Flag:
                                          Depth (ft):
File Info Flag:
                                          Thickness (in):
Sieve Info Flag:
Screen Info Flag:
                                          WELL CLOSURE INFORMATION:
                                          Reason For Closure:
Site Info Details:
                                          Method of Closure:
Other Info Flag:
                                          Closure Sealant Material:
Other Info Details:
                                          Closure Backfill Material:
                                          Details of Closure:
Screen from
                to feet
                                                 Slot Size
                                 Type
                                                                 Drive Shoe
Casing from
                to feet
                                 Diameter
                                                 Material
GENERAL REMARKS:
LITHOLOGY INFORMATION:
                  0 Ft.
         0 to
                         NO LOG- SOIL, CLAY & ROCK
```

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DMW-3

### Report 1 - Detailed Well Record

Construction Date: 1989-05-12 00:00:00.0 Well Tag Number: 58803 Driller: Dan Gare Drilling Owner: CITY OF VERNON Well Identification Plate Number: Plate Attached By: Address: BENCH ROW RD Where Plate Attached: PRODUCTION DATA AT TIME OF DRILLING: Area: VERNON Well Yield: 0 (Driller's Estimate) WELL LOCATION: Development Method: OSOYOOS (ODYD) Land District Pump Test Info Flag: District Lot: Plan: Lot: Artesian Flow: Township: 9 Section: 20 Range: Artesian Pressure (ft): Indian Reserve: Meridian: Block: Static Level: 10 feet Quarter: SW Island: WATER QUALITY: BCGS Number (NAD 27): 082L024142 Well: 12 Character: Colour: Class of Well: Odour: Well Disinfected: N Subclass of Well: Orientation of Well: EMS ID: Status of Well: New Water Chemistry Info Flag: Well Use: Private Domestic Field Chemistry Info Flag: Site Info (SEAM): Observation Well Number: Observation Well Status: Construction Method: Drilled Water Utility: Water Supply System Name: Diameter: 6.0 inches Casing drive shoe: Water Supply System Well Name: Well Depth: 19 feet Elevation: 0 feet (ASL) SURFACE SEAL: Final Casing Stick Up: inches Flag: Well Cap Type: Material: Bedrock Depth: 6 feet Method: Lithology Info Flag: Depth (ft): File Info Flag: Thickness (in): Sieve Info Flag: Screen Info Flag: WELL CLOSURE INFORMATION: Reason For Closure: Site Info Details: Method of Closure: Other Info Flag: Closure Sealant Material: Other Info Details: Closure Backfill Material: Details of Closure: Screen from Slot Size to feet Type to feet Diameter Material Drive Shoe Casing from GENERAL REMARKS: MONITOR WELL LITHOLOGY INFORMATION: From 0 to 6 Ft. SANDY CLAY, RED 10 Ft. 6 to BROKEN BEDROCK From From 10 to 19 Ft. FRACTURED BEDROCK

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### DMW-6

# **Report 1 - Detailed Well Record**

```
Well Tag Number: 22488
                                          Construction Date: 1969-06-18 00:00:00
Owner: PAUL WARWICK
                                          Driller: Pacific Water Wells
                                          Well Identification Plate Number:
Address: OK AVENUE
                                          Plate Attached By:
                                          Where Plate Attached:
Area: VERNON
                                          PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:
                                          Well Yield: 30 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
OSOYOOS (ODYD) Land District
                                          Development Method:
District Lot: Plan: B3911 Lot:
                                          Pump Test Info Flag:
Township: 9 Section: 28 Range:
                                          Artesian Flow:
Indian Reserve: Meridian: Block:
                                          Artesian Pressure (ft):
Quarter: NW
                                          Static Level: 32 feet
Island:
BCGS Number (NAD 83): 082L024322 Well: 38 WATER QUALITY:
                                          Character:
Class of Well:
                                          Colour:
Subclass of Well:
                                          Odour:
Orientation of Well:
                                          Well Disinfected: N
Status of Well: New
                                          EMS ID:
Licence General Status: UNLICENSED
                                          Water Chemistry Info Flag:
Well Use: Unknown Well Use
                                          Field Chemistry Info Flag:
Observation Well Number:
                                          Site Info (SEAM):
Observation Well Status:
Construction Method: Drilled
                                          Water Utility:
Diameter: 6.0 inches
                                          Water Supply System Name:
Casing drive shoe:
                                          Water Supply System Well Name:
Well Depth: 76 feet
Elevation: 0 feet (ASL)
                                          SURFACE SEAL:
Final Casing Stick Up: inches
                                          Flag:
Well Cap Type:
                                          Material:
Bedrock Depth: feet
                                          Method:
Lithology Info Flag:
                                          Depth (ft):
File Info Flag:
                                          Thickness (in):
Sieve Info Flag:
Screen Info Flag:
                                          WELL CLOSURE INFORMATION:
                                          Reason For Closure:
Site Info Details:
                                          Method of Closure:
Other Info Flag:
                                          Closure Sealant Material:
Other Info Details:
                                          Closure Backfill Material:
```

				Details of Closure	:			
Screen	from	to	feet	Type	Slot Size			
Casing	from	to	feet	Diameter	Material	Drive Shoe		
GENERAI	L REMARKS	:						
LITHOLC	LITHOLOGY INFORMATION:							
From	0 to	60 Ft.	SANDY GRAVEL					
From	60 to	76 Ft.	GRAVEL WATER-BE.	ARING				

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### **Information Disclaimer**

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# **Report 1 - Detailed Well Record**

Well Tag Number: 58804 | Construction Date: 1989-05-12 00:00:00

Owner: CITY OF VERNON Driller: Dan Gare Drilling

Well Identification Plate Number:

Address: OKANAGAN AVE. Plate Attached By:

Where Plate Attached:

Area: VERNON

PRODUCTION DATA AT TIME OF DRILLING:

WELL LOCATION: Well Yield: 0 (Driller's Estimate)

OSOYOOS (ODYD) Land District Development Method:

District Lot: 64 Plan: 2591 Lot: B Pump Test Info Flag:

Township: 9 Section: Range: Artesian Flow:

Indian Reserve: Meridian: Block: Artesian Pressure (ft):

Quarter: Static Level: 39 feet

Island:

BCGS Number (NAD 83): 082L024144 Well: 48 WATER QUALITY:

Character:

Class of Well:

Subclass of Well: Odour:

Orientation of Well: Well Disinfected: N

Status of Well: New EMS ID:

Licence General Status: UNLICENSED | Water Chemistry Info Flag:

Well Use: Private Domestic || Field Chemistry Info Flag:

Observation Well Number: ||Site Info (SEAM):

Observation Well Status:

Well Depth: 47 feet

Construction Method: Drilled | Water Utility:

Diameter: 6.0 inches | Water Supply System Name:

Casing drive shoe: | Water Supply System Well Name:

Elevation: 0 feet (ASL) SURFACE SEAL:

Final Casing Stick Up: inches Flag: Well Cap Type: Material: Bedrock Depth: feet Method: Lithology Info Flag: Depth (ft): File Info Flag: Thickness (in): Sieve Info Flag: Screen Info Flag: WELL CLOSURE INFORMATION: Reason For Closure: Site Info Details: Method of Closure: Other Info Flag: Closure Sealant Material: Other Info Details: Closure Backfill Material: Details of Closure: Screen from to feet Slot Size Type Casing from to feet Diameter Material Drive Shoe GENERAL REMARKS: LITHOLOGY INFORMATION: From 0 to 8 Ft. CLAY & ROCKS From SAND & GRAVEL, RED 8 to 30 Ft. From 30 to 42 Ft. CLAY & ROCKS COARSE GRAVEL 42 to 47 Ft. From

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#### Report 1 - Detailed Well Record

```
Well Tag Number: 39421
                                         Construction Date: 1978-03-28 00:00:00
Owner: CROWN VILLA MHP - CAROL GOLDSTONE Driller: Okanagan Rotary Well Drilling
                                        Well Identification Plate Number: 10073
Address: 6080 OKANAGAN AVE
                                        Plate Attached By: MIKE KAPINIAK
                                         Where Plate Attached: WELL CASING
Area: VERNON
                                         PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:
                                        Well Yield: 80 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
OSOYOOS (ODYD) Land District
                                        Development Method:
District Lot: 62 Plan: 4685 Lot: 1
                                        Pump Test Info Flag: N
                                        Artesian Flow: 3 Gallons per Minute (U.S./Imperial)
Township: Section: Range:
Indian Reserve: Meridian: Block:
                                        Artesian Pressure (ft):
Quarter:
                                        Static Level:
Island:
BCGS Number (NAD 83): 082L024144 Well: 9 WATER QUALITY:
                                        Character:
Class of Well: Water supply
                                        Colour:
Subclass of Well: Domestic
                                        Odour:
Orientation of Well:
                                        Well Disinfected: N
Status of Well: New
                                        EMS ID: E262160
Licence General Status: UNLICENSED
                                        Water Chemistry Info Flag: N
Well Use: Water Supply System
                                        Field Chemistry Info Flag:
                                        Site Info (SEAM): N
Observation Well Number:
Observation Well Status:
Construction Method: Drilled
                                        Water Utility: N
Diameter: inches
                                        Water Supply System Name: CROWN VILLA MHP WATER SYSTEM
Casing drive shoe:
                                        Water Supply System Well Name:
Well Depth: 148 feet
Elevation: 1171.3 feet (ASL)
                                        SURFACE SEAL:
Final Casing Stick Up: inches
                                        Flag: N
Well Cap Type:
                                         Material:
Bedrock Depth: feet
                                        Method:
Lithology Info Flag: Y
                                        Depth (ft):
File Info Flag: N
                                        Thickness (in):
Sieve Info Flag: N
                                        Liner from
                                                       To:
                                                                 feet
Screen Info Flag: N
                                        WELL CLOSURE INFORMATION:
Site Info Details:
                                        Reason For Closure:
Other Info Flag:
                                        Method of Closure:
```

Other	Info Deta	ails:	Closure	e Sealant Material:		
			Closure	e Backfill Material:		
			Details	of Closure:		
Screen	from	to	feet Ty	pe	Slot Size	
Casing 0	from	to 16		ameter 11	Material null	Drive Shoe null
GENERA:	L REMARKS	3:				
LITHOL	OGY INFOR	RMATION:				
From	0 to	14 Ft.	SAND & GRAVEL (DRY)	0 nothing entered		
From	14 to	23 Ft.	BROWN CLAY			
From	23 to	60 Ft.	HARD GRAYISH BLUE CLA	Y		
From	60 to	100 Ft.	SOFT LIGHT GRAY CLAY			
From	100 to	126 Ft.	VERY HARD STIFF DARK	GRAY CLAY		
From	126 to	134 Ft.	FINE SAND			
From	134 to	148 Ft.	CLEAN GRAVEL (WATER)	0 nothing entered		

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## Report 1 - Detailed Well Record

```
Construction Date: 1971-06-24 00:00:00
Well Tag Number: 24991
Owner: CLAIRMONT UTILITIES
                                          Driller: Pacific Water Wells
                                          Well Identification Plate Number: 10033
Address:
                                          Plate Attached By:
                                          Where Plate Attached:
Area: OKANAGAN LANDING
                                          PRODUCTION DATA AT TIME OF DRILLING:
WELL LOCATION:
                                          Well Yield: 30 (Driller's Estimate) U.S. Gallons per Minute
OSOYOOS (ODYD) Land District
                                         Development Method:
District Lot: 62 & 63 Plan: Lot:
                                          Pump Test Info Flag: Y
Township: Section: Range:
                                         Artesian Flow:
Indian Reserve: Meridian: Block:
                                         Artesian Pressure (ft):
Ouarter:
                                          Static Level: 8 feet
Island:
BCGS Number (NAD 83): 082L024143 Well: 44 WATER QUALITY:
                                         Character:
Class of Well: Water supply
                                          Colour:
Subclass of Well: Domestic
                                          Odour:
Orientation of Well:
                                          Well Disinfected: N
Status of Well: New
                                          EMS ID: E262182
Licence General Status: UNLICENSED
                                         Water Chemistry Info Flag: Y
Well Use: Water Supply System
                                         Field Chemistry Info Flag:
Observation Well Number:
                                         Site Info (SEAM): N
Observation Well Status:
Construction Method: Drilled
                                          Water Utility: Y
Diameter: 8 inches
                                          Water Supply System Name: CLAREMONT UTILITIES
Casing drive shoe:
                                          Water Supply System Well Name: WELL NO. 2
Well Depth: 370 feet
Elevation: 1177.8 feet (ASL)
                                         SURFACE SEAL:
Final Casing Stick Up: inches
                                         Flag: N
Well Cap Type:
                                          Material:
Bedrock Depth: feet
                                          Method:
Lithology Info Flag: Y
                                         Depth (ft):
File Info Flag: N
                                         Thickness (in):
Sieve Info Flag: N
```

```
Screen Info Flag: Y
                                           WELL CLOSURE INFORMATION:
                                           Reason For Closure:
Site Info Details:
                                           Method of Closure:
Other Info Flag:
                                            Closure Sealant Material:
Other Info Details:
                                            Closure Backfill Material:
                                            Details of Closure:
Screen from
                      to feet
                                                                 Slot Size
334
                      null
                                                                 20
null
                                                                 30
                      null
null
                                                                 50
                      null
                      355
                                                                 80
null
Casing from
                                                                 Material
                      to feet
                                           Diameter
                                                                                       Drive Shoe
                      210
                                           10
                                                                 null
                                                                                       null
                      335
                                                                 null
                                                                                       null
                                           8
GENERAL REMARKS:
 DRAWDOWN AT 1.6 X 108 TO THE 4TH. SPECIFIC CAPACITY = 2.54 USGM
LITHOLOGY INFORMATION:
From
         0 to
                  13 Ft.
                           COBBLES, GRAVEL
From
        13 to
                 48 Ft.
                           CLAY
From
        48 to
                102 Ft.
                           TIGHT GRAVEL, WATER-BEARING
From
       102 to
                115 Ft.
                           CLAY
       115 to
                           SAND, FINE SILTY
From
                210 Ft.
From
       210 to
                 280 Ft.
                           CLAY
                305 Ft.
                           SILTY SAND
       280 to
From
From
       305 to
                 325 Ft.
                           STONEY CLAY
From
       325 to
                 355 Ft.
                           SAND GRAVEL
       355 to
                 370 Ft.
From
                           CLAY, BACKFILLED TO 355'
```

- Return to Main
- Return to Search Options
- Return to Search Criteria

#### **Information Disclaimer**

The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

# APPENDIX B - TABULATED 2022 WATER QUALITY DATA

## Legend for Table B-1:

<	Less than reported detection limit
GCDWQ AO	Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives
GCDWQ MAC	Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations
BCAWQG AL (ST)	BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute)
BCWWQG AL	BC Working Water Quality Guidelines for Freshwater Aquatic Life
BCAWQG I	BC Approved Water Quality Guidelines for Irrigation
BCWWQG I	BC Working Water Quality Guidelines for Irrigation
BCAWQG L	BC Approved Water Quality Guidelines for Livestock
BCWWQG L	BC Working Water Quality Guidelines for Livestock
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
CSR AW	BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life
CSR DW	BC CSR Generic Numerical Water Standards for Drinking Water
CSR IW	BC CSR Generic Numerical Water Standards for Irrigation
CSR LW	BC CSR Generic Numerical Water Standards for Livestock
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
NG	No Guideline
GCDWQ AO	Highlighted value exceeds GCDWQ AO
GCDWQ MAC	Highlighted value exceeds GCDWQ MAC
BC SDWQG AO	Highlighted value exceeds BC SDWQG AO
BC SDWQG MAC	Highlighted value exceeds BC SDWQG MAC
CSR DW	Highlighted value exceeds CSR DW
<u>BCAWQG I</u>	Highlighted value exceeds BCAWQG I
<u>BCWWQG I</u>	Highlighted value exceeds BCWWQG I
<u>CSR IW</u>	Highlighted value exceeds CSR IW
BCAWQG L	Highlighted value exceeds BCAWQG L
BCWWQG L	Highlighted value exceeds BCWWQG L
CSR LW	Highlighted value exceeds CSR LW
BCAWQG AL (ST)	Highlighted value exceeds BCAWQG AL (ST)
BCWWQG AL	Highlighted value exceeds BCWWQG AL
CSR AW	Highlighted value exceeds CSR AW

Sampling Location DMW-1 DMW18-1 DMW18-1 DMW18-1 DMW18-1 DMW18-1 DMW-3

DMW-4

															pling Location	DMW-1	DMW18-1	DMW18-1	DMW18-1	DMW18-1	DMW18-1	DMW-3	DMW-4
															Date Sampled Lab Sample ID	06-Oct-22 22J0954-04	04-May-22 22E0627-04	04-May-22 22E0627-08	14-Sep-22 22l2067-05	14-Sep-22 22I2067-06	24-Nov-22 22K3088-02	06-Oct-22 22J0954-05	05-Oct-22 22J0983-01
														•	Sample Type	22J0954-04 Normal	Normal	Duplicate	2212067-05 Normal	Duplicate	Normal	Normal	Normal
								Guio	deline						Guillere . Jr .	110	1,0	Dap	110	Dap	110	1,0	
Analyte	Unit	GCDWQ	200,000	BC SDWQG	BC SDWQG	CCD DW	BOANNOC I	DOMINIOCI	000 114/	DOMMOC I	DOM/MOC I	CODIW	BCAWQG AL	DOMANAGO AL	CCD AW	1							1
		MAC	GCDWQ AO	MAC	AO	CSR DW	BCAWQG I	BCWWQG I	CSR IW	BCAWQG L	BCWWQG L	CSR LW	(ST)	BCWWQG AL	CSR AW								1
Field Results																							
Conductivity	µS/cm	NG	NG	NG	NG	NG	NG	700 7.1	NG	NG	NG	NG	NG	NG	NG	<u>982</u>	<u>1088</u>	<u>1088</u>	<u>1115</u>	<u>1115</u>	832	<u>1131</u>	873
Depth to Water	m	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.405	-	-	-	-	-	2.919	-
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	100.0	-	-	135	135	131.2	26.4	91.8
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	min 5 <sup>12.1</sup>	NG	NG	4.50	7.00	7.00	4.01	4.01	3.88	1.88	2.35 <b>6.95</b>
pH Temperature	°C	NG NG	7.0 - 10.5 <sup>2.1</sup>	NG NG	NG 15	NG NG	5.0 - 9.5 <sup>6.1</sup> N <sup>6.2</sup>	NG NG	NG NG	5.0 - 9.5 <sup>9.1</sup> N <sup>9.2</sup>	NG NG	NG NG	NG 19 <sup>12.2</sup>	NG NG	NG NG	7.36 14.1	7.82 10.4	7.82 10.4	7.61	7.61 12.4	7.26 12	7.01 13.8	14.3
Turbidity	NTU	N <sup>1.1</sup>	NG	N 3.1	NG	NG	N 6.3	NG	NG	N 9.3	NG	NG	N 12.3	NG	NG	0.09	0.21	0.21	0.01	0.01	0.01	0.91	0.13
Turbialty	1110	IN	140	IN IN	NO	110	IN .	110	140	IN	NO NO	140	IN	110	i i i	0.00	0.21	0.21	0.01	0.01	0.01	0.51	0.10
Lab Results																							
General																							
Alkalinity (bicarbonate, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	222	198	199	296	297	216	425	293
Alkalinity (carbonate, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (hydroxide, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (phenolphthalein, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	N <sup>13.1</sup>	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (total, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	N <sup>13.2</sup>	NG	222	198	199	296	297	216	425	293
Bromide	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.10	-	-	-	-	-	<0.10	<0.10
Chloride	mg/L	NG	250	NG	250	250 <sup>5.1</sup>	100	NG	100 8.1	600 9.4	NG	600	600 12.4	NG	1500	88.4	24.4	24.6	44.1	42.5	29.9	<u>112</u>	<u>115</u>
Fluoride	mg/L	1.5	NG	1.5	NG	1.500	2.0 <sup>6.4</sup>	NG	1.000	1.5 9.5	NG	1.000 11.1	Calc 12.5	NG	Calc 14.1	0.18	405	-			- 400	0.53	0.39
Hardness (as CaCO3), dissolved Total dissolved solids	mg/L	NG	NG 500	NG NG	NG NG	NG NG	NG NG	NG 500 <sup>7.2</sup>	NG	NG NG	NG 1000 <sup>10.1</sup>	NG	NG	NG	NG NG	532	405	411	571	572	489	620	322
Sulphate	mg/L mg/L	NG NG	500 2.2	NG	500	500 <sup>5.2</sup>	NG	NG	NG NG	1000	1000	NG 1000	NG NG	NG NG	Calc <sup>14.2</sup>	<b>807</b> 276	737 369	727 365	<b>941</b> 395	<b>929</b> 394	772 368	919 169	<u><b>669</b></u> 105
Culphate	I IIIg/L	110	500	INO INO	300	500	INO	110	110	1000	1000	1000	140	NO	Calc	270	303	303	333	334	300	109	103
Nutrients																							
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	Calc 12.6	NG	Calc 14.3	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Nitrate (as N)	mg/L	10	NG	10	NG	10 <sup>5.3</sup>	NG	NG	NG	100 9.6	NG	100 11.2	32.8 <sup>12.7</sup>	NG	400 14.4	3.29	1.46	1.48	12.7	12.6	5.53	0.224	0.684
Nitrate + Nitrite (as N)	mg/L	10 <sup>1.2</sup>	NG	NG	NG	10 5.4	NG	NG	NG	100 9.7	NG	100 11.3	NG	NG	400 <sup>14.5</sup>	3.29	1.46	1.48	-	-	-	0.224	0.684
Nitrite (as N)	mg/L	1	NG	1.0	NG	1	NG	NG	NG	10 <sup>9.8</sup>	NG	10.000	Calc 12.8	NG	Calc 14.6	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	3.40	1.46	1.48	-	-	-	0.568	1.17
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.111	-	-	-	-	-	0.344	0.490
Total organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.111	<0.0500	<0.0500	-	-	-	0.344	0.490
Orthophosphate (dissolved, as P)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.0050	-	-	-	-	-	<0.0050	0.133
Phosphorus (dissolved, by ICPMS/ICPOES)	) mg/L	NG	NG	NG	N <sup>4.1</sup>	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.264
Phosphorus (discolved APHA 4500-P)	mg/L	NG	NG	NG	N <sup>4.2</sup>	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.0162	0.0126	0.0109	0.0122	0.0119	0.0089	0.0074	0.274
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG NC	NG NG	N <sup>4.3</sup>	NG NG	NG NG	NG NG	NG	NG NG	NG NG	NG NG	NG NG	NG NG	NG NG	0.0161 7.04	5.19	- 5 20	- 662	6.62	6.17	0.0073 8.94	0.270 17.9
Potassium (dissolved)	mg/L	NG	NG	ING	NG	NG	ING	ING	NG	NG NG	NG	ING	ING	ING	NG	7.04	5.19	5.28	6.62	0.02	0.17	0.94	17.9
Dissolved Metals																							
Aluminum (dissolved)	mg/L	2.9 <sup>1.3</sup>	0.100 <sup>2.3</sup>	9.5	NG	9.500 <sup>5.5</sup>	5 <sup>6.5</sup>	NG	5.000	5 <sup>9.9</sup>	NG	5.000	Calc 12.9	NG	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (dissolved)	mg/L	0.006	NG	0.006	NG	0.006	NG	NG	NG	NG	NG	NG	NG	0.009 13.3	0.090	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic (dissolved)	mg/L	0.010 1.4	NG	0.01	NG	0.010	0.100 <sup>6.6</sup>	NG	0.100	0.025 <sup>9.10</sup>	NG	0.025	NG	NG	0.050	0.00080	0.00252	0.00251	0.00247	0.00249	0.00247	<0.00050	0.00218
Barium (dissolved)	mg/L	2.0 <sup>1.5</sup>	NG	NG	NG	1.000	NG	NG	NG	NG	NG	NG	NG	1	10.000	0.0409	0.0216	0.0209	0.0330	0.0330	0.0272	0.0321	0.0280
Beryllium (dissolved)	mg/L	NG	NG	NG	NG	0.008	NG	0.100	0.100	NG	0.100	0.100	NG	0.00013	0.0015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (dissolved)	mg/L	5	NG	5.0	NG	5.000	0.5 <sup>6.7</sup>	NG	0.500 8.2	5 <sup>9.11</sup>	NG	5.000	NG	NG	12.000	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	0.200
Cadmium (dissolved)	mg/L	0.007 1.6	NG	0.005	NG	0.005	NG	0.0051 7.3	0.005	NG	0.080 10.3	0.080	Calc 12.10	NG	Calc 14.7	0.000024	0.000016	0.000027	0.000029	0.000025	0.000025	0.000055	0.000316
Calcium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	1000	1000	NG	N 13.4	NG	103	67.5	68.2	100	102	82.8	172	90.6
Chromium (dissolved)	mg/L	0.05	NG	0.05	NG	0.050 5.6	NG	0.0049 7.4	0.005 8.3	NG	0.050 10.4	0.050 11.4	NG	0.001 13.5	0.010 14.8	0.00555	0.00130	0.00135	0.00329	0.00340	0.00215	<0.00050	<0.00050
Copper (dissolved)	mg/L	NG 2 <sup>1.7</sup>	NG 1 <sup>2,4</sup>	0.001	NG 1.0	0.020 5.8	NG	0.050 <sup>7.5</sup>	0.050	NG	NC.	1.000	0.110 <sup>12.11</sup> N <sup>12.12</sup>	NG	0.040 Calc <sup>14.9</sup>	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00039
Copper (dissolved)	mg/L	NG	0.3	2.0 <sup>3.2</sup> NG	1.0 0.3	1.500 <sup>5.8</sup> 6.500 <sup>5.9</sup>	0.200 <sup>6.8</sup> NG	NG NG	0.200 5.000 <sup>8.4</sup>	0.300 <sup>9.12</sup> NG	NG NG	0.300 NG	0.35 <sup>12.13</sup>	NG NG	NG NG	<0.00040 <0.010	0.00166 <0.010	0.00175 <0.010	0.00205 <0.010	0.00203 <0.010	0.00193 <0.010	0.00302 <0.010	0.0131 0.011
Iron (dissolved) Lead (dissolved)	mg/L mg/L	0.005 <sup>1.8</sup>	NG	0.005	NG	0.010	0.200 <sup>6.9</sup>	NG NG	0.200	0.100 <sup>9.13</sup>	NG NG	0.100	0.35 <sup>12.14</sup>	NG	Calc 14.10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.00035
Lithium (dissolved)	mg/L	0.005 NG	NG	0.003 NG	NG	0.010	0.200 NG	0.75 <sup>7.6</sup>	2.500 <sup>8.5</sup>	0.100 NG	NG	5.000	NG	NG	NG	0.00020	0.00020	0.00753	0.0107	0.0104	0.00020	0.0206	0.00033
Magnesium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	0.75 NG	2.500 NG	NG	NG	NG	NG	NG	NG	66.5	57.4	58.5	77.8	77.0	68.6	46.2	23.1
Manganese (dissolved)	mg/L	0.12 1.9	0.02 2.5	0.12	0.02	1.500 5.10	NG	0.200	0.200 8.6	NG	NG	NG	Calc 12.15	NG	NG	<0.00020	0.00065	0.00071	0.00043	0.00044	0.00049	0.00641	0.00028
Mercury (dissolved)	mg/L	0.001	NG	0.001	NG	0.001	0.0020 6.10	NG	0.200	0.0030 9.14	NG	0.002	NG	NG	0.00025	<0.00010	<0.000010	<0.00011	<0.00043	<0.00010	<0.00043	<0.00041	<0.00020
Molybdenum (dissolved)	mg/L	NG	NG	0.088	NG	0.250	0.01 6.11	NG	0.010 8.7	0.016 9.15	NG	0.050	46 12.16	NG	10.000	0.00804	0.0126	0.0126	0.0150	0.0150	0.0142	0.00787	<u>0.0136</u>
	1 2 1			1	· -	<del>-</del>	J 3.01		1 0.010		1			-								· · · · · · · · · · · · · · · · · · ·	

Sampling Location DMW-1 DMW18-1 DMW18-1 DMW18-1 DMW18-1 DMW18-1

DMW-4

														Saiii	Dillig Location	DIVIVV-1	ו-10 וייווע ן	DIVIVV 10-1	DIVIVV 10-1	ו-10 ויוועום	DIVIVV 10-1	DIVIVV-3	DIVIVV-4
															Date Sampled	06-Oct-22	04-May-22	04-May-22	14-Sep-22	14-Sep-22	24-Nov-22	06-Oct-22	05-Oct-22
														1	ab Sample ID	22J0954-04	22E0627-04	22E0627-08	2212067-05	2212067-06	22K3088-02	22J0954-05	22J0983-01
															Sample Type	Normal	Normal	Duplicate	Normal	Duplicate	Normal	Normal	Normal
								Guid	leline														
Analyte	Unit	GCDWQ MAC	GCDWQ AO	BC SDWQG MAC	BC SDWQG AO	CSR DW	BCAWQG I	BCWWQG I	CSR IW	BCAWQG L	BCWWQG L	CSR LW	BCAWQG AL (ST)	BCWWQG AL	CSR AW								
Nickel (dissolved)	mg/L	NG	NG	0.08	NG	0.080	NG	0.200	0.200	NG	1	1.000	NG	Calc <sup>13.6</sup>	Calc 14.11	0.00098	0.00101	0.00103	0.00054	0.00051	<0.00040	0.00142	0.00167
Selenium (dissolved)	mg/L	0.05	NG	0.01	NG	0.010	0.010 6.12	NG	0.020 8.8	0.0300 9.16	NG	0.030	NG	NG	0.020	0.0276	0.0100	0.0103	0.0113	<u>0.0117</u>	0.0106	0.00258	<0.00050
Silicon (dissolved, as Si)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	10.8	7.7	7.8	9.1	9.3	9.1	13.6	8.6
Silver (dissolved)	mg/L	NG	NG	NG	NG	0.020	NG	NG	NG	NG	NG	NG	Calc 12.17	NG	Calc 14.12	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (dissolved)	mg/L	NG	200	NG	NG	200 5.11	NG	NG	NG	NG	NG	NG	NG	NG	NG	49.7	54.1	54.8	73.4	75.0	64.1	70.2	111
Strontium (dissolved)	mg/L	7.0 <sup>1.10</sup>	NG	7.0	NG	2.500	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.20	0.769	0.802	1.07	1.07	0.947	1.32	0.765
Sulphur (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	103	109	112	123	125	124	58.5	37.5
Tellurium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.0008 13.7	0.003	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thorium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (dissolved)	mg/L	NG	NG	NG	NG	2.500	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (dissolved)	mg/L	NG	NG	NG	NG	0.003	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (dissolved)	mg/L	0.02	NG	0.02	NG	0.020	NG	0.010	0.010	NG	0.200	0.200	NG	0.0085	0.085	0.0214	0.00858	0.00858	<u>0.0187</u>	<u>0.0188</u>	<u>0.0124</u>	0.00521	0.00548
Vanadium (dissolved)	mg/L	NG	NG	NG	NG	0.020	NG	0.100	0.100	NG	0.100	0.100	NG	NG	NG	<0.0050	<0.0010	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc (dissolved)	mg/L	NG	5.0	3.0	5.0	3.000 5.12	1.000 6.13	NG	1.000 8.9	2.000 <sup>9.17</sup>	NG	2.000	Calc 12.18	NG	Calc 14.13	<0.0040	0.0063	0.0070	0.0069	0.0069	0.0094	0.0903	0.0221
Zirconium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014



Sampling Location DMW-4

DMW-5

MW-2

MW11-02

MW-5

WTN 24991 WTN 39421

														Sam	pling Location	DMW-4	DMW-5	MW-2	MW11-02	MW-5	WTN 24991	
															Date Sampled	05-Oct-22	05-Oct-22	06-Oct-22	06-Oct-22	06-Oct-22	06-Oct-22	05-Oct-22
															Lab Sample ID Sample Type		22J0983-02	22J0954-01	22J0954-03	22J0954-02	22J0954-06	22J0983-03
								Guid	leline						Sample Type	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal
Analyte	Unit	GCDWO	1	BC SDWOG	BC SDWQG			I					BONNOO N									
Analyte	Oilit	GCDWQ MAC	GCDWQ AO	MAC	AO	CSR DW	BCAWQG I	BCWWQG I	CSR IW	BCAWQG L	BCWWQG L	CSR LW	BCAWQG AL (ST)	BCWWQG AL	CSR AW							
Field Results		IIIAO		IIIAG	AU								, ,									
Conductivity	μS/cm	NG	NG	NG	NG	NG	NG	700 7.1	NG	NG	NG	NG	NG	NG	NG	873	1442	641	1959	371	379	832
Depth to Water	m	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	-	-	3.31	32.895	0	-	-
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	91.8	189.3	99.5	96.8	-75.0	-55.1	124.0
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	min 5 <sup>12.1</sup>	NG	NG	2.35	2.19	2.39	6.45	1.75	2.23	3.59
pH	J .	NG	7.0 - 10.5 <sup>2.1</sup>	NG	NG	NG	5.0 - 9.5 <sup>6.1</sup>	NG	NG	5.0 - 9.5 <sup>9.1</sup>	NG	NG	NG	NG	NG	6.95	6.99	7.61	7.16	9.22	7.87	7.42
Temperature	°C	NG	15	NG	15	NG	N <sup>6.2</sup>	NG	NG	N <sup>9.2</sup>	NG	NG	19 <sup>12.2</sup>	NG	NG	14.3	13.1	13.2	12.9	12.0	12.1	12.1
Turbidity	NTU	N <sup>1.1</sup>	NG	N <sup>3.1</sup>	NG	NG	N <sup>6.3</sup>	NG	NG	N <sup>9.3</sup>	NG	NG	N <sup>12.3</sup>	NG	NG	0.13	0.32	0.51	209	73.4	0.60	6.25
Lab Results																						
General General																						
Alkalinity (bicarbonate, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	297	427	165	364	69.2	187	179
Alkalinity (carbonate, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<1.0	<1.0	<1.0	<1.0	15.9	<1.0	<1.0
Alkalinity (bydroxide, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (phenolphthalein, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	N 13.1	NG	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (total, as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	N 13.2	NG	297	427	165	364	85.0	187	179
Bromide	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride	mg/L	NG	250	NG	250	250 <sup>5.1</sup>	100	NG	100 8.1	600 <sup>9.4</sup>	NG	600	600 12.4	NG	1500	109	197	5.15	<u>115</u>	8.31	1.60	43.4
Fluoride	mg/L	1.5	NG	1.5	NG	1.500	2.0 6.4	NG	1.000	1.5 9.5	NG	1.000 11.1	Calc 12.5	NG	Calc 14.1	0.41	1.26	0.29	0.25	<0.10	0.26	0.19
Hardness (as CaCO3), dissolved	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	324	577	172	1200	378	198	508
Total dissolved solids	mg/L	NG	500	NG	NG	NG	NG	500 <sup>7.2</sup>	NG	NG	1000 10.1	NG	NG	NG	NG	643	1120	<u>584</u>	1930	335	318	<u>723</u>
Sulphate	mg/L	NG	500 <sup>2.2</sup>	NG	500	500 <sup>5.2</sup>	NG	NG	NG	1000	1000 10.2	1000	NG	NG	Calc 14.2	109	259	283	913	198	83.3	320
Nutrients																						
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	Calc 12.6	NG	Calc <sup>14.3</sup>	<0.050	<0.050	<0.050	<0.050	0.281	0.116	<0.050
Nitrate (as N)	mg/L	10	NG	10	NG	10 <sup>5.3</sup>	NG	NG	NG	100 9.6	NG	100 11.2	32.8 <sup>12.7</sup>	NG	400 <sup>14.4</sup>	0.688	2.72	0.022	8.69	<0.010	<0.010	2.65
Nitrate + Nitrite (as N)	mg/L	10 1.2	NG	NG	NG	10 5.4	NG	NG	NG	100	NG	100 11.3	NG	NG	400 14.5	0.688	2.72	0.0221	8.69	<0.0100	<0.0100	2.65
Nitrite (as N)	mg/L	1	NG	1.0	NG	1	NG	NG	NG	100	NG	10.000	Calc 12.8	NG	Calc <sup>14.6</sup>	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.26	3.12	<0.0500	9.18	0.544	0.111	2.72
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.576	0.401	<0.050	0.490	0.544	0.111	0.065
Total organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.576	0.401	<0.0500	0.490	0.263	<0.0500	0.0650
Orthophosphate (dissolved, as P)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.151	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus (dissolved, by ICPMS/ICPOES)	mg/L	NG	NG	NG	N <sup>4.1</sup>	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.265	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phosphorus (total, APHA 4500-P)	mg/L	NG	NG	NG	N <sup>4.2</sup>	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.270	0.0307	0.0233	0.160	0.0407	0.0203	0.0129
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG	NG	N <sup>4.3</sup>	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.270	0.0243	0.0205	0.0257	<0.0050	0.0169	0.0126
Potassium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	18.0	11.3	3.03	11.1	5.63	3.50	7.04
Dissolved Metals																						
Aluminum (dissolved)	mg/L	2.9 <sup>1.3</sup>	0.100 <sup>2.3</sup>	9.5	NG	9.500 <sup>5.5</sup>	5 <sup>6.5</sup>	NG	5.000	5 <sup>9.9</sup>	NG	5.000	Calc 12.9	NG	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Antimony (dissolved)	mg/L	0.006	NG	0.006	NG	0.006	NG	NG	NG	NG	NG	NG	NG	0.009 13.3	0.090	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic (dissolved)	mg/L	0.010 <sup>1.4</sup>	NG	0.01	NG	0.010	0.100 <sup>6.6</sup>	NG	0.100	0.025 9.10	NG	0.025	NG	NG	0.050	0.00219	<0.00050	<0.00050	0.00062	0.00061	0.00116	0.00070
Barium (dissolved)	mg/L	2.0 <sup>1.5</sup>	NG	NG	NG	1.000	NG	NG	NG	NG	NG	NG	NG	1	10.000	0.0282	0.0691	<0.0050	0.0297	0.0315	0.0190	0.0465
Beryllium (dissolved)	mg/L	NG	NG	NG	NG	0.008	NG	0.100	0.100	NG	0.100	0.100	NG	0.00013	0.0015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (dissolved)	mg/L	5	NG	5.0	NG	5.000	0.5 <sup>6.7</sup>	NG	0.500 8.2	5 <sup>9.11</sup>	NG	5.000	NG	NG	12.000	0.199	0.120	<0.0500	0.101	<0.0500	<0.0500	<0.0500
Cadmium (dissolved)	mg/L	0.007 1.6	NG	0.005	NG	0.005	NG	0.0051 <sup>7.3</sup>	0.005	NG	0.080 10.3	0.080	Calc 12.10	NG	Calc 14.7	0.000323	0.000016	<0.000010	0.000089	0.000036	<0.000010	<0.000010
Calcium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	1000	1000	NG	N 13.4	NG	91.5	135	5.42	248	70.6	47.7	115
Chromium (dissolved)	mg/L	0.05	NG	0.05	NG	0.050 <sup>5.6</sup>	NG	0.0049 7.4	0.005 8.3	NG	0.050 10.4	0.050 11.4	NG	0.001 13.5	0.010 14.8	<0.00050	<0.00050	<0.00050	0.00199	<0.00050	<0.00050	0.00212
Cobalt (dissolved)	mg/L	NG	NG	0.001	NG	0.020 5.7	NG	0.050 7.5	0.050	NG	1	1.000	0.110 12.11	NG	0.040	0.00040	0.00023	<0.00010	0.00196	<0.00010	<0.00010	<0.00010
Copper (dissolved)	mg/L	2 <sup>1.7</sup>	1 2.4	2.0 <sup>3.2</sup>	1.0	1.500 <sup>5.8</sup>	0.200 <sup>6.8</sup>	NG	0.200	0.300 9.12	NG	0.300	N 12.12	NG	Calc 14.9	0.0132	0.00138	<0.00040	0.00191	<0.00040	<0.00040	<0.00040
Iron (dissolved)	mg/L	NG	0.3	NG	0.3	6.500 <sup>5.9</sup>	NG	NG	5.000 8.4	NG	NG	NG	0.35 12.13	NG	NG	0.010	<0.010	<0.010	<0.010	<0.010	0.212	0.027
Lead (dissolved)	mg/L	0.005 <sup>1.8</sup>	NG	0.005	NG	0.010	0.200 <sup>6.9</sup>	NG	0.200	0.100 9.13	NG	0.100	Calc 12.14	NG	Calc 14.10	0.00027	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium (dissolved)	mg/L	NG	NG	NG	NG	0.008	NG	0.75 <sup>7.6</sup>	2.500 <sup>8.5</sup>	NG	NG	5.000	NG	NG	NG	0.0184	0.0602	0.00120	0.0207	0.00534	0.00393	0.00880
Magnesium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	23.2	58.3	38.4	141	48.9	19.1	53.7
Manganese (dissolved)	mg/L	0.12 <sup>1.9</sup>	0.02 2.5	0.12	0.02	1.500 <sup>5.10</sup>	NG	0.200	0.200 8.6	NG	NG	NG	Calc 12.15	NG	NG	0.00028	0.299	0.0389	0.00025	<0.00020	0.0809	0.00208
Mercury (dissolved)	mg/L	0.001	NG	0.001	NG	0.001	0.0020 6.10	NG	0.001	0.0030 9.14	NG	0.002	NG	NG	0.00025	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (dissolved)	mg/L	NG	NG	0.088	NG	0.250	0.01 6.11	NG	0.010 8.7	0.016 <sup>9.15</sup>	NG	0.050	46 <sup>12.16</sup>	NG	10.000	0.0138	0.0179	0.00289	0.0115	0.0143	0.0104	0.00661

Sampling Location DMW-4

Date Sampled

05-Oct-22

DMW-5

05-Oct-22

MW-2

06-Oct-22

MW11-02

06-Oct-22

MW-5

06-Oct-22

WTN 24991 WTN 39421

05-Oct-22

06-Oct-22

														l	_ab Sample ID	22J0983-04	22J0983-02	22J0954-01	22J0954-03	22J0954-02	22J0954-06	22J0983-03
															Sample Type	Duplicate	Normal	Normal	Normal	Normal	Normal	Normal
								Guid	eline				-									
Analyte	Unit	GCDWQ Mac	GCDWQ AO	BC SDWQG MAC	BC SDWQG AO	CSR DW	BCAWQG I	BCWWQG I	CSR IW	BCAWQG L	BCWWQG L	CSR LW	BCAWQG AL (ST)	BCWWQG AL	CSR AW							
Nickel (dissolved)	mg/L	NG	NG	0.08	NG	0.080	NG	0.200	0.200	NG	1	1.000	NG	Calc 13.6	Calc 14.11	0.00164	0.00341	<0.00040	0.0106	<0.00040	<0.00040	0.00092
Selenium (dissolved)	mg/L	0.05	NG	0.01	NG	0.010	0.010 6.12	NG	0.020 8.8	0.0300 9.16	NG	0.030	NG	NG	0.020	<0.00050	0.00060	<0.00050	<u>0.0304</u>	<0.00050	<0.00050	<u>0.0333</u>
Silicon (dissolved, as Si)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	8.8	15.7	<1.0	13.4	8.8	10.2	13.0
Silver (dissolved)	mg/L	NG	NG	NG	NG	0.020	NG	NG	NG	NG	NG	NG	Calc 12.17	NG	Calc 14.12	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (dissolved)	mg/L	NG	200	NG	NG	200 5.11	NG	NG	NG	NG	NG	NG	NG	NG	NG	113	202	46.5	154	34.7	32.9	41.7
Strontium (dissolved)	mg/L	7.0 1.10	NG	7.0	NG	2.500	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.782	1.95	0.0328	1.72	0.813	0.493	1.15
Sulphur (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	38.5	90.7	66.3	357	105	28.7	118
Tellurium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.0008 13.7	0.003	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Thorium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (dissolved)	mg/L	NG	NG	NG	NG	2.500	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	1.000	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (dissolved)	mg/L	NG	NG	NG	NG	0.003	NG	NG	NG	NG	NG	NG	NG	NG	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (dissolved)	mg/L	0.02	NG	0.02	NG	0.020	NG	0.010	0.010	NG	0.200	0.200	NG	0.0085	0.085	0.00556	0.0242	<0.000020	0.0547	0.00678	0.00182	0.00472
Vanadium (dissolved)	mg/L	NG	NG	NG	NG	0.020	NG	0.100	0.100	NG	0.100	0.100	NG	NG	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050
Zinc (dissolved)	mg/L	NG	5.0	3.0	5.0	3.000 5.12	1.000 6.13	NG	1.000 8.9	2.000 9.17	NG	2.000	Calc 12.18	NG	Calc 14.13	0.0214	<0.0040	<0.0040	<0.0040	0.0406	<0.0040	0.0132
Zirconium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010



### 1. Notes for Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)

#### Note 1.1 for Turbidity:

Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters should meet the requirements described in GCDWQ.

For systems that use groundwater that is not under the direct influence of surface water, which are considered less vulnerable to faecal contamination, turbidity should generally be below 1.0 NTU.

For effective operation of the distribution system, it is good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU.

#### Note 1.2 for Nitrate + Nitrite (as N):

The MAC for Nitrate (as N) is 10 mg/L

#### Note 1.3 for Aluminum (dissolved):

The maximum acceptable concentration (MAC) for total aluminum in drinking water is 2.9 mg/L (2 900  $\mu$ g/L) based on a locational running annual average of a minimum of quarterly samples taken in the distribution system. (Update March 5, 2021)

#### Note 1.4 for Arsenic (dissolved):

Every effort should be made to maintain arsenic levels in drinking water as low as reasonably achievable.

#### Note 1.5 for Barium (dissolved):

Update January 24, 2020. The MAC was revised from 1.0 mg/L to 2.0 mg/L.

#### Note 1.6 for Cadmium (dissolved):

A maximum acceptable concentration (MAC) of 0.007 mg/L (7  $\mu$ g/L) is established for total cadmium in drinking water, based on a sample of water taken at the tap. (Update July 14, 2020)

## Note 1.7 for Copper (dissolved):

A maximum acceptable concentration (MAC) of 2 mg/L is established for total copper in drinking water, based on a sample of water taken at the tap. Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on Copper, June 2019.

### Note 1.8 for Lead (dissolved):

The maximum acceptable concentration (MAC) for total lead in drinking water is 0.005 mg/L ( $5 \mu \text{g/L}$ ), based on a sample of water taken at the tap and using the appropriate protocol for the type of building being sampled. Every effort should be made to maintain lead levels in drinking water as low as reasonably achievable (or ALARA). (GCDWQ: Guideline Technical Document; March, 2019)

#### Note 1.9 for Manganese (dissolved):

Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on manganese, May 2019.

### Note 1.10 for Strontium (dissolved):

Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on strontium, May 2019.

#### 2. Notes for Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

#### Note 2.1 for pH:

The operational guideline for pH is a range of 7.0 to 10.5 in finished drinking water.

#### Note 2.2 for Sulphate:

There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L. Health authorities should be notified of drinking water sources containing above 500 mg/L.

### Note 2.3 for Aluminum (dissolved):

The operational guidance (OG) value for total aluminum in drinking water is 0.100 mg/L (100 µg/L) to optimize water treatment and distribution system operations. This value is based on a locational running annual average. The sampling frequency required to calculate the locational running annual average will vary based on the type of treatment facility and the sampling location. (Update March 5, 2021)

### Note 2.4 for Copper (dissolved):

Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on Copper, June 2019.

## Note 2.5 for Manganese (dissolved):

Guidelines for Canadian Drinking Water Quality - Guideline Technical Document on manganese, May 2019.

## 3. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2020 and updates) (BC SDWQG MAC)

## General Notes:

Reference: British Columbia Ministry of Environment and Climate Change Strategy. 2020. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.

## Note 3.1 for Turbidity:

For raw drinking water without treatment for particulates the guideline is:  $\le 1 \text{ NTU}$  of turbidity.

For raw drinking water with treatment for particulates the guideline is:

Natural background turbidity is ≤ 50 NTU: Change from background should not exceed 5 NTU.

Natural background turbidity is > 50 NTU: Change from background should not exceed 10% of the background turbidity.

## Note 3.2 for Copper (dissolved):

Includes short-term and long-term exposure.

## 4. Notes for BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2020 and updates) (BC SDWQG AO)

## General Notes:

Reference: British Columbia Ministry of Environment and Climate Change Strategy. 2020. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.

## Note 4.1 for Phosphorus (dissolved, by ICPMS/ICPOES):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

## Note 4.2 for Phosphorus (total, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

## Note 4.3 for Phosphorus (dissolved, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

## 5. Notes for BC CSR Generic Numerical Water Standards for Drinking Water (CSR DW)

## **General Notes:**

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019. Drinking water standards are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total substance concentrations unless otherwise indicated.

## Note 5.1 for Chloride:

Standard to protect against taste and odour concerns.

## Note 5.2 for Sulphate:

Standard to protect against taste and odour concerns.

## Note 5.3 for Nitrate (as N):

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

## Note 5.4 for Nitrate + Nitrite (as N):

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

## Note 5.5 for Aluminum (dissolved):

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

#### Note 5.6 for Chromium (dissolved):

Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.

Standard is  $50 \mu g/L$  for chromium, hexavalent. Standard is  $6000 \mu g/L$  for chromium, trivalent. The standard of  $50 \mu g/L$  was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

#### Note 5.7 for Cobalt (dissolved):

The standard in Schedule 3.2 is 1  $\mu$ g/L. However the BC Ministry of Environment and Climate Change Strategy has set an interim background groundwater concentration estimate of 20  $\mu$ g/L for Cobalt at sites in the Province. Therefore a standard of 20  $\mu$ g/L has been used for this criteria set.

#### Note 5.8 for Copper (dissolved):

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

#### Note 5.9 for Iron (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as

(a) item A6, A7, A8 or A11

(b) item C1, C2, C3, C4 or C6,

(c) item D2, D3, D5, or D6

(d) item E4, or

(e) item H14.

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

#### Note 5.10 for Manganese (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as

(a) item B1

(b) item C1, C3 or C4

(c) item D2, D3, D5, or D6

(d) item E4, or

(e) item H3 or H14.

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

#### Note 5.11 for Sodium (dissolved):

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

#### Note 5.12 for Zinc (dissolved):

Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

### 6. Notes for BC Approved Water Quality Guidelines for irrigation (BCAWQG I)

#### **General Notes:**

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports.

#### Note 6.1 for pH:

Update August 2019 Summary Report.

#### Note 6.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

## Note 6.3 for Turbidity:

Induced turbidity should not exceed 10 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 20 % of background when background is greater than 50 NTU.

## Note 6.4 for Fluoride:

Total fluoride in irrigation water should not exceed 1.0 mg/L as a 30-day average or a maximum of 2.0 mg/L.

## Note 6.5 for Aluminum (dissolved):

The guideline maximum for total aluminum is 5 mg/L. A separate guideline for dissolved aluminum is not provided.

## Note 6.6 for Arsenic (dissolved):

The interim guideline for total arsenic is 100 μg/L.

## Note 6.7 for Boron (dissolved):

The guideline for total boron depends on the crop, and varies from 0.5 mg/L to 6 mg/L. The most stringent guideline maximum of 0.5 mg/L, for very sensitive and sensitive crops, was used to identify exceedances for this report.

## Note 6.8 for Copper (dissolved):

The guideline maximum for total copper is 200  $\mu g/L$ 

## Note 6.9 for Lead (dissolved):

For neutral and alkaline fine-textured soils the total lead concentration in irrigation water should not exceed 400  $\mu$ g/L at any time. The concentration of total lead in irrigation water for use on all other soils should not exceed 200  $\mu$ g/L at any time. The most stringent guideline maximum was used in this report.

## Note 6.10 for Mercury (dissolved):

The guideline maximum for total mercury is 2.0 μg/L.

## Note 6.11 for Molybdenum (dissolved):

The long-term chronic guidelines for total molybdenum are as follows:

Forage crops-poorly drained soil: 0.01 mg/L

Forage crops-well drained soil:  $0.02\ mg/L$ 

Non-forage crops: 0.028 mg/L. This guideline is intended to be protective of terrestrial plants and is not necessarily protective of livestock consuming these plants.

The most stringent guideline (0.01 mg/L for forage crops-poorly drained soil) has been used.

## Note 6.12 for Selenium (dissolved):

The guideline for total selenium is  $10 \mu g/L$  mean. The mean concentrations in the water column are based on at least 5 weekly samples taken over a 30-day period.

## Note 6.13 for Zinc (dissolved):

The guideline maximum for total zinc for irrigation is as follows:

- Soil pH less than 6: 1000 μg/L.
- Soil pH equal to or greater than 6, and less than 7: 2000 μg/L.
- Soil pH greater than or equal to 7: 5000 μg/L. / The most stringent guideline maximum was used in this report.

## 7. Notes for BC Working Water Quality Guidelines for Irrigation (2021) (BCWWQG I)

## General Notes:

Reference: B.C. Ministry of Environment and Climate Change Strategy. 2021. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the "Notes" for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

## Note 7.1 for Conductivity:

The guideline varies from 700 to  $5000 \,\mu\text{S/cm}$  depending on the type of crop. The most stringent guideline has been used for this report.

## Note 7.2 for Total dissolved solids:

The guideline varies from 500 to 3500 mg/L depending on the type of crop. The most stringent guideline has been used for this report.

#### Note 7.3 for Cadmium (dissolved):

This is a Short-term maximum guideline.

#### Note 7.4 for Chromium (dissolved):

The guideline for Cr(VI) is 8  $\mu g/L$  (total).

The guideline for Cr(III) is 4.9  $\mu$ g/L (total).

The guideline of 4.9  $\mu$ g/L for Cr(III) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

#### Note 7.5 for Cobalt (dissolved):

Continuous or intermittent use on all soils.

#### Note 7.6 for Lithium (dissolved):

The guideline is 2.5 mg/L for non-citrus crops (May not be protective of barley and other cereal crops; 1.0 mg/L suggested for cereal crops). The guideline is 0.75 mg/L for citrus crops. / The most stringent guideline was used in this report.

#### 8. Notes for BC CSR Generic Numerical Water Standards for Irrigation (CSR IW)

#### **General Notes:**

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019. Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered. Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.

Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for total substance concentrations. Standards apply to irrigation of all soil types, unless otherwise indicated.

There are several different standards for site-specific factors for some analytes. The most stringent standards were used for this criteria set.

#### Note 8.1 for Chloride:

Standard to protect all types of crops.

#### Note 8.2 for Boron (dissolved):

Standard varies depending on crop. This standard is for blackberry crop.

#### Note 8.3 for Chromium (dissolved):

Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.

Standard is 8  $\mu$ g/L for chromium, hexavalent. Standard is 5  $\mu$ g/L for chromium, trivalent. The standard of 5  $\mu$ g/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

#### Note 8.4 for Iron (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as

(a) item A6, A7, A8 or A11

(b) item C1, C2, C3, C4 or C6,

(c) item D2, D3, D5, or D6

(d) item E4, or

(e) item H14.

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.

#### Note 8.5 for Lithium (dissolved):

Standard to protect all types of crops.

## Note 8.6 for Manganese (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as

(a) item B1

(b) item C1, C3 or C4

(c) item D2, D3, D5, or D6

(d) item E4, or

(e) item H3 or H14.

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.

## Note 8.7 for Molybdenum (dissolved):

Standard varies with crop, soil drainage and Mo:Cu ratio. Standard is 10 – 30 μg/L. Consult a director for further advice.

The most stringent standard of 10  $\mu$ g/L has been used.

## Note 8.8 for Selenium (dissolved):

Standard varies with type of application; continuous or intermittent. This standard is for continuous applications on crops.

## Note 8.9 for Zinc (dissolved):

The standard varies (from 1000 to 5000  $\mu$ g/L) with soil pH. This standard (which is the most stringent) is for soil pH less than 6.0

## 9. Notes for BC Approved Water Quality Guidelines for livestock (BCAWQG L)

## General Notes:

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports.

## Note 9.1 for pH:

Update August 2019 Summary Report.

## Note 9.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

## Note 9.3 for Turbidity:

Induced turbidity should not exceed 5 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 10 % of background when background is greater than 50 NTU.

## Note 9.4 for Chloride:

The water quality guideline for chloride for livestock watering is 600 mg/L

## Note 9.5 for Fluoride:

The total fluoride recommendation for dairy cows, breeding stock and other long-lived animals is 1.0 mg/L as a 30-day mean and 1.5 mg/L as a maximum. Total fluoride should not exceed 2.0 mg/L as a 30-day mean or 4.0 mg/L maximum in the drinking water of all other types of livestock, unless fluoride is provided in the diet by bone meal or mineral additives, in which case 1.0 mg/L as a 30-day mean and 2.0 mg/L maximum is recommended. / The most stringent guideline maximum was used in this report.

## Note 9.6 for Nitrate (as N):

Overview Report Update, September 2009.

## Note 9.7 for Nitrate + Nitrite (as N):

The guideline maximum for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value. Overview Report Update, September 2009.

## Note 9.8 for Nitrite (as N):

Overview Report Update, September 2009.

## Note 9.9 for Aluminum (dissolved):

The guideline maximum for total aluminum is 5 mg/L. A separate guideline for dissolved aluminum is not provided.

## Note 9.10 for Arsenic (dissolved):

The interim guideline for total arsenic is 25  $\mu g/L$ 

#### Note 9.11 for Boron (dissolved):

The guideline maximum for total boron is 5 mg/L.

#### Note 9.12 for Copper (dissolved):

The guideline maximum for total copper is 300 μg/L.

#### Note 9.13 for Lead (dissolved):

The guideline maximum for total lead is 100 µg/L.

#### Note 9.14 for Mercury (dissolved):

The guideline maximum for total mercury is 3.0 μg/L.

#### Note 9.15 for Molybdenum (dissolved):

Interim guidelines for total molybdenum are based on differences in sensitivity to molybdenum exposure: 1) ruminant livestock, 0.016 mg/L; and 2) non-ruminant livestock: 0.284 mg/L. The most stringent guideline (0.016 mg/L for ruminant livestock) has been used.

#### Note 9.16 for Selenium (dissolved):

The guideline for total selenium is 30.0 µg/L mean. The mean concentrations in the water column are based on at least 5 weekly samples taken over a 30-day period.

#### Note 9.17 for Zinc (dissolved):

The guideline maximum for total zinc is 2000 µg/L.

#### 10. Notes for BC Working Water Quality Guidelines for Livestock (2021) (BCWWQG L)

#### **General Notes:**

Reference: B.C. Ministry of Environment and Climate Change Strategy. 2021. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the "Notes" for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

#### Note 10.1 for Total dissolved solids:

The guideline is 1,000-3,000 mg/L, and is species dependent. Maximum of 1000 mg/L is relatively low level of salinity; excellent for all classes of livestock. TDS between 1000 and 3000 mg/L is satisfactory for all classes of livestock and poultry, but some loss in productivity should be anticipated: may cause temporary and mild diarrhoea in livestock not accustomed to them or watery droppings in poultry. / The most stringent guideline was used in this report.

#### Note 10.2 for Sulphate:

The guideline is for dissolved sulphate.

### Note 10.3 for Cadmium (dissolved):

This is a Short-term maximum guideline.

#### Note 10.4 for Chromium (dissolved):

The guideline for Cr(VI) is 50 µg/L (total). The guideline for Cr(III) is 50 µg/L (total). The guideline of 50 µg/L for Cr(VI), and for Cr(III) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

#### 11. Notes for BC CSR Generic Numerical Water Standards for Livestock (CSR LW)

#### General Notes:

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019. Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered. Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.

Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for total substance concentrations.

### Note 11.1 for Fluoride:

Standard varies with type of livestock. Consult a director for further advice.

## Note 11.2 for Nitrate (as N):

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

## Note 11.3 for Nitrate + Nitrite (as N):

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

## Note 11.4 for Chromium (dissolved):

Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.

Standard is 50 µg/L for chromium, hexavalent. Standard is 50 µg/L for chromium, trivalent. The standard of 50 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

## 12. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute) (BCAWQG AL (ST))

## **General Notes:**

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports. / There are two types of water quality guidelines: the shortterm acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). Only the short-term acute guidelines are included in this criteria set.

## Note 12.1 for Dissolved oxygen:

The aquatic life instantaneous minimum guideline for dissolved oxygen is 5 mg/L for all life stages other than buried embryo/alevin. The instantaneous minimum guideline for dissolved oxygen in the water column is 9 mg/L for buried embryo/alevin. The instantaneous minimum guideline for dissolved oxygen in interstitial water is 6 mg/L for buried embryo/alevin. Guideline is not considered to apply to groundwater.

## **Note 12.2 for Temperature:**

The freshwater aquatic life guideline for streams with unknown fish distribution is:

Maximum daily temperature of 19 degrees Celsius;

MWMT = 18 degrees Celsius. (MWMT, mean weekly short-term temperature, is defined as the average of the warmest daily short-term temperatures for 7 consecutive days;

Hourly rate of change not to exceed 1 degree Celsius;

Short-term incubation temperature = 12 degrees Celsius (in spring and fall).

See BC MOE Overview Report for additional details for streams with unknown fish distribution, and specific guidelines for streams with known fish distribution, and guideline for lakes and impoundments.

## Note 12.3 for Turbidity:

Note 12.4 for Chloride:

Aquatic life guidelines for turbidity are:

Change from background of 8 NTU at any one time for a duration of 24 h in all waters during clear flows or in clear waters;

Change from background of 2 NTU at any one time for a duration of 30 d in all waters during clear flows or in clear waters;

Change from background of 5 NTU at any time when background is 8 - 50 NTU during high flows or in turbid waters;

## Change from background of 10% when background is > 50 NTU at any time during high flows or in turbid waters.

#### When ambient chloride concentrations exceed guidelines, increases in chloride due to human activities should be avoided. Note 12.5 for Fluoride:

The freshwater aquatic life short-term acute Interim guideline for total fluoride is as follows: If hardness is less than or equal to 10 mg/L then the guideline is 0.4 mg/L;

If hardness is greater than 10 mg/L then the guideline (in units mg/L) is based on the equation: WQG =  $[-51.73 + 92.57 \log 10 \text{ (hardness)}] \times 0.01$ .

Hardness is as CaCO3 in units mg/L.

The equation applies to water hardness (as CaCO3) between 10 - 385 mg/L, and is an interim WQG until carefully controlled experiments can determine the appropriate levels of fluoride under various combinations of water temperature and hardness. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.

To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.

#### Note 12.6 for Ammonia (total, as N):

The freshwater aquatic life short-term acute guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia for this report. If a lab pH result was not available then the field pH result was used.

#### Note 12.7 for Nitrate (as N):

Freshwater aquatic life short-term acute guideline.

### Note 12.8 for Nitrite (as N):

The freshwater aquatic life short-term acute guideline for nitrite as N is:

0.06 mg/L if chloride less than 2 mg/L

0.12 mg/L if chloride is 2 to 4 mg/L

0.18 mg/L if chloride is 4 to 6 mg/L

0.24 mg/L if chloride is 6 to 8 mg/L

0.30 mg/L if chloride is 8 to 10 mg/L

0.60 mg/L if chloride is greater than 10 mg/L.

#### Note 12.9 for Aluminum (dissolved):

Freshwater aquatic life short-term acute guideline: the maximum concentration of dissolved aluminum at any time should not exceed:

1. 0.10 mg/L when the pH is greater than or equal to 6.5

2. The value (in mg/L) determined by the following relationship if pH less than 6.5

Dissolved Aluminum = e (1.209-2.426 (pH) + 0.286 (pH)<sup>2</sup>)

#### Note 12.10 for Cadmium (dissolved):

Freshwater aquatic life short-term acute guideline: The guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for cadmium (dissolved) in  $\mu$ g/L is determined by the following equations for short term exposure:

- 1. If hardness (as CaCO3) is less than 7 mg/L then maximum is  $0.0380 \mu g/L$
- 2. If hardness (as CaCO3) is from 7 to 45 mg/L then maximum is based on equation:

e to the power of {1.03[ln(hardness)] - 5.274}

3. If hardness (as CaCO3) is greater than 455 mg/L then maximum is 2.8  $\mu$ g/L.

When water hardness is greater than the upper bound (i.e., highest water hardness tested), a site-specific assessment may be required.

#### Note 12.11 for Cobalt (dissolved):

Freshwater aquatic life short-term acute guideline.

#### Note 12.12 for Copper (dissolved):

The freshwater aquatic life short-term acute guideline is for dissolved copper and is dependent on the specific chemistry of the water body and can only be calculated using the British Columbia Biotic Ligand Model (BC BLM) software. The model requires (at a minimum), pH, hardness, and dissolved organic carbon (DOC). As DOC was not tested, the guideline could not be calculated.

#### Note 12.13 for Iron (dissolved):

Freshwater aquatic life short-term acute guideline.

#### Note 12.14 for Lead (dissolved):

The freshwater aquatic life short-term acute guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is 3  $\mu$ g/L. When water hardness exceeds 8 mg/L (as CaCO3) the short-term acute guideline ( $\mu$ g/L) is given by the following equation: exp (1.273 ln(hardness) - 1.460).

The guideline applies to water hardness up to 360 mg/L (as CaCO3). If natural levels exceed the guideline, then any allowed increase in total lead above natural levels should be based on site-specific data. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.

#### Note 12.15 for Manganese (dissolved):

The freshwater aquatic life short-term acute guideline for total manganese in mg/L is determined by the following relationship:

0.01102 hardness + 0.54

where water hardness is reported as mg/L of CaCO3.

The guideline applies to water hardness between 25 – 259 mg/L CaCO3. When water hardness is outside hardness range tested (i.e. lower or upper bound), a site-specific assessment may be required.

## Note 12.16 for Molybdenum (dissolved):

The guideline is for total molybdenum.

## Note 12.17 for Silver (dissolved):

The freshwater aquatic life short-term acute guideline for total silver is:

 $0.1\,\mu g/L$  maximum if hardness less than or equal to  $100\,m g/L$ 

 $3.0\,\mu g/L$  maximum if hardness greater than  $100\,mg/L$ 

## Note 12.18 for Zinc (dissolved):

The freshwater aquatic life short-term acute guideline for total zinc ( $\mu g/L$ ) is:

When water hardness is less than or equal to 90 mg/L as CaCO3 the guideline is 33  $\mu\text{g}/L$ ;

When water hardness exceeds 90 mg/L CaCO3, the guideline in  $\mu$ g/L for total zinc is the value determined by the following relationship:

33 + 0.75 \* (hardness - 90)

where water hardness is reported as mg/L of CaCO3.

The short-term acute guideline formula applies to water hardness between 90 – 500 mg/L CaCO3.

## 13. Notes for BC Working Water Quality Guidelines for Freshwater Aquatic Life (2021) (BCWWQG AL)

## General Notes:

Reference: B.C. Ministry of Environment and Climate Change Strategy. 2021. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the "Notes" for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

## Note 13.1 for Alkalinity (phenolphthalein, as CaCO3):

The guideline for alkalinity (total as CaCO3) is as follows:

- Less than 10 mg/L, highly sensitive to acid inputs
- 10 to 20 mg/L, moderately sensitive to acid inputs
- Greater than 20 mg/L, low sensitivity to acid inputs.

Sensitivity to acid inputs can be determined by the concentration of dissolved calcium: < 4 mg/L is highly sensitive to acid inputs; 4 to 8 mg/L is moderately sensitive; and > 8 mg/L is low sensitivity.

## Note 13.2 for Alkalinity (total, as CaCO3):

The guideline for alkalinity (total as CaCO3) is as follows:

- Less than 10 mg/L, highly sensitive to acid inputs
- 10 to 20 mg/L, moderately sensitive to acid inputs
   Greater than 20 mg/L, low sensitivity to acid inputs.

Sensitivity to acid inputs can be determined by the concentration of dissolved calcium: < 4 mg/L is highly sensitive to acid inputs; 4 to 8 mg/L is moderately sensitive; and > 8 mg/L is low sensitivity.

## Note 13.3 for Antimony (dissolved):

The guideline is for antimony (III).

## Note 13.4 for Calcium (dissolved):

The guideline for dissolved calcium in mg/L is as follows:

- Less than 4, highly sensitive to acid inputs
- 4 to 8, moderately sensitive
- Greater than 8, low sensitivity.

## Note 13.5 for Chromium (dissolved):

The guideline for Cr(VI) is  $1 \mu g/L$  (total). The guideline for Cr(III) is  $8.9 \mu g/L$  (total). The guideline of  $1 \mu g/L$  for Cr(VI) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

#### Note 13.6 for Nickel (dissolved):

The guideline for nickel in  $\mu$ g/L is determined as follows:

When the water hardness is 0 to  $\leq$  60 mg/L, the maximum is 25  $\mu$ g/L

At hardness > 60 to ≤ 180 mg/L the maximum is calculated using the equation:

e raised to the power of {0.76[ln(hardness)] + 1.06}

At hardness >180 mg/L, the maximum is 150  $\mu$ g/L

Where water hardness is reported as mg/L CaCO3.

If the water hardness is unknown, the maximum is 25  $\mu$ g/L.

#### Note 13.7 for Thallium (dissolved):

30-day average, site-specific objective for the lower Columbia River, BC

#### 14. Notes for BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life (CSR AW)

#### **General Notes:**

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 179/2021, July 7, 2021. Aquatic life standards assume minimum 1:10 dilution available, and are to protect freshwater life.

Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered. Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.

Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for total substance concentrations.

#### Note 14.1 for Fluoride:

The standard for fluoride is:

2000 μg/L @ H < 50

3000 µg/L @ H ≥ 50

Where H means water hardness in mg/L as CaCO3.

#### Note 14.2 for Sulphate:

The standard for sulfate is:

1280 mg/L @ H ≤ 30

2180 mg/L @ H 31 - 75

3090 mg/L @ H 76 - 180

4290 mg/L @ H > 180

Where H means water hardness in mg/L as CaCO3.

#### Note 14.3 for Ammonia (total, as N):

Standard varies with pH and temperature. 10 degrees C is assumed. Consult a director for further advice.

The standard for ammonia, total (as N) is:

1,310  $\mu$ g/L @ pH ≥ to 8.5

3,700 μg/L @ pH 8.0 - < 8.5

11,300 μg/L @ pH 7.5 - < 8.0

18,500 μg/L @ pH 7.0 - < 7.5

18,400 μg/L @ pH < 7.0

### Note 14.4 for Nitrate (as N):

Standard may not protect all amphibians. Consult director for further advice.

## Note 14.5 for Nitrate + Nitrite (as N):

Standard may not protect all amphibians. Consult director for further advice.

## Note 14.6 for Nitrite (as N):

Standard varies with chloride concentration. Consult a director for further advice.

The standard for nitrite (as N) is:

 $200~\mu g/L$  (Cl < 2~mg/L)

 $400 \mu g/L$  (CI 2 - < 4 mg/L)  $600 \mu g/L$  (CI 4 - < 6 mg/L)

800 μg/L (Cl 6 - < 8 mg/L)

1,000  $\mu$ g/L (Cl 8 - < 10 mg/L)

2,000 µg/L (Cl ≥ 10 mg/L)

## Note 14.7 for Cadmium (dissolved):

The standard for cadmium is as follows:

0.5 μg/L @ H < 30

 $1.5~\mu g/L$  @ H 30 - < 90

2.5 μg/L @ H 90 - < 150

 $3.5~\mu g/L$  @ H 150 - < 210

4 μg/L @ H ≥ 210

Where H means water hardness in mg/L as CaCO3.

## Note 14.8 for Chromium (dissolved):

Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.

Standard is 10 µg/L for chromium, hexavalent. Standard is 90 µg/L for chromium, trivalent. The standard of 10 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

## Note 14.9 for Copper (dissolved):

The standard for copper is as follows:

20 μg/L @ H < 50

30 μg/L @ H 50 - < 75

40 μg/L @ H 75 - < 100

50 μg/L @ H 100 - < 125 60 μg/L @ H 125 - < 150

70 μg/L @ H 125 - < 150

70 μg/L @ H 150 - < 175 80 μg/L @ H 175 - < 200

80 μg/L @ H 1/5 - 90 μg/L @ H ≥ 200

Where H means water hardness in mg/L as CaCO3.

## Note 14.10 for Lead (dissolved):

The standard for lead is as follows:

40 μg/L @ H < 50

50 μg/L @ H 50 - < 100

 $60~\mu g/L$  @ H 100 - < 200

110 μg/L @ H 200 - < 300

 $160 \, \mu g/L @ \ge 300$ 

Where H means water hardness in mg/L as CaCO3.

### Note 14.11 for Nickel (dissolved):

The standard for nickel is as follows:

 $250 \,\mu g/L @ H < 60$ 

650 μg/L @ H 60 - < 120

1,100 μg/L @ H 120 - < 180

 $1,500 \mu g/L @ H \ge 180$ 

Where H means water hardness in mg/L as CaCO3.

#### Note 14.12 for Silver (dissolved):

The standard for silver is:

 $0.5 \,\mu g/L @ H \le 100$ 

 $15 \,\mu g/L @ H > 100$ 

Where H means water hardness in mg/L as CaCO3.

### Note 14.13 for Zinc (dissolved):

The standard for zinc is as follows:

 $75 \,\mu g/L @ H < 90$ 

150 μg/L @ H = 90 - < 100

 $900 \,\mu g/L @ H = 100 - < 200$ 

 $1,650 \mu g/L @ H = 200 - < 300$ 

2,400 μg/L @ H = 300 - < 400

 $3,150 \mu g/L @ H = 400 - < 500$ 

If  $H \ge 500$  then use following formula:

Standard ( $\mu$ g/L) = 10 x [7.5 +{(0.75)(H - 90)}]

Where H means water hardness in mg/L as CaCO3.

There are special ministry approval and data reporting requirements for water hardness values ≥ 500 mg/L as CaCO3.

Reference is Schedule 3.2 and Protocol 10.

# Table B-2: 2022 Bailey Springs Results City of Vernon Reclaimed Water Irrigation Groundwater Monitoring Program

## Legend for Table B-2:

<	Less than reported detection limit
>	Greater than reported upper detection limit
BC RWQG	BC Recreational Water Quality Guidelines (2019)
BCAWQG AL (LT)	BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic)
BCAWQG AL (ST)	BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute)
BCWWQG AL	BC Working Water Quality Guidelines for Freshwater Aquatic Life (2021)
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
N	Narrative type of guideline or standard, or Result Note.
NG	No Guideline
BC RWQG	Highlighted value exceeds BC RWQG
BCAWQG AL (LT)	Highlighted value exceeds BCAWQG AL (LT)
BCAWQG AL (ST)	Highlighted value exceeds BCAWQG AL (ST)
BCWWQG AL	Highlighted value exceeds BCWWQG AL

# Table B-2: 2022 Bailey Springs Results City of Vernon Reclaimed Water Irrigation Groundwater Monitoring Program

				Sam	pling Location	Bailey Springs												
					Date Sampled		17-Feb-22	09-Mar-22	20-Apr-22	17-May-22	09-Jun-22	21-Jun-22	12-Jul-22	04-Aug-22	08-Sep-22	19-Oct-22	17-Nov-22	14-Dec-22
				I	Lab Sample ID													
Г	T	T		Calla Piana	Sample Type													
Analyte	Unit			ideline	1													
Allalyte	Oilit	(ST)	BCAWQG AL (LT)	BCWWQG AL	BC RWQG													
Field Results																		
Temperature	°C	19 <sup>1.1</sup>	NG	NG	N <sup>3.1</sup>	4	4	4	4.5	8	12	-	15	16	12	9	4	4
Lab Results																		
General																		
Chloride	mg/L	600 <sup>1.2</sup>	150 <sup>2.1</sup>	NG	NG	152	156	151	144	148	152	-	134	136	128	140	159	150
Conductivity	μS/cm	NG	NG	NG	NG	1350	1320	1290	1160	1140	1240	-	1160	1160	1130	1200	1230	1240
рН		NG	N <sup>2.2</sup>	NG	5.0 - 9.0	8.28	8.41	8.39	8.47	8.24	8.36	-	8.47	8.5	8.47	8.41	8.37	8.38
Total dissolved solids	mg/L	NG	NG	NG	NG	778	817	762	719	713	721	-	-	-	-	-	-	-
Nutrients																		
Ammonia (total, as N)	mg/L	Calc <sup>1.3</sup>	Calc <sup>2.3</sup>	NG	NG	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	-	<0.050	0.064	<0.050	<0.050	<0.050	0.059
Nitrate (as N)	mg/L	32.8 <sup>1.4</sup>	3.0 2.4	NG	10	0.464	0.461	0.756	0.431	0.622	0.036	0.101	0.061	0.028	0.071	0.123	0.255	0.35
Nitrate + Nitrite (as N)	mg/L	NG	NG	NG	NG	0.464	0.461	0.756	0.431	0.622	0.0359	0.101	0.061	0.0281	0.0708	0.123	0.255	0.35
Nitrite (as N)	mg/L	Calc <sup>1.5</sup>	Calc <sup>2.5</sup>	NG	1.0	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total nitrogen	mg/L	NG	NG	NG	NG	0.994	0.951	1.41	0.943	1.19	0.678	-	0.713	0.711	0.778	0.718	0.755	0.772
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	0.53	0.49	0.656	0.512	0.564	0.642	-	0.652	0.683	0.707	0.595	0.5	0.423
Total organic nitrogen	mg/L	NG	NG	NG	NG	0.53	0.49	0.656	0.512	0.564	0.591	-	0.652	0.619	0.707	0.595	0.5	0.364
Orthophosphate (dissolved, as P)	mg/L	NG	NG	NG	NG	0.0515	0.071	0.0526	0.0127	0.0319	<0.0050	0.059	0.029	0.0369	0.0753	0.0259	0.0109	0.0153
Phosphorus (total, APHA 4500-P)	mg/L	NG	N <sup>2.6</sup>	NG	N <sup>3.2</sup>	0.131	0.128	0.122	0.103	0.148	0.152	-	0.148	0.167	0.182	0.111	0.0927	0.0733
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	N <sup>2.7</sup>	NG	N <sup>3.3</sup>	0.12	0.119	0.113	0.0892	0.133	0.115	-	0.121	0.132	0.152	0.0962	0.0859	0.0673
Microbiological																		
Fecal coliforms (MPN)	MPN/100 mL	NG	N <sup>2.8</sup>	NG	NG	3	2	2	70	1200	770	613	575	579	435	-	11	1
Total coliforms (MPN)	MPN/100 mL	NG	NG	NG	NG	156	387	75	326	>2420	2460	3280	11200	24200	11800	-	271	201
Total Metals																		
Sodium (total)	mg/L	NG	NG	NG	NG	127	138	140	120	113	118	-	119	122	122	124	123	128



# Guideline Notes for Table B-2: 2022 Bailey Springs Results City of Vernon Reclaimed Water Irrigation Groundwater Monitoring Program

## 1. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute) (BCAWQG AL (ST))

General Notes:

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports. / There are two types of water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). Only the short-term acute guidelines are included in this criteria set.

#### **Note 1.1 for Temperature:**

The freshwater aquatic life guideline for streams with unknown fish distribution is:

Maximum daily temperature of 19 degrees Celsius;

MWMT = 18 degrees Celsius. (MWMT, mean weekly short-term temperature, is defined as the average of the warmest daily short-term temperatures for 7 consecutive days;

Hourly rate of change not to exceed 1 degree Celsius;

Short-term incubation temperature = 12 degrees Celsius (in spring and fall).

See BC MOE Overview Report for additional details for streams with unknown fish distribution, and specific guidelines for streams with known fish distribution, and guideline for lakes and impoundments.

#### Note 1.2 for Chloride:

To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L. When ambient chloride concentrations exceed guidelines, increases in chloride due to human activities should be avoided.

#### Note 1.3 for Ammonia (total, as N):

The freshwater aquatic life short-term acute guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia for this report. If a lab pH result was not available then the field pH result was used.

#### Note 1.4 for Nitrate (as N):

Freshwater aquatic life short-term acute guideline.

#### Note 1.5 for Nitrite (as N):

The freshwater aquatic life short-term acute guideline for nitrite as N is:

0.06 mg/L if chloride less than 2 mg/L

0.12 mg/L if chloride is 2 to 4 mg/L

0.18 mg/L if chloride is 4 to 6 mg/L

0.24 mg/L if chloride is 6 to 8 mg/L

0.30 mg/L if chloride is 8 to 10 mg/L

0.60 mg/L if chloride is greater than 10 mg/L.

## 2. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic) (BCAWQG AL (LT))

#### **General Notes:**

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports. / There are two types of water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). Only the long-term chronic guidelines are included in this criteria set.

#### Note 2.1 for Chloride:

To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L. When ambient chloride concentrations exceed guidelines, increases in chloride due to human activities should be avoided.

#### Note 2.2 for pH:

The freshwater aquatic life long-term chronic guideline is:

pH less than 6.5: No statistically significant decrease in pH from background;

pH from 6.5 to 9.0: Unrestricted change permitted within this range;

pH over 9.0: No statistically significant increase in pH from background.

See BC MOE Overview Report for additional details.

#### Note 2.3 for Ammonia (total, as N):

The freshwater aquatic life long-term chronic guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia concentration for this report. If a lab pH result was not available then the field pH result was used.

#### Note 2.4 for Nitrate (as N):

Freshwater aquatic life long-term chronic guideline.

# Guideline Notes for Table B-2: 2022 Bailey Springs Results City of Vernon Reclaimed Water Irrigation Groundwater Monitoring Program

#### Note 2.5 for Nitrite (as N):

The freshwater aquatic life long-term chronic guideline for nitrite as N is:

0.02 mg/L if chloride less than 2 mg/L

0.04 mg/L if chloride is 2 to 4 mg/L

0.06 mg/L if chloride is 4 to 6 mg/L

0.08 mg/L if chloride is 6 to 8 mg/L

0.10 mg/L if chloride is 8 to 10 mg/L

0.20 mg/L if chloride is greater than 10 mg/L.

#### Note 2.6 for Phosphorus (total, APHA 4500-P):

Streams: None proposed for streams.

Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15  $\mu$ g/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

#### Note 2.7 for Phosphorus (dissolved, APHA 4500-P):

Streams: None proposed for streams.

Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15  $\mu$ g/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

#### Note 2.8 for Fecal coliforms (MPN):

There are insufficient data to set criteria for microbiological indicators for the protection of the health of aquatic organisms. The criteria below are for fresh or marine waters used for the growth and harvesting of shellfish for human consumption where the shellfish may be eaten raw and are used directly without a cleansing period prior to killing. The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

#### 3. Notes for BC Recreational Water Quality Guidelines (2019) (BC RWQG)

#### **General Notes:**

Reference: British Columbia Ministry of Environment and Climate Change Strategy. 2019. B.C. Recreational Water Quality Guidelines: Guideline Summary.

The guidelines are for primary contact recreational uses. Primary contact is defined as activities, such as swimming (this includes bathing/wading for the purposes of this document), windsurfing and waterskiing, as well as secondary contact activities, such as canoeing or fishing, in natural waters through intentional or incidental immersion.

#### Note 3.1 for Temperature:

No numerical guideline is recommended.

Precise guideline values for the temperature of waters to be used for swimming cannot be established. Tolerance to water temperatures can vary considerably from individual to individual. Users should not engage in recreational activities at temperature-time combinations sufficient to cause an appreciable increase or decrease in their core body temperature (Health Canada 2012).

#### Note 3.2 for Phosphorus (total, APHA 4500-P):

The guideline for lakes is 0.01 mg/L.

#### Note 3.3 for Phosphorus (dissolved, APHA 4500-P):

The guideline for lakes is 0.01 mg/L.

# Table B-3: 2022 Clay Valve #4 Results City of Vernon Reclaimed Water Irrigation Groundawter Monitoring Program

	Sampling Location Date Sampled Lab Sample ID Sample Type	Clay Valve #4 17-May-22	Clay Valve #4 27-May-22	Clay Valve #4 09-Jun-22	Clay Valve #4 21-Jun-22	Clay Valve #4 12-Jul-22	Clay Valve #4 04-Aug-22	Clay Valve #4 17-Aug-22	Clay Valve #4 08-Sep-22
Analyte	Unit								
Lab Results									
General									
Biochemical oxygen demand	mg/L	<7.1	-	<7.1	-	<6.2	<7.0	-	<7.4
Chloride	mg/L	101	-	94.8	-	93.7	87.7	-	89.6
Fluoride	mg/L	0.3	-	<0.10	-	0.28	<0.10	-	0.21
Hardness (as CaCO3), dissolved	mg/L	214	-	216	-	230	218	-	213
рН		7.61	-	7.54	-	8.11	8.12	-	7.94
Total dissolved solids	mg/L		-		-	-	-	-	494
Total suspended solids	mg/L	<2.0	-	<3.3	-	<3.3	<2.0	-	2.6
Sulphate	mg/L	94.3	-	68.8	-	90.9	81.2	-	83.9
Turbidity	NTU	0.59	-	0.5	-	0.61	0.85	-	0.77
Nutrients									
Ammonia (total, as N)	mg/L	0.555	-	1.15	-	1.02	0.869	-	1.08
Nitrate (as N)	mg/L	1.2	-	0.674	1.07	1.1	1.2	-	0.704
Nitrate + Nitrite (as N)	mg/L	1.21	-	0.674	1.09	1.11	1.24	-	0.728
Nitrite (as N)	mg/L	0.014	-	<0.010	0.019	0.013	0.031	-	0.024
Total nitrogen	mg/L	2.81	-	2.65	-	3.04	3.29	-	2.84
Total kjeldahl nitrogen	mg/L	1.6	-	1.98	-	1.93	2.05	-	2.12
Total organic nitrogen	mg/L	1.04	-	0.83	-	0.91	1.18	-	1.04
Orthophosphate (dissolved, as P)	mg/L	0.452	-	0.334	0.397	0.419	0.408	-	0.764
Phosphorus (dissolved, by ICPMS/ICPOE	·	0.689	-	0.695	-	0.828	0.809	-	0.895
Phosphorus (total, APHA 4500-P)	mg/L	0.691	-	0.725	-	0.779	0.854	-	0.922
Phosphorus (dissolved, APHA 4500-P)	mg/L	0.685	-	0.717	-	0.772	0.829	-	0.716
Potassium (dissolved)	mg/L	19	-	18.7	-	19.2	18.1	-	18.1
Microbiological									
Fecal coliforms (MPN)	MPN/100 mL	<1	<1	<1	<1	<1	2	<1	<1
Total coliforms (MPN)	MPN/100 mL	261	1	<1	>2420	1	2	<1	<1
Total Metals									
Sodium (total)	mg/L	87.6	-	87.9	-	88.1	-	-	88.4
Dissolved Metals		-0.0050		-0.0050		10 0050	10.0050		-0.0050
Autimorny (discolved)	mg/L	<0.0050	-	<0.0050	-	<0.0050	<0.0050	-	<0.0050
Antimony (dissolved) Arsenic (dissolved)	mg/L	0.00023	-	0.00023	-	0.00027	0.00025	-	<0.00020
Barium (dissolved)	mg/L mg/L	0.00082 0.0314	-	0.00084 0.0279	-	0.00089 0.03	0.00082 0.0272	-	0.00081 0.0279
Beryllium (dissolved)	mg/L	<0.0014	<u>-</u>	<0.0010	_	<0.00010	<0.0010	-	<0.0010
Bismuth (dissolved)	mg/L	<0.00010	<u>-</u>	<0.00010	_	<0.00010	<0.00010	_	<0.00010
Boron (dissolved)	mg/L	0.155	-	0.169	_	0.175	0.161	_	0.197
Cadmium (dissolved)	mg/L	<0.000010	-	<0.000010	-	0.000028	0.000014	-	<0.000010
Calcium (dissolved)	mg/L	51.8	-	52.2	-	55.7	54.2	-	49.2
Chromium (dissolved)	mg/L	<0.00050	-	<0.00050	-	<0.00050	<0.00050	-	<0.00050
Cobalt (dissolved)	mg/L	0.00034	-	0.00032	-	0.00033	0.00031	-	0.00033
Copper (dissolved)	mg/L	0.00278	-	0.00256	-	0.00334	0.00364	-	0.00291
Iron (dissolved)	mg/L	0.033	-	0.035	-	0.043	0.045	-	0.075
Lead (dissolved)	mg/L	<0.00020	-	<0.00020	-	<0.00020	<0.00020	-	<0.00020
Lithium (dissolved)	mg/L	0.00907	-	0.00911	-	0.0105	0.00915	-	0.00971
Magnesium (dissolved)	mg/L	20.6	-	20.7	-	22.1	20.1	-	21.9
Manganese (dissolved)	mg/L	0.103	-	0.123	-	0.154	0.123	-	0.166
Molybdenum (dissolved)	mg/L	0.00255	-	0.00336	-	0.00222	0.00267	-	0.00297
Nickel (dissolved)	mg/L	0.00154	-	0.00158	-	0.00173	0.00175	-	0.00183
Selenium (dissolved)	mg/L	<0.00050	-	0.0006	-	0.00053	0.00052	-	0.00055
Silicon (dissolved, as Si)	mg/L	1.2	-	1.4	-	1.8	1.9	-	1.9
Silver (dissolved)	mg/L	<0.000050	-	<0.000050	-	<0.000050	<0.000050	-	<0.000050
Sodium (dissolved)	mg/L	87	-	87.1	-	94.1	83.1	-	89.7
Strontium (dissolved)	mg/L	0.561	-	0.497	-	0.553	0.48	-	0.492
Sulphur (dissolved)	mg/L	30.7	-	31.4	-	32.4	30.6	-	28.4
Tellurium (dissolved)	mg/L	<0.00050	-	<0.00050	-	<0.00050	<0.00050	-	<0.00050
Thallium (dissolved)	mg/L	<0.000020	-	<0.000020	-	<0.000020	<0.000020	-	<0.000020
Thorium (dissolved)	mg/L	<0.00010	-	<0.00010	-	<0.00010	<0.00010	-	<0.00010
Tin (dissolved)	mg/L	<0.00020	-	<0.00020	-	<0.00020	<0.00020	-	<0.00020
Titanium (dissolved)	mg/L mg/L	<0.0050	-	<0.0050	-	<0.0050	<0.0050	-	<0.0050
Tungsten (dissolved)	ı ma/ı	<0.0010	-	<0.0010	-	<0.0010	<0.0010	-	<0.0010
Il Iranium (dissolved)		U UU143		0.00170		0 00124	0 0015		U UU144
Uranium (dissolved) Vanadium (dissolved)	mg/L	0.00142 <0.0050	-	0.00172 <0.0050	-	0.00124 <0.0050	0.0015 <0.0050	-	0.00144 <0.0050
Vanadium (dissolved)  Zinc (dissolved)		0.00142 <0.0050 0.0268		0.00172 <0.0050 0.0261	-	0.00124 <0.0050 0.0285	0.0015 <0.0050 0.0301	-	0.00144 <0.0050 0.0285



# APPENDIX C - TIME-SERIES PLOTS

#### **List of Acronyms:**

GCDWQ MAC	Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations
GCDWQ AO	Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives
CSR DW	BC CSR Generic Numerical Water Standards for Drinking Water
BCAWQG I	BC Approved Water Quality Guidelines for Irrigation
BCWWQG I	BC Working Water Quality Guidelines for Irrigation
CSR IW	BC CSR Generic Numerical Water Standards for Irrigation
BCAWQG L	BC Approved Water Quality Guidelines for Livestock
BCWWQG L	BC Working Water Quality Guidelines for Livestock
CSR LW	BC CSR Generic Numerical Water Standards for Livestock
BCAWQG AL (ST)	BC Approved Water Quality Guidelines for Freshwater Aquatic Life (short-term; acute)
BCAWQG AL (LT)	BC Approved Water Quality Guidelines for Freshwater Aquatic Life (long-term; chronic – Bailey Springs only)
BCWWQG AL	BC Working Water Quality Guidelines for Freshwater Aquatic Life
CSR AW	BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life
BC RWQG	BC Recreational Water Quality Guidelines (Bailey Springs only)
Calc	Calculated guideline: the guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table. Therefore, it is not shown on the plot. Refer to guideline notes in Appendix C for further details.
N	Narrative type of guideline; therefore, it is not shown on the plot. Refer to guideline notes in Appendix C for further details.

Note: On all plots, results that were below detection are plotted at one-half the detection limit. Guidelines are only shown on the figures if there is an applicable guideline for that parameter.

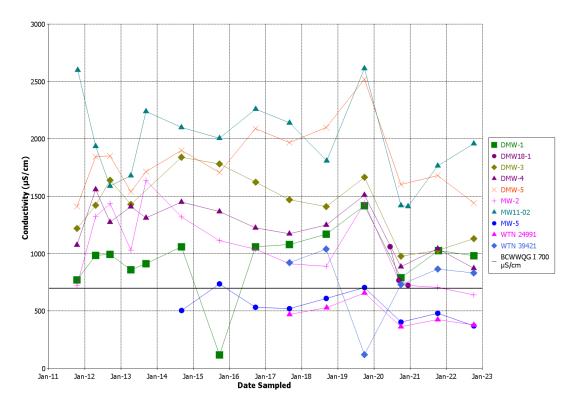


Figure C-1: Plot of field-measured conductivity in groundwater (all data since 2011)<sup>1</sup>

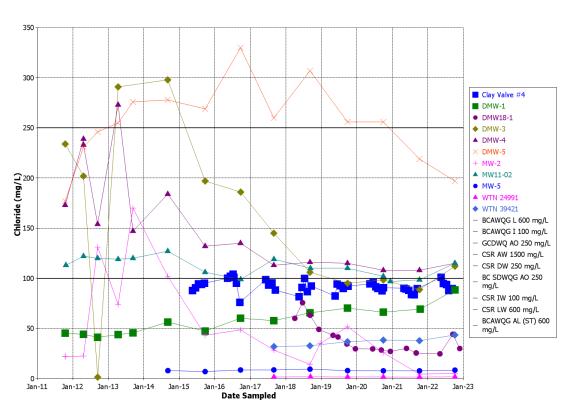


Figure C-3: Plot of chloride in groundwater and Clay Valve #4 (all data since 2011)

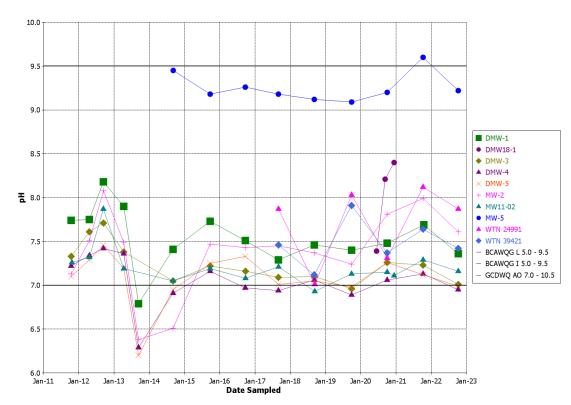


Figure C-2: Plot of field-measured pH in groundwater (all data since 2011)<sup>1</sup>

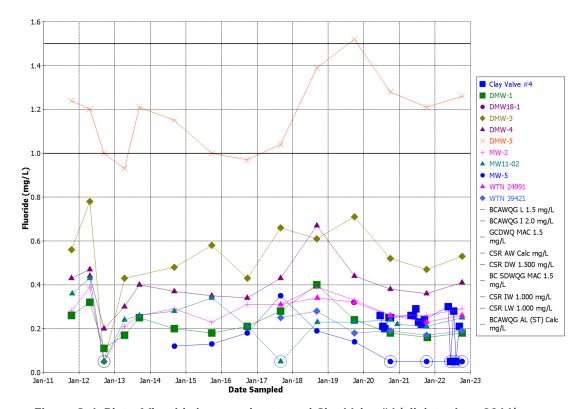


Figure C-4: Plot of fluoride in groundwater and Clay Valve #4 (all data since 2011)

<sup>1</sup> Conductivity and pH for Clay Valve #4 is not shown on Figures C-1 and C-2 because it is measured in the laboratory, and the figures show field-measured data only. Clay Valve #4 results from 2022 can be found in Appendix B.

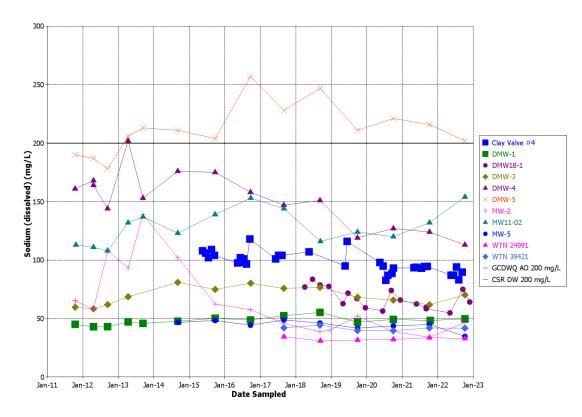


Figure C-5: Plot of dissolved sodium in groundwater and Clay Valve #4 (all data since 2011)

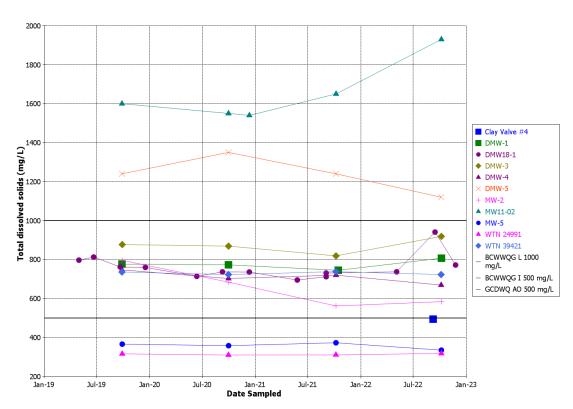


Figure C-7: Plot of TDS in groundwater since 2019 (i.e., since monitoring of TDS began)

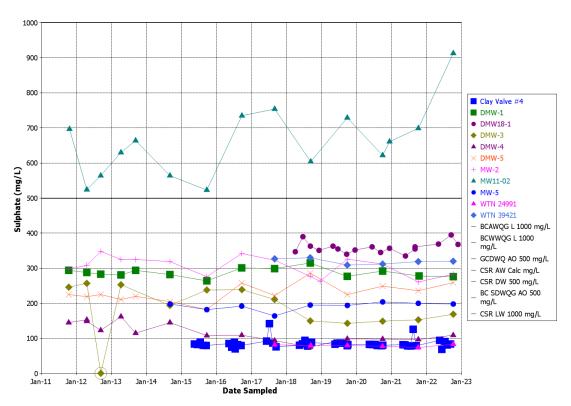


Figure C-6: Plot of sulphate in groundwater and Clay Valve #4 (all data since 2011)

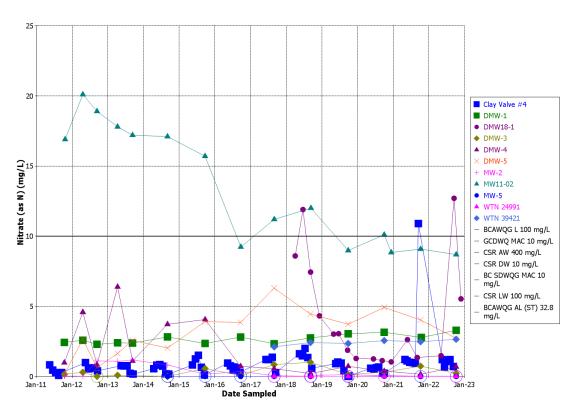


Figure C-8: Plot of nitrate-N in groundwater and Clay Valve #4 (all data since 2011)

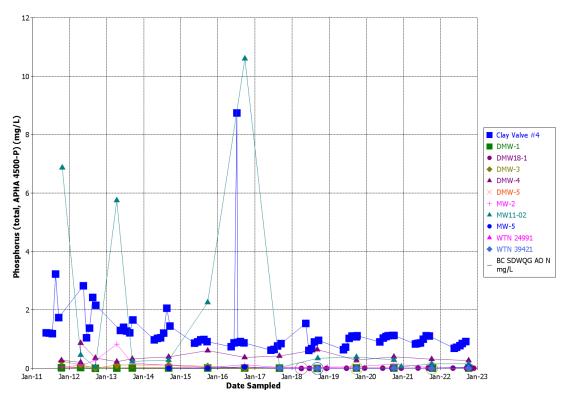


Figure C-9: Plot of total phosphorus in groundwater and Clay Valve #4 (all data since 2011)

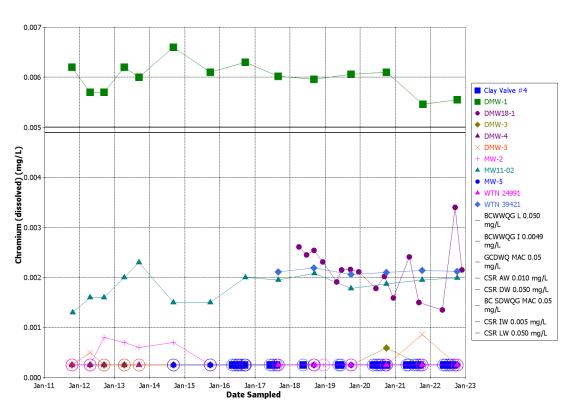


Figure C-11: Plot of dissolved chromium in groundwater and Clay Valve #4 (all data since 2011)

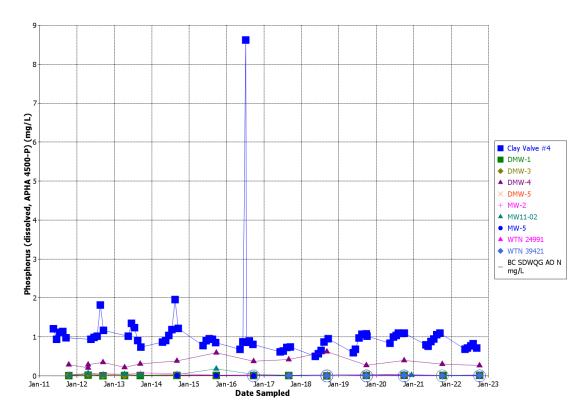


Figure C-10: Plot of dissolved phosphorus in groundwater and Clay Valve #4 (all data since 2011)

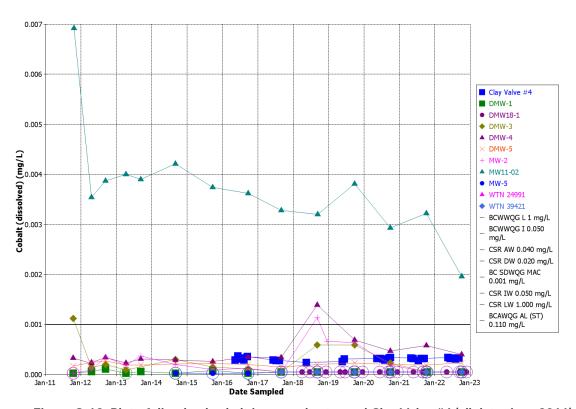


Figure C-12: Plot of dissolved cobalt in groundwater and Clay Valve #4 (all data since 2011)

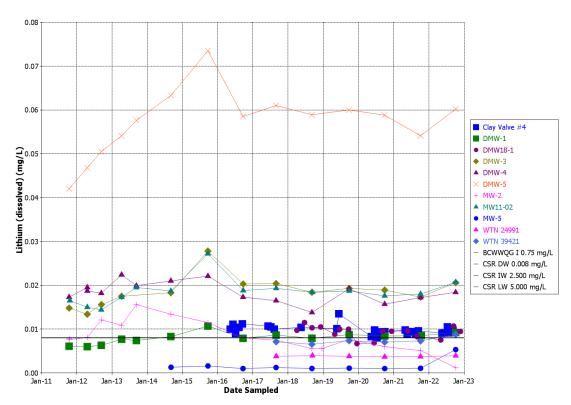


Figure C-13: Plot of dissolved lithium in groundwater and Clay Valve #4 (all data since 2011)

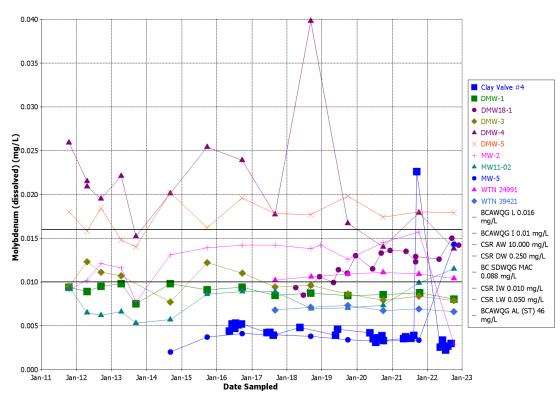


Figure C-15: Plot of dissolved molybdenum in groundwater and Clay Valve #4 (all data since 2011)

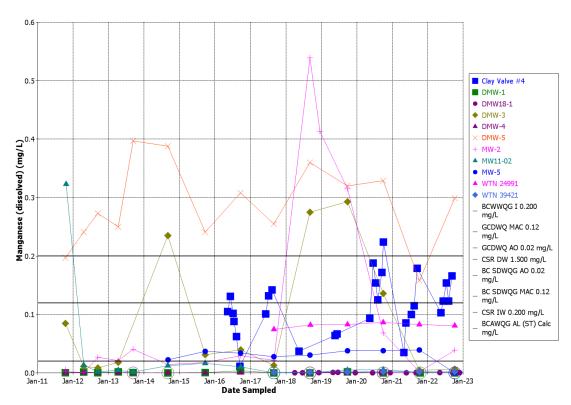


Figure C-14: Plot of dissolved manganese in groundwater and Clay Valve #4 (all data since 2011)

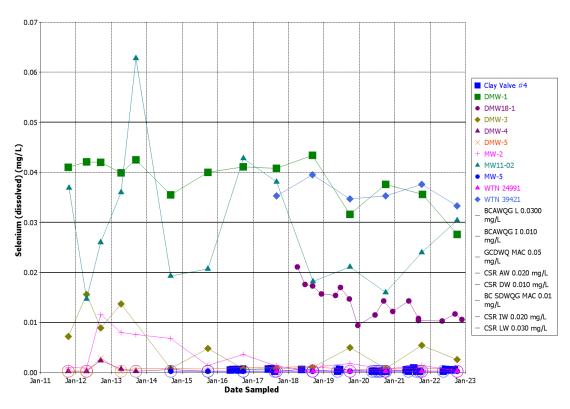


Figure C-16: Plot of dissolved selenium in groundwater and Clay Valve #4 (all data since 2011)

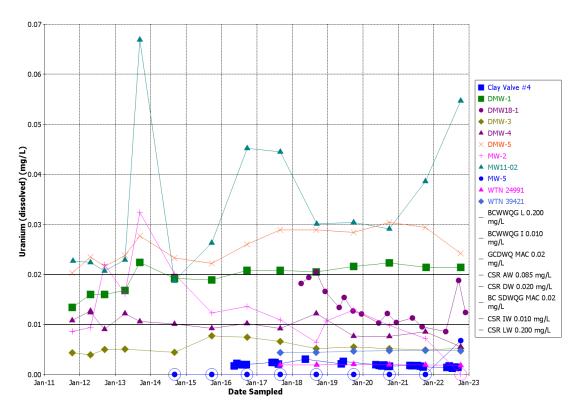


Figure C-17: Plot of dissolved uranium in groundwater and Clay Valve #4 (all data since 2011)

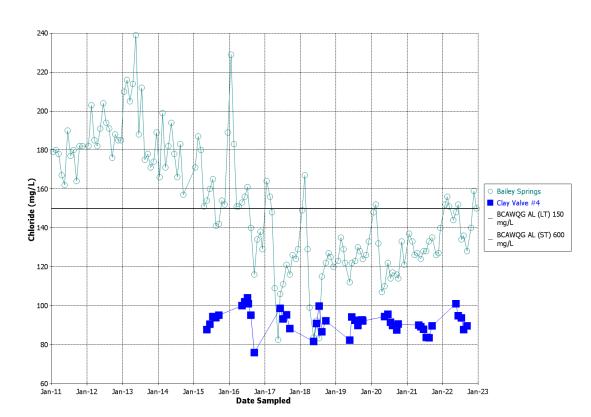


Figure C-19: Plot of chloride in Bailey Springs and Clay Valve #4 (data since 2011)

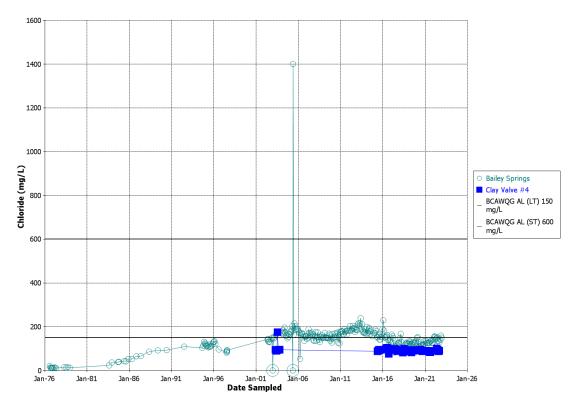


Figure C-18: Plot of chloride in Bailey Springs and Clay Valve #4 (all data)

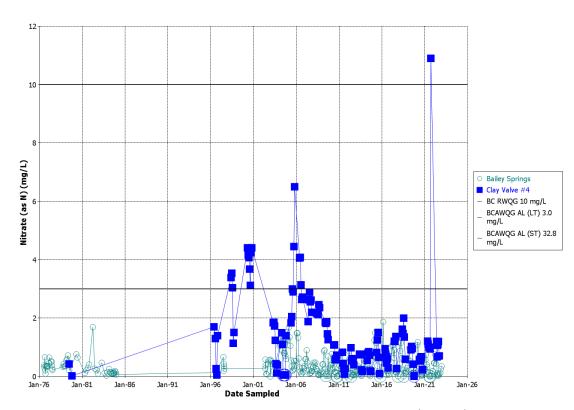


Figure C-20: Plot of nitrate-N in Bailey Springs and Clay Valve #4 (all data)



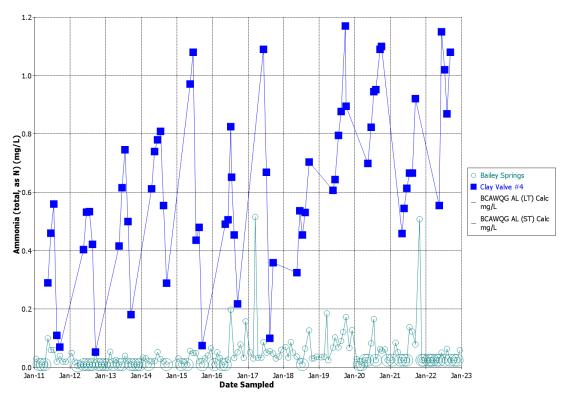


Figure C-21: Plot of ammonia-N in Bailey Springs and Clay Valve #4 (all data)

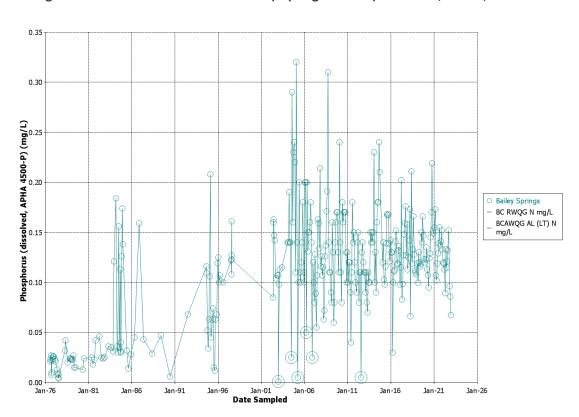


Figure C-23: Plot of dissolved phosphorus in Bailey Springs (all data)

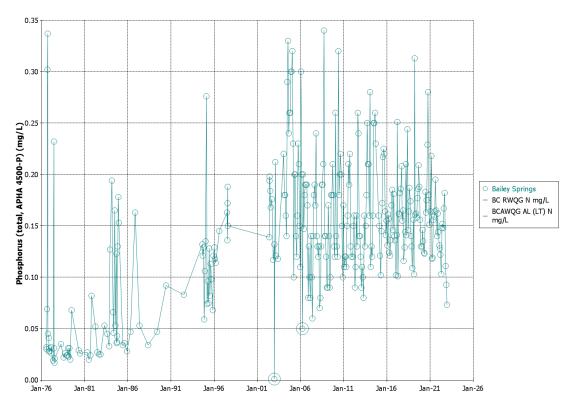


Figure C-22: Plot of total phosphorus in Bailey Springs (all data)

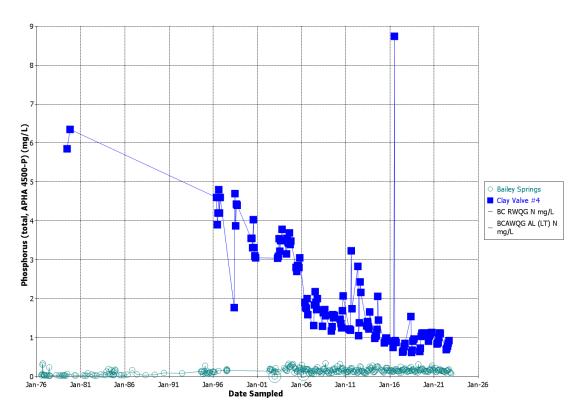


Figure C-24: Plot of total phosphorus in Bailey Springs and Clay Valve #4 (all data)

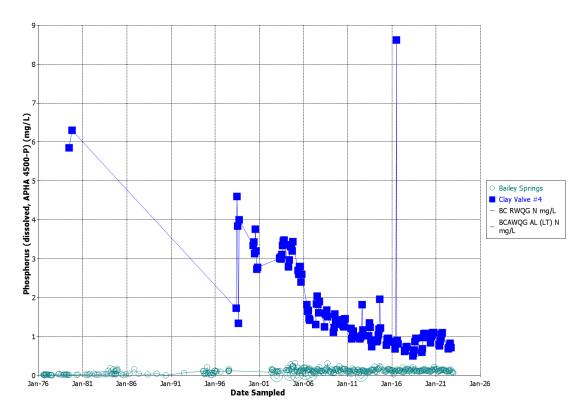


Figure C-25: Plot of dissolved phosphorus in Bailey Springs and Clay Valve #4 (all data)

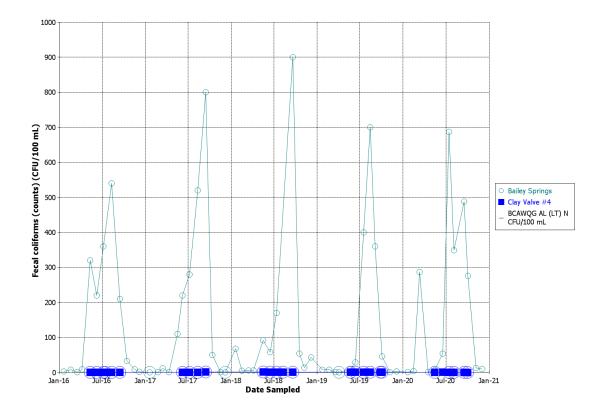


Figure C-26: Plot of fecal coliforms in Bailey Springs and Clay Valve #4 (data since 2016)<sup>2</sup>

<sup>&</sup>lt;sup>2</sup> On Figure C-26, only data since 2016 is shown because the analytical method changed (MPN to CFU). Furthermore, a value of 8,700 CFU/100 mL was reported in Bailey Springs in August 2018 but is not shown on the above figure so as to not obscure trends from more recent (e.g. 2022) data.

## **APPENDIX D - LABORATORY REPORTS**





2022-10-06 14:15 / 11.6°C

#### **CERTIFICATE OF ANALYSIS**

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.

**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

#200 - 2800 29th Street Vernon, BC V1T 9P9

ATTENTION Nicole Penner WORK ORDER 22J0983

PO NUMBER RECEIVED / TEMP

 PROJECT
 2022-8307.000
 REPORTED
 2022-10-14 17:42

 PROJECT INFO
 City of Vernon
 COC NUMBER
 No Number

#### 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/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

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.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

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

Authorized By:

Brent Whitehead Account Manager M what



## **TEST RESULTS**

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	<b>WORK ORDER</b>	22J0983
PROJECT	2022-8307.000	REPORTED	2022-10-14 17:42

DMW-4 (22J0983-01)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	< 0.10 115 0.39 0.684 < 0.010 0.133 105  322 0.684 1.17 0.490	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required N/A N/A N/A	0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	115 0.39 0.684 < 0.010 0.133 105 322 0.684 1.17 0.490	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A	
Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	115 0.39 0.684 < 0.010 0.133 105 322 0.684 1.17 0.490	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A	
Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	0.39 0.684 < 0.010 0.133 105 322 0.684 1.17 0.490	MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	
Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	0.684 < 0.010 0.133 105 322 0.684 1.17 0.490	MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A	
Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	< 0.010 0.133 105 322 0.684 1.17 0.490	MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A	
Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	0.133 105 322 0.684 1.17 0.490	N/A AO ≤ 500  None Required N/A N/A	0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 N/A N/A N/A	
Sulfate  Calculated Parameters  Hardness, Total (as CaCO3)  Nitrate+Nitrite (as N)  Nitrogen, Total	322 0.684 1.17 0.490	AO ≤ 500  None Required  N/A  N/A	0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L	2022-10-08 N/A N/A N/A	
Calculated Parameters  Hardness, Total (as CaCO3)  Nitrate+Nitrite (as N)  Nitrogen, Total	322 0.684 1.17 0.490	None Required N/A N/A	0.500 0.0100 0.0500	mg/L mg/L mg/L	N/A N/A N/A	
Hardness, Total (as CaCO3)  Nitrate+Nitrite (as N)  Nitrogen, Total	0.684 1.17 0.490	N/A N/A	0.0100 0.0500	mg/L mg/L	N/A N/A	
Nitrate+Nitrite (as N) Nitrogen, Total	0.684 1.17 0.490	N/A N/A	0.0100 0.0500	mg/L mg/L	N/A N/A	
Nitrate+Nitrite (as N) Nitrogen, Total	0.684 1.17 0.490	N/A N/A	0.0100 0.0500	mg/L mg/L	N/A N/A	
Nitrogen, Total	1.17 0.490	N/A	0.0500	mg/L	N/A	
	0.490					
		<u> </u>		111U/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	ma/l	2022-10-14	
Antimony, dissolved	< 0.00020	N/A	0.00020		2022-10-14	
Arsenic, dissolved	0.00218	N/A	0.00050		2022-10-14	
Barium, dissolved	0.0280	N/A	0.0050		2022-10-14	
Beryllium, dissolved	< 0.00010	N/A	0.00010		2022-10-14	
Bismuth, dissolved	< 0.00010	N/A	0.00010		2022-10-14	
Boron, dissolved	0.200	N/A	0.0500		2022-10-14	
Cadmium, dissolved	0.000316	N/A	0.000010		2022-10-14	
Calcium, dissolved	90.6	N/A		mg/L	2022-10-14	
Chromium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	
Cobalt, dissolved	0.00039	N/A	0.00010		2022-10-14	
Copper, dissolved	0.0131	N/A	0.00040		2022-10-14	
Iron, dissolved	0.011	N/A	0.010		2022-10-14	
Lead, dissolved	0.00035	N/A	0.00020		2022-10-14	
Lithium, dissolved	0.0182	N/A	0.00010		2022-10-14	
Magnesium, dissolved	23.1	N/A	0.010		2022-10-14	
Manganese, dissolved	0.00028	N/A	0.00020		2022-10-14	
Mercury, dissolved	< 0.000010	N/A	0.000010		2022-10-13	
Molybdenum, dissolved	0.0136	N/A	0.00010		2022-10-14	
Nickel, dissolved	0.00167	N/A	0.00040		2022-10-14	
Phosphorus, dissolved	0.264	N/A	0.050		2022-10-14	
Potassium, dissolved	17.9	N/A		mg/L	2022-10-14	
Selenium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	
Silicon, dissolved	8.6	N/A		mg/L	2022-10-14	
Silver, dissolved	< 0.000050	N/A	0.000050		2022-10-14	
Sodium, dissolved	111	N/A		mg/L	2022-10-14	
Strontium, dissolved	0.765	N/A	0.0010		2022-10-14	
Sulfur, dissolved	37.5	N/A		mg/L	2022-10-14	
Tellurium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	



## **TEST RESULTS**

REPORTED TO Associated Environmental Consultants Inc. (Vernon) PROJECT 2022-8307.000				WORK ORDER REPORTED	22J0983 2022-10-14 17:42	
Analyte	Result	Guideline	RL	Units	Analyzed	Qualifie
DMW-4 (22J0983-01)   Matr	rix: Water   Sampled: 2022-10	-05 16:55, Continue	d			
Dissolved Metals, Continued						
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-14	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-14	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Tungsten, dissolved	< 0.0010	N/A	0.0010		2022-10-14	
Uranium, dissolved	0.00548	N/A	0.000020	mg/L	2022-10-14	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Zinc, dissolved	0.0221	N/A	0.0040	mg/L	2022-10-14	
Zirconium, dissolved	0.00014	N/A	0.00010	mg/L	2022-10-14	
General Parameters						
Alkalinity, Total (as CaCO3)	293	N/A	1.0	mg/L	2022-10-13	
Alkalinity, Phenolphthalein (a	as CaCO3) < 1.0	N/A	1.0	mg/L	2022-10-13	
Alkalinity, Bicarbonate (as Ca	aCO3) <b>293</b>	N/A	1.0	mg/L	2022-10-13	
Alkalinity, Carbonate (as CaC		N/A		mg/L	2022-10-13	
Alkalinity, Hydroxide (as CaC	<u> </u>	N/A		mg/L	2022-10-13	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	0.490	N/A		mg/L	2022-10-14	
Phosphorus, Total (as P)	0.274	N/A		mg/L	2022-10-13	
Phosphorus, Total Dissolved		N/A		mg/L	2022-10-13	
Solids, Total Dissolved	669	AO ≤ 500		mg/L	2022-10-13	HT1
DMW-5 (22J0983-02)   Matr	rix: Water   Sampled: 2022-10-	05 17:35				
Anions						
<b>Anions</b> Bromide	< 0.10	N/A	0.10	mg/L	2022-10-08	
	< 0.10 <b>197</b>	N/A AO ≤ 250		mg/L mg/L	2022-10-08 2022-10-08	
Bromide			0.10			
Bromide Chloride	197	AO ≤ 250	0.10	mg/L mg/L	2022-10-08	
Bromide Chloride Fluoride	197 1.26	AO ≤ 250 MAC = 1.5	0.10 0.10	mg/L mg/L mg/L	2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N)	197 1.26 2.72	AO ≤ 250 MAC = 1.5 MAC = 10	0.10 0.10 0.010	mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N)	197 1.26 2.72 < 0.010	AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1	0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P)	197 1.26 2.72 < 0.010 < 0.0050	AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A	0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate	197 1.26 2.72 < 0.010 < 0.0050 259	AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A	0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters	197 1.26 2.72 < 0.010 < 0.0050 259	AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500	0.10 0.10 0.010 0.010 0.0050 1.0	mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N)	197 1.26 2.72 < 0.010 < 0.0050 259	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required	0.10 0.10 0.010 0.010 0.0050 1.0	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	197 1.26 2.72 < 0.010 < 0.0050 259  577 2.72 3.12	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	197 1.26 2.72 < 0.010 < 0.0050 259  577 2.72	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	197 1.26 2.72 < 0.010 < 0.0050 259  577 2.72 3.12	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved	197 1.26 2.72 < 0.010 < 0.0050 259  577 2.72 3.12 0.401	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A N/A	
Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals	197 1.26 2.72 < 0.010 < 0.0050 259  577 2.72 3.12 0.401 << 0.0050	AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A N/A N/A	



## **TEST RESULTS**

REPORTED TO Associated Environmental Consultants Inc. (Vernon) WORK ORD

**PROJECT** 2022-8307.000

WORK ORDER REPORTED 22J0983 2022-10-14 17:42

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifie
DMW-5 (22J0983-02)   Matrix: Water   Sa	mpled: 2022-10-05	17:35, Continued				
Dissolved Metals, Continued						
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Boron, dissolved	0.120	N/A	0.0500	mg/L	2022-10-14	
Cadmium, dissolved	0.000016	N/A	0.000010	mg/L	2022-10-14	
Calcium, dissolved	135	N/A	0.20	mg/L	2022-10-14	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-14	
Cobalt, dissolved	0.00023	N/A	0.00010	mg/L	2022-10-14	
Copper, dissolved	0.00138	N/A	0.00040	mg/L	2022-10-14	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-14	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-14	
Lithium, dissolved	0.0602	N/A	0.00010	mg/L	2022-10-14	
Magnesium, dissolved	58.3	N/A	0.010	mg/L	2022-10-14	
Manganese, dissolved	0.299	N/A	0.00020	mg/L	2022-10-14	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-13	
Molybdenum, dissolved	0.0179	N/A	0.00010	mg/L	2022-10-14	
Nickel, dissolved	0.00341	N/A	0.00040	mg/L	2022-10-14	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-14	
Potassium, dissolved	11.3	N/A	0.10	mg/L	2022-10-14	
Selenium, dissolved	0.00060	N/A	0.00050	mg/L	2022-10-14	
Silicon, dissolved	15.7	N/A	1.0	mg/L	2022-10-14	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-14	
Sodium, dissolved	202	N/A	0.10	mg/L	2022-10-14	
Strontium, dissolved	1.95	N/A	0.0010	mg/L	2022-10-14	
Sulfur, dissolved	90.7	N/A	3.0	mg/L	2022-10-14	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-14	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-14	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-14	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-14	
Uranium, dissolved	0.0242	N/A	0.000020	mg/L	2022-10-14	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-10-14	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
General Parameters						
Alkalinity, Total (as CaCO3)	427	N/A	1.0	mg/L	2022-10-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-13	
Alkalinity, Bicarbonate (as CaCO3)	427	N/A		mg/L	2022-10-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A		mg/L	2022-10-13	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	0.401	N/A	0.050		2022-10-14	



Phosphorus, dissolved

					<u> </u>			
REPORTED TO PROJECT	Associated Environ 2022-8307.000	mental Consultants Ir	nc. (Vernon)		WORK ORDER REPORTED	22J0983 2022-10-1	14 17:42	
Analyte		Result	Guideline	RL	Units	Analyzed	Qualifier	
DMW-5 (22J0983-	-02)   Matrix: Water	Sampled: 2022-10-05	5 17:35, Continued					
General Parameter	s, Continued							
Phosphorus, Total	(as P)	0.0307	N/A	0.0050	mg/L	2022-10-13		
Phosphorus, Total	Dissolved	0.0243	N/A	0.0050	mg/L	2022-10-13		
Solids, Total Disso	olved	1120	AO ≤ 500	15	mg/L	2022-10-13	HT1	
WTN 39421 (22J0	983-03)   Matrix: Wat	ter   Sampled: 2022-1	0-05 15:50					
Anions								
Bromide		< 0.10	N/A	0.10	mg/L	2022-10-08		
Chloride		43.4	AO ≤ 250	0.10	mg/L	2022-10-08		
Fluoride		0.19	MAC = 1.5	0.10	mg/L	2022-10-08		
Nitrate (as N)		2.65	MAC = 10	0.010	mg/L	2022-10-08		
Nitrite (as N)		< 0.010	MAC = 1	0.010	mg/L	2022-10-08		
Phosphate (as P)		< 0.0050	N/A	0.0050	mg/L	2022-10-08		
Sulfate		320	AO ≤ 500	1.0	mg/L	2022-10-08		
Calculated Parame	ters							
Hardness, Total (a	s CaCO3)	508	None Required	0.500	mg/L	N/A		
Nitrate+Nitrite (as	N)	2.65	N/A	0.0100	mg/L	N/A		
Nitrogen, Total		2.72	N/A	0.0500	mg/L	N/A		
Nitrogen, Organic		0.0650	N/A	0.0500	mg/L	N/A		
Dissolved Metals								
Aluminum, dissolv	ed	< 0.0050	N/A	0.0050	mg/L	2022-10-14		
Antimony, dissolve	ed	< 0.00020	N/A	0.00020		2022-10-14		
Arsenic, dissolved		0.00070	N/A	0.00050	mg/L	2022-10-14		
Barium, dissolved		0.0465	N/A	0.0050	mg/L	2022-10-14		
Beryllium, dissolve	ed	< 0.00010	N/A	0.00010	mg/L	2022-10-14		
Bismuth, dissolved	t	< 0.00010	N/A	0.00010	mg/L	2022-10-14		
Boron, dissolved		< 0.0500	N/A	0.0500	mg/L	2022-10-14		
Cadmium, dissolve	ed	< 0.000010	N/A	0.000010	mg/L	2022-10-14		
Calcium, dissolved	t	115	N/A	0.20	mg/L	2022-10-14		
Chromium, dissolv	/ed	0.00212	N/A	0.00050	mg/L	2022-10-14		
Cobalt, dissolved		< 0.00010	N/A	0.00010	mg/L	2022-10-14		
Copper, dissolved		< 0.00040	N/A	0.00040	mg/L	2022-10-14		
Iron, dissolved		0.027	N/A	0.010		2022-10-14		
Lead, dissolved		< 0.00020	N/A	0.00020	mg/L	2022-10-14		
Lithium, dissolved		0.00880	N/A	0.00010	mg/L	2022-10-14		
Magnesium, disso	lved	53.7	N/A	0.010	mg/L	2022-10-14		
Manganese, disso	lved	0.00208	N/A	0.00020	mg/L	2022-10-14		
Mercury, dissolved	d	< 0.000010	N/A	0.000010	mg/L	2022-10-13		
Molybdenum, diss	olved	0.00661	N/A	0.00010	mg/L	2022-10-14		
Nickel, dissolved		0.00092	N/A	0.00040	mg/L	2022-10-14		

2022-10-14

N/A

0.050 mg/L

< 0.050



Hardness, Total (as CaCO3)

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	WORK ORDER	22J0983
PROJECT	2022-8307.000	REPORTED	2022-10-14 17:42

Analyte	Result	Guideline	RL	Units	Analyzed	Qualif
/TN 39421 (22J0983-03)   Matrix: Water	Sampled: 2022-1	0-05 15:50, Continu	ued			
Dissolved Metals, Continued						
Potassium, dissolved	7.04	N/A	0.10	mg/L	2022-10-14	
Selenium, dissolved	0.0333	N/A	0.00050	mg/L	2022-10-14	
Silicon, dissolved	13.0	N/A	1.0	mg/L	2022-10-14	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-14	
Sodium, dissolved	41.7	N/A	0.10	mg/L	2022-10-14	
Strontium, dissolved	1.15	N/A	0.0010	mg/L	2022-10-14	
Sulfur, dissolved	118	N/A	3.0	mg/L	2022-10-14	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-14	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-14	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-14	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-14	
Uranium, dissolved	0.00472	N/A	0.000020	mg/L	2022-10-14	
Vanadium, dissolved	0.0050	N/A	0.0050	mg/L	2022-10-14	
Zinc, dissolved	0.0132	N/A	0.0040	mg/L	2022-10-14	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
General Parameters						
Alkalinity, Total (as CaCO3)	179	N/A		mg/L	2022-10-13	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-13	
Alkalinity, Bicarbonate (as CaCO3)	179	N/A		mg/L	2022-10-13	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-13	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-13	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	0.065	N/A	0.050	mg/L	2022-10-14	
Phosphorus, Total (as P)	0.0129	N/A	0.0050		2022-10-13	
Phosphorus, Total Dissolved	0.0126	N/A	0.0050	mg/L	2022-10-13	
Solids, Total Dissolved	723	AO ≤ 500	15	mg/L	2022-10-13	HT
Oup (22J0983-04)   Matrix: Water   Samp	led: 2022-10-05 17	2:00				
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-10-08	
Chloride	109	AO ≤ 250	0.10	mg/L	2022-10-08	
Fluoride	0.41	MAC = 1.5	0.10	mg/L	2022-10-08	
Nitrate (as N)	0.688	MAC = 10	0.010	mg/L	2022-10-08	
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-10-08	
Phosphate (as P)	0.151	N/A	0.0050	mg/L	2022-10-08	
Sulfate	109	AO ≤ 500	1.0	mg/L	2022-10-08	

N/A

None Required

0.500 mg/L

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**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER REPORTED 22J0983 2022-10-14 17:42

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Dup (22J0983-04)   Matrix: Water   San	npled: 2022-10-05 17:	00, Continued				
Calculated Parameters, Continued						
Nitrate+Nitrite (as N)	0.688	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	1.26	N/A	0.0500		N/A	
Nitrogen, Organic	0.576	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Antimony, dissolved	< 0.00020	N/A	0.00020		2022-10-14	
Arsenic, dissolved	0.00219	N/A	0.00050		2022-10-14	
Barium, dissolved	0.0282	N/A	0.0050		2022-10-14	
Beryllium, dissolved	< 0.00010	N/A	0.00010		2022-10-14	
Bismuth, dissolved	< 0.00010	N/A	0.00010		2022-10-14	
Boron, dissolved	0.199	N/A	0.0500		2022-10-14	
Cadmium, dissolved	0.000323	N/A	0.000010		2022-10-14	
Calcium, dissolved	91.5	N/A	0.20		2022-10-14	
Chromium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	
Cobalt, dissolved	0.00040	N/A	0.00010		2022-10-14	
Copper, dissolved	0.0132	N/A	0.00040		2022-10-14	
Iron, dissolved	0.010	N/A	0.00040		2022-10-14	
Lead, dissolved	0.00027	N/A	0.00020		2022-10-14	
Lithium, dissolved	0.0027	N/A	0.00020		2022-10-14	
Magnesium, dissolved	23.2	N/A	0.00010		2022-10-14	
Manganese, dissolved	0.00028	N/A	0.00020		2022-10-14	
Mercury, dissolved	< 0.00028	N/A	0.00020		2022-10-14	
Molybdenum, dissolved	0.0138	N/A	0.000010		2022-10-13	
Nickel, dissolved	0.00164	N/A	0.00010		2022-10-14	
Phosphorus, dissolved	0.00164	N/A	0.00040		2022-10-14	
Potassium, dissolved	18.0	N/A		mg/L	2022-10-14	
Selenium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	
Silicon, dissolved		N/A	1.0		2022-10-14	
Silver, dissolved	8.8					
	< 0.000050	N/A	0.000050		2022-10-14	
Sodium, dissolved	113	N/A		mg/L	2022-10-14	
Strontium, dissolved	0.782	N/A	0.0010		2022-10-14	
Sulfur, dissolved	38.5	N/A		mg/L	2022-10-14	
Tellurium, dissolved	< 0.00050	N/A	0.00050		2022-10-14	
Thallium, dissolved	< 0.000020	N/A	0.000020		2022-10-14	
Thorium, dissolved	< 0.00010	N/A	0.00010		2022-10-14	
Tin, dissolved	< 0.00020	N/A	0.00020		2022-10-14	
Titanium, dissolved	< 0.0050	N/A	0.0050		2022-10-14	
Tungsten, dissolved	< 0.0010	N/A	0.0010		2022-10-14	
Uranium, dissolved	0.00556	N/A	0.000020		2022-10-14	
Vanadium, dissolved	< 0.0050	N/A	0.0050		2022-10-14	
Zinc, dissolved	0.0214	N/A	0.0040		2022-10-14	
Zirconium, dissolved	0.00014	N/A	0.00010	mg/L	2022-10-14	



**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER

22J0983

**REPORTED** 2022-10-14 17:42

Result	Guideline	RL Units	Analyzed	Qualifier
ed: 2022-10-05 17	':00, Continued			
297	N/A	1.0 mg/L	2022-10-13	
< 1.0	N/A	1.0 mg/L	2022-10-13	
297	N/A	1.0 mg/L	2022-10-13	
< 1.0	N/A	1.0 mg/L	2022-10-13	
< 1.0	N/A	1.0 mg/L	2022-10-13	
< 0.050	None Required	0.050 mg/L	2022-10-12	
0.576	N/A	0.050 mg/L	2022-10-14	
0.270	N/A	0.0050 mg/L	2022-10-13	
0.270	N/A	0.0050 mg/L	2022-10-13	
643	AO ≤ 500	15 mg/L	2022-10-13	HT1
	297 < 1.0 297 < 1.0 < 1.0 < 1.0 < 1.0 < 1.0 < 1.0 < 0.050 0.576 0.270 0.270	297 N/A < 1.0 N/A	297 N/A 1.0 mg/L < 1.0 N/A 1.0 mg/L 297 N/A 1.0 mg/L 297 N/A 1.0 mg/L 297 N/A 1.0 mg/L < 1.0 N/A 1.0 mg/L < 1.0 N/A 1.0 mg/L < 1.0 N/A 0.050 mg/L  0.270 N/A 0.0050 mg/L 0.270 N/A 0.0050 mg/L	297 N/A 1.0 mg/L 2022-10-13 < 1.0 N/A 1.0 mg/L 2022-10-13 297 N/A 1.0 mg/L 2022-10-13 297 N/A 1.0 mg/L 2022-10-13 < 1.0 N/A 0.050 mg/L 2022-10-12  0.576 N/A 0.050 mg/L 2022-10-14  0.270 N/A 0.0050 mg/L 2022-10-13  0.270 N/A 0.0050 mg/L 2022-10-13

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



### **APPENDIX 1: SUPPORTING INFORMATION**

REPORTED TO Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER REPORTED 22J0983

**TED** 2022-10-14 17:42

Analysis Description	Method Ref.	Technique	Accredited	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
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	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	Solids in Water, Filtered / SM 2540 C* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

#### **Glossary of Terms:**

RL Reporting Limit (default)

Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors

AO Aesthetic Objective

MAC Maximum Acceptable Concentration (health based)

mg/L Milligrams per litre

EPA United States Environmental Protection Agency Test Methods

SM Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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

#### Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user



### **APPENDIX 1: SUPPORTING INFORMATION**

**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER
REPORTED

22J0983

2022-10-14 17:42

#### **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 or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

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 <u>not</u> 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:bwhitehead@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.



**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER REPORTED 22J0983 2022-10-14 17:42

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- Duplicate (Dup): An additional or second portion of a randomly selected sample in the analytical run carried through the entire
  analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- Blank Spike (BS): A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- Matrix Spike (MS): A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- Reference Material (SRM): A homogenous material of similar matrix to the samples, certified for the parameter(s) listed.
   Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2J0853									
Blank (B2J0853-BLK1)			Prepared	d: 2022-10-	12, Analyze	d: 2022-	10-12		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK2)			Prepared	d: 2022-10-	12, Analyze	d: 2022-	10-12		
Bromide	< 0.10	0.10 mg/L			-				
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK3)			Prepared	d: 2022-10-	13, Analyze	d: 2022-	10-13		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK4)			Prepared	d: 2022-10-	13, Analyze	d: 2022-	10-13		
Bromide	< 0.10	0.10 mg/L			. ,				
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B2J0853-BS1)			Prepared	d: 2022-10-	12, Analyze	ed: 2022-	10-12		
Bromide	4.15	0.10 mg/L	4.00		104	85-115			



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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B2J0853, Continued									
LCS (B2J0853-BS1), Continued			Prepared	d: 2022-10-1	12, Analyze	ed: 2022-	10-12		
Chloride	16.1	0.10 mg/L	16.0		100	90-110			
Fluoride	4.02	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	3.97	0.010 mg/L	4.00		99	90-110			
Nitrite (as N)	1.85	0.010 mg/L	2.00		93	85-115			
Phosphate (as P)	1.06	0.0050 mg/L	1.00		106	80-120			
Sulfate	16.2	1.0 mg/L	16.0		101	90-110			
LCS (B2J0853-BS2)			Prepared	d: 2022-10-1	12, Analyze	ed: 2022-	10-12		
Bromide	3.92	0.10 mg/L	4.00		98	85-115			
Chloride	15.9	0.10 mg/L	16.0		99	90-110			
Fluoride	3.98	0.10 mg/L	4.00		99	88-108			
Nitrate (as N)	3.96	0.010 mg/L	4.00		99	90-110			
Nitrite (as N)	1.92	0.010 mg/L	2.00		96	85-115			
Phosphate (as P)	1.03	0.0050 mg/L	1.00		103	80-120			
Sulfate	15.6	1.0 mg/L	16.0		97	90-110			
LCS (B2J0853-BS3)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Bromide	4.14	0.10 mg/L	4.00		104	85-115			
Chloride	15.5	0.10 mg/L	16.0		97	90-110			
Fluoride	4.01	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	4.03	0.010 mg/L	4.00		101	90-110			
Nitrite (as N)	1.96	0.010 mg/L	2.00		98	85-115			
Phosphate (as P)	1.05	0.0050 mg/L	1.00		105	80-120			
Sulfate	16.2	1.0 mg/L	16.0		101	90-110			
LCS (B2J0853-BS4)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Bromide	4.08	0.10 mg/L	4.00		102	85-115			
Chloride	15.6	0.10 mg/L	16.0		98	90-110			
Fluoride	3.93	0.10 mg/L	4.00		98	88-108			
Nitrate (as N)	3.91	0.010 mg/L	4.00		98	90-110			
Nitrite (as N)	1.84	0.010 mg/L	2.00		92	85-115			
Phosphate (as P)	1.07	0.0050 mg/L	1.00		107	80-120			
Sulfate	15.6	1.0 mg/L	16.0		98	90-110			
Dissolved Metals, Batch B2J1342									
Blank (B2J1342-BLK1)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Mercury, dissolved	< 0.000010	0.000010 mg/L	· · · · · · · · · · · · · · · · · · ·						
Blank (B2J1342-BLK2)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Mercury, dissolved	< 0.000010	0.000010 mg/L	•		. ,				
Blank (B2J1342-BLK3)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Mercury, dissolved	< 0.000010	0.000010 mg/L	· · · · · · · · · · · · · · · · · · ·						
LCS (B2J1342-BS1)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Mercury, dissolved	0.000523	0.000010 mg/L	0.000500		105	80-120			
LCS (B2J1342-BS2)			Prepared	d: 2022-10-1	13, Analyze	ed: 2022-	10-13		
Mercury, dissolved	0.000525	0.000010 mg/L	0.000500		105	80-120	-		
LCS (B2J1342-BS3)		<u> </u>		d: 2022-10-1			10-13		
	0.000500	0.000010//		4. ZUZZ-1U-			10-10		
Mercury, dissolved	0.000523	0.000010 mg/L	0.000500		105	80-120			

Dissolved Metals, Batch B2J1490



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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B2J1490,	Continued								
Blank (B2J1490-BLK1)			Prepared	I: 2022-10-1	4, Analyze	ed: 2022-1	0-14		
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							
Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0500	0.0500 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20 mg/L							
Chalt dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved Copper, dissolved	< 0.00010 < 0.00040	0.00010 mg/L 0.00040 mg/L							
Iron, dissolved	< 0.0040	0.00040 mg/L 0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Lithium, dissolved	< 0.00020	0.00020 Hig/L 0.00010 mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved Uranium, dissolved	< 0.0010 < 0.00020	0.0010 mg/L 0.000020 mg/L							
Vanadium, dissolved	< 0.0050	0.00020 mg/L							
Zinc, dissolved	< 0.0030	0.0030 mg/L							
Zirconium, dissolved	< 0.00010	0.00010 mg/L							
LCS (B2J1490-BS1)	0.00010	0.00010g, 2	Prepared	I: 2022-10-1	4, Analyze	ed: 2022-1	0-14		
Aluminum, dissolved	4.22	0.0050 mg/L	4.00		105	80-120			
Antimony, dissolved	0.0401	0.00020 mg/L	0.0400		100	80-120			
Arsenic, dissolved	0.0424	0.00050 mg/L	0.0400		106	80-120			
Barium, dissolved	0.0393	0.0050 mg/L	0.0400		98	80-120			
Beryllium, dissolved	0.0400	0.00010 mg/L	0.0400		100	80-120			
Bismuth, dissolved	0.0409	0.00010 mg/L	0.0400		102	80-120			
Boron, dissolved	< 0.0500	0.0500 mg/L	0.0400		104	80-120			
Cadmium, dissolved	0.0407	0.000010 mg/L	0.0400		102	80-120			
Calcium, dissolved, dissolved	3.93	0.20 mg/L	4.00		98	80-120			
Chromium, dissolved	0.0419	0.00050 mg/L	0.0400		105	80-120			
Cobalt, dissolved	0.0413	0.00010 mg/L	0.0400		103	80-120			
Copper, dissolved	0.0419	0.00040 mg/L	0.0400		105	80-120			
Iron, dissolved	4.19	0.010 mg/L	4.00		105	80-120			
Lead, dissolved	0.0408	0.00020 mg/L	0.0400		102	80-120			
Lithium, dissolved	0.0410	0.00010 mg/L	0.0400		102	80-120			
Magnesium, dissolved, dissolved	4.37	0.010 mg/L	4.00		109	80-120			
Manganese, dissolved	0.0414	0.00020 mg/L	0.0400		103	80-120			



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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier	
Dissolved Metals, Batch B2J1490,	Continued									
LCS (B2J1490-BS1), Continued			Prepared	: 2022-10-1	4, Analyze	d: 2022-1	0-14			
Molybdenum, dissolved	0.0406	0.00010 mg/L	0.0400		101	80-120				
Nickel, dissolved	0.0415	0.00040 mg/L	0.0400		104	80-120				
Phosphorus, dissolved	4.21	0.050 mg/L	4.00		105	80-120				
Potassium, dissolved	4.22	0.10 mg/L	4.00		105	80-120				
Selenium, dissolved	0.0400	0.00050 mg/L	0.0400		100	80-120				
Silicon, dissolved	4.2	1.0 mg/L	4.00		106	80-120				
Silver, dissolved	0.0400	0.000050 mg/L	0.0400		100	80-120				
Sodium, dissolved	4.07	0.10 mg/L	4.00		102	80-120				
Strontium, dissolved	0.0408	0.0010 mg/L	0.0400		102	80-120				
Sulfur, dissolved	41.7	3.0 mg/L	40.0		104	80-120				
Tellurium, dissolved	0.0390	0.00050 mg/L	0.0400		97	80-120				
Thallium, dissolved	0.0398	0.000020 mg/L	0.0400		100	80-120				
Thorium, dissolved	0.0418	0.00010 mg/L	0.0400		104	80-120				
Tin, dissolved	0.0404	0.00020 mg/L	0.0400		101	80-120				
Titanium, dissolved	0.0422	0.0050 mg/L	0.0400		106	80-120				
Tungsten, dissolved	0.0406	0.0010 mg/L	0.0400		101	80-120				
Uranium, dissolved	0.0416	0.000020 mg/L	0.0400		104	80-120				
Vanadium, dissolved	0.0414	0.0050 mg/L	0.0400		103	80-120				
Zinc, dissolved Zirconium, dissolved	0.0410 0.0407	0.0040 mg/L 0.00010 mg/L	0.0400		102 102	80-120 80-120				
Blank (B2J1208-BLK1) Ammonia, Total (as N)	< 0.050	0.050 mg/L	Prepared	: 2022-10-1	2, Analyze	ed: 2022-1	0-12			
	<u> </u>	0.030 Hig/L	D	. 0000 40 4	0 4 1	d. 0000 4	0.40			
Ammonia, Total (as N)	< 0.050	0.050 mg/L	Prepared	: 2022-10-1	2, Analyze	ea: 2022-1	0-12			
	< 0.030	0.030 Hig/L	Dranarad	. 2022 40 4	2 Analyza	٠ ١٠٥٥ ١	0.10			
Ammonia, Total (as N)	< 0.050	0.050 mg/L	Prepared	: 2022-10-1	z, Analyze	:u. 2022-1	0-12			
Blank (B2J1208-BLK4)		0.000 mg/L	Prenared	: 2022-10-1	2 Analyze	nd: 2022-1	0-12			
Ammonia, Total (as N)	< 0.050	0.050 mg/L	Порагоа	. 2022 10 1	2,7 mary20		0 12			
Blank (B2J1208-BLK5)		-	Prepared	: 2022-10-1	2, Analyze	d: 2022-1	0-12			
Ammonia, Total (as N)	< 0.050	0.050 mg/L	· ·							
LCS (B2J1208-BS1)			Prepared	: 2022-10-1	2, Analyze	d: 2022-1	0-12			
Ammonia, Total (as N)	0.951	0.050 mg/L	1.00		95	90-115				
LCS (B2J1208-BS2)			Prepared	: 2022-10-1	2, Analyze	d: 2022-1	0-12			
Ammonia, Total (as N)	0.962	0.050 mg/L	1.00		96	90-115				
LCS (B2J1208-BS3)			<u> </u>	: 2022-10-1			0-12			
Ammonia, Total (as N)	0.958	0.050 mg/L	1.00		96	90-115				
LCS (B2J1208-BS4)				: 2022-10-1			0-12			
Ammonia, Total (as N)	0.972	0.050 mg/L	1.00		97	90-115				
LCS (B2J1208-BS5)				: 2022-10-1			0-12			
Ammonia, Total (as N)	0.957	0.050 mg/L	1.00		96	90-115				

General Parameters, Batch B2J1293



Analyte  General Parameters, Bat  Blank (B2J1293-BLK1)			nmental Consultants Inc. (Vernon)			WORK ORDER REPORTED			22J0983 2022-10-14 17:42		
·		Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifie	
Blank (B2J1293-BLK1)	tch B2J1293, Conti	nued									
				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-14			
Nitrogen, Total Kjeldahl		< 0.050	0.050 mg/L								
Blank (B2J1293-BLK2)				Prepared	l: 2022-10-1	2 Analyze	ed: 2022-1	0-14			
Nitrogen, Total Kjeldahl		< 0.050	0.050 mg/L	1 Toparoa	. 2022 10 1		G. LOLL				
		0.000	0.000g/_	D	L 0000 40 4	0 4 1	-l. 0000 4	0.44			
LCS (B2J1293-BS1)		0.000	0.050		l: 2022-10-1			0-14			
Nitrogen, Total Kjeldahl		0.989	0.050 mg/L	1.00		99	85-115				
LCS (B2J1293-BS2)				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-14			
Nitrogen, Total Kjeldahl		0.993	0.050 mg/L	1.00		99	85-115				
General Parameters, Ba	tch B2J1307										
Blank (B2J1307-BLK1)				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-13			
Phosphorus, Total (as P)		< 0.0050	0.0050 mg/L								
Blank (B2J1307-BLK2)				Prepared	l: 2022-10-1	2 Analyze	ed: 2022-1	0-13			
Phosphorus, Total Dissolved	 	< 0.0050	0.0050 mg/L			_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
Blank (B2J1307-BLK3)				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-13			
Phosphorus, Total (as P)		< 0.0050	0.0050 mg/L								
Phosphorus, Total Dissolved		< 0.0050	0.0050 mg/L								
LCS (B2J1307-BS1)				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-13			
Phosphorus, Total (as P)		0.114	0.0050 mg/L	0.100		114	85-115				
LCS (B2J1307-BS2)				Prepared	l: 2022-10-1	2, Analyze	ed: 2022-1	0-13			
Phosphorus, Total Dissolved		0.115	0.0050 mg/L	0.100		115	85-115				
LCS (B2J1307-BS3)				Prepared	I: 2022-10-1	2, Analyze	ed: 2022-1	0-13			
Phosphorus, Total (as P)		0.107	0.0050 mg/L	0.100		107	85-115				
Phosphorus, Total Dissolved		0.107	0.0050 mg/L	0.100		107	85-115				
General Parameters, Bai Blank (B2J1348-BLK1)	tch B2J1348			Prepared	l: 2022-10-1	3, Analyze	ed: 2022-1	0-13			
Alkalinity, Total (as CaCO3)	0-000)	< 1.0	1.0 mg/L								
Alkalinity, Phenolphthalein (a Alkalinity, Bicarbonate (as C		< 1.0 < 1.0	1.0 mg/L 1.0 mg/L								
Alkalinity, Carbonate (as Ca		< 1.0	1.0 mg/L								
Alkalinity, Hydroxide (as Ca0	,	< 1.0	1.0 mg/L								
Blank (B2J1348-BLK2)				Prepared	I: 2022-10-1	3, Analyze	ed: 2022-1	0-13			
Alkalinity, Total (as CaCO3)		< 1.0	1.0 mg/L								
Alkalinity, Phenolphthalein (a		< 1.0	1.0 mg/L								
Alkalinity, Bicarbonate (as Cal		< 1.0	1.0 mg/L								
Alkalinity, Carbonate (as Car Alkalinity, Hydroxide (as Car		< 1.0 < 1.0	1.0 mg/L 1.0 mg/L								
Blank (B2J1348-BLK3)	,		- 3	Prepared	l: 2022-10-1	3, Analyze	ed: 2022-1	0-13			
Alkalinity, Total (as CaCO3)		2.4	1.0 mg/L								
Alkalinity, Phenolphthalein (a	as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Bicarbonate (as C		2.4	1.0 mg/L								
Alkalinity, Carbonate (as Car Alkalinity, Hydroxide (as Car		< 1.0 < 1.0	1.0 mg/L 1.0 mg/L								



REPORTED TO PROJECT	Associated Enviror 2022-8307.000	nmental Consulta	ants Inc. (Vernor	٦)		WORK REPOR	ORDER TED		22J0983 2022-10-14 17:42	
Analyte		Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameter	rs, Batch B2J1348, Co	ntinued								
Blank (B2J1348-B	LK4)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphth		< 1.0	1.0 mg/L							
Alkalinity, Bicarbonat	e (as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate	(as CaCO3)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide		< 1.0	1.0 mg/L							
LCS (B2J1348-BS	1)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	101	1.0 mg/L	100		101	80-120			
LCS (B2J1348-BS	2)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	107	1.0 mg/L	100		107	80-120			
LCS (B2J1348-BS	3)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	99.4	1.0 mg/L	100		99	80-120			
LCS (B2J1348-BS	7)		-	Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	97.2	1.0 mg/L	100		97	80-120			
Duplicate (B2J134	I8-DUP3)	Sour	ce: 22J0983-01	Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Alkalinity, Total (as C	aCO3)	294	1.0 mg/L		293			< 1	10	
Alkalinity, Phenolphth	nalein (as CaCO3)	< 1.0	1.0 mg/L		< 1.0				10	
Alkalinity, Bicarbonat	e (as CaCO3)	294	1.0 mg/L		293			< 1	10	
Alkalinity, Carbonate	(as CaCO3)	< 1.0	1.0 mg/L		< 1.0				10	
Alkalinity, Hydroxide	(as CaCO3)	< 1.0	1.0 mg/L		< 1.0				10	
General Parameter	rs, Batch B2J1434									
Blank (B2J1434-B	LK1)			Prepared	d: 2022-10-1	13, Analyze	d: 2022-1	10-13		
Solids, Total Dissolve	ed	< 15	15 mg/L							
Blank (B2J1434-B	LK2)			Prepared	d: 2022-10-1	13, Analyze	d: 2022-1	10-13		
Solids, Total Dissolve	ed	< 15	15 mg/L							
LCS (B2J1434-BS	1)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Solids, Total Dissolve	ed	228	15 mg/L	240		95	85-115			
LCS (B2J1434-BS	2)			Prepared	d: 2022-10-1	I3, Analyze	d: 2022-1	10-13		
Solids, Total Dissolve	ed	229	15 mg/L	240		95	85-115			
			-							





#### **CERTIFICATE OF ANALYSIS**

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.

**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

#200 - 2800 29th Street Vernon, BC V1T 9P9

ATTENTION Nicole Penner WORK ORDER 22J0954

PO NUMBER RECEIVED / TEMP 2022-10-07 10:00 / 3.8°C

**PROJECT** 2022-8307.000 **REPORTED** 2022-10-18 10:14

PROJECT INFO City of Vernon COC NUMBER No #

#### 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/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

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.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

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

Authorized By:

Brent Whitehead Account Manager M what



PROJECT	Associated Environmental 2022-8307.000	iental Consultants Inc. (Vernori)			REPORTED	2022-10-18 10:14	
Analyte		Result	Guideline	RL	Units	Analyzed	Qualifier
MW-2 (22J0954-0	1)   Matrix: Water   Sample	d: <b>2022-10-06</b> 1	5:10				
Anions							
Bromide		< 0.10	N/A	0.10	mg/L	2022-10-08	
Chloride		5.15	AO ≤ 250	0.10	mg/L	2022-10-08	
Fluoride		0.29	MAC = 1.5	0.10	mg/L	2022-10-08	
Nitrate (as N)		0.022	MAC = 10	0.010	mg/L	2022-10-08	
Nitrite (as N)		< 0.010	MAC = 1	0.010	mg/L	2022-10-08	

< 0.0050

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#### **Calculated Parameters**

Phosphate (as P)

Sulfate

Hardness, Total (as CaCO3)	172	None Required	0.500 mg/L	N/A	
Nitrate+Nitrite (as N)	0.0221	N/A	0.0100 mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500 mg/L	N/A	
Nitrogen, Organic	< 0.0500	N/A	0.0500 mg/L	N/A	
			<u> </u>		

N/A

AO ≤ 500

0.0050 mg/L

1.0 mg/L

2022-10-08

2022-10-08

Nitrate+Nitrite (as N)	0.0221	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Nitrogen, Organic	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Barium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-10-15	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-15	
Calcium, dissolved	5.42	N/A	0.20	mg/L	2022-10-15	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-15	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Lithium, dissolved	0.00120	N/A	0.00010	mg/L	2022-10-15	
Magnesium, dissolved	38.4	N/A	0.010	mg/L	2022-10-15	
Manganese, dissolved	0.0389	N/A	0.00020	mg/L	2022-10-15	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-12	
Molybdenum, dissolved	0.00289	N/A	0.00010	mg/L	2022-10-15	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-15	
Potassium, dissolved	3.03	N/A	0.10	mg/L	2022-10-15	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Silicon, dissolved	< 1.0	N/A	1.0	mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-15	
Sodium, dissolved	46.5	N/A	0.10	mg/L	2022-10-15	Ξ
Strontium, dissolved	0.0328	N/A	0.0010	mg/L	2022-10-15	Τ
Sulfur, dissolved	66.3	N/A	3.0	mg/L	2022-10-15	Τ
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
					Dogo 2 o	- 6

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<b>PROJECT</b> 2022-8307.000	ental Consultants Ir	nc. (Vernon)		WORK ORDER REPORTED	22J0954 2022-10-	18 10:14
Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MW-2 (22J0954-01)   Matrix: Water   Sam	npled: 2022-10-06	15:10, Continued				
Dissolved Metals, Continued						
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
General Parameters						
Alkalinity, Total (as CaCO3)	165	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	165	N/A		mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-14	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050		2022-10-12	
Phosphorus, Total (as P)	0.0233	N/A	0.0050		2022-10-14	
Phosphorus, Total Dissolved	0.0205	N/A	0.0050		2022-10-14	
1 Hoophords, Total Bissolved	0.0200	14// \	0.0000	mg/L	2022 10 17	
Solids, Total Dissolved	584	AO ≤ 500	15	mg/L	2022-10-14	HT1
Solids, Total Dissolved  MW-5 (22J0954-02)   Matrix: Water   Sam  Anions			15	mg/L	2022-10-14	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam				mg/L	2022-10-14	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam Anions	npled: 2022-10-06 (	08:20	0.10			HT1
MW-5 (22J0954-02)   Matrix: Water   Sam Anions Bromide	npled: 2022-10-06 (	08:20 N/A	0.10 0.10	mg/L	2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam Anions Bromide Chloride	<pre>control = 0.10</pre>	08:20 N/A AO ≤ 250	0.10 0.10	mg/L mg/L mg/L	2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam Anions Bromide Chloride Fluoride	<pre>&lt; 0.10</pre>	N/A AO ≤ 250 MAC = 1.5	0.10 0.10 0.10	mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam Anions Bromide Chloride Fluoride Nitrate (as N)	< 0.10  8.31  < 0.10  < 0.10  0.10	N/A AO ≤ 250 MAC = 1.5 MAC = 10	0.10 0.10 0.10 0.010	mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N)	<pre>&lt; 0.10</pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1	0.10 0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate	<pre>&lt; 0.10</pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A	0.10 0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate	<pre>&lt; 0.10</pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A	0.10 0.10 0.10 0.010 0.010 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters	<pre>&lt; 0.10</pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500	0.10 0.10 0.10 0.010 0.010 0.0050 1.0	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3)	<ul> <li>&lt; 0.10</li> <li>8.31</li> <li>&lt; 0.10</li> <li>&lt; 0.010</li> <li>&lt; 0.010</li> <li>&lt; 0.0050</li> <li>198</li> </ul>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required	0.10 0.10 0.10 0.010 0.010 0.0050 1.0	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	<ul> <li>&lt; 0.10</li> <li>8.31</li> <li>&lt; 0.10</li> <li>&lt; 0.010</li> <li>&lt; 0.010</li> <li>&lt; 0.0050</li> <li>198</li> <li>378</li> <li>&lt; 0.0100</li> </ul>	N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	<ul> <li>&lt; 0.10</li> <li>8.31</li> <li>&lt; 0.10</li> <li>&lt; 0.010</li> <li>&lt; 0.010</li> <li>&lt; 0.0050</li> <li>198</li> <li>378</li> <li>&lt; 0.0100</li> <li>0.544</li> </ul>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required N/A N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	<ul> <li>&lt; 0.10</li> <li>8.31</li> <li>&lt; 0.10</li> <li>&lt; 0.010</li> <li>&lt; 0.010</li> <li>&lt; 0.0050</li> <li>198</li> <li>378</li> <li>&lt; 0.0100</li> <li>0.544</li> </ul>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required N/A N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
MW-5 (22J0954-02)   Matrix: Water   Sam  Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals	<pre></pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required N/A N/A N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A N/A	HT1
Anions Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved	<pre></pre>	N/A AO ≤ 250 MAC = 1.5 MAC = 10 MAC = 1 N/A AO ≤ 500  None Required N/A N/A N/A N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A N/A N/A	HT1



REPORTED TO Associated Environmental Consultants Inc. (Vernon) WORK ORDER 22J0954
PROJECT 2022-8307.000 REPORTED 2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifie
MW-5 (22J0954-02)   Matrix: Water   Sam	npled: 2022-10-06 (	08:20, Continued				
Dissolved Metals, Continued						
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-10-15	
Cadmium, dissolved	0.000036	N/A	0.000010	mg/L	2022-10-15	
Calcium, dissolved	70.6	N/A	0.20	mg/L	2022-10-15	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-15	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Lithium, dissolved	0.00534	N/A	0.00010	mg/L	2022-10-15	
Magnesium, dissolved	48.9	N/A	0.010	mg/L	2022-10-15	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-12	
Molybdenum, dissolved	0.0143	N/A	0.00010	mg/L	2022-10-15	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-15	
Potassium, dissolved	5.63	N/A		mg/L	2022-10-15	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Silicon, dissolved	8.8	N/A	1.0	mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-15	
Sodium, dissolved	34.7	N/A	0.10	mg/L	2022-10-15	
Strontium, dissolved	0.813	N/A	0.0010	mg/L	2022-10-15	
Sulfur, dissolved	105	N/A		mg/L	2022-10-15	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	0.00678	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	0.0406	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
General Parameters						
Alkalinity, Total (as CaCO3)	85.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	69.2	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	15.9	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Ammonia, Total (as N)	0.281	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	0.544	N/A	0.050		2022-10-16	



REPORTED TO PROJECT	Associated Environme 2022-8307.000	ental Consultants In	c. (Vernon)		WORK ORDER REPORTED	22J0954 2022-10-1	8 10:14
Analyte		Result	Guideline	RL	Units	Analyzed	Qualifier
MW-5 (22J0954-0	2)   Matrix: Water   Sam	pled: 2022-10-06 0	8:20, Continued				
General Parameter	rs, Continued						
Phosphorus, Tota	l (as P)	0.0407	N/A	0.0050	mg/L	2022-10-14	
Phosphorus, Tota	l Dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Solids, Total Disso	olved	335	AO ≤ 500	15	mg/L	2022-10-14	HT1
MW11-02 (22J09	54-03)   Matrix: Water   S	Sampled: 2022-10-	06 11:15				
Anions							
Bromide		< 0.10	N/A	0.10	mg/L	2022-10-08	
Chloride		115	AO ≤ 250		mg/L	2022-10-08	
Fluoride		0.25	MAC = 1.5	0.10	mg/L	2022-10-08	
Nitrate (as N)		8.69	MAC = 10	0.010	mg/L	2022-10-08	
Nitrite (as N)		< 0.010	MAC = 1	0.010	mg/L	2022-10-08	
Phosphate (as P)		< 0.0050	N/A	0.0050	mg/L	2022-10-08	
Sulfate		913	AO ≤ 500	1.0	mg/L	2022-10-13	
Calculated Parame	eters						
Hardness, Total (a	as CaCO3)	1200	None Required	0.500		N/A	
Nitrate+Nitrite (as	N)	8.69	N/A	0.0100		N/A	
Nitrogen, Total		9.18	N/A	0.0500		N/A	
Nitrogen, Organic		0.490	N/A	0.0500	mg/L	N/A	
Dissolved Metals							
Aluminum, dissolv	/ed	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Antimony, dissolve	ed	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Arsenic, dissolved	1	0.00062	N/A	0.00050	mg/L	2022-10-15	
Barium, dissolved		0.0297	N/A	0.0050	mg/L	2022-10-15	
Beryllium, dissolve	ed	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Bismuth, dissolve	d	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Boron, dissolved		0.101	N/A	0.0500	mg/L	2022-10-15	
Cadmium, dissolv	red	0.000089	N/A	0.000010	mg/L	2022-10-15	
Calcium, dissolve	d	248	N/A	0.20	mg/L	2022-10-15	
Chromium, dissol	ved	0.00199	N/A	0.00050	mg/L	2022-10-15	
Cobalt, dissolved		0.00196	N/A	0.00010	mg/L	2022-10-15	
Copper, dissolved		0.00191	N/A	0.00040	mg/L	2022-10-15	
Iron, dissolved		< 0.010	N/A	0.010		2022-10-15	
Lead, dissolved		< 0.00020	N/A	0.00020		2022-10-15	
Lithium, dissolved		0.0207	N/A	0.00010		2022-10-15	
Magnesium, disso	olved	141	N/A	0.010	mg/L	2022-10-15	
Manganese, disso	olved	0.00025	N/A	0.00020	mg/L	2022-10-15	
Mercury, dissolve	d	< 0.000010	N/A	0.000010		2022-10-12	
Molybdenum, diss	solved	0.0115	N/A	0.00010		2022-10-15	
Nickel, dissolved		0.0106	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, disso	nlved	< 0.050	N/A	0.050	ma/l	2022-10-15	



REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	WORK ORDER	22J0954
PROJECT	2022-8307.000	REPORTED	2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifie
	Sampled: 2022-10-	06 11:15, Continue	d			
Dissolved Metals, Continued						
Potassium, dissolved	11.1	N/A	0.10	mg/L	2022-10-15	
Selenium, dissolved	0.0304	N/A	0.00050	mg/L	2022-10-15	
Silicon, dissolved	13.4	N/A	1.0	mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-15	
Sodium, dissolved	154	N/A	0.10	mg/L	2022-10-15	
Strontium, dissolved	1.72	N/A	0.0010	mg/L	2022-10-15	
Sulfur, dissolved	357	N/A	3.0	mg/L	2022-10-15	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	0.0547	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
General Parameters						
Alkalinity, Total (as CaCO3)	364	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	364	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-10-12	
Nitrogen, Total Kjeldahl	0.490	N/A	0.050	mg/L	2022-10-16	
Phosphorus, Total (as P)	0.160	N/A	0.0050	mg/L	2022-10-14	
Phosphorus, Total Dissolved	0.0257	N/A	0.0050	mg/L	2022-10-14	
Solids, Total Dissolved	1930	AO ≤ 500	15	mg/L	2022-10-14	HT1

Bromide	< 0.10	N/A	0.10	mg/L	2022-10-08
Chloride	88.4	AO ≤ 250	0.10	mg/L	2022-10-08
Fluoride	0.18	MAC = 1.5	0.10	mg/L	2022-10-08
Nitrate (as N)	3.29	MAC = 10	0.010	mg/L	2022-10-08
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-10-08
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-10-08
Sulfate	276	AO ≤ 500	1.0	mg/L	2022-10-08



**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

**PROJECT** 2022-8307.000

WORK ORDER REPORTED 22J0954 2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifie
DMW-1 (22J0954-04)   Matrix: Water	Sampled: 2022-10-06	13:45, Continued				
Calculated Parameters, Continued						
Nitrate+Nitrite (as N)	3.29	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	3.40	N/A	0.0500	mg/L	N/A	
Nitrogen, Organic	0.111	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	ma/L	2022-10-15	
Antimony, dissolved	< 0.00020	N/A	0.00020		2022-10-15	
Arsenic, dissolved	0.00080	N/A	0.00050	mg/L	2022-10-15	
Barium, dissolved	0.0409	N/A	0.0050		2022-10-15	
Beryllium, dissolved	< 0.00010	N/A	0.00010		2022-10-15	
Bismuth, dissolved	< 0.00010	N/A	0.00010		2022-10-15	
Boron, dissolved	< 0.0500	N/A	0.0500		2022-10-15	
Cadmium, dissolved	0.000024	N/A	0.000010		2022-10-15	
Calcium, dissolved	103	N/A		mg/L	2022-10-15	
Chromium, dissolved	0.00555	N/A	0.00050		2022-10-15	
Cobalt, dissolved	< 0.00010	N/A	0.00010		2022-10-15	
Copper, dissolved	< 0.00040	N/A	0.00040		2022-10-15	
Iron, dissolved	< 0.010	N/A	0.010		2022-10-15	
Lead, dissolved	< 0.00020	N/A	0.00020		2022-10-15	
Lithium, dissolved	0.00922	N/A	0.00010		2022-10-15	
Magnesium, dissolved	66.5	N/A	0.010		2022-10-15	
Manganese, dissolved	< 0.00020	N/A	0.00020		2022-10-15	
Mercury, dissolved	< 0.000010	N/A	0.000010		2022-10-12	
Molybdenum, dissolved	0.00804	N/A	0.00010		2022-10-15	
Nickel, dissolved	0.00098	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-15	
Potassium, dissolved	7.04	N/A	0.10		2022-10-15	
Selenium, dissolved	0.0276	N/A	0.00050		2022-10-15	
Silicon, dissolved	10.8	N/A		mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050		2022-10-15	
Sodium, dissolved	49.7	N/A		mg/L	2022-10-15	
Strontium, dissolved	1.20	N/A	0.0010		2022-10-15	
Sulfur, dissolved	103	N/A		mg/L	2022-10-15	
Tellurium, dissolved	< 0.00050	N/A	0.00050		2022-10-15	
Thallium, dissolved	< 0.000020	N/A	0.000020		2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010		2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020		2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050		2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010		2022-10-15	
Uranium, dissolved	0.0214	N/A	0.000020		2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050		2022-10-15	
Zinc, dissolved	< 0.0040	N/A	0.0040		2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010		2022-10-15	



REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	WORK ORDER	22J0954
PROJECT	2022-8307.000	REPORTED	2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DMW-1 (22J0954-04)   Matrix: Water   S	ampled: 2022-10-06	3 13:45, Continued				
General Parameters						
Alkalinity, Total (as CaCO3)	222	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	222	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-10-12	
Nitrogen, Total Kjeldahl	0.111	N/A	0.050	mg/L	2022-10-16	
Phosphorus, Total (as P)	0.0162	N/A	0.0050	mg/L	2022-10-14	
Phosphorus, Total Dissolved	0.0161	N/A	0.0050	mg/L	2022-10-14	
Solids, Total Dissolved	807	AO ≤ 500	15	mg/L	2022-10-14	HT1
Anions	.0.40	NI/A	0.40	/I	2022 40 00	
Bromide	< 0.10	N/A		mg/L	2022-10-08	
Chloride	112	AO ≤ 250		mg/L	2022-10-08	
Fluoride	0.53	MAC = 1.5		mg/L	2022-10-08	
Nitrate (as N)	0.224	MAC = 10	0.010		2022-10-08	
Nitrite (as N)	< 0.010	MAC = 1	0.010		2022-10-08	
Phosphate (as P)	< 0.0050	N/A	0.0050		2022-10-08	
Sulfate	169	AO ≤ 500	1.0	mg/L	2022-10-08	
Calculated Parameters						
Hardness, Total (as CaCO3)	620	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	0.224	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	0.568	N/A	0.0500	mg/L	N/A	
Nitrogen, Organic	0.344	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Barium, dissolved	0.0321	N/A	0.0050	mg/L	2022-10-15	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2022-10-15	
Cadmium, dissolved	0.000055	N/A	0.000010	mg/L	2022-10-15	
Calcium, dissolved	172	N/A	0.20	mg/L	2022-10-15	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Copper, dissolved	0.00302	N/A	0.00040	mg/L	2022-10-15	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-15	
Lead, dissolved	< 0.00020	N/A	0.00020	m a /l	2022-10-15	



**Analyte** 

**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

2022-8307.000 **PROJECT** 

**WORK ORDER REPORTED** 

**RL** Units

15 mg/L

22J0954 2022-10-18 10:14

Qualifier

Analyzed

DMW-3 (22,10954-05)	Matrix: Water   C	ampled: 2022-10	1_06 12:50	Continued

Result

Dissolved Metals, Continued						
Lithium, dissolved	0.0206	N/A	0.00010	mg/L	2022-10-15	
Magnesium, dissolved	46.2	N/A	0.010	mg/L	2022-10-15	
Manganese, dissolved	0.00641	N/A	0.00020	mg/L	2022-10-15	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-12	
Molybdenum, dissolved	0.00787	N/A	0.00010	mg/L	2022-10-15	
Nickel, dissolved	0.00142	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-15	
Potassium, dissolved	8.94	N/A	0.10	mg/L	2022-10-15	
Selenium, dissolved	0.00258	N/A	0.00050	mg/L	2022-10-15	
Silicon, dissolved	13.6	N/A	1.0	mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-15	
Sodium, dissolved	70.2	N/A	0.10	mg/L	2022-10-15	
Strontium, dissolved	1.32	N/A	0.0010	mg/L	2022-10-15	
Sulfur, dissolved	58.5	N/A	3.0	mg/L	2022-10-15	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	0.00521	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	0.0903	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
General Parameters						
Alkalinity, Total (as CaCO3)	425	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	425	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050	mg/L	2022-10-12	
Nitrogen, Total Kjeldahl	0.344	N/A	0.050		2022-10-16	
Phosphorus, Total (as P)	0.0074	N/A	0.0050		2022-10-14	
Phosphorus, Total Dissolved	0.0073	N/A	0.0050	mg/L	2022-10-14	
0 I' I T I I D' I I		10 : 500		- "	2000 10 11	

Guideline

#### WTN 24991 (22J0954-06) | Matrix: Water | Sampled: 2022-10-06 08:50

Solids, Total Dissolved

Anions					
Bromide	< 0.10	N/A	0.10 mg/L	2022-10-08	
Chloride	1.60	AO ≤ 250	0.10 mg/L	2022-10-08	
Fluoride	0.26	MAC = 1.5	0.10 mg/L	2022-10-08	

AO ≤ 500

919

HT1

2022-10-14



REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	WORK ORDER	22J0954
PROJECT	2022-8307.000	REPORTED	2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed Qualifie
WTN 24991 (22J0954-06)   Matrix: W	/ater   Sampled: 2022-1	0-06 08:50, Contin	ued		
Anions, Continued					
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2022-10-08
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2022-10-08
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2022-10-08
Sulfate	83.3	AO ≤ 500	1.0	mg/L	2022-10-08
Calculated Parameters					
Hardness, Total (as CaCO3)	198	None Required	0.500	mg/L	N/A
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100		N/A
Nitrogen, Total	0.111	N/A	0.0500		N/A
Nitrogen, Organic	< 0.0500	N/A	0.0500		N/A
Dissolved Metals					
Aluminum, dissolved	< 0.0050	N/A	0.0050	ma/l	2022-10-15
Antimony, dissolved	< 0.00020	N/A	0.00020		2022-10-15
Arsenic, dissolved	0.00116	N/A	0.00050		2022-10-15
Barium, dissolved	0.0190	N/A	0.0050		2022-10-15
Beryllium, dissolved	< 0.00010	N/A	0.00010		2022-10-15
Bismuth, dissolved	< 0.00010	N/A	0.00010		2022-10-15
Boron, dissolved	< 0.0500	N/A	0.0500		2022-10-15
Cadmium, dissolved	< 0.000010	N/A	0.000010		2022-10-15
Calcium, dissolved	47.7	N/A		mg/L	2022-10-15
Chromium, dissolved	< 0.00050	N/A	0.00050		2022-10-15
Cobalt, dissolved	< 0.00010	N/A	0.00010		2022-10-15
Copper, dissolved	< 0.00040	N/A	0.00040		2022-10-15
Iron, dissolved	0.212	N/A	0.010		2022-10-15
Lead, dissolved	< 0.00020	N/A	0.00020		2022-10-15
Lithium, dissolved	0.00393	N/A	0.00010		2022-10-15
Magnesium, dissolved	19.1	N/A	0.010		2022-10-15
Manganese, dissolved	0.0809	N/A	0.00020		2022-10-15
Mercury, dissolved	< 0.000010	N/A	0.000010		2022-10-12
Molybdenum, dissolved	0.0104	N/A	0.00010		2022-10-15
Nickel, dissolved	< 0.00040	N/A	0.00040		2022-10-15
Phosphorus, dissolved	< 0.050	N/A	0.050		2022-10-15
Potassium, dissolved	3.50	N/A		mg/L	2022-10-15
Selenium, dissolved	< 0.00050	N/A	0.00050		2022-10-15
Silicon, dissolved	10.2	N/A		mg/L	2022-10-15
Silver, dissolved	< 0.000050	N/A	0.000050		2022-10-15
Sodium, dissolved	32.9	N/A		mg/L	2022-10-15
Strontium, dissolved	0.493	N/A	0.0010		2022-10-15
Sulfur, dissolved	28.7	N/A		mg/L	2022-10-15
Tellurium, dissolved	< 0.00050	N/A	0.00050		2022-10-15
Thallium, dissolved	< 0.000020	N/A	0.00000		2022-10-15
Thorium, dissolved	< 0.00010	N/A	0.00010		2022-10-15
Tin, dissolved	< 0.00010	N/A	0.00010		2022-10-15
, 4.000.104	- 0.00020	13// 1	0.00020	ਭ, =	Page 10 o



REPORTED TO Associated Environment PROJECT 2022-8307.000	,			WORK ORDER REPORTED		
Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
WTN 24991 (22J0954-06)   Matrix: Water	Sampled: 2022-1	0-06 08:50, Continu	ıed			
Dissolved Metals, Continued						
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	0.00182	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
General Parameters						
Alkalinity, Total (as CaCO3)	187	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	187	N/A	1.0		2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0		2022-10-14	
Ammonia, Total (as N)	0.116	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	0.111	N/A	0.050		2022-10-16	
Phosphorus, Total (as P)	0.0203	N/A	0.0050		2022-10-14	
, , , ,					2022-10-14	
Phosphorus, Total Dissolved	0.0169	N/A	0.0050	ma/L		
Phosphorus, Total Dissolved Solids, Total Dissolved Field Blank (22J0954-07)   Matrix: Water	0.0169 318 Sampled: 2022-1	N/A AO ≤ 500 <b>0-06 14:00</b>	0.0050	mg/L mg/L	2022-10-14	HT1
•	318	AO ≤ 500				HT1
Solids, Total Dissolved Field Blank (22J0954-07)   Matrix: Water	318	AO ≤ 500	0.10	mg/L		HT1
Solids, Total Dissolved  Field Blank (22J0954-07)   Matrix: Water    Anions	318   Sampled: 2022-1	AO ≤ 500 <b>0-06 14:00</b>	0.10	mg/L	2022-10-14	HT1
Solids, Total Dissolved  Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide	318   Sampled: 2022-1	AO ≤ 500 <b>0-06 14:00</b> N/A	0.10 0.10	mg/L	2022-10-14	HT1
Solids, Total Dissolved  Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride	318   Sampled: 2022-1   < 0.10   < 0.10	AO ≤ 500  0-06 14:00  N/A  AO ≤ 250	0.10 0.10	mg/L mg/L mg/L mg/L	2022-10-14 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Solids, Total Dissolved  Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride	<pre>318 Sampled: 2022-1 &lt; 0.10 &lt; 0.10 &lt; 0.10 &lt; 0.010 &lt; 0.010 &lt; 0.010</pre>	AO ≤ 500  0-06 14:00  N/A  AO ≤ 250  MAC = 1.5	0.10 0.10 0.10 0.010 0.010	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P)	<pre>318 Sampled: 2022-1 &lt; 0.10 &lt; 0.10 &lt; 0.10 &lt; 0.010 &lt; 0.010 &lt; 0.010 &lt; 0.010</pre>	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A	0.10 0.10 0.10 0.10	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N)	<pre>318 Sampled: 2022-1 &lt; 0.10 &lt; 0.10 &lt; 0.10 &lt; 0.010 &lt; 0.010 &lt; 0.010</pre>	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1	0.10 0.10 0.10 0.010 0.010 0.010	mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate	<pre>318 Sampled: 2022-1 &lt; 0.10 &lt; 0.10 &lt; 0.10 &lt; 0.010 &lt; 0.010 &lt; 0.010 &lt; 0.010</pre>	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A	0.10 0.10 0.10 0.010 0.010 0.010	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3)	<pre>318 Sampled: 2022-1 &lt; 0.10 &lt; 0.10 &lt; 0.10 &lt; 0.010 &lt; 0.010 &lt; 0.010 &lt; 0.010</pre>	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A	0.10 0.10 0.10 0.010 0.010 0.010	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N)	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0   < 0.500   < 0.0100   < 0.0500	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N)	318 Sampled: 2022-1 < 0.10 < 0.10 < 0.010 < 0.010 < 0.0050 < 1.0 < 0.500 < 0.0100	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0   < 0.500   < 0.0100   < 0.0500	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0   < 0.500   < 0.0100   < 0.0500	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0   < 0.500   < 0.0100   < 0.0500   < 0.0500   < 0.0500	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500 0.0050 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 N/A N/A N/A N/A	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved	318   Sampled: 2022-1   < 0.10   < 0.10   < 0.10   < 0.010   < 0.010   < 0.0050   < 1.0   < 0.500   < 0.0100   < 0.0500   < 0.0500   < 0.0500   < 0.0500   < 0.0500	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A	0.10 0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14  2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08  N/A N/A N/A N/A N/A 2022-10-15	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved Antimony, dissolved	318   Sampled: 2022-1   < 0.10	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500 0.0050 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14  2022-10-08  2022-10-08  2022-10-08  2022-10-08  2022-10-08  N/A  N/A  N/A  N/A  N/A  2022-10-15  2022-10-15	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved Arsenic, dissolved	318   Sampled: 2022-1   < 0.10	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A  N/A  N/A  N/A	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500 0.0050 0.00050 0.0050 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14  2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08  N/A N/A N/A N/A N/A 2022-10-15 2022-10-15	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved Arsenic, dissolved Barium, dissolved	318   Sampled: 2022-1   < 0.10	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A  N/A  N/A  N/A  N/	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500 0.0050 0.00050 0.00050 0.00050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14  2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08  N/A N/A N/A N/A 2022-10-15 2022-10-15 2022-10-15	HT1
Field Blank (22J0954-07)   Matrix: Water    Anions  Bromide Chloride Fluoride Nitrate (as N) Nitrite (as N) Phosphate (as P) Sulfate  Calculated Parameters Hardness, Total (as CaCO3) Nitrate+Nitrite (as N) Nitrogen, Total Nitrogen, Organic  Dissolved Metals Aluminum, dissolved Arsenic, dissolved Barium, dissolved Beryllium, dissolved	318   Sampled: 2022-1   < 0.10	AO ≤ 500  N/A  AO ≤ 250  MAC = 1.5  MAC = 10  MAC = 1  N/A  AO ≤ 500  None Required  N/A  N/A  N/A  N/A  N/A  N/A  N/A  N/	0.10 0.10 0.010 0.010 0.0050 1.0 0.500 0.0100 0.0500 0.0500 0.0050 0.00050 0.0050 0.0050	mg/L mg/L mg/L mg/L mg/L mg/L mg/L mg/L	2022-10-14  2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08 2022-10-08  N/A N/A N/A N/A N/A 2022-10-15 2022-10-15 2022-10-15 2022-10-15 2022-10-15 2022-10-15	HT1



REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	WORK ORDER	22J0954
PROJECT	2022-8307.000	REPORTED	2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Field Blank (22J0954-07)   Matrix: Wate	r   Sampled: 2022-1	0-06 14:00, Contin	ued			
Dissolved Metals, Continued						
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-15	
Calcium, dissolved	< 0.20	N/A	0.20	mg/L	2022-10-15	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-15	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Lithium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Magnesium, dissolved	< 0.010	N/A	0.010	mg/L	2022-10-15	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2022-10-12	
Molybdenum, dissolved	< 0.00010	N/A	0.00010		2022-10-15	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2022-10-15	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2022-10-15	
Potassium, dissolved	< 0.10	N/A	0.10	mg/L	2022-10-15	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Silicon, dissolved	< 1.0	N/A	1.0	mg/L	2022-10-15	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2022-10-15	
Sodium, dissolved	< 0.10	N/A	0.10	mg/L	2022-10-15	
Strontium, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Sulfur, dissolved	< 3.0	N/A		mg/L	2022-10-15	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2022-10-15	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2022-10-15	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2022-10-15	
Uranium, dissolved	< 0.000020	N/A	0.000020	mg/L	2022-10-15	
Vanadium, dissolved	< 0.0050	N/A	0.0050	mg/L	2022-10-15	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2022-10-15	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2022-10-15	
eneral Parameters						
Alkalinity, Total (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050		2022-10-16	
Phosphorus, Total (as P)	0.0083	N/A	0.0050		2022-10-14	
Phosphorus, Total Dissolved	0.0052	N/A	0.0050		2022-10-14	
Solids, Total Dissolved	< 15	AO ≤ 500		mg/L	2022-10-14	HT1



REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	<b>WORK ORDER</b>	22J0954
PROJECT	2022-8307.000	REPORTED	2022-10-18 10:14

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Trip Blank (22J0954-08)   Matrix: Water	Sampled: 2022-10	)-06				
Anions						
Bromide	< 0.10	N/A	0.10	mg/L	2022-10-08	
Chloride	< 0.10	AO ≤ 250		mg/L	2022-10-08	
Fluoride	< 0.10	MAC = 1.5		mg/L	2022-10-08	
Nitrate (as N)	< 0.010	MAC = 10	0.010		2022-10-08	
Nitrite (as N)	< 0.010	MAC = 1	0.010		2022-10-08	
Phosphate (as P)	< 0.0050	N/A	0.0050		2022-10-08	
Sulfate	< 1.0	AO ≤ 500		mg/L	2022-10-08	
Calculated Parameters						
Hardness, Total (as CaCO3)	< 0.500	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Nitrogen, Organic	< 0.0500	N/A	0.0500	mg/L	N/A	
General Parameters						
Alkalinity, Total (as CaCO3)	< 1.0	N/A	1.0	mg/L	2022-10-14	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A		mg/L	2022-10-14	
Ammonia, Total (as N)	< 0.050	None Required	0.050		2022-10-12	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050		2022-10-16	
Phosphorus, Total (as P)	< 0.0050	N/A	0.0050		2022-10-14	
Solids, Total Dissolved	< 15	AO ≤ 500		mg/L	2022-10-14	HT1
Total Metals						
Aluminum, total	< 0.0050	OG < 0.1	0.0050	mg/L	2022-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2022-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2022-10-14	
Barium, total	< 0.0050	MAC = 2	0.0050	mg/L	2022-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2022-10-14	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2022-10-14	
Calcium, total	< 0.20	None Required	0.20	mg/L	2022-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2022-10-14	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2022-10-14	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2022-10-14	
Lithium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Magnesium, total	< 0.010	None Required	0.010	mg/L	2022-10-14	
Manganese, total	< 0.00020	MAC = 0.12	0.00020	mg/L	2022-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	ma/l	2022-10-12	



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Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Ггір Blank (22J0954-08)   Matri	x: Water   Sampled: 2022-	10-06, Continued				
Total Metals, Continued						
Molybdenum, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2022-10-14	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2022-10-14	
Potassium, total	< 0.10	N/A	0.10	mg/L	2022-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2022-10-14	
Silicon, total	< 1.0	N/A	1.0	mg/L	2022-10-14	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2022-10-14	
Sodium, total	< 0.10	AO ≤ 200	0.10	mg/L	2022-10-14	
Strontium, total	< 0.0010	MAC = 7	0.0010	mg/L	2022-10-14	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2022-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2022-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2022-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2022-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Tungsten, total	< 0.0002	N/A	0.0002	mg/L	2022-10-14	
Uranium, total	< 0.000020	MAC = 0.02	0.000020	mg/L	2022-10-14	
Vanadium, total	< 0.0050	N/A	0.0050	mg/L	2022-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2022-10-14	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2022-10-14	

#### Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.



### **APPENDIX 1: SUPPORTING INFORMATION**

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<b>Analysis Description</b>	Method Ref.	Technique	Accredited	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
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	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	Solids in Water, Filtered / SM 2540 C* (2017)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	<b>√</b>	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

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)

< Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors

AO Aesthetic Objective

MAC Maximum Acceptable Concentration (health based)

mg/L Milligrams per litre

OG Operational Guideline (treated water)

EPA United States Environmental Protection Agency Test Methods

SM Standard Methods for the Examination of Water and Wastewater, American Public Health Association

#### **Guidelines Referenced in this Report:**

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user



### **APPENDIX 1: SUPPORTING INFORMATION**

**REPORTED TO** Associated Environmental Consultants Inc. (Vernon)

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#### **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 or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

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 <u>not</u> 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:bwhitehead@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline(s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.



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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- Duplicate (Dup): An additional or second portion of a randomly selected sample in the analytical run carried through the entire
  analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- Blank Spike (BS): A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- Matrix Spike (MS): A second aliquot of sample is fortified with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- Reference Material (SRM): A homogenous material of similar matrix to the samples, certified for the parameter(s) listed.
   Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifie
Anions, Batch B2J0853									
Blank (B2J0853-BLK1)			Prepared	l: 2022-10-	12, Analyze	d: 2022-1	10-12		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK2)			Prepared	l: 2022-10-	12, Analyze	d: 2022-1	10-12		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK3)			Prepared	l: 2022-10-	13, Analyze	d: 2022-1	10-13		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
Blank (B2J0853-BLK4)			Prepared	l: 2022-10-	13, Analyze	d: 2022-1	10-13		
Bromide	< 0.10	0.10 mg/L							
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Phosphate (as P)	< 0.0050	0.0050 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B2J0853-BS1)			Prepared	l: 2022-10-	12, Analyze	d: 2022-1	10-12		
Bromide	4.15	0.10 mg/L	4.00		104	85-115			



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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier	
Anions, Batch B2J0853, Continued	d									
LCS (B2J0853-BS1), Continued			Prepared	l: 2022-10-	12, Analyze	ed: 2022-1	10-12			
Chloride	16.1	0.10 mg/L	16.0		100	90-110				
Fluoride	4.02	0.10 mg/L	4.00		100	88-108				
Nitrate (as N)	3.97	0.010 mg/L	4.00		99	90-110				
Nitrite (as N)	1.85	0.010 mg/L	2.00		93	85-115				
Phosphate (as P)	1.06	0.0050 mg/L	1.00		106	80-120				
Sulfate	16.2	1.0 mg/L	16.0		101	90-110				
LCS (B2J0853-BS2)			Prepared	l: 2022-10-	12, Analyze	ed: 2022-	10-12			
Bromide	3.92	0.10 mg/L	4.00		98	85-115				
Chloride	15.9	0.10 mg/L	16.0		99	90-110				
Fluoride	3.98	0.10 mg/L	4.00		99	88-108				
Nitrate (as N)	3.96	0.010 mg/L	4.00		99	90-110				
Nitrite (as N) Phosphate (as P)	1.92 1.03	0.010 mg/L 0.0050 mg/L	2.00 1.00		96 103	85-115 80-120				
Sulfate	15.6	1.0 mg/L	16.0		97	90-110				
LCS (B2J0853-BS3)				l: 2022-10-	13 Analyze		10_13			
Bromide	4.14	0.10 mg/L	4.00	1. 2022-10-	104	85-115	10-13			
Chloride	15.5	0.10 mg/L	16.0		97	90-110				
Fluoride	4.01	0.10 mg/L	4.00		100	88-108				
Nitrate (as N)	4.03	0.010 mg/L	4.00		101	90-110				
Nitrite (as N)	1.96	0.010 mg/L	2.00		98	85-115				
Phosphate (as P)	1.05	0.0050 mg/L	1.00		105	80-120				
Sulfate	16.2	1.0 mg/L	16.0		101	90-110				
LCS (B2J0853-BS4)			Prepared	l: 2022-10-	13, Analyze	ed: 2022-	10-13			
Bromide	4.08	0.10 mg/L	4.00		102	85-115				
Chloride	15.6	0.10 mg/L	16.0		98	90-110				
Fluoride	3.93	0.10 mg/L	4.00		98	88-108				
Nitrate (as N)	3.91	0.010 mg/L	4.00		98	90-110				
Nitrite (as N)	1.84	0.010 mg/L	2.00		92	85-115				
Phosphate (as P) Sulfate	1.07 15.6	0.0050 mg/L 1.0 mg/L	1.00 16.0		107 98	80-120 90-110				
Dissolved Metals, Batch B2J1192	10.0	e mg/z	10.0			00 110				
Blank (B2J1192-BLK1)			Prepared	l: 2022-10-	12, Analyze	ed: 2022-	10-12			
Mercury, dissolved	< 0.000010	0.000010 mg/L								
Blank (B2J1192-BLK2)			Prepared	l: 2022-10-1	12, Analyze	ed: 2022-1	10-12			
Mercury, dissolved	< 0.000010	0.000010 mg/L								
LCS (B2J1192-BS1)			Prepared	l: 2022-10-	12, Analyze	ed: 2022-	10-12			
Mercury, dissolved	0.000535	0.000010 mg/L	0.000500		107	80-120				
LCS (B2J1192-BS2)			Prepared	l: 2022-10-1	12, Analyze	ed: 2022-	10-12			
Mercury, dissolved	0.000537	0.000010 mg/L	0.000500		107	80-120				
Dissolved Metals, Batch B2J1665										
Blank (B2J1665-BLK1)			Prepared	l: 2022-10-	15, Analyze	ed: 2022-	10-15			
Aluminum, dissolved	< 0.0050	0.0050 mg/L								
Antimony, dissolved	< 0.00020	0.00020 mg/L								
Arsenic, dissolved	< 0.00050	0.00050 mg/L								
Barium, dissolved	< 0.0050	0.0050 mg/L								
Beryllium, dissolved	< 0.00010	0.00010 mg/L							ae 18 of	



Analyse		ociated Environmental Cons 2-8307.000	nvironmental Consultants Inc. 0			(Vernon)			22J0954 2022-10-18 10:14		
Blamuk (B2J1665-BLK1), Continued	Analyte	Result	RL	Units	•		% REC		% RPD		Qualifier
Barmurh, dissolved	Dissolved Metals, Batch	B2J1665, Continued									
Boron, dissolved	Blank (B2J1665-BLK1), C	ontinued			Prepared	: 2022-10-1	5, Analyze	d: 2022-1	10-15		
Cadmin, dissolved	Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Calcium, dissolved, dissolved   6.0050	Boron, dissolved	< 0.0500									
Chromism, dissolved	Cadmium, dissolved										
Coball         4 0 00010         0 00010 mgl.           Fon, dissolved         < 0.010											
Copper, dissolved         < 0,0004 0         0,0004 mg/L         Inchasolved         < 0,0010 mg/L         Inchasolved         < 0,00020 mg/L         Inchasolved         < 0,00010 mg/L         Inchasolved         < 0,00010 mg/L         Inchasolved         < 0,00010 mg/L         Inchasolved         < 0,00010 mg/L <th< td=""><td>· · · · · · · · · · · · · · · · · · ·</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	· · · · · · · · · · · · · · · · · · ·										
Inc. dissolved											
Lead, dissolved											
Lithlum, dissolved											
Magnatium, dissolved         < 0,010											
Manganese, dissolved         < 0.000200											
Molydednum, dissolved											
Nickel, dissolved	-										
Phosphorus, dissolved											
Potassium, dissolved											
Selenium, dissolved											
Sillore, dissolved         < 1.0         1.0 mg/L           Silver, dissolved         < 0.000050											
Silver, dissolved											
Strontium, dissolved         < 0.0010         mg/L           Suffur, dissolved         < 3.0	· · · · · · · · · · · · · · · · · · ·										
Sulfur, dissolved         < 3.0         3.0         mg/L           Tallurium, dissolved         < 0.00050	Sodium, dissolved	< 0.10	0.10	mg/L							
Tellurium, dissolved	Strontium, dissolved	< 0.0010	0.0010	mg/L							
Thallum, dissolved         < 0.000020         0.000020 mg/L           Thorium, dissolved         < 0.00010	Sulfur, dissolved	< 3.0									
Thorium, dissolved         < 0.00010         0.00010 mg/L           Tin, dissolved         < 0.00050 mg/L	Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Tin, dissolved         < 0.00020 0.00020 mg/L           Titanium, dissolved         < 0.00050 0.00050 mg/L           Uranjsten, dissolved         < 0.00010 0.00020 0.000020 mg/L           Vanadium, dissolved         < 0.000020 0.000020 mg/L           Vanadium, dissolved         < 0.00050 0.00050 mg/L           Zirconium, dissolved         < 0.00040 0.00040 mg/L           Zirconium, dissolved         < 0.00040 0.00010 mg/L           ECS (B2J1665-BS1)         Prepared: 2022-10-15, Analyzed: 2022-10-15           Aluminum, dissolved         4.09 0.0050 mg/L         4.00 102 80-120           Antimony, dissolved         0.0416 0.00000 mg/L         0.0400 104 80-120           Antimony, dissolved         0.0416 0.00000 mg/L         0.0400 104 80-120           Barium, dissolved         0.0416 0.00000 mg/L         0.0400 104 80-120           Barium, dissolved         0.0402 0.0000 mg/L         0.0400 100 80-120           Barium, dissolved         0.0400 0.00010 mg/L         0.0400 100 80-120           Bismuth, dissolved         0.0400 0.00010 mg/L         0.0400 102 80-120           Cadmium, dissolved         0.0406 0.00010 mg/L         0.0400 102 80-120           Cadmium, dissolved         0.0406 0.000010 mg/L         0.0400 102 80-120           Chromium, dissolved         0.0410 0.00000 mg/L         0.0400 102 80-1	Thallium, dissolved	< 0.000020	0.000020	mg/L							
Titanium, dissolved         < 0.0050         0.0050 mg/L           Uranium, dissolved         < 0.000020	Thorium, dissolved	< 0.00010									
Tungsten, dissolved         < 0.0010         0.0010 mg/L           Uranium, dissolved         < 0.000020	Tin, dissolved	< 0.00020	0.00020	mg/L							
Uranium, dissolved         < 0.000020         0.000020 mg/L           Vanadium, dissolved         < 0.0050											
Vanadium, dissolved         < 0.0040         0.0050 mg/L           Zinc, dissolved         < 0.0040											
Zinc, dissolved         < 0.0040         0.0040 mg/L           LCS (B2J1665-BS1)         Prepared: 2022-10-15, Analyzed: 2022-10-15           Aluminum, dissolved         4.09         0.050 mg/L         4.00         102         80-120           Antimony, dissolved         0.0406         0.00020 mg/L         0.0400         102         80-120           Arsenic, dissolved         0.0416         0.00050 mg/L         0.0400         104         80-120           Barium, dissolved         0.0416         0.00050 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.0001 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.0001 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.0001 mg/L         0.0400         100         80-120           Boron, dissolved         0.0400         0.0001 mg/L         0.0400         102         80-120           Cadmium, dissolved, dissolved         0.0406         0.00001 mg/L         0.0400         102         80-120           Chromium, dissolved         0.0411         0.0000 mg/L         0.0400         103         80-120           Cob											
Zirconium, dissolved         < 0.00010         0.00010 mg/L           LCS (B2J1665-BS1)         Prepared: 2022-10-15, Analyzed: 2022-10-15           Aluminum, dissolved         4.09         0.0050 mg/L         4.00         102         80-120           Antimony, dissolved         0.0406         0.00020 mg/L         0.0400         102         80-120           Arsenic, dissolved         0.0416         0.00050 mg/L         0.0400         100         80-120           Barium, dissolved         0.0402         0.0500 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.0001 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0406         0.00010 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Cadrium, dissolved, dissolved         4.02         0.20 mg/L         4.00         103         80-120           Chomium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           C	· <del></del>										
Prepared: 2022-10-15, Analyzed: 2022-10-15	·										
Aluminum, dissolved         4.09         0.0050 mg/L         4.00         102         80-120           Antimony, dissolved         0.0406         0.00020 mg/L         0.0400         102         80-120           Arsenic, dissolved         0.0416         0.00050 mg/L         0.0400         104         80-120           Barium, dissolved         0.0402         0.0050 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.00010 mg/L         0.0400         100         80-120           Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         0.0406         0.00010 mg/L         0.0400         103         80-120           Cadmium, dissolved         0.0406         0.000010 mg/L         0.0400         103         80-120           Calcium, dissolved, dissolved         0.0406         0.000010 mg/L         0.0400         102         80-120           Calcium, dissolved, dissolved         0.0411         0.00050 mg/L         0.0400         100         80-120           Calcium, dissolved, dissolved         0.0411         0.00050 mg/L         0.0400         102         80-120           Cobalt, dissolved	Zirconium, dissolved	< 0.00010	0.00010	mg/L							
Antimony, dissolved         0.0406         0.00020 mg/L         0.0400         102         80-120           Arsenic, dissolved         0.0416         0.00050 mg/L         0.0400         104         80-120           Barium, dissolved         0.0402         0.0050 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.00010 mg/L         0.0400         100         80-120           Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         <0.0500	LCS (B2J1665-BS1)				Prepared	: 2022-10-1	5, Analyze	d: 2022-1	10-15		
Arsenic, dissolved         0.0416         0.00050 mg/L         0.0400         104         80-120           Barium, dissolved         0.0402         0.0050 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.00010 mg/L         0.0400         100         80-120           Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         0.0500         0.0500 mg/L         0.0400         103         80-120           Cadmium, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Calcium, dissolved, dissolved         4.02         0.20 mg/L         4.00         100         80-120           Calcium, dissolved, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Chromium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Copper, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         4.02         0.010 mg/L         0.0400         101         80-120           Lead, dissolved         4.02         0.0	Aluminum, dissolved	4.09			4.00		102	80-120			
Barium, dissolved         0.0402         0.0500 mg/L         0.0400         100         80-120           Beryllium, dissolved         0.0400         0.00010 mg/L         0.0400         100         80-120           Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         <0.0500	· · · · · · · · · · · · · · · · · · ·										
Beryllium, dissolved         0.0400         0.00010 mg/L         0.0400         100         80-120           Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         <0.0500											
Bismuth, dissolved         0.0406         0.00010 mg/L         0.0400         102         80-120           Boron, dissolved         < 0.0500	· · · · · · · · · · · · · · · · · · ·										
Boron, dissolved         < 0.0500         0.0500 mg/L         0.0400         103         80-120           Cadmium, dissolved         0.0406         0.000010 mg/L         0.0400         102         80-120           Calcium, dissolved, dissolved         4.02         0.20 mg/L         4.00         100         80-120           Chromium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Cobalt, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Lead, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Molybdenum, dissolved         0.0401         0.00020 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.000											
Cadmium, dissolved         0.0406         0.000010 mg/L         0.0400         102         80-120           Calcium, dissolved, dissolved         4.02         0.20 mg/L         4.00         100         80-120           Chromium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Cobalt, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Molybdenum, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Nickel, dissolved         0.0409         0.00004 mg/L         0.0400         100         80-120           Phosphorus, dissolved         4.11         0.0											
Calcium, dissolved, dissolved         4.02         0.20 mg/L         4.00         100         80-120           Chromium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Cobalt, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.											
Chromium, dissolved         0.0411         0.00050 mg/L         0.0400         103         80-120           Cobalt, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Molybdenum, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Nickel, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         103         80-120											
Cobalt, dissolved         0.0408         0.00010 mg/L         0.0400         102         80-120           Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Copper, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120	· · · · · · · · · · · · · · · · · · ·										
Iron, dissolved         4.02         0.010 mg/L         4.00         101         80-120           Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Lead, dissolved         0.0403         0.00020 mg/L         0.0400         101         80-120           Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Lithium, dissolved         0.0404         0.00010 mg/L         0.0400         101         80-120           Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Magnesium, dissolved, dissolved         4.13         0.010 mg/L         4.00         103         80-120           Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Manganese, dissolved         0.0409         0.00020 mg/L         0.0400         102         80-120           Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Molybdenum, dissolved         0.0401         0.00010 mg/L         0.0400         100         80-120           Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Nickel, dissolved         0.0409         0.00040 mg/L         0.0400         102         80-120           Phosphorus, dissolved         4.11         0.050 mg/L         4.00         103         80-120           Potassium, dissolved         4.25         0.10 mg/L         4.00         106         80-120											
Potassium, dissolved 4.25 0.10 mg/L 4.00 106 80-120											
•	Phosphorus, dissolved	4.11	0.050	mg/L	4.00		103	80-120			
Selenium, dissolved 0.0401 0.00050 mg/L 0.0400 100 80-120	Potassium, dissolved	4.25	0.10	mg/L	4.00		106	80-120			
	Selenium, dissolved	0.0401	0.00050	mg/L	0.0400		100	80-120			



REPORTED TO Associated E PROJECT 2022-8307.0		Environmental Consultants Inc. (Vernon) 000					WORK REPOR	ORDER RTED	22J0954 2022-10-18 10:14		
Analyte		Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals,	Batch B2J1665, Co	ntinued									
LCS (B2J1665-BS	1). Continued				Prepared	I: 2022-10-1	5, Analyze	ed: 2022-1	10-15		
Silicon, dissolved	,,	4.2	1.0	mg/L	4.00		104	80-120			
Silver, dissolved		0.0395	0.000050		0.0400		99	80-120			
Sodium, dissolved		4.11	0.10	mg/L	4.00		103	80-120			
Strontium, dissolved		0.0411	0.0010	mg/L	0.0400		103	80-120			
Sulfur, dissolved		41.6		mg/L	40.0		104	80-120			
Tellurium, dissolved		0.0404	0.00050		0.0400		101	80-120			
Thallium, dissolved		0.0404	0.000020		0.0400		101 101	80-120 80-120			
Thorium, dissolved Tin, dissolved		0.0405 0.0407	0.00010		0.0400		101	80-120			
Titanium, dissolved		0.0407	0.00020		0.0400		104	80-120			
Tungsten, dissolved		0.0405	0.0010		0.0400		101	80-120			
Uranium, dissolved		0.0412	0.000020		0.0400		103	80-120			
Vanadium, dissolved		0.0408	0.0050	mg/L	0.0400		102	80-120			
Zinc, dissolved		0.0417	0.0040	mg/L	0.0400		104	80-120			
Zirconium, dissolved		0.0409	0.00010	mg/L	0.0400		102	80-120			
Duplicate (B2J166	65-DUP1)	So	ource: 22J0	954-01	Prepared	I: 2022-10-1	5, Analyze	ed: 2022-1	10-15		
Aluminum, dissolved	•	< 0.0050	0.0050	ma/L		< 0.0050	· •			20	
Antimony, dissolved		< 0.00020	0.00020			< 0.00020				20	
Arsenic, dissolved		< 0.00050	0.00050			< 0.00050				20	
Barium, dissolved		< 0.0050	0.0050			< 0.0050				20	
Beryllium, dissolved		< 0.00010	0.00010			< 0.00010				20	
Bismuth, dissolved		< 0.00010	0.00010			< 0.00010				20	
Boron, dissolved		< 0.0500	0.0500			< 0.0500				20	
Cadmium, dissolved		< 0.000010	0.000010			< 0.000010				20	
Calcium, dissolved, o		5.41		mg/L		5.42			< 1	20	
Chromium, dissolved Cobalt, dissolved	]	< 0.00050 < 0.00010	0.00050 0.00010			< 0.00050 < 0.00010				20	
Copper, dissolved		< 0.00010	0.00010			< 0.00010				20	
Iron, dissolved		< 0.010		mg/L		< 0.010				20	
Lead, dissolved		< 0.00020	0.00020			< 0.00020				20	
Lithium, dissolved		0.00119	0.00010			0.00120			1	20	
Magnesium, dissolve	ed, dissolved	37.9	0.010	mg/L		38.4			1	20	
Manganese, dissolve	ed	0.0382	0.00020	mg/L		0.0389			2	20	
Molybdenum, dissolv	/ed	0.00285	0.00010	mg/L		0.00289			1	20	
Nickel, dissolved		< 0.00040	0.00040			< 0.00040				20	
Phosphorus, dissolve		< 0.050		mg/L		< 0.050				20	
Potassium, dissolved	<u> </u>	2.99		mg/L		3.03			2	20	
Selenium, dissolved Silicon, dissolved		< 0.00050 < 1.0	0.00050	mg/L mg/L		< 0.00050 < 1.0				20	
Silver, dissolved		< 0.000050	0.000050			< 0.000050				20	
Sodium, dissolved		45.1		mg/L		46.5			3	20	
Strontium, dissolved		0.0323	0.0010			0.0328			1	20	
Sulfur, dissolved		65.8		mg/L		66.3			< 1	20	
Tellurium, dissolved		< 0.00050	0.00050			< 0.00050				20	
Thallium, dissolved		< 0.000020	0.000020	mg/L		< 0.000020				20	
Thorium, dissolved		< 0.00010	0.00010			< 0.00010				20	
Tin, dissolved		< 0.00020	0.00020			< 0.00020				20	
Titanium, dissolved		< 0.0050	0.0050			< 0.0050				20	
Tungsten, dissolved		< 0.0010	0.0010			< 0.0010				20	
Uranium, dissolved		< 0.000020	0.000020			< 0.000020				20	
Vanadium, dissolved		< 0.0050 < 0.0040	0.0050 0.0040			< 0.0050 < 0.0040				20	
Zinc, dissolved Zirconium, dissolved		< 0.0040	0.0040			< 0.0040				20	
Matrix Spike (B2J	•		ource: 22J0			I: 2022-10-1	•		10-15		
Aluminum, dissolved		3.91	0.0050	mg/L	4.00	< 0.0050	98	70-130		Pa	ge 20 of
		0	aring Aho	ut Poeu	lts Obviou	ielv				ı a	90 20 01



	REPORTED TO Associated Enviror PROJECT 2022-8307.000	ociated Environmental Consultants Inc. (Vernor 2-8307.000				WORK ORDER REPORTED		22J0954 2022-10-18		10:14	
Matrix Spike (B2.11685-MS1), Continued   Source: 22.10984-02   Prepared: 2022-10-15, Analyzed: 2022-10-15   Analyzed: 2022-10-12   Anal	Analyte	Result	RL Unit	S .		% REC		% RPD		Qualifie	
Actimorpy, dissolved Actimorpy, dissolved Actimorpy, dissolved Actimorpy, dissolved Actimorphic (1974) (197	Dissolved Metals, Batch B2J1665, Conti	nued									
Arsenic, dissolved  Arsenic, dissolved  Arsenic, dissolved  Arrenic, dissolved  Arreni	Matrix Spike (B2J1665-MS1), Continued	Sc	ource: 22J0954-0	2 Prepared	d: 2022-10-1	5, Analyze	ed: 2022-10	0-15			
Barrum, dissolved	Antimony, dissolved	0.0392	0.00020 mg/L	0.0400	< 0.00020	98	70-130				
Beryllium, dissolved	Arsenic, dissolved	0.0413	0.00050 mg/L	0.0400	0.00061	102	70-130				
Bismuth, dissolved	Barium, dissolved										
Born, dissolved											
Cadminn, dissolved   0,0405   0,000010 mg/L   0,0400   0,000036   101   70-130   MS2   Calcilum, dissolved   0,338   0,00050 mg/L   0,0400   0,00050   98   70-130   MS2   Cobalt, dissolved   0,3378   0,00010 mg/L   0,0400   0,00010   95   70-130   Copert, dissolved   0,3378   0,00010 mg/L   0,0400   0,00010   95   70-130   Copert, dissolved   0,3370   0,00040 mg/L   0,0400   0,00010   95   70-130   Copert, dissolved   0,3378   0,00020 mg/L   0,0400   0,00020   97   70-130   Copert, dissolved   0,3387   0,00020 mg/L   0,0400   0,00020   97   70-130   Copert, dissolved   0,0433   0,00010   mg/L   0,0400   0,00020   97   70-130   Copert, dissolved   0,0433   0,00010   mg/L   0,0400   0,00020   97   70-130   Copert, dissolved   0,0430   0,00010   mg/L   0,0400   0,00020   97   70-130   Copert, dissolved   0,0381   0,0400   0,0400   0,00020   97   70-130   Copert, dissolved   0,0390   0,00020   mg/L   0,0400   0,0400   0,00020   97   70-130   Copert, dissolved   0,0390   0,00020   mg/L   0,0400   0,0400   0,00020   97   70-130   Copert, dissolved   0,0390   0,00010   mg/L   0,0400   0,0400   0,00020   0,0400   0,0											
Calcium, dissolved, dissolved   73.1   0.20 mg/L   4.00   70.6   61   70-130   MSZ	· · · · · · · · · · · · · · · · · · ·										
Chromium, dissolved	· · · · · · · · · · · · · · · · · · ·									MCO	
Cabalt, dissolved	·									IVIS2	
Copper, dissolved   0.0370   0.00040 mg/L   0.0400   < 0.00040   92   70-130	· · · · · · · · · · · · · · · · · · ·										
Iron., dissolved	<u> </u>										
Lead, dissolved											
Lithium, dissolved  0.0433											
Magnesium, dissolved, dissolved         52.0         0.010 mg/L         4.00         4.89         78         70-130           Manganese, dissolved         0.0390         0.00020 mg/L         0.0400         0.00020 g7         70-130           Molybdenum, dissolved         0.0553         0.00010 mg/L         0.0400         0.0143         103         70-130           Nickel, dissolved         0.0379         0.0040 mg/L         0.0400         < 0.0501	•										
Manganese, dissolved         0.0390         0.0020 mg/L         0.0400         <0.00020         97         70-130           Mokolydenum, dissolved         0.0553         0.00010 mg/L         0.0400         <0.00010         97         70-130           Nickel, dissolved         0.0553         0.00040 mg/L         0.0400         <0.0500         103         70-130           Phosphorus, dissolved         4.12         0.050 mg/L         4.00         <0.0501         103         70-130           Plosphorus, dissolved         9.49         0.10 mg/L         4.00         <0.0501         0.70 mg/L         70-130           Selenium, dissolved         0.0398         0.0050 mg/L         0.0400         <0.00050         99         70-130           Silver, dissolved         12.2         1.0 mg/L         4.00         8.8         87         70-130           Silver, dissolved         0.2924         0.000056 mg/L         0.0400         <0.000050 mg/L         70-130           Silver, dissolved         0.843         0.0010 mg/L         4.00         34.7         56         70-130           Silver, dissolved         1.42         3.0 mg/L         0.0400         8.13         76         70-130           Silver, dissolved         1.4	· · · · · · · · · · · · · · · · · · ·										
Nicke, dissolved	· · · · · · · · · · · · · · · · · · ·				< 0.00020	97	70-130				
Phosphorus, dissolved	Molybdenum, dissolved	0.0553	0.00010 mg/L	0.0400	0.0143	103	70-130				
Potassium, dissolved  9.49 0.10 mg/L 4.00 5.63 96 70-130  Selenium, dissolved  12.2 1.0 mg/L 4.00 8.8 87 70-130  Silver, dissolved  12.2 1.0 mg/L 4.00 8.8 87 70-130  Silver, dissolved  0.0294 0.000050 mg/L 0.0400 < 0.000050 74 70-130  Silver, dissolved  0.89 0.10 mg/L 4.00 8.8 87 70-130  Silver, dissolved  0.843 0.0010 mg/L 0.0400 < 0.000050 74 70-130  Silver, dissolved  0.843 0.0010 mg/L 0.0400 0.813 76 70-130  Silver, dissolved  12.2 1.0 mg/L 4.00 105 92 70-130  Silver, dissolved  0.843 0.0010 mg/L 0.0400 0.0050 103 70-130  Tellurium, dissolved  1.2 0.0050 mg/L 0.0400 0.00050 103 70-130  Tellurium, dissolved  0.0412 0.0050 mg/L 0.0400 0.00050 103 70-130  Thallium, dissolved  0.0393 0.000020 mg/L 0.0400 0.000010 100 70-130  Tinorium, dissolved  0.0416 0.00020 mg/L 0.0400 0.00010 100 70-130  Titanium, dissolved  0.0416 0.00020 mg/L 0.0400 0.00010 100 70-130  Titanium, dissolved  0.0400 0.00010 mg/L 0.0400 0.00010 100 70-130  Titanium, dissolved  0.0400 0.00010 mg/L 0.0400 0.00010 101 70-130  Uranium, dissolved  0.0400 0.00010 mg/L 0.0400 0.00070 101 70-130  Uranium, dissolved  0.0469 0.000020 mg/L 0.0400 0.00071 101 70-130  Uranium, dissolved  0.0469 0.000020 mg/L 0.0400 0.00071 101 70-130  Uranium, dissolved  0.0469 0.000020 mg/L 0.0400 0.00078 100 70-130  Vanadium, dissolved  0.0410 0.0000 mg/L 0.0400 0.00078 100 70-130  Vanadium, dissolved  0.0422 0.00010 mg/L 0.0400 0.00078 100 70-130  Vanadium, dissolved  0.0422 0.00010 mg/L 0.0400 0.00078 100 70-130  Verneral Parameters, Batch B2J1208  Blank (B2J1208-BLK1)  Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N)  0.050 0.050 mg/L  Blank (B2J1208-BLK3)  Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N)  0.050 0.050 mg/L  Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N)  0.050 0.050 mg/L  Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N)  0.050 0.050 mg/L  Prepared: 2022-10-12, Analyzed: 2022-10-12	Nickel, dissolved	0.0379	0.00040 mg/L	0.0400	< 0.00040	94	70-130				
Selentum, dissolved   0.0388   0.00050 mg/L   0.0400   0.000050   99   70-130	Phosphorus, dissolved	4.12	0.050 mg/L	4.00	< 0.050	103	70-130				
Silicon, dissolved 12.2 1.0 mg/L 4.00 8.8 87 70-130 Silicon, dissolved 0.0294 0.00050 mg/L 0.0400 < 0.00050 74 70-130 Sodium, dissolved 36.9 0.10 mg/L 4.00 34.7 56 70-130 MS2 Strontium, dissolved 0.843 0.0010 mg/L 0.0400 0.813 76 70-130 Silicon, dissolved 142 3.0 mg/L 40.0 105 92 70-130 Silicon, dissolved 0.0412 0.00050 mg/L 0.0400 < 0.00050 103 70-130 Silicon, dissolved 0.0412 0.00050 mg/L 0.0400 < 0.00050 103 70-130 Silicon, dissolved 0.0412 0.00050 mg/L 0.0400 < 0.00050 103 70-130 Silicon, dissolved 0.0412 0.00050 mg/L 0.0400 < 0.00050 103 70-130 Silicon, dissolved 0.0400 0.00010 mg/L 0.0400 < 0.00050 103 70-130 Silicon, dissolved 0.0416 0.00020 mg/L 0.0400 < 0.000020 mg/L 0.0400 Silicon, dissolved 0.0416 0.00020 mg/L 0.0400 < 0.00020 104 70-130 Silicon, dissolved 0.0416 0.00020 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0416 0.00050 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0405 0.00050 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0405 0.00050 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.00070 101 70-130 Silicon, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.00070 101 70-130 Silicon, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.00050 100 70-130 Silicon, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.00010 mg/L 0.0400 < 0.00010 mg/L 0.0400 Silicon, dissolved 0.0410 0.0500 mg/L 0.0400 < 0.00010 106 70-130 Silicon, dissolved 0.0410 0.0500 mg/L 0.0400 Silicon, dissolved 0.0410 0.0410 0.0500 mg/L 0.0410 Silicon, dissolved 0.0410 0.0500 mg/L 0.0410 Silicon, dissolved 0.0410 Silico	Potassium, dissolved	9.49			5.63	96	70-130				
Silver, dissolved	Selenium, dissolved		0.00050 mg/L	0.0400							
Sodium, dissolved   36.9   0.10 mg/L   4.00   34.7   56   70-130   MS2	<u> </u>										
Strontium, dissolved   0.843   0.0010 mg/L   0.0400   0.813   76   70-130											
Sulfur, dissolved										MS2	
Tellurium, dissolved	· · · · · · · · · · · · · · · · · · ·										
Thallium, dissolved 0.0393 0.000020 mg/L 0.0400 < 0.000020 98 70-130 Thorium, dissolved 0.0400 0.00010 mg/L 0.0400 < 0.00010 100 70-130 Thorium, dissolved 0.0416 0.00020 mg/L 0.0400 < 0.000010 100 70-130 Titra, dissolved 0.0399 0.0005 mg/L 0.0400 < 0.00050 100 70-130 Titranium, dissolved 0.0405 0.0010 mg/L 0.0400 < 0.0050 100 70-130 Tungsten, dissolved 0.0405 0.0010 mg/L 0.0400 < 0.0010 101 70-130 Uranium, dissolved 0.0469 0.000020 mg/L 0.0400 0.00678 100 70-130 Uranium, dissolved 0.0410 0.0005 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0410 0.0005 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0410 0.0005 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 < 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0400 0.0067 99 70-130 Uranium, diss											
Thorium, dissolved  0.0400  0.00010 mg/L  0.0400  0.00010 mg/L  0.0400  0.00020 mg/L  0.0400  0.00070  101 70-130  Tungsten, dissolved  0.0469  0.0010 mg/L  0.0400  0.00678  100 70-130  Vanadium, dissolved  0.0410  0.0401  0.0050 mg/L  0.0400  0.00678  100 70-130  Vanadium, dissolved  0.0410  0.0050 mg/L  0.0400  0.00678  100 70-130  Vanadium, dissolved  0.0410  0.0050 mg/L  0.0400  0.0406  99 70-130  Variation, dissolved  0.0410  0.0050 mg/L  0.0400  0.0406  0.0406  0.0010  0.0406  0.0406  0.0400  0.0406  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0400  0.0406  0.0406  0.0400  0.0406  0.0400  0.0406	·										
Tin, dissolved 0.0416 0.00020 mg/L 0.0400 < 0.00020 104 70-130 Titanium, dissolved 0.0399 0.0050 mg/L 0.0400 < 0.0050 100 70-130 Titanium, dissolved 0.0405 0.0010 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0406 0.0406 0.00010 101 70-130 Uranium, dissolved 0.0469 0.00020 mg/L 0.0400 0.00678 100 70-130 Uranium, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 0.0406 0.00010 106 70-130 Uranium, dissolved 0.0422 0.00010 mg/L 0.0400 0.0406 0.0406 0.0406 0.00010 0.0406 0.0406 0.00010 0.0406 0.0406 0.00010 0.0406 0.											
Titanium, dissolved 0.0399 0.0050 mg/L 0.0400 < 0.0050 100 70-130 Tungsten, dissolved 0.0405 0.0010 mg/L 0.0400 < 0.0010 101 70-130 Uranium, dissolved 0.0469 0.00020 mg/L 0.0400 < 0.0010 101 70-130 Uranium, dissolved 0.0469 0.00020 mg/L 0.0400 0.00678 100 70-130 Uranium, dissolved 0.0410 0.0055 mg/L 0.0400 < 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0050 100 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0822 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0822 0.00010 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Uranium, dissolved 0.0801 0.0040 mg/L 0.0400 0.0050 100 70-130 Uranium, dissolved 0.0400 0.0050 mg/L 0.0040 0.0050 mg/L Uranium, dissolved 0.0400 0.00678 100 70-130 Uranium, dissolved	·										
Tungsten, dissolved 0.0405 0.0010 mg/L 0.0400 < 0.0010 101 70-130   Uranium, dissolved 0.0468 0.000020 mg/L 0.0400 0.00678 100 70-130   Vanadium, dissolved 0.0410 0.0050 mg/L 0.0400 < 0.050 100 70-130   Zinc, dissolved 0.0801 0.0040 mg/L 0.0400 < 0.050 100 70-130   Zinc, dissolved 0.0412 0.0001 mg/L 0.0400 0.0406 99 70-130   Zirconium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.00010 106 70-130    Seneral Parameters, Batch B2J1208  Blank (B2J1208-BLK1)											
Uranium, dissolved         0.0469         0.000020 mg/L         0.0400 0.00678 100 70-130         100 70-130           Vanadium, dissolved         0.0410 0.0050 mg/L         0.0400 <0.0050 100 70-130	•										
Vanadium, dissolved         0.0410         0.050 mg/L         0.0400         < 0.050         100         70-130           Zinc, dissolved         0.0801         0.0040 mg/L         0.0400         0.0406         99         70-130           Zirconium, dissolved         0.0422         0.00010 mg/L         0.0400         < 0.00010	-										
Zinc, dissolved 0.0801 0.0040 mg/L 0.0400 0.0406 99 70-130 Zirconium, dissolved 0.0422 0.00010 mg/L 0.0400 < 0.00010 106 70-130  Seneral Parameters, Batch B2J1208  Blank (B2J1208-BLK1) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK2) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK3) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK4) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK4) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK5) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Prepared: 2022-10-12, Analyzed: 2022-10-12  Prepared: 2022-10-12, Analyzed: 2022-10-12  Prepared: 2022-10-12, Analyzed: 2022-10-12	•										
Prepared: 2022-10-12, Analyzed: 2022-10-12	Zinc, dissolved					99	70-130				
Prepared: 2022-10-12, Analyzed: 2022-10-12	Zirconium, dissolved	0.0422	0.00010 mg/L	0.0400	< 0.00010	106	70-130				
Ammonia, Total (as N)	·										
Prepared: 2022-10-12, Analyzed: 2022-10-12	,			•	a: 2022-10-1	2, Analyze	ea: 2022-10	U-12			
Ammonia, Total (as N) < 0.050	· · ·	< 0.050	0.050 mg/L								
Blank (B2J1208-BLK3)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           Blank (B2J1208-BLK4)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           Blank (B2J1208-BLK5)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           LCS (B2J1208-BS1)         Prepared: 2022-10-12, Analyzed: 2022-10-12	Blank (B2J1208-BLK2)			<u> </u>	d: 2022-10-1	2, Analyze	ed: 2022-10	0-12			
Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK4) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  Blank (B2J1208-BLK5) Prepared: 2022-10-12, Analyzed: 2022-10-12  Ammonia, Total (as N) < 0.050 0.050 mg/L  LCS (B2J1208-BS1) Prepared: 2022-10-12, Analyzed: 2022-10-12	Ammonia, Total (as N)	< 0.050	0.050 mg/L								
Blank (B2J1208-BLK4)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           Blank (B2J1208-BLK5)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           LCS (B2J1208-BS1)         Prepared: 2022-10-12, Analyzed: 2022-10-12	Blank (B2J1208-BLK3)			Prepared	d: 2022-10-1	2, Analyze	ed: 2022-10	0-12			
Ammonia, Total (as N)       < 0.050	Ammonia, Total (as N)	< 0.050	0.050 mg/L								
Blank (B2J1208-BLK5)         Prepared: 2022-10-12, Analyzed: 2022-10-12           Ammonia, Total (as N)         < 0.050         0.050 mg/L           LCS (B2J1208-BS1)         Prepared: 2022-10-12, Analyzed: 2022-10-12	Blank (B2J1208-BLK4)			Prepared	d: 2022-10-1	2, Analyze	ed: 2022-10	0-12			
Ammonia, Total (as N) < 0.050 0.050 mg/L  LCS (B2J1208-BS1) Prepared: 2022-10-12, Analyzed: 2022-10-12	Ammonia, Total (as N)	< 0.050	0.050 mg/L								
LCS (B2J1208-BS1) Prepared: 2022-10-12, Analyzed: 2022-10-12	Blank (B2J1208-BLK5)			Prepared	d: 2022-10-1	2, Analyze	ed: 2022-10	0-12			
	Ammonia, Total (as N)	< 0.050	0.050 mg/L								
Ammonia, Total (as N) 0.951 0.050 mg/L 1.00 95 90-115	LCS (B2J1208-BS1)			Prepared	d: 2022-10-1	2, Analyze	ed: 2022-10	0-12			
	Ammonia, Total (as N)	0.951	0.050 mg/L	1.00		95	90-115				



REPORTED TO Associated Environ 2022-8307.000	nmental Consul	Itants Inc. (Verno	n)		WORK ORDER REPORTED			22J0954 2022-10-18 10:14		
Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier	
General Parameters, Batch B2J1208, Co	ontinued									
LCS (B2J1208-BS2)			Prepared	I: 2022-10-1	2, Analyze	ed: 2022-1	10-12			
Ammonia, Total (as N)	0.962	0.050 mg/L	1.00		96	90-115				
		<u> </u>			o 4 1		10.40			
LCS (B2J1208-BS3)			•	I: 2022-10-1			10-12			
Ammonia, Total (as N)	0.958	0.050 mg/L	1.00		96	90-115				
LCS (B2J1208-BS4)			Prepared	I: 2022-10-1	2, Analyze	ed: 2022-1	10-12			
Ammonia, Total (as N)	0.972	0.050 mg/L	1.00		97	90-115				
L CC (P2 14200 PCE)		-	Droparad	I: 2022-10-1	2 Apolyz	A. 2022 1	10.12			
LCS (B2J1208-BS5)		0.050 "		1. 2022-10-1			10-12			
Ammonia, Total (as N)	0.957	0.050 mg/L	1.00		96	90-115				
General Parameters, Batch B2J1465 Blank (B2J1465-BLK1)			Prepared	I: 2022-10-1	3. Analyze	ed: 2022-1	10-14			
Phosphorus, Total (as P)	< 0.0050	0.0050 mg/L	•		<u> </u>					
	0.000	0.0000 mg/L								
Blank (B2J1465-BLK2)			Prepared	I: 2022-10-1	3, Analyze	ed: 2022-1	0-14			
Phosphorus, Total (as P)	< 0.0050	0.0050 mg/L								
Blank (B2J1465-BLK3)			Prepared	I: 2022-10-1	3, Analyze	ed: 2022-1	10-14			
Phosphorus, Total Dissolved	< 0.0050	0.0050 mg/L	•							
L CC (P2 14 465 PC4)			Droparad	I. 2022 10 1	2 Apolyz	A. 2022 1	10 14			
LCS (B2J1465-BS1)	0.400	0.0050		I: 2022-10-1			10-14			
Phosphorus, Total (as P)	0.106	0.0050 mg/L	0.100		106	85-115				
LCS (B2J1465-BS2)			Prepared	I: 2022-10-1	3, Analyze	ed: 2022-1	10-14			
Phosphorus, Total (as P)	0.106	0.0050 mg/L	0.100		106	85-115				
LCS (B2J1465-BS3)			Prepared	I: 2022-10-1	3 Analyze	ed: 2022-1	10-14			
Phosphorus, Total Dissolved	0.106	0.0050 mg/L	0.100	1. 2022 10 1	106	85-115	10 14			
General Parameters, Batch B2J1539		g.								
Blank (B2J1539-BLK1)			Prepared	I: 2022-10-1	4, Analyze	ed: 2022-1	10-14			
Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L 1.0 mg/L								
Alkalinity, Carbonate (as CaCO3)  Alkalinity, Hydroxide (as CaCO3)	< 1.0 < 1.0	1.0 mg/L 1.0 mg/L								
		1.0 Hig/L								
Blank (B2J1539-BLK2)			Prepared	I: 2022-10-1	4, Analyze	ed: 2022-1	10-14			
Alkalinity, Total (as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0 mg/L								
Alkalinity, Carbonate (as CaCO3)  Alkalinity, Hydroxide (as CaCO3)	< 1.0 < 1.0	1.0 mg/L 1.0 mg/L								
Airaillity, Tyuloxiue (as CaCO3)	< 1.0	1.0 IIIg/L								
LCS (B2J1539-BS1)			Prepared	I: 2022-10-1	4, Analyze	ed: 2022-1	10-14			
Alkalinity, Total (as CaCO3)	101	1.0 mg/L	100		101	80-120				
LCS (B2J1539-BS2)			Prepared	I: 2022-10-1	4. Analyza	ed: 2022-1	0-14			
Alkalinity, Total (as CaCO3)	97.4	1.0 mg/L	100	10 1	97	80-120				
/ intamility, Total (as GaGGG)	<i>31.</i> ₩	1.0 Hig/L	100		31	00-120				

General Parameters, Batch B2J1593



REPORTED TO Associated Environment 2022-8307.000		onmental Cons	ultants Inc. (Vernor	1)		WORK ORDER REPORTED			22J0954 2022-10-18 10:14		
Analyte		Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier	
General Parameter	s, Batch B2J1593, C	ontinued									
Blank (B2J1593-Bl	LK1)			Prepared	: 2022-10-1	4, Analyze	d: 2022 <b>-</b> 1	10-16			
Nitrogen, Total Kjelda	ıhl	< 0.050	0.050 mg/L								
Blank (B2J1593-Bl	LK2)			Prepared	: 2022-10-1	4 Analyze	d· 2022-1	10-16			
Nitrogen, Total Kjelda		< 0.050	0.050 mg/L			.,,,,					
LCS (B2J1593-BS	1)			Dropared	: 2022-10-1	1 Apolyzo	d. 2022 1	IN 16			
Nitrogen, Total Kjelda	,	0.994	0.050 mg/L	1.00	. 2022-10-1	+, Allaly26 99	85-115	10-10			
		0.994	0.030 Hig/L								
LCS (B2J1593-BS2	,				: 2022-10-1			10-16			
Nitrogen, Total Kjelda	ıhl	0.988	0.050 mg/L	1.00		99	85-115				
General Parameter				_	0055						
Blank (B2J1626-Bl				Prepared	: 2022-10-1	4, Analyze	d: 2022-1	10-14			
Solids, Total Dissolve	d	< 15	15 mg/L								
Blank (B2J1626-B	LK2)			Prepared	: 2022-10-1	4, Analyze	d: 2022-1	10-14			
Solids, Total Dissolve	d	< 15	15 mg/L								
LCS (B2J1626-BS	1)			Prepared	: 2022-10-1	4, Analyze	d: 2022-1	10-14			
Solids, Total Dissolve	d	243	15 mg/L	240		101	85-115				
LCS (B2J1626-BS2	2)			Prepared	: 2022-10-1	4. Analvze	d: 2022-1	10-14			
Solids, Total Dissolve	,	229	15 mg/L	240		95	85-115				
Duplicate (B2J162		9,	ource: 22J0954-03	Prenared	: 2022-10-1	4 Δnalvze	d· 2022-1	In_1 <i>4</i>			
Solids, Total Dissolve	·	1900	15 mg/L	Перагец	1930	+, Allaly26	u. 2022-1	2	15		
Total Metals, Batch			. 3						-		
Blank (B2J1193-Bl	LK1)			Prepared	: 2022-10-1	2, Analyze	d: 2022 <b>-</b> 1	10-12			
Mercury, total		< 0.000010	0.000010 mg/L								
Blank (B2J1193-Bl	LK2)			Prepared	: 2022-10-12	2, Analyze	d: 2022-1	10-12			
Mercury, total	,	< 0.000010	0.000010 mg/L	·		·					
LCS (B2J1193-BS1	1)			Prepared	: 2022-10-1	2 Analyze	d· 2022-1	10-12			
Mercury, total	• /	0.000529	0.000010 mg/L	0.000500		106	80-120				
	31				. 2022 10 1			10.12			
LCS (B2J1193-BS2 Mercury, total	<u>2)</u>	0.000525	0.000010 mg/L	0.000500	: 2022-10-1	2, Analyze 105	80-120	10-12			
Total Metals, Batcl		0.000323	0.000010 Hig/L								
Blank (B2J1596-Bl	LN1)	< 0.00F0	0.0050"	⊢repared	: 2022-10-1	+, Anaiyze	u: 2022-1	10-14			
Aluminum, total Antimony, total		< 0.0050 < 0.00020	0.0050 mg/L 0.00020 mg/L								
Arsenic, total		< 0.00050	0.00050 mg/L								
Barium, total		< 0.0050	0.0050 mg/L								
Beryllium, total		< 0.00010	0.00010 mg/L								
Bismuth, total Boron, total		< 0.00010 < 0.0500	0.00010 mg/L 0.0500 mg/L								
Cadmium, total		< 0.000010	0.000010 mg/L								
Calcium, total		< 0.20	0.20 mg/L								
Chromium, total		< 0.00050	0.00050 mg/L								
Cobalt, total		< 0.00010	0.00010 mg/L								



REPORTED TO PROJECT	Associated Environmental Co 2022-8307.000	on)		WORK ORDER REPORTED		22J0954 2022-10-18 10:14				
Analyte	Resu	lt RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batc	h B2J1596, Continued									
Blank (B2J1596-B	LK1), Continued			Prepared	: 2022-10-1	4, Analyze	d: 2022-1	10-14		
Copper, total	< 0.0004	0.00040	mg/L							
Iron, total	< 0.01	0.010	mg/L							
Lead, total	< 0.0002									
Lithium, total	< 0.0001	0.00010	mg/L							
Magnesium, total	< 0.01		mg/L							
Manganese, total	< 0.0002									
Molybdenum, total	< 0.0001									
Nickel, total	< 0.0004									
Phosphorus, total	< 0.05		mg/L							
Potassium, total	< 0.1		mg/L							
Selenium, total	< 0.0005									
Silicon, total	< 1.		mg/L							
Silver, total Sodium, total	< 0.00005 < 0.1		mg/L mg/L							
Strontium, total	< 0.001									
Sulfur, total	< 3.		mg/L							
Tellurium, total	< 0.0005									
Thallium, total	< 0.0000									
Thorium, total	< 0.0001									
Tin, total	< 0.0002									
Titanium, total	< 0.005									
Tungsten, total	< 0.000									
Uranium, total	< 0.00002									
Vanadium, total	< 0.005									
Zinc, total	< 0.004									
Zirconium, total	< 0.0001	0.00010	mg/L							
LCS (B2J1596-BS	1)			Prepared	: 2022-10-1	4, Analyze	d: 2022-1	10-14		
Aluminum, total	4.0	8 0.0050	mg/L	4.00		102	80-120			
Antimony, total	0.038	5 0.00020	mg/L	0.0400		96	80-120			
Arsenic, total	0.041			0.0400		104	80-120			
Barium, total	0.038			0.0400		96	80-120			
Beryllium, total	0.039			0.0400		100	80-120			
Bismuth, total	0.038			0.0400		97	80-120			
Boron, total	< 0.050			0.0400		107	80-120			
Cadmium, total	0.038			0.0400		96	80-120			
Calcium, total	4.0		mg/L	4.00		101	80-120			
Chromium, total	0.040			0.0400		102	80-120			
Cobalt, total Copper, total	0.040 0.040			0.0400 0.0400		101 100	80-120 80-120			
Iron, total	4.0		mg/L	4.00		101	80-120			
Lead, total	0.038			0.0400		97	80-120			
Lithium, total	0.030			0.0400		101	80-120			
Magnesium, total	4.1		mg/L	4.00		105	80-120			
Manganese, total	0.040			0.0400		101	80-120			
Molybdenum, total	0.038			0.0400		95	80-120			
Nickel, total	0.040			0.0400		100	80-120			
Phosphorus, total	4.0	3 0.050	mg/L	4.00		101	80-120			
Potassium, total	4.0		mg/L	4.00		101	80-120			
Selenium, total	0.040			0.0400		101	80-120			
Silicon, total	4.		mg/L	4.00		106	80-120			
Silver, total	0.038			0.0400		96	80-120			
Sodium, total	4.1	4 0.10	mg/L	4.00		104	80-120			
Strontium, total	0.041			0.0400		103	80-120			
Sulfur, total	41.		mg/L	40.0		104	80-120			
Tellurium, total	0.038	4 0.00050	ma/l	0.0400		96	80-120			



# **APPENDIX 2: QUALITY CONTROL RESULTS**

0.0388

REPORTED TO PROJECT	,				WORK ORDER REPORTED		22J0954 2022-10-18		10:14	
Analyte		Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B2J1596, Continued  LCS (B2J1596-BS1), Continued  Prepared: 2022-10-14, Analyzed: 2022-10-14										
	i), Continueu				. 2022-10-1			0-14		
Thallium, total		0.0387	0.000020 mg/L	0.0400		97	80-120			
Thorium, total		0.0400	0.00010 mg/L	0.0400		100	80-120			
Tin, total		0.0387	0.00020 mg/L	0.0400		97	80-120			
Titanium, total		0.0411	0.0050 mg/L	0.0400		103	80-120			
Tungsten, total		0.0393	0.0002 mg/L	0.0400		98	80-120			
Uranium, total		0.0386	0.000020 mg/L	0.0400		96	80-120			
Vanadium, total		0.0396	0.0050 mg/L	0.0400		99	80-120			
Zinc, total		0.0404	0.0040 mg/L	0.0400		101	80-120			

#### QC Qualifiers:

Zirconium, total

MS2 The native sample concentration is greater than the spike concentration hence the matrix spike limits do not apply.

0.0400

97

80-120

0.00010 mg/L

# Appendix H

Sanitary Use Bylaw



# THE CORPORATION OF THE CITY OF VERNON

# SANITARY USE BYLAW #4863

Consolidated for convenience

# PAGE 2

# BYLAW NUMBER 4863

# THE CORPORATION OF THE CITY OF VERNON BYLAW NUMBER 4863

BYLAW ADOPTION		AMENDMENT		
No.				
5100	September 10, 2007	Section 4.01 be deleted in its entirety.		

#### PAGE 3

#### **BYLAW NUMBER 4863**

## THE CORPORATION OF THE CITY OF VERNON

#### **BYLAW NUMBER 4863**

A bylaw to regulate discharges into the Sanitary Sewer System

WHEREAS pursuant to Section 8 of the Community Charter and amendments thereto, Council may, by bylaw, provide for the establishment of a system of sanitary sewer works and regulate the use of the sanitary sewer works of the City;

AND WHEREAS there are compounds in waste that in various concentrations are detrimental to the operation of the sanitary sewer works whose discharge must be regulated.

NOW THEREFORE BE IT RESOLVED that the Council of The Corporation of the City of Vernon, in open meeting assembled, enact as follows:

# 1.00 CITATION

1.01 This bylaw may be cited as the "City of Vernon Sanitary Sewer Use Bylaw Number 4863, 2005".

#### 2.00 SCOPE

- 2.01 This bylaw regulates the use of the sanitary sewer system within the City of Vernon.
- 2.02 The provisions of this bylaw apply to all direct and indirect discharges to any part of the City of Vernon sanitary sewer system.
- 2.03 This bylaw regulates the quantity and quality of wastes that may be discharged to the City of Vernon sanitary sewer system and the degree of pre-treatment required.
- 2.04 All applicable fees associated with this bylaw are charged in accordance with the City's current Fees and Charges Bylaw, and all subsequent amendments.
- 2.05 Nothing in this bylaw relieves any person or organization from complying with any provision of any Federal or Provincial legislation or any other bylaw of the City of Vernon.

#### 3.00 DEFINITIONS

3.01 In this bylaw, the following words and terms shall have the meanings hereinafter assigned to them:

# PAGE 4 BYLAW NUMBER 4863

"Adverse Effect" means impairment of or damage to the environment, human health or safety.

<u>"Biosolids"</u> means solids derived from primary, secondary, or advanced treatment of domestic wastewater which have been treated through one or more controlled processes that reduce pathogens, reduce volatile solids or chemically stabilize.

<u>"B.O.D."</u> or "Biochemical Oxygen Demand" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory conditions in five (5) days at 20 °C, expressed in milligrams per liter as determined by the appropriate procedure in "Standard Methods".

"BTEX" means the total of benzene, toluene, ethyl benzene, and xylene.

<u>"Building Sanitary Sewer"</u> means all pipes, conduits, drains and other equipment and facilities owned and maintained by the Owner for the purpose of collecting and transporting waste to the City of Vernon sanitary sewer.

"City" means the Corporation of the City of Vernon, in the Province of British Columbia.

<u>"C.O.D."</u> or "Chemical Oxygen Demand" means the measure of the oxygen consuming capacity of organic and inorganic matter present in wastewater as determined by the appropriate procedure described in "Standard Methods".

<u>"Cooling Water"</u> means untreated water originating from uses such as air conditioning, cooling or refrigeration where the only pollutant added to the water is heat.

<u>"Compatible Pollutant"</u> means B.O.D., S.S., pH and fecal coliform bacteria and such additional pollutants as are now, or may be in the future, specified and controlled in the City of Vernon Operational Certificate as issued by the Ministry of Water, Land and Air Protection, for its wastewater treatment works where said works have been designed and used to reduce or remove such pollutants.

"Composite Sample" means a sample which is composed of equal portions of a specified number of Grab Samples collected at the same sampling point at specified time intervals during a specified sampling period.

<u>"Contaminant"</u> means any substance, whether gaseous, liquid or solids, whether dissolved or suspended that:

- a. injures, or is capable of injuring, the health or safety of a person;
- b. injures, or is capable of injuring, property or any life form;
- c. interferes, or is capable of interfering, with the operation of a Sewer or Sewage Facility;
- d. causes, or is capable of causing, material physical discomfort to a person;

## PAGE 5 BYLAW NUMBER 4863

e. damages, or is capable of damaging, the environment.

<u>"Domestic Wastewater"</u> means wastewater that is composed of liquid and water carried wastes associated with the use of water for drinking, cooking, cleaning, washing, hygiene, sanitation or other domestic purposes.

<u>"Effluent"</u> means the liquid outflow of any facility designed to treat or convey wastewater.

"Garbage" means solid wastes from domestic and commercial preparation, cooking and dispensing of food, and from handling, storage and sale of food as well as any other refuse not normally associated with typical domestic wastewater.

"Grab Sample" means an aliquot of a sampled stream or discharge collected at one particular place and time.

"High Strength Wastes" means wastewater having;

- a. B.O.D. in excess of 500 mg/l as analyzed in a twenty-four-hour composite sample, 1000 mg/l as analyzed in a two-hour composite sample, or 2000 mg/l as analyzed in a grab sample or;
- b. C.O.D. in excess of 750 mg/l as analyzed in a twenty-four-hour composite sample, 1500 mg/l as analyzed in a two-hour composite sample, or 3000 mg/l as analyzed in a grab sample or;
- c. Suspended Solids (S.S.) in excess of 500 mg/l as analyzed in a twenty-four-hour composite sample, 1000 mg/l as analyzed in a two-hour composite sample, or 2000 mg/l as analyzed in a grab sample.

"Holding Tank" means a device or structure designed for the temporary storage of wastewater.

"Incompatible Pollutant" means any pollutant that is not a compatible pollutant as defined in this section.

<u>"Industrial Wastewater"</u> means wastewater that is composed of liquid and water carried wastes associated with processes employed in industrial manufacturing, trade, or commercial and business establishments, as distinct from domestic wastewater.

"mg/l" or "mg/litre" means milligrams per liter.

<u>"Non Polluted Water"</u> means water that does not contain any compatible pollutants or contaminants such as rainwater, groundwater, swimming pool water or any other non sewage wastewater.

<u>"Oil and Grease"</u> means organic substance including, but not limited to, hydrocarbons, esters, fats, oils, waxes and high molecular weight carboxylic acids.

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"Owner" shall have the same meaning as assigned to it under the Community Charter.

<u>"pH"</u> means the logarithm of the reciprocal of the concentration of hydrogen ions in a solution.

<u>"Pesticide"</u> means an organism or material that is represented, sold, used or intended to be used to prevent, destroy, repel or mitigate a pest and includes a plant growth regulator, plant defoliator or plant desiccant and a control product, other than a device that is a control product under the Pest Control Products Act (Canada).

<u>"Plumbing Fixture"</u> means a receptacle, appliance, apparatus or device that discharges wastewater to the sanitary sewer.

"Pool" means any man made structure with a water depth exceeding 450 mm.

<u>"Premises"</u> means any residential, commercial or industrial structure that has a building sanitary sewer connected to the City of Vernon Sanitary Sewer System.

<u>"Pretreatment"</u> means application of physical, chemical and/or biological processes to reduce the amount of pollutants in, or alter the nature of the pollutant properties in a wastewater prior to discharging such wastewater to the sanitary sewer.

<u>"Sanitary Sewer"</u> means a Sewer which carries Domestic or Industrial Wastewater but is not intended to carry stormwater, cooling water, groundwater, or unpolluted water.

<u>"Sanitary Sewer System"</u> means all pipes, conduits, drains and other equipment and facilities owned or otherwise under the control of the City for collecting, pumping and transporting wastewater including all such pipes, conduits, drains and other equipment and facilities which connect to those owned or otherwise under the control of the City.

<u>"Septic Tank"</u> means a device or structure in which the solids contained in wastewater are decomposed by anaerobic bacteria and the effluent is disposed of to an infiltration field.

<u>"Sewage Facility"</u> means any works owned by or under the control or jurisdiction of the City that collects, transports, stores, treats, utilizes or discharges wastewater.

<u>"Sewer Connection"</u> means the sanitary sewer or storm sewer connecting pipe from the property line to the sewer.

"Significant User" means any User of the City's Sanitary Sewer whose flow exceeds 125 m<sup>3</sup> per day (27,500 imperial gallons per day) or whose discharge to the sanitary sewer system typically has a strength of 500 mg/l S.S. or 500 mg/l B.O.D.

<u>"Special Waste"</u> means special waste as defined in the *Environmental Management Act* of British Columbia.

<u>"Special Waste Regulation"</u> means the Hazardous Waste Regulation pursuant to the *Environmental Management Act* of British Columbia.

# PAGE 7 BYLAW NUMBER 4863

<u>"Standard Methods"</u> means the latest edition of Standard Methods for the Examination of Water and Wastewater as published by the American Public Health Association, American Waterworks Association and the Water Environment Federation.

<u>"S.S."</u> means the solids matter, expressed in mg/l, in a liquid as determined according to Standard Methods.

<u>"Stormwater"</u> means water originating from rainwater, snowmelt or groundwater, including roof drain water.

<u>"Twenty-Four-Hour Composite Sample"</u> means a composite sample consisting of equal portions of 24 grab samples collected a 1 hour intervals.

<u>"Two-Hour Composite Sample"</u> means a composite sample consisting of equal portions of 8 grab samples collected at 15 minute intervals.

<u>"Trucked Waste"</u> means any waste that is collected and transported off site by means of a tank truck and discharged to the sanitary sewer system and includes septic tank waste (septage), holding tank waste and portable toilet waste.

<u>"Unpolluted Water"</u> is water not containing any pollutants limited or prohibited by the water quality standards in effect, or water whose discharge will not cause any violation of receiving water quality standards as established in Federal or Provincial legislation.

<u>"User"</u> means any person who discharges, causes or permits the discharge of wastewater into the City's Sanitary Sewer system.

<u>"Waste"</u> or "<u>Wastes"</u> means any substance, whether gaseous, liquid or solid, that is discharged or discarded, directly or indirectly to a sanitary sewer or wastewater treatment facility.

"Wastewater" means domestic wastewater or industrial wastewater.

<u>"Wastewater Treatment System"</u> means all facilities and equipment owned or otherwise under the control of the City of Vernon to treat domestic and industrial wastewater such that following treatment the effluent is suitable for reuse by the City's reclaimed water irrigation program or for discharge to Okanagan Lake via the deep lake outfall.

#### 4.00 CONNECTION TO THE SANITARY SEWER

- 4.01 Every sanitary sewer connection shall be installed in accordance with the standards contained in the City's current Subdivision and Development Servicing Bylaw, and all subsequent amendments, and shall be installed prior to the installation of the building sanitary sewer.
- 4.02 The owner or occupier of any premises upon which a new commercial or industrial facility will be operated and where, on average, it is projected that more than 300m<sup>3</sup> of

# PAGE 8 BYLAW NUMBER 4863

non domestic wastewater will be discharged to the sanitary sewer system in any 30 day period, must obtain a Sewer Use Permit from the City of Vernon by completing a Sewer Use Permit Application prior to connection to the sanitary sewer system.

- 4.03 The owner or occupier of any premises upon which an existing commercial or industrial facility is operated and where, on average, more than 300m<sup>3</sup> of non domestic wastewater is discharged to the sanitary sewer system in a 30 day period, must obtain a Sewer Use Permit from the City of Vernon by completing a Sewer Use Permit Application prior to any alteration or expansion of the facility.
- 4.04 Grease and oil interceptors shall be installed for all food preparation facilities sufficient to prevent the discharge of grease and oil to the sanitary sewer system.
- 4.05 Grease, oil and sand interceptors shall be installed at all vehicle repair and maintenance establishments sufficient to prevent the discharge of grease, oil and sand to the sanitary sewer system.
- 4.06 All interceptors shall be installed upstream of the sanitary sewer system service connection and shall be located so as to be readily accessible for inspection and maintenance.
- 4.07 The owner or occupier of any premises upon which an interceptor is installed shall maintain the interceptor in a serviceable condition at all times.
- 4.08 The City of Vernon may, at its sole discretion, request that the owner or occupier of any premises upon which a grease, oil or sand interceptor is installed to provide records of maintenance of the interceptor.
- 4.09 The control manhole shall be installed and maintained by the owner or occupier of the premises and shall be accessible to the City of Vernon at all times to inspect and sample material entering the sanitary sewer system.
- 4.010 The control manhole and flowmeter specification must be approved by the City of Vernon prior to connection to the sanitary sewer system.

# 5.00 MONITORING OF DISCHARGE TO THE SANITARY SEWER SYSTEM

- 5.01 Should it be determined through sampling and analysis that the discharge to the sanitary sewer system from a premises is in violation of this bylaw, the City of Vernon may direct the owner or occupier of the premises to take steps to comply with the bylaw and may require the owner or occupier to install monitoring equipment as necessary to demonstrate compliance with this bylaw.
- 5.02 All test, measurements, analysis and examinations of wastewater required to demonstrate compliance with this bylaw shall be at the cost of the owner or occupier of the premises where a discharge occurs.

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# 6.00 PENALTIES

Any person who violates any provision of this bylaw will be deemed to have committed an offence and shall be liable upon summary conviction to the following penalties:

- a. a minimum fine of \$500.00;
- b. a maximum fine of \$10,000;
- c. in the case of a continuing offense, for each day that the offense continues, either or both of:
  - 1. a minimum fine under paragraph a.
  - 2. a maximum fine under paragraph b;
- d. in a prosecution of an offense against a municipal bylaw, the justice or court may impose all or part of the penalties applicable in relation to the offense, together with the costs of prosecution.

#### 7.00 WASTE DISCHARGE

## 7.01 Prohibited Wastes

Except as otherwise provided in this bylaw, no person shall release or discharge, or permit the releasing or discharge into the sanitary sewer system of any Prohibited Waste as described in Schedule A.

#### 7.02 Restricted Wastes

Except as otherwise provided in this bylaw, no person shall release or discharge, or permit the releasing or discharge into the sanitary sewer system of any Restricted Waste as described in Schedule B.

#### 7.03 High Strength Wastes

The City may accept High Strength Wastes as defined in this bylaw into the sanitary sewer system at its sole discretion where the wastewater is not such that it can damage the sanitary sewer system or the wastewater treatment system. The City will impose a sewer service surcharge on High Strength Wastes as contained in the City's current Fees and Charges Bylaw, and all subsequent amendments.

# 7.04 Trucked Waste

All provisions in this bylaw apply to all trucked waste discharged to the sanitary sewer, with the exception of the limits for B.O.D. and S.S. contained in Schedule B, Section 1 and Section 3.

The City of Vernon will accept Trucked Waste from haulers holding a valid City of Vernon business license into the sanitary sewer system at the designated discharge location(s) and during the times designated by the City of Vernon. The location and times may vary at the discretion of the City of Vernon. The City of Vernon reserves the

# PAGE 10 BYLAW NUMBER 4863

right, at its sole discretion, to refuse to accept any load of trucked waste that it considers to be of questionable origin or quality.

The discharge of trucked waste to the sanitary sewer system at any location(s) other than those authorized by the City of Vernon are strictly prohibited and are subject to the penalties contained in this bylaw.

A properly completed load manifest for every load of trucked waste discharged to the City of Vernon sanitary sewer must be provided to the City of Vernon or its designated representative by the trucked waste hauler prior to discharge to the sanitary sewer. Failure to provide a properly completed load manifest will result in the refusal to accept the load of trucked waste.

Only trucked waste originating in the Regional District of the North Okanagan will be accepted.

Waste from commercial oil and grease separators and commercial car wash catch basins will not be accepted into the sanitary sewer.

In addition to the penalties described in this bylaw, the City of Vernon may, at its sole discretion, suspend or revoke access to the designated discharge location should a trucked waste hauler be found in violation of any of the provisions of this bylaw.

# 7.05 Non Polluted Water

No person shall release or discharge, or permit the releasing or discharge into the sanitary sewer system any non polluted water.

# 7.06 Pretreatment Requirements

Where wastewater discharged into the sanitary sewer collection system is found to have been deleterious to the sanitary sewer collection system or wastewater treatment plant, the City of Vernon may, by notice in writing to the owner or occupier of any premises:

- a. Refuse to allow any additional wastes to be discharged to the sanitary sewer system.
- b. Require the owner or occupier of any premises to construct, operate and maintain wastewater pre-treatment facilities to ensure compliance with this bylaw.
- c. Require the owner or occupier of any premises to construct, operate and maintain facilities to control the rate of discharge to the sanitary sewer system.
- d. Require the owner or occupier to pay additional charges to cover the added cost of treating the wastes discharged to the sanitary sewer system as contained in the City's current Fees and Charges Bylaw, and all subsequent amendments.

# PAGE 11 BYLAW NUMBER 4863

8.01	Any person who wishes to discharge wastewater to the sanitary sewer system on a temporary basis, must obtain a Temporary Sewer Use Permit from the City of Vernon by completing a Sewer Use Permit Application prior to any discharge to the sanitary sewer.
8.02	Charges for temporary discharges to the sanitary sewer system are as described in the City's current Fees and Charges Bylaw, and all subsequent amendments.
D	EAD A FIRST TIME this 27 day of June 2005
n	EAD A FIRST TIME this 27 day of June, 2005.
R	EAD A SECOND TIME this 27 day of June, 2005.
R	EAD A THIRD TIME this 27 day of June, 2005.
Al	DOPTED this 11 day of July, 2005.

City Clerk:

Mayor:

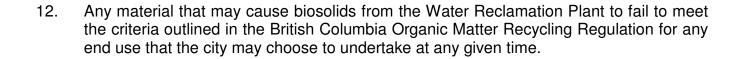
Attached hereto and forming Part of Bylaw No.4863

# **PROHIBITED WASTE**

The following are designated as Prohibited Waste:

- 1. Any material which causes or will cause an adverse effect.
- 2. Any stormwater or unpolluted water.
- 3. Any flammable or explosive material.
- 4. Any pesticides, insecticides, herbicides, or fungicides save and except chemicals contained in stormwater emanating from trees or vegetation treated in accordance with the Pesticide Control Act.
- 5. Any material capable of obstructing wastewater flow or interfering with the operation of any part of the sewage collection or treatment system. These materials include, but are not limited to, ashes, cinders, sand, mud, straw, grass clippings, insoluble shavings, metal, glass, rags, feathers, tar, asphalt, creosote, plastics, wood, animal paunch contents, offal, blood, bones, meat trimmings and waste, fish or fowl head, shrimp, crab or clam shells, fish scales, entrails, lard, mushrooms, tallow, baking dough, chemical residues, cannery or wine waste, bulk solids, hair and fleshings, spent grain and hops, whole or ground food or beverage containers, garbage, paint residues, cat box litter, slurries of concrete, cement, lime or mortar.
- 6. Any material, other than domestic wastewater, which by itself or in combination with another substance is capable of creating odours related to but not limited to hydrogen sulfide, carbon disulfide, other reduced sulfur compounds, amines or ammonia outside or in and around the wastewater collection system.
- 7. Any noxious or malodorous material which by itself or in combination with another material is capable of creating a public nuisance or hazard to life or may be prevent entry into a sewer or pump station for its maintenance or repair.
- 8. Any material with corrosive properties which by itself or in combination with another material may cause damage to any part of the sewage collection or wastewater treatment system.
- 9. Any infectious material which by itself or in combination with another material may create a contaminant in any part of the sewage collection or wastewater treatment system.
- 10. Grit removed from commercial or industrial premises including but not limited to grit removed from car washing establishments, automobile garages, restaurant sumps or interceptors.
- 11. Any material classified as a Special Waste.

# PAGE 2 SCHEDULE "A"



# **RESTRICTED WASTE**

The following are designated as Restricted Waste:

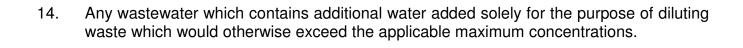
- 1. Any wastewater having a B.O.D. in excess of 500 mg/l as analyzed in a twenty-four-hour composite sample, 1000 mg/l as analyzed in a two-hour composite sample, or 2000 mg/l as analyzed in a grab sample.
- 2. Any wastewater having a C.O.D. in excess of 750 mg/l as analyzed in a twenty-four-hour composite sample, 1500 mg/l as analyzed in a two-hour composite sample, or 3000 mg/l as analyzed in a grab sample.
- 3. Any wastewater having a S.S. in excess of 500 mg/l as analyzed in a twenty-four-hour composite sample, 1000 mg/l as analyzed in a two-hour composite sample, or 2000 mg/l as analyzed in a grab sample.
- 4. Any wastewater which contains oil and grease in a concentration that is in excess of 100 mg/l as analyzed in a twenty-four-hour composite sample, 200 mg/l as analyzed in a two-hour composite sample, or 400 mg/l as analyzed in a grab sample.
- 5. Any wastewater which contains oil and grease derived from a petroleum source in a concentration that is in excess of 15 mg/l as analyzed in a twenty-four-hour composite sample, 30 mg/l as analyzed in a two-hour composite sample, or 60 mg/l as analyzed in a grab sample.
- 6. Any material which may solidify or become viscous at temperatures above 0 ℃.
- 7. Any wastewater having a temperature greater than 65°C.
- 8. Any wastewater having a pH lower than 5.0 or higher than 11.0 as determined by a grab sample, or less than 5.5 or higher than 10.5 as determined by a two-hour composite sample.
- 9. Any wastes from the preparation, cooking and dispensing of food that has not been property comminuted to 12mm or less in any dimension. Such waste must be shredded to such a degree that all particles will be freely carried under the flow conditions prevailing in the sanitary sewer collection system.
- 10. Any wastewater containing a hazardous, toxic or poisonous substance in sufficient quantity to injure or interfere with any sanitary sewer system or wastewater treatment system which could constitute a hazard to humans or animals, or create a hazard in areas receiving treated effluent from the wastewater treatment plant.
- 11. Any wastewater containing dyes or colouring material which pass through the sanitary sewer or wastewater treatment system and discolour any part of the sanitary sewer, wastewater treatment system or the treated effluent from wastewater treatment plant.

# PAGE 2 SCHEDULE "B"

- 12. Any wastewater containing substances in concentrations that are not amenable to treatment or reduction in the wastewater treatment process being employed by the City at any given time or that cannot be treated to such a degree during the normal wastewater treatment process to meet the requirements of the City of Vernon's Ministry of Water, Land and air Protection Operational Certificate or any other applicable provincial or federal legislation that may be in effect.
- 13. Any wastewater with a concentration, in a combined or uncombined form, in excess of the levels set out below:

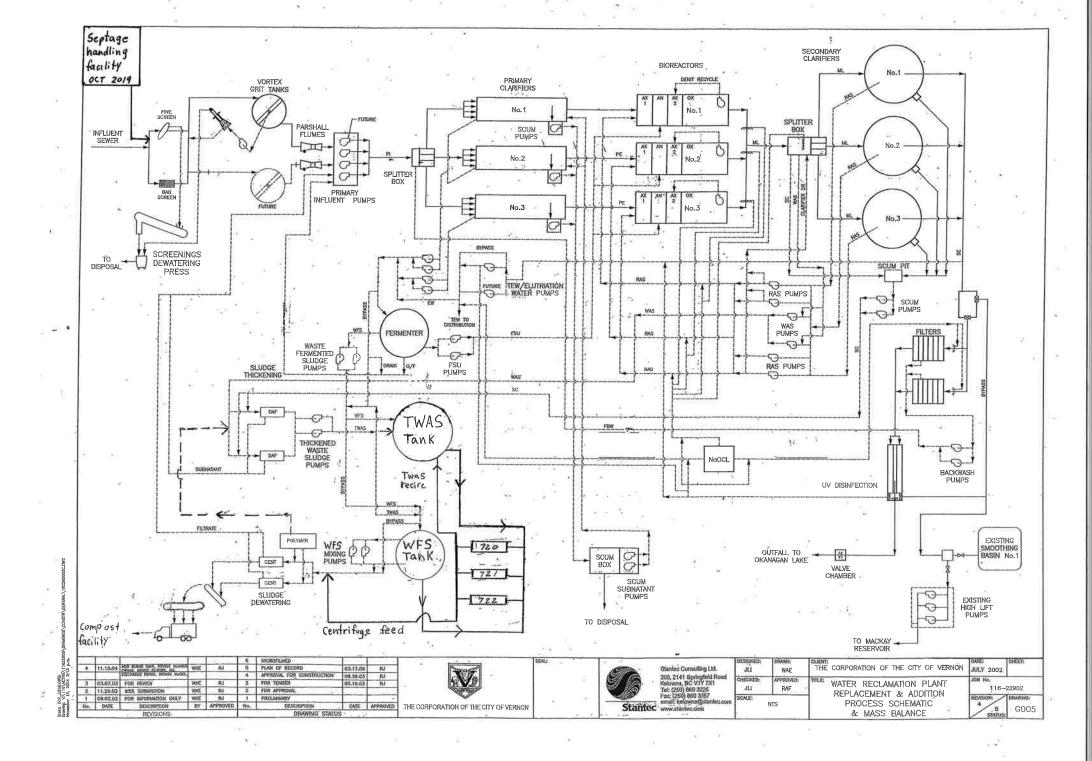
Substance	Expressed As	Concentration in mg/l				
Substance	Expressed As	Α	В	С		
Aluminum	Al	50	100	200		
Arsenic	As	1	2	4		
Boron	В	50	100	200		
Cadmium	Cd	0.2	0.4	0.8		
Chromium	Cr	4	8	16		
Cobalt	Co	5	10	20		
Copper	Cu	2	4	8		
Cyanide	Cn	1	2	4		
Iron	Fe	10	20	40		
Lead	Pb	1	2	4		
Manganese	Mn	5	10	20		
Mercury	Hg	0.05	0.1	0.2		
Molybdenum	Мо	1	2	4		
Nickel	Ni	2	4	8		
Phenols		1	2	4		
Phosphorus	Р	12.5	25	50		
Silver	Ag	1	2	4		
Sulphate	SO <sub>4</sub>	1500	3000	6000		
Sulphide	S	1	2	4		
Tin	Tin Sn		10	20		
Zinc Zn		3	6 12			
A:						
B:						
C:						

# PAGE 3 SCHEDULE "B"



# Appendix I

**VWRC Process Schematic** 



# Appendix J

VWRC Discharge Plan



Associated Environmental Consultants Inc. Suite 200, 2800 29 Street Vernon, B.C., Canada, V1T 9P9

> TEL: 250.545.3672 FAX: 250.545.3654

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November 18, 2022 File: 2021-8917.000

Serge Kozin Manager Vernon Water Reclamation Centre City of Vernon 1900 48th Ave Vernon, BC V1T 8Y7

Re: PROJECTED WATER LEVELS OF MACKAY RESERVOIR PRIOR TO 2023 IRRIGATION SEASON AND PLANNED DISCHARGE TO OKANAGAN LAKE (OC#12215)

Dear Serge Kozin:

The City of Vernon (the City) retained Associated Environmental Consultants Inc. (Associated) to estimate whether the elevation of MacKay Reservoir is likely to exceed the thresholds set by their Operational Certificate ME 12215 (the OC) (MOE 2008) prior to the start of the 2023 irrigation season (i.e., early May). This work was completed to support the City's notification to the BC Ministry of Environment and Climate Change Strategy (ENV) of a planned discharge to Okanagan Lake, as authorized under the OC.

#### 1 BACKGROUND

Under the OC, the City is authorized to store municipal wastewater that has been treated to an advanced (tertiary) level at the Vernon Water Reclamation Centre (VWRC) in the MacKay Reservoir and beneficially reuse the reclaimed water for irrigation purposes. Section 3.3b of the OC also authorizes discharge of reclaimed water to Okanagan Lake via the City's deep lake outfall when the elevation of MacKay Reservoir meets both of the following criteria (MOE 2008):

- exceeds 1,935 feet above mean sea level (fasl); and
- is projected to exceed 1,939 fasl prior to the start of the next irrigation season.

Under this scenario, the City must notify ENV by providing a discharge plan at least 60 days in advance of any lake discharge. Therefore, the purpose of this letter is to project the reservoir levels for the start of the irrigation season to support a notification of a planned release to Okanagan Lake. Levels are projected through a simplified water balance, following the approach adopted in previous years (Urban Systems 2019; City of Vernon 2019; Associated 2020).







#### 2 METHODS

The City provided Associated with weekly historical and current (as of November 16, 2022) reservoir levels. The dates at which reservoir levels are anticipated to reach 1,935 fasl and 1,939 fasl were then estimated considering a continued inflow of effluent to MacKay Reservoir and the reservoir stage-storage curve presented by Urban Systems (2019). Further information on key assumptions and input/output variables are as follows:

- The effluent inflow volume to MacKay Reservoir was estimated based on average historical
  inflows to the VWRC (provided by the City). Also, we assumed that all flows entering the
  VWRC exit the VWRC¹ and are discharged to MacKay Reservoir.
- No outflow from MacKay Reservoir was considered, as reclaimed water is only extracted from the reservoir during the irrigation months. No other discharge from MacKay Reservoir is permitted by the OC.
- Evaporation from the reservoir is considered negligible during the winter due to low air temperatures and leakage from the reservoir is unknown and assumed insignificant.
- Natural surface water inflows<sup>2</sup> to the reservoir are deemed negligible during the winter period
  and direct precipitation was not considered due to daily variability and, at times, the presence
  of ice on the reservoir. However, although natural inflows and precipitation are not considered,
  their inclusion would only serve to further increase the estimated reservoir levels.

This method follows the same approach used by Urban Systems (2019) and Associated (2020). The approach and assumptions used were applied most recently in 2020 to project reservoir levels, and the data show that the projected results agreed well with the actual levels (Associated 2020).

<sup>&</sup>lt;sup>2</sup> Provincial mapping shows there are two mapped streams flowing into the reservoir. Contributions from these streams to the reservoir has not been confirmed or quantified.



<sup>&</sup>lt;sup>1</sup> We understand there is no effluent flow meter and that outside of the irrigation season, all treated effluent is discharged to the reservoir.



#### 3 PROJECTED LEVELS

Table 1 presents the input parameters and projected levels.

Table 1: Reservoir Level Projections for Winter 2022/2023

Parameter	Unit	Result		
Current reservoir elevation as of November 16, 2022	fasl	1929.3		
Estimated current reservoir volume as of November 16, 2022 <sup>1</sup>	ML	7,458		
Estimated daily reservoir inflow (average inflow to the VWRC) <sup>2</sup>	ML/day	12.4		
Estimated reservoir volume at 1,935 fasl <sup>1</sup>	ML	8,634		
Available volume before reaching 1,935 fasl (from current)	ML	1,176		
Number of days until 1,935 fasl is reached <sup>3</sup>	Days	~94		
Projected date at which 1,935 fasl is reached	Date	~February 18, 2023		
Estimated reservoir volume at 1,939 fasl <sup>1</sup>		9,498		
Available volume before reaching 1,939 fasl (from current)		2,040		
Number of days until 1,939 fasl is reached <sup>3</sup>	Days	~164		
Projected date at which 1,939 fasl is reached	Date	~April 29, 2023		

#### Notes:

The irrigation season start date varies by year, but typically begins in May (between 2017 and 2022, irrigation start dates ranged from May 1 to May 31). The current projections indicate that 1,939 fasl will be reached just prior to the start of the next irrigation season. However, there is a significant amount of uncertainty in these projections, and it is important to note that the City has no mechanism to reduce the reservoir levels other than through irrigation. Preventing the reservoir from exceeding 1,939 fasl can only be achieved proactively by diverting flow away from the reservoir.

#### 4 ALLOWABLE DISCHARGE VOLUME

When the Mackay Reservoir elevation criteria are both met, OC Section 3.3b authorizes the City to discharge '150% of the volume of reclaimed water necessary to prevent MacKay Reservoir from exceeding 1,939 feet prior to the start of the irrigation season'. Following the City's agreed approach with ENV in 2019, which is based on the trigger levels of 1,935 and 1,939 fasl in the OC, and using the stage-storage curve provided by Urban Systems (2019), we understand that the ENV calculates the allowable discharge volume to be the following (S. Kozin, personal communication, 2020):



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(MacKay Reservoir Volume at 1,939 fasl - MacKay Reservoir Volume at 1,935 fasl) \* 1.5

(9,498 ML - 8,634 ML) \* 1.5 = **1,296 ML** 

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Following the above calculations and discussions with the City, the City's proposed discharge plan is as follows:

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- Use reclaimed water for irrigation purposes when the irrigation season begins, following the OC requirements.

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#### 6 CLOSURE

Please contact the undersigned at 250-545-3672 if you have any questions regarding the content of this letter.

Associated Environmental Consultants Inc.

Yours truly,

Nicole Penner, P.Ag. Environmental Scientist Reviewed by:

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