

Magic Lake Estates Water and Sewer System

2022 Annual Report

CRD | Drinking Water and Wastewater

Introduction

This report provides a summary of the Magic Lake Estates (MLE) Water and Sewer Service for 2022 and provides a description of the water and sewer services including: summary of the water supply, demand and production, drinking water quality, wastewater treatment flows, effluent quality, operations highlights, capital project updates and financial report.

WATER SYSTEM

Water Service Description

The community of Magic Lake Estates is primarily a rural residential development with some community properties located on Pender Island in the Southern Gulf Islands Electoral Area which was originally serviced by a private water utility and in 1981 the service converted to the Capital Regional District (CRD). The Magic Lake Estates water service is made up of 1,196 parcels, of which there are 1,059 single family equivalents (or approximately the same amount of customers) obtaining service from the water system.

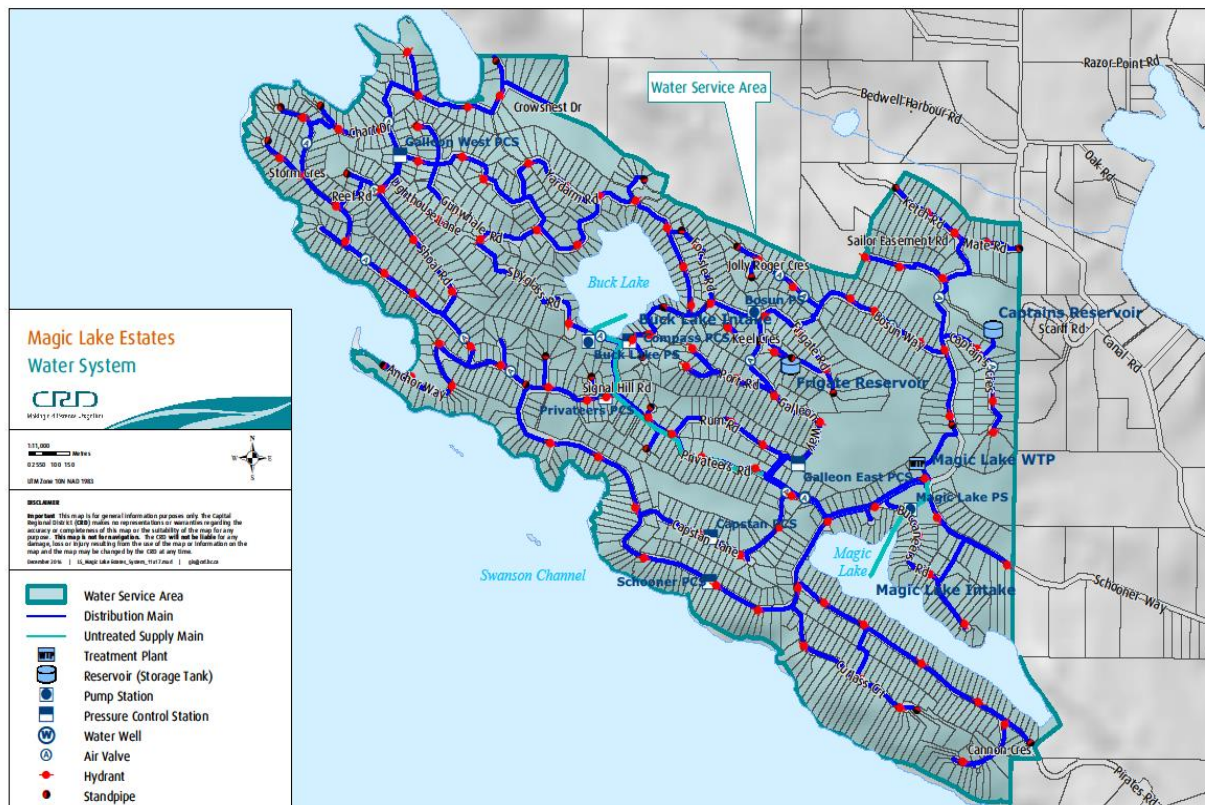


Figure 1: Map of Magic Lake Estates Water System

The Magic Lake Estates water system is primarily comprised of:

- Two raw water sources; Buck Lake (primary source) and Magic Lake (secondary source).
- Four earthen dam structures (two at Buck Lake and two at Magic Lake).
- Two raw water pump stations, one each related to the raw water supplies, with pretreatment oxidation equipment to treat and control dissolved manganese and iron in the raw water source.
- Centralized water treatment plant consisting of a dual process including dissolved air flotation (DAF), filtration, ultraviolet light disinfection and chlorine disinfection.
- One booster pump station / pressure reducing station (Bosun).
- Two steel storage tanks, Frigate and Captains (volumes: Frigate 750 cubic meters or 200,000 USg and Captains 341 cubic meters or 90,000 USg).
- Supervisory Control and Data Acquisition (SCADA) system.
- Distribution system and supply pipe network (in excess of 27 kilometers of water mains).
- Other water system assets: water service connections and meters, approximately 70 fire hydrants, 6 pressure reducing valve stations, 100 gate valves and standpipes.

Water Supply

Surface water supply monthly water levels are provided in Figures 2 and 3 for Buck Lake and Magic Lake respectively. It is important to note that under normal operating conditions, Buck Lake provides 80% and Magic Lake provides 20% of the annual raw water demand for the service. However, due to an algae event in Magic Lake, Buck Lake provided 100% of the raw water supply from approximately August to December of 2022.

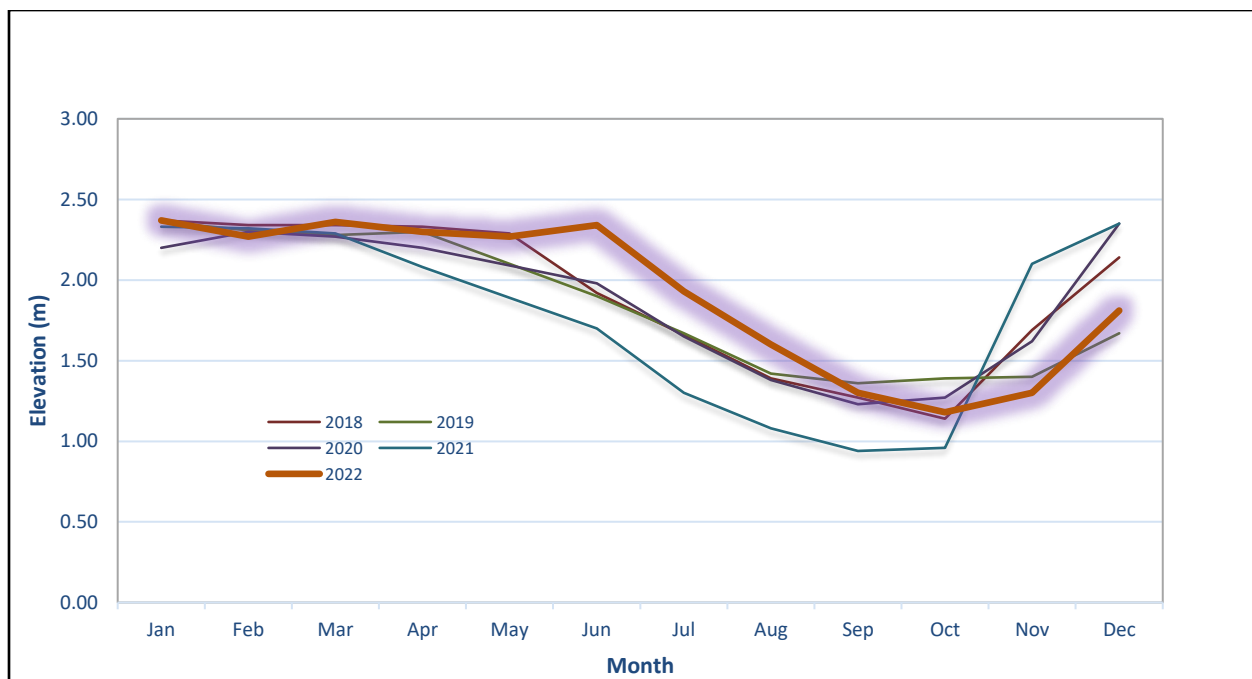


Figure 2: Buck Lake Monthly Water Level

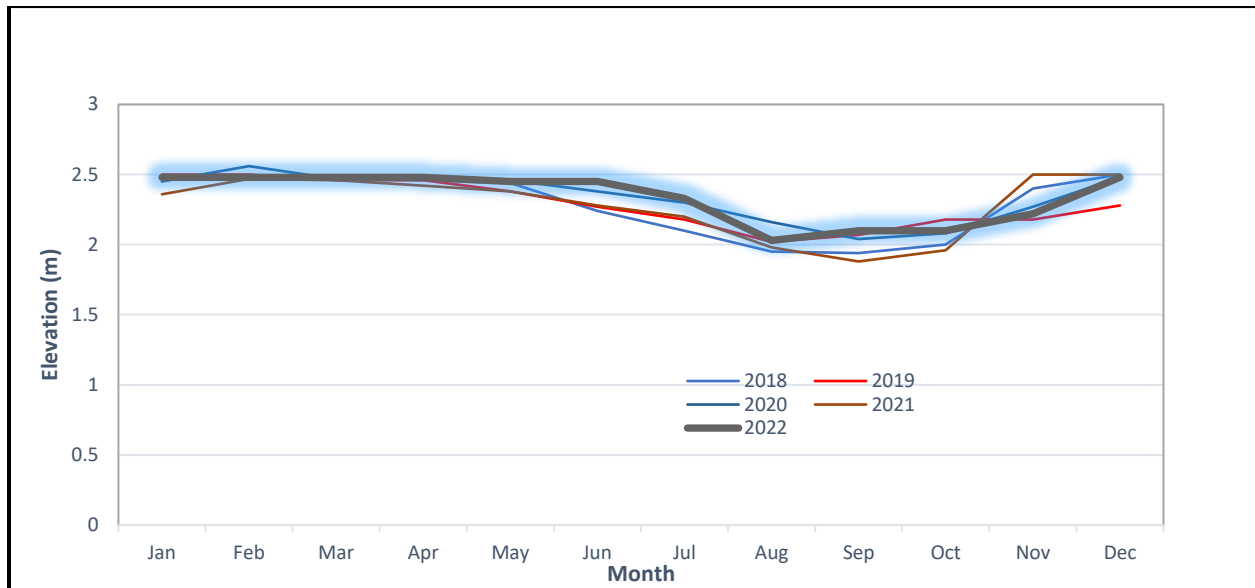


Figure 3: Magic Lake Monthly Water Level

Water Production and Demand

Referring to Figure 4, 182,708 cubic meters of water was extracted (water production) from both Buck Lake and Magic Lake water sources in 2022; a 10% decrease from the previous year and an 3% increase in the rolling five-year average. Water demand (customer water billing) for the service totaled 126,941 cubic meters of water; a 9% decrease from the previous year and a 1% decrease from the rolling five-year average.

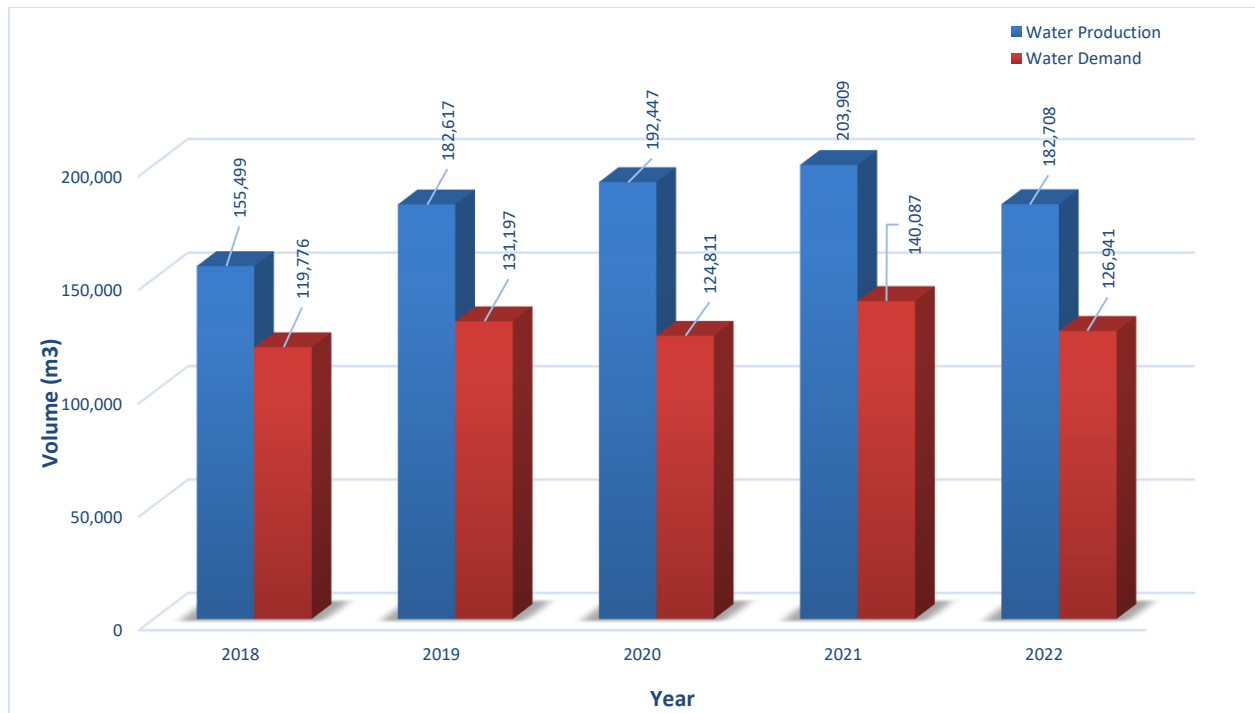


Figure 4: Magic Lake Estates Water System Annual Water Production and Demand

The difference between annual water production and annual customer water demand is referred to as non-revenue water and can include water system leaks, water system maintenance and operational use (e.g. water main flushing, filter system backwashing), potential unauthorized use and fire-fighting use.

The 2022 non-revenue water (55,767 cubic meters) represents about 31% of the total water production for the service area. However, approximately 5,000 cubic meters of the non-revenue water can be attributed to operational use. Therefore, the non-revenue water associated with system losses is approximately 28% which is slight decrease from the previous year is moderate for a water distribution system the size of Magic Lake Estates.

Figure 5 below illustrates the monthly water production for Magic Lake Estates for the past five years. The monthly water production trends are typical for smaller water systems such as Magic Lake Estates. In review of water production for 2022, the monthly trend for August through October is higher than the previous years and is likely due to outdoor watering due to a dryer than normal fall period.

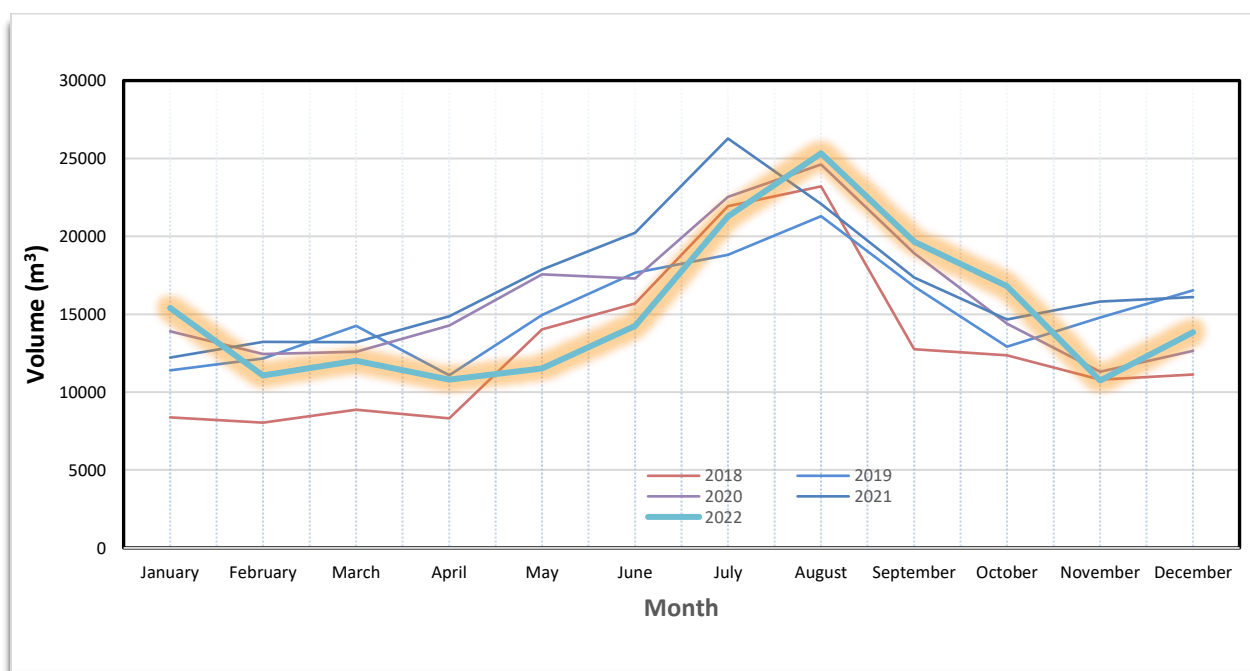


Figure 5: Magic Lake Estates Water System Monthly Water Production.

Drinking Water Quality

Two intake lines from Buck Lake and Magic Lake provided blended source water to the DAF treatment plant. The typical intake blending ratio in 2022 was 80/20 Buck/Magic lakes unless water quality concerns or operational needs required a temporary adjustment. Due to a cyanobacteria bloom in Magic Lake, the source water supply came from Buck Lake only between August 22 and October 20, 2022. Buck Lake experienced an even more severe cyanobacteria bloom from the beginning of September to the end of October. During this period, the pot perm pre-oxidation treatment was discontinued to avoid lysing of the cyanobacteria cells which could introduce cyanotoxins to the water. Fortunately, no cyanotoxins were detected throughout this algal event. By October 25 the system went back to normal operation with an 80/20 raw water blending rate and reinstated pot perm treatment for iron and manganese removal. The drinking water supplied to the service area was safe for consumption throughout the year.

The existing multi-barrier treatment system was able to deal with several algal as well as high manganese events in both source lakes throughout the year. The treatment system was also able to reduce the total organic carbon (TOC) concentration by >50%, however, the high organic loading of the raw water still resulted in a high organic carbon concentration in the treated drinking water which can have taste and odour implications and can lead to high disinfection by-product concentrations. As in previous years, operations staff successfully mitigated localized adverse water quality events due to aging and stagnant water through spot-flushing.

Overall Magic Lake Estates drinking water quality characteristics for 2022 are summarized below.

Raw Water:

- Both lake sources exhibited low concentrations of total coliform bacteria throughout the winter months but higher concentration during the warm water period, which was extended well into October in 2022 due to an usually dry and warm fall. In Magic Lake, the peak total coliform bacteria concentrations was 2,100 CFU/100mL in mid July. This was lower than in 2021 and more in line with summers prior to the heat dome in 2021. Buck Lake saw a total coliform spike of 4,700 CFU/100mL at the end of May which was higher than in previous years.
- E. coli bacteria concentrations were generally low in both lakes throughout the year. During the summer months the concentrations were slightly higher than during the rest of the year. This is a typical pattern for lakes.
- Raw water from both sources was medium hard (50 – 65 mg/L CaCO₃).
- Buck Lake exhibited a raw water turbidity range from 0.45 to 3.0 nephelometric turbidity units (NTU) with an annual median of 1.2 NTU, and Magic Lake a range from 0.5 to 3.6 NTU with an annual median of 1.5 NTU. The higher turbidity occurred typically during the periods of increased algal activity in late summer and fall. The turbidity in both lakes was generally consistent with historical turbidity trends.
- Buck Lake, with an annual median total organic carbon (TOC) of 6.7 mg/L, and Magic Lake, with a median TOC of 8.8 mg/L, are considered mesotrophic lakes (medium productive).
- Both lakes exhibited seasonally elevated iron and manganese concentrations which reached peaks of 238 µg/L (Fe) in May and 80.7 µg/L (Mn) in September in Magic Lake, and 157 µg/L (Fe) in February and 129 µg/L (Mn) in November in Buck Lake. These metal concentrations were in line with long term trends.

Treated Water:

- Treated water was bacteriologically safe to drink with no E. coli or total coliform bacteria in the treated water found.
- Treated water turbidity (cloudiness) was typically well below the Guidelines for Canadian Drinking Water Quality (GCDWQ) limit of 1 NTU with the exception of very few isolated samples exceeding this limit on few occasions, mostly associated with operational activities such as flushing or pipe repairs.
- Total organic carbon (TOC median 3.6 mg/L) was consistent with results in previous years. A 54% reduction of TOC indicates a satisfactory performance of the DAF plant. TOC concentrations of > 4 mg/L are considered a strong precursor for disinfection by-product formation and potential guidelines exceedance.
- Metals were below maximum acceptable concentration (MAC) and consistently below the aesthetic objective (AO) limits, confirming the efficacy of the potassium permanganate treatment system in removing in particular iron and manganese.

- Disinfection by-products such as total trihalomethanes (TTHM) were in compliance with the annual average requirement in the GCDWQ; no individual samples did exceed the GCDWQ limit of 100 µg/L. TTHM concentrations fluctuated between 45 and 74 µg/L for an annual average of 59 µg/L. Haloacetic acids (HAA) were not tested in 2022 but are typically low when TTHM are low.
- Periods with algal blooms or high algal activity in the source lakes affected occasionally the taste and odour of the drinking water.
- The water temperature exceeded the GCDWQ aesthetic limit of 15°C between June and mid October.
- The newly established GCDWQ MAC for aluminum was at no time in 2022 exceeded.

Table 1 and 2 below provide a summary of the 2022 raw and treated water test results.

Water Quality data collected from this drinking water system can be reviewed on the CRD website:

<https://www.crd.bc.ca/about/data/drinking-water-quality-reports>

Water System Operational Highlights

The following is a summary of the major operational issues that were addressed by CRD Integrated Water Services staff:

- Water Treatment Plant:
 - Air saturator system equipment troubleshooting.
 - Air blower system troubleshooting and control modifications.
 - Emergency safety lighting repairs.
 - Replacement of backwash flow meter equipment.
 - Replacement of DAF train 2 skimmer gearbox equipment.
 - Train 2 DAF skimmer chain replacement.
- Service line leak repairs:
 - Yardarm Road
 - Frigate Road
 - Schooner Road
 - Pirates Road
 - Mate Road
- Captains Reservoir (Tank) structural roof assessment to address safety concerns so that preventative maintenance tasks can be completed.
- Emergency response due to extended freezing weather event. The exposed pipe to Captains Reservoir froze.
- Unplanned SCADA system software upgrade to address the risk of continued reliable operation.

Water System Capital Project Updates

The Capital Projects that were in progress or completed in 2022 included:

1. Design and Construction Buck Lake and Magic Lake Adjustable Intakes – Detailed design was completed. A contractor was selected and final contract execution and completion of the works is anticipated to be complete in 2023.
2. Buck Lake Dam Repairs – Phase 1 – Dam breach analysis completed.

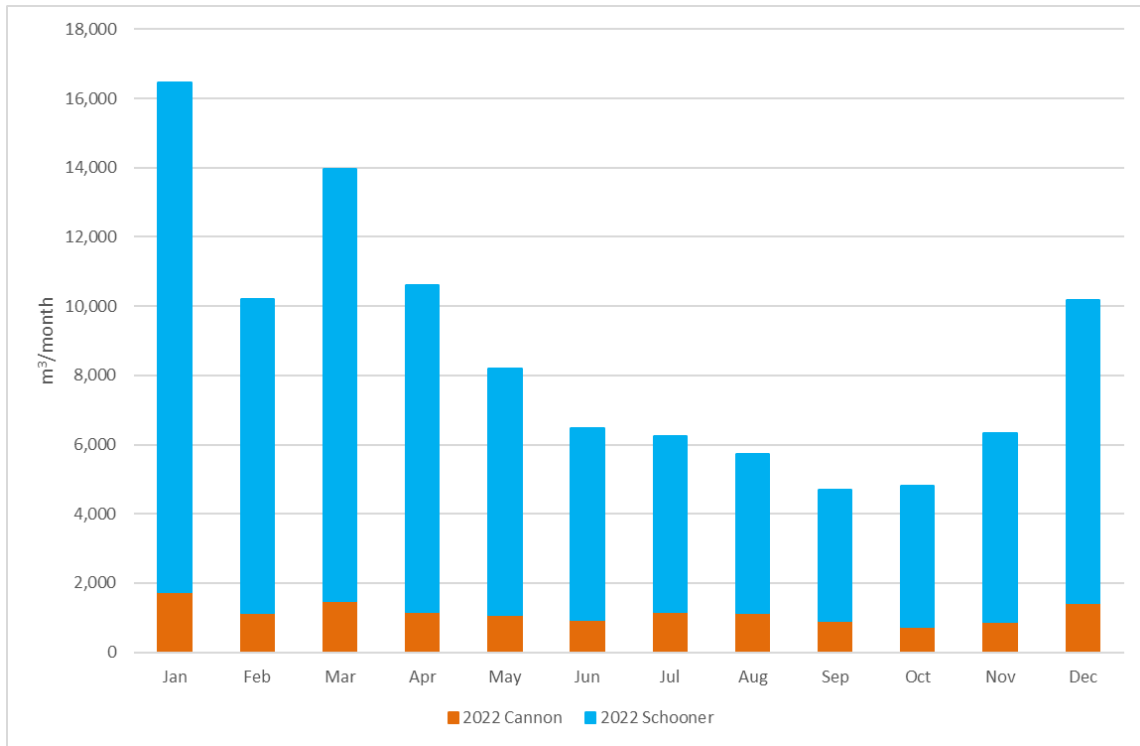


Figure 6: Total Monthly Flows (m³/month)

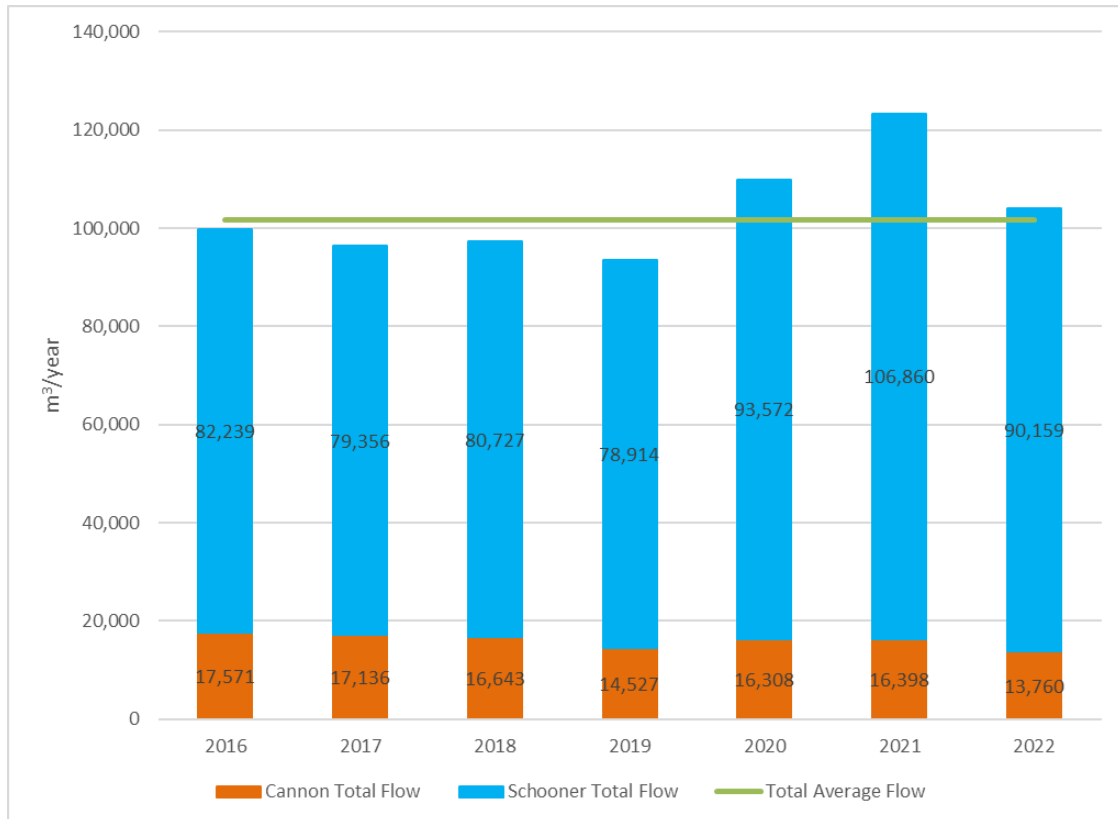


Figure 7: Total Wastewater Flows (m³/year)

Treated Effluent – Regulatory Compliance

Flow and effluent quality are assessed for compliance with the federal regulatory limits (Schooner only) and provincial discharge permits (both Schooner and Cannon) on a daily and monthly basis, respectively. In 2022, treated wastewater from Cannon exceeded regulatory limits for total suspended solids (TSS) and carbonaceous biochemical oxygen demand (CBOD) one time, and there were 14 presumed or documented compliance exceedances at Schooner. The Schooner exceedances were associated with heavy rain events, power outages, or unusual dumping events when the treatment system was unable to function as designed. Both plants exceeded their permitted daily flow allowances in 2022 on multiple occasions. The exceedances all occurred during storm events when inflow and infiltration occurs and because neither plant has equalization tanks to attenuate the peak flows. Figure 8 shows the number of exceedances at each plant along with the annual precipitation. In 2022 there were far fewer flow exceedances than 2021, with 5 at Schooner and 11 at Cannon (totaling 16 in 2022 versus 73 in 2021). This was primarily due to 2022 having significantly less precipitation than previous years. The British Columbia Ministry of Environment and Climate Change Strategy has issued non-compliance warning letters for these two treatment facilities and is expecting upgrades to bring them back into compliance.

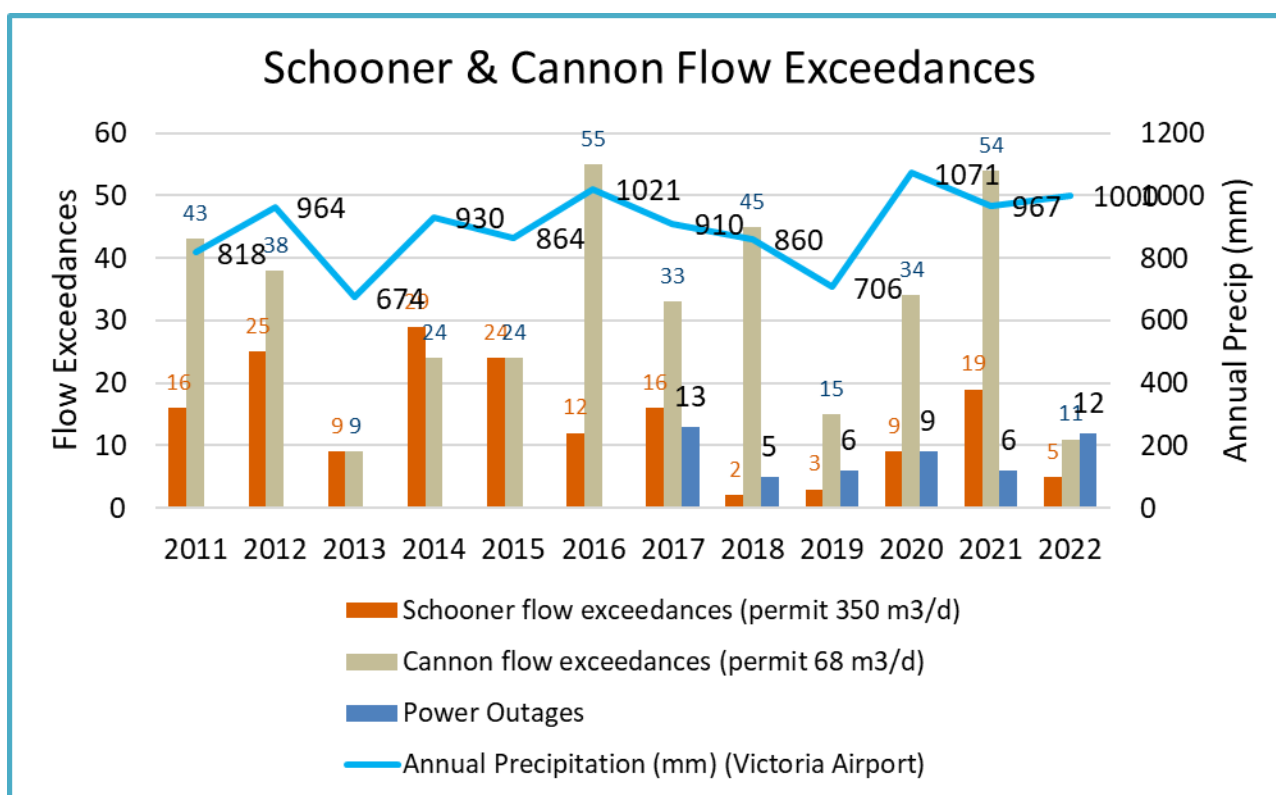


Figure 8: Schooner and Cannon Wastewater Treatment Plant (WWTP) Flow Exceedances

Receiving Water

Routine receiving water monitoring was last required for both Magic Lake Estates Wastewater Treatment Plants in 2020 and will be next required in 2024 unless there are planned bypasses, plant failures/overflows, or wet weather overflows that exceed three days duration in the winter or one day duration in the summer. Bypass or overflow sampling is only required once per season for events that are similar in nature as long as the first seasonal sampling confirms results were within guidelines set to protect human primary contact for recreation.

There was no overflow/emergency receiving water sampling conducted in 2022.

Sewer Service Operational Highlights

The following is a summary of the major operational issues that were addressed by CRD Integrated Water Services staff:

- Schooner Wastewater Treatment Plant
 - Replacement of damaged valves due to freezing during December/January cold weather event; installation of freeze protection equipment
 - Replacement of air blower variable frequency drive equipment
 - Replacement of influent sewage grinder electrical motor
 - Replacement of Return Activated Sludge (RAS) pump #2
 - Replacement of laboratory oven and vacuum pump
- Schooner Sewer Lift Station mechanical check valve removal and repair
- Sewer lateral repairs for Pirates Road
- Chart Drive Lift Station pump and pump check valve removal and replacement
- Sewer collection system backup near Schooner Way

Sewer Service Capital Project Updates

The Capital Projects that were in progress or completed in 2022 included:

1. Wastewater Infrastructure Renewal – Sewer Replacement.

After public consultation, a referendum was held on November 23, 2019 to borrow up to \$6 million to complete Phase 1 upgrades. The referendum was successful and a design consultant (Stantec) was retained to complete the design of about 3km of sewer pipe replacement. The design was tendered in December 2020 and closed in February 2021. A contract was awarded and construction commenced in May, was substantially completed by December 2021, and closed out in 2022.

2. Wastewater Infrastructure Renewal – Pump Station and Treatment Plant Upgrades.

In 2020, the CRD submitted a grant application to the “Investing in Canada Infrastructure Program” for \$5.65 million of additional funding to complete the following work:

- Renew Buccaneer, Galleon, Schooner, Capstan, Cutlass and Masthead Pump Stations;
- Replace Cannon WWTP with a new pump station; and
- Upgrade Schooner WWTP.

The grant was approved in late summer 2021. A Request for Proposals was issued in the fall and McElhanney Ltd. was retained in 2022 to complete the design of the upgrades. It is anticipated that the design will be tendered in the first quarter of 2023 and construction will commence in the summer of 2023.

Refer to the website <https://www.crd.bc.ca/project/capital-projects/magic-lake-estates-wastewater-system-infrastructure-replacement-project-infrastructure-replacement-project> for more information.

Financial Report

Please refer to the attached 2022 Statement of Operations and Reserve Balances.

Revenue includes parcel taxes (Transfers from Government), fixed user fees (User Charges), interest on savings (Interest earnings), a transfer from the maintenance reserve account, and miscellaneous revenue such as late payment charges (Other revenue). Expenses include all

costs of providing the service. General Government Services include budget preparation, financial management, utility billing and risk management services.

CRD Labour and Operating Costs include CRD staff time as well as the cost of equipment, tools and vehicles. Debt servicing costs are interest and principal payments on long term debt. Other Expenses include all other costs to administer and operate the water and sewer systems, including insurance, supplies, water testing and electricity.

The difference between Revenue and Expenses is reported as Net revenue (expenses). Any transfers to or from capital or reserve accounts for the service (Transfers to Own Funds) are deducted from this amount and added to any surplus or deficit carry forward from the prior year, yielding an Accumulated Surplus (or deficit) that is carried forward to the following year.

As of December 31, 2022, the accumulated minor deficit in Magic Lake Sewer-Debt Only (\$6 million) was \$4,529 due to the slightly higher interest rate for 2022 spring borrowing than estimate. In alignment with Local Government Act Section 374 (11), if actual expenditures exceed actual revenues, any deficiency must be included in the next years' financial plan. The financial plan approved by CRD Board on March 29, 2023 incorporated this deficit.

Submitted by:	Jason Dales, B.Sc., WD IV, Senior Manager, Wastewater Infrastructure Operations
	Joseph Marr, P.Eng., Acting Senior Manager, Infrastructure Engineering
	Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection
	Rianna Lachance, BCom, CPA, CA, Senior Manager, Financial Services
Concurrence:	Ian Jesney, P.Eng., Acting General Manager, Integrated Water Services
	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services

Attachments: Table 1
Table 2
2022 Statement of Operations and Reserve Balances

For questions related to this Annual Report please email IWSAdministration@crd.bc.ca

Table 1

Table 1: 2022 Summary of Raw Water Test Results, Magic Lake Estates Water System										
PARAMETER		2022 ANALYTICAL RESULTS				CANADIAN GUIDELINES	2012 - 2021 ANALYTICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum Maximum		≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum Maximum	
(ND means Not Detected by analytical method used)										
Physical/Biological Parameters										
Buck Lake										
Carbon, Total Organic	mg/L	6.7	11	5.3	8.5		6.6	79	5.6	9.84
Colour, True	TCU	11	17	9	29	≤ 15 AO	11	115	7	28
Hardness as CaCO ₃	mg/L	59.5	5	58.6	64.7	No Guideline Required	65.8	37	50.4	91.9
pH	pH units	Not tested in 2022				7.0 - 10.5 AO	7.66	29	6.86	8.78
Turbidity	NTU	1.2	17	0.45	3		0.9	165	0.36	10
Magic Lake										
Carbon, Total Organic	mg/L	8.8	11	6.4	11		8.6	75	6.76	11
Colour, True	TCU	24	17	15	45	≤ 15 AO	26	108	6	50
Hardness as CaCO ₃	mg/L	54.9	4	50.7	60.2	No Guideline Required	60.2	35	48.7	96
pH	pH units	Not tested in 2022				7.0 - 10.5 AO	7.4	23	6.9	8.13
Turbidity	NTU	1.5	17	0.5	3.6		1.6	106	0.19	24.5
Non-Metallic Inorganic Chemicals										
Buck Lake										
Silicon	mg/L as Si	4590	5	3310	5320		5140	37	4.6	11900
Magic Lake										
Silicon	mg/L as Si	1384.5	4	296	2740		1290	35	281	5760
Metals										
Buck Lake										
Aluminum	ug/L as Al	< 3	5	< 3	16.8	2900 MAC / 100 OG	10.3	37	< 3	194
Antimony	ug/L as Sb	< 0.5	5	< 0.5	< 0.5	6 MAC	< 0.5	37	0.041	0.578
Arsenic	ug/L as As	0.35	5	0.32	0.48	10 MAC	0.41	37	0.31	0.654
Barium	ug/L as Ba	8.8	5	8.6	10.5	1000 MAC	10.8	37	7.5	21.9
Beryllium	ug/L as Be	< 0.1	5	< 0.1	< 0.1		< 0.1	37	< 0.01	< 3
Bismuth	ug/L as Bi	< 1	5	< 1	< 1		< 1	31	0.074	< 1
Boron	ug/L as B	< 50	5	< 50	< 50	5000 MAC	< 50	37	< 50	656
Cadmium	ug/L as Cd	< 0.01	5	< 0.01	< 0.01	5 MAC	< 0.01	37	< 0.005	< 0.1
Calcium	mg/L as Ca	16.5	5	16.2	17.9	No Guideline Required	18.1	37	13.6	21.4
Chromium	ug/L as Cr	< 1	5	< 1	< 1	50 MAC	< 1	37	< 0.1	< 10
Cobalt	ug/L as Co	< 0.2	5	< 0.2	< 0.2		< 0.2	36	0.089	< 20
Copper	ug/L as Cu	0.66	5	0.35	0.68	2000 MAC / ≤ 1000 AO	1.23	37	0.36	37.3
Iron	ug/L as Fe	46.8	5	19.6	157	≤ 300 AO	66.6	37	14.2	507
Lead	ug/L as Pb	< 0.2	5	< 0.2	< 0.2	5 MAC	< 0.2	37	< 0.2	3.7
Lithium	ug/L as Li	< 2	5	< 2	< 2		< 2	17	< 2	< 2
Magnesium	mg/L as Mg	4.55	5	4.33	4.95	No Guideline Required	4.97	37	4	9.34
Manganese	ug/L as Mn	18.3	5	17.3	129	120 MAC / ≤ 20 AO	39.8	37	11	506
Molybdenum	ug/L as Mo	< 1	5	< 1	< 1		< 1	37	0.065	28
Nickel	ug/L as Ni	< 1	5	< 1	< 1		< 1	37	< 0.5	< 50
Potassium	mg/L as K	1.14	5	1.06	1.23		1.17	37	0.509	1.64
Selenium	ug/L as Se	< 0.1	5	< 0.1	< 0.1	50 MAC	< 0.1	37	0.047	0.739
Silver	ug/L as Ag	< 0.02	5	< 0.02	< 0.02	No Guideline Required	< 0.02	37	< 0.001	< 10
Sodium	mg/L as Na	10.2	5	9.95	10.8	≤ 200 AO	11	37	8.75	14.3
Strontium	ug/L as Sr	115	5	109	118	7000 MAC	117	37	81	134
Sulphur	mg/L as S	< 3	5	< 3	< 3		< 3	31	< 3	4.1
Tin	ug/L as Sn	< 5	5	< 5	< 5		< 5	37	< 0.2	< 20
Titanium	ug/L as Ti	< 5	5	< 5	< 5		< 5	37	< 0.5	< 10
Thallium	ug/L as Tl	< 0.01	5	< 0.01	< 0.01		< 0.01	31	< 0.002	< 0.05
Uranium	ug/L as U	< 0.1	5	< 0.1	< 0.1	20 MAC	< 0.1	31	0.012	< 0.1
Vanadium	ug/L as V	< 5	5	< 5	< 5		< 5	37	0.28	< 10
Zinc	ug/L as Zn	< 5	5	< 5	< 5	≤ 5000 AO	< 5	37	< 1	205
Zirconium	ug/L as Zr	< 0.1	5	< 0.1	< 0.1		< 0.1	31	< 0.1	< 0.5
Magic Lake										
Aluminum	ug/L as Al	10	4	9	22.3	2900 MAC / 100 OG	27.4	35	< 0.01	713
Antimony	ug/L as Sb	< 0.5	4	< 0.5	< 0.5	6 MAC	< 0.5	35	< 0.5	< 0.5
Arsenic	ug/L as As	0.425	4	0.35	0.75	10 MAC	0.53	35	0.35	2.75
Barium	ug/L as Ba	13.3	4	12.2	14.7	1000 MAC	15.3	35	< 9	84.9
Beryllium	ug/L as Be	< 0.1	4	< 0.1	< 0.1		< 0.1	35	< 0.1	< 3
Bismuth	ug/L as Bi	< 1	4	< 1	< 1		< 1	29	< 1	< 1
Boron	ug/L as B	< 50	4	< 50	64	5000 MAC	< 50	35	< 50	874
Cadmium	ug/L as Cd	< 0.01	4	< 0.01	< 0.01	5 MAC	< 0.01	34	< 0.01	< 0.1
Calcium	mg/L as Ca	13.8	4	12.9	15.1	No Guideline Required	15.2	35	11.6	19.8
Chromium	ug/L as Cr	< 1	4	< 1	< 1	50 MAC	< 1	35	< 1	< 10
Cobalt	ug/L as Co	< 0.2	4	< 0.2	< 0.2		< 0.2	35	< 0.2	< 20
Copper	ug/L as Cu	0.845	4	0.41	1.41	2000 MAC / ≤ 1000 AO	1.55	35	0.43	12
Iron	ug/L as Fe	168.5	4	48.6	238	≤ 300 AO	233	35	53.2	4260
Lead	ug/L as Pb	< 0.2	4	< 0.2	< 0.2	5 MAC	< 0.2	35	< 0.2	1.42
Lithium	ug/L as Li	< 2	4	< 2	< 2		< 2	20	< 2	< 2
Magnesium	mg/L as Mg	4.955	4	4.5	5.47	No Guideline Required	5.58	35	4.52	11.5
Manganese	ug/L as Mn	23.05	4	6.9	80.7	120 MAC / ≤ 20 AO	49.1	35	2.8	5000
Molybdenum	ug/L as Mo	< 1	4	< 1	< 1		< 1	35	< 1	27
Nickel	ug/L as Ni	< 1	4	< 1	< 1		< 1	35	< 1	< 50
Potassium	mg/L as K	1.145	4	0.895	1.24		1.09	35	0.17	1.62
Selenium	ug/L as Se	< 0.1	4	< 0.1	< 0.1	50 MAC	< 0.1	35	< 0.1	< 0.5
Silver	ug/L as Ag	< 0.02	4	< 0.02	< 0.02	No Guideline Required	< 0.02	35	< 0.02	< 10
Sodium	mg/L as Na	10.65	4	10	11.5	≤ 200 AO	11.2	35	9.02	15.4
Strontium	ug/L as Sr	97.1	4	90.4	114	7000 MAC	109	35	75	158
Sulphur	mg/L as S	< 3	4	< 3	< 3		< 3	29	< 3	3.7
Tin	ug/L as Sn	< 5	4	< 5	< 5		< 5	35	< 5	< 20
Titanium	ug/L as Ti	< 5	4	< 5	< 5		< 5	35	< 5	22
Thallium	ug/L as Tl	< 0.01	4	< 0.01	< 0.01		< 0.01	29	< 0.01	< 0.05
Uranium	ug/L as U	< 0.1	4	< 0.1	< 0.1	20 MAC	< 0.1	29	< 0.1	0.19
Vanadium	ug/L as V	< 5	4	< 5	< 5		< 5	35	< 5	< 10
Zinc	ug/L as Zn	< 5	4	< 5	< 5	≤ 5000 AO	< 5	35	< 1	215
Zirconium	ug/L as Zr	< 0.1	4	< 0.1	0.12		< 0.1	29	< 0.05	< 0.5
Microbial Parameters										
Indicator Bacteria (Buck Lake)										
Coliform, Total	CFU/100 mL	45	17	2	4700	0 MAC	75.5	191	<1	10400
<i>E. coli</i>	CFU/100 mL	1.5	16	< 1	< 10	0 MAC	< 1	191	< 1	200
Hetero. Plate Count, 7 day	CFU/1 mL	Not tested in 2022				No Guideline Required	1345	64	330	A 5800
Indicator Bacteria (Magic Lake)										
Coliform, Total	CFU/100 mL	182	16	9	2100	0 MAC	640	144	<1	7600
<i>E. coli</i>	CFU/100 mL	< 1	16	< 1	36	0 MAC	< 2	151	< 1	115
Hetero. Plate Count, 7 day	CFU/1 mL	Not tested in 2022				No Guideline Required	2600	59	370	G 20000
Parasites (Buck Lake)										
<i>Cryptosporidium</i> , Total oocysts	oocysts/100 L	< 1	2	< 1	< 1	Zero detection desirable	< 1	14	< 1	1.45
<i>Giardia</i> , Total cysts	cysts/100 L	< 1	2	< 1	< 1	Zero detection desirable	< 1	14	< 1	< 1
Parasites (Magic Lake)										
<i>Cryptosporidium</i> , Total oocysts	oocysts/100 L	< 1	2	< 1	< 1	Zero detection desirable	< 1	14	< 1	5.3
<i>Giardia</i> , Total cysts	cysts/100 L	< 1	2	< 1	< 1	Zero detection desirable	< 1	14	< 1	< 1

Table 2

Table 2: 2022 Summary of Treated Water Test Results, Magic Lake Estates Water System										
PARAMETER		2022 ANALYTICAL RESULTS				CANADIAN GUIDELINES	2012 - 2021 ANALYTICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min. Max.		≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum Maximum	
ND means Not Detected by analytical method used										
Physical Parameters										
Carbon, Total Organic	mg/L as C	3.6	19	2.2	20		3.93	139	< 0.3	43.5
Colour, True	TCU	< 2	63	< 2	< 2	15 AO	< 2	628	< 2	5
Hardness as CaCO3	mg/L	58.7	11	56.4	63.4		64.9	85	58.1	72.1
pH	No units	Not tested in 2022				7.0-10.5 AO	7.16	29	6.89	7.7
Turbidity	NTU	0.15	63	0.1	3.9	1 MAC and ≤ 5 AO	0.16	964	0.11	4.4
Water Temperature	Degrees C	11.1	206	2.9	23.1	≤ 15 C°C	8.6	5315	3.9	24
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	< 1	189	< 1	< 1	0 MAC	< 1	1458	< 1	45
E. coli	CFU/100 mL	< 1	178	< 1	< 1	0 MAC	< 1	1460	< 1	< 1
Hetero. Plate Count, 7 day	CFU/1 mL	45	22	< 10	2300	No Guideline Required	< 10	168	< 10	6700
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	0.43	208	0.03	1.95	No Guideline Required	0.32	5342	0.02	4.9
Chlorine, Total Residual	mg/L as Cl2	0.54	146	0.11	2.18	No Guideline Required	0.66	5703	0.1	3.8
Disinfection By-Products										
Trihalomethanes (THMs)										
Bromodichloromethane	ug/L	14	8	< 1	19		18.5	57	11.2	24
Bromoform	ug/L	< 1	8	< 1	< 1		< 1	57	< 0.1	< 1
Chloroform	ug/L	47	8	36	65		54.5	57	18.8	100
Chlorodibromomethane	ug/L	2.2	8	< 1	3.6		3.25	56	<0.1	4.9
Total Trihalomethanes	ug/L	58.5	8	38	88	100 MAC	71	57	25.9	124
Haloacetic Acids (HAAs)										
HAA5	ug/L	Not tested in 2022				80 MAC	33.5	12	< 0.1	46
Metals										
Aluminum	ug/L as Al	21.4	11	15.7	34.8	2900 MAC / 100 OG	25.7	85	11.7	186
Antimony	ug/L as Sb	< 0.5	11	< 0.5	< 0.5	6 MAC	< 0.5	85	0.033	< 0.5
Arsenic	ug/L as As	0.22	11	0.18	0.28	10 MAC	0.22	85	0.14	0.36
Barium	ug/L as Ba	7.5	11	5.7	9.4	1000 MAC	< 7.8	85	6	10.7
Beryllium	ug/L as Be	< 0.1	11	< 0.1	< 0.1		< 0.1	85	< 0.01	0.1
Bismuth	ug/L as Bi	< 1	11	< 1	< 1		< 1	85	< 0.005	1
Boron	ug/L as B	< 50	11	< 50	< 50	5000 MAC	< 50	85	< 50	52
Cadmium	ug/L as Cd	< 0.01	11	< 0.01	< 0.01	5 MAC	< 0.01	85	< 0.005	< 0.01
Calcium	mg/L as Ca	15.9	11	15.2	17.1	No Guideline Required	17.5	85	15.8	19.8
Chromium	ug/L as Cr	< 1	11	< 1	< 1	50 MAC	< 1	85	< 0.1	< 1
Cobalt	ug/L as Co	< 0.2	11	< 0.2	< 0.2		< 0.2	85	0.02	< 0.5
Copper	ug/L as Cu	9.26	11	0.21	55.4	2000 MAC / ≤ 1000 AO	9.75	85	0.25	23.3
Iron	ug/L as Fe	6.8	11	< 5	32.3	≤ 300 AO	8.3	85	2.4	34.5
Lead	ug/L as Pb	0.47	11	< 0.2	2.21	5 MAC	0.84	85	< 0.2	1.67
Lithium	ug/L as Li	< 2	11	< 2	< 2		< 5	42	0.85	< 5
Magnesium	mg/L as Mg	4.65	11	4.47	5.13	No Guideline Required	5.08	85	4.31	5.7
Manganese	ug/L as Mn	1.6	11	< 1	6.7	120 MAC / ≤ 20 AO	3.8	85	< 1	190
Molybdenum	ug/L as Mo	< 1	11	< 1	< 1		< 1	85	0.05	< 1
Nickel	ug/L as Ni	< 1	11	< 1	2.3		< 1	85	0.309	2.8
Potassium	mg/L as K	1.32	11	1.24	1.41		1.37	85	1.17	1.63
Selenium	ug/L as Se	< 0.1	11	< 0.1	< 0.1	50 MAC	< 0.1	85	< 0.04	0.11
Silicon	ug/L as Si	3760	11	3660	4590		4070	85	4.13	5140
Silver	ug/L as Ag	< 0.02	11	< 0.02	< 0.02	No Guideline Required	< 0.02	85	< 0.005	< 0.02
Sodium	mg/L as Na	12.2	11	11.8	13.9	≤ 200 AO	13.9	85	11.6	14.9
Strontium	ug/L as Sr	108	11	104	117	7000 MAC	119	85	102	133
Sulphur	mg/L as S	< 3	11	< 3	< 3		< 3	85	< 3	4.5
Tin	ug/L as Sn	< 5	11	< 5	< 5		< 5	85	< 0.2	< 5
Titanium	ug/L as Ti	< 5	11	< 5	< 5		< 5	85	< 0.5	< 5
Thallium	ug/L as Tl	< 0.01	11	< 0.01	< 0.01		< 0.01	85	< 0.002	< 0.05
Uranium	ug/L as U	< 0.1	11	< 0.1	< 0.1	20 MAC	< 0.1	85	< 0.002	< 0.1
Vanadium	ug/L as V	< 5	11	< 5	< 5		< 5	85	< 0.2	< 5
Zinc	ug/L as Zn	7	11	< 5	33.2	≤ 5000 AO	5.1	85	2.02	39.7
Zirconium	ug/L as Zr	< 0.1	11	< 0.1	< 0.1		< 0.1	84	< 0.1	< 0.5