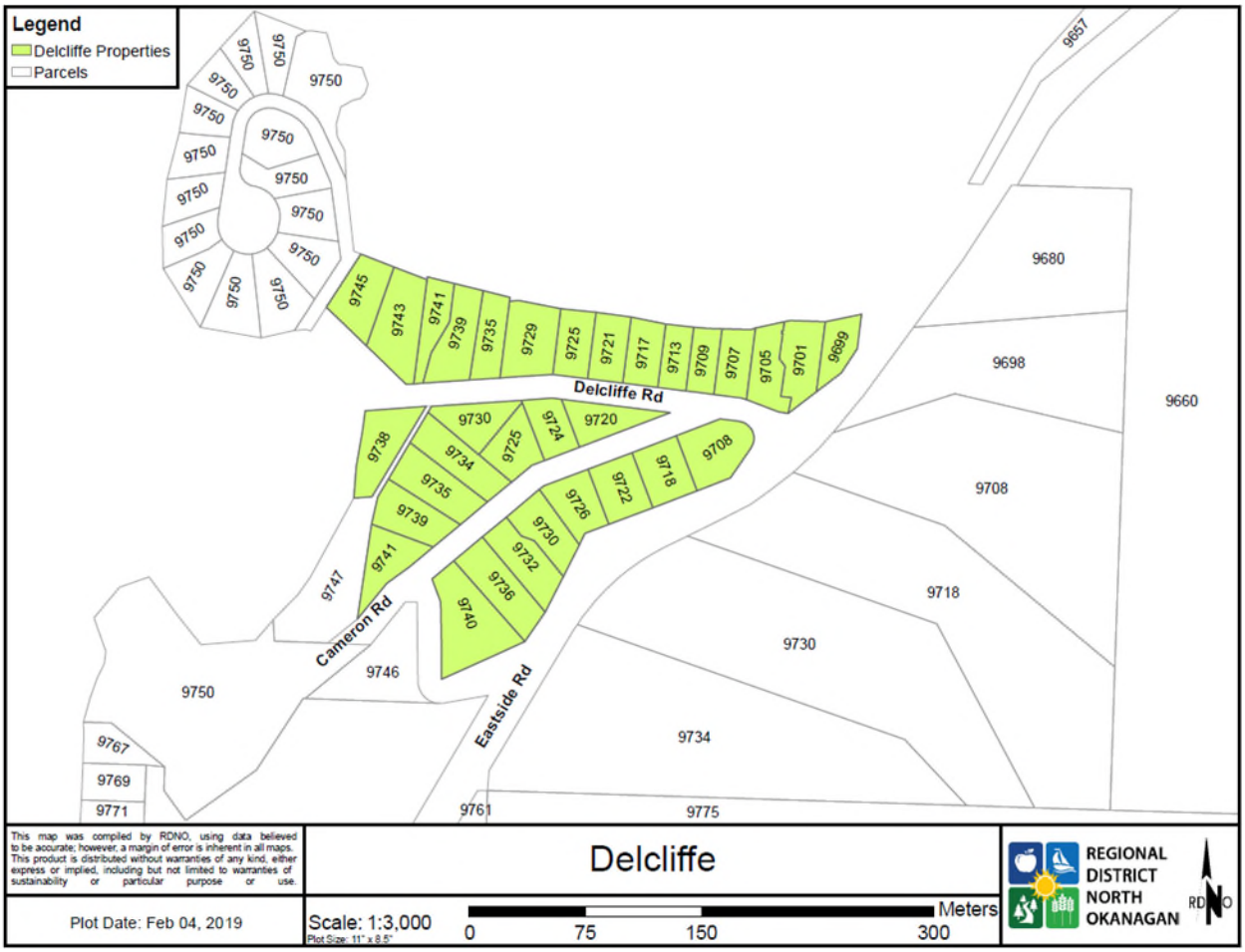
Delcliffe Water Utility
2023 Annual Report



Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, BC V1B 2K9

Prepared for: Interior Health & RDNO
Prepared by: RDNO Utility Department
November 2024

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ACRONYMS

AO	Aesthetic Objectives
AWWA	American Water Works Association
Caro	Caro Analytical Services
CCC	Cross Connection Control
CCCO	Cross Connection Control Officer
CCCP	Cross Connection Control Program
COP	Conditions on Permit
CoV	City of Vernon
DBP	Disinfection By-Products
DTRT	Decision Tree for Responding to Turbidity Event in Unfiltered Drinking Water
DWPA	*Drinking Water Protection Act*
DWPR	*Drinking Water Protection Regulation*
DWU	Delcliffe Water Utility
DWTO	Drinking Water Treatment Objectives (Microbiologial) for Surface Water Supplies
ENKI	Internet based data software system with centralized information management
EOCP	Environmental Operators Certification Program
GCDWQ	Guidelines for Canadian Drinking Water Quality
GVW	Greater Vernon Water
IH	Interior Health
MAC	Maximum Acceptable Concentrations
MoE	Ministry of Environment
MPN	Most Probable Number
NTU	Nephelometric Turbidity Units
P/A	Presence/ Absence
PS	Pump Station
RDL	Read Detection Limit
RDNO	Regional District of North Okanagan
SCADA	Supervisory Control and Data Acquisition software
SS	Sample Station
SDWQG	Source Drinking Water Quality Guidelines
TCU	True Color Units
THM	Trihalomethane
TOC	Total Organic Carbon
UVT	Ultra Violet Transmissivity
WQA	Water Quality Advisory
WQG-01	British Columbia Source Drinking Water Quality Guidelines
WQI	Water Quality Indicators

1.0 INTRODUCTION

As required by the *British Columbia Drinking Water Protection Act*, the Regional District of North Okanagan (RDNO), Delcliffe Water Utility (DWU) provides the following annual report in accordance with the Conditions on Permit (COP) issued by Interior Health.

This report provides an overview of the following:

- the DWU water system,
- DWU operations including management, Environmental Operator Certification Program (EOCP) classification, and operations programs,
- the annual water quality monitoring program and a summary of the 2023 water quality analysis,
- water consumption,
- emergency response,
- reporting requirements,
- annual completed works, and
- long-term plans.

The annual reports are available to the public on the RDNO website.

2.0 WATER SYSTEM OVERVIEW

2.1. SYSTEM OVERVIEW

The DWU system is located within the Greater Vernon Water (GVW) service area but is a separate system from GVW and is classified as a small water system in its Permit to Operate, facility # 0411809. The water quality monitoring program is coordinated and monitored by RDNO water quality staff. The system supplies water to 32 residential customers around Delcliffe Road and Cameron Road in Vernon, BC. RDNO manages the supply and treatment system and are required to respond to emergencies 24 hours a day, 7 days a week. RDNO contracts out to CoV operators to manage and maintain the DWU water distribution system.

Table 1 lists the DWU system component descriptions and Figures 1 to 5 show photos of the system.

3.0 WATER SOURCE

The water source for the DWU is Okanagan Lake. The intake is 160 meters from shore and has an approximate depth of between 3.4 and 6.4 meters (due to lake level fluctuations). The intake was upgraded in 2012 with two stainless steel screens that meet fish screen requirements by the

province and was raised off the bottom of the lake by 1 meter to improve water quality. The intake pipe is connected to the lake pump station which lifts water to a covered reservoir. The water is pumped through the booster station near the reservoir to the distribution system.

3.1. TREATMENT REQUIREMENTS

The treated water quality objectives for all BC water systems using a surface water source need to meet the Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies (DWTO) in BC which include the following:

- 4 log removal or inactivation for viruses,
- 3 log removal or inactivation for protozoa (*Giardia* and *Cryptosporidium*),
- 2 treatment processes for surface water,
- 1 Nephelometric turbidity units (NTU) maximum turbidity, and
- 0 *Escherichia coli* (*E.coli*).

The treatment levels at the DWU are not compliant with these standards as it does not provide sufficient treatment for 3 log inactivation for protozoa nor does the system have 2 treatment barriers. Currently, the DWU source water is only chlorinated at the booster station. Options have been reviewed on bringing DWU to standards but due to funding constraints, have not been achieved yet. The long term goal is to connect DWU to either GVW or the Outback in the future with development.

Chlorination of the water is completed at this site to ensure sufficient contact time (CT) to provide 4 log inactivation of viruses, to meet the 0 *E.coli* condition and to inhibit microbial growth in the distribution system to achieve a minimum of 0.2 mg/L free chlorine throughout the system. Turbidity is continuously measured with online turbidity meters and is monitored by Supervisory Control and Data Acquisition software (SCADA). A comparison with a hand-held turbidity meter is completed weekly at the site to ensure the SCADA monitored meter is reading correctly. If turbidity increases above 1 Nephelometric Turbidity Unit (NTU) based on a 24 hour average, a Water Quality Advisory (WQA) will be issued.

3.2. DISTRIBUTION SYSTEM

The Delcliffe distribution system has 1.2 km of pipeline, 1 lake pump station, 1 booster station and 1 enclosed reservoir delivering approximately 27 ML of water to customers annually.

All the water for the DWU distribution system is pumped from Okanagan Lake. There is 1 pressure zone controlled by the booster pump station. The enclosed reservoir is at an elevation 370 m

(1214 ft.) above sea level. Water must be pumped 28 m (92 ft.) from Okanagan Lake in elevation to this reservoir.

4.0 OPERATIONS

4.1. MANAGEMENT

The DWU is a function of the RDNO and managed and operated by the RDNO Utilities department (Table 2). Operations and maintenance of the water supply and water treatment is completed by RDNO operators (Table 3). RDNO staff manages the Cross Connection Control (CCC) and Water Quality Programs for the utility.

The RDNO operators are responsible for operating and maintaining the source, reservoir and chlorination facility. The distribution system is contracted under an agreement with the City of Vernon (CoV) to operate and maintain the water distribution system and any after hours issues with the distribution system. Customers should call the CoV after hours number for emergencies outside the normal operating hours.

4.2. EOCP CLASSIFICATION

Section 12 of the *Drinking Water Protection Regulations* (DWPR) refers to qualification standards for persons operating water supply systems. In this section, the operators of a water system are required to have EOCP certification. With this certification, a person is qualified to operate, maintain, or repair a water supply system for the classification stated under the EOCP.

Operators with EOCP certification and employed by the RDNO and CoV can be found in Tables 3 and 4. The RDNO operators are responsible for operating and maintaining the source, reservoir and chlorination facility. The CoV operators are contracted by the RDNO to operate and maintain the DWU water distribution system and any after hours issues with the distribution system, such as leaks, customers should call the CoV after hours number.

4.3. OPERATIONS PROGRAMS

4.3.1. FLUSHING AND STANDPIPE MAINTENANCE

Annual water main flushing and standpipe maintenance is completed by CoV operators.

4.3.2. CROSS CONNECTION CONTROL PROGRAM

The Cross Connection Control Program is managed by the Utilities Department as outlined in the RDNO *Cross Connection Control Regulation Bylaw No. 2651, 2014* available at: www.rdno.ca/ccc

4.3.3. SYSTEM CONTROL - SCADA SOFTWARE

Operations and maintenance including monitoring of the water levels in the reservoir, pump operations, quality control equipment and historical data files are made easier by using SCADA. The system is automated and used SCADA software for monitoring and alarms.

5.0 SOURCE ASSESSMENT AND WATERSHED PROTECTION PLANNING

Currently, the watershed area surrounding the OBW is minimally developed. With respect to activities on Okanagan Lake, RDNO participates in the Okanagan Collaborative Conservation Program (OCCP) projects around Okanagan Lake and the Okanagan Basin Water Board (OBWB).

6.0 WATER QUALITY MONITORING

The DWU Water Quality Program references the following legislation, regulation, and guidelines to develop a Reporting and Monitoring Plan:

1. Guidelines for Canadian Drinking Water Quality (GCDWQ),
2. *British Columbia Drinking Water Protection Act and Regulation* (DWPA and DWPR),
3. British Columbia Source Drinking Water Quality Guidelines (WQG-01),
4. Drinking Water Treatment Objectives (microbiological) for Surface Water in BC (DWTO), (BC. MOH, 2012) and
5. Decision Tree for Responding to Turbidity Event in Unfiltered Drinking Water (DTRT), (BC Ministry of Health, 2013).

The Water Quality Program is designed to monitor weekly and monthly variations in water quality and provide statistics for yearly trends from source to tap.

The DWU system reports to the Small Water Systems Health Officer independently from the larger Greater Vernon Water system.

Source water quality monitoring is an important component of this multi-barrier approach to drinking water management. It is important for monitoring programs to be as comprehensive as possible. The source water quality program compares source water with guidelines, criteria, and regulations that have been set for both health and aesthetic reasons. The program also observes seasonal trends that may affect chlorine demand.

The distribution water quality program is designed to meet the community water system regulations prescribed by the *British Columbia Drinking Water Protection Regulation* Schedules

A and B. Supporting the program is also the Canadian Drinking Water Guidelines which provides Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO), for health and aesthetic reasons. Other parameters may be monitored if they are known to create problems within water distribution systems.

Drinking water quality is a function of source water quality and post chlorination. As a result, the monitoring of drinking water quality consists of 4 components in the *Source to Tap Approach*:

1. Source water monitoring (Intake),
2. Monitoring after chlorination (at outflow reservoir),
3. Monitoring in the distribution system, and
4. Customer concerns.

For more information regarding testing parameters and MAC levels, please visit Health Canada's website at: www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html.

6.1. PROGRAM AND SCHEDULE

Water quality monitoring for the DWU is based on the requirements under Schedules A and B of the *Drinking Water Protection Regulation* (DWPR) (Government of BC, 2003), the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) (Health Canada, 2017), and the *Source Drinking Water Quality Guidelines* (SDWQG) (MoE, 2017).

The Water Quality Monitoring Program for the DWU is reviewed annually in the fall for implementation of the following year. The sampling program and schedules are provided in Appendix A and Table 5 for 2023. RDNO provides this updated Water Quality Monitoring Plan to IH at the beginning of each year.

To meet Schedule B requirements in the DWPR for populations less than 5,000, a minimum of 4 microbiological samples are required per month. In 2023, DWU met this requirement for all months.

The RDNO operators collect distribution bacterial samples each week, alternating the two sample sites weekly, and drop them off with RDNO water quality staff to process for shipment to Caro Analytical Services (Caro). Caro sends results to IH and RDNO. RDNO water quality staff monitors results not in compliance with the standards to ensure appropriate action based on the RDNO Water Deviation Response Plan and to initiate customer notification if required.

RDNO water quality staff samples the source water at the Delcliffe Intake once a month. The water quality monitoring program can be found in Appendix A.

6.2. SOURCE WATER QUALITY MONITORING

This section outlines the bacterial, turbidity, ultraviolet transmissivity UVT, pH, temperature, and annual chemical results for the 2023 source water at the DWU.

6.2.1. BACTERIA

In Table 6 of the DWTO states source water must meet:

- the number of *E.coli* in source water does not exceed 20/100 mL, or
- if *E.coli* data are not available (less than 100/100 mL of TC) in at least 90% of the weekly samples from the previous six (6) months.

Total Coliform is monitored as an indicator bacteria to assess changes in source water. E.coli is monitored as an indicator bacteria to assess contaminant levels in the raw water and review changes in this water.

In 2023, Caro analytical and RDNO laboratory analyzed 13 bacterial samples. Caro Analytical results had a maximum Total Coliform count of >2420 MPN/100 mL and a maximum E.coli count was 2 MPN/100 mL. RDNO Laboratory results had a maximum Total Coliform count of >2419.6 MPN/100mL and a maximum E.coli count of 2 MPN/100 mL (Table 6). DWU met this requirement.

6.2.2. TURBIDITY

Turbidity measurements relate to the optical properties of water, which is caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, organic compounds, plankton, and other microscopic organisms. Excessively high turbidity can have a negative effect on disinfection. The RDNO uses the DTRT document during turbidity events and to guide communications with RDNO water customers.

At this time, the DWU is only chlorinated to provide contact time for viruses (4 log reduction). It is not filtered and does not have a secondary disinfection. Turbidity is continuously measured with on-line turbidity meters and is monitored by SCADA.
In 2023, the turbidity had a monthly average of 0.47 NTU with a maximum of 1.08 NTU (Table 7). Due to high turbidity, one Water Quality Advisory was issued for the DWU on May 6th.

6.2.3. UV TRANSMISSIVITY

RDNO water quality staff monitor UV Transmissivity (UVT), which represents the percentage of light transmitted through the water. The purpose of this monitoring is for future planning to determine if UV disinfection is a viable option to install on-site.

Samples are collected and analyzed at the RDNO laboratory using Standard Methods 10054 as unfiltered sample. In 2023, 12 samples were collected with results showing a minimum of 82.2% and an average of 85.7% (Table 8). This indicates that UV would be an effective disinfection method for this source. This trending will continue to be monitored in 2024.

6.2.4. ORGANIC CARBON

Total Organic Carbon (TOC) is a measure of suspended carbon bound in organic molecules and organisms. The SDWQG MAC for TOC is 4.0 mg/L.

Samples are collected and analyzed at Caro Analytical. In 2023, 11 samples were collected with results showing an average of 4.54 mg/L (Table 9). TOC will continue to be monitored at DWU as it is above the SDWQG MAC.

6.2.5. FIELD PARAMETERS

Table 10 summarizes the field pH, temperature and conductivity for the source water in 2023. Monitoring these parameters provides operations with a method to ensure the continual safety of the system.

In 2023, the temperature had a minimum of 3.8^{o}C, a maximum of 23.5 ^{o}C and an average of 11.6 ^{o}C. The pH had a minimum of 7.0, a maximum or 8.5 and an average of 7.8. The conductivity had a minimum of 260 µS/cm, a maximum of 310 µS/cm and an average of 288 µS/cm.

6.2.6. ANNUAL COMPREHENSIVE

Comprehensive sampling is completed annually in July or August each year. The 2023 comprehensive samples were taken on August 23 and all parameters were well within the GCDWQ limits (Appendix B).

6.3. TREATMENT PROCESS

6.3.1. CHLORINE

Under normal operations, the target free residual after chlorine injection is normally between 1.50 to 2.00 mg/L to achieve the minimum target chlorine residual of 0.20 mg/L at the end of the distribution system.

Chlorine is injected at the booster station on the reservoir inlet line. Continuous online free chlorine monitoring is completed with an analyzer that is located off the sample line from the reservoir outlet after contact time. In the event of a low-level chlorine alarm, an operator would respond, assess the issue, analyze the cause, and implement the solution.

The SCADA free chlorine in 2023 had a monthly minimum of 1.29 mg/L, a monthly maximum of 1.96 mg/L and a monthly average of 1.61 mg/L (Table 7).

6.4. DISTRIBUTION

Distribution sampling follows the specifications outlined in the COPAdditional parameters and monitoring can occur for individual projects or during and incident. There are 2 sample sites within the DWU distribution system: the Delcliffe Hill Pumpstation (PS) and Delcliffe Road Sample Station (SS). See Appendix A for the detailed schedule.

6.4.1. BACTERIA

The Guidelines for Canadian Drinking Water Quality and the *BC Drinking Water Protection Act Regulations* have established the following microbiological criteria for drinking water distribution systems. Schedule A of the DWPR requires the following criteria to be met for potable water:

1. **No detectable Escherichia coli (E.coli) per 100 ml.**

   In 2023, all samples were non-detect for *E.coli* in the DWU distribution system (Table 11). DWU met this regulation.

2. **At least 90% of samples have no detectable Total Coliform bacteria per 100 ml.**

   In 2023, all samples were non-detect for Total Coliform in the DWU distribution system (Table 11). DWU met this regulation.

3. **No sample has more than 10 Total Coliform per 100 ml.**

   In 2023, no samples had more than 10 Total Coliform (Table 11). DWU met this regulation. DWU met this regulation.

Table 11 shows the summary of the bacterial testing and results for the DWU distribution system. There were 53 bacteria samples sent to a certified lab with no samples containing Total Coliform or *E.coli.*

6.4.2. TURBIDITY

While turbidity is monitored online and alarmed through SCADA, turbidity is also monitored with a handheld turbidity meter at two distribution sites whenever operators visit the site. Field

parameters are also recorded on requisition sheets and submitted to an accredited lab with bacterial samples. The field parameters are entered into ENKI by RDNO water quality staff.

The average turbidity of the distribution sites in 2023 was 0.56 NTU. (Table 12). A minimum turbidity of 0.22 NTU occurred at both distribution sites and maximum turbidity of 1.61 NTU at Delcliffe Road SS.

6.4.3. CHLORINE

Free chlorine is monitored and alarmed online through SCADA, total and free chlorine are monitored with a handheld chlorine meter concurrently with the turbidity readings.

The average free chlorine of the distribution sites in 2023 ranged from 1.62 to 1.63 mg/L (Table 12). A minimum of 0.85 mg/L occurred at Delcliffe Road SS. A maximum grab sample of 2.4 mg/L occurred at the Delcliffe Hill PS.

6.4.4. FIELD PARAMETERS

Table 12 summarizes the field chlorine, temperature, turbidity, pH, and conductivity for the distribution system in 2023.

In 2023, the average temperature ranged from 11.8 to 12.6 degrees Celsius. The average pH ranged from 7.95 to 7.97. The average conductivity ranged from 323 to 329 µS/cm.

7.0 WATER CONSUMPTION

Table 13 provides the monthly consumption data for 2023. Figure 6 shows the monthly consumption for 2023. Water consumption begins to significantly increase in April with peak flows usually observed in July or August.

In 2023, the water consumption peaked in July. The total consumption for 2023 was 35.92 ML with a monthly average of 2.99 ML.

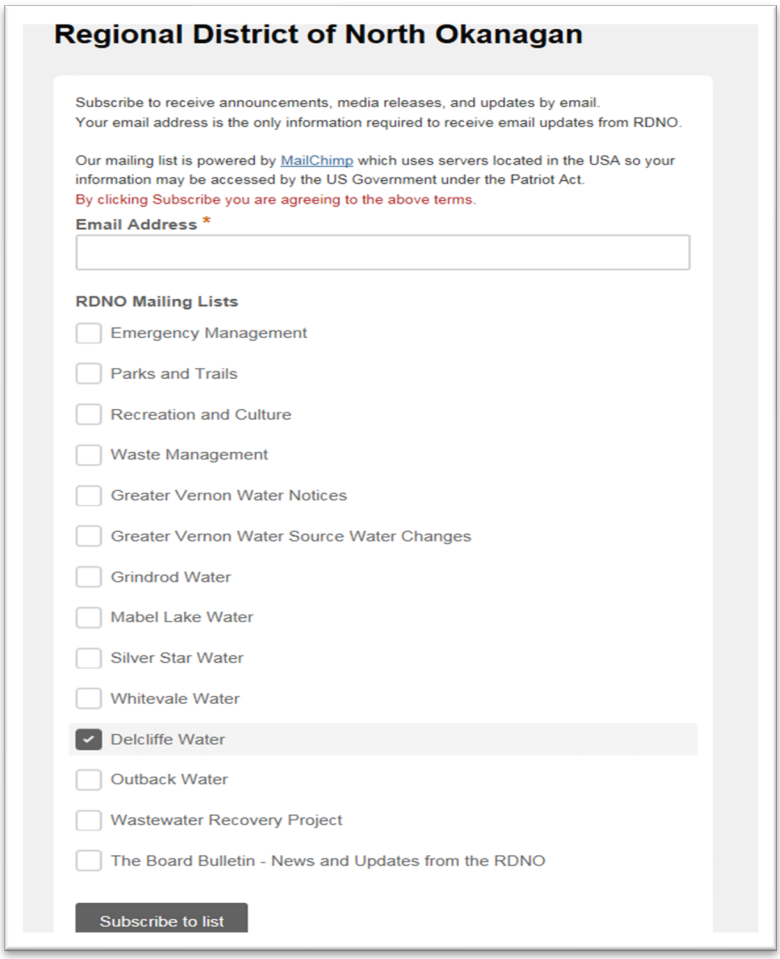
8.0 EMERGENCY RESPONSE PLANNING

8.1. THE EMERGENCY RESPONSE PLAN

RDNO Utilities staff has an Emergency Response Plan (ERP) and are trained annually. The ERP has the GVW Water Quality Deviation Response Plan that provides guidelines to actions during times of water quality changes or emergencies.

The above documents contain the contacts, criteria, and procedures necessary to assist operators and staff to make timely, informed decisions. The response plans are reviewed and updated annually and provided to IH.

In the case of a water quality change or an emergency, an advisory or notice is delivered as quickly and efficiently as possible. Notification may include “Alert” road signs, radio and/or media releases. Under specific circumstances notifications are hand delivered. Customers can also subscribe to the DWU mailing list by going to www.rdno.ca/subscribe and clicking on “Subscribe for Updates” and subscribe for the Delcliffe Water email updates (shown below).



8.2. INCIDENTS AND NOTIFICATIONS

Reporting of incidents is required by RDNO or operations staff when there is a deviation from normal operating procedure or a water quality issue. Incident reporting allows staff to track and review issues to assess if improvements could reduce the risks from each issue.

In 2023, there were four incidents of which three required water quality notifications in the DWU. The incidents are as follows:

- On March 30th, a notification was issued for Immediate Water Restrictions due to a blockage at the intake. On March 31st, the Water Restrictions Notice was rescinded after repair work was completed.
- On May 6th, a Water Quality Advisory was issued due to turbidity >1 NTU. On May 30th the Water Quality Advisory was rescinded.
- On July 28th, a sunken fishing boat off Cameron Point, was recovered by a third party. No advisory was needed due to flows and no leakage.

9.0 REPORTING REQUIREMENTS

Monthly and annual reports are submitted to IH as per the COP and are available to the public on the RDNO website at www.rdno.ca. Monthly reports for the last 12 months are available on the website and if historical reports are wanted, please contact the RDNO at 250-550-3700.

9.1. WATER MAIN BREAKS

Most water utilities frequently experience minor disruptions. Pipes break, valves seize, hydrants leak and power outages occur. Although not anticipated, the problems experienced can usually be corrected with minimal disruption, and regular service can be restored quickly.

In cases of water main breaks, DWU adheres to the procedures set out in the American Water Works Association (AWWA) Standard C651-14 regarding water main chlorination prior to re-commissioning of the water main.

In 2023, no main failures occurred on the DWU distribution system.

Typically, breaks or disruptions to water service are caused by conditions that can be repaired and reinstated quickly, without risk to public health. Sometimes however, situations arise that require extra care to ensure the integrity of the water system has not been compromised. DWU endeavours to keep IH and customers apprised of any extraordinary situations that may adversely impact the water system.

10.0 PLANNED WORKS

10.1. 2023 WORK COMPLETED

Operational changes and improvement projects have been completed to increase the safety and reliability of the DWU system. These include:

- Replaced second intake pump in 2023 and replumbed lake station.

- Replaced one hypo pumps in 2023 to improve automation.

10.2. LONG TERM PLANS

Long term, the DWU requires improvements and there are several options possible. Each option has pros and cons. The DWU may continue to be a stand-alone system and treatment and intake conditions may be improved; alternatively, the DWU may be connected to the larger GVW system. Each of these options is costly and must be considered on the basis of their individual merits but may be impacted by development pressures outside the control of GVW. At present, direction for improvement for the system has not been determined.

11.0 CLOSING

RDNO is pleased to present the 2023 DWU Annual Report. If you have any questions about this report or want more information, please contact RDNO at 250-550-3700 or email utilities@rdno.ca.

TABLES

Table 1: Delcliffe Component Descriptions for the Reservoir, Booster Pump Station and Distribution Piping

COMPONENT	DESCRIPTION
Reservoir	• Reservoir is in-ground and located at the end of Cameron Road. • Material is a concrete tank lined with a swimming pool liner and a wood truss roof with aluminum sheeting and wood siding. • Screens are installed on all openings to reduce rodent access. • Reservoir level is monitored by a pressure sensor connected to a low-level alarm located at the lake pump station.
Reservoir Booser Pump Station	• Reservoir booster pump station is a wood frame and concrete building located near the reservoir at the end of Cameron Road. • Comprised of two pumps connected in parallel for redundancy. • Piping is galvanized steel. • Electrical controls and panel are located within the building. • Building is heated, vented and secured with no reported rodent problems.
System Piping	• Supply main pipe material from the lake pump station to the reservoir booster pump station is 150 mm C900 PVC. • Distribution pipe material type throughout the system is unknown.

Table 2 RDNO Utilities Department

RDNO Utilities	
Zee Marcolin, P.Eng	General Manager, Utilities
John Lord, P.Eng	Manager, Water Distribution
Tricia Brett, MSc., PAg	Manager, Water Quality
Connie Hewitt, AScT	Water Quality Technologist
Jamie Ferris	Water Quality Technician
Chris Cannon	Water Quality Technician
Kimberly Berndt	Engineering Technician
Mike Philips, AScT	Engineering Technologist / Bylaw Officer
Skyler Ganz, AScT	Engineering Technologist
Alec Busby, EIT	Assistant Utilities Engineer
Keiko Parker, AScT	Manager, Small Utilities
Sandy Edwards, AScT	Manager, Projects
Jonathn McLuskie	Utilities Quality Assurance Inspector

Table 3: RDNO Water Operators EOCP Certifications

RDNO Operators			
Last Name	First Name	Certification #	Certification Held
Heidt	Dustin	4498	WDIII, WTIV
Hartwig	Corey	9378	WTI
Mykytuk	Becky	9086	WTIII
Beckett	Jemma	1001610	WTI
Cimon	Caroline	1001075	WTII
Lockwood	Ryan	1000755	WDI, WTII
Tucker	Chris	6489	WTIV, WDII
Radu	David	1002040	WTII

Table 4: CoV Water Operators EOCP Certifications

City of Vernon Operators			
Last Name	**First Name**	**Certification #**	**Certification Held**
Austin	Mercedes	1001060	WDI
Briggs	Geordie	6495	WDIII, WWCII
Becraft	Spencer	1001538	WWCI
Bouchard	Martin	1000696	WDI, WWCII
Browne	Ryan	8176	WDII, WWClI
Callbeck	Brad	1001930	WWCI
Cleverly	Curtis	7193	WDIII, WWCI
Cruz-Santos	Edwin	1001325	WDII, WWCI
Dobson	Scott	100438	WDII, WWCII
Gaythorpe	Glen	7271	WDII, WWCIl
Greenan	Craig	1001795	WWCI
Holloway	Ryan	8876	WDII, WWCl, SWS
Holtz	Colin	9158	WDI, WWCII
Irwin	Sean	8610	WDII,WWCII
Jacob	Mason	1000333	WDI, WWCI
Johannson	Iain	9427	WDII, WWCI
Knight	Jessie	1000335	WDII, WWCI
Martin	Derek	1001431	WDI, WWCI
Novakowski	Dan	1001106	WDII, WWCI
Parker	Ryan	6988	WDIV, WWCII
Price	Eric	9215	WDII, WWCI
Rempel	Chris	7192	WDI
Rempel	Cory		
Rennie	Dylan	100532	WDI, WWCI
Roberts	Alex	1001050	WDI, WWCI
Rowan	Jared	1001263	WDII, WWCI
Stowards	Blaine	8247	WDII, WCII
Thomas	Jamie	7550	WDI, WWCI

Table 5 Delcliffe parameter sampling frequency

Physical/ Chemical Parameters	Accredited Lab Analysis	RDNO Lab Analysis	Sampling	
			Monthly	Quarterly
Turbidity		x	x	x
pH		x	x	x
Temperature		x	x	x
Conductivity		x	x	x
Algae Density		x*	x*	x*
Chlorophyll a	x*		x*	x*
Phosphorus (Total)	x		x	x
Nitrogen (Total)	x		x	x
Dissolved Organic Carbon (DOC)	x		x	x
Total Organic Carbon (TOC)	x		x	x
Ultra-violet transmissivity (UVT)		x	x	x
Biological Parameters	**Accredited Lab Analysis**	**RDNO Lab Analysis**	**Monthly**	
Total Coliform	x	x	x	x
E. coli	x	x	x	X

*Monthly – May to November

Table 6 Source Water Bacterial Summary

Total Coliform CFU/100 mL	Accredited Lab	RDNO Lab
Min	**<1**	**<1**
Max	**>2420**	**>2419.6**
# of Samples	**13**	**13**
Counts ≥ 100 MPN/100mL	**3**	**4**
Counts <1 MPN/100mL	**1**	**3**
***E.coli* CFU/100 mL**	**Accredited Lab**	**RDNO Lab**
Min	**<1**	**<1**
Max	**2**	**2**
# of Samples	**13**	**13**
Counts >20 MPN/100mL	**0**	**0**
Counts <1 MPN/100mL	**10**	**12**

Table 7 SCADA data for chlorine and Turbidity for Treated Water

SCADA Monthly Average		
Month	Chlorine (mg/L)	Turbidity (NTU)
January	1.29	0.18
February	1.96	0.26
March	1.64	0.39
April	1.56	0.34
May	1.42	1.08
June	1.51	0.63
July	1.67	0.65
August	1.70	0.63
September	1.48	0.56
October	1.79	0.39
November	1.62	0.27
December	1.72	0.23
Monthly Min	**1.29**	**0.18**
Monthly Max	**1.96**	**1.08**
Monthly Average	**1.61**	**0.47**

Table 8 Source Water UV Transmittance (Unfiltered)

Source Water UV Transmittance (Unfiltered)				
Grab Samples (%)	Min	Max	Average	# Samples
	82.2	88.1	85.7	12

Table 9 Source Water Total Organic Carbon

Source Water Total Organic Carbon				
Grab Samples (mg/L)	Min	Max	Average	# Samples
	3.80	5.41	4.54	11

Table 10 Source Water Field Parameter Summary

Source Water Field Parameters					
Parameter	**Guidelines**	**Min**	**Max**	**Average**	**# Samples**
pH	7 to 10.5	7.0	8.5	7.8	14
Temperature (degrees C)	<15	3.8	23.5	11.6	13
Conductivity (uS/cm)	na	260	310	288	14

Table 11 Distribution Water Bacterial Summary

Distribution Bacterial Summary		
	Delcliffe Hill PS	Delcliffe Road SS
Total Coliform CFU/100 mL	**Accredited Lab**	**Accredited Lab**
Min	<1	<1
Max	<1	<1
# of Samples	25	28
***E.coli* CFU/100 mL**	**Accredited Lab**	**Accredited Lab**
Min	<1	<1
Max	<1	<1
# of Samples	25	28

Table 12 Distribution Field Parameter Summary

	Delcliffe Hill PS				Delcliffe Road SS			
Parameter	Min	Max	Average	Counts	Min	Max	Average	Counts
Free Chlorine	1.03	2.4	1.63	29	0.85	2.3	1.62	30
Total Chlorine	1.14	2.7	1.79	29	1.04	2.6	1.82	30
Temp	4.5	23.2	11.8	29	3.8	22.7	12.6	30
Turbidity	0.22	1.52	0.55	29	0.22	1.61	0.57	30
pH	7.56	8.48	7.97	29	7.41	8.52	7.95	30
Conductivity	285	441	329	29	289	392	323	30

Table 13 Monthly Water Consumption

Month	Total Monthly Consumption (ML)
January	2.31
February	2.16
March	2.29
April	2.24
May	3.25
June	3.73
July	4.37
August	4.28
September	3.36
October	2.54
November	2.71
December	2.68
Monthly Min	**2.16**
Monthly Max	**4.37**
Monthly Average	**2.99**
Total	**35.92**

FIGURES

Figure 1 Delcliffe Covered Reservoir

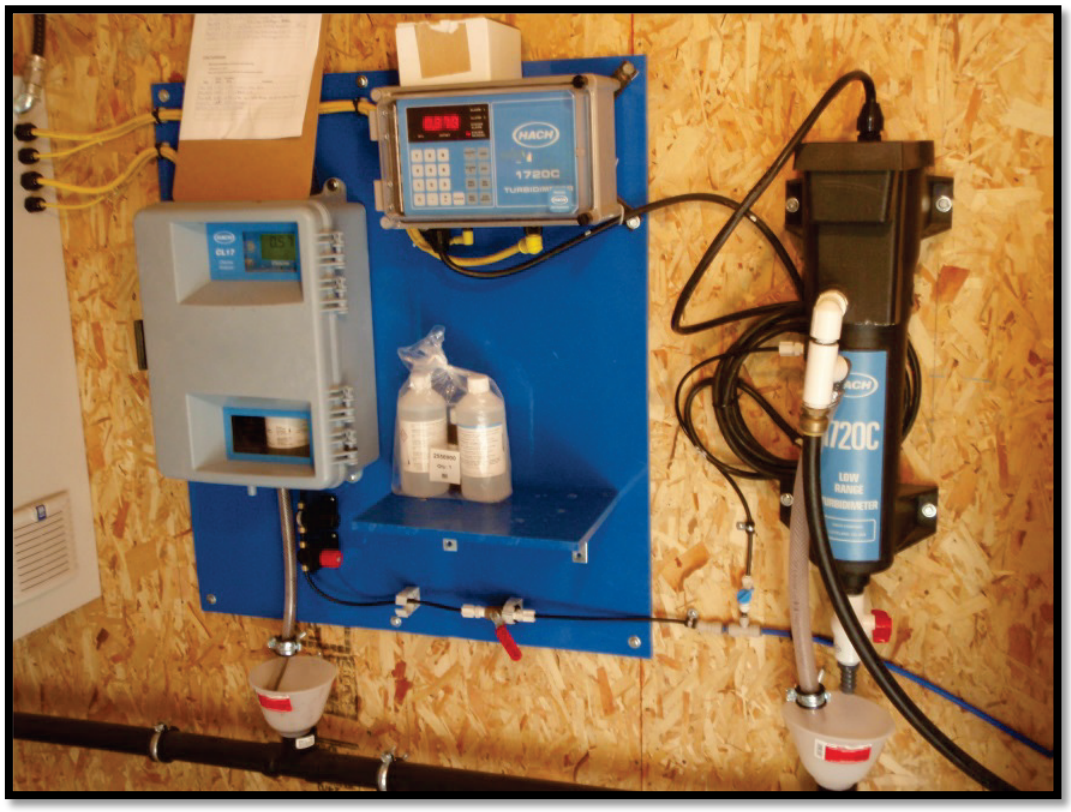


Figure 2 Delcliffe Booster Station Chlorine and Turbidity Online Analyzers

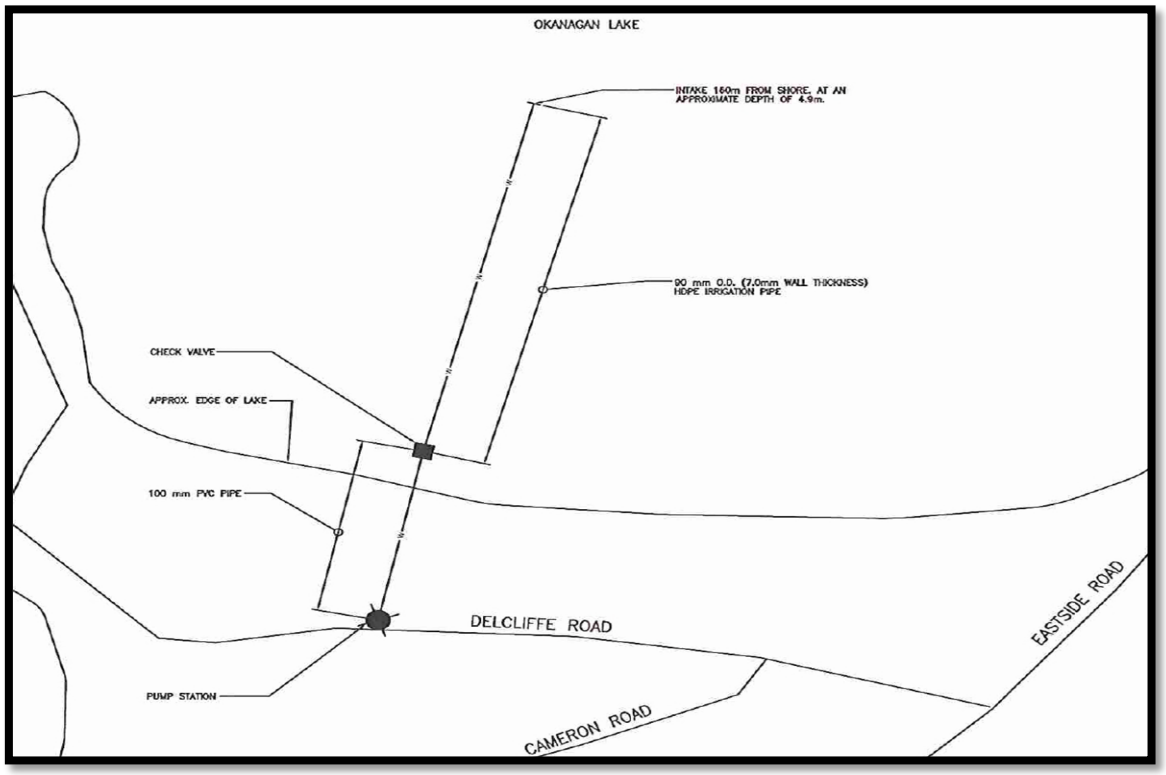


Figure 3 Delcliffe Water Intake

Figure 4 Delcliffe Lake Station

Figure 5 Delcliffe Lake Station Pumps

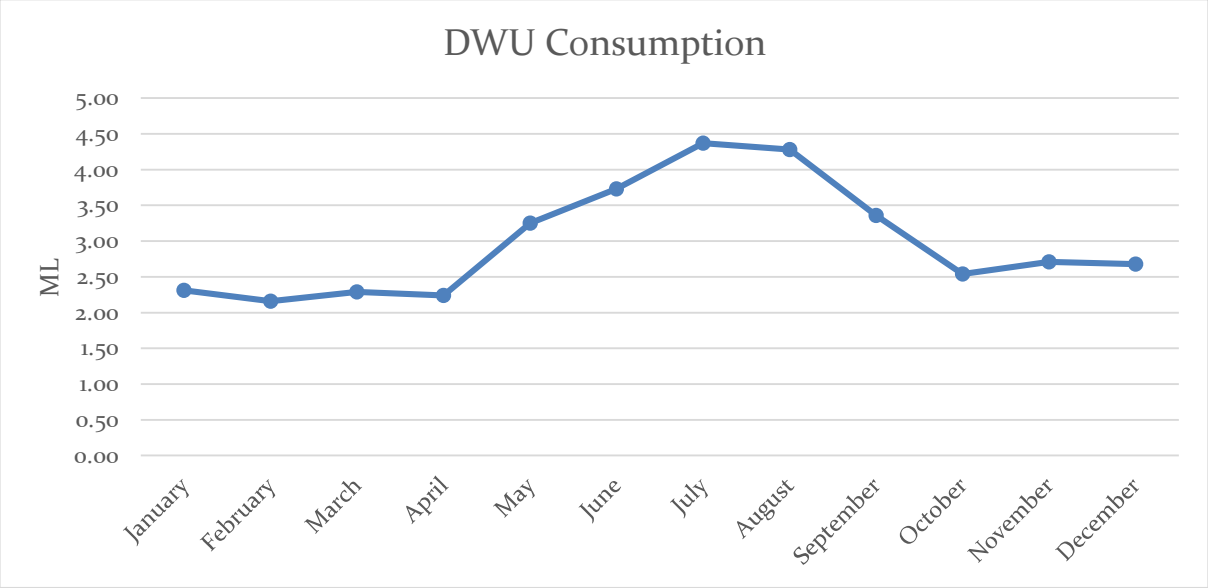


Figure 6 DWU Monthly Consumption

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APPENDIX A

2023 DECLIFFE WATER QUALITY MONITORING PROGRAM

2023 Outback and Delcliffe Schedule			
Week	**RDNO Water Quality Sampling (Monday)**	**RDNO Operator Sampling (Tuesday)**	**Instrument Maintenance**
Jan 2 - 6		Outback Reservoir SS, Delcliffe Road SS	
Jan 9 - 13		Outback Reservoir SS, Delcliffe Hill PS	
Jan 16 - 20		Outback Reservoir SS, Delcliffe Road SS	
Jan 23 - 27	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity
Jan 30 - Feb 3		Outback Reservoir SS, Delcliffe Road SS	
Feb 6 - 10		Outback Reservoir SS, Delcliffe Hill PS	
Feb 13 - 17		Outback Reservoir SS, Delcliffe Road SS	
Feb 20 - 24		Outback Reservoir SS, Delcliffe Hill PS	
Feb 27 - Mar 3	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Turbidity
Mar 6 - 10		Outback Reservoir SS, Delcliffe Hill PS	
Mar 13 - 17		Outback Reservoir SS, Delcliffe Road SS	
Mar 20 - 24		Outback Reservoir SS, Delcliffe Hill PS	
Mar 27 - 31	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Chlorine
Apr 3 - 7		Outback Reservoir SS, Delcliffe Hill PS	
Apr 10 - 14		Outback Reservoir SS, Delcliffe Road SS	
Apr 17 - 21		Outback Reservoir SS, Delcliffe Hill PS	
Apr 24 - 28	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
May 1 - 5		Outback Reservoir SS, Delcliffe Hill PS	
May 8 - 12		Outback Reservoir SS, Delcliffe Road SS	
May 15 - 19		Outback Reservoir SS, Delcliffe Hill PS	
May 22 - 26		Outback Reservoir SS, Delcliffe Road SS	
May 29 - Jun 2	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity Turbidity
June 5 - 9		Outback Reservoir SS, Delcliffe Road SS	
Jun 12 - 16		Outback Reservoir SS, Delcliffe Hill PS	
Jun 19 - 23		Outback Reservoir SS, Delcliffe Road SS	
Jun 26 - 30	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity

2023 Outback and Delcliffe Schedule			
Week	**RDNO Water Quality Sampling (Monday)**	**RDNO Operator Sampling (Tuesday)**	**Instrument Maintenance**
Jul 3 - 7		Outback Reservoir SS, Delcliffe Road SS	
Jul 10 - 14		Outback Reservoir SS, Delcliffe Hill PS	
Jul 17 - 21		Outback Reservoir SS, Delcliffe Road SS	
Jul 24 - 28	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity
Jul 31 - Aug 4		Outback Reservoir SS, Delcliffe Road SS	
Aug 7 - 11		Outback Reservoir SS, Delcliffe Hill PS	
Aug 14 - 18		Outback Reservoir SS, Delcliffe Road SS	
Aug 21 - 25		Outback Reservoir SS, Delcliffe Hill PS	
Aug 28 - Sep 1	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Turbidity
Sep 4 - 8		Outback Reservoir SS, Delcliffe Hill PS	
Sep 11 - 15		Outback Reservoir SS, Delcliffe Road SS	
Sep 18 - 22		Outback Reservoir SS, Delcliffe Hill PS	
Sep 25 - 29	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Oct 2 - 6		Outback Reservoir SS, Delcliffe Hill PS	
Oct 9 - 13		Outback Reservoir SS, Delcliffe Road SS	
Oct 16 - 20		Outback Reservoir SS, Delcliffe Hill PS	
Oct 23 - 27	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Oct 30 - Nov 3		Outback Reservoir SS, Delcliffe Hill PS	
Nov 6 - 10		Outback Reservoir SS, Delcliffe Road SS	
Nov 13 - 17		Outback Reservoir SS, Delcliffe Hill PS	
Nov 20 - 24		Outback Reservoir SS, Delcliffe Road SS	
Nov 27 - Dec 1	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity Turbidity
Dec 4 - 8		Outback Reservoir SS, Delcliffe Road SS	
Dec 11 - 15		Outback Reservoir SS, Delcliffe Hill PS	
Dec 18 - 22	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Dec 25 - 29		Outback Reservoir SS, Delcliffe Hill PS	

Delcliffe - Weekly Sampling

Site & WaterTrax #	Bottles	Parameters
Alternate Weekly: Delcliffe Hill PS (35535) and Delcliffe Road SS (32730)	1 - Caro Bacterial	Total Coliform, E.Coli

Delcliffe - Monthly Sampling

Site & WaterTrax #	Bottles	Parameters
Delcliffe Intake 3272D	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - PA	Bacterial (Most Probable Number)
	1 - 125 mL Caro (yellow lid)	TP
	1 - 250 mL Caro	DOC, TN
	1 - TOC (2 bottles)	TOC
	1 - 500 mL in house	UVT (UF)
	1 - 1 L in house	Algae Density
	1 - 4 L Caro	Chlorophyll a (May to November)

Delcliffe - Annual Sampling (July)

Site and WaterTrax #	Bottles	Parameters
Delcliffe Intake 3272D	1 - Caro Baterial	Total Coliform, E.Coli
	1 - PA	Bacterial (Most Probable Number)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (yellow lid)	
	1 - Cyanide	Cyanide
	1 - TOC	TOC
	1 - 1 L Caro	
	1 - 500 mL in house	UVT (UF)
	1 - 4 L Caro	Chlorophyll a
	1 - 1 L in house	Algae Density

APPENDIX B

2023 DELCLIFFE SOURCE WATER COMPREHENSIVE ANALYSIS

Delcliffe Water Quality 2023

Water System: Greater Vernon Water
Source: Okanagan Lake

Sampling Point: Delcliffe Intake
Date of Sample: August 23, 2023

Parameter	Result	Guideline	Unit
ALKALINITY (BICARBONATE, AS CACO3)	117	N/A	mg/L
ALKALINITY (CARBONATE, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (HYDROXIDE, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (PHENOLPHTHALEIN, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (TOTAL, AS CACO3)	117	N/A	mg/L
ALUMINUM (TOTAL)	0.0099	OG < 0.1	mg/L
ANTIMONY (TOTAL)	<0.0002	MAC = 0.006	mg/L
ARSENIC (TOTAL)	<0.0005	MAC = 0.01	mg/L
BARIUM (TOTAL)	0.0226	MAC = 2	mg/L
BERYLLIUM (TOTAL)	<0.0001	N/A	mg/L
BISMUTH (TOTAL)	<0.0001	N/A	mg/L
BORON (TOTAL)	<0.05	MAC = 5	mg/L
CADMIUM (TOTAL)	<0.00001	MAC = 0.007	mg/L
CALCIUM (TOTAL)	33.7	N/A	mg/L
CHLORIDE	6.25	N/A	mg/L
CHLOROPHYLL A	1.58	N/A	mg/L
CHROMIUM (TOTAL)	<0.0005	MAC = 0.05	mg/L
COBALT (TOTAL)	<0.0001	N/A	mg/L
COLOUR (TRUE)	<5.0	AO ≤ 15	TCU
CONDUCTIVITY	281	N/A	µS/cm
COPPER (TOTAL)	0.00195	MAC = 2	mg/L
CYANIDE (TOTAL)	<0.002	MAC = 0.2	mg/L
DISSOLVED ORGANIC CARBON	5.16	N/A	mg/L
FLUORIDE	0.12	MAC=1.5	mg/L
HARDNESS (TOTAL, AS CACO3)	125	N/A	mg/L
IRON (TOTAL)	0.012	AO ≤ 0.3	mg/L
LEAD (TOTAL)	<0.0002	MAC = 0.005	mg/L
LITHIUM (TOTAL)	0.00328	N/A	mg/L
MAGNESIUM (TOTAL)	9.95	N/A	mg/L
MANGANESE (TOTAL)	0.00122	MAC = 0.12	mg/L
MERCURY (TOTAL)	<0.00001	MAC = 0.001	mg/L
MOLYBDENUM (TOTAL)	0.0034	N/A	mg/L
NICKEL (TOTAL)	0.00044	N/A	mg/L
NITRATE + NITRITE	<0.01	N/A	mg N/L
NITRATE	<0.01	N/A	mg N/L
NITRITE	<0.01	N/A	mg N/L
NITROGEN (TOTAL)	0.236	N/A	mg/L
PHOSPHORUS (TOTAL DISSOLVED)	<0.005	N/A	mg/L

PHOSPHORUS (TOTAL)	<0.005	N/A	mg/L
PH	8.2	7.0-10.5	pH units
POTASSIUM (TOTAL)	2.53	N/A	mg/L
SELENIUM (TOTAL)	<0.0005	MAC = 0.05	mg/L
SILICON (TOTAL, AS SI)	3.2	N/A	mg/L
SILVER (TOTAL)	<0.00005	N/A	mg/L
SODIUM (TOTAL)	12.2	AO ≤ 200	mg/L
STRONTIUM (TOTAL)	0.286	MAC = 7	mg/L
SULFUR (TOTAL)	10.7	N/A	mg/L
SULPHATE	32.3	N/A	mg/L
TELLURIUM (TOTAL)	<0.0005	N/A	°C
THALLIUM (TOTAL)	<0.00002	N/A	mg/L
THORIUM (TOTAL)	<0.0001	N/A	mg/L
TIN (TOTAL)	<0.0002	N/A	mg/L
TITANIUM (TOTAL)	<0.005	N/A	mg/L
TOTAL DISSOLVED SOLIDS	174	AO ≤ 500	mg/L
TOTAL KJELDAHL NITROGEN	0.236	N/A	mg/L
TOTAL ORGANIC CARBON	5.34	N/A	mg/L
TUNGSTEN (TOTAL)	<0.001	N/A	NTU
TURBIDITY	0.84	OG < 1	mg/L
URANIUM (TOTAL)	0.00251	MAC = 0.02	% T
UV TRANSMITTANCE (FILTERED)	84	N/A	% T
VANADIUM (TOTAL)	<0.005	N/A	mg/L
ZINC (TOTAL)	0.0041	AO ≤ 5	mg/L
ZIRCONIUM (TOTAL)	<0.0001	N/A	mg/L

"<" = Less than the detection limit shown

N/A = No current guideline

OG = Operational Guideline

MAC = Maximum Acceptable Concentration Guideline

AO = Aesthetic Objective Guideline