Mabel Lake Water Utility
2020 and 2021 Annual Report

Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, BC

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ACRONYMS

AO	Aesthetic Objective
BPD	Backflow Prevention Device
BWN	Boil Water Notice
Caro	Caro Analytical Services
CCCP	Cross Connection Control Program
CFU	Colony Forming Units
COP	Conditions on Permit
CT	Contact Time
DBP	Disinfection By-Product
DCC	Development Cost Charge
DOC	Dissolved Organic Carbon
DWO	Drinking Water Officer
DWPA	Drinking Water Protection Act
DWPR	Drinking Water Protection Regulation
DWTO	Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies
E. coli	Escherichia coli
EOCP	Environmental Operator Certification Program
ERP	Emergency Response Plan
FIP	Financial Implementation Plan
GCDWQ	Guidelines for Canadian Drinking Water Quality
HAA	Haloacetic Acids
IH	Interior Health
LPH	Lakeshore Pump House
M	Meters
MAC	Maximum Acceptable Concentration
MLW	Mabel Lake Water Utility
MWP	Master Water Plan
mm	millimeters
NTU	Nephelometric Turbidity Units
OC	Operational Certificate
Old PH	Old Pump house
OP	Operating Permit
PRV	Pressure Reducing Valve
RDNO	Regional District of North Okanagan
SCADA	Supervisory Control and Data Acquisition
SDWQG	Source Drinking Water Quality Guidelines
SRWSP	Shuswap River Watershed Sustainability Plan
SS	Sample Site
Teale’s	Teale’s Water Utility Service
THAA	Total Haloacetic Acids
THM	Trihalomethanes
TOC	Total Organic Carbon
TTHM	Total Trihalomethanes
TWL	Top Water Level
UVT	UV Transmissivity
VOC	Volatile Organic Compounds
WQA	Water Quality Advisory

1.0 INTRODUCTION

As required by the *Drinking Water Protection Act* (DWPA) of BC, the Regional District of North Okanagan (RDNO) provides the following annual report in accordance with Conditions on Permit (COP) for the Mabel Lake Water Utility (MLW).

This report provides an overview of the following for 2020 and 2021:

- The water system of MLW,
- the operations of the water utility including the management, Environmental Operator Certification Program (EOCP) classification, and operations programs,
- source assessment and watershed protection,
- the annual water quality monitoring program and a summary of 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 eastern half of the MLW system, Mabel Ridge Estates, was constructed in the 1970s and operated as a private water utility until 2003 when it became a function of the RDNO and was expanded west with the development of the Mabel Lake Golf Course. It was further expanded to the west to service the Kingfisher RV Park in 2005. Appendix A provides the water service boundary and properties serviced by MLW.

MLW currently provides potable water to 369 residential connections (301 single family units and 68 multi-family units) and 3 commercial connections. The majority of connected residents and all 3 commercial connections are seasonally occupied, with approximately 20 connections considered to be occupied year-round.

Two of the commercial connections are campground/RV parks consisting of 70 and 90 campsites respectively and 6 cabins. The third commercial connection is the golf course clubhouse which includes a restaurant. MLW only supplies water for potable use to the golf course which shares the intake with MLW and supplies their own irrigation water for the golf course.

Based on an estimate of 3 persons per single family connection, 2 persons per multi-family connection, and 2 persons per campsite/cabins, the population during peak summer months is an estimated 1359 persons. It should be noted that this estimate is likely not applicable to weekends and especially long weekends and occupancy is likely much higher. The winter population is approximately 60 persons.

The MLW system is comprised of the following:

- An intake screen located in Mabel Lake approximately 235 meters (m) southeast of the Lakeshore Pump House (LPH), about 26 m deep. A 250 mm diameter intake pipe delivers water from the intake to a clear well beneath the LPH (water level elevation approximately 394 m). Within the LPH, there is an online turbidity analyzer that continuously monitors raw water turbidity and a chlorine analyzer that monitors dosing chlorine levels to calculate contact time (CT).
- Water from the clear well is pumped into a 250 mm diameter transmission main that is 526 m long. Chlorine is injected into the transmission main in the LPH to provide adequate chlorine CT within the transmission main before the first customer receives water and to provide residual chlorine in the distribution main to inhibit microbial growth.
- The mid-level reservoir located off Lusk Lake Road East, with a top water level (TWL) of 469 m, is supplied from the LPH via the distribution network.
- A pump station at Lusk Lake Road East pumps water to the upper level reservoir located off Walker Road, with a TWL of 518 m.
- MLW does not provide fire protection services. The reservoirs and pipe mains are undersized for this purpose according to the Fire Underwriters Survey, and there is no backup power. Also, there is insufficient human resources to staff a volunteer fire department during the off season.
- The reservoirs provide water by gravity during power outages, and therefore customers do not lose water supply from short term power outages. For long term outages, portable generators may be considered to maintain system operation if a portable generator was found (rented) to plug into the transfer switch installed at Mabel Lake Sewer lift station. If the lift station is not operation, the contingency plan is to allow residents to run out of water

to avoid overflow to the lake. A backup generator is in the MLS budget and once installed, this contingency plan will be reviewed and updated.

2.2. WATER SOURCE

The water source for the MLW system is Mabel Lake. Based on the limnology characteristics, Mabel Lake is an oligotrophic lake (Bryan and Jensen, 1999). This means that as a whole Mabel Lake is clear, with low nutrient levels and low algae levels (Bryan and Jensen, 1999). As indicated in Section 2.1, the intake is about 26 m deep located in an area upstream of the majority of cabins and the marina.

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

Currently MLW raw water is treated with only chlorinated at the LPH. Chlorination of the water is completed 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. At the maximum flow rate with two distribution pumps in operation simultaneously, the CT achieved in the transmission main is 28 minutes. This meets the minimum CT requirement for viruses of 8 minutes during winter conditions (during the summer, only 6 minutes is required). See Appendix B for the MLW CT calculation.

This level of treatment is not compliant with these standards as this does not meet 3 log inactivation for protozoa nor have 2 treatment processes.

After the intake was deepened to 26 meters in the spring of 2014, the 1 NTU maximum turbidity condition was met from 2014 until 2016. However in both 2017 and 2018 the turbidity conditions

exceeded 5 NTU resulting in Boil Water Notices both years. There was excessive flooding both of these years which is likely the cause of the unusually high turbidity events. In 2019, turbidity daily averages did not exceed 1 NTU and no advisories were issued.

In 2020, turbidity was >5 and then >1 NTU for an extended period of time. The water utility launched an investigation in July and August into the cause of this high turbidity and it was discovered the intake had been tipped over and the screen was in contact with the lake bottom. This was repaired on August 31 and the turbidity did not improve for another week. Although the screen being in contact with the lake bottom may have aggravated the turbidity, it appears that the turbidity was high during this year.

In 2021, turbidity SCADA daily averages only exceeded 1 NTU twice but did not exceed 1 NTU for a 24 hour period. No advisories were issued.

In order to meet the DWTO, MLW must either install filtration or if the raw water meets the filtration exclusion criteria, then UV treatment can be installed which is less expensive than filtration. The criteria for filtration exclusion are as follows:

- Overall inactivation is met using a minimum of two disinfections, providing 4-log reduction of viruses and 3-log reduction of *Cryptosporidium* and *Giardia*.
- The number of Escherichia coli (E. coli) in raw water does not exceed 20/100 mL (or if E. coli data are not available less than 100/100 mL of total coliform) in at least 90% of the weekly samples from the previous six months.
- Average daily turbidity levels measured at equal intervals (at least every four hours) immediately prior to where the disinfectant is applied, are around 1 NTU but do not exceed 5 NTU for more than two days in a 12-month period.
- A watershed control program is maintained that minimizes the potential for fecal contamination in the source water.

A water sampling program was completed in 2016 and 2017 to assess if the raw water for MLW meets the criteria of a filtration exclusion. A more detailed discussion on meeting Provincial standards and on support for a filtration exclusion at MLW is provided in Section 10.2 of this report.

3.0 OPERATIONS

3.1. MANAGEMENT

MLW is owned and managed by RDNO. The Manager, Small Utilities is responsible for the operation and management with oversight provided by the General Manager, Utilities and the RDNO Board of Directors. The water quality monitoring program is coordinated and monitored by the water quality staff of the RDNO. The RDNO employs a contract operator to complete day to day operation and maintenance tasks. The operator is also required to respond to emergencies, 24 hours a day, 7 days a week, and have a backup operator available to respond if necessary.

Interior Health (IH) is the regulator of water utilities and is responsible for ensuring compliance with legislation and Provincial standards. IH also issues the Operating Permit (OP) (Appendix C) and COP (Appendix D). The IH representative is often an Environmental Health Officer or a Drinking Water Officer (DWO) who works closely with the water utility to ensure conditions on permit (COP) are met. The Environmental Health Officer position for MLW was vacant due to a retirement for most of 2021 and was being filled by a rotation of staff as required. In November 2021, Interior Health reclassified Mabel Lake Water Utility as a Large Water Utility and Pouria Mojtahedi is now the Environmental Health Officer for MLW.

3.2. EOCP CLASSIFICATION

MLW is classified by the EOCP as a Water Treatment Facility Level II (WT-II) (EOCP #2270), and a Water Distribution Facility Level I (WD-I) (EOCP #1596).

The MLW operations is contracted to Aberdeen Electric Ltd., see Table 1 for the list of operators certified through the EOCP. The contracted operators are responsible for operating and maintaining the source, treatment, and distribution system and also sampling as required by the water quality monitoring program.

The operator duties include on-site checks of the facilities at least three times per week with continual monitoring by the SCADA system with set alarms. The operators are also required to check the system via SCADA at least once per day but they typically check more. All alarms are responded to by an operator. If immediate attention is required, the operator will proceed to the site to respond. If required, the system operator will contact management for guidance or assistance.

3.3. OPERATIONS PROGRAMS

3.3.1. FLUSHING AND STANDPIPE MAINTENANCE

Standpipe maintenance was completed by Teale's in 2016. Records of the standpipe maintenance are kept on file. At RDNO water utilities with Fire Protection services, local fire departments are responsible for the costs for hydrant maintenance. As MLW is not in a fire protection area, maintenance has been paid for by water users through the MLW annual repairs and maintenance budget and is not regularly scheduled.

MLW has been replacing two old standpipes per year when the budget allows, and this program will continue in future years. In 2021, three fire hydrants were replaced with new standpipes. Full funding for this project was provided by the RDNO Electoral Area "F" Community Works Fund.

There is one dead-end on the water system and a standpipe has been installed at this location. It is flushed during the low flow season (September to May) to maintain chlorine residuals within the distribution system. The standpipe is located at:

1. Lot #8 Kingfisher

3.3.2. CROSS CONNECTION CONTROL PROGRAM

The RDNO has a Cross Connection Control Program (CCCP) for all water utilities owned by RDNO, including the MLW. The CCCP is focused on identifying high and medium backflow risks and ensuring annual compliance of Backflow Prevention Device (BPD) testing for these facilities. Currently the majority of connections in the Kingfisher community are residential with the exception of a few businesses, including 2 campgrounds, a restaurant and store.

3.3.3. EFFLUENT PROGRAM

Mabel Lake Community Sewer also has an Operational Certificate (OC) #14490 for authorized discharge of effluent from individual septic tanks draining to a common tile field (Appendix E).

This OC was issued by Ministry of Environment and falls under the Environmental Management Act. An annual report is submitted to the Ministry of Environment for this Operational Certificate and can be found on the RDNO website: www.rdno.ca/mls.

For further information regarding analysis and operational results see Section 5.5.

4.0 SOURCE ASSESSMENT AND WATERSHED PROTECTION PLANNING

The majority of the watershed directly contributing to Mabel Lake is crown land with primarily forestry activities with some localized areas with cabins and two campgrounds (one provincial and one recreation site). This does not include the Shuswap River upstream of Mabel Lake, which encompasses a very large area with 2 communities, rural subdivisions and large agricultural properties. Due to the large contribution size of the watershed upstream of the community of Kingfisher and the small size of the water utility, aspects of source protection for this utility have been identified in the Shuswap River Watershed Sustainability Plan (SRWSP). The SRWSP was completed by the RDNO planning department and endorsed by the RDNO Board in 2014. It can be found at the following website:

www.rdno.ca/sites/default/files/2021-09/Shuswap%20River%20Watershed%20Sustainability%20Plan.pdf

The purpose of the SRWSP is to create a common long term vision for the management of the Shuswap River watershed, and a comprehensive plan for decision making with regard to land and water planning within the watershed. Another purpose is to develop a sense of responsibility for the watershed within the community. The SRWSP develops objectives for Land Use Planning/ Urban/Residential Development, Agricultural Management Practices, Forestry Management Practices, Industrial and Commercial Operations, Water Quantity, and outlines strategies pertaining to each.

The goal for water quality and quantity is “to preserve and protect the Shuswap River Watershed to ensure water quality and quantity that supports the ecosystems and communities that rely on it.”

To further understand the source water for the MLW the *Shuswap Watershed Council* has released a summary report covering results of recent water quality monitoring in the Shuswap watershed. The 2021 report was not available at the time this report was completed. The 2020 report can be found at:

www.fraserbasin.bc.ca/_Library/TR_SWC/SWC_WaterQualityReport_2020-WEB.pdf

In order to identify localized risks to MLW drinking water source and increase protection efforts, a Source Protection Plan (SPP) was completed in 2021 with the completion of a Source Water Assessment (SWA). Staff initiated the SWA in 2020 with the knowledge that it would be required to apply for a Filtration Exclusion in the future. In 2020, the RDNO retained the services of Larratt Aquatic Consulting Ltd. (Larratt) to complete a preliminary SWA for the MLW source water that

also included the work required to calculate an Intake Protection Zone (IPZ) for the MLW intake (Appendix F). Further work will be completed in the future if it is determined that more information is required to expand on the preliminary SWA.

5.0 WATER QUALITY MONITORING

The goal of the water quality program at MLW is to monitor the quality of the raw water and treated water within the distribution system to detect the presence of microorganisms or other issues that can degrade water quality. As issues are found, operations and staff can respond to correct any issues or appropriately notify customers as required.

5.1. PROGRAM AND SCHEDULE

Water quality monitoring for MLW is based on the requirements of the Drinking Water Protection Regulation (DWPR) Schedules A and B (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 MLW is reviewed and updated annually in January. The updated sampling program and schedules for 2020 and 2021 are provided in Appendix G. RDNO provides an updated Water Quality Monitoring Plan (WQ Plan) to IH at the beginning of each year after the program is developed. Included in the WQ Plan submitted is the monitoring schedule, parameters, and frequency of samples taken at different times of the year.

To meet Schedule B in the DWPR for populations less than 5,000, a minimum of four microbiological samples are required per month. In 2020 and 2021, MLW met this requirement with the exception of January and February 2020. This was accomplished by taking 2 samples on the first and third Tuesday of each month. There are no bacterial results for January and February 2020 due to a communication error. During this time, there was no interruption in water treatment and all monitored parameters indicated there was good water quality throughout the system.

In 2017, IH directed the RDNO to take two samples weekly in the distribution from mid-May to mid-September to increase the sampling frequency during the peak season with the highest population. The five sites were rotated each week to complete this request in 2020 and 2021. During the remainder of the year, the sampling frequency remains as mentioned above to meet Schedule B of the DWPR.

During freshet (May, June, and July) bacterial, UV Transmissivity (UVT), and Total Organic Carbon (TOC) samples are taken weekly on the raw water. The remainder of the year the raw water is sampled monthly for these parameters with the exception of UVT. UVT on the raw water is sampled based on the distribution sampling schedule (Appendix G).

The system operators collect bacterial samples and drop them off with RDNO water quality staff to process for shipment to Caro Analytical Services (Caro). Caro sends results to IH and uploads results to WaterTrax, a third party online database the RDNO utilizes to store lab data. WaterTrax sends automatic alerts to the relevant RDNO staff for any results not in compliance with standards.

5.2. SOURCE

This section outlines the bacterial, turbidity, UVT, TOC, pH, temperature, and annual chemical results for 2020 and 2021 raw water at MLW.

5.2.1. BACTERIA

At least one monthly raw water sample is collected from the intake. The MLW system has a good microbial history, as demonstrated in Table 2 which summarizes the source water bacterial results from Caro. In 2020, Total Coliform <1 counts were in the 51ST Percentile, and E. coli <1 counts were in the 87th Percentile (Table 2). In 2021, Total Coliform <1 counts were in the 43RD Percentile, and E. coli <1 counts were in the 95th Percentile (Table 2).

E.coli is monitored as an indicator bacteria to assess contaminant levels in the raw water and review changes in this water. The criteria of a filtration exclusion also requires that E. coli in raw water does not exceed 20/100 mL in at least 90% of the weekly samples from the previous six months.

In 2020, the E.coli results in the raw water met this objective with all recorded results being < 1 Colony Forming Unit (CFU) / 100 mL, except for four samples where E. coli results ranged from 1 to 3 CFU/100 mL (Figure 1). 100% of the raw water samples in 2020 and 2021 were <20/100 mL for E. coli. This meets and exceeds the criteria set out in the DWTO.

In 2021, the E. coli results in the raw water met this objective with only one sample of 1 CFU/100mL, out of twenty-four samples taken having an E. coli result (Figure1).

Total Coliform is monitored as an indicator bacteria to assess changes in source water. The DWTO indicates that Total Coliform should not exceed 100 CFU / 100 mL in at least 90% of the weekly samples.

In 2020, the Total Coliform results in the raw water met this objective with twenty one of the recorded results being <1 CFU / 100 mL. The thirteen other samples ranged from 1 to 40 CFU/100mL (Figure 2). 100% of the raw water samples in 2020 were <100/100 mL for Total Coliforms.

In 2021, the Total Coliform results in the raw water met this objective with eleven of the recorded results being <1 CFU / 100 mL. The thirteen other samples ranged from 1 to 22 CFU/100mL (Figure 2). 100% of the raw water samples in 2021 were <100/100 mL for Total Coliforms. This meets the criteria set out in the DWTO.

5.2.2. TURBIDITY

Turbidity measurements relate to the optical properties of water. Turbidity is caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, plankton, and other microscopic organisms. Excessively high turbidity can have a negative effect on disinfection techniques. A provincial guidance document issued in April 2013, *the Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water* (BC Ministry of Health, 2013) assists RDNO during turbidity events and communication with the water customers.

Turbidity at Mabel Lake intake has historically been below 1 NTU during most of the year except during freshet, as seen in Figure 3. During freshet, if turbidity is > 1 NTU, the utility issues a Water Quality Advisory (WQA). If the turbidity increases above 5 NTU a BWN is issued. In order to mitigate freshet turbidity events, the water intake at Mabel Lake was relocated to a greater depth of 26 m in spring 2014 and the intake is located approximately 2 m above the lake bottom. The previous depth was 12 meters and the intake was located just above the lake bottom. The utility was able to avoid WQAs and BWNs during freshet from 2014 to 2016 after the intake improvement project, however due to extreme weather conditions in 2017 and 2018, a WQA and a BWN could not be avoided in those years.

In 2020 and 2021, the online daily raw water turbidity data is not available for the following dates:

- January 1, 2020,
- March 30, 2020,
- March 30, 2021, and
- October 10 to 12, 2021

SCADA data during this time was lost due to computer transfer errors.

The MLW intake daily average SCADA turbidity ranged from 0.18 to 5.56 NTU in 2020 and 0.11 to 1.82 NTU in 2021 (Table 3 and Figure 4). In 2020, 95% of the values were less than the calculated value of <2.81 NTU (turbidity grab samples) and <2.08 NTU (turbidity SCADA samples) (Table 3). In 2021, 95% of the values were less than the calculated value of <0.89 NTU (turbidity grab samples) and <0.80 NTU (turbidity SCADA samples) (Table 3).

In 2020, turbidity was greater than 1 NTU for an extended period of time. The water utility launched an investigation in July and August into the cause of this high turbidity and it was discovered the intake had been tipped over and the screen was in contact with the lake bottom. This was repaired on August 31 and the turbidity improved shortly after the repair.

In 2021, turbidity SCADA daily averages only exceeded 1 NTU twice but did not exceed 1 NTU for a 24 hour period and no advisories needed to be issued.

5.2.3. UV TRANSMISSIVITY

In anticipation of the installation of UV disinfection, assuming a filtration exclusion application is successful, RDNO water quality staff monitor UV Transmissivity (UVT) throughout the year. See Appendix G for the UVT schedule. UVT represents the percent of light transmitted through the water. Current UV treatment technologies are validated to be effective down to a minimum UVT measurement of 70% and hence UVT measurements provide an indication if UV is an acceptable treatment method for this source water.

Table 4 summarizes the raw water UVT % filtered and unfiltered results in 2020 and 2021. In-house UV analysis for filtered and unfiltered samples was completed at least twice a month in 2020 and 2021. When observing historic UVT since 2014, no trend was evident (Figure 5).

The UVT is measured using Standard Methods 10054 as a filtered and unfiltered sample (staff analyze filtered and unfiltered UVT in-house). The lowest UVT unfiltered result in 2020 was 84.1% (July 2), with an average of 89.6% noted for the year (Table 4 and Figure 6). The lowest UVT unfiltered result in 2021 was 86.2% (June 8), with an average of 89.2% noted for the year (Table 4 and Figure 6). This indicates that UV would likely be an effective disinfection method for this source. This trending will continue to be monitored.

The UVT is monitored along with turbidity to determine if there is a relationship between turbidity and UVT. 2020 showed turbidity increasing during freshet and remaining high until the end of August which was caused by the intake being on the lake bottom. In 2020, UVT did appear to be

somewhat impacted by the increase in turbidity in June and July (Figure 7), but this is likely because the intake had fallen over onto the lake bottom.

2021 showed turbidity increasing during freshet, in September, and in November. The freshet and September turbidity increases are normal when compared with historical but the November turbidity increase was unusual. It occurred after there was a very large storm in the area that results in flooding. In 2021, UVT did decrease during freshet for a short period of time but does not appear to be severely impacted by an increase in turbidity (Figure 7).

5.2.4. TOTAL ORGANIC CARBON

TOC and Dissolved Organic Carbon (DOC) are a measure of dissolved and suspended carbon bound in organic molecules and organisms. These are important parameters as they are precursors for disinfection by-products (this is discussed further in Section 5.4.5 Disinfection By-Products (DBP)). Organics can interfere with the effectiveness of UV disinfection by reducing the UVT. The SDWQG Maximum Acceptable Concentration (MAC) for TOC is 4.0 mg/L. There are no current standards/guidelines for DOC.

Historically TOC for MLW raw water has been fairly stable with a range between 0.90 mg/L and 4.4 mg/L with little variability since 2014 (Figure 8). The historical average for TOC was 1.98 mg/L at this site. The historical average TOC for this site is well below the SDWQG MAC of 4.0 mg/L.

Table 5 summarizes the raw water TOC results in 2020 and 2021. 2020 TOC results had an average of 2.47 mg/L. The 2020 TOC data, when compared to historic trend data for TOC, is normal for this site, as seen in Figures 8 and 9 with the exception of some slightly higher than normal TOC data in the late summer. The highest level of TOC observed in 2020 was 3.90 mg/L on September 8.

2021 TOC results had an average TOC of 1.75 mg/L. The 2021 TOC data, when compared to historic trend data for TOC, is normal for this site, as seen in Figures 8 and 9. The highest level of TOC observed in 2021 was 2.52 mg/L on May 4. Based on the 2020 and 2021 sampling results, TOC is within the SDWQG MAC guideline (Figure 9).

5.2.5. ALGAE DENSITY

Algae density sampling was started on the raw water on August 11, 2020 and continued to September 22, 2020. This sampling was completed to investigate the higher than normal turbidity that was occurring through the summer. The 2020 algae density sampling showed very little algae in the water and was not continued in 2021.

5.2.6. FIELD PARAMETERS

Table 4 summarizes the field pH and temperature for the raw water in 2020 and 2021. All results were within guidelines with the exception of one temperature reading at 18.0 ◦C on September 15, 2020 and three pH readings of 6.9 on April 6, August 17, and September 21, 2021. These are not a health concern.

5.2.7. ANNUAL COMPREHENSIVE

Comprehensive sampling is completed annually. The annual sampling is rotated between spring and fall to ensure the source water meets water quality guidelines during different times of the year. The 2020 and 2021 comprehensive samples were taken in May and October respectively. All parameters were well within the GCDWQ limits (Appendix H).

5.3. TREATMENT PROCESS

MLW is sourced from surface water and some variability can occur within water quality parameters throughout the year. Treatment requirements at MLW occur as per Section 2.3.

5.3.1. CHLORINE

Under normal operations, the target 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.

Continuous online chlorine monitoring is completed with an analyzer that monitors the free chlorine just past the injection point in the LPH (Table 6). There is a sample line delivering treated water to the chlorine analyzer approximately 5 m after the chlorine injection point off the transmission main. In the event of a low level chlorine alarm the system is programed through SCADA to shut off the lake pumps automatically to ensure that raw water is not pumped into the distribution system and to notify the operator via an alarm.

In 2020, the online daily free chlorine data is not available for the following dates:

- March 31, 2020, and
- March 30, 2021

SCADA data during this time was lost due to computer transfer errors. The MLW treatment process was working normally during these times.

The average monthly SCADA free chlorine in 2020 was 1.66 mg/L with a minimum of 1.44 mg/L in December and a maximum of 1.86 mg/L in May (Table 6).

The average monthly SCADA free chlorine in 2021 was 1.59 mg/L with a minimum of 1.46 mg/L in November and a maximum of 1.76 mg/L in April (Table 6).

5.4. DISTRIBUTION

Distribution sampling follows the specifications outlined in the COP and also as directed by IH, see Sections 3.1 and 3.3. Additional parameters and monitoring can occur for individual projects. See Appendix G for the detailed schedule.

5.4.1. BACTERIA

Schedule A of the DWPR requires the following criteria be met for potable water:

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

   In 2020 and 2021, all samples were non-detect for E.coli in the MLW distribution system (Tables 7 and 8).

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

   In 2020, only one sample had detectable Total Coliform per 100 ml, of 1 CFU/100 mL (Table 7). 98.4% of samples in 2020 had no detectable Total Coliform bacteria.

   In 2021, only one sample had detectable Total Coliform per 100 ml, of 2 CFU/100 mL (Table 7). 98.7% of samples in 2021 had no detectable Total Coliform bacteria.

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

   In 2020 and 2021, no samples had more than 10 Total Coliform (Table 7). MLW met this regulation.

The results met the GCDWQ and the DWPR and Tables 7 and 8 summarize the distribution bacterial results.

5.4.2. TURBIDITY

Turbidity is monitored with a hand held turbidity meter at four distribution sites whenever operators visit the site, which is a minimum of 3 times per week. Operators record the residual readings and field parameters on an electronic operator log sheet which is backed up to the RDNO system by

water quality staff monthly. Field parameters are also recorded on the submitted requisition sheets to Caro with bacterial samples and entered into WaterTrax.

The turbidity of the distribution sites in 2020 ranged from 0.12 to 5.64 NTU. The average distribution turbidity in 2020 for all sites (752 samples) was 0.84 NTU. This is well within guidelines. A minimum turbidity grab sample of 0.12 NTU occurred at the Old Pump house Sample Site (SS). A maximum turbidity grab sample of 5.64 NTU occurred at Kingfisher SS (Table 9). The water utility was on a Boil Water Notice at the time of the high turbidity readings. Chlorine residuals were within an acceptable range at the Kingfisher SS when this turbidity reading occurred.

The turbidity of the distribution sites in 2021 ranged from 0.09 to 1.88 NTU. The average distribution turbidity in 2021 for all sites (764 samples) was 0.42 NTU. This is well within guidelines. A minimum turbidity grab sample of 0.09 NTU occurred at the Old Pump house Sample Site (SS). A maximum turbidity grab sample of 1.88 NTU occurred at 41 Dolly Varden Road SS (Table 9). All other sample sites within the distribution when this turbidity sample was taken were <1 NTU. Chlorine residuals were within an acceptable range at the 41 Dolly Varden Road SS when this turbidity reading occurred. This higher turbidity was likely localized to the area and was not a health concern.

5.4.3. CHLORINE

Total and free chlorine is also monitored with a hand held chlorine meter concurrently with the turbidity readings.

The free chlorine of the distribution sites in 2020 ranged from 0.15 to 2.11 mg/L. The average distribution free chlorine in 2020 for all sites (743 samples) was 0.90 mg/L. A minimum free chlorine grab sample of 0.15 mg/L occurred at the Old Pumphouse SS. A maximum chlorine grab sample of 2.11 mg/L occurred at Lot #41 Above Campground SS (Table 9).

The free chlorine of the distribution sites in 2021 ranged from 0.21 to 2.20 mg/L. The average distribution free chlorine in 2021 for all sites (767 samples) was 0.92 mg/L. A minimum free chlorine grab sample of 0.11 mg/L occurred at #41 Dolly Varden Rd SS. A maximum chlorine grab sample of 2.20 mg/L occurred at the Old Pumphouse SS (Table 9).

5.4.4. FIELD PARAMETERS

The field pH for all distribution sites (63 samples) in 2020 ranged from 6.4 to 8.3 pH. The average pH of all the distribution sites in 2020 was 7.5 pH (Table 9). One pH reading was <7 and all other pH results were within guidelines in 2020.

The field pH for all distribution sites (68 samples) in 2021 ranged from 6.7 to 8.3 pH. The average pH of all the distribution sites in 2021 was 7.3 pH (Table 9). Seven pH readings were <7 and all other pH results were within guidelines in 2021.

The temperature readings of the distribution sites in 2020 ranged from 4.0 to 18.9° Celsius (Table 9). All temperature results were within guidelines with the exception of fifteen out of the sixty-three readings taken. The GCDWQ Aesthetic Objective (AO) for temperature is 15° Celsius. Fifteen samples in 2020 exceeded this objective for temperature, however this is an aesthetic objective not a health guideline. All eight of these readings were <20° Celsius.

The temperature readings of the distribution sites in 2021 ranged from 3.9 to 17.3° Celsius (Table 9). All temperature results were within guidelines with the exception of eight out of the sixty-six readings taken. The GCDWQ Aesthetic Objective (AO) for temperature is 15° Celsius. Eight samples in 2021 exceeded this objective for temperature, however this is an aesthetic objective not a health guideline. All eight of these readings were <20° Celsius.

5.4.5. DISINFECTION BY-PRODUCTS

Trihalomethanes (THMs) are a disinfection by-product formed when organic compounds naturally present in the source water react to being chlorinated. The level of THMs in treated water depends on numerous factors including: TOC, temperature, pH, water age, and chlorination dose. Ten distinct THM compounds are possible but only four occur to any significant degree in treated drinking water:

- Chloroform,
- Bromodichloromethane,
- Dibromochloromethane, and
- Bromoform.

Collectively the above THM compounds are referred to as total trihalomethanes (TTHMs). Further in this text TTHMs will refer to sample site averages of all four compounds, not the individual parameters. Figures 10 and 11 and Table 10 are reported as an average of all four compounds, therefore TTHMs.

The GCDWQ MAC for TTHMs is 0.1 mg/L and is based on a locational running annual average of a minimum of quarterly samples taken at the point in the distribution system with the highest

potential THM levels. Figure 10 provides the TTHM results for 2020 and 2021 which were well below the MAC with a TTHM average of 0.052 and 0.058 mg/L respectively.

The Mabel Lake distribution has been monitored for THMs since 2010, with consistently low TTHM results (Table 10 and Figure 11). This is likely due to the source water having little to no measurable color and low TOC levels throughout most of the year. Table 10 shows the TTHM average from 2010 to 2021. The TTHM annual average for the longest retention at the end of the system site is also included in Table 10 for 2010 to 2021. All years show that TTHMs did not exceed guidelines (Figure 11). TTHMs showed a decreased since 2012 but there is a slight increase in the last five years.

The average from 2010 to 2017 was from the start and end of the system sites (Table 10 and Figure 11). THM sampling from 2010 to 2017 occurred at two sites: the Old PH (start of the distribution) and Kingfisher (longest retention time). This sampling only occurred twice a year. It was decided for the 2018 monitoring program to eliminate the Old PH site and instead sample Kingfisher quarterly. This would comply with the GCDWQ as it requires a minimum of quarterly samples at the point where the distribution system has the highest potential THM levels, (Health Canada, 2017). Therefore starting in 2018, THMs were only sampled at the Kingfisher site and sampling occurred quarterly to comply with GCDWQ.

Haloacetic acids (HAAs) are a disinfection by-product formed when organic compounds naturally present in the source water react to being chlorinated. The level of HAAs in treated water depends on numerous factors including: bromide, temperature, pH, water age, and chlorination dose (Health Canada, 2017). Several distinct HAA compounds are possible but only five occur to any significant degree in treated drinking water.

- Monochloroacetic acid,
- Monobromoacetic acid,
- Dichloroacetic acid,
- Trichloroacetic acid, and
- Dibromoacetic acid.

Collectively the above HAA compounds are referred to as total haloacetic acids (THAAs). Further in this text THAAs will refer to sample site averages of all five compounds, not the individual parameters. Figure 12 is reported as an average of all five compounds, therefore THAAs.

HAA sampling was added to the Kingfisher site in 2018 following the same schedule as THMs. It was decided to add HAA analysis to the Kingfisher site as it is a disinfection by-product of rising concern and the water utility wanted to investigate this concern. THAA’s in 2020 and 2021 were

below guidelines (Figure 12) but did show an increase in 2020 compared to the previous two years of data. There is only four years of data though so no determination of a trend is possible at this time (Figure 13).

5.5. EFFLUENT MONITORING

An annual report is submitted to the Ministry of Environment as required by the OC. All monitoring well parameters sampled in 2020 were within guidelines. The report can be found on the RDNO website: www.rdno.ca/mls

6.0 WATER CONSUMPTION

Table 11 provides the monthly consumption for MLW in 2020 and 2021 while Figure 14 provides a graph of the monthly consumption from 2013 to 2021 except 2015 which is not available. Figure 15 provides daily water consumption trend data from 2018 to 2021. There are periodically gaps in data due to computer issues which is seen from April of 2019 and January 1, 2020.

The typical water consumption trend for MLW is low winter water use with a significantly increase in May with peak flows usually observed in July and August, while September shows a decrease in monthly flows. Water consumption is highly dependent on weather however Figure 14 shows that monthly water consumption started to increase in 2017, around the time that more connections started to occur (i.e. 35 new connections occurred from 2014 to 2021). Figure 15 shows increasing peaks from 2019. There is a decrease in flows in 2021, however this is due to outdoor water restrictions being implemented on July 1, 2021 required as demand was beyond the limits of the water system and the pumps could not keep up with the unusually high demands of water in July. Operation upgrades had to be made to keep up with high seasonal demands during the summer. Outdoor water restrictions were reduced on August 4, 2021 but some restrictions were kept in place as the government of BC had declared a Level 3 drought for the watershed and some restrictions were required to protect the water supply. These restrictions were removed on October 7, 2021.

7.0 EMERGENCY RESPONSE PLANNING

7.1. THE ERP

A comprehensive update of the MLW Emergency Response Plan (ERP) was completed in 2018 and a review is completed annually. Sampling methodology and RDNO small utility ERP training for the operators also occurs annually.

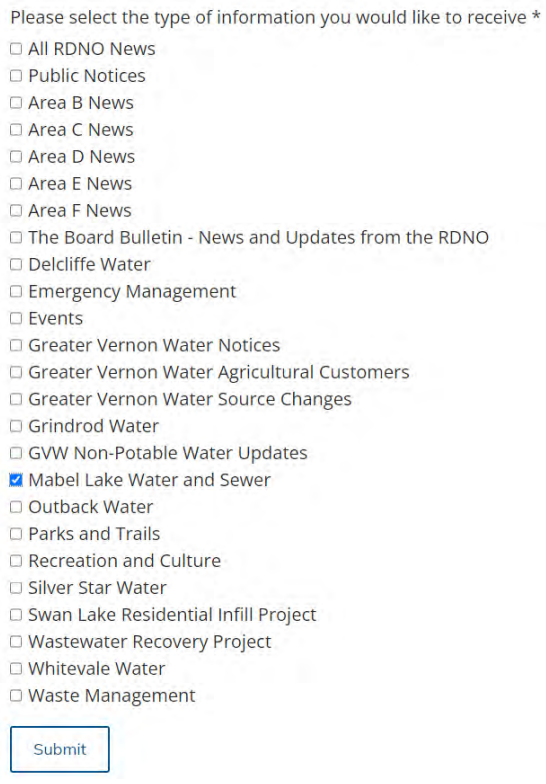
RDNO Utilities staff, as well as the operators are all instructed on how to use the following supporting documents in times of water quality changes or emergencies:

1. MLW Emergency Response Plan
2. MLW Water Quality Deviation Response Plan

The above documents contain the contacts, criteria, and procedures necessary to assist operators and staff to make timely, informed decisions. Staff typically participate in mock emergency training scenarios annually.

MLW must inform customers when their drinking water does not meet standards with the appropriate notifications based on risk. A WQA is released when the water poses a modest health risk. A BWN is released when there is a known or higher risk of a possible health impact to the customer.

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 notification is hand-delivered. Customers are advised to subscribe to the Mabel Lake Water Mailing List by going to www.rdno.ca/subscribe and subscribe for Mabel Lake Water email updates (shown below).



7.2. INCIDENT TRACKING

Eight incidents were recorded for 2020 and four in 2021. Summaries of these are provided Table 12.

RDNO Emergency Response Procedures require that incidents are reported. Incidents are defined when there is a deviation from normal operating procedure or there is a water quality issue. Incident reporting allows staff to track and review issues to assess if improvements could reduce the risks from each issue.

7.3. NOTIFICATION

In 2020, two public notifications were issued for the MLW utility.

A WQA was issued May 23 due to the raw water turbidity increasing to greater than 3 NTU. The WQA was upgraded to a BWN on June 23 due to the raw water turbidity increasing to greater than 5 NTU. The BWN was in effect until July 24 when it downgraded to a WQA. Because the turbidity continued to hold above 1 NTU into late July, MLW launched an investigation and on August 6 divers discovered the intake had been tipped over with the screen being in contact with the lake bottom. The intake was repaired on August 31 and while it might have aggravated the turbidity issue it is believed that the high turbidity was naturally occurring in the lake. The WQA was rescinded on September 3, 2020 due to the turbidity in the water returning to below 1 NTU.

In 2021, two public notifications were issued for the MLW utility. Outdoor water restrictions were issued on July 1, 2021 due to high water demand and the water system not being able to keep up with demand. There were two updates to these restrictions throughout the summer with the outdoor watering restrictions being rescinded on October 7, 2021.

Notices of water service interruption were issued in September for a portion of the community. Planned water system upgrades were completed which included water main valve and standpipe replacements.

In 2020, there was one water quality call about the extended length of time of the WQA. Customer was informed about the investigation and the intake being tipped over and the resulting work.

In 2021, there was one customer call to report a leaking curb stop. The curb stop was fixed.

Public notifications are usually related to water infrastructure upgrades and are in localized areas where the work is occurring. These notifications are usually to make customers aware of planned

work and advise them to store water for household use during the work. The notifications are usually hand delivered to the affected customers.

8.0 REPORTING REQUIREMENTS

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

9.0 WORKS COMPLETED IN 2020 and 2021

- 2020: Installed Air Release Valve on Walker Road – This station is to release air from a high point on Walker Road. Customers served by connections in this area experienced more air than normal in their water service causing the water to look cloudy due to air bubbles.
- 2020: Installed Water Level Transmitter at Lakeshore Pumphouse – This provided real time data on the lake level and allows monitoring of the pump impacts in the wet well.
- 2020: Installed Siding and New Roof on the Upper Level Reservoir Control House – This was completed to protect the structure from damage due to weather events and from other age related deterioration.
- 2020/2021: Intake Protection Zone Study – A drogue study tracked water current movement around the immediate area that affects the intake. A 2 hour travel time around the intake was mapped and provides an intake protection zone, Appendix F.
- 2021: Intake Upgrade – A permanent brace was installed to the screen to keep it vertical and prevent it from falling over.
- 2021: Replaced all water main valves in Mabel Ridge Estates – Many of the valves were not operable which prevented isolating sections of the water main in this area. Appendix I shows the valves that were replaced as Details 1 to 7, as well as a picture of some of the corroded valves replaced.
- 2021: Replaced old hydrants with new standpipes in Mabel Ridge Estates – Replaced three old hydrants with standpipes.
- 2021: Purchased backup chlorine pump – This provides redundancy if there was a chlorine pump failure.
- 2021: Upgraded chlorine pump heads – This improves the performance of the chlorine pumps and helps mitigate chlorine failure.

- 2021: Installed a valve to drain 250 mm water main – This allows the operator to drain the contact time pipe in the event of poor water quality entering distribution system helping prevent water quality issues.
- 2021: Purchased Turbidity Handheld Monitoring Unit – This replaces the old handheld turbidity unit which was no longer working properly.

10.0 PLANNED WORKS

10.1. 2022 WORK PLANS

Works planned for 2022 include:

- Filtration Exclusion – RDNO plans to apply for filtration exclusion for MLW in 2022. The filtration exclusion direction from IH will help determine future planning for this water utility.
- Cityworks Implementation – Tracking database for maintenance, utility works, and customer calls to improve managing and reporting for the utility.
- Confined Space Assessment – Required by WorkSafeBC.
- Replace Raw Water Turbidity Meter – The existing turbidity meter failed in 2021 and a new one is needed. Currently using a unit that is borrowed from a different utility.
- Install Starlink – This will improve equipment communications and ability of staff and operations to monitor the system remotely.

10.2. LONG TERM PLANS

The current disinfection process at MLW is only treated with chlorine. As outlined in Section 2.3, UV treatment is the proposed second barrier. With the existing water system, a 3 log inactivation of Giardia and Cryptosporidium is not possible with chlorination alone. In order to meet provincial standards, UV treatment was proposed in the Mabel Lake Water Treatment Study completed by Kerr Wood Leidal on May 13, 2011. This document is outdated though and a more current and in-depth study was required.

An engineering assessment (EA) was completed for the MLW utility in February 2020.

A copy of the report is now available at: www.rdno.ca/sites/default/files/2021-05/200228_MLW_MWP_FINAL_-_Signed.pdf

The EA includes the following information:

- Source water quality summary,
- water use and demands,
- current and future population projections,
- hydraulic modelling,
- treatment requirement and Filtration Exclusion criteria,
- water conservation, asset management, and financial servicing plans, and
- 20 year capital plan.

There had been a significant water quality improvement observed after the lake intake was deepened in 2014. RDNO plans to apply for filtration exclusion for MLW in 2022. The following provides a summary of the progress on the IH filtration exclusion criteria that need to be met to fulfil the filtration exclusion criteria:

- RDNO has completed a monthly sampling program for protozoa to assess background concentrations of Cryptosporidium and Giardia in the water source to demonstrate if the raw water fully meets the filtration exclusion requirements for protozoa. These monthly samples were completed for one year from November 2014 to October 2015. Some Cryptosporidium was detected during this sample period but the number of cysts detected was low (0 to 2 dead per sample) and (0 to 1 viable per sample). Some Giardia was also detected but the number of cysts detected was also low (0 to 3 dead per sample) and (0 to 1 viable per sample).

Once the protozoa risk is assessed and the raw water quality has been gathered, the conceptual design for a second barrier for the MLW system and cost estimate will be undertaken. For example, if the protozoan risk and raw water quality meets the exclusion criteria, planning to install UV will be undertaken. If the risk does not meet the criteria then plans for filtration will be required. The 2019 EA will help provide direction on how MLW should proceed.

- The EA indicated that UV was required and conceptual planning for future UV will be implemented for 2022. This plan may also include a conceptual plan for filtration in the event that this treatment method is required in the future.
- A project installation schedule and Financial Implementation Plan (FIP) will be developed and will be presented to the RDNO Board for endorsement and submitted to IH for approval.

Based on the FIP, Development Cost Charges (DCC) will be calculated and a DCC Bylaw presented to the RDNO Board for approval to assist in collecting funds for this project.

11.0 CLOSING

RDNO has made significant strides in fulfilling the RDNO program objectives, meeting Provincial Standards and requirements outlined by IH, and in implementing BC's DWPA and DWPR at MLW. RDNO will continue to move forward on implementation of system improvements within the constraints of the MLW budget and through applications for grant funding.

TABLES

Table 1: Contracted Operators

2020/2021 Contracted Operators			
Last Name	First Name	Certification #	Certification Held
McKim	Warren	1336	WDIII, WTII, WWCI, WWTII
McKim	Nicholas	9341	WDI, WTII

Table 2: Raw Water Bacterial Results

2020 Raw Water Bacterial Results					
Total Coliform CFU/100 mL	Min	Max	51st Percentile*	# of Samples	Counts <1 CFU/100 mL
	<1	40	<1	34	21
E.coli CFU/100 mL	Min	Max	87th Percentile**	# of Samples	Counts <1 CFU/100 mL
	<1	3	<1	34	22
2021 Raw Water Bacterial Results					
Total Coliform CFU/100 mL	Min	Max	43th Percentile*	# of Samples	Counts <1 CFU/100 mL
	<1	22	<1	24	11
E.coli CFU/100 mL	Min	Max	95th Percentile**	# of Samples	Counts <1 CFU/100 mL
	<1	1	<1	24	23

OG = Overgrown

*51% (Year 2020) and 43% (Year 2021) of the values are <1

**87% (Year 2020) and 95% (Year 2021) of the values are <1

Table 3: Raw Water Turbidity Results

2020 Turbidity Statistics		
	Mabel Lake - Raw Grab Samples (NTU)	Mabel Lake - Raw SCADA (NTU)
Min	0.18	0.04
Max	5.56	4.45
Average	0.86	0.68
95% Percentile*	2.81	2.08
# Samples	87	364
Counts <1 NTU	66	271
Counts >1 NTU	21	93
Counts > 3.5 NTU	3	7
Counts > 5 NTU	1	0
2021 Turbidity Statistics		
Min	0.11	0.10
Max	1.82	1.10
Average	0.44	0.37
95% Percentile*	0.89	0.80
# Samples	154	361
Counts <1 NTU	150	359
Counts >1 NTU	4	2
Counts > 3.5 NTU	0	0
Counts > 5 NTU	0	0

*95% of the values are less than the calculated value of 2.81 NTU (grab samples) and 2.08 NTU (SCADA) for 2020
*95% of the values are less than the calculated value of 0.89 NTU (grab samples) and 0.80 NTU (SCADA) for 2021

Table 4: Raw Water Field Parameters and In-House UVT Results

2020 Raw Water Field Parameters and In-House UVT				
	Min	Max	Average	Count
pH	7.0	8.2	7.5	36
Temperature (Co)	5.7	18.0	10.4	36
UV - Filtered (%)	85.3	94.7	89.8	34
UV - Unfiltered (%)	84.1	94.4	89.6	35
2021 Raw Water Field Parameters and In-House UVT				
pH	6.9	8.0	7.3	33
Temperature (Co)	5.6	11.8	9.4	32
UV - Filtered (%)	87.5	92.9	90.0	32
UV - Unfiltered (%)	86.2	92.8	89.2	34

Table 5: Raw Water Total and Dissolved Organic Carbon Results

2020 Raw Water Total and Dissolved Organic Carbon				
	Min	Max	Average	Count
Total Organic Carbon (mg/L)	1.14	3.90	2.47	28
Dissolved Organic Carbon (mg/L)	2.00	2.59	2.29	3
2021 Raw Water Total and Dissolved Organic Carbon				
Total Organic Carbon (mg/L)	1.36	2.52	1.75	21
Dissolved Organic Carbon (mg/L)	1.77	1.77	1.77	1

Table 6: Monthly Free Chlorine Data

Mabel Lake Chlorine Averages		
	2020	**2021**
Month	Free Chlorine After Treatment (mg/L) SCADA Monthly Average	Free Chlorine After Treatment (mg/L) SCADA Monthly Average
January	1.61	1.54
February	1.67	1.6
March	1.66	1.59
April	1.76	1.76
May	1.86	1.66
June	1.78	1.65
July	1.76	1.6
August	1.77	1.65
September	1.76	1.58
October	1.46	1.48
November	1.47	1.46
December	1.44	1.47
Monthly Min	1.44	1.46
Monthly Max	1.86	1.76
Monthly Average	1.66	1.59

Table 7: Five Distribution Site Bacteriological Stats Summary

2020 Distribution Bacteriological Stats					
	Min	Max	Average	# of Samples	Counts >1 CFU/100 mL
Total Coliform (CFU/100 mL)	<1	1	<1	64	1
E.coli (CFU/100 mL)	<1	<1	<1	64	0
2021 Distribution Bacteriological Stats					
	Min	Max	Average	# of Samples	Counts >1 CFU/100 mL
Total Coliform (CFU/100 mL)	<1	2	<1	75	1
E.coli (CFU/100 mL)	<1	<1	<1	75	0

Table 8: Distribution Sample Sites Bacteriological Summary

Mabel Lake Distribution Bacteria				
Mabel Lake Distribution Sample Sites	2020		2021	
	# Bacterial samples sent to Caro	Results	# Bacterial samples sent to Caro	Results
Lot #41 Above Campground SS	22	1 out of 22 samples resulted in 1 CFU/100 mL for Total Coliforms	29	1 out of 29 samples resulted in 2 CFU/100 mL for Total Coliforms
#41 Dolly Varden Rd SS	12	All Samples <1 for E. coli and Total coliforms	14	All Samples <1 for E. coli and Total coliforms
Kingfisher	12	All Samples <1 for E. coli and Total coliforms	13	All Samples <1 for E. coli and Total coliforms
Lot #12 Golf Course	12	All Samples <1 for E. coli and Total coliforms	13	All Samples <1 for E. coli and Total coliforms
Old Pumphouse	6	All Samples <1 for E. coli and Total coliforms	6	All Samples <1 for E. coli and Total coliforms
Total Samples	**64**	**All Samples <1 for E. coli and Total coliforms with the exception of a count of 1 Total Coliforms at Lot #41 Above Campground SS**	**75**	**All Samples <1 for E. coli and Total coliforms with the exception of a count of 2 Total Coliforms at Lot #41 Above Campground SS**

Table 9: Distribution Field Parameters Stats

2020 Distribution Field Parameters Stats					
Field Parameter	Free Chlorine	Total Chlorine	Turbidity	pH	Temperature
Min	0.15	0.22	0.12	6.40	4.00
Max	2.11	2.17	5.64	8.30	18.90
Average	0.90	0.97	0.84	7.50	12.10
Count	743	752	752	63	63
2021 Distribution Field Parameters Stats					
Field Parameter	Free Chlorine	Total Chlorine	Turbidity	pH	Temperature
Min	0.21	0.26	0.05	6.7	3.9
Max	2.20	2.20	1.88	8.3	17.3
Average	0.92	1.03	0.42	7.3	11.5
Count	767	762	764	68	66

Table 10: Annual Average TTHMs from 2010 to 2021

Annual TTHM Average for Mabel Lake Water System			
Year	Average ug/L	Average Longest Retention ug/L	GCDWQ MAC
2010	48	53	100
2011	55	61	100
2012	73	84	100
2013	61	70	100
2014	48	54	100
2015	35	39	100
2016	39	40	100
2017	39	39	100
2018	43	43	100
2019	51	51	100
2020	52	52	100
2021	58	58	100

Table 11: Monthly Consumption Data

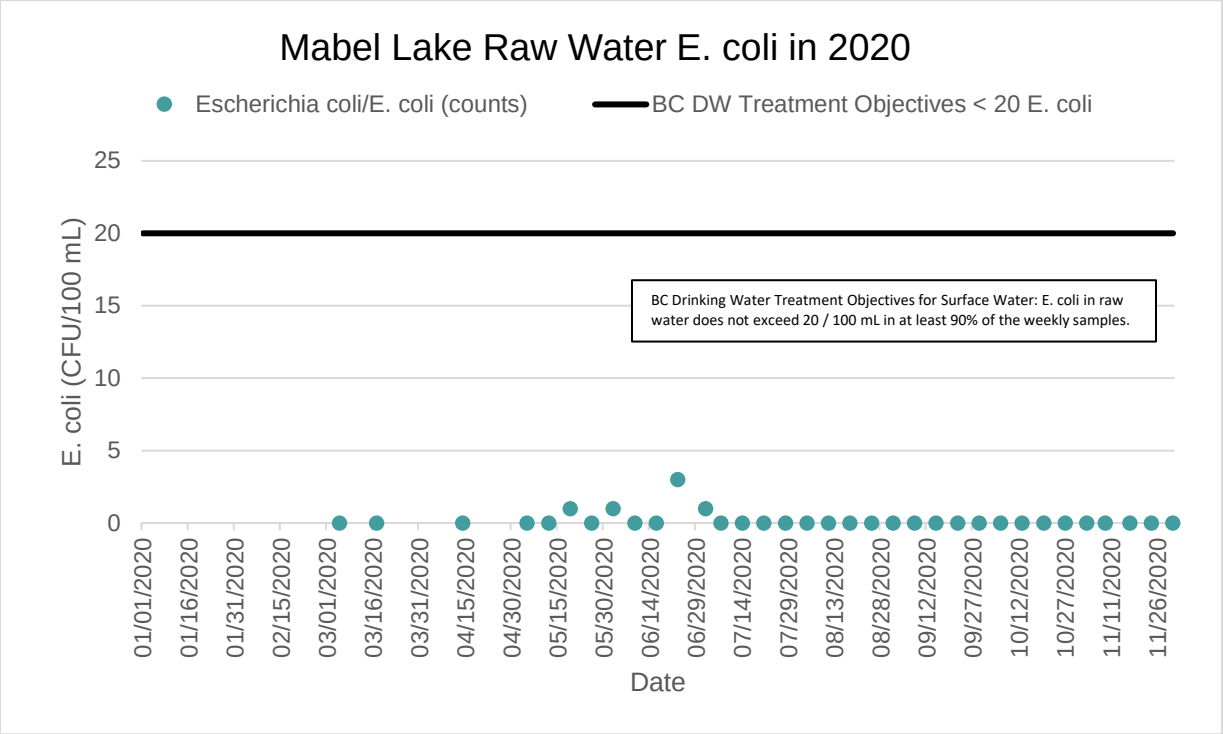
Mabel Lake Consumption				
	2020		2021	
Month	Total Monthly Consumption (m3)	Average Daily Consumption (m3)	Total Monthly Consumption (m3)	Average Daily Consumption (m3)
January	2973	99	2634	85
February	2735	94	2890	103
March	3136	101	3084	99
April	4202	140	4399	147
May	9309	300	10912	352
June	9571	319	15900	530
July	14692	474	20137	650
August	18799	606	14922	481
September	12255	408	8240	275
October	3780	122	3466	112
November	1970	66	3019	101
December	2401	80	3258	105
Monthly Min	**1970**	**66**	**2634**	**85**
Monthly Max	**18799**	**606**	**20137**	**650**
Monthly Average	**7152**	**234**	**7738**	**253**
Total	**85823**	**2809**	**92861**	**3040**

Table 12: Incident Summary

MLW: 2020 Incidents			
Cause	Date Reported	Trigger Event	Actions Completed
No bacterial samples	5-Mar-20	Water quality staff were made aware that no bacterial samples were taken in January and February 2020	Samples were taken on March 5 as soon as staff were aware of the incident. There was no interruption in the treatment process during this time period (continuous SCADA monitoring showed chlorine and turbidity within acceptable limits). All field parameters taken three times per week showed no water quality concern. Historically water quality is very good at that time of year.
Turbidity Increase	13-May-20	Turbidity increase when irrigation pump was run	Increased flow from irrigation pump run caused turbidity increase. Operations flushed turbid water from water main and avoided having to issue an advisory.
Turbidity Increase	23-Jun-20	Turbidity increased to greater than 5 NTU	Boil Water Notice issued June 23, 2020, downgraded to a Water Quality Advisory on July 24, Water Quality Advisory rescinded September 3
Pooling Water	2-Jul-20	Pooling water in driveway	Investigated and determined pooling water was groundwater.
Issue with Alarm Call Out System	28-Jul-20	Low reservoir noted on SCADA system but no alarms were issued to operations	System restarted and server upgrades planned for the future.
Intake Tipped Over	10-Aug-20	Intake inspection found the intake had fallen over and screen was in contact with lake substrate	Intake was reposition upright and a permanent fix was planned for 2021. Annual intake inspections will be included in future operations and maintenance plan.
Leaking Service	5-Oct-20	Customer had no water	Operations investigated and determined leak was on customer's portion of the service line. Customer repaired leak.
Turbidity Increase	7-Oct-20	Turbidity increased to greater than 1 NTU	Turned water pumps off for a short time. When water pumps turned back on turbidity was at acceptable levels. No Water Quality Advisory required.

MLW: 2021 Incidents			
Cause	Date Reported	Trigger Event	Actions Completed
Turbidity Increase	22-Apr-21	Turbidity increase when irrigation pump was run	Increased flow from irrigation pump run caused turbidity increase. Filled potable water tanks and then allowed irrigation pump to run. When water pumps came on again, turbidity did not increase above acceptable limits
High Water Usage	1-Jul-21	Low reservoir levels with high water demand	No Outdoor Water Use notices issued, changed to outdoor water restrictions on July 15. These restrictions were rescinded on October 7.
Power Outage	16-Nov-21	Large storm caused a power outage which lasted approximately 6 hours	Reservoir levels managed consumption. No issues when power came back on with equipment.
Power Outage	27-Dec-21	Power outage which lasted approximately 1 hour	Reservoir levels managed consumption. No issues when power came back on with equipment.

FIGURES



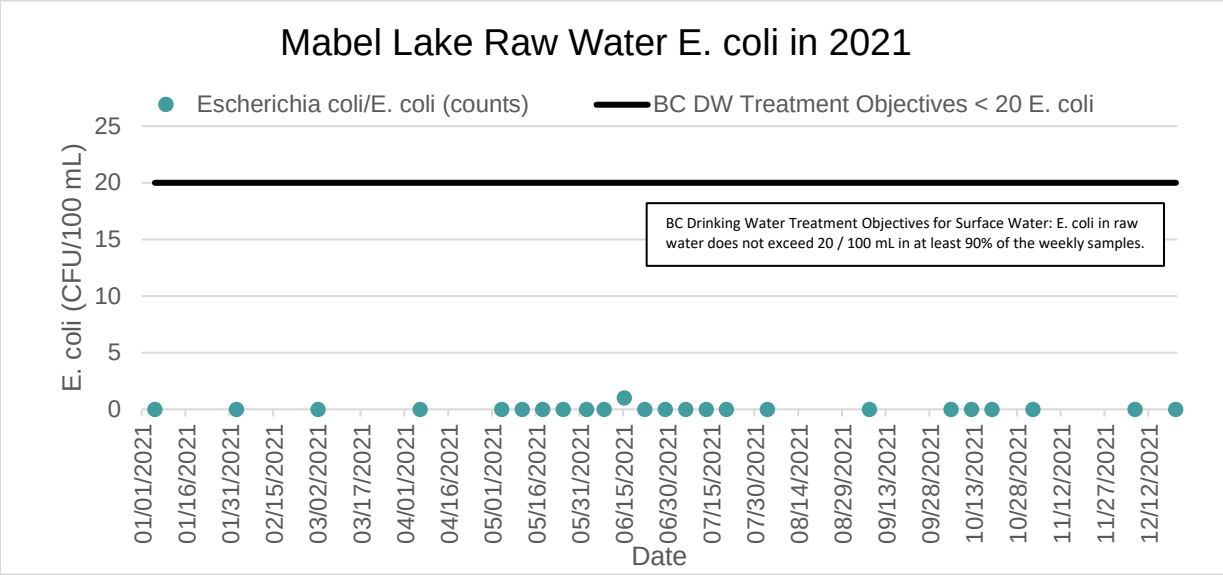
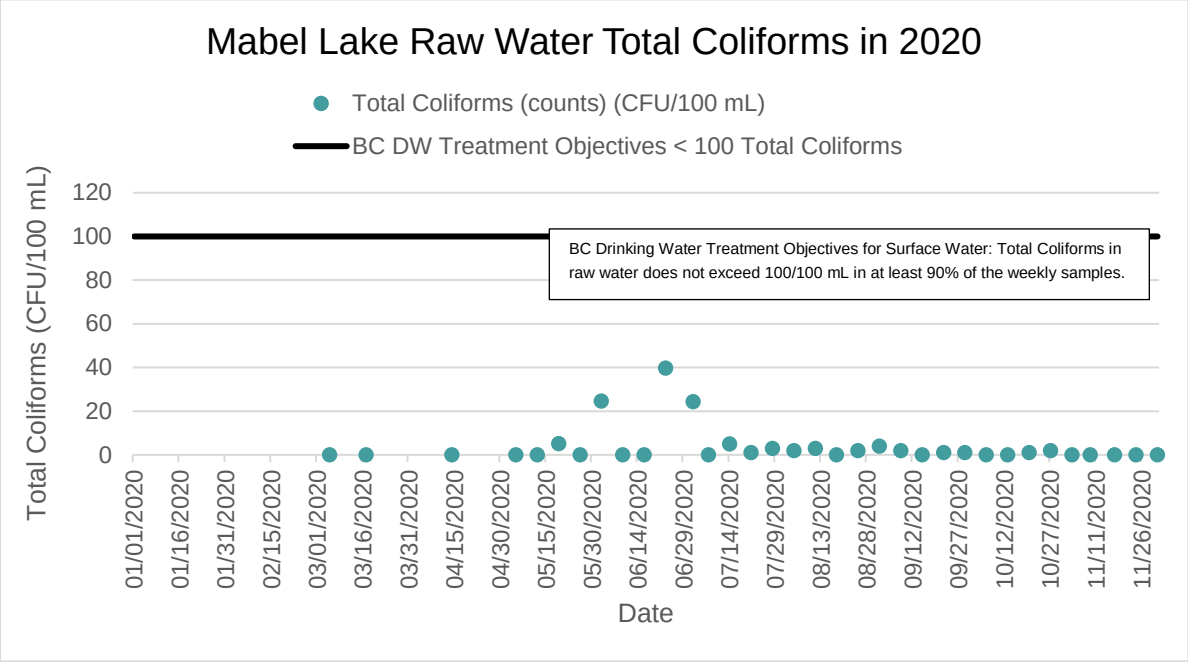


Figure 1: Raw Water E. coli Results

Note: <1 E. coli are being shown on the graph as 0 E. coli



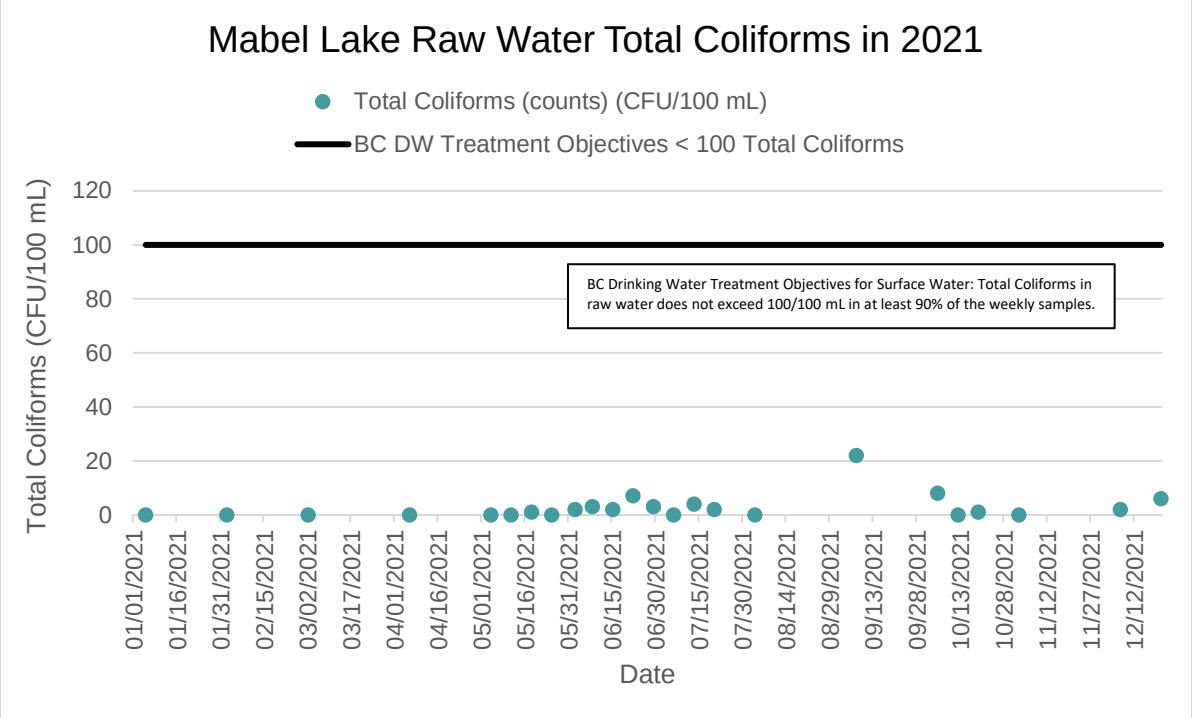


Figure 2: Raw Water Total Coliform Results

Note: <1 Total Coliform are shown on the graph as 0 Total Coliform

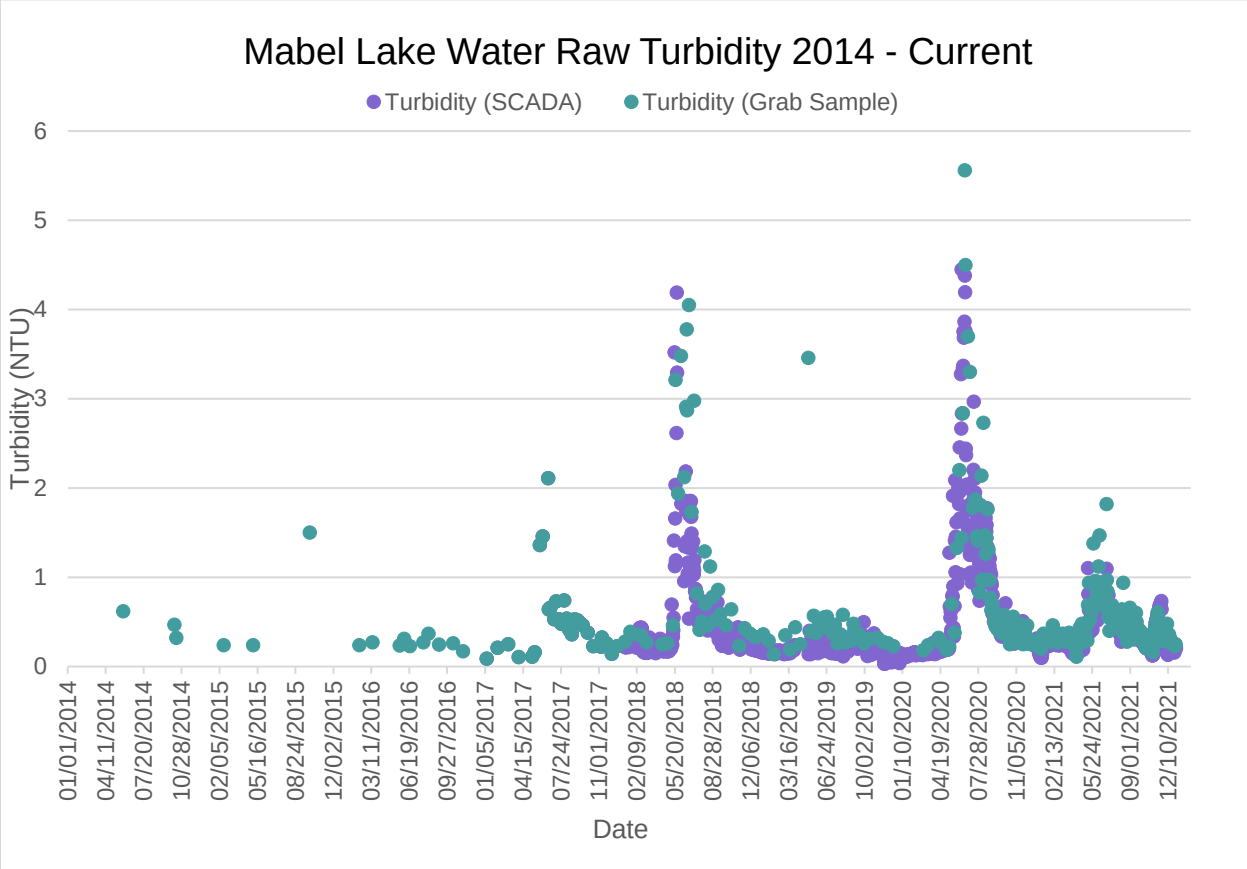
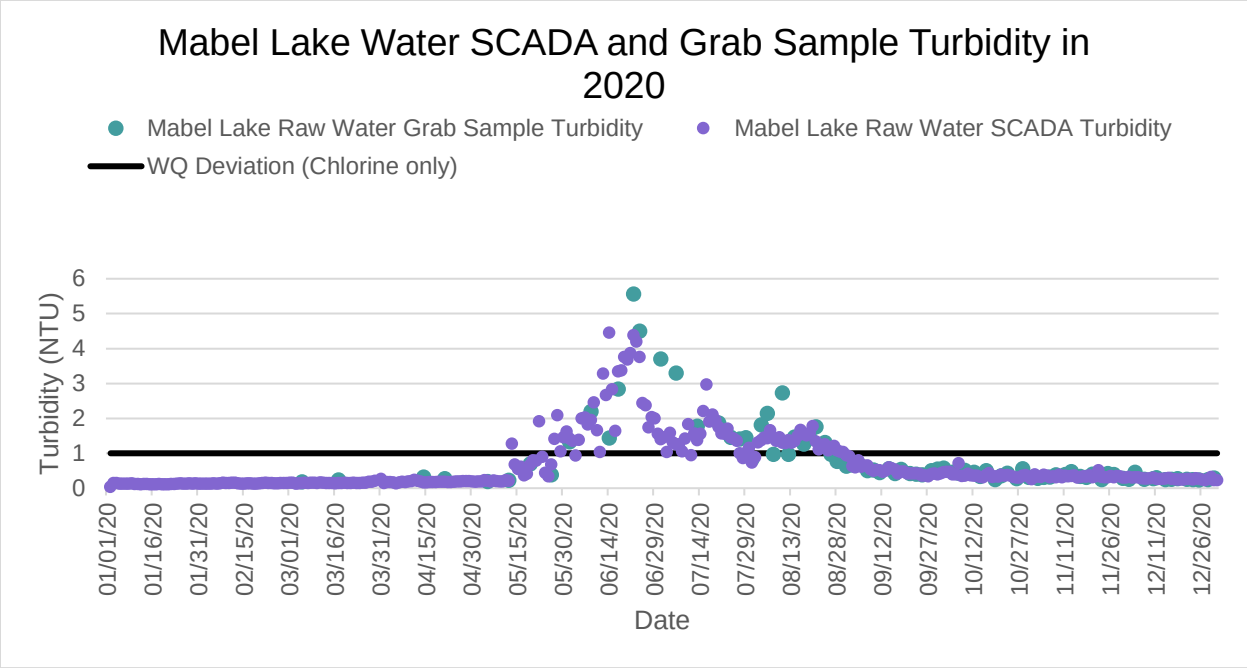


Figure 3: Historic (2014-2021) SCADA and Grab Sample Turbidity



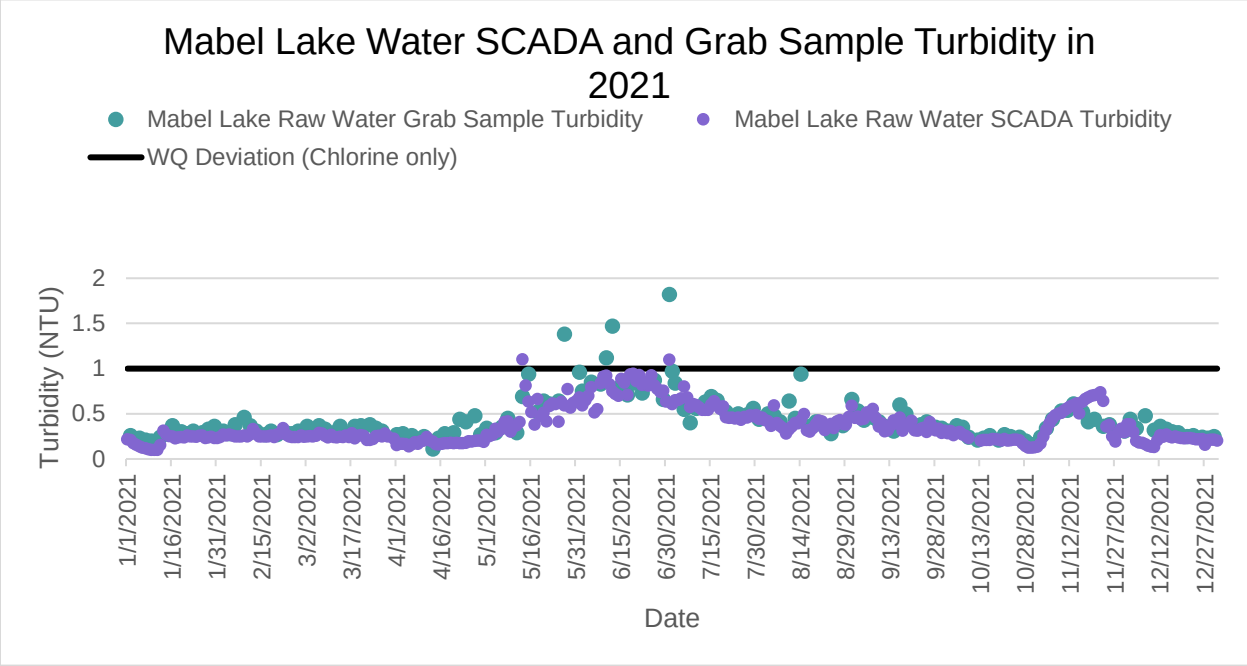


Figure 4: SCADA and Grab Sample Turbidity

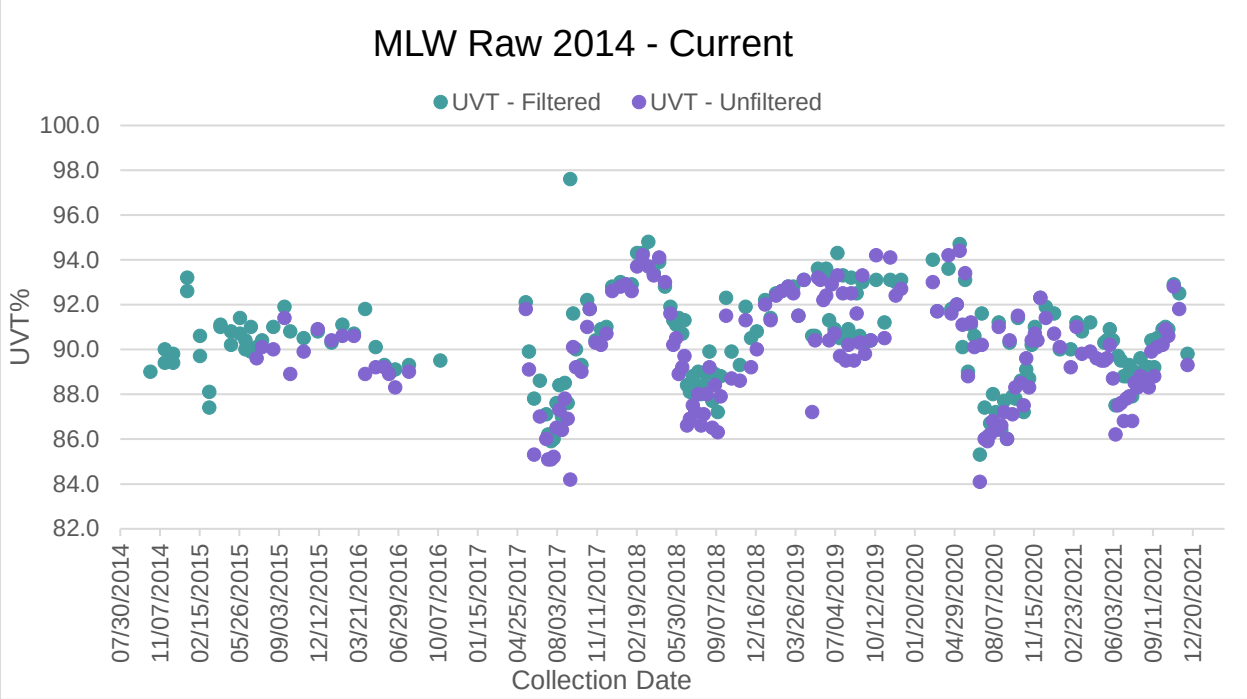
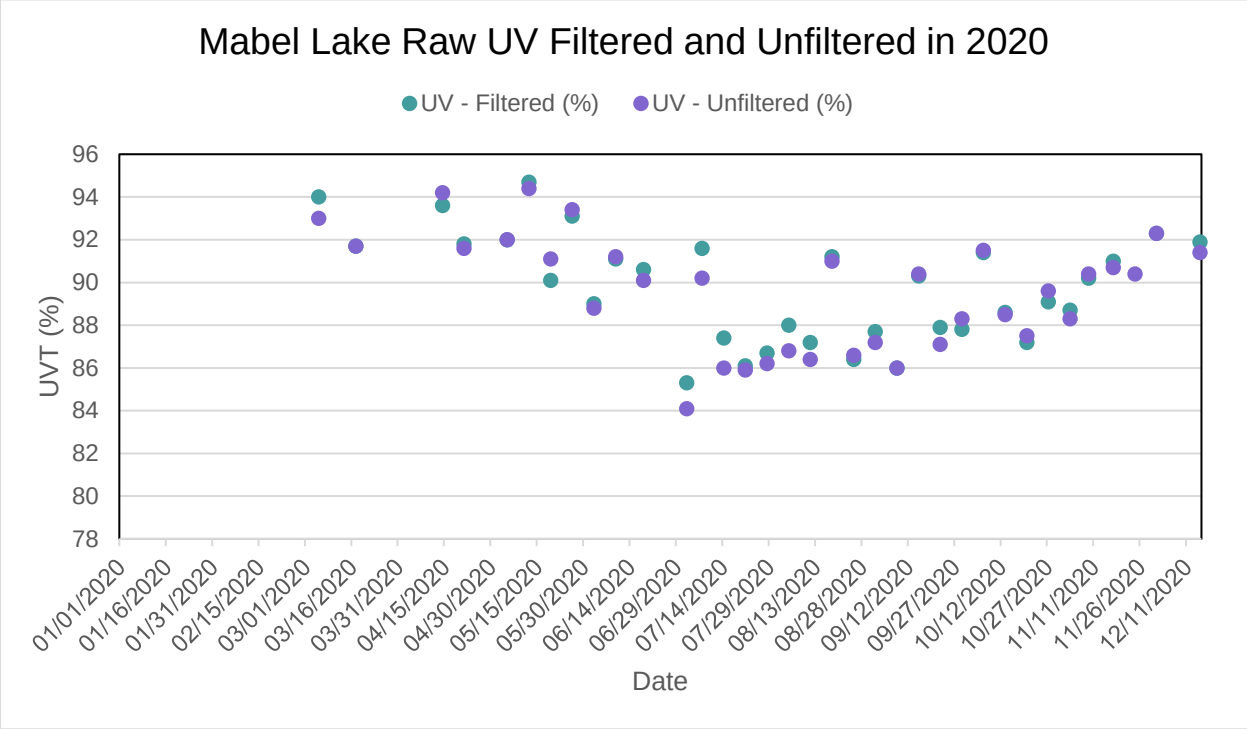


Figure 5: Historic (2014-2021) UVT Filtered and Unfiltered

[1]Starting in 2017 UVT analysis was performed in house, prior to 2017 UVT analysis was performed by CARO.



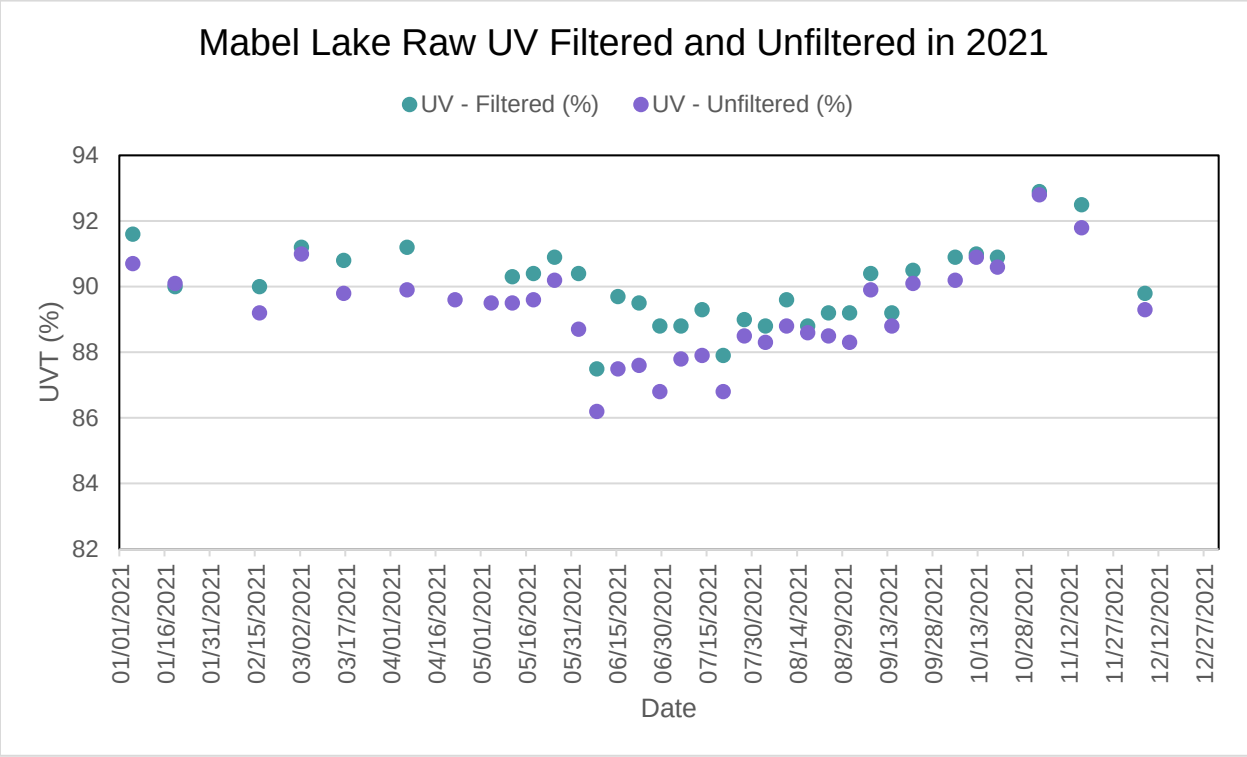
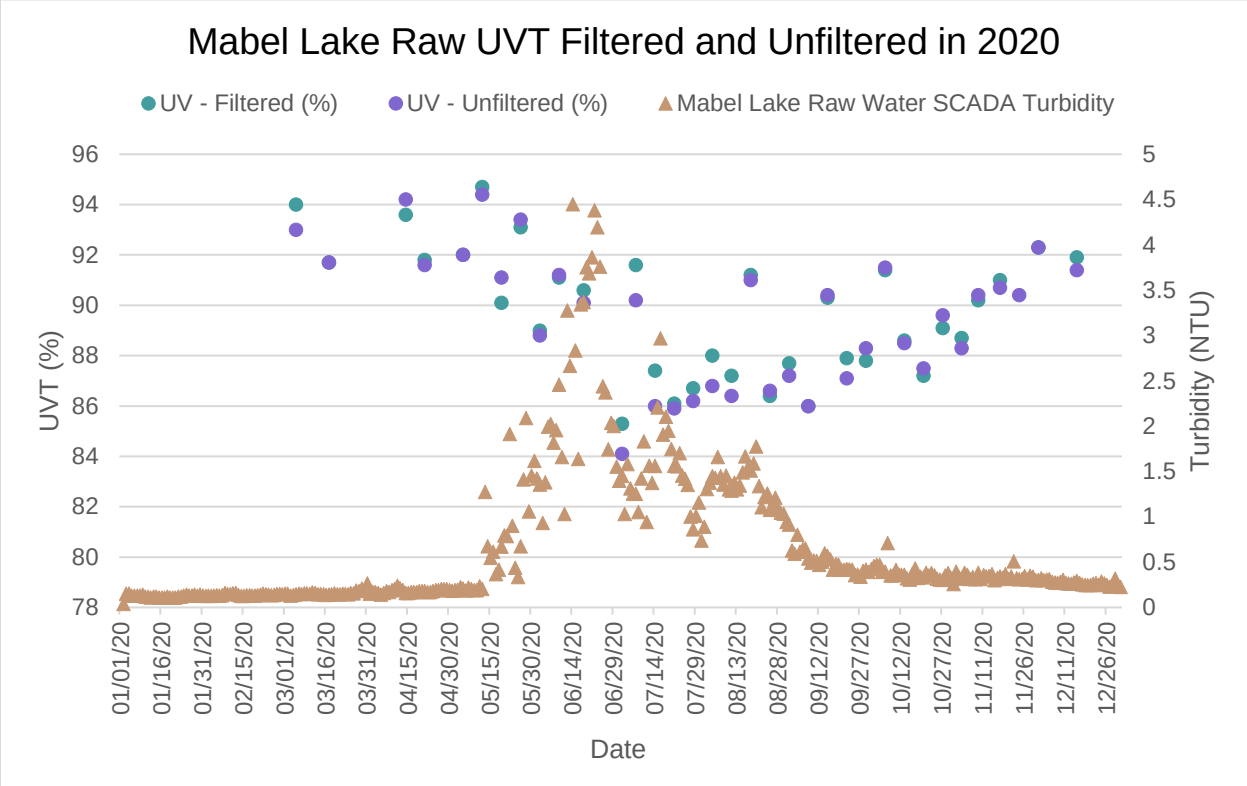


Figure 6: UV Transmissivity (Filtered and Unfiltered)



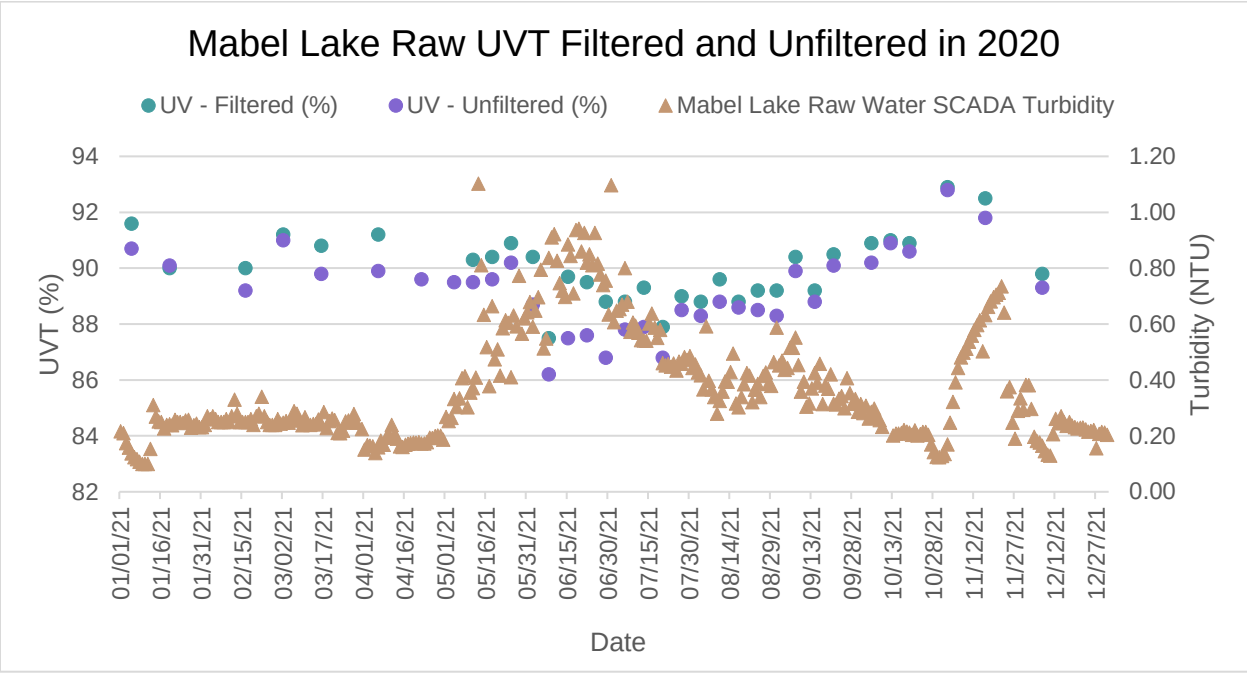


Figure 7: UVT (Filtered and Unfiltered) Compared to Turbidity

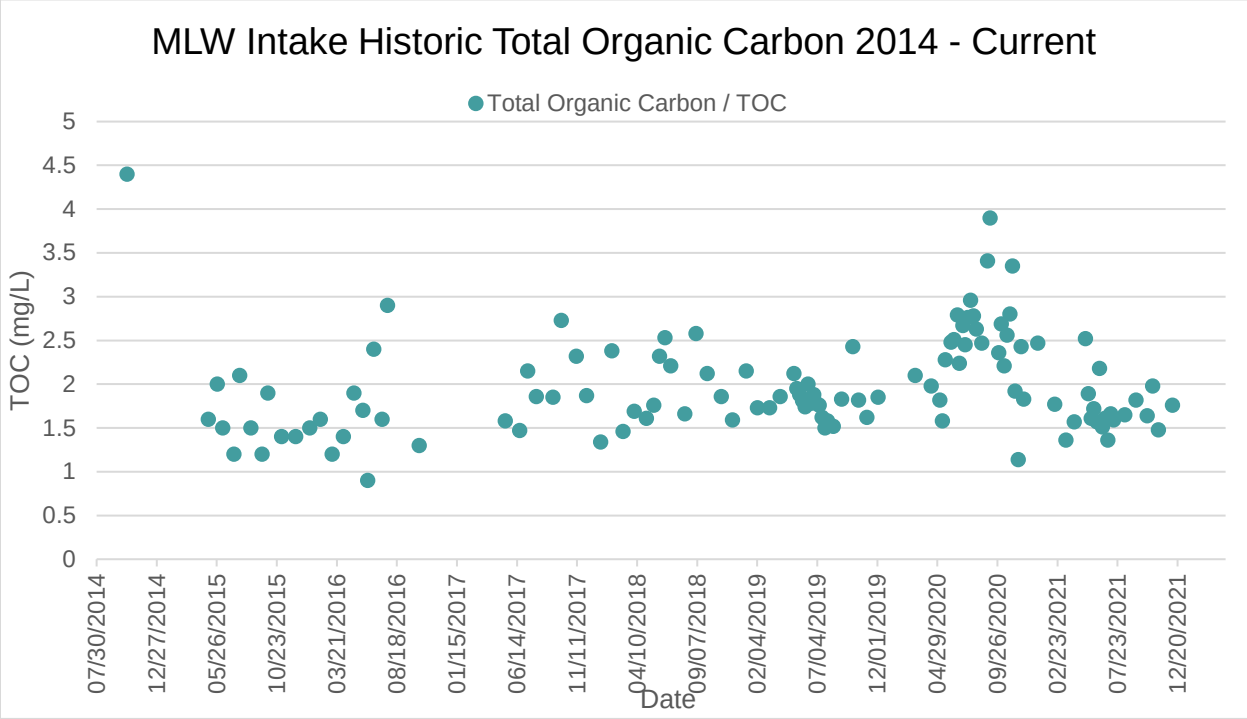
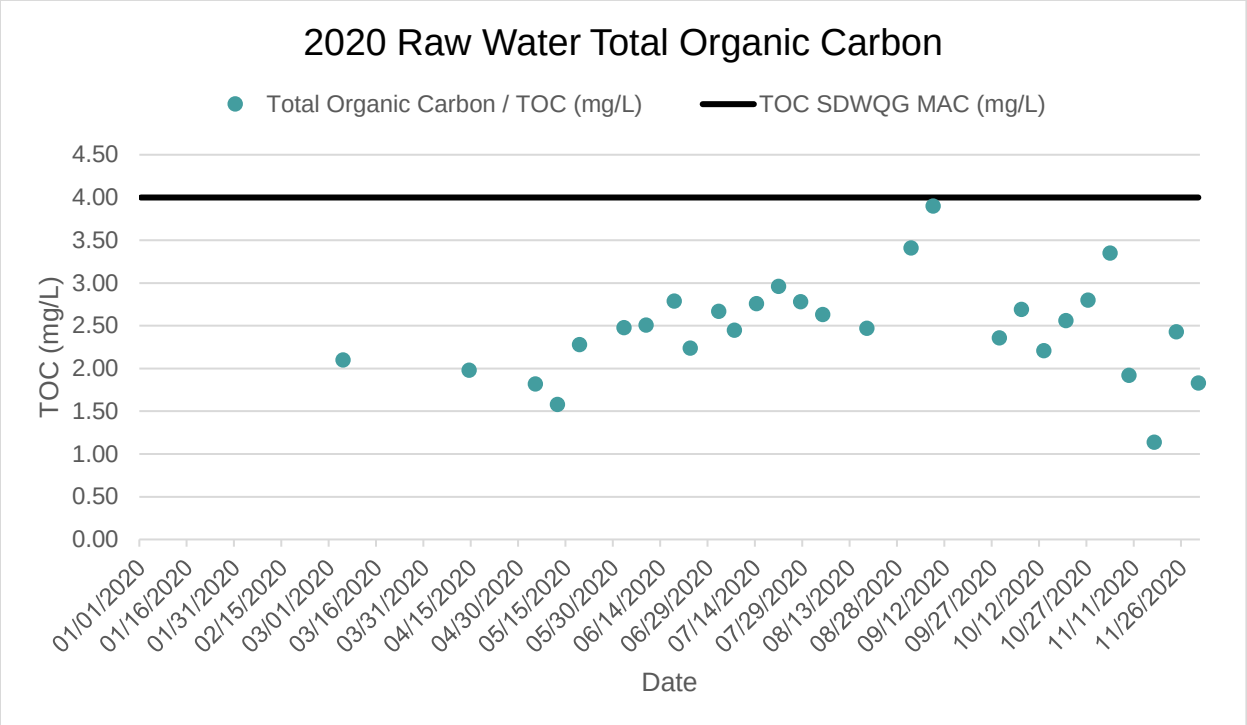


Figure 8: Historic (2014-2021) TOC results



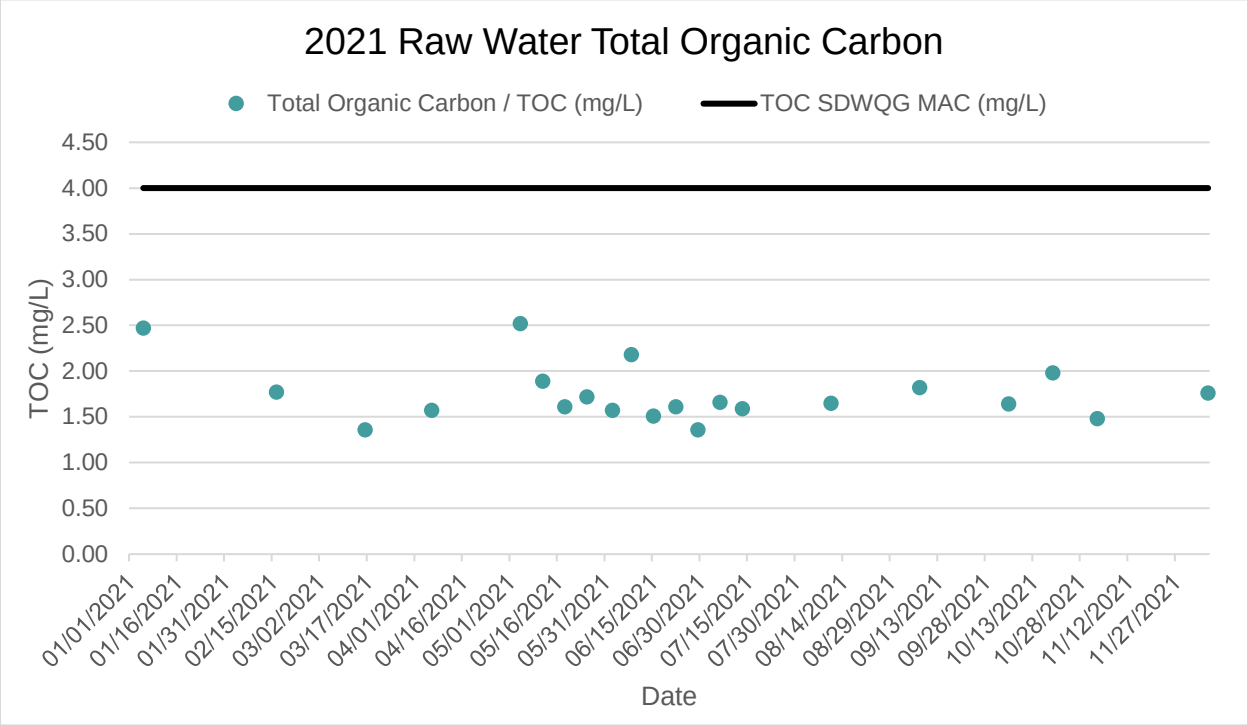
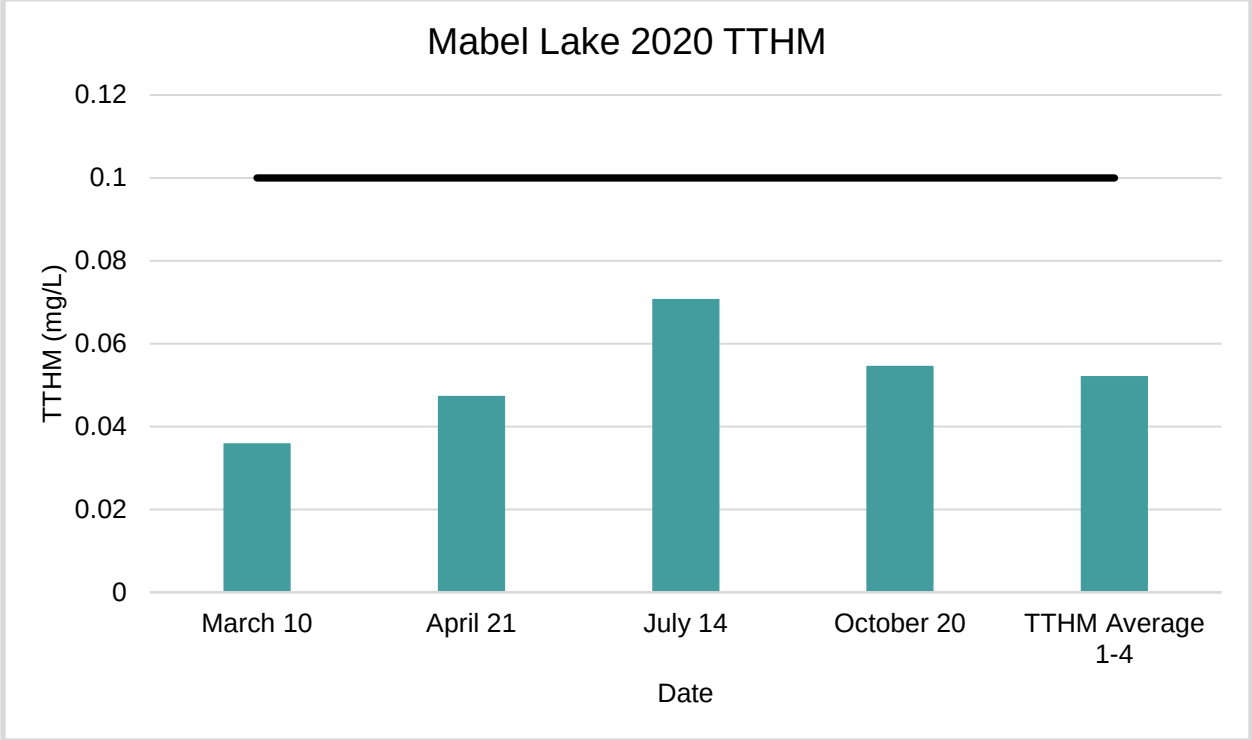


Figure 9: TOC Results



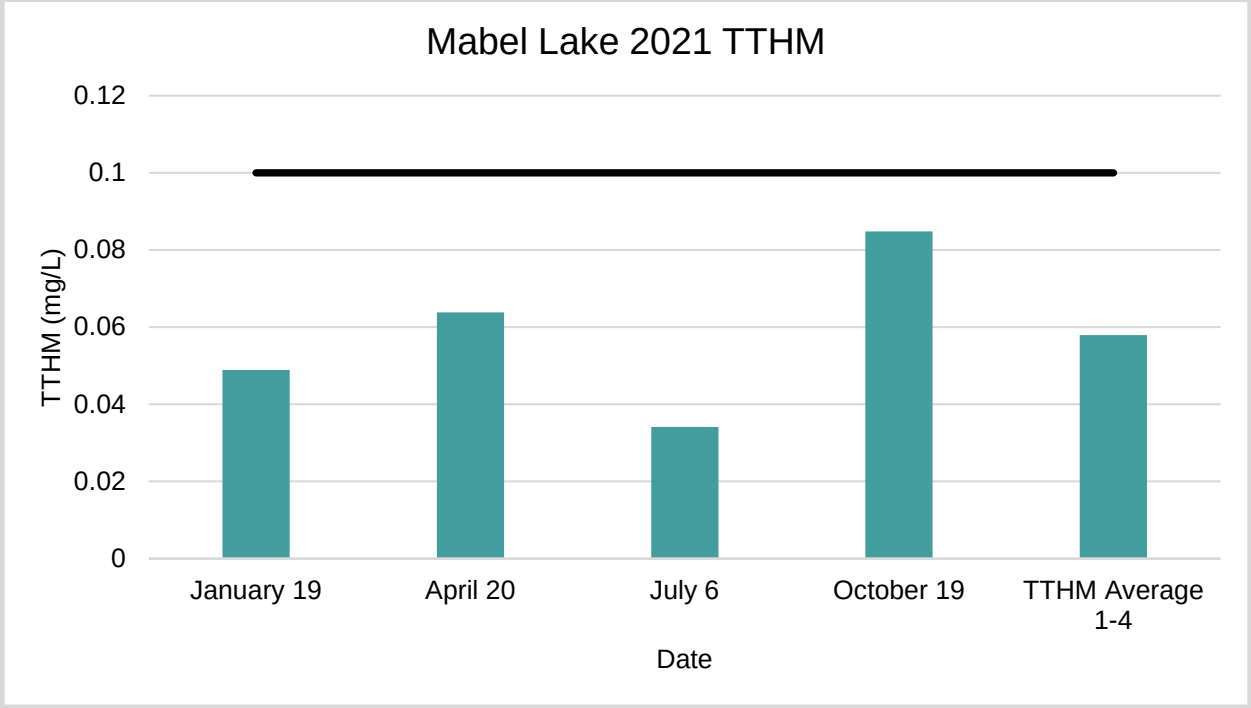


Figure 10: TTHM Average for Each Sample Date

Note: TTHM Locational Running Average for Each Sample Date with the Annual Average shown as TTHM 1-4

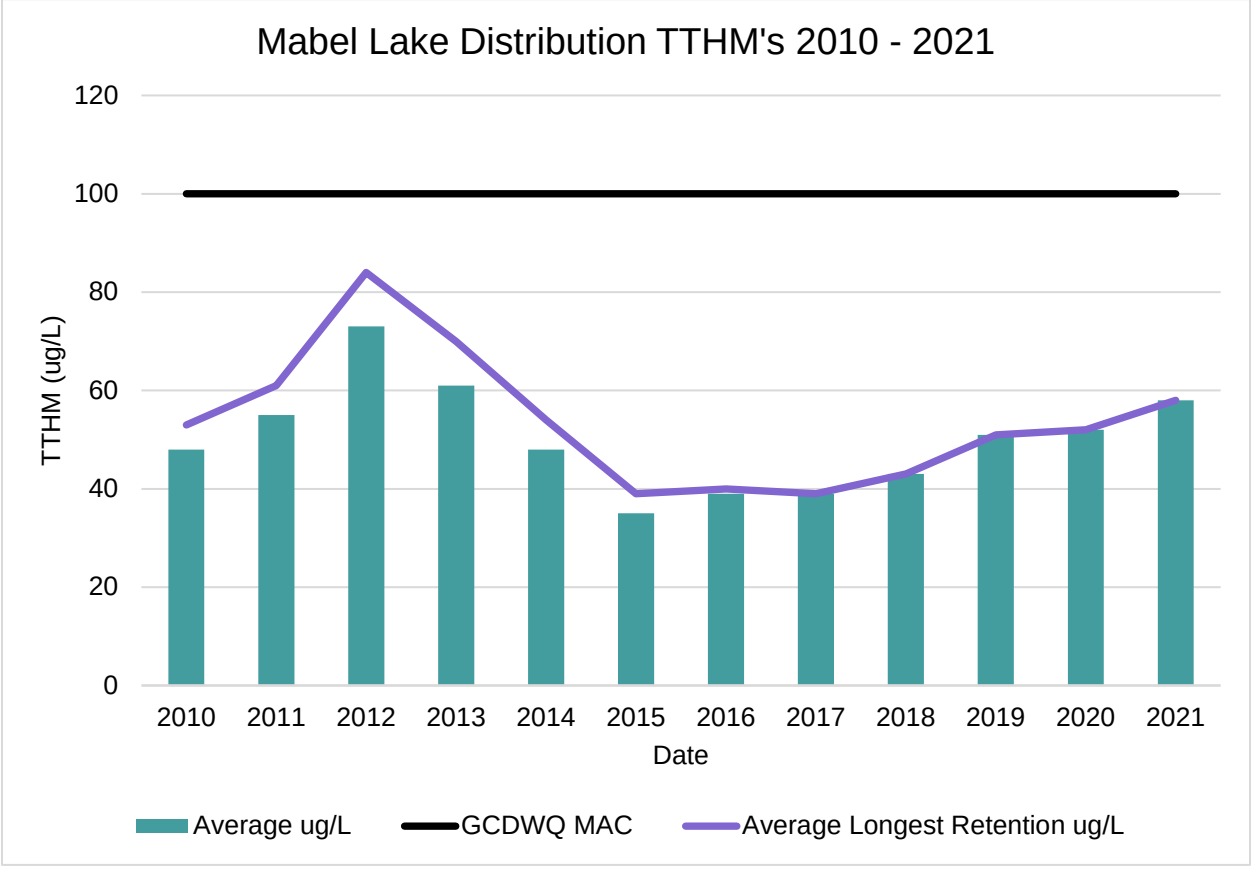
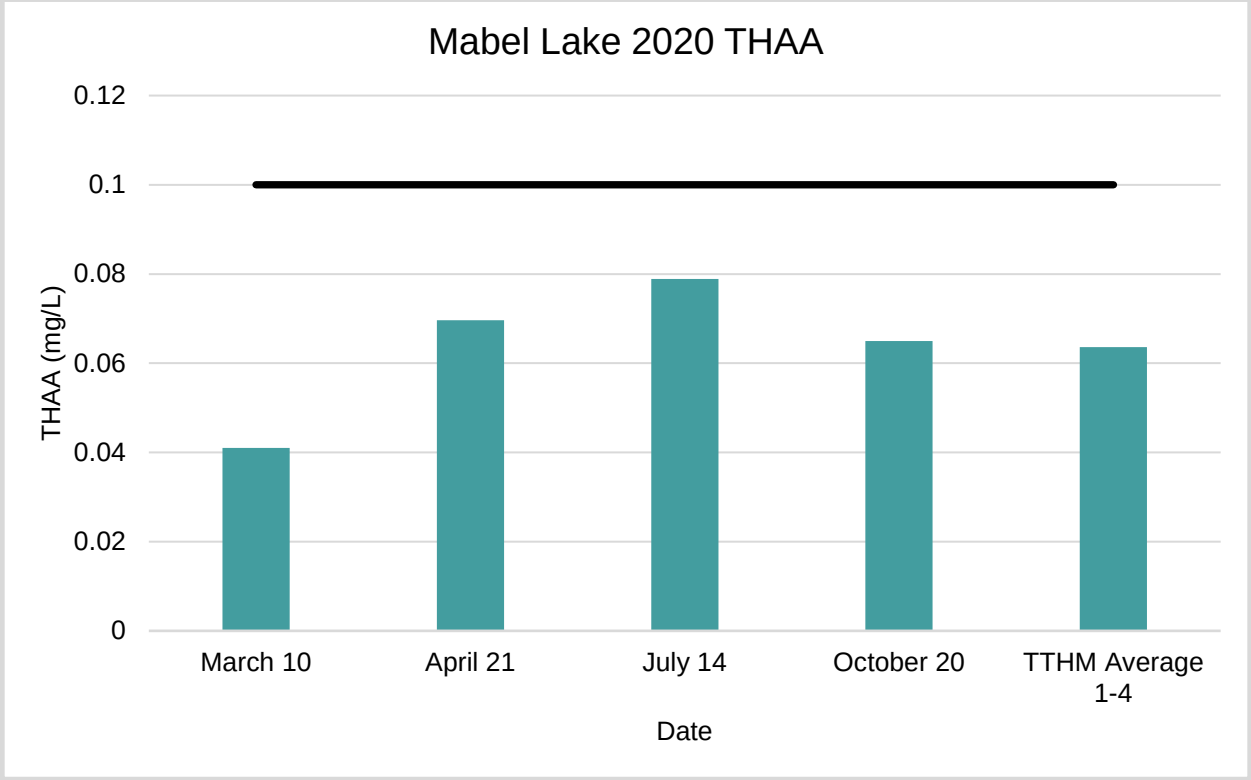


Figure 11: Historical TTHMs



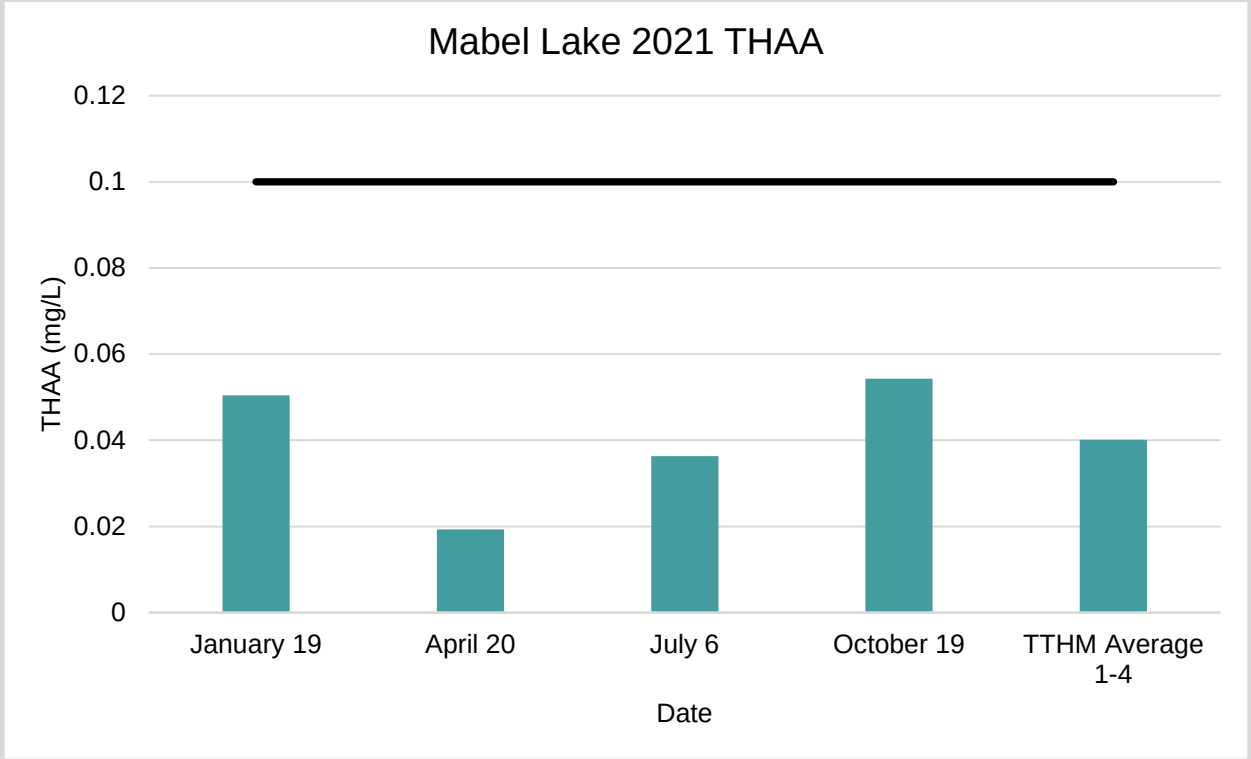


Figure 12: THAA Average for Each Sample Date

Note: THAA Locational Running Average for Each Sample Date with the Annual Average shown as THAA 1-4

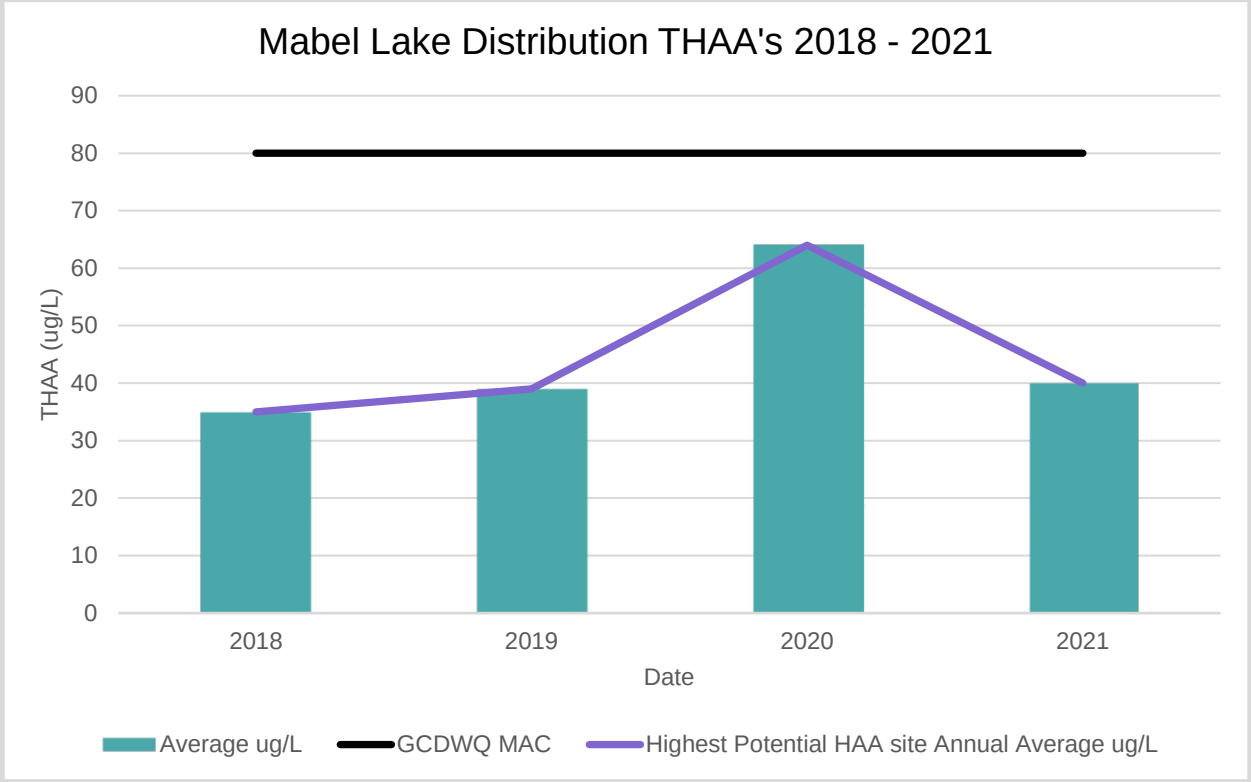


Figure 13: Historical THAAs

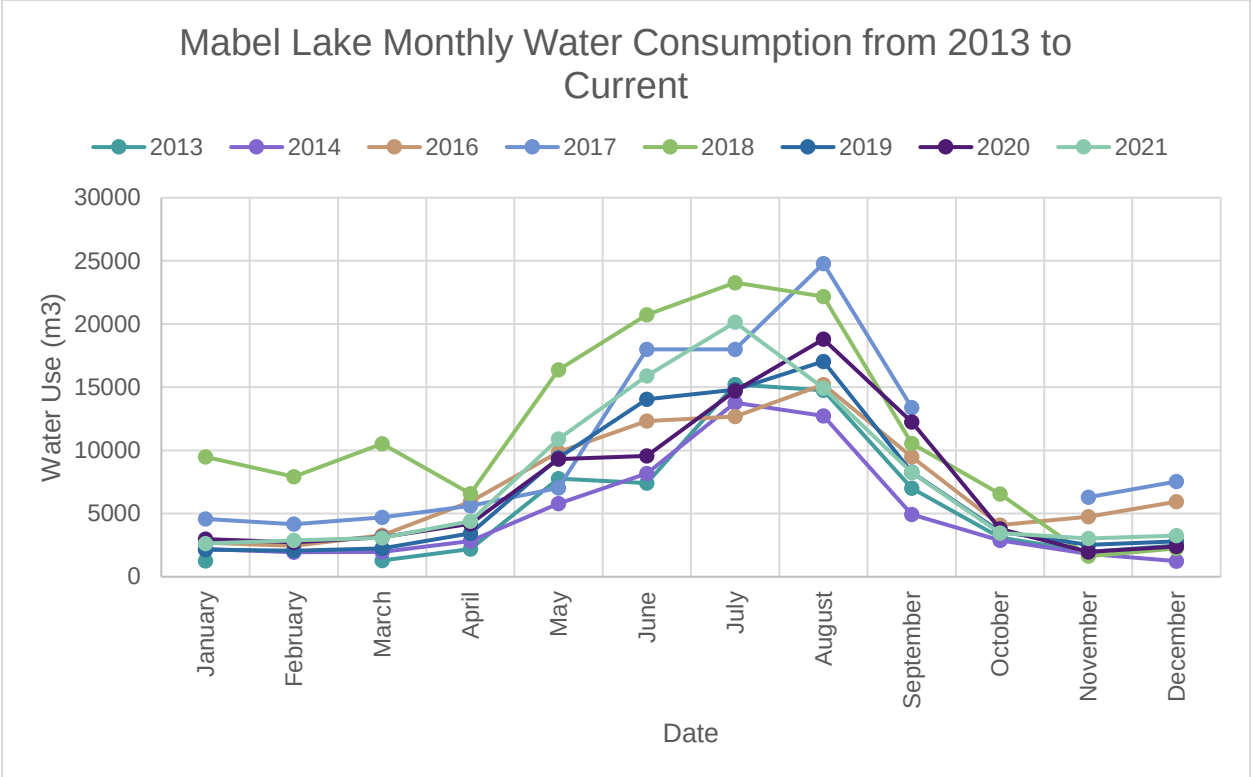


Figure 14: Monthly Water Consumption from 2013 to 2021*

*Note: There is no data available for 2015 as the flow meter was not working properly.

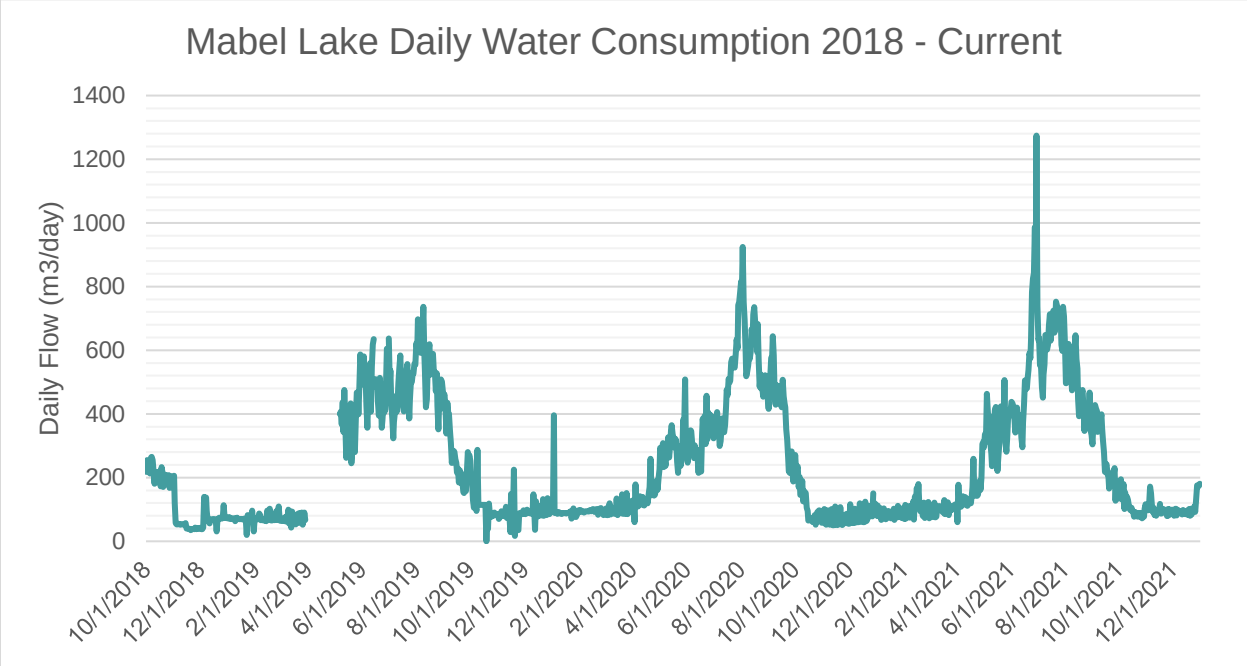


Figure 15: Daily Water Consumption from 2018 to 2021

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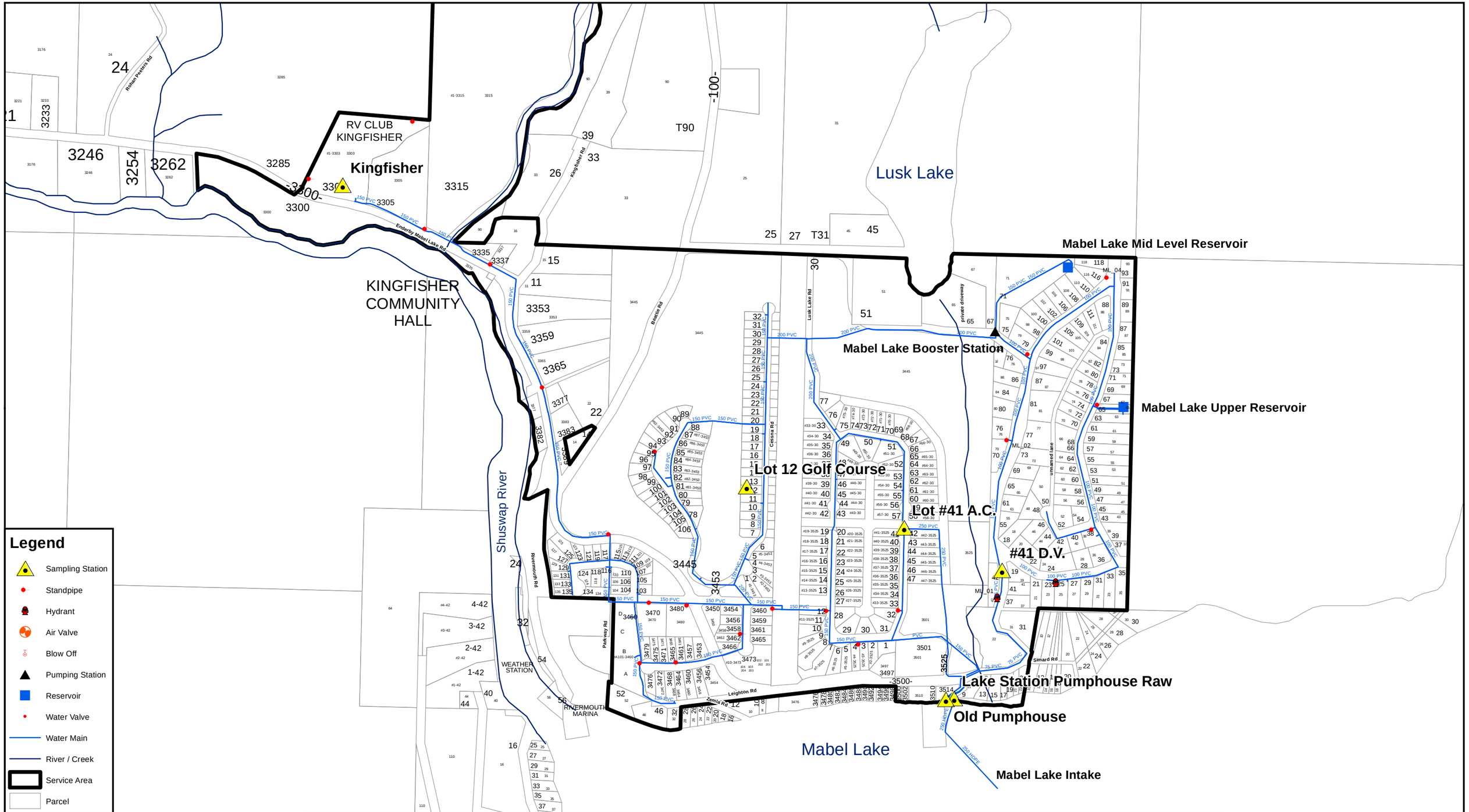
APPENDIX A

MLW WATER SYSTEM MAP



Mabel Lake Water Utility

Plot Date: Jan 17, 2022

Scale: 1:8,000

Meters

0 287.5 575 1,150

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN RDNO

APPENDIX B

CHLORINE CONTACT TIME

Mabel Lake Water Chlorine Contact Time Calculation 2020

0.25	m	ID = Inside Diameter of transmission main
526	m	L = Length of transmission main
26	m^3	V = Total Volume transmission main
480	USgpm	Q = Maximum Day Demand (MDD) plus fire flow conditions, with 2 distribution pumps and 1 fire pump running, Usgpm
30	L/s	Q_1 = MDD plus fire flow conditions, with 2 distribution pumps and 1 fire pump running, L/s
7.57	L/s	Q_2 = maximum flow rate under Average Day Demand (ADD) conditions, 1 distribution pump running
15.1	L/s	Q_3 = maximum flow rate under Maximum Day Demand (MDD) conditions, 2 distribution pumps running
14	minutes	Contact Time (V/Q_1) = Theoretical Detention Time (TDT) in transmission main, MDD plus fire flow conditions
57	minutes	Contact Time (V/Q_2) in transmission main under ADD conditions, 1 distribution pump running
28	minutes	Contact Time (V/Q_3) in transmission main under MDD conditions, 2 distribution pumps running

The Lakeshore Pump House operates normally under ADD conditions with 1 distribution pump running, but under MDD conditions 2 distribution pumps operate together, or 1 fire pump (see Note 3)
Contact Time in Pipe for ADD conditions assumes duplex flow, where 1 distribution pump is running continuously
Contact Time in transmission main for MDD assumes 2 distribution pumps are running continuously

CT calculation for 1st customer - Cl2 sampling point at water sample station near Lot 42, at airpark taxiway

	Cl_2 Residual mg/L (free) (note 1)	Cl_2 Injection mg/L	pH raw water	Raw Water temp °C (note 2)	CT_a = (Cl_2 * CT in Pipe)	CT_r (Virus) (note 4)	CT_a/CT_r (Virus)	CT (Virus) % Achieved
	Minimum	Minimum	Average	Average	min-mg/L	Required		
ADD, Annual Avg. Temp	1.43	2.00	8.00	9.7	81.3	**8.0**	10.16	100
ADD, Winter Temp	0.86	2.00	8.00	6.2	48.9	**8.0**	6.11	100
ADD, Summer Temp	0.92	2.00	8.00	12.2	52.3	**6.0**	8.72	100
MDD, Annual Avg. Temp	1.43	2.00	8.00	9.7	40.8	**8.0**	5.09	100
MDD, Winter Temp	0.86	2.00	8.00	6.2	24.5	**8.0**	3.06	100
MDD, Summer Temp	0.92	2.00	8.00	12.2	26.2	**6.0**	4.37	100
MDD+fire flow, An. Avg. Temp	1.43	2.00	8.00	9.7	20.3	**8.0**	2.54	100
MDD+fire flow, Winter Temp	0.86	2.00	8.00	6.2	12.2	**8.0**	1.53	100
MDD+fire flow, Summer Temp	0.92	2.00	8.00	12.2	13.1	**6.0**	2.18	100

Notes:

1. Normal residual Cl2 range at 1st customer is 0.86 to 2.12 mg/L, minimum is 0.86 mg/L, average is 1.43 mg/L based off 2019 data.
2. Temperature average is about 9.7°C with lows of near 6°C in Winter months, and highs near 12°C in Summer.
3. Peak Flow Rates occur normally in Summer when water temperatures are warmest.
4. From CT Values Table B-2 of US EPA Guidance Manual LT1ESWTR Disinfection Profiling and Benchmarking

virus log inactivation = $4*(Ct_a/CT_r)$ log

virus percent achieved =$100-(100/(10^{(4*CT_a/CT_r)}))$ $\log(x)=4*CT_a/CT_r \Longrightarrow x=10^{(4*CT_a/CT_r)}$ x_{virus} = 2.38E+20

Completed by: ZM
Update (JdeP): August 25, 2020

Date Printed: 8/31/2020, 10:02 AM

APPENDIX C

OPERATING PERMIT

PERMIT VALIDATION

Interior Health

ACCOUNTS RECEIVABLE
#200, 235 Lansdowne St., Kamloops, BC V2C 1X8 Accountsreceivab
Telephone: 1-866-314-2806 Local 2780 Fax: 250-314-2791

TO VALIDATE your operating permit, immediately affix this decal in the designated location on the permit. The Health Act Fees Regulation states that an operation permit is valid only if it bears an unexpired decal.

Regional District of North Okanagan
Mabel Lake Water Utility
9848 Aberdeen Road
Coldstream, BC V1B 2K9

Permit Number:	**004216**
Issue Date:	27-Feb-2020
Expiry Date:	31-Mar-2021
Facility Number:	0412111
Facility Name:	Mabel Lake Water Utility

Drinking Water System 15 - 300 Connections

Interior Health

ACCOUNTS RECEIVABLE
200-235 Lansdowne St. Kamloops BC Canada V2C 1X8
Toll Free: 1-844-868-5200 ext. 10365 Local calls: 778-362-6810 ext. 1
accountsreceivable@interiorhealth.ca

PERM

TO VALIDATE your operating permit, immediately affix this decal in the designated location on the permit. The Health Act Fees Regulation states that an operation permit is valid only if it bears an unexpired decal.

Regional District of North Okanagan
Mabel Lake Water Utility
9848 Aberdeen Road
Vernon BC V1B 2K9
Canada

Permit Number: **000838**

Issue Date: 24-Feb-2021
Expiry Date: 31-Mar-2022
Facility Number: 0412111
Facility Name: Mabel Lake Water Utility

Drinking Water System 15 - 300 Connections

APPENDIX D

CONDITIONS ON PERMIT

Interior Health

Environmental Health Protection
1340 Ellis Street,
Kelowna, BC V1Y 9N1

October 04, 2010

Al Cotsworth, P.Eng
Utilities Manager
Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, BC
V1B 2K9

Re: Mabel Lake Water Utility
Drinking Water Quality Improvement Program – 2010 Conditions on Permit

Interior Health is pleased to acknowledge our mutual accountability to drinking water consumers and our shared commitment with the **Mabel Lake Water Utility**. The intent of the Drinking Water Quality Improvement Program is to provide consistent and clear expectations for all stakeholders and to ensure consistent program delivery throughout the Interior Health region. The foundation of the Drinking Water Quality Improvement Program is a set of typical terms and conditions that may be attached to the Operating Permit. The Drinking Water Quality Improvement Program provides a documented and verifiable management system for promoting and protecting public health.

Water Suppliers and Interior Health recognize the need for working relationships to consistently achieve good quality drinking water. We expect to have on-going long term planning discussions with the outcome of setting target dates for staged improvements.

All participating water systems should develop realistic and attainable target dates to implement 43210 as described below.

- **4** log (99.99%) inactivation of Viruses
- **3** log (99.9%) inactivation or removal of *Giardia* and *Cryptosporidium*
- **2** treatment processes for all surface drinking water systems
- **1** for <1 NTU of turbidity with a target of 0.1 NTU
- **0 Total coliform, 0 fecal coliform and 0 *E. coli***

The following terms and conditions on your Permit to Operate are placed under Section 8 of the Drinking Water Protection Act. As such, there is a legal requirement to comply with all terms and conditions of the permit. It is important to note that any amendment of an operating permit must occur in accordance with section 8 (4) of the Act, which requires prior consultation with the water supplier and consideration of any comments the water supplier may provide in respect of the proposed changes. These consultations have occurred on an annual basis prior to the issuance of the yearly Conditions on Permit letter.

The terms and conditions in this letter will supersede and update previous terms and conditions:

1. **Provide a Source Protection Plan for Each Water Source**

Status:

- Source Assessment/Assessment Response Plan has not yet been initiated for the Mabel Lake Drinking Water Source/Intake.

Objective:

- Initiate and complete a Source Water Assessment that will address (at a minimum) the requirements contained within Modules 1, 2, 7 & 8 of the BC Comprehensive Drinking Water Source to Tap Assessment Guideline.
  - Schedule an initial source water assessment meeting with the Drinking Water Officer & Technical Advisory Committee (TAC) to establish a scope of study prior to issuance of Assessment Terms of Reference.
  - Engage the TAC to review the characterization and delineation of the source watershed (Module 1) and contaminant survey (Module 2).
  - Engage the TAC to review the characterization of risks (Module 7) and the recommended actions to improve drinking water protection (Module 8)
- The completed Source Water Assessment will provide the basis for the development of an Assessment Response Plan.
- Initiate an Assessment Response Plan, including the establishment of strategies and target dates for resolving issues/report recommendations, maintaining a source protection program and contingency, and emergency planning.

Target Date:

- Provide a capital plan and proposed timeline for initiating a Source Assessment per the above objectives by March 31, 2011.
- Complete a Source Assessment per the above objectives by March 31, 2012.
- Initiate an Assessment Response Plan & demonstrate that a Source Protection Plan is in place by October 1, 2012.

2. **Provide a Certified Operator to Operate the System**

Status:

- This system has been EOCP classified in the past as a Small Water System.
- Lane Skead is the principal operator & holds Small Water System Certification.

Objective:

- Please confirm current EOCP system classification (Water Distribution & Water Treatment) and provide new classification as required/as system is upgraded.
- Maintain a certified operator at the level of system classification for both treatment and distribution requirements.

Target Date:

- Provide current EOCP system classification by November 30, 2010.
- Provide confirmation of operator certification at level of system classification by Dec 01, 2010 or, provide a work plan which outlines course/hour requirements and proposed date for attaining required operator certification to system classification (by Dec 01, 2010).

3. **Provide a Drinking Water Quality Monitoring Program**

Status:

- A total of 1 raw water and 4 treated water bacterial samples are collected monthly (one set per month collected by operator and one set per month by RDNO staff).

- A 2010/2011 Water Quality Monitoring Program update has not been provided for review detailing sample sites for bacteriological, chemical and chlorine residual checks (include a distribution map), to ensure that a representative set of samples are collected from end of line sites, different pressure zones, post reservoirs, etc.

Objective:

- Provide an annual written Drinking Water Quality Monitoring Program update for the Mabel Lake Water Utility system with established schedules for systematic & routine sampling to ensure that a representative set of samples are collected from end of line sites, different pressure zones, post reservoirs, etc, including:
  - A treatment and distribution system map to identify raw and distribution bacteriological sampling points and schedules.
  - Chemical sampling point(s) and schedules for basic potability monitoring (raw water chemical & distribution THM, turbidity, etc).

Target date:

- Update to be provided prior to July 1st each year.

4. **Develop a Cross-Connection Control Program**

Status:

- A cross-connection control program has not yet been initiated at this water system.

Objective:

- Implement a Cross-Connection Control Program that is consistent with industry Best Management Practices. Refer to the BCWWA cross connection control page for information: http://www.BCWWA.org. Ensure completion of surveys, routine maintenance, tracking & testing of devices and education initiatives.
- Provide an annual Cross-Connection Control Program update including % of ACII (Agricultural, Commercial, Industrial, Institutional) and residential connections assessed, number of backflow preventors installed, tracking of backflow prevention devices and testing, as well as education initiatives.

Target Date:

- Confirm capital for a Cross-Connection Control Program at the Mabel Lake Water Utility by March 31, 2011.
- Initiate a Cross-Connection Control Program for this system per the above objectives by July 01, 2011.
- Provide an annual Cross-Connection Control Program update prior to July 1st each year.

5. **Provide Continuous On-line Monitoring of the Water Disinfection Process**

Status:

- On-line chlorine residual analyzer has been installed and is monitored/recorded on SCADA.

Objective:

- Please confirm SCADA alarm set-points & callout capacity to operator/RNDO staff for exceedance of a chlorine alarm/loss of chlorine and include response in ERP.
- Provide SCADA summary information on the water disinfection process in monthly reports (ie. cl residual summary graph).

Target Date:

- Confirm installation of SCADA alarming & callout capacity per the above objective prior to March 31, 2011.
- Include SCADA summary information in monthly reports starting November 01, 2010.

6. **Provide Continuous On-line Turbidity Sampling and Recording of Raw Water for Each Surface Source**

Status:

- On-line turbidity meter has been installed prior to the point of disinfection and is monitored/recorded on SCADA.

Objective:

- When water turbidity measured at the above referenced turbidity monitoring point and taken as a 24 hour rolling average exceeds 1NTU, the water supplier must make verbal contact with the Health Department. Please confirm SCADA alarm set-points & callout capacity to operator/RNDO staff for exceedance to a turbidity alarm set-point and include response in ERP.
- Provide SCADA summary information on turbidity in monthly reports (ie. turbidity summary graph).

Target Date:

- Confirm installation of SCADA alarming & callout capacity per the above objective prior to March 31, 2011.
- Include SCADA summary information in monthly reports starting November 01, 2010.

7. **Provide Long-term Plans for Source, Treatment and Distribution System Improvements Taking into Account the Goal of 43210 Treatment Objectives**

Status:

- Lake pumphouse/treatment facility currently has single disinfection only (ie. chlorination).
- We note that an RFP has been confirmed by Rod Pleasance for a study of water treatment options in 2010/2011 at the Mabel Lake Water Utility. Both filtration and UV technologies will be evaluated as indicated by RDNO, relative to meeting the 43210 Drinking Water Objectives. Where filtration deferral is being contemplated, we note that a Filtration Deferral Application has not been received or reviewed for the Mabel Lake Water Utility & accordingly, the utility has not yet demonstrated that this source meets all of the filtration deferral criteria.

Objective:

- **Provision of two forms of disinfection is required as criteria to apply to defer filtration but does not guarantee that filtration deferral is acceptable.**
- **Provide treatment processes that will fully meet the 43210 treatment objectives including two methods of disinfection by 2013 if filtration deferral is contemplated.**
- **If filtration deferral is not contemplated then disinfection with filtration or equivalent technologies is required prior to 2015 for all source water.**
- Conceptual plans for filtration must be identified with or without filtration deferral.
- Filtration deferral plans will be reviewed annually and water suppliers must be prepared to install filtration within 2 years in the event that any of the following occur:
    1. waterborne illness outbreak

2. excess of avoidable disinfection byproducts
3. failure to provide or meet the filtration deferral criteria monitoring requirements
4. significant degradation of raw water quality and,
5. health threats

- A financial plan for filtration/full 43210 treatment is therefore required, with or without grant funding and with or without the potential to defer filtration.
- The implementation plan must ensure a land footprint is available for a filtration plant, identify a selected technology, confirm financial planning and, identify staged and continuous benchmarks with clear target dates.
- Water Suppliers must provide progress reports with implementation of treatment infrastructure upgrades.

Target date:

- Provide a written plan demonstrating how the above/below objectives will be met prior to March 31, 2011, including timelines for completion and confirmation of capital to complete necessary works.
- Where filtration deferral is contemplated, demonstrate that the Filtration Deferral Criteria can be met through an Application to Defer Filtration (by March 31, 2011). Refer to the Interior Health Drinking Water Filtration Policy document for required information to be included in an Application for Filtration Deferral (see attached).

8. Review and Update the Emergency Response Plan Annually

Status:

- Interior Health has not received a 2009-2010 Emergency Response Plan.
- As noted during our September 27, 2010 site inspection, operator (Lane Skead) has not been provided with an Emergency Response Plan and has not received Emergency Response Training on what situations are considered "Emergency Situations", response procedures, corrective action/public notification and contact procedures to inform RDNO staff & IH.

Objective:

- Provide an Emergency Response Plan to address public notification and corrective measures in response to deviation from acceptable operating range /emergency situation, including:
  - Turbidity events
  - Disinfection residual
  - Bacterial sampling results
  - Loss of pressure/loss of water/backflow
  - Source contamination

Target Date:

- Operator must be provided with an up-to-date ERP for the Mabel Lake Water Utility and receive training on Emergency Response by November 01, 2010 (also provide an up-to-date copy to IH for review).
- Please provide an up-to date Emergency Response Plan prior to March 1st annually.

9. Provide Monthly Reports and an Annual Summary

Status:

- Bacteriological sample results are provided monthly, additional monitoring information is required in monthly reporting per the below objectives.
- Interior Health has not received a 2009/2010 annual report for Mabel Lake Water Utility.

Objective:

Monthly reporting should include (as applicable):

- Daily water consumption.
- Microbiological test results.
- SCADA/Continuous online monitoring information on chlorine residuals & turbidity.
- Comments on source, treatment, distribution system events. Any variances from normal operations for the facility are commented on and explained in written text.
- Records of customer complaints and response.
- Operational activities.

Annual reports should include:

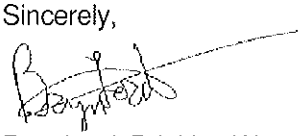
- Annual consumption/water quality summary data.
- Updates to Water System Assessment and Capital Works Plan.
- Updates to Water Monitoring Plan.
- Updates to Emergency Response Plan.
- Updates to Cross Connection Control Program.
- Provide Environmental Operators Certification Program updates.

Target Date:

- Monthly reports to be submitted by the 15th day of the following month.
- Send to: bryn.lord@interiorhealth.ca
- Annual reports should be submitted prior to July 1st annually.

Thank you for your continuing cooperation. I look forward to working with you over the coming year.

Sincerely,



Bryn Lord, Drinking Water Officer
Interior Health Authority
1340 Ellis Street
Kelowna, BC V1Y 9N1

Phone: (250) 308-9288
Fax: (250) 868-7760

Copies: Dr. Paul Hasselback, Medical Health Officer
Ivor Norlin, Acting Assistant Director
Mike Adams, Okanagan Service Area Team Leader
Gundie Volk, Okanagan Service Area Team Leader
Christina Yamada, Public Health Engineer

APPENDIX E

MABEL LAKE COMMUNITY SEWER OPERATIONAL CERTIFICATE 14490

BRITISH COLUMBIA
The Best Place on Earth

January 23, 2012

Tracking Number: 77
Authorization Number: 14490

REGISTERED MAIL

NORTH OKANAGAN REGIONAL DISTRICT
9848 Aberdeen Road
Vernon, BC V1B 2K9

Dear Operational Certificate Holder:

Enclosed is Operational Certificate 14490 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. An annual fee will be determined according to the Permit Fees Regulation.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Okanagan Region. Plans, data and reports pertinent to the operational certificate are to be submitted to the Regional Manager, Environmental Protection, at Ministry of Environment, Regional Operations, Okanagan Region, 102 Industrial Pl., Penticton, BC V2A 7C8.

Yours truly,

Sajid A. Barlas, Ph.D. , P.Ag.
for Director, *Environmental Management Act*
Okanagan Region

Enclosure

cc: Environment Canada

Ministry of Environment | Environmental Protection Division | 102 Industrial Pl. Penticton, BC V2A 7C8 | Southern Interior Region - Okanagan
Telephone: (250) 490-8200
Facsimile: (250) 490-2231

BRITISH COLUMBIA
The Best Place on Earth

MINISTRY OF ENVIRONMENT

OPERATIONAL CERTIFICATE

14490

Under the Provisions of the *Environmental Management Act*

NORTH OKANAGAN REGIONAL DISTRICT

9848 ABERDEEN ROAD
VERNON, BC V1B 2K9

Hereinafter referred to as "the Regional District"

is authorized to discharge effluent to the ground from a municipal sewage treatment facility located at Mabel Lake, which is part of the larger community of Kingfisher, British Columbia, subject to the terms and conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may lead to prosecution.

1. AUTHORIZED DISCHARGES

1.1 Authorized Source

This section applies to the discharge of effluent from INDIVIDUAL SEPTIC TANKS DRAINING TO A COMMON TILE FIELD. The site reference number for this discharge is E248369.

1.1.1 The maximum rate of discharge is 250 cubic metres per day averaged on a monthly basis.

1.1.2 The characteristics of the discharge are similar to those of a typical septic tank effluent and for the purposes of permit fee calculations the following discharge factors will be used:

Biochemical Oxygen Demand	Maximum: 130 mg/L
Total Suspended Solids	Maximum: 130 mg/L

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1.1.3 The authorized works are a series of septic tanks on individual properties, STEP pumping system to a centrally located septic tank, dosing siphon or pumps, disposal fields and related appurtenances approximately located as shown on Site Plan A.

1.1.4 The authorized works are complete and in operation.

1.1.5 The location of the facilities from which the discharge originates is within the community of Kingfisher.

1.1.6 The location of the point of discharge is Lot A, KAP 45947 (existing airstrip), KAP 47282 (existing taxiways), and the Remainder of Part of West 25 Chains of the SE 1/4 of Sec 14 (proposed taxiways MLG and CC).

2. GENERAL REQUIREMENTS

2.1 Maintenanee of Works and Emergency Procedures

The Regional District must inspect the authorized works regularly and maintain them in good working order. In the event of an emergency or condition beyond the control of the Regional District which prevents effective operation of the authorized works or leads to unauthorized discharge, the Regional District must comply with all applicable statutory requirements, immediately notify the Director and take appropriate remedial action for the prevention or mitigation of pollution. The Director may reduce or suspend operations to protect the environment until the authorized works have been restored and/or corrective steps have been taken to prevent unauthorized discharges.

2.2 Bypasses

The discharge of effluent which has bypassed the authorized treatment works is prohibited unless the prior approval of the Director is obtained and confirmed in writing.

2.3 Process Modifications

The Director must be notified prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge.

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2.4 **Plans - Existing**

A copy of all "as built", plans of modifications and/or extensions to the sewage collection system must be retained by the Regional District for perusal by the Director, or designate, upon request.

2.5 **Plans - New Works**

Plans of modifications and/or extensions to the existing works must be signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia.

Plans and specifications of any proposed modifications or additions to works authorized in this Operational Certificate, with the exception of the sewage collection system, must be submitted to the Director, and his written consent obtained before construction commences. The works must be constructed in accordance with such plans.

2.6 **Sludge Management**

Sludge wasted from the effluent treatment facilities must be disposed of to a site and in a manner approved by the Director. The residue, removed from the individual septic tanks, must be disposed of in a manner authorized by the Director, or as authorized by regulation under the *Environmental Management Act.*

2.7 **Contingency Plan**

The Regional District must prepare a Contingency Plan that will address the appropriate course of action to be taken in any particular preconceived emergency situation, and submit a copy of the Contingency Plan to the Director on or before **March 1, 2012.** The Contingency Plan must include Spill Procedures including other leaks and any potential point of concern in the collection, treatment and disposal systems. Attention is to be given to public safety and the protection of the environment. The Contingency Plan is to be continually updated as necessary to reflect the current operation. Any revisions to the Contingency Plan are to be submitted annually to the Director.

2.8 **Additional Phosphorus Treatment**

In the event that significant levels of phosphorus are found in the groundwater

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wells or surface waters, as a result of effluent infiltration, a higher level of phosphorus removal may be specified by the Director.

2.9 **Odours**

Should there be objectionable odours being produced, as determined by the Director, additional works may be required if so directed in writing by the Director.

2.10 **Operation and Maintenance**

2.10.1 The Regional District must develop and maintain both an Operational and Maintenance Manual for the sewage collection, sewage treatment and effluent disposal works on or before **March 1, 2012.** A copy of the Operational and Maintenance Manuals must be retained at the Regional District office for inspection by the Director or designate.

2.10.2 Operate and maintain a system of preventative maintenance for the wastewater collection, wastewater treatment and effluent disposal.

2.11 **Facility Classification and Operator Certification**

The operational certificate holder must have the works authorized by this permit classified (and the classification must be maintained) by the Environmental Operators Certification Program Society (the Society). The works must be operated and maintained by persons certified within and according to the program provided by the Society.
Certification must be completed to the satisfaction of the Director. In addition, the Director must be notified of the classification level of the facility and certification level of the operators and changes of operators and/or operator certification levels within 30 days of any change.

Alternatively, the works authorized by this permit must be operated and maintained by persons who the operational certificate holder can demonstrate to the satisfaction of the Director, are qualified in the safe and proper operation of the facility for the protection of the environment.

2.12 **Alternate Water Supply**

The Regional District must provide a potable water supply (for domestic use only) to affected residents should groundwater wells become adversely affected

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by the effluent treatment facilities or disposal, as determined by the Director.

2.13 **Water Conservation**

The Regional District must take all reasonable measures to ensure that the consumptive use of water is minimized, by utilizing all appropriate water conserving devices throughout the collection area.

2.14 **Improvement of Works**

The Regional District must acquire and/or reserve sufficient land for the construction and/or expansion of future sewage treatment facilities. The installation of new works must be in accord with the Regional District of North Okanagan's, Kingfisher Liquid Waste Management Plan.

2.15 **Observation and Ventilation Ports**

Place observation and monitoring ports at the extremities of the disposal pipe to provide a clear view of the end of the disposal pipe and to the bottom of the backfill. To assist in maintaining an aerobic atmosphere within the pipe layout and the interstices in the granular backfill provide one ventilation port of the same diameter as, and connected to, the distribution pipe for every 152 m of pipe, with a minimum of four, arranged to promote air circulation throughout the field except during periods of sub-freezing temperature when they should be closed.

2.16 **Tile Field Operation**

The Regional District must alternate the use of the tile fields. The Director may change this period of alternation based on the results of visual inspections by Ministry staff and/or other information.

2.17 **Requirement to Upgrade Treatment Works and Operating Period**

The operating certificate authorizes a seasonal cottage operation for the purposes of field design. The operating period authorized for the seasonal component is from May 1st to Oct 31st each year. It is recognized that up to 10% of the flow may be year-round in nature. When the year-round flows exceed 10% of the maximum flow, the operation will no longer be considered seasonal in nature and disposal fields and reserve areas re-designated to reflect the change. When the system reaches effluent flows of 250 m^3/d, an

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for Director, *Environmental Management Act*
Okanagan Region

Environmental Impact Assessment (EIS) study must be undertaken to determine if the disposal fields are capable of supporting additional loading without significant adverse impact of the receiving environment. The scope of the work for EIS study must be approved by the Director prior to the study being undertaken.

2.18 **Sewage Collection System - Groundwater Infiltration, Inflow and Cross Connections**

Institute a routine inspection, operation and maintenance schedule for the sewage collection system. Maintain the sewage collection system works so as to minimize the possibility of cross connections between any future storm and sanitary sewer systems, minimize infiltration of groundwater, minimize inflow of water from basement sump pumps and roof drains, and minimize exfiltration of the collected sewage from the sewage collection system to the ground. Report of efforts made to reduce infiltration, inflow and cross-connections are to be included in the Annual Report each year.

2.19 **Influent Wastes Bylaw**

In order to minimize the potential effect of heavy metals, or other toxic materials in the effluent and/or sludge, prepare, implement and/or amend an Influent Wastes Bylaw, Building Bylaw, or other similar bylaw(s), to regulate the input of such wastes to the sewage collection system. The Regional District is encouraged to prohibit devices to process household putrescible waste for disposal to the sewage collection system. Copy of existing Influent Bylaws, or amendments, or similar bylaws or building codes, is to be included in the first Annual Report and any amendments submitted with subsequent annual reports.

2.20 **Surface Water Diversionary Works**

Surface water must be intercepted and diverted away from the effluent treatment and infiltration facilities to the greatest extent possible.

2.21 **Restrictive Covenant**

The Operational certificate holder must register a restrictive covenant on the property designated as sewage treatment works, disposal tile fields and standby field area to preclude the use of land for any other purpose. This restrictive covenant must not be removed without written authorization from the Director.

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2.22 Standby Facilities

A standby area must be set aside equivalent to 50% of the total installed disposal field area. The standby area is to be held in reserve for future use as a disposal field and is to be maintained free of any permanent structures.

3. MONITORING REQUIREMENTS

3.1 Effluent - Monitoring Program

3.1.1 Provide and maintain a suitable flow measuring device and record the daily effluent volume discharged as follows:
Septic Treatment:

- May 15th to September 15th record average daily flow twice per week.
- September 16th to May 14th record average daily flow once per 2 weeks

The EMS reference number for this site is E248369.

3.2 Groundwater Observation Wells

3.2.1 On or before **December 30, 2011**, a minimum of three observation wells must be installed at locations hydrogeologically appropriate, relative to the final location of the discharge to monitor the surface elevation of the groundwater table and to allow sampling of the renovated effluent on a semi-annual basis. One of the wells must be hydrogeologically located for sampling of background elevations and analyses and must be located outside of the zone of influence, up gradient of the disposal fields.

3.2.2 Obtain analyses of the sample for the following:

- total phosphorus, ortho phosphorus and total dissolved phosphorus, mg/L;
- total nitrogen, nitrate nitrogen and ammonia nitrogen, mg/L;
- pH and conductivity;
- sodium and chloride, mg/L; and
- E. coli, MPN (or CFU)/100 ml.

3.3 Sampling and Analytical Procedures

Date issued: January 23, 2012

Sajid A. Barlas, Ph.D. , P.Ag.
for Director, *Environmental Management Act*
Okanagan Region

3.3.1 Sampling is to be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual (Field Sampling Manual)for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition (Permittee)", or most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual may be purchased from the Queen's Printer Publications Centre, P. O. Box 9452, Stn. Prov. Gov't. Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409) or via the internet at www.crownpub.bc.ca. A copy of the manual is also available for review at all Environmental Protection offices.

3.3.2 Analyses are to be carried out in accordance with procedures described in the "British Columbia Laboratory Manual (2009 Permittee Edition)", or the most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual may be purchased from the Queen's Printer Publications Centre, P. O. Box 9452, Stn. Prov. Gov't. Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409) at the internet at www.crownpub.bc.ca. A copy of the manual is also available for review at all Environmental Protection offices.

3.3.3All data of analyses required to be submitted by the operational certificate must be conducted by a laboratory acceptable to the Director. At the request of the Director, the Regional District must provide the laboratory quality assurance data, associated field blanks and duplicate analyses results in accordance with the above mentioned Field Sampling Manual along with the submission of data required under Sec 3 of the operational certificate.

3.4 Environmental Monitoring System (EMS) Sites

The Regional District must provide precise latitude and longitude values, with an accuracy of at least plus or minus 10 metres, for each of the EMS sites monitored and for any additional sites added each year. Monitoring data is to be submitted to the Director.

3.5 Environmental Impact

Environmental Management Program personnel, as a part of the routine permit

Date issued: January 23, 2012

Sajid A. Barlas, Ph.D. , P.Ag.
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Okanagan Region

inspection procedure, will carry out inspections of the discharge. Based on these inspections and any other information available to the Director on the effect of the discharge on the receiving environment, the Operational Certificate holder may be required to undertake additional monitoring and/or install additional pollution control works.

4. REPORTING

4.1 General Reporting

Maintain all monitoring data for inspection by the Director his designate. The groundwater analyses are to be submitted to the Director such that they are received by the Director within 30 days of the results being received, or produced, by the District.

Monitoring data is to be submitted in electronic format and entered into EMS electronically.

4.2 Annual Reporting

Annually all data, as required by this Operational Certificate, is to be combined into a single report, suitably tabulated, indexed and forwarded to the Director, such that it is received by the Director, on or before March 1, each year for the previous year's monitoring. Copies of all raw data are to be attached as appendices to the report. The report must include graphical trend analysis of amenable data, an evaluation of those trends and discussion of any points of action, which may arise from the data.

4.2.1 Maintain records of flow measurements for inspection by the Director his and submit the data, suitably tabulated, to the Director.

4.2.2 Maintain records of ground water elevations and analyses, and submit the data, suitably tabulated, to the Director.

4.2.3 Submit the Contingency Plan, and thereafter any revisions which may have been made to the Plan over the previous year.

4.2.4 Maintain records of efforts to implement water conservation initiatives and submit to the Director.

Date issued: January 23, 2012

Sajid A. Barlas, Ph.D. , P.Ag.
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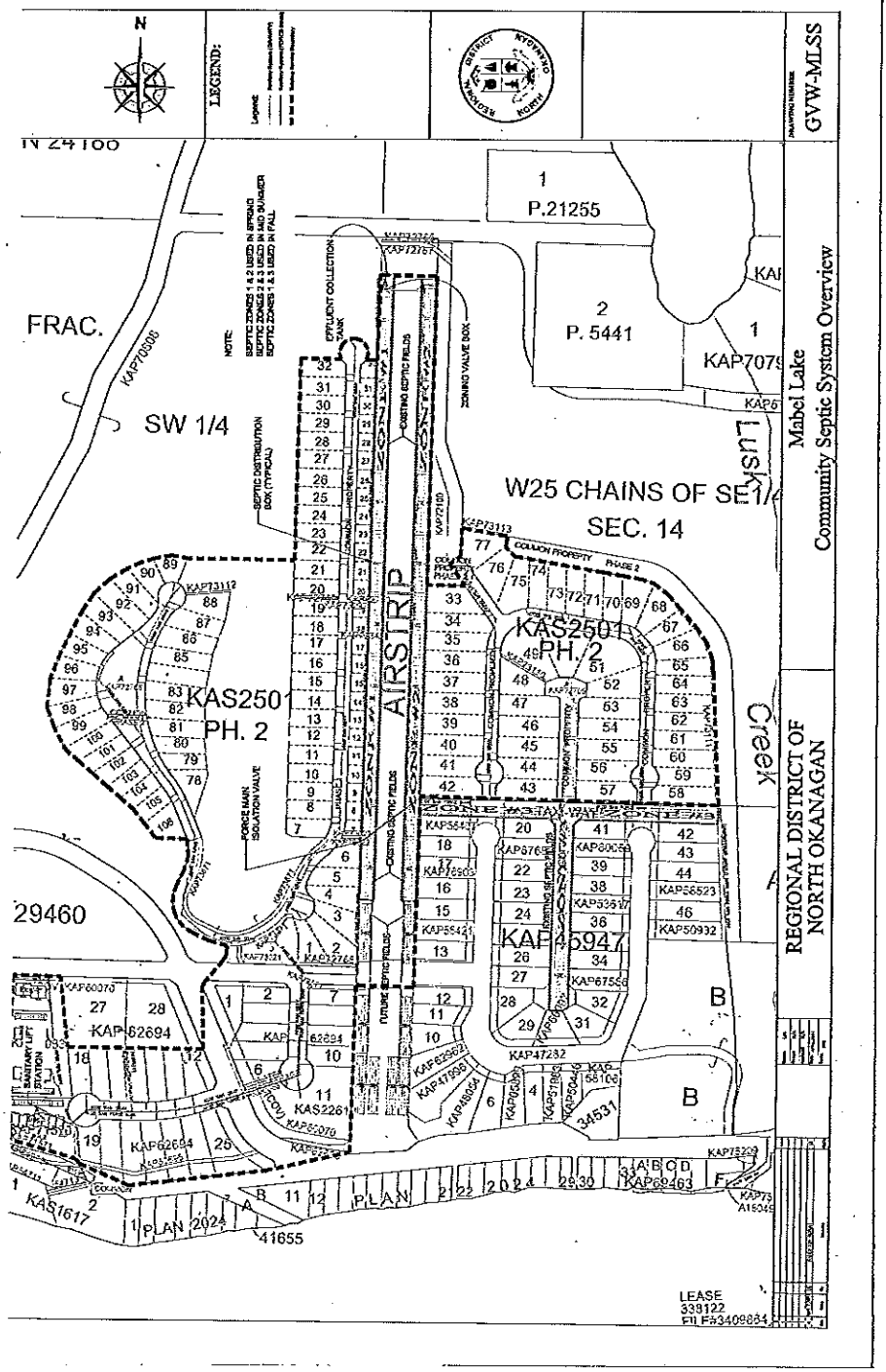
SITE PLAN A



Date issued: January 23, 2012

Sajid A. Barlas, Ph.D. , P.Ag.
for Director, *Environmental Management Act*
Okanagan Region

APPENDIX F

2021 MABEL LAKE INTAKE PROTECTION ZONE


Lusk Creek
Intake Protection Zone
Boat Launch
Pumphouse
Lusk Creek Plume
Area of Greater Influence
Intake Pipeline
Mabel Lake Marina
Intake Location (25m)
Legend
Intake pipeline
Project Points
Intake
Infrastructure
Risk points
Proposed Intake Protection Zone
Area of Vulnerability
2-hour Travel Buffer
LARRATT AQUATIC
0
75
150 m

APPENDIX G

2020/2021 SAMPLING PROGRAM and SCHEDULES

Mabel Lake Water Utility

Mabel Lake Sampling Schedule 2020		
January	**Operator**	**1st and 3rd week of the month**
February	**Operator**	**1st and 3rd week of the month**
March	**Operator**	**1st and 3rd week of the month**
April	**Operator**	**1st and 3rd week of the month**
May	**Operator**	**Every week**
June	**Operator**	**Every week**
July	**Operator**	**Every week**
August	**Operator**	**Every week**
September	**Operator**	**1st, 2nd, and 3rd week of the month**
October	**Operator**	**1st and 3rd week of the month**
November	**Operator**	**1st and 3rd week of the month**
December	**Operator**	**1st and 3rd week of the month**

Operator Tasks	
Sampling	Sampling will occur the first and third weeks of every month (exception: May, June, and August (every week), and September (1st, 2nd, and 3rd week). See sampling calendar
Chlorine	At all distribution sites use handheld meter and log data on worksheet
Turbidity	At all distribution sites use handheld meter and log data on worksheet
pH	At all distribution sites use handheld meter and log data on worksheet
Distribution Water Sample Sites	At scheduled distribution sites take 1 - Caro Bacterial and Kingfisher sample site at scheduled dates take THMs and HAAS. See sampling calendar
Raw Water Sample Site	Caro Bacterial & TOC (monthly except May, June & July (weekly)) & 500 ml in-house bottle for UVT analysis (bi-weekly or weekly as scheduled). See sampling calendar
Requisition Sheets	All bacterial samples have requisition sheets for IHA. Raw water samples only use requisition sheets quarterly, see sampling calendar
Bottle Drop off	Bring bottles to RDNO to send to Caro for analysis
Instrument Cleaning and Calibration	Bring instruments to RDNO according to instrument schedule
Turbidity Meter Cleaning	Flush, clean, and calibrate online turbidity meter quarterly (March, June, September and December) and write when flushed, cleaned, calibrated and any other comments in online excel sheet operator's log.

Mabel Lake Sample Sites	
Sites	**WaterTrax ID#**
Mabel Lake - Raw	1374C
Lot #41 A. C. SS	3B063
Kingfisher (3300 Block Enderby-Mabel Lk Rd SS)	34799
Lot #12 Golf Course (Random Tap on Cessna Road)	276DC
#41 D. V. Rd SS	3B03B
Old Pumphouse	19F77

Mabel Lake Water Utility

If the operator needs to drop off the samples themselves, below are the health unit options.

Interior Health Unit Information
Enderby Community Health Centre 707 - 3rd Avenue Enderby, BC 250-838-2450 Water Sample drop off: **Wednesday by 12 noon**
Salmon Arm Health Centre 851 - 16 Street NE Salmon Arm, BC 250-833-4100 Water Sample drop off: **Monday, Tuesday or Wednesday by 2 pm**

Instrument Calibration by RDNO:		
Handheld:	Chlorine	Hach Pocket colorimeter
	Turbidity	HACH 2100Q
	pH	Oakton ECO Testr

*Note - Operator should bring in handheld instruments for calibration according to the instrument schedule provided

- 4 times/ year for chlorine and turbidity
- monthly for pH
- New chlorine and turbidity in 2017 GL & KP
- Revised 2019 to add pH monthly KP & CH)

NOTE: operator calibrates online chlorine and turbidity analyzers

MABEL LAKE

Raw and Distribution Sample Sites and Bottles

Sites and Water Trax #	Bottles	Parameters
Mabel Lake - Raw 1374C	1 - Caro Bacterial	Total Coliform, E. Coli
	2 - TOC	TOC
	1 - 500 ml in-house	UVT - Filtered and Unfiltered
Lot #41 A. C. SS 3B063	1 - Caro Bacterial	Total Coliform, E. Coli
Kingfisher (3300 Block Enderby-Mabel Lk Rd SS) 34799	1 - Caro Bacterial	Total Coliform, E. Coli
Lot #12 Golf Course (Random Tap on Cessna Road) 276DC	1 - Caro Bacterial	Total Coliform, E. Coli
#41 D. V. Rd SS 3B03B	1 - Caro Bacterial	Total Coliform, E. Coli
Old Pumphouse 19F77	1 - Caro Bacterial	Total Coliform, E. Coli

Mabel Lake THM & HAA Samples (January, April, July, October)

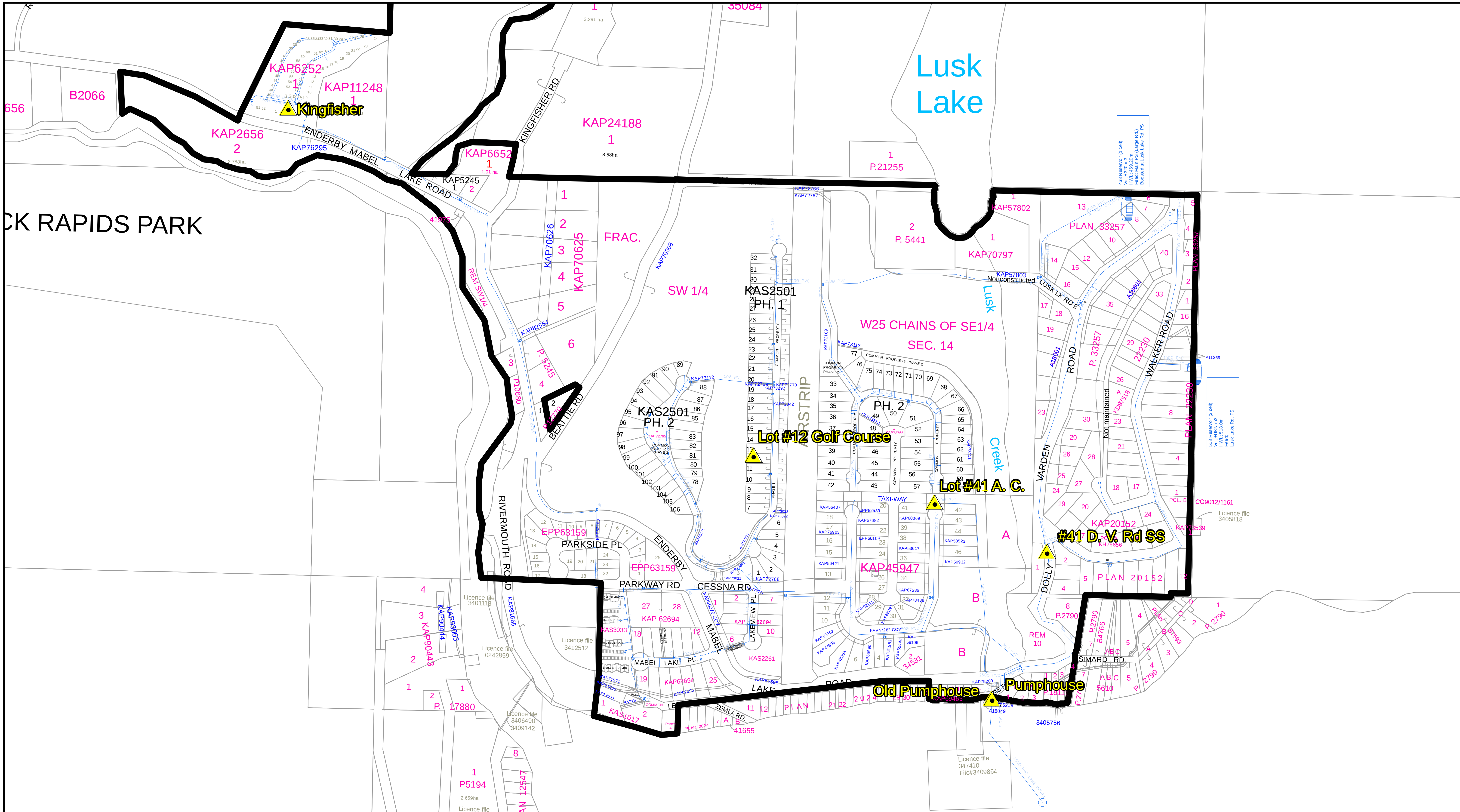
Sites and Water Trax #	Bottles	Parameters
Kingfisher (3300 Block Enderby-Mabel Lk Rd SS) 34799	1 - Caro Bacterial	Total Coliform, E. Coli
	2 - THM bottles	THMs
	2 - HAA bottles	HAAs

Yearly (May or October)

Site and Water Trax #	Bottles	Parameters
Mabel Lake - Raw 1374C	1 - Caro Baterial	Total Coliform, E.Coli
	1 - PA	MPN
	1 - 250 mL metals	
	1 - Cyanide	Cyanide
	1 - TOC	TOC
	1 - 1 L Caro	
	1 - 1 L Algae Density	algae density
	1 - 4 L Caro	chlorophyll a

Annual Raw Water Sampling Records

2012	October
2013	May
2014	October
2015	May
2016	October
2017	July
2018	May
2019	October
2020	May



This map was compiled by RDNO, using data believed to be accurate; however, a margin of error is inherent in all maps. This product is distributed without warranties of any kind, either express or implied, including but not limited to warranties of sustainability or particular purpose or use.

Mabel Lake Sampling Stations

Plot Date: May 07, 2019

Scale: 1:7,000

0 250 500 1,000 Meters

Plot Size: 17" x 11"

RDNO

Regional District of North Okanagan

Mabel Lake Water Utility

Date:_____

Weather:_____

Operator:_____

HOT SPOT: MLWater, password: MabelWiFi. Imessages, emails, and Wi-Fi Calling only

NOTE: key to monitoring wells is in main pumphouse on blue ribbon above the sink

Winter Worksheet (October to April)

Time	Site	Water Trax	FCl_2	TCl_2	Turbidity	pH	Temp	Cond	Counts		Bacterial P/A		Comments
									T Coli	E Coli	T P/A	Ecoli P/A	
	Mabel Lake Raw	1374C											**Bi-weekly** with regular samples: In-house UVT **Monthly:** TOC (small brown vials) & bacterial
	Lot #41 A. C.	3B063											**Monthly:** Bacterial Sample station next to Lot 42, located on road through campground
	Kingfisher (3300 Block Enderby-Mabel Lk Rd SS)	34799											**Monthly:** Bacterial **(January, April, July, & October):** THMs & HAAs Kingfisher Lot #3
	Lot #12 Golf Course (Random Tap on Cessna Road)	276DC											**Monthly:** Bacterial Lot #12 Golf Course
	#41 D. V. Rd SS	3B03B											**Monthly:** Bacterial 41 Dolly Varden Rd SS

Revised: 180710 by KP

Regional District of North Okanagan

Mabel Lake Water Utility

Date:_____

Weather:_____

Operator:_____

HOT SPOT: MLWater, password: MabelWiFi. Imessages, emails, and Wi-Fi Calling only

NOTE: key to monitoring wells is in main pumphouse on blue ribbon above the sink

Summer Worksheet (May to September)

Time	Site	Water Trax	FCl_2	TCl_2	Turbidity	pH	Temp	Cond	Counts		Bacterial P/A		Comments
									T Coli	E Coli	T P/A	Ecoli P/A	
	Mabel Lake Raw	1374C											**Weekly** with regular samples: In-house UVT **Monthly:** TOC (small brown vials) & bacterial
	Lot #41 A. C. SS	3B063											**Weekly:** Bacterial Sample station next to Lot 42, located on road through campground
	Kingfisher (3300 Block Enderby-Mabel Lk Rd SS)	34799											**Monthly:** Bacterial **(January, April, July, & October):** THMs & HAAs Kingfisher Lot #3
	Lot #12 Golf Course (Random Tap on Cessna Road)	276DC											**Monthly:** Bacterial Lot #12 Golf Course
	#41 D. V. Rd SS	3B03B											**Monthly:** Bacterial # 41 Dolly Varden Rd SS
	Old Pumphouse	19F77											**Monthly:** Bacterial

Revised: 180522 by KP

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
JANUARY	30 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	31	**1 NEW YEARS DAY**	2	3 Keiko
	6 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	7 GRW - Mayberry, James St. SS	8	9	10 Connie
	13 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **SSW Instruments (Turb, Cl2, pH)**	14	15	16	17 Keiko
	20 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	21 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (Turb, Cl2, pH, DO Probe)** **MLW Instruments (Turb, Cl2, pH)**	22	23	24 Connie
	27 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	28	29	30	31 Keiko

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
FEBRUARY	3 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **Annuals:** Vance, Paradise, Well 1	4 GRW - Mayberry, James St. SS	5	6	7 Connie
	10 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **Annuals:** Well 2, 3, 5, 12 **SSW Instruments (pH)**	11	12	13	14 Keiko
	17 FAMILY DAY **SSW** **Distribution** (Peak Season) **THM's** **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	18 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **(THM's)** **GRW Instruments (pH)** **MLW Instruments (pH)**	19	20	21 Connie
	24 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	25	29	27	28 Keiko

RDNO Utilities

	Monday	Tuesday	Wednesday	Thursday	Friday
MARCH	2 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **SSW Instruments (pH)**	3 GRW - Mayberry, James St. SS	4	5 MLW - Kingfisher, Lot #41 SS, Raw (UVT, bacterial (**Requisition)**, TOC)	6 Connie
	9 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **Well #2 (selenium)**	10 MLW - Lot #12, Old PH	11	12	13 Keiko
	16 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	**17 GRW** - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (pH, DO Probe)** MLW - Lot #12, #41 D.V. Rd SS, Raw (UVT), Kingfisher (**THM & HAA)** **MLW Instruments (pH)**	18	19	20 Connie
	23 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	24	25	26	27 Keiko
	30 **SSW Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	31			

RDNO Utilities

	Monday	Tuesday	Wednesday	Thursday	Friday
APRIL			1	2	3 Connie
	16 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw **SSW Instruments (Turb, Cl2, pH)**	7 GRW - Mayberry, James St. SS MLW - Lot #12, #41 D.V. Rd SS, Raw (UVT, bacterial, TOC)	8	9 Keiko	**10 GOOD FRIDAY**
	13 EASTER MONDAY **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	14	15	16	17 Connie
	20 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	21 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (Turb, Cl2, pH)** MLW - Lot #41 SS, Kingfisher **(THM & HAA)**, Raw (UVT) **MLW Instruments (Turb, Cl2, pH)**	22	23	24 Keiko
	27 **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	28	29	30	

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
MAY					1 Connie
	4 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	5 GRW - Mayberry, James St. SS MLW - Lot #41 SS, Lot #12, Raw (UVT, bacterial, TOC)	6 **MLS - Monitoring Wells - KP**	7 **MLW - Monitoring Wells - KP**	8 Keiko
	11 **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **SSW Instruments (pH)**	12 MLW - Lot #41 SS, #41 D.V. Rd SS, Raw (UVT, bacterial, TOC)	13	14	15 Connie
	18 VICTORIA DAY **SSW Distribution** Week 1 (Low Season) **THM'S** **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	19 GRW - Treatment Plant: Treated & Raw **(Annuals)**, Fourth Ave SS **(THM's)** **GRW Instruments (pH, DO Probe)** **MLW - Lot # 41 SS, Kingfisher, Raw (UVT, (Annual), bacterial, TOC)**	20	21	22 Keiko
	25 **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **ANNUAL:** Well 5 & 12	26 MLW - Lot # 41 SS, Old PH, Raw (UVT) **MLW Instruments (pH)**	27	28	29 Connie

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
JUNE	1 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	2 MLW - Lot # 41 SS, Lot #12, Raw (bacterial (Requisition), UVT, TOC)	3	4	5 Keiko
	8 **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **WELL #2** Selenium **SSW Instruments (pH)**	9 GRW - Mayberry, James St. SS MLW - Lot # 41 SS, #41 D.V. Rd SS, Raw (UVT, bacterial, TOC	10	11	12 Connie
	15 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	16 MLW - Lot # 41 SS, Kingfisher, Raw (UVT, bacterial, TOC	17	18	19 Keiko
	22 **SSW Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	**23 GRW -** Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (pH)** **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Old PH (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC) **MLW Instruments (pH)**	24	25	26 Connie
	29 **SSW Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	30			

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
JULY			**1 CANADA DAY**	2 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Lot #12 (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	3 Keiko
	6 **SSW** **Distribution** Week 2 (Low Season) Creekside Condo's **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	7 GRW - Mayberry, James St. SS **MLW** - Lot # 41 A.C. SS (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	8	9	10 Connie
	13 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **SSW Instruments (Turb, Cl2, pH)**	14 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Kingfisher **(**Caro bacteria, **THM & HAA)** **-** Raw (in-house UVT, Caro bacteria, TOC)	15	16	17 Keiko
	20 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	21 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (Turb, Cl2, pH, DO Probe)** **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Old PH (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC **MLW Instruments (Turb, Cl2, pH)**	22	23	24 Connie
	27 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	28 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Lot #12 (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	29	30	31 Keiko

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
AUGUST	**3 CIVIC HOLIDAY** **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	4 GRW - Mayberry, James St. SS **MLW** - Lot # 41 A.C. SS (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	5	6	7 Connie
	10 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **SSW Instruments (pH)**	11 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Kingfisher (Caro bacteria) - Raw (in-house UVT)	12	13	14 Keiko
	17 **SSW** **Distribution** Week 2 (Low Season) **THM's** **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	18 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **(THM's)** **GRW Instruments (pH)** **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Old PH (Caro bacteria) - Raw (in-house UVT) **MLW Instruments (pH)**	19	20	21 Connie
	24 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	25 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Lot #12 (Caro bacteria) - Raw (in-house UVT)	26	27	28 Keiko
	31 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)				

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
SEPTEMBER		1 GRW - Mayberry, James St. SS **MLW** - Lot # 41 A.C. SS (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria **(Requisition Sheet)**, TOC)	2	3	4 Connie
	7 LABOUR DAY **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **WELL #2** Selenium	8 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Kingfisher (Caro bacteria) - Raw (in-house UVT)	9	10	11 Keiko
	14 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month)	15 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (pH, DO Probe)** **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Lot #12 (Caro bacteria) - Raw (in-house UVT) **MLW Instruments (pH)**	16	17	18 Connie
	21 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line** **SSW Instruments (pH)**	22 **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Old PH (Caro bacteria) - Raw (in-house UVT)	23	24	25 Keiko
	28 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line**	29	30 **MLS - Monitoring Wells - KP**		

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
OCTOBER				1 **MLS - Monitoring Wells - KP**	2 Connie
	5 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line**	6 GRW - Mayberry, James St. SS **MLW** - Lot #12 (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	7	8	9 Keiko
	12 THANKSGIVING **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line**	13	14	15	16 Connie
	19 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line** **SSW Instruments (Turb, Cl2, pH)**	**20 GRW** - Treatment Plant: Treated & Raw, Fourth Ave SS **GRW Instruments (Turb, Cl2, pH)** **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Kingfisher **(**Caro bacteria, **THM & HAA)** **-** Raw (in-house UVT) **MLW Instruments (Turb, Cl2, pH)**	21	22	23 Keiko
	26 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw (If on but at least once a month) **Vance Flush Line**	27	28	29	30 Connie

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
NOVEMBER	2 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	3 GRW - Mayberry, James St. SS **MLW** - Lot #12 (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria, TOC)	4	5	6 Keiko
	9 **SSW** **Distribution** Week 2 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	10	**11 REMEMBERANCE DAY**	12	13 Connie
	16 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **SSW Instruments (pH)**	17 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **(THM's)** **GRW Instruments (pH, DO Probe)** **MLW** - Lot # 41 SS (Caro bacteria) - Kingfisher (Caro bacteria) - Raw (in-house UVT) **MLW Instruments (pH)**	18	19	20 Keiko
	23 **SSW** **Distribution** Week 2 (Low Season) **THM'S** **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	24	25	26	27 Connie
	30 **SSW** **Distribution** Week 1 (Low Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw				

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
DECEMBER		1 GRW - Mayberry, James St. SS **GRW Instruments (pH)** **MLW** - Lot #12 (Caro bacteria) - #41 D.V. Rd SS (Caro bacteria) - Raw (in-house UVT, Caro bacteria **(Requisition Sheet)**, TOC) **MLW Instruments (pH)**	2	3	4 Keiko
	7 **SSW** **Distribution** (Peak Season) Creekside Condo's **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **WELL #2** Selenium	8	9	10	11 Connie
	14 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw **SSW Instruments (pH)**	15 GRW - Treatment Plant: Treated & Raw, Fourth Ave SS **MLW** - Lot # 41 A.C. SS (Caro bacteria) - Kingfisher (Caro bacteria) - Raw (in-house UVT)	16	17	18 Keiko
	21 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	22	23 Connie	**24 CHRISTMAS EVE**	**25 CHRISTMAS DAY**
	28 **SSW** **Distribution** (Peak Season) **WTP:** Mid T Treated SS "A" Mid T UVT Sample Line **Sources:** Mid T Raw Vance / Paradise Raw	29	30	31	

RDNO Utilities					
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**

Legend:	
Silver Star Water	(SSW)
Mabel Lake Water	(MLW)
Grindrod Water	(GRW)

Grindrod - tri-annually				
Keiko - MLW & WVW Sampling				
Connie - SSW & GRW Sampling				

January 2018

Mid T Treated SS "c"

- weekly bacterial (operator sampling)
- Manganese, Iron, Colour

(**weekly** 4-6 weeks when surface sources come online; then **monthly** for the rest of the season)

Vance/Paradise

- Weekly: UVT
- UVT, Manganese, Iron, Colour

(**Weekly** during flushing then **Monthly** for the rest of the season)

APPENDIX H

2020/2021 RAW WATER COMPREHENSIVE ANALYSIS

Mabel Lake Raw Water Quality 2020

Water System:	**Mabel Lake Water Utility**
Source:	**Mabel Lake**
Sampling Point:	**Raw water line**
Date of Sample:	**5/19/2020**

REGIONAL DISTRICT NORTH OKANAGAN

		Canadian Drinking Water Guidelines	
Anions	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Chloride	0.54		<250
Fluoride	<0.10	1.5	
Nitrate (As N)	0.09	10	
Nitrite (as N)	<0.010	1	
Sulphate	7.1		≤500
General Parameters	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Alkalinity, Bicarbonate (as CaCO3)	81.6	N/A	
Alkalinity, Carbonate (as CaCO3)	<1.0	N/A	
Alkalinity, Hydroxide (as CaCO3)	<1.0	N/A	
Alkalinity, Phenolphthalein (as CaCO3)	<1.0	N/A	
Alkalinity, Total (as CaCO3)	81.6	N/A	
Carbon, Dissolved Organic	2.00	N/A	
Carbon, Total Organic	2.28	N/A	
Chlorophyll a	0.26	N/A	
Colour, True (CU)	<5.0		≤15
Conductivity (umho/cm)	107	N/A	
Cyanide, Total	<0.0020	0.2	
Nitrogen, Total Kjeldahl	0.058	N/A	
pH	7.78	7.0 - 10.5	
Phosphorus, Total (as P)	0.0038	N/A	
Phosphorus, Total Dissolved	0.0027	N/A	
Turbidity (NTU)	0.66		OG <1
UV Transmittance @ 254nm (%)	90.0	N/A	
Calculated Parameters	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Hardness, Total	47.9	N/A	
Total Dissolved Solids	77.8		≤500
Total Metals	**Results (mg/L unless noted)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Aluminum, total	0.0093		OG ≤0.1
Antimony, total	<0.00020	0.006	
Arsenic, total	<0.00050	0.01	
Barium, total	0.0096	2	
Boron, total	0.0819	5	
Cadmium, total	<0.000010	0.005	
Calcium, total	15.8	N/A	
Chromium, total	<0.00050	0.05	
Cobalt, total	<0.00010	N/A	
Copper, total	0.00128		<1
Iron, total	0.024		≤0.3
Lead, total	<0.00020	0.005	
Magnesium, total	2.01	N/A	
Manganese, total	0.00161		≤0.02
Mercury, total	<0.000040	0.001	
Molybdenum, total	0.00076	N/A	
Nickel, total	<0.00040	N/A	
Potassium, total	0.83		
Selenium, total	<0.00050	0.05	
Sodium, total	1.28		≤200
Strontium, total	0.0765		
Uranium, total	0.000404	0.02	
Zinc, total	<0.0040		≤5

Mabel Lake Raw Water Quality 2021

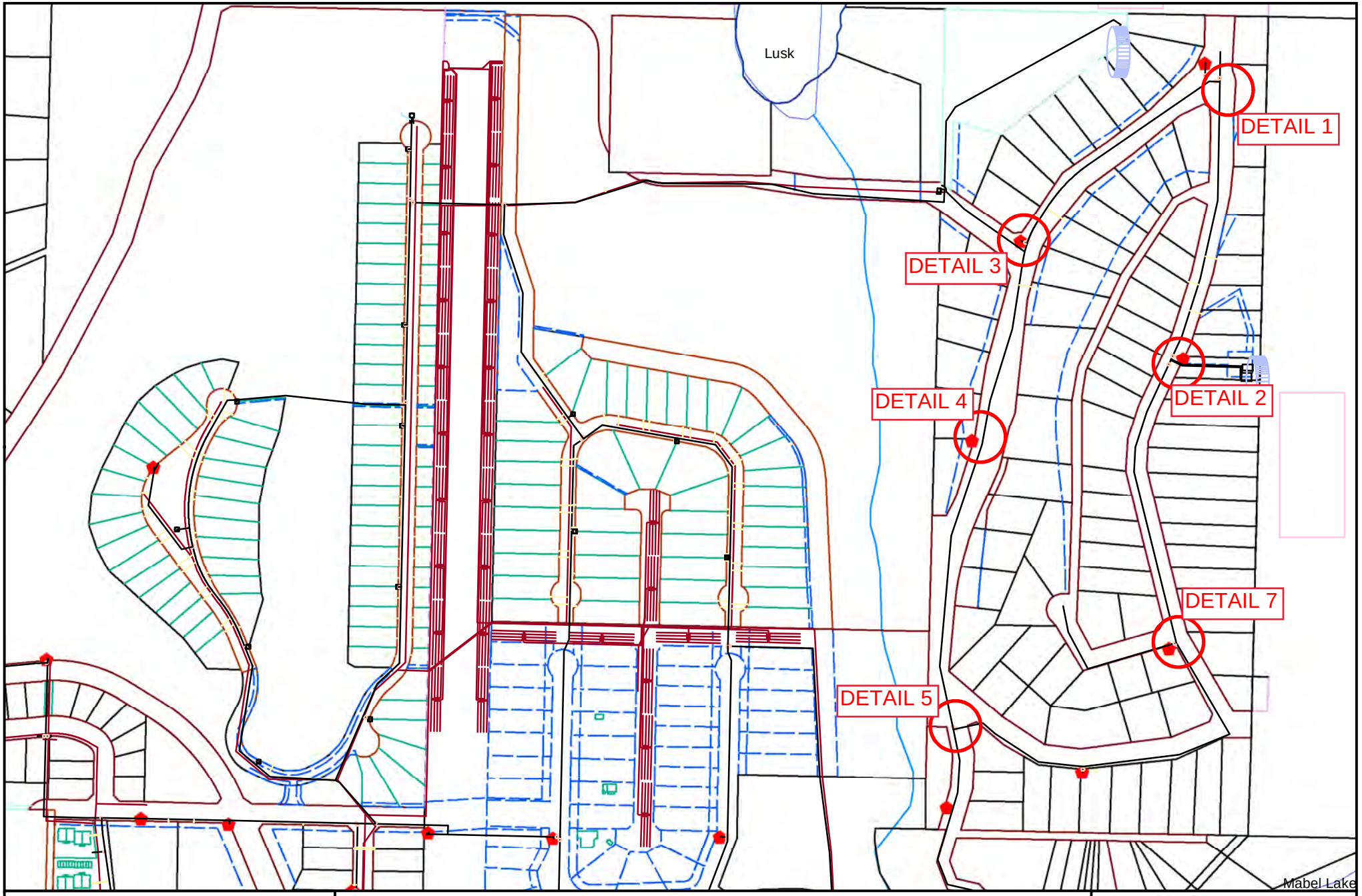
Water System:	**Mabel Lake Water Utility**
Source:	**Mabel Lake**
Sampling Point:	**Raw water line**
Date of Sample:	**10/19/2021**

REGIONAL DISTRICT
NORTH OKANAGAN

		Canadian Drinking Water Guidelines	
Anions	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Chloride	0.60		<250
Fluoride	<0.10	1.5	
Nitrate (As N)	0.088	10	
Nitrite (as N)	<0.010	1	
Sulphate	6.8		≤500
General Parameters	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Alkalinity, Bicarbonate (as CaCO3)	51.1	N/A	
Alkalinity, Carbonate (as CaCO3)	<1.0	N/A	
Alkalinity, Hydroxide (as CaCO3)	<1.0	N/A	
Alkalinity, Phenolphthalein (as CaCO3)	<1.0	N/A	
Alkalinity, Total (as CaCO3)	51.1	N/A	
Carbon, Dissolved Organic	1.77	N/A	
Carbon, Total Organic	1.98	N/A	
Chlorophyll a	<1.00	N/A	
Colour, True (CU)	5.7		≤15
Conductivity (umho/cm)	108	N/A	
Cyanide, Total	<0.0020	0.2	
Nitrate (As N)	0.088	10	
Nitrite (as N)	<0.010	1	
pH	7.75	7.0 - 10.5	
Phosphorus, Total (as P)	0.0057	N/A	
Phosphorus, Total Dissolved	0.0053	N/A	
Turbidity (NTU)	0.21		OG <1
UV Transmittance @ 254nm (%)	90.5	N/A	
Calculated Parameters	**Results (mg/L)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Hardness, Total	68.7	N/A	
Total Dissolved Solids	66.2		≤500
Total Metals	**Results (mg/L unless noted)**	**Maximum Acceptable Concentration (MAC)**	**Aesthetic Objective (AO)**
Aluminum, total	0.0092		OG ≤0.1
Antimony, total	<0.00020	0.006	
Arsenic, total	<0.00050	0.01	
Barium, total	0.0095	2	
Boron, total	<0.0500	5	
Cadmium, total	<0.000010	0.005	
Calcium, total	19.5	N/A	
Chromium, total	<0.00050	0.05	
Cobalt, total	<0.00010	N/A	
Copper, total	0.00335		<1
Iron, total	0.012		≤0.3
Lead, total	<0.00020	0.005	
Magnesium, total	4.84	N/A	
Manganese, total	0.00372		≤0.02
Mercury, total	<0.000040	0.001	
Molybdenum, total	0.0008	N/A	
Nickel, total	<0.00040	N/A	
Potassium, total	1.07		
Selenium, total	<0.00050	0.05	
Sodium, total	1.75		≤200
Strontium, total	0.0778		
Uranium, total	0.000510	0.02	
Zinc, total	<0.0040		≤5

APPENDIX I

2021 MABEL RIDGE ESTATES WATER VALVE REPAIRS



2021 Valve Replacement Project
MLW

Plot Date: Dec 08, 2020

Scale: 1:5,000

Plot Size: 8.5" x 11"

0 125 250 500 Meters

RDNO